We claim:

1. Flashing jewelry comprising:
   A) an infrared emitter positioned to emit infrared light into tissue of a wearer,
   B) an infrared detector positioned to detect infrared light emanating from said tissue,
   C) a power source for said emitter and said detector,
   D) an electrical circuit for analyzing electrical signals from said detector to detect each beat of a wearers heart,
   E) at least two visible light emitters,
   F) a first trigger circuit for initiating electrical pulses to cause one of said visible light emitters to flash once for each heart beat,
   G) a pulse rate calculation means for calculating the wearer's pulse rate, and
   H) a second trigger circuit for initiating pulses to cause a second of said visible light emitters to flash once for each heart beat when said pulse rate exceeds a first predetermined rate.
2. Jewelry as in Claim 1 and further comprising a third trigger circuit for initiating pulses to cause a third of said at least two visible light emitters to flash once for each heart beat when said pulse rate exceeds a second predetermined rate.
3. Jewelry as in Claim 2 wherein said at least two visible light emitters are three visible light emitters emitting respectively red, green and blue light.
4. Jewelry as in Claim 1 wherein said jewelry is an earring.
5. Jewelry as in Claim 1 wherein said jewelry is a finger ring.
6. Jewelry as in Claim 1 wherein said jewelry is attached to skin of said wearer by a patch.
7. Jewelry as in Claim 1 wherein said jewelry is a patch in the shape of a heart.
8. Jewelry as in Claim 1 wherein said at least one visible light emitter is three visible light emitters.

Petitioner Samsung Ex-1004, 0681

9. Jewelry as in Claim 8 wherein said three visible light emitters are red green and blue emitters and said jewelry further comprises a means to determine heart rates of said wearer.
10. Jewelry as in Claim 9 wherein said red emitter is programmed to flash with each heart beat, said green emitter is programmed to flash with each heart beat when the heart rate of the wearer is in excess of a first threshold in excess of the wearer's rest heart rate and said blue emitter is programmed to flash with each heart beat when the heart rate of said wearer is in excess of a second threshold in excess of said first threshold.
11. Jewelry as in Claim 10 wherein said first threshold is at least 115 % of the wearer's resting heart rate and said second threshold is at least 130 % of wearer's resting heart rate.
12. Jewelry as in Claim 1 wherein said electric circuit comprises and ASIC circuit.
13. Jewelry as in Claim 1 wherein said electric circuit comprises surface mounted circuit.
14. Jewelry as in Claim 3 and further comprising a transmitter for transmitting a signal to an audio device to initiate a sound when one of said thresholds are exceeded.
15. Jewelry as in Claim 14 wherein said sound is church bells.
16. Jewelry as in Claim 1 wherein said power source is a battery unit positioned on the inside of an earlobe and connected through an earlobe to a circuit board comprising said infrared emitter, said infrared detector and said at least two visible light sources

Petitioner Samsung Ex-1004, 0682



FIG. 1
PRIOR ART

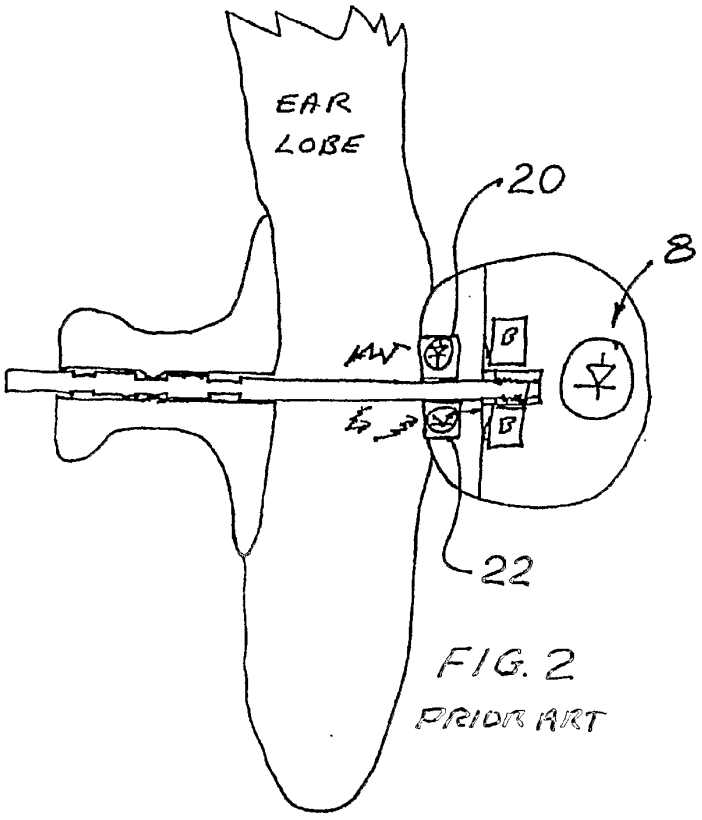


FIG. 2
PRIOR ART

Petitioner Samsung Ex-1004, 0683

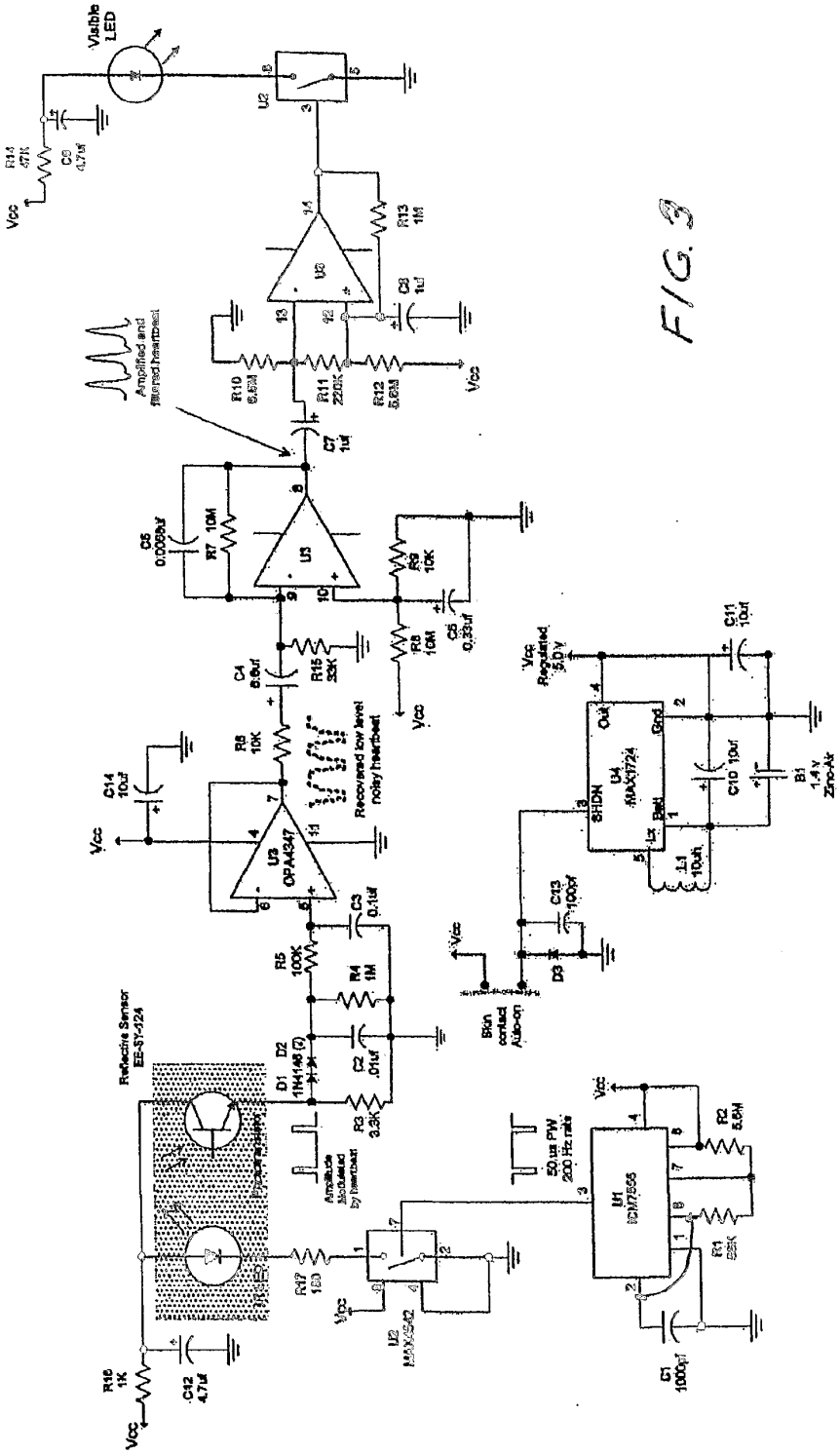


FIG. 3

Petitioner Samsung Ex-1004, 0684

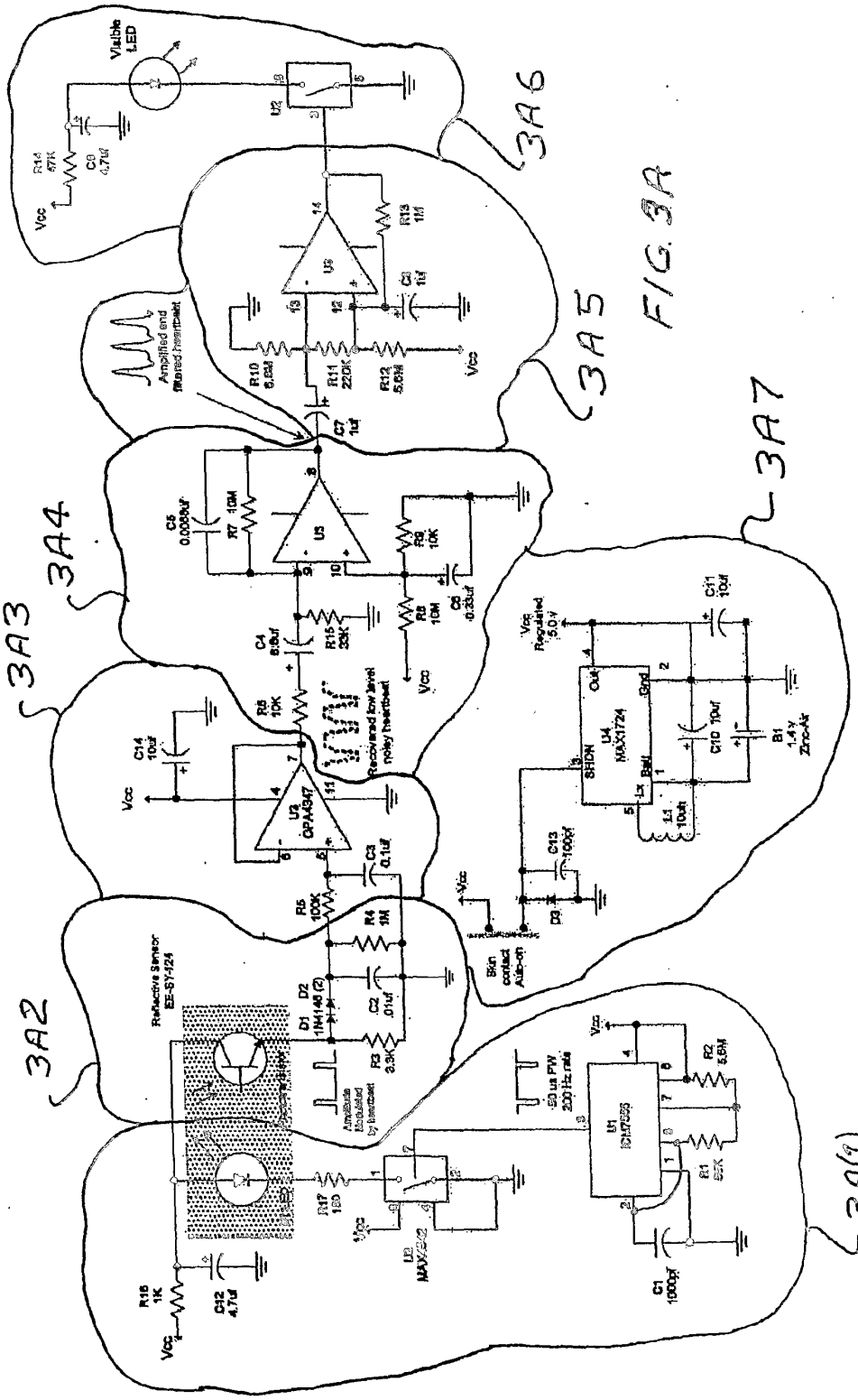
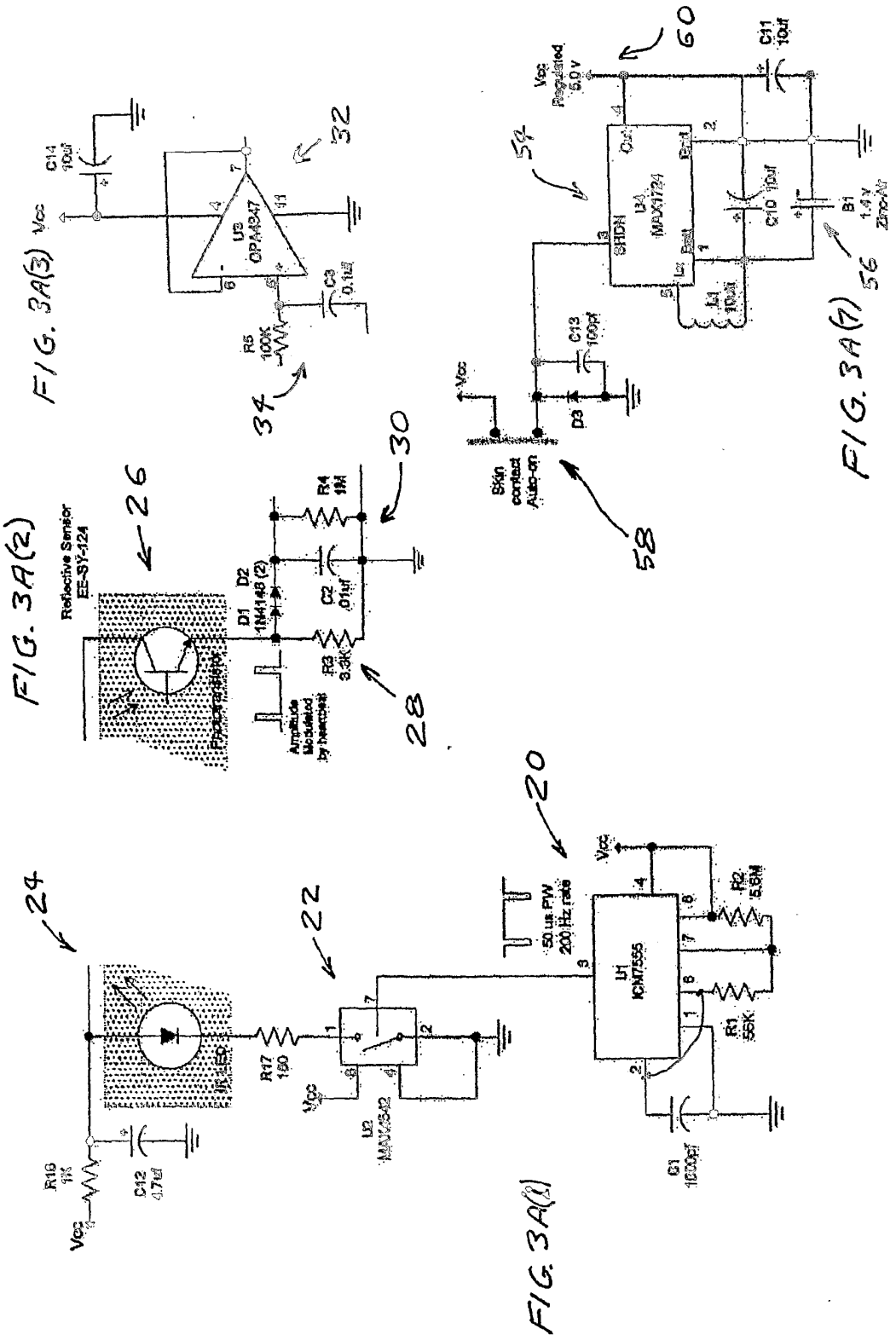


FIG. 3A

Petitioner Samsung Ex-1004, 0685



Petitioner Samsung Ex-1004, 0686

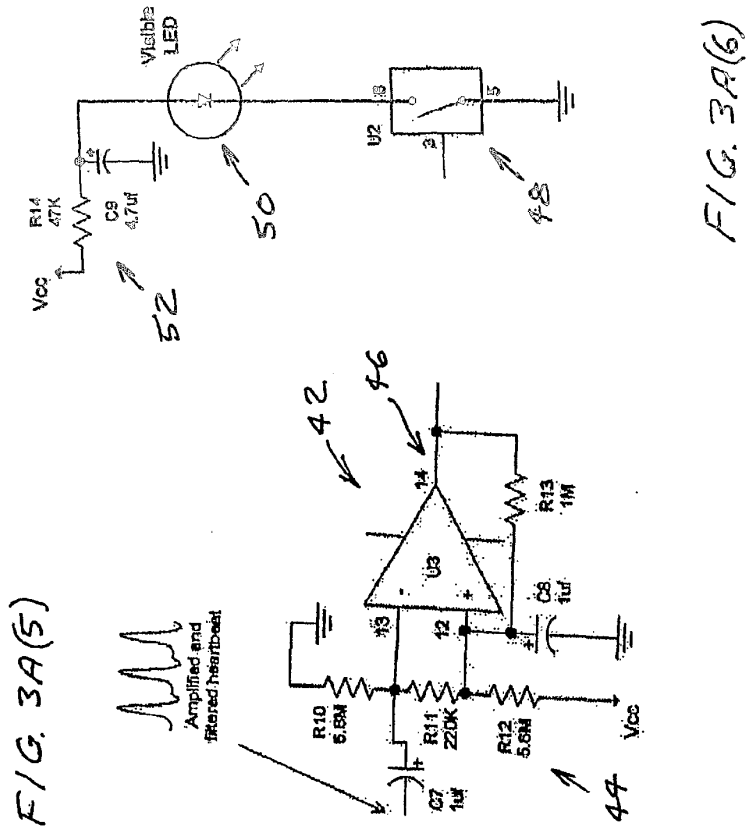


FIG. 3A(5)

FIG. 3A(6)

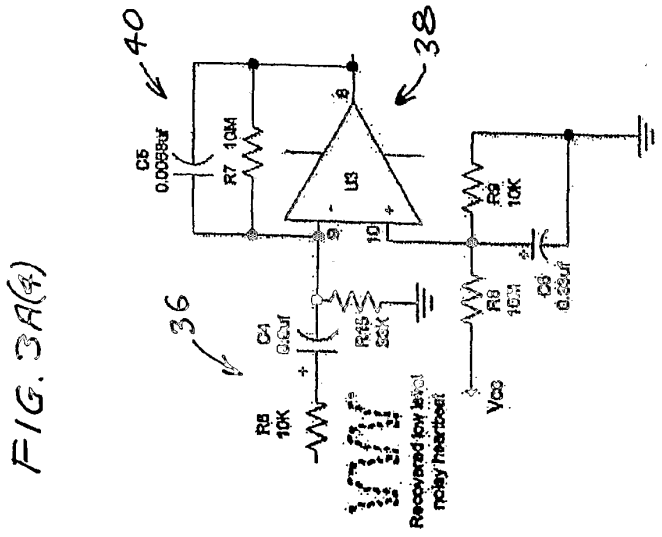
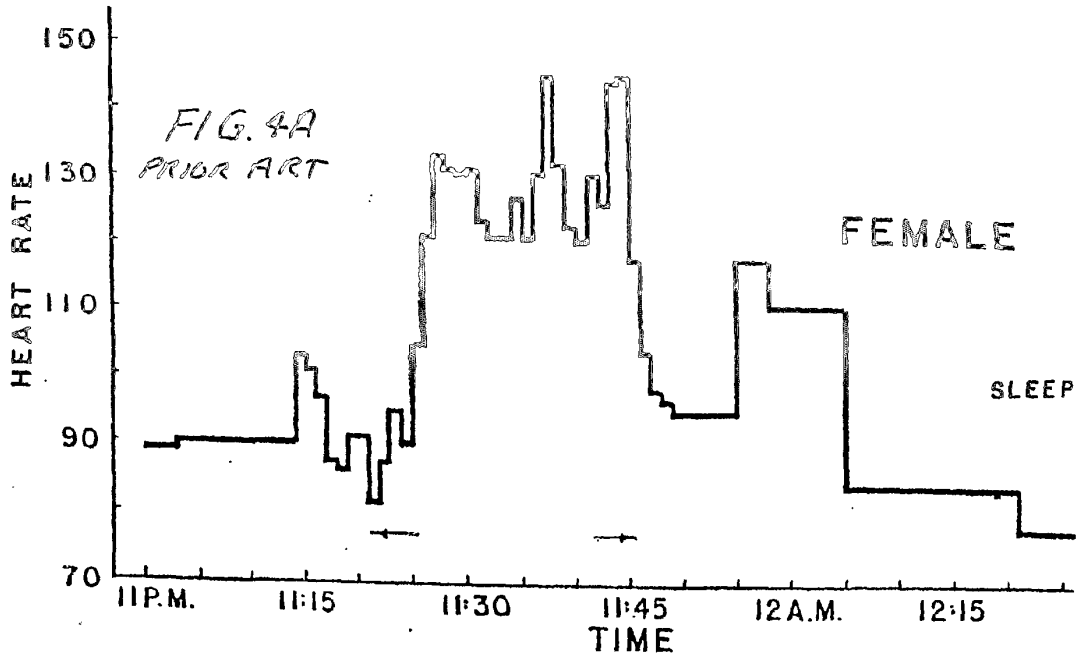
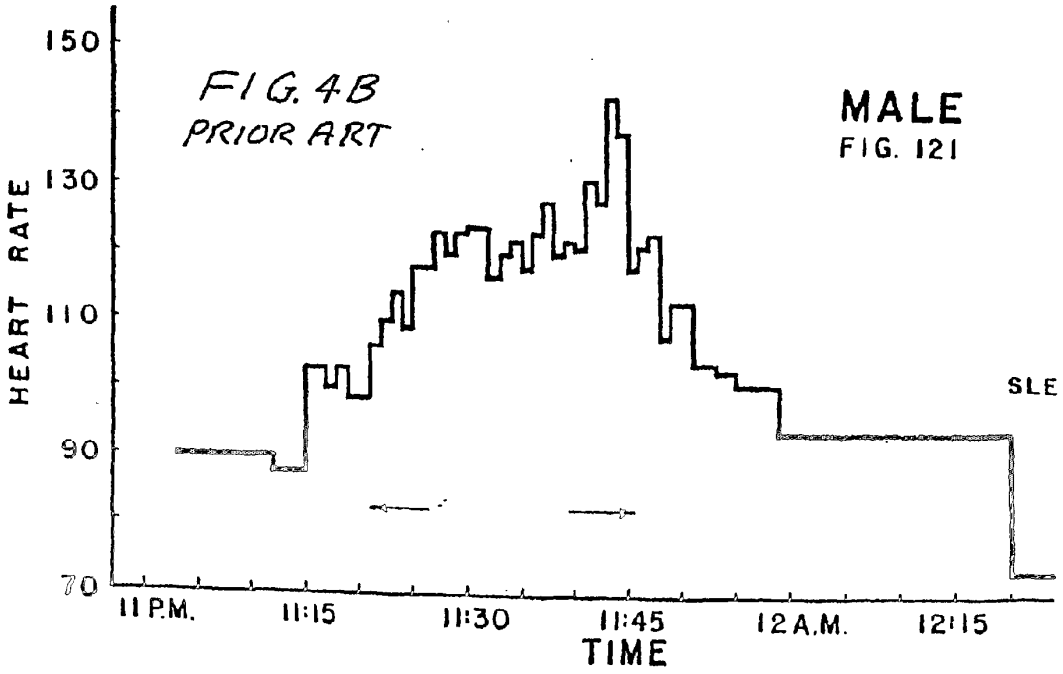


FIG. 3A(4)

Petitioner Samsung Ex-1004, 0687





Petitioner Samsung Ex-1004, 0688

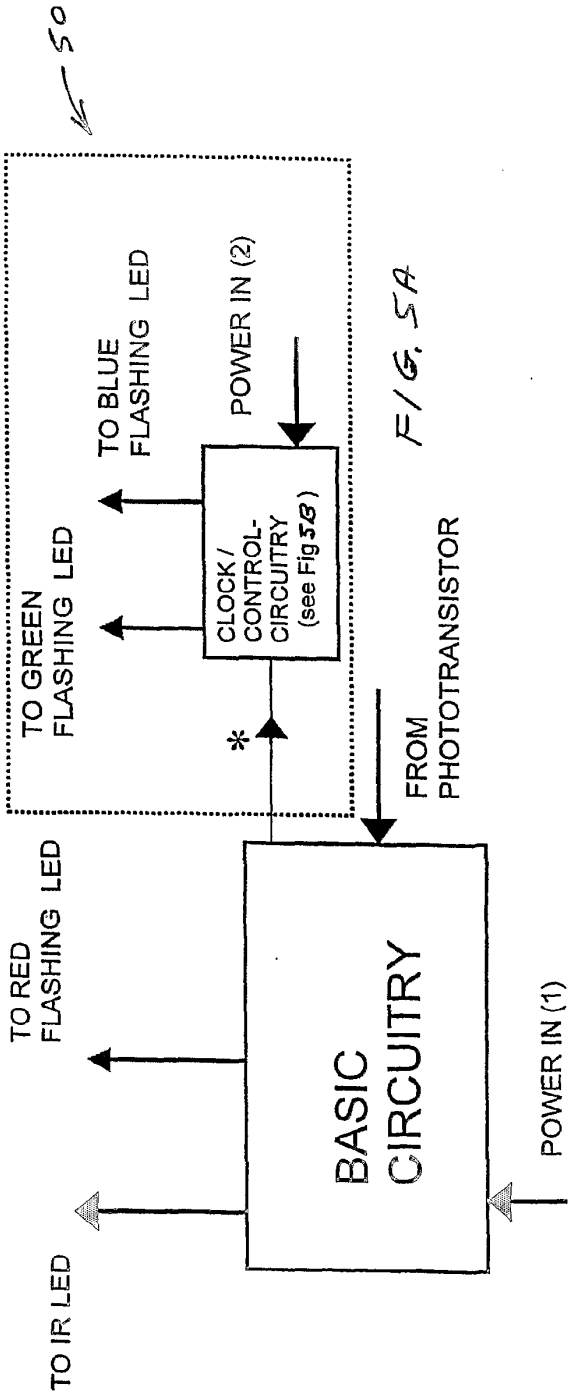


FIG. 5A

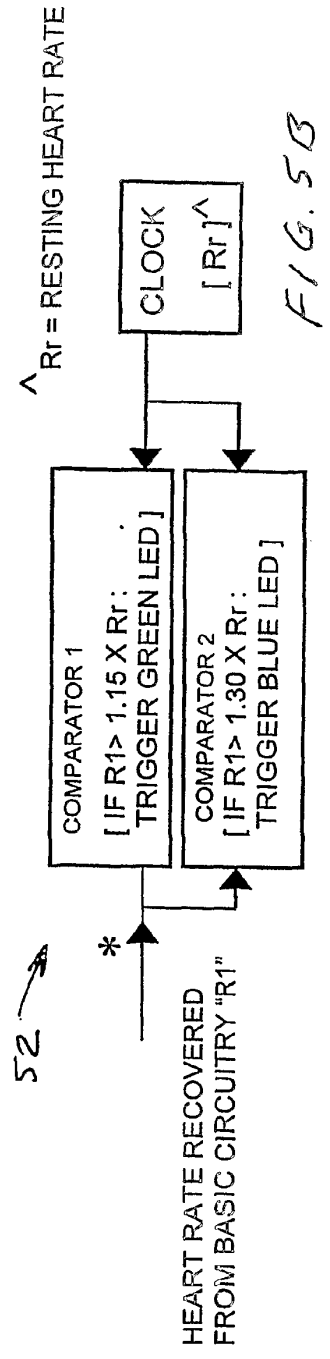


FIG. 5B

Petitioner Samsung Ex-1004, 0689

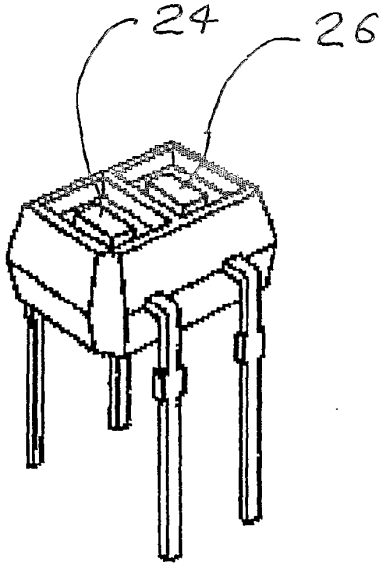


FIG. 6

Petitioner Samsung Ex-1004, 0690

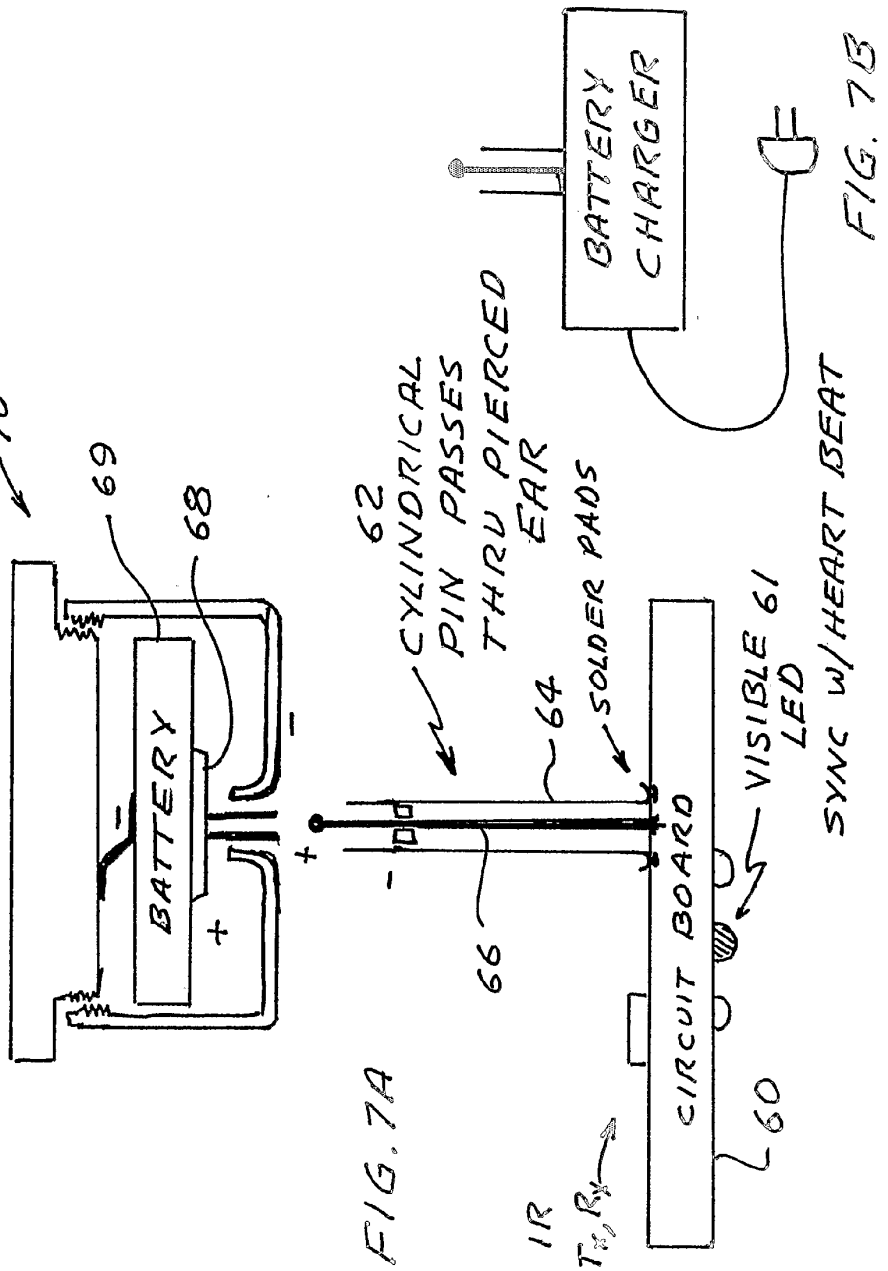


FIG. 7A FIG. 7B

Petitioner Samsung Ex-1004, 0691

Health bracelet

List of publications

Publication date

Application number 2006KR-U006666 Date 2006-03-13 Register

KR20-0417885 Y1 Utility model specification2006-06-05

English Title

Health bracelet

English Abstract (Native or MT)

The present invention relates to a health as a bracelet, the bracelet, the inner ring and outer ring composed of a body, wherein the inner ring and outer ring are formed at regular intervals between a plurality of laser diode, formed on one side of the body from the laser diode and a power supply cable connected to a power supply section made of features.

According to the present design, the interior of the body is composed of a double at regular intervals by laser diode device according to the user with a low power state laser beam penetrates the skin at an angle to remove dispersed in inflammation, pain relief, an increase power, dermatitis protection effect can be expected.

Other Abstracts

본 고안은 건강팔찌에 관한 것으로서, 팔찌에 있어서, 내부링과 외부링으로 구성되는 몸체와, 상기 내부링과 외부링 사이에 일정간격으로 형성되는 다수개의 레이저 다이오드와, 상기 몸체의 일측에 형성되고 상기 레이저 다이오드와는 전선으로 연결되어 전원을 공급하는 전원공급부를 포함하여 이루어지는 것을 특징으로 한다.

Application Language KOREAN (KOR)

Inventor(s) KIM, Na Kyung

Inventor(s) 김나경

Applicant/Assignee

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owned by EUN GYUNG LEE

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Patent Assignee History KIM, Na Kyung

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Representative 정병호

Application Numbers & Dates KR20060006666U 2006-03-13 [2006KR-U006666]

Priority Numbers & Dates KR20060006666U 2006-03-13 [2006KR-U006666]

Other Publication Date 2006-05-26(Registration date)

Technology domain Other consumer goods

US codes history

IPC codes

A44C-005/00* A44C-005/12

IPC codes history

A44C-005/00* A44C-005/12

CPC codes

A44C-005/00/23* A44C-005/12

CPC codes history

A44C-005/00/23* A44C-005/12

Description

DESCRIPTION DRAWINGS

[0001] Figure 1 is a perspective view showing a health bracelet of the present invention.

[0002] Figure 2 is a cross-sectional view showing a health bracelet of the present invention.

[0003] ● Description of signs for the main part of the drawings

[0004] 1: Health bracelet 10: body

[0005] 11: inner ring 12: outer ring

[0006] 13: groove 14: wire groove

[0007] 20: laser diode 22: electric wire

[0008] 30: power supply 32: switch

DISCLOSURE

INVENTION PURPOSE

BACKGROUND ART

[0009] The present invention relates to a health bracelet, and more particularly, to a health bracelet in which laser diode devices are embedded at certain intervals in the interior of a double-constituted body, whereby laser heat and light rays are dispersed and penetrated into the skin at a low output angle to expect effects of deinflammation, pain relief, immune strength increase, and dermatitis protection.

[0010] Recently, as environmental pollution due to industry development and theft, people have increased life environment and health attention. in recent years, health problems or discomfort perceived by residents are becoming social issues due to harmful substances coming from building materials or wallpaper used to refresh homes or buildings.

[0011] In this social issue, products that are always worn and grafted to accessories that are encouraged aesthetically appealing and the like, are rapidly released. Of these conventional accessory

products, a health bracelet formed by mixing tormarin which anions are emitted in a large amount and germanium emitted in a large amount of far-infrared rays with silicon is implemented.

[0012] As described in Korean Registered Utility Model 20-0375903, conventional health bracelets such as tormarin or germanium from which anions are irradiated in a large amount are ground into fine powder and molded together with silicone to perform flexible health bracelets.

[0013] However, when such anion-spun stone is ground into fine powder and molded after mixing with silicone, it has not been possible to produce a health bracelet that clearly exhibits bright colors such as white and so on due to its own color.

[0014] In addition, in order to impart stretchability of health bracelets, the content of negative ion emitting stone becomes relatively lower than the content of silicon, so that radiation amounts of negative ions and far-infrared rays are significantly reduced. Therefore, there is a problem in that it is not possible to perform the inherent functions of health bracelets emitting negative ions and far-infrared rays.

[0015] The problems of health bracelet formed by mixing such conventional anion-emitting raw stone and silicon are improved, and thus the negative ion emitting material such as tormarin, germanium, and the like, and far-infrared emitting material were pulverized into a silicon tube performed in Korean Registered Utility Model No. 20-0377551 and filled into a silicon tube in a particle form.

[0016] However, the improved conventional health bracelet has been obtained by filling and using particles in a silicone tube, a problem of filling the negative ion emitting material of the particles into the silicone tube is generated, thereby significantly increasing the product production time, resulting in deterioration in productivity, and thus incapable of expressing various aesthetic shapes.

ABSTRACT PROBLEM

[0017] The present invention is designed to solve the problems of the related art, and therefore the present invention is directed to providing a health bracelet capable of expecting inflammation removal, pain relief, immune strength increase, and dermatitis protection effects by embedding laser heat and light rays at a low output angle to the skin by dispersing laser heat and light rays into the skin at a low output angle.

[0018] The bracelet includes: a body including an inner ring and an outer ring; a plurality of laser diodes formed at predetermined intervals between the inner ring and the outer ring; and a power supply unit formed at one side of the body and electrically connected to the laser diodes to supply power.

INVENTION CONFIGURATION

[0019] Hereinafter, the configuration of the present invention will be described with reference to the accompanying drawings.

[0020] In the health bracelet 1 of the present invention, when referring to Figs. 1 and 2 illustrated, the health bracelet 1 can be alternated into a body 10 composed of an inner ring 11 and an outer ring 12, a laser diode 20 interposed between the inner ring 11 and the outer ring 12, and a power supply 30 for supplying power to the laser diode 20.

[0021] The body 10 formed of the inner ring 11 and the outer ring 12 may be both made of synthetic resin or elastic metal materials and may be formed to have different sizes, but for an effective configuration, the inner ring 11 and the outer ring 12 may be preferably formed to be integral with each other.

[0022] The coupling of the inner ring 11 and the outer ring 12 constituting the body 10 may not only be coupled by a plurality of bolts but may also be coupled by interference fit of the inner ring 11 and the outer ring 12, but may also be coupled by interference fit, for example, described herein.

[0023] In addition, a groove 13 into which the laser diode 20 is inserted is formed on both sides of the inner ring 11 and the outer ring 12 facing each other, and an electric wire groove 14 into which an electric wire 22 for connecting the laser diode 20 is inserted is formed on one side, wherein the electric wire groove 14 is formed in the outer ring 12.

[0024] A recess 15 for receiving a power supply 30 for supplying power to the laser diode 20 may be formed on one side of the body 10, i.e., the inner ring 11 and the outer ring 12, and may be formed on one side surface of the inner ring 11, for example.

[0025] Front surfaces of a plurality of laser diodes (20) interposed between the inner ring (11) and the outer ring (12) are rounded to form heat generated to spread to the skin and a predetermined area.

[0026] A power supply unit 30 formed on one side of the body 10 and electrically connected to the laser diode 20 to supply power is formed on an upper portion thereof with a switch 32 serving to supply and shut off power to the laser diode 20, wherein the switch 32 is formed integrally with an outer peripheral surface and is formed to protrude as necessary.

[0027] The power supply for supplying power to the laser diode (20) in accordance with the operation of the switch (32) is not only a normal dry battery but also a mercury dry battery or the like.

[0028] Looking at the action and use state of the health bracelet 1 configured as described above is as follows.

[0029] First, a plurality of laser diodes (20) are inserted into a groove (13) formed between the inner ring (11) and the outer ring (12), and the plurality of laser diodes (20) are connected by an electric wire (22).

[0030] Next, when the dry battery 34 is supplied to the groove 15 in which the power supply 30 is formed, the assembly is completed when the inner ring 11 and the outer ring 12 are press-fit. In addition, decorative accessories may be separately provided on the outer peripheral surface of the health fillet 1 and used.

[0031] When the switch 32 of the power supply 30 is operated in the state described above, power is supplied to the laser diode 20 to generate laser heat and light rays, and the light rays are dispersed and penetrated into the skin at a low output angle and massages the skin.

ADVANTAGEOUS EFFECTS

[0032] According to the present invention, laser diode devices are embedded at certain intervals in the interior of a double-constituted body, so that laser heat and light rays are dispersed and penetrated into the skin at a low output angle to expect the effects of removing inflammation, alleviating pain, increasing immunity, and protecting dermatitis.

(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 103109462 A
(43)申请公布日 2013.05.15

(21)申请号 201180029020.6
(22)申请日 2011.04.18
(30)优先权数据
61/324,824 2010.04.16 US
61/346,974 2010.05.21 US
(85)PCT申请进入国家阶段日
2012.12.12
(86)PCT申请的申请数据
PCT/US2011/032934 2011.04.18
(87)PCT申请的公布数据
WO2011/130752 EN 2011.10.20
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(51)Int.Cl.
H03K 17/94(2006.01)

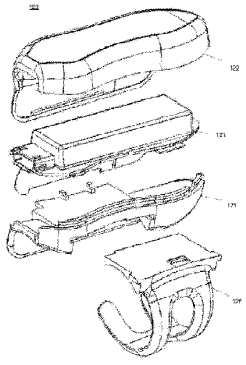
权利要求书5页 说明书19页 附图26页

(54)发明名称

可佩戴式动作感测计算接口

(57)摘要

本发明涉及一种设备，该设备包括被配置成检测移动并且生成与所检测到的至少部分移动相关的移动数据的传感器；被配置成生成被配置成包括有至少部分地基于移动数据的移动信息的消息传送单元；与消息传送单元相通信并且被配置成发送消息的发射器以及被配置成至少部分地包裹传感器、消息传送单元和传送器中的至少一个的壳体，并且该壳体包括确保包裹手指的手指握部。本发明还提供了使用该设备的方法。



CN 103109462 A

Petitioner Samsung Ex-1004, 0698

1. 一种设备，包括：

传感器，被配置成检测移动并生成与至少部分所检测到的移动相关的移动数据；

消息传送单元，被配置成生成被配置成包括至少部分地基于所述移动数据的移动信息的消息；

发射器，与所述消息传送单元进行数据通信并且被配置成发送所述消息；以及

壳体，被配置成至少部分地包裹所述传感器、所述消息传送单元和所述发射器中的至少一个，并且所述壳体包括手指握部，所述手指握部被配置成将所述壳体固定在人体手指上。

2. 根据权利要求 1 所述的设备，其中，所述手指握部与所述壳体可拆装地相连接。

3. 根据权利要求 2 所述的设备，其中，所述手指握部包括绑带。

4. 根据权利要求 3 所述的设备，其中，所述传感器包括加速计。

5. 根据权利要求 4 所述的设备，其中，所述移动信息包括所述加速计的加速度数据

6. 根据权利要求 5 所述的设备，其中，所述消息被配置成包括至少部分地基于作为手指敲击特征的移动的检测的敲击信息。

7. 根据权利要求 6 所述的设备，其中，所述加速计是三轴加速计。

8. 根据权利要求 7 所述的设备，其中，所述传感器包括陀螺仪。

9. 根据权利要求 8 所述的设备，其中，所述移动信息进一步包括所述陀螺仪的旋转数据。

10. 根据权利要求 9 所述的设备，其中，所述陀螺仪是三轴陀螺仪。

11. 根据权利要求 10 所述的设备，进一步包括：

电源，被配置成为所述发射器和所述传感器中的至少一个提供电能。

12. 根据权利要求 11 所述的设备，其中，所述电源是选自由电池、电容器和与所述设备相连接的外部电源所构成的组中的电源。

13. 根据权利要求 11 所述的设备，其中，所述电源与所述消息传送单元可拆装地相连接。

14. 根据权利要求 13 所述的设备，进一步包括：

接触传感器，包括与所述消息传送单元进行数据通信的接触面并且被配置成检测所述接触传感器的接触面上的接触。

15. 根据权利要求 14 所述的设备，进一步包括：

滑动传感器，包括与所述消息传送单元进行数据通信的接触面并且被配置成检测所述滑动传感器的接触面上的滑动接触。

16. 根据权利要求 15 所述的设备，其中，所述接触传感器和所述滑动传感器均是电容传感器。

17. 根据权利要求 16 所述的设备，其中，所述消息被配置成包括所述接触传感器的接触数据和所述滑动传感器的接触数据。

18. 根据权利要求 17 所述的设备，其中，所述消息被配置成包括头部、装置标识符和尾部。

19. 根据权利要求 18 所述的设备，进一步包括：被配置成管理验证数据的验证单元。

20. 根据权利要求 19 所述的设备，其中，所述消息进一步被配置成包括来自所述验证

Petitioner Samsung Ex-1004, 0699

单元的验证数据。

21. 根据权利要求 20 所述的设备，其中，所述消息传送单元被配置成至少部分地基于激活接触传感器来请求与远程装置建立通信信道。

22. 根据权利要求 21 所述的设备，其中，所述消息传送单元被配置成至少部分地基于选自由失去通信链接、所检测到的移动减少、检测到激活序列、计时器到时、检测到低功率条件、检测到错误条件以及接收到停止消息所构成的组中的条件来停止生成所述消息。

23. 根据权利要求 22 所述的设备，其中，所述发射器被配置成使用选自由电气与电子工程师协会 (IEEE) 协议、无线协议、IEEE 802.x 协议、红外线数据组织 (IrDA) 协议、并行通信协议、同步串行协议、异步串行协议、通用串行总线 (USB) 协议、传送控制协议 / 互联网协议 (TCP/IP) 协议、用户数据协议 / 互联网协议 (UDP/IP) 协议以及 IEEE 1394 协议所构成的组中的通信协议。

24. 根据权利要求 23 所述的设备，进一步包括 ：振动器，所述振动器被配置成由所接收到的消息和所述设备的状态条件中的至少一个激活。

25. 根据权利要求 24 所述的设备，进一步包括 ：发声器，所述发声器被配置成基于接收到消息和所述设备的状态条件中的至少一个发出声音警报。

26. 根据权利要求 25 所述的设备，进一步包括 ：

视觉指示器，所述视觉指示器被配置成至少部分地基于选自由通电条件、自检条件、移动、发送消息、接收消息以及建立通信道所构成的组中的条件来激活所述视觉指示器。

27. 一种设备，包括 ：

接收器，被配置成接收由动作感测装置发送的动作信号 ；

转换电路，被配置成将所述动作信号转换成与计算装置的输入接口兼容的输入消息 ；以及

输出接口，被配置成将所述输入消息发送至所述计算装置的所述输入接口。

28. 根据权利要求 27 所述的设备，进一步包括 ：

发射器，被配置成将动作信号确认发送至所述动作感测装置。

29. 根据权利要求 28 所述的设备，其中，所述接收器进一步被配置成请求再次发送所述动作信号。

30. 根据权利要求 29 所述的设备，其中，所述输入消息与选自由移动鼠标、点击鼠标、按下按键事件、松开按键事件、点击按键事件以及键盘事件所构成的组中的事件相关。

31. 根据权利要求 30 所述的设备，其中，所述接收器被配置成使用选自由电气与电子工程师协会 (IEEE) 协议、无线协议、IEEE 802.x 协议、IEEE 802.15.4 协议、IEEE 802.16 协议、IEEE 802.11 协议、红外线数据组织 (IrDA) 协议、并行通信协议、同步串行协议、异步串行协议、通用串行总线 (USB) 协议、以太网协议、TCP/IP 协议、UDP/IP 协议以及 IEEE 1394 协议所构成的组中的通信协议。

32. 根据权利要求 31 所述的设备，其中，所述输出接口选自由 USB 端口、串行端口、以太网端口、LAN 端口、卡座、总线接口卡以及无线接口所构成的组。

33. 一种方法，包括 ：

生成与传感器所检测到的至少部分移动相关的移动数据 ；

利用消息传送单元生成被配置成包括至少部分地基于所述移动数据的移动信息的消

Petitioner Samsung Ex-1004, 0700

息；以及

发送所生成的消息；

其中，所述传感器、所述消息传送单元和发射器中的至少一个至少部分地被包裹在壳体中，所述壳体包括被配置成将所述壳体固定至人体手指的手指握部。

34. 根据权利要求 33 所述的方法，其中，所述手指握部与所述壳体可拆装地相连接。

35. 根据权利要求 34 所述的方法，其中，所述手指握部包括绑带。

36. 根据权利要求 35 所述的方法，其中，所述传感器包括加速计。

37. 根据权利要求 36 所述的方法，其中，所述移动信息包括所述加速计的加速度数据。

38. 根据权利要求 37 所述的方法，其中，所述消息被配置成包括敲击信息，所述敲击信息至少部分地基于作为手指敲击特征的移动的检测。

39. 根据权利要求 38 所述的方法，其中，所述加速计是三轴加速计。

40. 根据权利要求 39 所述的方法，其中，所述传感器包括陀螺仪。

41. 根据权利要求 40 所述的方法，其中，所述移动信息进一步包括所述陀螺仪的旋转信息。

42. 根据权利要求 41 所述的方法，其中，所述陀螺仪是三轴陀螺仪。

43. 根据权利要求 42 所述的方法，进一步包括：

通过由电源提供电能来为所述发射器和所述传感器中的至少一个供电。

44. 根据权利要求 43 所述的方法，其中，所述电源是选自由电池、电容器和外部电源所构成的组中的电源。

45. 根据权利要求 43 所述的方法，其中，所述电源被可拆装地连接。

46. 根据权利要求 45 所述的方法，进一步包括：

生成与接触传感器的接触面上的接触相关的接触数据，所述接触传感器与所述消息传送单元进行数据通信。

47. 根据权利要求 46 所述的方法，进一步包括：

生成与滑动传感器的接触面上的滑动接触相关的接触数据，所述滑动传感器与所述消息传送单元进行数据通信。

48. 根据权利要求 47 所述的方法，其中，所述接触传感器和所述滑动传感器均是电容传感器。

49. 根据权利要求 48 所述的方法，其中，所述消息被配置成包括所述接触传感器的接触数据和所述滑动传感器的接触数据。

50. 根据权利要求 49 所述的方法，其中，所述消息被配置成包括头部和装置标识符。

51. 根据权利要求 50 所述的方法，进一步包括：至少部分地基于激活所述接触传感器而请求与远程装置建立通信信道。

52. 根据权利要求 51 所述的方法，进一步包括：基于接收消息和检测状态条件中的至少一个激活振动器。

53. 根据权利要求 52 所述的方法，进一步包括：基于接收消息和检测状态条件中的至少一个发出声音警报。

54. 根据权利要求 53 所述的方法，进一步包括：

至少部分地基于检测到选自由通电条件、自检条件、移动、发送消息、接收消息以及建

Petitioner Samsung Ex-1004, 0701

立通信信道所构成的组中的条件来激活视觉指示器。

55. 一种方法，包括：

接收与可佩戴式动作感测装置的至少部分移动相关的数据；

过滤所述数据，以生成所述可佩戴式动作感测装置的移动变化率；

求所述移动变化率的积分，以生成所述可佩戴式动作感测装置的测量移动；

将所述测量移动和所累积的移动加和，以生成所述可佩戴式动作感测装置的更新位置和所述可佩戴式动作感测装置的更新定向中的至少一个；以及

至少部分地基于所述更新位置和所述更新定向之一来更新计算装置的用户接口的特征。

56. 根据权利要求 55 所述的方法，其中，所述数据是来自所述可佩戴式动作感测装置的加速计的至少一个轴的加速度数据。

57. 根据权利要求 55 所述的方法，其中，所述数据是来自所述可佩戴式动作感测装置的陀螺仪的至少一个轴的角速率数据。

58. 根据权利要求 55 的方法，进一步包括：

缩放所述数据。

59. 根据权利要求 58 所述的方法，其中，通过缩放函数来执行所述缩放，所述缩放函数选自由以下缩放函数所构成的组：线性缩放函数；指数缩放函数；根据方程 $A_i' = ((4/32768)*A_i)*9.81$ 进行缩放的缩放函数，其中 A_i 是选自 x 轴、y 轴和 z 轴中的一个轴上的加速度数据；以及根据方程 $Gi' = ((500dps/32786)*(pi/180))*Gi$ 进行缩放的缩放函数，其中 Gi 是选自 x 轴、y 轴和 z 轴的一个轴上的角速率数据。

60. 根据权利要求 55 所述的方法，其中，所述计算装置的所述用户接口的所述特征是光标位置。

61. 根据权利要求 60 所述的方法，其中，至少部分地基于经过缩放的测量移动来更新所述光标位置。

62. 根据权利要求 60 所述的方法，其中，通过所述可佩戴式动作感测装置的第二轴上的移动来生成第一轴上的光标位置变化。

63. 根据权利要求 55 所述的方法，进一步包括：

接收所述可佩戴式动作感测装置的传感器激活指示，并且

其中，至少部分地基于接收到所述传感器激活指示来更新所述特征。

64. 根据权利要求 55 所述的方法，其中，所述特征选自由点击左键、点击右键、点击应用定义键、点击用户定义键、滚动功能、放大功能、缩小功能、打开应用、关闭应用、查看邮件、编辑字符、键入字符、复制字符、删除字符、粘贴字符、选择用户可选选项、将项目发至回收站、更改音量、静音、选择多媒体项目、播放多媒体项目、暂停多媒体项目回放、改变多媒体项目回放速度、重复多媒体项目回放、快进多媒体项目回放、跳过部分多媒体项目回放、图像旋转、改变图像尺寸、缩放图像、修整图像、图像的图像处理以及电影编辑功能所构成的组。

65. 根据权利要求 55 所述的方法，其中，通过选自由平滑滤波器、高通滤波器、卡尔曼滤波器或迭代算法所构成的组中的滤波器来执行所述过滤。

66. 根据权利要求 55 所述的方法，其中，所述过滤进一步包括：

Petitioner Samsung Ex-1004, 0702

从所述数据中选择多个数据点；

计算所选择的多个数据点的平均值；

计算所选择的多个数据点的标准偏差；

将所述标准偏差与最小标准偏差相比较；以及

当所述标准偏差小于所述最小标准偏差时，从数据点中减去所述平均值，以从所述数据点中去除 DC 偏移并且生成所述可佩戴式动作感测装置的移动变化率。

67. 根据权利要求 66 所述的方法，其中，对于与加速度的轴相关的数据，所述最小标准偏差是 .03，并且对于与角速率的轴相关的数据，所述最小标准偏差是 .003。

68. 根据权利要求 66 所述的方法，其中，通过向所述数据应用窗口函数来执行选择所述多个数据点的步骤，以选择出大约 50 个数据点。

69. 根据权利要求 55 所述的方法，进一步包括：

通过测量由所述可佩戴式动作感测装置的重力所产生的加速度来确定所述可佩戴式动作感测装置的定向。

Petitioner Samsung Ex-1004, 0703

可佩戴式动作感测计算接口

[0001] 相关申请参考

[0002] 本申请要求于2010年4月16日提交的序列号为61/324,824,标题为“User Interface and Computer Interface with Accelerometer,Gyroscope andWireless Interface”的美国在先申请以及于2010年5月21日提交的序列号为61/346,974,标题为“Accelerometer-Based Computing Interface”的美国在先申请的优先权。

技术领域

[0003] 下面描述的装置、方法和系统大体上涉及计算装置领域,更具体地涉及的是用于人机互动的装置、方法和系统。

发明内容

[0004] 一种设备可以包括被配置成检测移动并且生成与所检测的至少部分移动相关的移动数据的传感器,被配置成生成包括有基于移动数据的移动信息的消息传送单元,与消息传送单元相互通信发送消息的发送器以及包裹有传感器、消息发送单元和发送器的壳体,并且该壳体具有将外壳固定至人体手指的手指握部。在多种配置中,手指握部是可从壳体上拆装下来的并且可以包括绑带。在多种配置中,传感器可以包括加速计,例如,三轴加速计,而移动信息可以包括来自加速计的加速度数据。在多种配置中,传感器可以包括陀螺仪,例如,三轴陀螺仪,而移动信息可以包括来自陀螺仪的旋转数据。在多种配置中,消息可以包括来自手指敲击移动特征检测的敲击信息。在多种配置中,该设备可以包括电源,例如,可拆装的电源、电池、电容器或与设备相耦合的外部电源,该电源为发送器和传感器提供电能。在多种配置中,该设备可以包括与消息发送单元相互通信的接触传感器,该接触传感器具有用于检测接触的接触面。在多种配置中,该设备可以包括具有用于检测接触的接触面的滑动传感器,该滑动传感器与消息发送单元相互通信。在多种配置中,接触传感器和滑动传感器是电容传感器。在多种配置中,消息包括接触传感器和滑动传感器的接触信息。

[0005] 在多种配置中,该设备进一步包括管理验证数据的验证单元,并且该消息可以包括验证数据。在多种配置中,消息传送单元可以被配置成基于接触传感器的激活而请求与远程装置的建立通信信道,并且基于以下条件生成停止消息,诸如,失去通信链接、所检测到的移动减少、激活顺序检测、计时器到时、检测到低功率条件、检测到错误条件以及接收到停止消息。在多种配置中,发射器可以使用通信协议,诸如,电气与电子工程师协会(IEEE)协议、无线协议、IEEE802.x协议、红外线数据组织(IrDA)协议、并行通信协议、同步串行协议、异步串行协议、通用串行总线(USB)协议、传送控制协议/互联网协议(TCP/IP)协议、用户数据协议/互联网协议(UDP/IP)以及IEEE 1394协议。该设备可以包括能够被所接收到的消息或设备状态条件激活的振动器。该设备可以包括能够发出声音报警的发声器,可以通过所接收到的消息或设备状态条件激活该发声器。该设备可以包括视觉指示器,可以通过设备状态条件,诸如,电源开启条件、自测条件、移动、传送消息、接收消息以及建立通信道来激活该视觉指示器。

Petitioner Samsung Ex-1004, 0704

[0006] 该设备可以包括被配置成接收来自动作感测装置的动作信号的接收器；被配置成将动作信号转换成与计算装置的输入接口相兼容的输入消息的转换电路；以及被配置成将输入消息发送给计算装置的输入接口的输出接口。该设备可以进一步包括被配置成将动作信号确认发送给动作感测装置的发射器。可以进一步将接收器配置成请求再传送动作信号。该输入消息可以与选自于由鼠标动作、鼠标点击、按下按键活动、松开按键活动、点击按键活动以及键盘活动所构成的组中的活动相关。可以进一步将接收器配置成使用选自于由电气与电子工程师协会 (IEEE) 协议、无线协议、IEEE802.x 协议、IEEE802.15.4 协议、IEEE802.16 协议、IEEE802.11 协议、红外线数据组织 (IrDA) 协议、并行通信协议、同步串行协议、异步串行协议、通用串行总线 (USB) 协议、以太网协议、TCP/IP 协议、UDP/IP 协议以及 IEEE 1394 协议所构成的组中的通信协议。该输出接口可以是选自于由 USB 端口、串行端口、以太网端口、LAN 端口、卡座、总线接口所构成的组中的输出接口和无线接口。

[0007] 一种方法可以包括生成与传感器所检测到的至少一部分移动相关的移动数据；利用消息单元生成可以被配置成包括至少部分基于移动数据的移动信息的消息；以及发送所生成的消息；其中，传感器、消息单元和发射器中的至少一个可以至少部分地包括在壳体中，该壳体可以包括被配置成将该壳体固定至人体手指的手指握部。该手指握部可以可拆装地与壳体相连接且可以包括绑带。该传感器可以包括加速计。该移动信息可以包括加速计的加速度数据。该消息可以被配置成包括至少部分地基于移动检测的敲击信息，该敲击信息可以表现出手指的点击特征。该加速计可以是三轴加速计。该传感器可以包括陀螺仪。移动信息可以进一步包括陀螺仪的旋转信息。该陀螺仪可以是三轴陀螺仪。

[0008] 该方法可以进一步包括通过从电源提供的电能来为发射器和传感器中的至少一个供电。该电源可以是选自由电池、电容器和外部电源所构成的组中的电源。该电源可以被可拆装地连接。

[0009] 该方法可以进一步包括与接触传感器的接触面上的接触相关地生成接触数据，该接触传感器与消息单元数据通信。该方法还可以进一步包括生成与滑动传感器的接触面上的滑动接触相关的接触数据，该滑动接触器与消息单元数据通信。接触传感器和滑动传感器中的每个均可以是电容传感器。该消息可以被配置成包括接触传感器的接触数据和滑动传感器的接触数据。该消息可以被配置成包括数据头和装置标识。

[0010] 该方法仍可以进一步包括请求至少部分基于接触传感器的激活而与远程装置建立通信信道。该方法还可以进一步包括基于至少一个接收消息和检测状态条件的振动器。该方法还进一步包括基于消息接收条件和检测状态条件中的至少一个发出声音警报。该方法仍进一步包括至少部分基于选自于由通电条件、自检条件、移动、消息传送、消息接收以及建立通信信道所构成的组中的条件的检测来激活视觉指示器。

[0011] 该方法可以包括接收与可佩戴式动作感测装置的至少一部分移动相关的数据；滤波该数据从而生成可佩戴式动作感测装置的移动变化率；计算测量的移动和所累积的移动之和从而生成可佩戴式动作感测装置的更新位置以及可佩戴式动作感测装置的更新方向中的至少一个；以及至少部分地基于更新位置和更新方向之一地更新计算装置的用户接口特征。该数据可以是来自可佩戴式动作感测装置的加速计的至少一轴的加速度数据。可选地，该数据可以是来自可佩戴式动作感测装置的陀螺仪的至少一轴的角速率数据。该方法可以进一步包括按比例缩放数据。可以通过按比例缩放功能来执行按比例缩放，该按比

Petitioner Samsung Ex-1004, 0705

例缩放功能选自于由以下按比例缩放功能所构成的组，即，线性按比例缩放功能，根据公式 $A_i' = ((4/32768)*A_i)*9.81$ 进行缩放的指数缩放功能且 Ai 是选自 x 轴、y 轴和 z 轴中的一个轴上的加速度数据，以及根据公式 $G_i' = ((500dps/32786)*(pi/180))*G_i$ 进行缩放的缩放函数且 G_i 是选自 x 轴、y 轴和 z 轴中的一个轴上的角速率。

[0012] 该方法可以进一步包括接收可佩戴式动作感测装置的传感器激活指示，并且其中，可以至少部分基于接收传感器激活指示而更新该特征。计算装置的用户接口特征可以是光标位置。可以至少部分地基于经过缩放的测量移动来更新光标位置。可以通过可佩戴式动作感测装置的第二轴中的移动来生成第一轴中的光标位置变化。另外，该特征选自于由点击左键、点击右键、点击应用定义键、点击用户定义键、滚动功能、放大功能、缩小功能、打开应用、关闭应用、查看邮件、编辑字符、键入字符、复制字符、删除字符、粘贴字符、选择用户可选选项、将项目发送给回收站、更改音量、静音、选择多媒体项目、播放多媒体项目、暂停多媒体项目回放、改变多媒体项目回放速度、重复多媒体项目回放、快进多媒体项目回放、跳过部分多媒体项目回放、图像旋转、改变图像尺寸、按比例缩放图像、修整图像、图像的图像处理以及电影编辑功能所构成的组。

[0013] 该方法可以进一步包括过滤，可以通过选自于由平滑滤波器、高通滤波器、卡尔曼滤波器或迭代算法所构成的组中的滤波器或算法来执行该滤波。该滤波另外可以包括从数据中选择多个数据点，计算所选择的多个数据点的平均值、计算所选择的多个数据点的标准偏差、将该标准偏差与最小标准偏差相比较以及当标准偏差小于最小标准偏差时从数据点中减去平均值；以从数据点中去除 DC 偏移并且生成可佩戴式动作感测装置的移动变化率。对于与加速度轴相关的数据而言最小标准偏差可以是 .03，并且其中，对于与角速率轴相关的数据而言最小标准偏差可以是 .003。通过向数据应用窗口函数来执行选择多个数据点的步骤，从而选择出大约 50 个数据点。该方法可以进一步包括通过测量出可佩戴式动作感测装置的重力所产生的加速度来确定可佩戴式动作感测装置的方向。

附图说明

[0014] 图 1A 是手指鼠标的分解立体图；

[0015] 图 1B 是手指鼠标的立体图；

[0016] 图 1C 是手指鼠标的立体图；

[0017] 图 1D 是手指鼠标系统的立体图；

[0018] 图 1E 是人体工学的手指鼠标的分解图；

[0019] 图 1F 是人体工学的手指鼠标的分解图；

[0020] 图 1G 是手指鼠标电路板的立体图；

[0021] 图 1H 是带有移动电源模块的手指鼠标的部分分解图；

[0022] 图 1I 是手指鼠标子板的平面图；

[0023] 图 2 是人体手部食指上的手指鼠标的立体图；

[0024] 图 3A 是人体手部食指上的手指鼠标的立体图；

[0025] 图 3B 是人体手部食指上的手指鼠标的立体图；

[0026] 图 3C 是人体手部食指上的手指鼠标的立体图；

[0027] 图 4 是人体手部两个手指上的两个手指鼠标的立体图；

Petitioner Samsung Ex-1004, 0706

[0028] 图 5A 是人体手部两个手指上的两个手指鼠标的立体图；

[0029] 图 5B 是人体手部两个手指上的两个手指鼠标的立体图；

[0030] 图 5C 是人体手部两个手指上的两个手指鼠标的立体图；

[0031] 图 6 是人体手部食指上的手指鼠标的立体图；

[0032] 图 7 是人体手部食指上的手指鼠标的立体图；

[0033] 图 8 是人体手部的立体图；

[0034] 图 9 是个人计算机系统的立体图；

[0035] 图 10 是在打字时人体手部食指上的手指鼠标的立体图；

[0036] 图 11 是敲击表面时人体手部食指的手指鼠标的立体图；

[0037] 图 12 是处理手指鼠标的移动数据的方法的流程图；

[0038] 图 13 是处理手指鼠标的移动数据的方法的流程图；

[0039] 图 14 是将手指鼠标与计算装置相连接 (interfacing) 的方法的流程图；

[0040] 图 15A 是将手指鼠标与计算装置相连接的方法的流程图；

[0041] 图 15B 是将手指鼠标与计算装置相连接的方法的流程图；

[0042] 图 15C 是将手指鼠标与计算装置相连接的方法的流程图；

[0043] 图 15D 是将手指鼠标与计算装置相连接的方法的流程图；

具体实施方式

[0044] 在本文献中所公开和描述的装置、方法和系统可以用于将动作感测装置和计算装置相连接。为了简化说明，包括在本文献中的实例专注于可以用于与计算装置的用户接口相连接的可佩戴式动作感测装置以及通信方法和协议堆栈。本领域普通技术人员通过阅读该描述将了解，所描述的装置、方法和系统可以用于或阼简单修改以用于其他类型的设备、其他协议和通信协议堆栈中的其他层。单独地作为动作感测装置和计算装置之间的直接通信链接部分的部件的说明并不意味着不能使用其他结构，诸如，以网络为基础的结构。相反地，在阅读了该文件中的公开内容之后，可能修改对本领域的技术人员而言将是显而易见的。类似的参考标号旨在涉及相同的或类似的部件。

[0045] 在整个公开中，对部件或模块的参考大体上涉及了逻辑上可被组成组从而执行一个功能或一组相关功能的项目。可以在软件、硬件或软件和硬件的组合中实施部件和模块。广泛地使用术语“软件”，其不仅包括可执行的代码，还包括数据结构、任意电子格式的数据存储和计算指令、固件以及内置软件。广泛地使用术语“信息”且该信息包括多种电子信息，包括但不限于机器可执行或机器可读的指令；内容，诸如，文本、视频数据和音频数据及其他的；以及各种代码或标记。在上下文允许时，时常可交换使用术语“信息”和“内容”。应该注意，尽管为了明确和为了理解下面所论述的一些实例可能将具体部件或功能描述为具体部件或模块的部分或生成在计算装置的具体层（例如，硬件层、操作系统层或应用层）上，但仍可以将那些部件或功能实施成不同部件或模块的部分或在不同层上实施。

[0046] 下面所论述的实例仅仅是实例并且被用于辅助解释所述的系统和方法。除非特别指出是强制性的，对于这些系统或方法中的任意一种的任意具体的实施而言，图中所示的或下面论述的任何特征或部件均不是强制性的。为了简化阅读和清楚，可以单独地结合具体视图来描述特定部件、模块或方法。任意没有具体描述的部件组合或变形均不应该理解

Petitioner Samsung Ex-1004, 0707

成示出任意组合或变形是不可能的。同样，对于所描述的任意方法而言，无论是否结合流程图描述了此方法，除非上下文另行说明或要求都应该理解为，方法执行过程中任意明确的或暗含的执行步骤顺序均不意味着必须以所示步骤执行那些步骤，而可以不同的顺序或并行地执行。

[0047] 计算系统通常具有用于允许人员访问或在计算装置内输入数据的用户接口。计算装置可以是台式计算机、笔记本电脑、平板电脑、智能手机、游戏系统、自动化亭 (kiosk) 系统、带有内置处理器的装置、汽车系统、音乐播放装置以及在其中使用人输入来控制系统或装置功能的人体上任意类型的系统和装置。结合计算系统所使用的大多数普通用户接口数据输入装置是键盘和鼠标，键盘允许用户将信息输入成文本或数字信息，而鼠标涉及的是一种类型的用户接口，在其中计算机操作者可以在2D平面视频图案屏幕（诸如，计算机400的视屏屏幕402）中操纵光标。传统的鼠标也被用作为在视屏图案屏幕上选择数据输入点和其他相关功能的导航工具。如在此所述那样，与传统的鼠标相比，手指鼠标100对用户或计算机操作者的限制更少。通过阅读该说明本领域的技术人员将意识到，在此所述的装置、方法以及系统可以应用于或简单地更改后用于其他设备。类似的参考标号旨在涉及相同的或类似的项目。

[0048] 现参考图1A、图1B和图1C，示出了手指鼠标100的视图。手指鼠标100是可以与计算装置相连接并且有助于人机互动的动作感测装置。手指鼠标100包括底部壳体101、顶部壳体102、包括RF收发器105的刚性电路板103、至少一个轴的加速计106、作用在至少三个轴（俯仰 (pitch)、偏航 (yaw)、滚转 (roll)）中的陀螺仪107，可以感测包括按键、滑杆或这两者的区域的电容感测电路108、电池109、视觉指示器110（例如，发光二极管 (LED)）以及可以包括电容感测按键111、112、113或接触传感器、滑杆或触觉按键的柔性电路104。

[0049] 在一些配置中，刚性电路板103可以是柔性的或可以包括两个或多个分离的电路板。在其他配置中，刚性电路板103和柔性电路104可以是单个柔性电路。在另外的其他配置中，RF收发器105、加速计106、陀螺仪107、电容电路108、电池109、视觉指示器110以及柔性电路104可以与刚性电路板103相分离并且通过总线或引线（未示出）与其电连接。在可选的配置中，手指鼠标100可以仅包括所列举的部件的一个子集。例如，陀螺仪107可以具有少于三个轴，或者刚性电路板103可以不包括视觉指示器110。

[0050] 在可选的配置中，正如本领域的技术人员所理解的那样，各个部件可以是相结合的或是相分离的。例如，加速计106和陀螺仪107可以是单个部件或芯片，或加速计106和陀螺仪107的每个轴均可以包括分离的离散部件。在另一个实例配置中，壳体101、102可以是单个模塑单元，该模塑单元使用例如，模塑硅、塑料、橡胶、其他化合物或他们的组合通过包围所有或部分的外部电子器件来提供保护性凹槽。在一个配置中，壳体101、102可以包括绑带115或可拆装的手指握部125并且可以是单个的材料单元，例如，模塑硅或橡胶单元，其中，刚性电路板103和柔性电路104嵌在该材料内。

[0051] 在多种配置中，手指鼠标100可以包括用于测量心率的脉搏血氧计155，该脉搏血氧计可以包括分离的装配在壳体101、102、115、125中的传感器、全球定位系统 (GPS)156电路、无线射频识别 (RFID) 芯片154、照相机（未示出）、电荷耦合装置、对电磁辐射的各种频率敏感的焦平面阵列或线性传感器阵列（未示出）、高度计（未示出）以及磁强计，以作为额外的传感器来生成更为全面的数据组从而了解使用手指鼠标100的用户的移动、位置和

Petitioner Samsung Ex-1004, 0708

状态。利用额外的传感器输入，手指鼠标 100 可以生成更为完整、全面的用户在手指鼠标 100 方面的体验事件分析。

[0052] 手指鼠标 100 中的电源可以是电池 109。电池 109 可以是通常用于小功率电子装置的那种类型的纽扣电池。导电固定夹（未示出）既可以用于将电池 109 可释放地附接在装置上，又可以用于完成包括作为电源的电池 109 的电源电路。这种可释放结构可以用于允许为了进行替换或充电等等而去除电池 109。手指鼠标 100 要么直接通过电线或引线与外部电源（未示出）相连接，要么通过电感耦合与外部电源相连接。手指鼠标 100 可以由与手指鼠标 100 可操作性地相耦合的外部电源（未示出）供电。例如，可以通过计算机 400 利用 USB 端口 130 为手指鼠标 100 供电；计算机 400 可以是外部电源。本领域普通技术人员将从阅读本公开中意识到正如所期望的、所需要的或适合的那样，可以以不同配置使用其他类型的电池和电源（诸如，太阳能电池或超级电容器）。

[0053] 可以将指示器窗 114 放置在手指鼠标 100 外部并且可以暴露 LED 或视觉指示器 110，其可以示出多种功能、移动以及手指鼠标 100 的条件，例如，电源开启条件、自测条件和休眠模式条件。用户拇指或另一根手指的鼠标选择可以导致 LED 或视觉指示器 110 出现特定类型的闪光。在光标模式或滚动模式中手指的移动可以引起另一种类型的闪光。另一种类型的闪光可以是对手指鼠标 100 与另一个计算装置之间的有效通信的指示，例如，建立通信链接或发送消息以及从计算装置接收消息。手指鼠标 100 还可以具有振动性部件 152 和发声部件 153（见图 1I）。可以对这些部件进行编程从而使其与视觉反馈装置（未示出）上所描绘的移动一致地进行互动，例如，通过从计算装置接收消息。例如，视频屏幕 402 上的光标指示器移动和撞击视频图案屏幕的边缘可以与振动部件 152 振动相联系。触觉的使用可以有助于用户指出光标位置，或在另一个配置中接触反馈可以增强视频游戏参与者的体验。在其他配置中，来自发射器的声觉线索可以类似地相互作用，或可以基于手指鼠标 100 的内部状态，例如，电源开启或电源关闭状态。

[0054] 通信可操作地将手指鼠标 100 与计算装置相耦合。通信可以包括有线通信和无线通信。可以使用有线数据传送路径来传送可以包括来自手指鼠标 100 的包格式化数据 (packetized data)、消息和信号的数据，该有线数据传送路径包括通用串行总线（“USB”）、以太网或 IEEE1394（“FireWire™”或“iLink™”）以及其他方式的具体实施方式或变形。可以使用无线数据传送或接收部件来传送手指鼠标 100 的数据。可以根据具体的通信协议来操作无线数据传送或接收部件。适当协议包括电气与电子工程协会（“IEEE”）802- 系列中的那些协议，诸如，ZigBee™(IEEE 802.15.4)、Bluetooth™(IEEE 802.16) 以及 WiFi™(IEEE 802.11) 及其他的。

[0055] 现参考图 14，示出了将手指鼠标 100 与计算装置相连接的方法 600 的流程图。在开始框 610 处开始执行该方法。在步骤框 620 中，将手指鼠标 100 与计算装置相关联。处理持续进行到步骤框 625，其中手指鼠标被激活来感测移动。处理继续进行到步骤框 630，其中手指鼠标 100 被初始化。处理继续进行到步骤框 640，其中感测到的移动被处理成移动数据。处理继续进行到步骤框 660，其中，数据包或消息被传送给接收器。处理然后继续进行到步骤框 670，其中，通过接收器接收数据包或消息。处理随后继续进行到步骤框 680，其中数据包或信息被格式化成用于计算装置的移动数据。处理然后继续进行到步骤框 690，其中移动数据被处理成用于计算装置的行动或计算装置的上的事件。处理然后继续进行到步

Petitioner Samsung Ex-1004, 0709

骤框 700，其中对计算装置的用户接口特征进行更新。然后，处理在结束框 710 处终止。

[0056] 现参考图 15A，示出了利用手指鼠标 100 验证用户的方法 800 的流程图。在开始框 805 处开始执行该方法。处理继续进行到步骤框 810，其中利用计算装置验证用户。处理继续进行到步骤框 820，其中配置通向计算装置的访问。处理然后在结束框 825 处终止。利用手指鼠标 100 验证 800 用户的方法可以是图 14 的步骤框 620 的部分，其中手指鼠标与计算装置相关联。

[0057] 现参考图 15B，示出了通过第一手指鼠标 100 从第二手指鼠标 100 接收移动数据 830 的方法流程图。在开始框 835 处开始执行该方法。处理继续进行步骤框 840，其中第一手指鼠标 100 从第二手指鼠标 100 接收移动数据。处理继续进行到步骤框 840，其中第一手指鼠标 100 处理来自第二手指鼠标 100 的移动数据从而生成新数据包或新消息。处理随后在结束框 845 处终止。从第二手指鼠标 100 中接收移动数据 830 的方法可以是图 14 的步骤框 640 的部分，其中手指鼠标 100 处理移动数据。

[0058] 现参考图 15C，示出了提供指示 850 的方法流程图。在开始框 855 处开始执行该方法。处理继续进行到步骤框 860，其中手指鼠标 100 向用户示出指示，例如，视觉指示、听觉指示、振动指示或任意其他类型的指示。然后在结束框 865 处结束处理。提供指示 850 的方法可以是步骤框 620、625、630、660、670 或任意其他处理框的部分，其中用户可以接收发生特定事件或用于提供与手指鼠标 100 的内部状态相关的状态的信息。

[0059] 现参考图 15D，示出了数据传送 900 的方法的流程图。在开始框 905 处开始执行该方法。处理继续进行到步骤框 660，其中将数据包或消息传送至接收器。然后，处理继续进行到步骤框 670，其中通过接收器接收数据包或消息。然后，处理继续进行到决定框 910，其中决定该数据包或消息是否是有效数据包或如果使用定序信息的话是否是下一个预期的数据包或消息。如果该决定为否的话，那么处理继续进行到步骤框 930，其中接收器要求重新传送数据包或消息。处理然后继续返回到步骤框 670。如果决定为是的话，那么处理继续进行到步骤框 920，其中数据包或消息的接收被反馈给手指鼠标 100 并且随后处理在结束框 935 处终止。数据传送 900 的方法可以是图 14 的步骤框 660 的部分，其中手指鼠标 100 利用计算装置传送和接收数据。

[0060] 继续参考图 1A、图 1B 和图 1C 并且现也参考图 14、图 15A、图 15B、图 15C 以及图 15D，示出了将手指鼠标 100 和计算装置相连接的实例方法 600。手指鼠标 100 可以通过激活 625 计算装置附近的手指鼠标 100 与计算装置相关联 620。在配置中，手指鼠标 100 可以通过激活 625 手指鼠标 100 并且例如通过使用动态主机控制协议 (DHCP) 从计算装置获得网络地址来与计算系统相关联 620。手指鼠标 100 可以通过附接至计算装置的 USB 端口和向计算装置传递配置信息而与计算装置相关联 620。在配置中，手指鼠标 100 可以请求验证方法 800。例如，如果手指鼠标 100 和计算装置使用 Bluetooth™，那么初始配对程序开始，该程序将手指鼠标 100 中的 Bluetooth™ 接口与接收装置相关联 620。在配置中，手指鼠标 100 还可以利用计算装置来验证 810 用户，例如通过以下方式：由预先与特定用户相关联的手指鼠标 100 的装置标识号码来识别特定的手指鼠标 100，或通过由用户进行的手指鼠标 100 的一系列移动或传感器激活。验证方法 800 还可以使用数字证书、加密方法或本领域公知的其他验证方法。一旦验证 810 完毕，计算装置可以为其上的用户配置 820 对文件、应用以及系统资源的适当用户入口。

Petitioner Samsung Ex-1004, 0710

[0061] 现在还参考图 11，在配置中，手指鼠标 100 中的 RFID 154 芯片可以为手指鼠标 100 提供识别和验证信息。计算装置可以直接询问 RFID 154 芯片，或可以通过另一个装置执行询问并且通过网络将其提供给计算装置。例如，可以通过例如设置在门框中的 RFID 读取器来识别用户进入房间。手指鼠标 100 中的 RFID154 芯片，或与用户相关联的分离的 RFID 装置提供了关于用户和手指鼠标 100 的验证和识别。可以通过验证系统来验证 800 该信息，该验证系统能够利用该计算装置启动使用该手指鼠标 100。

[0062] 手指鼠标 100 将所感测到的移动处理 640 成移动数据，将移动数据格式化 650 成适用于所使用的有线或无线的通信协议的消息结构，例如，数据包，并且将消息传送 660 给接收器，诸如，计算装置。接收器接收 670 该消息，并且如果使用了适当协议，那么可以报告收到 920 该消息，并且如果协议支持消息定序信息或如果手指鼠标 100 确定消息丢失的话，那么可以请求再次传送 930 数据包。如果接收器不是计算装置，而是例如加密狗或无线适配器，那么接收器可以例如通过格式化 680、再格式化或将消息转换成适用于计算装置的协议来进一步处理该消息。在非限制性的实例中，手指鼠标 100 可以使用 ZigBee™ 协议与加密狗无线通信，并且加密狗可以使用 USB 端口与计算装置相互通信。消息中的移动数据可以受到处理 690 并且转化成移动、事件或用于计算装置的命令，例如，显示 700 给用户的计算装置上光标移动。

[0063] 如果手指鼠标 100 使用无线网络协议，那么手指鼠标 100 可以形成带有另一个手指鼠标 100 的自适应网络并且将消息路由给接收器，例如，如果用户同时使用多个手指鼠标 100 的话。在配置中，手指鼠标 100 也可以从其他手指鼠标 100 接收 840 消息，并且处理 850 发送给计算装置的新消息。这有利地要求用户仅仅需要利用计算系统验证第一手指鼠标 100，而无需利用计算系统分别验证 810 一个或多个手指鼠标 100。在一个配置中，手指鼠标 100 可以从其他手指鼠标 100 接收消息，并且处理 850 该消息从而基于来自一个或多个手指鼠标 100 的数据组合生成新消息，由此便于基于多个手指鼠标 100 的移动组合来控制计算装置的用户接口。

[0064] 在配置中，手指鼠标 100 使用互联网协议上传送控制协议 (TCP/IP)。在配置中，手指鼠标 100 使用的是互联网协议上用户数据协议 (UDP/IP)。在配置中，手指鼠标 100 使用的是适用于低功率无线传送的轻型协议。

[0065] 在非限制性实例中，手指鼠标 100 可以使用无线通信协议，诸如，TexasInstruments 的 SimpliciTI™ 协议，或另一种适合的协议。手指鼠标 100 可以在 250Hz 的数据传送率下向接收器 116 或计算装置传送数据。在一个非限制性实例中，数据包可以包括下面要素：

[0066] 0xAA, (unsigned Byte[8bit integer](0-255))/

[0067] （无符号字节 [8 字节整数](0-255))

[0068] 0x55, (unsigned Byte[8bit integer](0-255))/

[0069] （无符号字节 [8 字节整数](0-255))

[0070] 0x12, (unsigned Byte[8bit integer](0-255))/

[0071] （无符号字节 [8 字节整数](0-255))

[0072] Peer#, (unsigned Byte[8bit integer](0-255))/

[0073] （无符号字节 [8 字节整数](0-255))

Petitioner Samsung Ex-1004, 0711

[0074] Transaction I.D., (unsigned word[8bit integer](0-255))/

[0075] (无符号字节[16 字节整数](0-65535))

[0076] Capsense Data Byte, (unsigned Byte[8bit integer](0-255))/

[0077] (无符号字节[8 字节整数](0-255))

[0078] Capsense Data Byte 2,(unsigned Byte[8bit integer](0-255))/

[0079] (无符号字节[8 字节整数](0-255))

[0080] Ax, (word[16bit integer](-32768 to 32768))/

[0081] (无符号字节[16 字节整数](-32768 至 3768))

[0082] Ay, (word[16bit integer](-32768 to 32768))/

[0083] (无符号字节[16 字节整数](-32768 至 3768))

[0084] Az, (word[16bit integer](-32768to 32768))/

[0085] (无符号字节[16 字节整数](-32768 至 3768))

[0086] Gx, (word[16bit integer](-32768to 32768))/

[0087] (无符号字节[16 字节整数](-32768 至 3768))

[0088] Gy, (word[16bit integer](-32768to 32768))/

[0089] (无符号字节[16 字节整数](-32768 至 3768))

[0090] Gz, (word[16bit integer](-32768to 32768))/

[0091] (无符号字节[16 字节整数](-32768 至 3768))

[0092] 数据的前三个字节(0xAA,0x55,0x12)可以是用于核实数据包开始的开始字节。Peer# 字节可以用来使多个手指鼠标 100 相互配合。TransactionI.D. 可以包括被传送的数据包的一个序列号,并且可以被用于数据包的开窗功能或适合地定序数据包。Capsense Data Byte(电容数据字节)可以包括光标按键激活、滑动激活以及质心定位信息。例如,字节 0 通常可以是 1;字节 1 可以激活按键 111 或接触传感器区域 129;字节 2 可以示出按键 112、113 或活动传感器区域 128 激活,而字节 3-7 可以用于按键 112、113 激活或活动传感器区域 128 中的质心定位。质心定位示出了用户手指在滑动传感器区域 128 内的所在位置。电容感应数字字节 2 可以包括充电状态和链接状态信息。例如,字节 0 可以是调试字节;字节 1-5 可以留待将来使用,例如,课外的接触传感器;字节 6 可以用于链接状态;而字节 7 可以用于充电状态,例如,如果手指鼠标 100 正通过 USB 端口 130 充电的话。

[0093] 在一个实例操作中,当用户接触按键 111 或接触传感器区域 129 时,手指鼠标 100 唤醒,将电容数据字节的字节 1 设定为高,并且开始将加速度数据,Ax、Ay、Az 和角速率数据 Gx、Gy、Gz 传送给计算装置。当按键 111 或接触传感器区域 129 被触碰时,手指鼠标 100 还能够执行初始化 630 或加速度数据归零,Ax、Ay、Az 和角速率数据 Gx、Gy、Gz 用于去除任何漂移或偏移。可以通过手指鼠标 100、接收器 116 或装置驱动将数据转化成显示 700 给用户的计算装置上的光标移动,该光标移动跟踪手指鼠标 100 的移动。

[0094] 在配置中,仅仅当按键 111 或接触传感器区域 129 被接触时,手指鼠标 100 才可以将移动数据发送给计算装置,该移动数据用作激活序列。激活序列可以由用户或计算装置被配置成任意类型的移动,从而命令手指鼠标 100 向计算装置发送移动数据,诸如,手指鼠标 100 电源开启,按键 11 或手指鼠标 100 的接触传感器 129 的用户初始激活,手指鼠标 100 的滑动传感器区域 128 的用户初始激活,手指鼠标 100 的用户初始激活以及从计算装置接

Petitioner Samsung Ex-1004, 0712

收信号。当用户停止接触按键 111 或接触传感器区域 129 时手指鼠标 100 可以停止向计算装置发送消息。手指鼠标还可以基于与接收器 116 的通信链接丢失，手指鼠标 100 的移动减小，第二激活序列，激活序列被激活之后计时器到期，低电池功率状态，手指鼠标 100 的错误状态以及从计算装置接收信号而停止发送消息。

[0095] 当用户接触其他感测区域时，例如，其他按键 112、113 或滑动传感器区域 128，电容感应字节的字节 2 变高。根据质心定位数据 (Centroid PositionData，CPD)：例如，对于左侧鼠标点击而言是 (6 > = CPD < = 9)，对于中间鼠标点击而言是 (13 > = CPD < = 16)，以及对于右侧鼠标点击而言是 (22 > = CPD < = 26)，手指或拇指，指部或手指全部短暂地轻击滑动传感器区域 128 可以表现为左侧、中间以及右侧敲击。以用户可配置的时间激活滑动传感器区域 128 能够使光标无法移动并且表现为左右拖动操作。可以通过检测 CPD 中的变化来控制放大和缩小性能。用户手指在滑动传感器区域 128 上方的快速扫动导致 CPD 值迅速增人或减小。如果 CPD 中的变化发生在较短时间周期中，那么根据光标的状态和计算装置上运行的应用来激活缩放功能或轴功能。

[0096] 加速度数据 Ax、Ay、Az 和角速率数据 Gx、Gy、Gz 可以作为原始数据或处理后数据发送。软件 (例如，手指鼠标 100、接收器 116 或计算装置上的装置驱动上的算法 300) 可以处理 324 原始数据或将其转换成与位置值相应的处理后数据。下面说明的是用于将原始数据转换成位置值的算法 300 的非限制性实例。

[0097] 图 12 是用于控制手指鼠标 100 的算法 300 的流程图。在开始框 310 中开始执行该方法。在步骤框 320 处获取移动数据。处理继续进行到步骤框 330，其中按比例缩放移动数据。处理继续进行到步骤框 340，其中对移动数据进行过滤。处理继续进行到步骤框 350，其中处理该移动数据从而去除 DC 偏移。在决定框 360 处决定是否向处理后的移动数据应用增益。如果决定为是的话，那么处理继续进行至步骤框 400，其中向移动数据应用增益并且然后处理继续进行到决定框 270。如果决定为否的话，那么处理继续进行到决定框 270。在决定框 270 处做出决定，从而确定手指鼠标 100 的基线方向。如果决定为是的话，处理然后继续进行到步骤框 410，其中使用由重力产生的手指鼠标 100 的加速度来确定手指鼠标 100 的当前方向，并且随后，处理继续进行到步骤框 380。如果决定为否的话，那么处理继续进行到步骤框 380。在步骤框 380 处，处理后的移动数据被集成从而获得累积的位置或角数据。处理继续进行至步骤框 390，其中累积的位置或角数据可以被用来更新计算装置的用户接口特征。处理然后在结束框 420 处终止。

[0098] 图 13 是用于过滤和处理移动数据以去除偏移的精确控制算法 500 的流程图。除了图 12 的步骤框 340 和 350 以外或为了替代其而可以使用该精确控制算法 500。在开始框 510 处开始执行该方法。在步骤框 520 处，选择移动数据的子集。处理持续进行到步骤框 530，其中确定出移动数据子集的平均值。处理继续进行至步骤框 540，其中确定移动数据子集的标准偏差。处理继续进行至步骤框 550。在决定框 550 处决定移动数据子集的标准偏差是否超过了阈值标准偏差。如果决定为是的话，那么手指鼠标 100 的移动过大而无法用于精确控制并且在结束框 570 处终止该处理。如果决定为否的话，那么手指鼠标 100 移动地足够缓慢从而可用于精确控制并且该处理持续进行到步骤框 560。在步骤框 560 处，使用在步骤框 530 处计算出的平均值来从移动数据中去除偏移。处理随后在结束框 570 处终止。

Petitioner Samsung Ex-1004, 0713

[0099] 在用于控制手指鼠标 100 的算法 300 和精确控制算法 500 的实例中，当用户激活手指鼠标 100 时，手指鼠标 100 确定移动数据并且将其发送给装置 100、116 或运行该算法的计算装置。一旦获得 320 移动数据，可以按比例缩放 330 该移动数据。原始加速度数据 Ax、Ay、Az 和角速率数据 Gx、Gy、Gz 可以被转换或按比例缩放 330 成与实际价值相应的可用单元。例如，加速度数据可以被按比例缩放 330，从而加上或减去 4g 的比例 (scale)，例如，A_i' (m/s^2) = ((4g/32768)*A_i)*9.81，其中 i = x，y 或 z。角速率数据可以按比例缩放 330 从而加上或减去 500 度每秒 (dps) 的比例，例如，Gi'（弧度 /s) = ((500dps/32786)*(pi/180)*Gi，其中，i = x，y 或 z。

[0100] 算法 300 可以过滤 340 数据，例如，使用平滑函数或移动平均来去除瞬变现象，该瞬变现象可能导致光标在用户接口上出现不期望的大幅度移动并且阻碍用户接口上的光标的精确控制。算法也可以去除 350DC 偏移，例如，使用高通滤波器来获得仅代表手指鼠标 100 的移动中的变化的数据。为了更精确地进行控制，可以使用卡尔曼滤波器或迭代算法，例如，精确控制算法 500。例如，选择 520 数据子集并且可以确定 530 加速度和角速率的每个轴的平均值计算。可以使用窗函数来选择 520 数据子集，并且可以仅使用窗中的数据点的子集来进行确定 530 或计算。窗尺寸可以是可调的并且名义上为 50 数据点。计算 540 每个轴的标准偏差并且将其与最小标准偏差相比较 550。对于加速度而言，最小标准偏差可以是可调的，并且名义上为 .03。对于角速率而言，最小标准偏差是可调的并且名义上为 .003。当轴的标准偏差低于最小标准偏差时，那么用户的手和手指鼠标 100 对于从数据点中所减去的轴的平均值而言已足够稳定，由此去除 560 了用于生成代表实际移动的数据值的每个数据点的 DC 偏移。

[0101] 算法 300 也可以执行基线测量，从而确定 370 手指鼠标 100 的方向，例如，由于使用 410 由于重力而产生的手指鼠标 100 的加速度。算法 300 可以例如通过对表示带有累积的位置或角度数据的实际移动的数据值执行离散积分 380 而将加速度数据转换成位置数据并且将角速率转换成旋转度，从而确定手指鼠标 100 的位置和手指鼠标 100 的方向。算法 300 还可以基于角度变化再调整位置数据。算法 300 可以向代表实际移动的数据值应用增益从而控制光标加速度；该增益可以是可选的 360 并且可以是线性的、指数的或任意其他函数。该算法随后以期望的形式（例如，X，Y 光标位置）或其他形式输出位置数据，从而更新 390 用户接口的光标或任意其他特征。输出位置数据可以是 Cartesian 或 X，Y，Z 坐标系统，或可以被转换成以球体为基础的坐标系统，或任意其他所需的坐标系统。

[0102] 再次参考图 1C，示出了位于手指鼠标 100 的尖端 (tip) 处的加速度方向源点的通常方向。可以从与加速度方向源点相关的固定参考平面或浮动参考平面中选择三维框架。在固定参考平面的一个实例中，由加速计 106 和陀螺仪 107 所检测到的重力加速度和角加速度在三维空间中提供手指鼠标 100 的方向。可以在与手指尖相关的平面中插入加速计 106 的移动。如图 1C 所示，可以将各个轴的方向和 2D 参考平面固定在手指鼠标 100 本身上。通过这种方式，如果加速计 106 的 ZX 平面不再完全垂直，那么可以基于加速度和来自陀螺仪 107 的位置反馈而插入指针位置 (pointer position) 的平移面。上述控制可以归因于，无论手指鼠标 100 是笔直地向外指向还是向下指向，用户手指均执行了相同的移动。

[0103] 可以处理 640 来自手指鼠标 100 的数据或将其转换成用户接口上所显示 700 的特征，用户接口包括键盘按键、鼠标移动或使用在人机用户接口中的任何其他类型的命令。经

Petitioner Samsung Ex-1004, 0714

过处理 640 或转换成特征的手指鼠标 100 的数据可以包括下面的一种或多种 :原始加速度数据 Ax、Ay、Az 和角速率数据 Gx、Gy、Gz 形式的手指鼠标 100 的移动或处理后的位置数据以及各个按键 111、112、113,接触传感器区域 129 和活动传感器区域 128 的各种激活。经过处理 640 或经过转换的数据可以包括各个数据点,诸如,各个传感器激活或可以包括数据组。例如,手指鼠标 100 可以捕获用户的手势作为一个移动集合或多个移动集合。移动集合可以是不连续的移动,例如,可以通过以下方式由手指鼠标 100 处理得到感叹号 :将手指 100 迅速向下移动来表示竖线,然后在较短时间间隔之后通过手指鼠标 100 的向前移动来表示该竖线下面的句点。

[0104] 来自手指鼠标 100 的数据可以被处理或转换成通用的键盘或鼠标命令,诸如,光标移动、左键点击、右键点击、滚动功能、打开应用、关闭应用以及删除项目或发将项目发送给回收站。也可以将数据处理或转换成限制应用的键点击或限制用户的键点击。例如,可以使用数据来执行屏幕上窗口的放大功能或缩小功能或便于查看邮件。可以将数据用于生成文本,例如,通过提供虚拟键盘用于键入字符或将移动转换成字母和字符或用于文件编辑,例如,编辑字符串、块复制文本、粘贴文本或删除文本。命令和控制的其他非限制性实例包括控制多媒体文件回放,诸如,选择要播放的多媒体项目,更改音量或静音,暂停回放,迅速前进或倒退或在文件内的各点处开始回放。为了编辑图像,手指鼠标 100 可以提供图像的直观控制和操作,例如,旋转图像,改变图像尺寸或按比例缩放图像,修剪图像或其他图像处理特征。手指鼠标 100 还可以提供用于控制电影编辑特征的直观控制。在一个配置中,根据具体环境可以通过应用以不同方式转换数据。例如,如果用户之前正在阅读但并未编辑文件的话,那么横跨滑动传感器区域 128 地滑动手指可以用来滚动文件。然而,如果用户已经对文件进行了编辑的话,那么横跨滑动传感器区域 128 滑动手指可以选择文本。具体的环境可以取决于用户之前的移动,或可以例如,通过应用的中心 (focus)(例如,是整个窗口的中心或与窗口内的文本区域相关的中心) 来确定。

[0105] RF 收发器 105 可以直接与具有兼容的无线接口的计算装置相通信。RF 收发器 105 还可以通过接收器 116 与计算装置相通信。现参考图 1D,接收器 116 可以具有 :用于与手指鼠标 100 通信的 RF 收发器 105,可以是处理器或微控制器的控制器 117,用于与计算装置通信的 USB 收发芯片 131,用于连接计算装置的 USB 端口的公 USB 连接件接口 118,并且可以具有位于 RF 收发器 105 和 USB 连接件接口 118 之间的线缆 119。在一些配置中,接收器 116 可以使用任意数量的接口与计算装置接口连接,该接口包括串行端口,该串行端口可以是异步的或同步的,以太网端口、LAN 端口、卡座,例如, PCMCIA 卡槽,总线接口卡,例如,内部 ISA 或 PCI 卡槽,并且如果分开通电的话则通过另一个无线接口。

[0106] 接收器 116 可以通过线缆 (cord)119 与计算装置相连接,从而允许接收器与计算装置相隔一段距离放置。线缆 119 有利地允许接收器 116 更接近用户地放置从而便于手指鼠标 100 和计算装置之间的通信。例如,接收器 116 可以放置在对用户而言实现清晰的位置上。更接近手指鼠标 100 地放置接收器 116 可以减少手指鼠标 100 的 RF 功率损耗。设置接收器 116 还可以控制手指鼠标的可用区域。例如,手指鼠标 100 和接收器 116 可以使用小范围 RF 协议,微微网协议或无线个人局域网 (WPAN) 协议,诸如,红外线数据组织 (IrDA) 协议,无线 USB, ZigBee™ 或通用的 IEEE802.15 协议。这些协议具有局限的范围并且可以防止来自接收器 116 和手指鼠标 100 的信号冲突,防止干扰其他用户的接收器和手指鼠标。

Petitioner Samsung Ex-1004, 0715

这在可以存在相对较近地相邻的多个用户而这些用户利用他们的个人计算装置同时使用手指鼠标 100 的公共区域或办公室隔间中是有利的。

[0107] 接收器 116 可以是不处理数据的哑接收器 (dumb receiver)，例如，插入到计算装置的 USB 端口中并且在计算装置和手指鼠标 100 之间传递数据、信号或消息的 Bluetooth™ 加密狗或 WiFi™ 无线适配器。接收器 116 也可以结合到计算装置中，例如，作为计算装置主板的部件或处在卡槽中。在这些配置中，手指鼠标 100 可以使用位于计算装置上的装置驱动，从而通过计算装置将来自手指鼠标 100 的数据、信号或消息转换成将被执行的移动，或将被执行的命令。

[0108] 在配置中，手指鼠标 100 可以执行移动数据处理，从而将移动数据处理成处理后的命令并且将该处理后的命令发送给接收器 116。然而，接收器 116 也可以是转换或处理从手指鼠标 100 中所接收到的通信的智能接收器。在配置中，接收器 116 可以保持与手指鼠标 100 的链接，从手指鼠标 100 接收通信，处理或转换来自手指鼠标 100 的通信，该通信可以包括原始数据、信号或包格式化消息，以及生成使用通向计算装置的输入接口的输出接口所输出的经过处理的消息。由于可以通过计算装置为接收器 116 供电，例如，通过使用直接来自计算装置的 USB 连接的功率，接收器 116 上的执行和处理可以最小化手指鼠标 100 上的功率损耗并且有利地延长了电池使用寿命。

[0109] 在配置中，接收器 116 或手指鼠标 100 可以通过以标准识别格式向计算装置发送消息来仿真装置，例如，计算机鼠标。例如，接收器 116 可以向计算装置发送命令和消息，计算装置的默认鼠标驱动可以识别出该命令和消息。通过这种方式，接收器 116 可以在不要求装配新装置驱动的情况下确保与各种不同的计算装置的反向兼容性。这有利地允许共同使用手指鼠标 100 和计算装置，该计算装置使用内置的处理器或运行专有软件或操作系统，在该操作系统中发展装置驱动可能没有成本效益或是不可能的。接收器 116 也可以使得手指鼠标与运行专用协议 (诸如，X10 或 Z-Wave) 的装置接口连接，该装置可以用于家庭自动化以及控制家庭电气装置，诸如，灯。接收器 116 的各种配置的使用允许在不需要改变手指鼠标 100 本身的情况下共同使用手指鼠标 100 和各种不同的电子装置。

[0110] 图 1C 还具有用于将手指鼠标 100 与用户相附接 (attach) 的附接结构的立体图。将手指鼠标 100 固定在食指或人体手部 200 的任意其他手指上的绑带 115 可以由各种不同材料构成并且形成多种不同的款式。绑带 115 可以由柔性材料，诸如，硅树脂、橡胶、弹性纤维等构成。使用柔性材料构造绑带 115 提供了以 90％人群的手指尺寸为目标的无限尺寸 (sizing) 范围。用户可以选择最为适合的绑带 115。绑带 115 还可以由刚性材料 (诸如，塑料或金属) 构成。在刚性材料的情况下可以使用减小绑带 115 的内径的副绑带来完成绑带 115 的分级，这很像为手指的戒指进行分级。绑带 115 也可以是可互换的，具有多种符合相同轮廓的内径。可互换的绑带可以允许风格变化或在多个不同用户之间共用一个装置。正如本领域的普通技术人员可意识到的那样，手指鼠标 100 可以通过多种其他附接方式进行附接。

[0111] 现参考图 1G、图 1E 和图 1F，示出了人体工学的手指鼠标 120。人体工学的手指鼠标 120 包括手指鼠标 100 的一些特征和方面，但还进一步包括模塑的被配置用于保护模塑的底部壳体 121 的顶部壳体 122。当固定完毕时，模塑的顶部壳体 122 和模塑的底部壳体 121 形成了保护槽，保护电路 123 和柔性感测电路 124。用于握紧 (gripping) 手指的可拆

Petitioner Samsung Ex-1004, 0716

装手指握部 125 被配置成与模制的底部壳体 121 物理附接。同时，模制的顶部壳体 122、模制的底部壳体 121 以及可拆装的手指握部 125 包括壳体 122、121、125。可拆装的手指握部 125 可以与模塑的底部壳体 121 的弧形部分 126 共同作用，从而将人体工学的手指鼠标 120 与手指或用户的附属物相附接。可以将可拆装的手指握部 125 的尺寸设定在一定范围内，从而符合手指或拇指（整体上为手指或指部）或其他附属物，诸如，脚趾或手臂。可拆装的手指握部 125 便于在多种不同附属物尺寸下附接人体工学的手指鼠标 120，并且这是单一尺寸符合所有类型方法的一个备选。可拆装的手指握部 125 可以配置成不同几何形状从而容许设置在手指的不同部分上。例如，可拆装的手指握部 125 的尖端可以被配置成具有不同的直径或形状，这有助于将人体工学手指鼠标舒适地固定在下面的手指的骨结构上，如指骨。例如，可拆装的手指握部 125 的尖端可以具有近似锥形的几何形状从而容许将人体工学手指鼠标 120 设置在指骨的末端和中间。在另一个实例中，可拆装的手指握部 125 的尖端可以被配置成在基本上不影响指骨末端和中间的活动的情况下支持其附接在邻近的指骨上。

[0112] 模塑的顶部壳体 122 可以与模塑的底部壳体 121 相连接，从而形成用于柔性感测电路 124 的保护槽。模塑的底部壳体 121 的户型部分 126 可以作为柔性感测电路 124 的支撑面。模塑的顶部壳体 122 中的弧形感测区域 127 可以为柔性感测电路 124 提供保护性覆盖。弧形的感测区域 127 也可以提供通过升高、下降或在用户以其手指所接触的位置上生成视觉标记来提供接触传感器区域 129 的视觉指示。接触传感器区域 129 设置在柔性感测电路 124 被配置成记录手指接触的区域上方。弧形感测区域 127 可以类似地提供滑动传感器区域 128 的视觉指示，下面的柔性感测区域 124 被配置成记录滑动传感器区域 128 内的一个或多个手指位置。例如，柔性感测电路 124 可以被配置成记录滑动移动，例如，横跨滑动传感器区域 128 的表面的手指的平移，或滑动传感器区域 128 内的一个或多个手指触碰位置。

[0113] 模塑的顶部壳体 122 可以与模塑的底部壳体 121 相连接，从而为电路 123 形成保护槽。继续参考图 1G、1E 和 1F 并且现参考图 1H，示出了电路 123。电路 123 包括 USB 连接件 130、USB 收发芯片 131、微控制器 132、电容感测芯片 108、陀螺仪 107、加速计 106、用于连接柔性感测电路 124 的挠性连接件 (flex connector) 136、电池模块 138 以及第二挠性连接件 137。电容感测电路 108 通过挠性连接件 136 监控柔性感测电路 124。

[0114] 将电池模块 138 与电路 123 相分离提供了多种优点。这样允许使用更大的电池，其原因在于通过将电池设置电路 123 上的电池固定件中，用于电池的空间不再是强制性的。这样还允许电池模块 138 根据应用具有不同的几何形状，例如，为了更低重量的薄的节省空间的几何形状或为了更长电池使用寿命的更厚的几何形状。另外，这可以使得电池模块 138 更容易替换，例如，为了维修和保养工序。

[0115] 继续参考图 1G 并且现在还参考图 1I，示出了子板 150。子板 150 包括收发模块 148、RF 天线 151、振动部件 152、发声部件 133、RFID 154 电路、脉搏血氧计电路 155 以及 GPS 156 电路。在一些实施例中，除了图 1G 中所示出的一些部件以外，或替代这些部件，子板 150 可以具有高度计（未示出）或磁强计（未示出）。子板 150 可以通过第二挠曲连接件 137 与电路 123 相连接。振动部件 152 可以是具有不规则不平衡的负载或凸轮的小电动机。第二发声部件 153 可以是压电装置。可以使用其他振动部件 152 或发声部件 153。在

Petitioner Samsung Ex-1004, 0717

不同的配置中，子板 150 可以被配置具有或不具有振动部件 150，并且具有或不具有发声部件 153。振动部件 152 和发声部件 153 也可以设置在电路 123 上或电池模块 138 上。RFID 154 电路、脉搏血氧计电路 155 以及 GPS 156 电路可以如上所述那样提供关于用户和用户环境的额外信息。脉搏血氧计电路 155 可以与装配在绑带 115 中的传感器（未示出）、可拆装的手指握部 125 或壳体 101、121、141 相连接或分离地附接在用户上。

[0116] 在配置中，RF 收发模块和 RF 天线 151 可以设置在电路 123 或电池模块 138 上。在图 1I 中，子板 150 上示出了 RF 收发模块和 RF 天线 151。移动 RF 接收模块 148 和 RF 天线 151 离开电路 123 减少了电路 123 所需的 RF 屏蔽和其他隔离措施。通过使 RF 接收模块 148 与电路 123 相分开能够在不改变电路 123 的硬件的情况下，改变人体工学手指鼠标 120 上的无线接口的类型。例如，可以程序化相同的电路 123，从而使其以 ZigBee™ RF 收发模块、Bluetooth™ 收发模块或 WiFi™ RF 收发模块进行工作。在不同的配置中，可以为电路 123 预装入 RF 接收模块的特定类型所用的一个驱动，或为电路 123 预装入 RF 接收模块的多种不同类型所用的多个驱动。当电路 123 预装入了多个驱动时，电路 123 可以自动确定 RF 收发模块的类型，或可以通过软件，例如，通过所用户或在初始化步骤过程中配置电路 123。

[0117] 再次参考图 1G，USB 连接件 130 可以被配置成允许与计算机 400 的 USB 端口相连接。与 USB 连接件 130 相连接的 USB 接收芯片 131 可以接收数据或将数据从人体工学手指鼠标 120 发送给计算机 400。USB 收发芯片 131 有助于将原始配置输入至人体工学手指鼠标 120，例如，配置无线通信参数。USB 收发芯片 131 还有助于更新人体工学手指鼠标 120 的原始软件。

[0118] USB 连接件 130 可以被配置成允许与连接了电源（未示出，例如，AC 适配器）的 USB 相连接。USB 连接件也可以与单独的电池组（未示出，例如，用户携带的电池组）相连接。除了由电池模块 138 供电以外，人体工学鼠标 120 还可以由 USB 连接件 130 供电。可以通过 USB 连接件 130 为电池模块 138 再充电。

[0119] 微控制器 132 控制人体工学手指鼠标 120 的移动和特征。微控制器 132 接收来自加速计 106、陀螺仪 107 以及电容感测电路 108 的输入，并且处理来自其输入的信息，从而生成代表一个或多个输入的至少一部分的信号。如上所述，微控制器 132 可以将来自加速计 106 和陀螺仪 107 的原始数据处理或者转换成经过处理的数据。微控制器 132 还可以处理多个按键 111、112、113、接触传感器区域 129 以及滑动传感器区域 128 的激活或将其转换成处理后数据，或仅仅将数据格式化成适合的消息格式或数据包并且将通信发送给计算装置。微控制器 132 可以通过轮询加速计 106、陀螺仪 107 和电容感测电路 108 来接收输入。除了轮询以外，可以通过中断驱动过程或通过轮询和中断两者的组合来接收输入。

[0120] 微控制器 132 可以将信号格式化成适用于通过 USB 连接件 130 传送的格式。微控制器 132 可以将信号格式化成适用于例如，通过电路 132、子板 150 或电路模块 138 中的 RF 接收器进行无线传送的格式。微控制器 132 可以运行协议堆栈，该协议堆栈能够实现适当的信号交换和链路建立、错误校正、数据包格式化以及与遥控接收器（诸如，遥控计算机 400 或智能手机（未示出））的通信的消息剖析。在一个配置中，微控制器 132 是消息单元。在一些配置中，刚性电路板 103、电路 123、子板 150 和微控制器 132 或它们的任意组合可以是消息传送单元或执行消息传送单元的功能。

[0121] 可以使用硬件部件、软件模块或它们的组合来实现微控制器 132。微控制器 132 可

Petitioner Samsung Ex-1004, 0718

以包括处理器、微处理器、电路、中央处理单元 (CPU)、专用集成电路 (ASIC)、可编程逻辑器件 (PLD)、现场可编程门阵列 (FPGA) 或任意其他类型的处理器或多种其他适当电子部件，包括但不限于晶体管、电阻器、电容器、电感器、逻辑门、寄存器、半导体器件、芯片、微芯片、集成电路、算数逻辑单元 (ALU)、芯片组、输入 / 输出 (I/O) 装置、随机存储器 (RAM)，诸如，动态 RAM(DRAM) 和只读存储器 (ROM)、数模和模数转换器 (DAC、ADC) 以及总线。微控制器 132 可以是多重处理单元、精简指令集计算机 (RISC)、具有路径或并行线程性能的处理器、复杂指令集电脑 (CISC) 或数字信号处理器 (DSP)。适当微控制器 132 的影响因素选项可以包括计算速率或处理时间、功率要求、耐热性、数据总线速度、微控制器 132 上可用输入和输出类型、输入和输入数据速率以及存储器资源。

[0122] 软件可以包括操作、代码、程序、子程序、物体、函数调用、应用程序接口 (API)、应用、程序、中间件、操作系统、嵌入码、微码以及固件。应该注意以下术语“处理”、“计算 (computing)”、“运行”、“确定”、“计算 (calculating)”以及“转换”或类似的术语涉及的是计算装置或微控制器 132 的各种操作。以上术语被作为通常通过计算装置执行的非限制性操作的实例，这些操作被用于改变、移动或另外操纵数据，无论是否以存储在各种类型的存储器中的数据结构。

[0123] 现参考图 1H，示出了带有可拆装的电源模块 140 的手指鼠标。带有可拆装的电源模块 140 的手指鼠标包括与可拆装的顶部 142 相连接的底部 141。底部 141 和可拆装的顶部 142 可以使用机械连接件 142(例如，连锁切口) 配合在一起。底部 141 和可拆装的顶部 142 可以使用磁连接件 144 配合在一起。可以使用电连接 145(例如，刚性插头和插座机构、柔性的线束、带有可移动接触件的通常出现在移动电话和移动电话电池中的电池类连接件，或引脚和电接触件的接合栅格阵列) 来电连接底部 141 和可拆装的顶部 142。可以使用电感耦合来连接底部 141 和可拆装的顶部 142。

[0124] 与人体工学手指鼠标 120 相类似，带有可拆装的电源模块 140 的手指鼠标的底部 141 可以包括弧形感测区域 127、接触传感器区域 129 以及滑动传感器区域 128。顶部 142 可以包括电池 146，一个或多个电容感测按键 147、RF 收发器 148 以及一个或多个视觉指示器 149。电容感测按键 147 也可以是滑动型的电容传感器，或是一个或多个电容感测按键 147 与一个或多个滑动型电容传感器的组合。

[0125] 在操作中，电容感测按键 147 可以用于选择哪个计算装置将与带有可拆装的电源模块 140 的手指鼠标相连接。视觉指示器 149 能够指示出哪个计算装置正与带有可拆装的电源模块 140 的手指鼠标相互通信。例如，用户能够选择电容感测按键 147 之一，以使用 ZigBee™ 连接将带有可拆装的电源模块 140 的手指鼠标与手提电脑或台式计算机 400 相连接。用户可以选择不同的电容感测按键 147 来连接带有可拆装的电源模块 140 的手指鼠标，在智能手机中使用的是 Bluetooth™ 连接。用户可以选择不同的电容感测按键 147，利用交互式网络电视 (IPTV)、网络电视 (TVoIP)、游戏系统或使用 IrDa 或 WiFi™ 连接的机顶盒来连接带有可拆装的电源模块 140 的手指鼠标。带有可拆装的电源模块 140 的手指鼠标可以被配置成支持任意数量的手指按压或电容感测按键 147 的手指按压组合来控制计算装置或与计算装置的通信链接。

[0126] 图 2 至图 7 和图 10 至图 11 示出了人体手部 200 上的至少一个手指鼠标 100 的立体图。仅仅为了简单论述的目的，这些立体图已被限制为人右手 200 的食指和 / 或中指，但

Petitioner Samsung Ex-1004, 0719

并不应该被视作是对人体手部 200 上的手指鼠标 100 的位置或使用的限制。正如本领域的技术人员可以理解的那样，尽管示出手指鼠标 100 处在一根手指上，但手指鼠标 100 仍可以例如，通过使用较大的绑带 115 设置在多根手指上或右手 200 或左手（未示出）上或其他附属物上（未示出）。用于在右手 200 的食指上设置手指鼠标 100 的基础位置可以处在图 8 所示的沿着手指长度的点 204 和 201 之间。用于在右手 200 的中指上设置手指鼠标 100 的基础位置可以处在图 8 所示的沿着手指长度的点 209 和 206 之间。可以沿着人体手部 200 的任意手指重复该基础点，从而允许出现多个手指鼠标 100 位置。手指鼠标 100 可以被固定在食指的点 203 和 202 之间，中指的点 208 和 207 之间以及拇指的点 205 和 201 之间。这种对准仅仅是实例并不用于限制手指鼠标 100 沿着右手 200 或左手（未示出）的任意手指的长度的位置。

[0127] 图 2 至图 3C 是设置在人体右手 200 上的手指鼠标 100 的立体图，示出使用手指鼠标 100 操纵光标位置的实例方法；例如，可以在 2D 平面视频图案屏幕（诸如，计算机 400 的视频屏幕）中操纵光标位置。在这个实例方法中，可以通过操纵支撑着手指鼠标 100 的食指旁的拇指接触一个或多个按键 111、112、113 从而激活手指鼠标 100 内的传感器的数据采集来实现光标移动。可以通过采集角和直线加速度数据来跟踪支撑着手指鼠标 100 的手指的移动。可以将所采集到的数据无线地传送给计算装置，例如，个人计算机 400 或智能手机（未示出），在此可以对数据进行处理。例如，在一种配置中，经过处理的数据可以调动或移动 2D 平面视频图案屏幕（诸如，计算机 400 的视频屏幕 402）中的光标。在另一个配置中，所采集和无线传送给个人计算机 400 或其他计算装置的数据可以被处理成书面文本，由此将手指鼠标 100 转换成电子书写用具。在表面或在半空中移移动为书写装置的手指鼠标 100 可以生成转录的文本和图画（例如，手写形式的签名、笔记、初稿、图画）的电子文件。光标移动可以与手指鼠标 100 的移动相关联。在配置中，可以例如，在屏幕上显示出虚拟键盘。当用户移动手指鼠标 100 并且光标进入到虚拟键盘区域中，或执行诸如，选择按键或执行敲击或系列敲击或特定手指的移动时，在虚拟键盘上将显示出虚拟手指或虚拟手。虚拟手或虚拟手指保持在虚拟键盘上方并且用户可以打字。例如，如果用户具有多个手指鼠标 100 的话，那么那些带有手指鼠标 100 的手指可以在虚拟键盘上打字，每次敲击均被记录为击键。

[0128] 在配置中，可以利用拇指和一个或多个按键 111、112、113 的互动来限制光标功能的意外激活，从而使得所有光标功能均是有意为之并且取消那些功能的意外激活。在配置中，可以通过仅仅在拇指和按键 111、112、113 的互动过程中实现光标定位功能来控制光标位移。在另一种配置中，光标控制可以被配置成通过单击或双击激活以及通过随后的单击或双击取消。

[0129] 图 4 至图 5C 是人体右手 200 食指上的手指鼠标 100 以及人体右手 200 中指上的第二手指鼠标 100 的立体图，从而演示出使用手指鼠标 100 在例如 2D 平面视频图案屏幕（诸如，计算机 400 的视频屏幕 402）中操纵光标位置的方法。在配置中，可以通过操纵支撑着手指鼠标 100 的中指旁的拇指接触一个或多个按键 111、112、113 来激活手指鼠标 100 内的传感器的数据采集来实现光标移动。在配置中，一个或多个按键 111、112 和 113 的激活可以支持以下功能，诸如，典型的媒体控制、音量、轨道、加速 (advance)、前进、倒退、单击功能和多击功能。可以通过采集角和直线加速度数据来跟踪支撑着手指鼠标 100 的手指的

Petitioner Samsung Ex-1004, 0720

移动。可以将所采集的数据无线传送给个人计算机 400 或计算装置，诸如，智能手机（未示出），在此可以对数据进行处理。处理后的数据可以用于调动或移动 2D 平面视频图案屏幕（诸如，计算机 400 的视频屏幕 402）中的光标。光标的移动可以与手指鼠标 100 的移动相关联。

[0130] 在一些配置中，可以获得非典型的鼠标控制。图 6 示出了手指鼠标在人右手 200 的食指上的配置并且示出了空中功能控制方法。根据可调节的加速度阈值，手指鼠标 100 的突然移动（诸如，迅速拉动移动）可能触发程控功能。从这种移动中所采集到的数据可以无线地传送给计算装置，例如，个人计算机 400 或智能手机（未示出），在此对该数据进行处理。由此，处理后的数据可以控制计算装置上的移动。例如，处理后的数据可以控制 2D 平面视频图案屏幕（诸如，计算机 400 的视频屏幕 402 或其上所显示的 3D 虚拟世界）中的光标。

[0131] 图 7 是人体右手 200 的食指上的手指鼠标 100 的立体图并且示出了用于检测功能控制的敲击的实施性方法。一旦达到了特定的可调加速度阈值，例如，通过将敲击指示以消息的形式发送给计算装置，附接有手指鼠标 100 的手指在物体（诸如，桌子、腿等）上的敲击可以触发程控功能。可以将所采集到的数据传送给个人计算机 400 或其他计算装置，诸如，智能手机（未示出），在此可以处理该数据。例如，处理后的数据可以控制光标在 2D 平面视频图案屏幕（诸如，计算机 400 的视频屏幕 402）中的移动。

[0132] 图 9 示出了现有技术中由 CPU 401、鼠标 404、键盘 403 以及监控或视频屏幕 402 所构成的个人计算机系统 400。图 9 进一步示出了在现有技术中当使用鼠标 404 和键盘时右手 200 是如何操作的图像。在这种系统中，为了使用鼠标和使用任何可应用的鼠标功能，用户必须将手 200 从键盘上移开。

[0133] 在鼠标 100 的一个实例应用中，可以克服为了使用鼠标而需要额外地移动手部 200 并且强行地明显降低了打字速度以及增加了手的弯曲重复的现有技术使用方式。手指鼠标优于传统鼠标 404 的优点在于在控制光标功能和位置时手部 200 可以更少从键盘上移开。减少手部的移动对减少可能造成皮管综合征的手部疲劳具有显著效果并且可以明显提高用户的互动速度。图 10 是手部 200 的一个或多个手指上的手指鼠标 100 的立体图并且示出了在打字时使用手指鼠标 100 的配置。这些配置可以通过消除为了使用鼠标而将手 200 从键盘上移开的需要来降低处理时间，为了操作鼠标类功能，将这种功能设置成用户手指不需要离开键盘 403 区域的方式。用户可以使用一个拇指来激活手指鼠标 100，同时手指仍保持在键盘上并且另一个拇指保持在空格键上。在手指不离开键盘区域的情况下直接使用鼠标功能能够明显提高打字速度并且提供更快和更接近人体工学的使用体验。

[0134] 图 11 是右手 200 的食指上的手指鼠标 100 的立体图，示出当食指敲击时手指鼠标 100 的使用性。一旦达到了特定可调加速度阈值，例如，通过将敲击指示以消息的形式发送给计算装置，手指鼠标 100 所属的手指在物体（诸如，桌子、腿部等）上的敲击可以触发程控功能。可以将在该移动开始时所采集的数据无线传送至个人计算机 400 或其他计算装置，诸如，智能手机（未示出），在此可以处理该数据。例如，处理后的数据和功能可以控制光标在 2D 平面视频图案屏幕（诸如，计算机 400 的视频屏幕 402）中的移动。

[0135] 正如本领域的技术人员可以意识到的那样，可以使用手指鼠标 100 的这些和其他配置作为当前的游戏控制器或遥控控制装置的增强。各个部件和方法的上述描述被用于示

Petitioner Samsung Ex-1004, 0721

出具体的实例以及描述制造和使用在此所公开和描述的装置的特定方式。这些说明既不旨在也不应该被用作为制造和使用这些部件的可能方式的详细清单。可以做出许多更改，其包括在两个实例之间或在两个以上实例之中的置换以及组合之中的变形。在阅读完这个文件之后，那些更改和变型对本领域的普通技术人员而言是显而易见的。

Petitioner Samsung Ex-1004, 0722

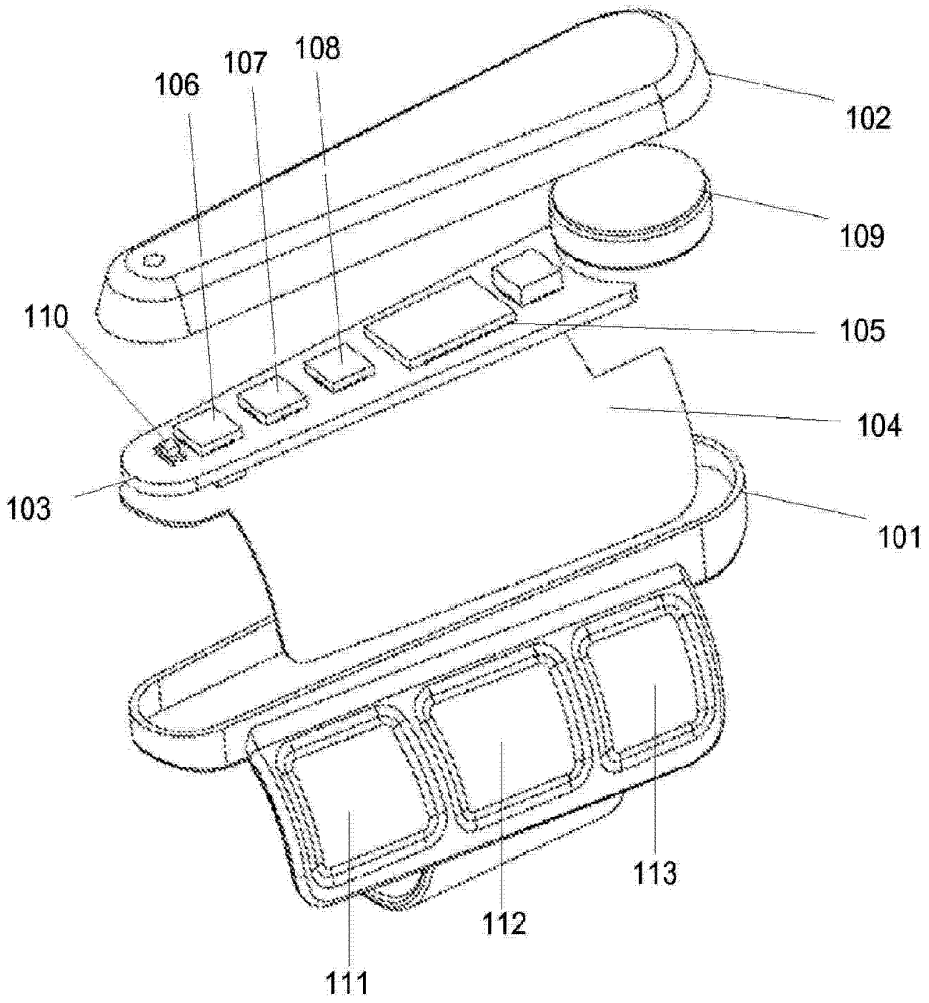


图 1A

Petitioner Samsung Ex-1004, 0723

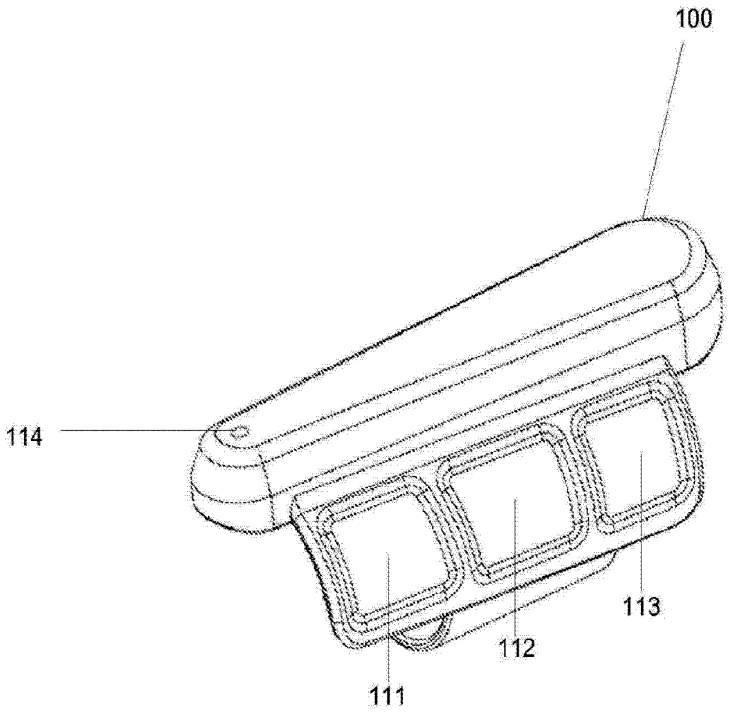


图 1B

Petitioner Samsung Ex-1004, 0724

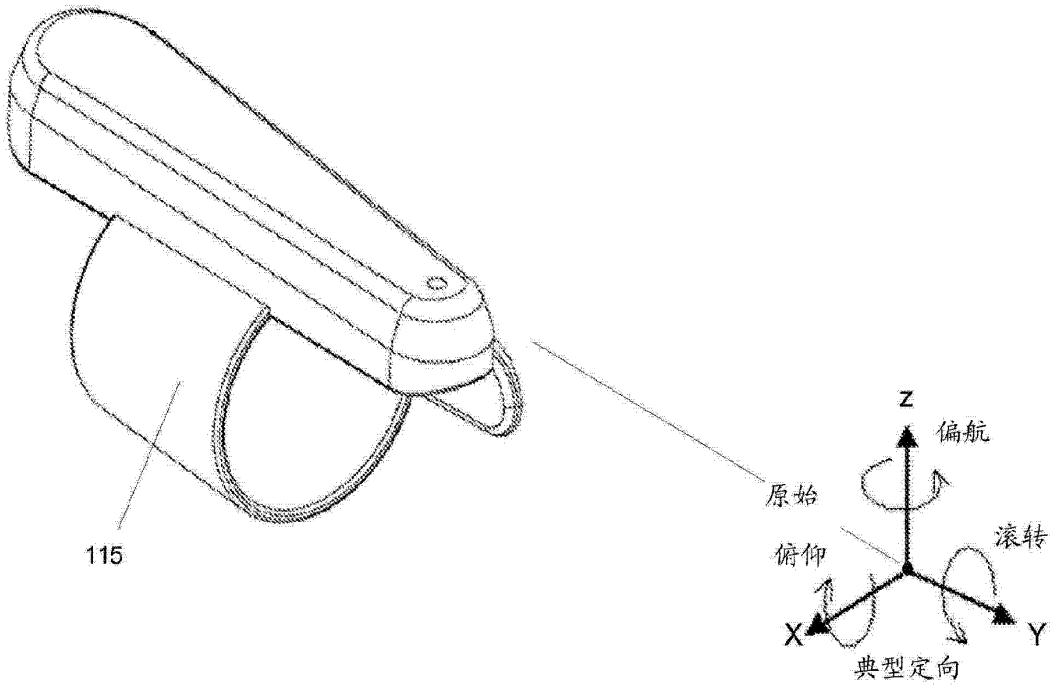


图 1C

Petitioner Samsung Ex-1004, 0725

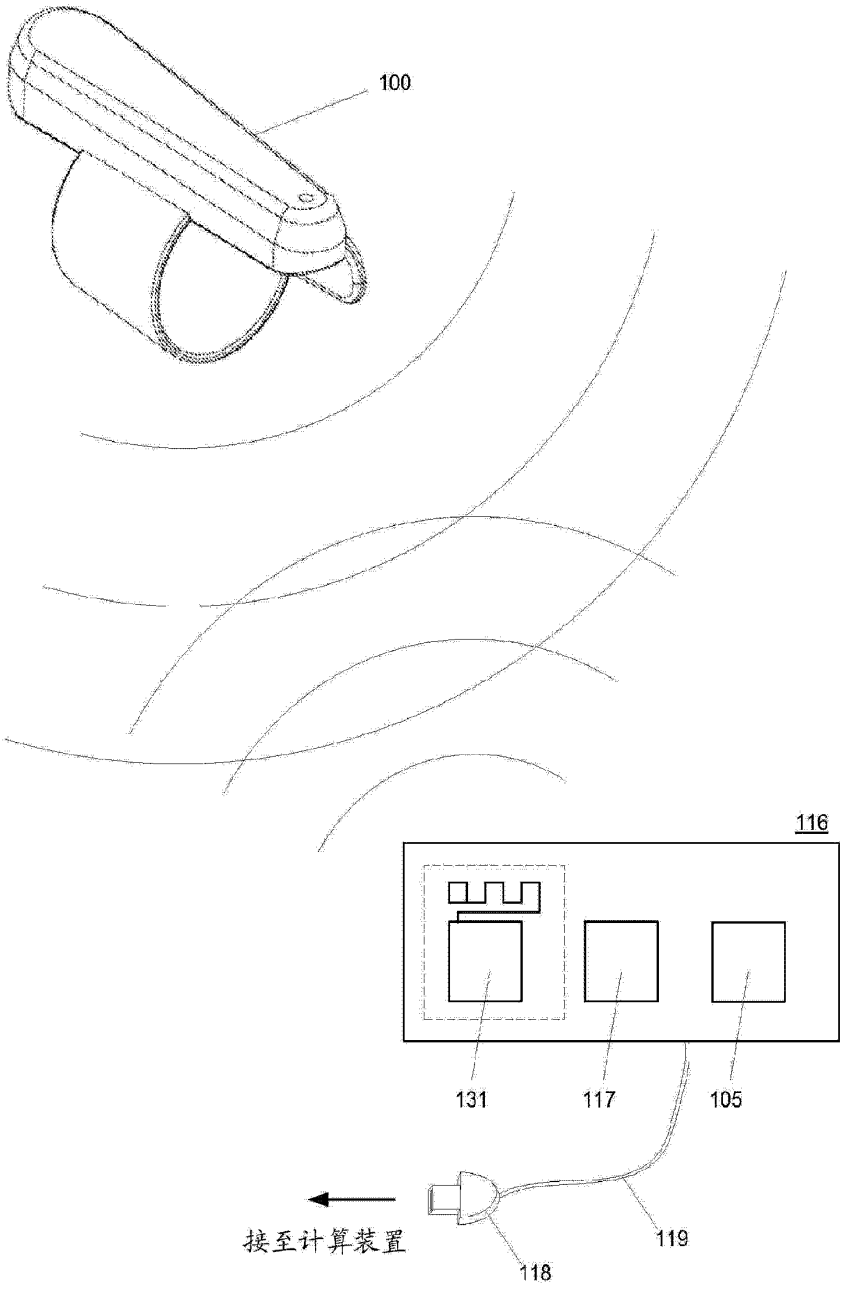


图 1D

Petitioner Samsung Ex-1004, 0726

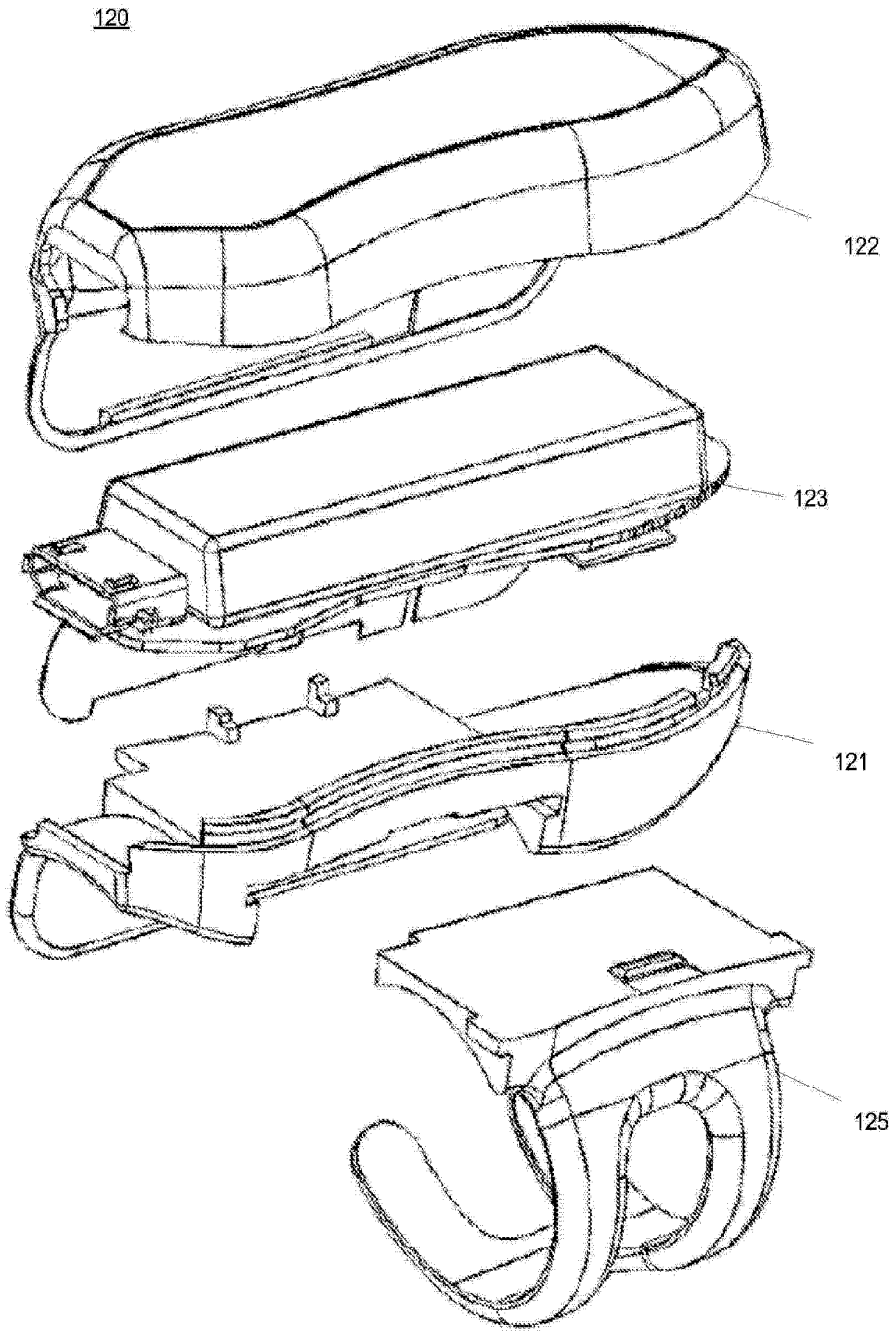


图 1E

Petitioner Samsung Ex-1004, 0727

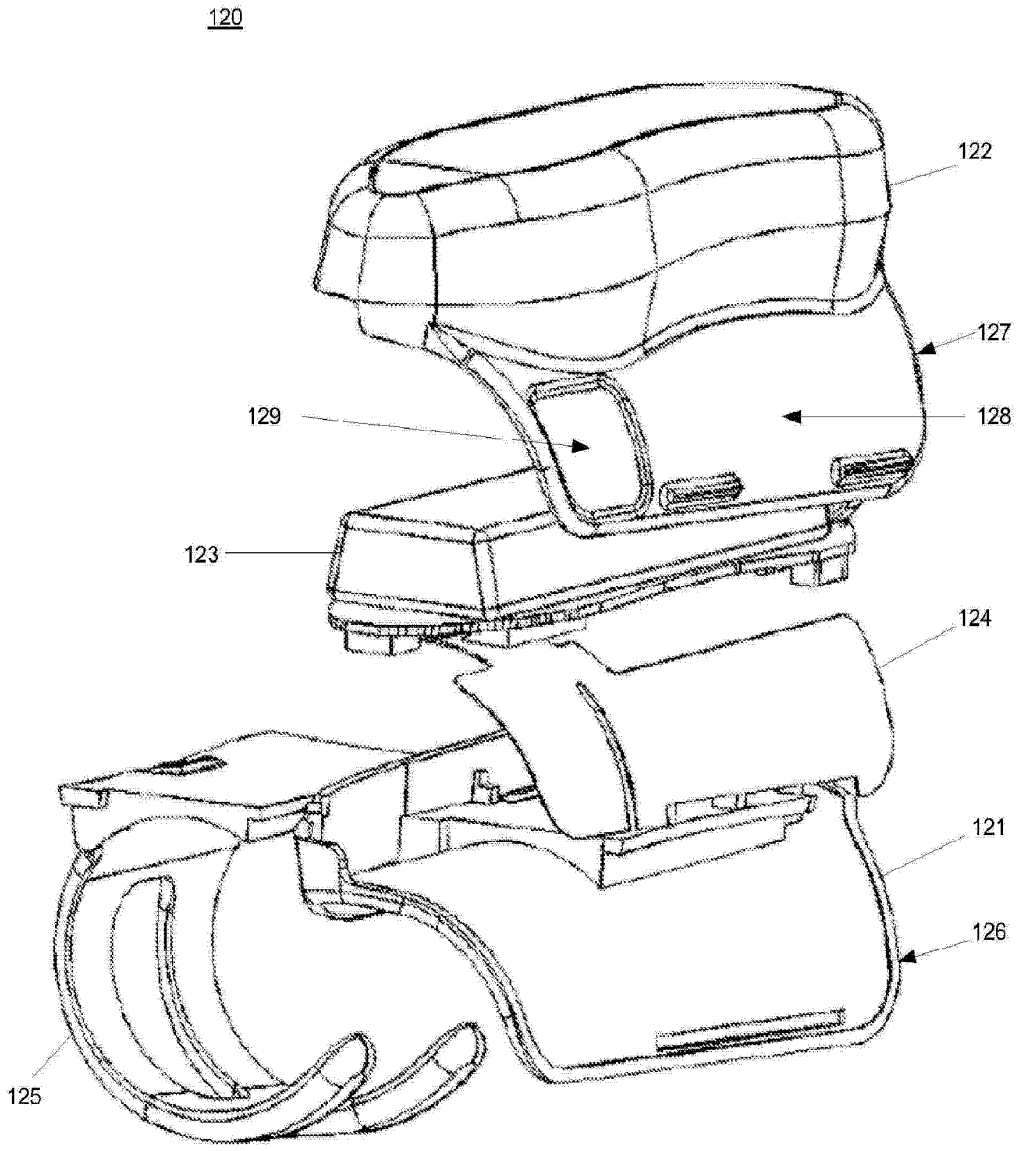


图 1F

Petitioner Samsung Ex-1004, 0728

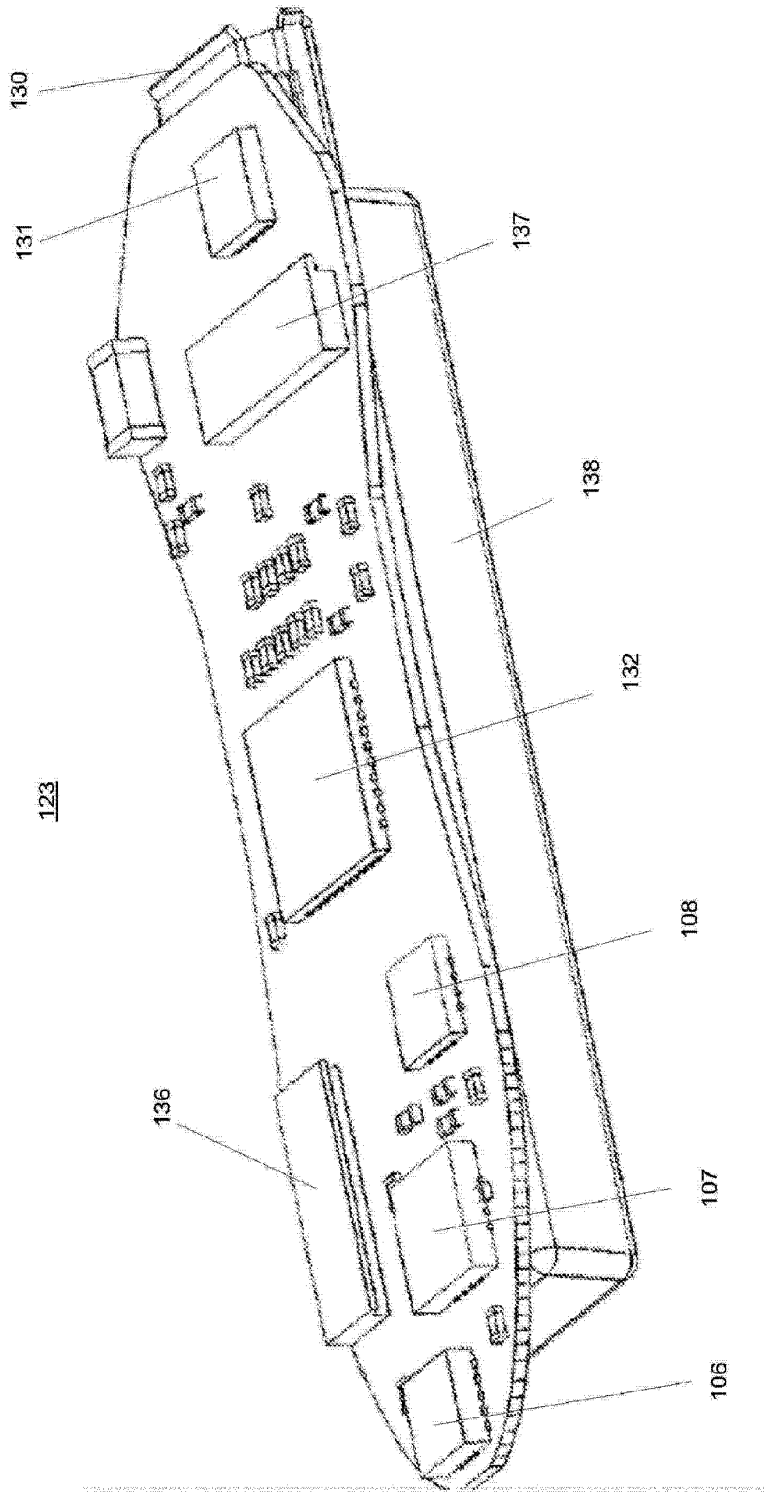


图 1G

Petitioner Samsung Ex-1004, 0729

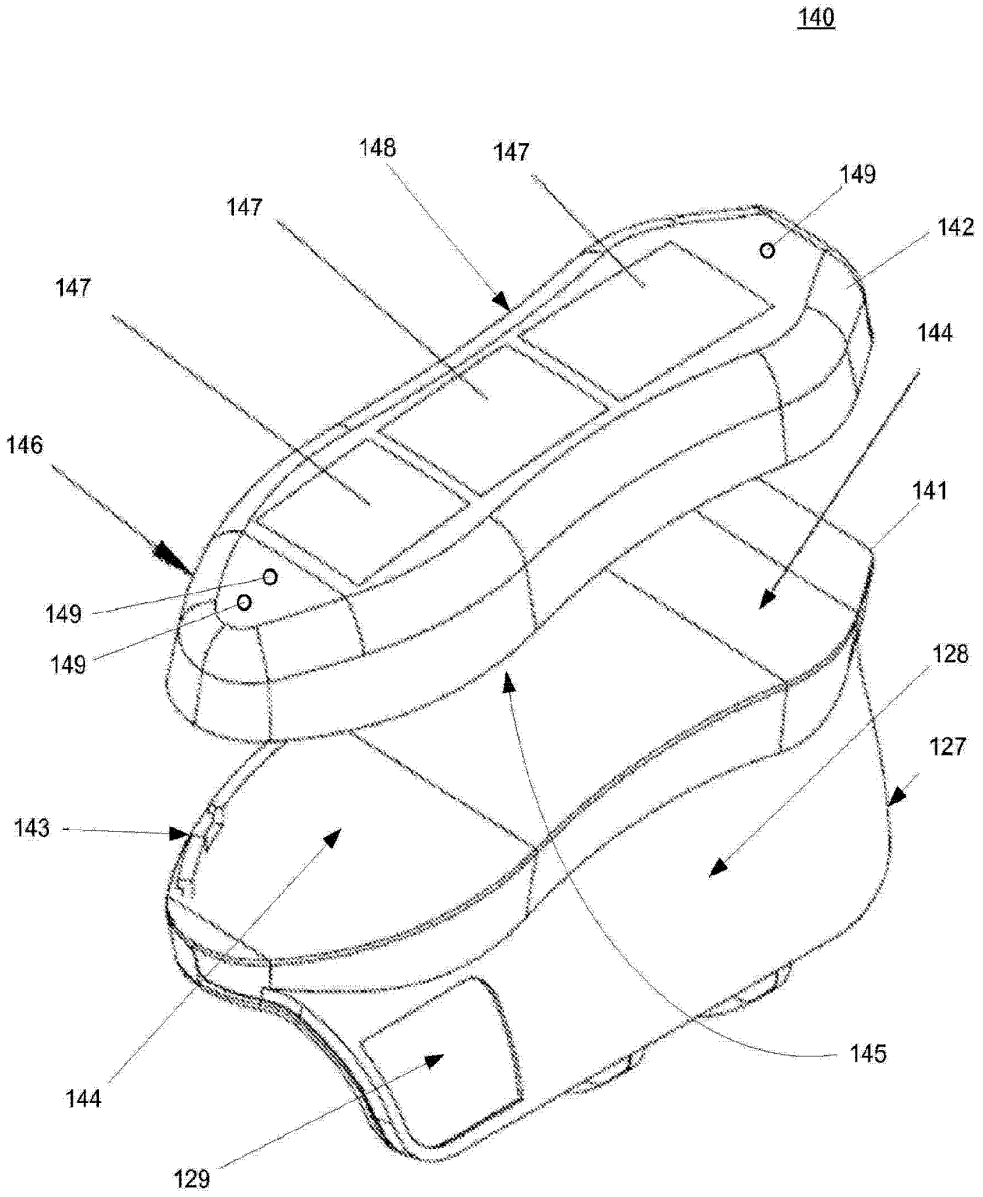


图 1H

Petitioner Samsung Ex-1004, 0730

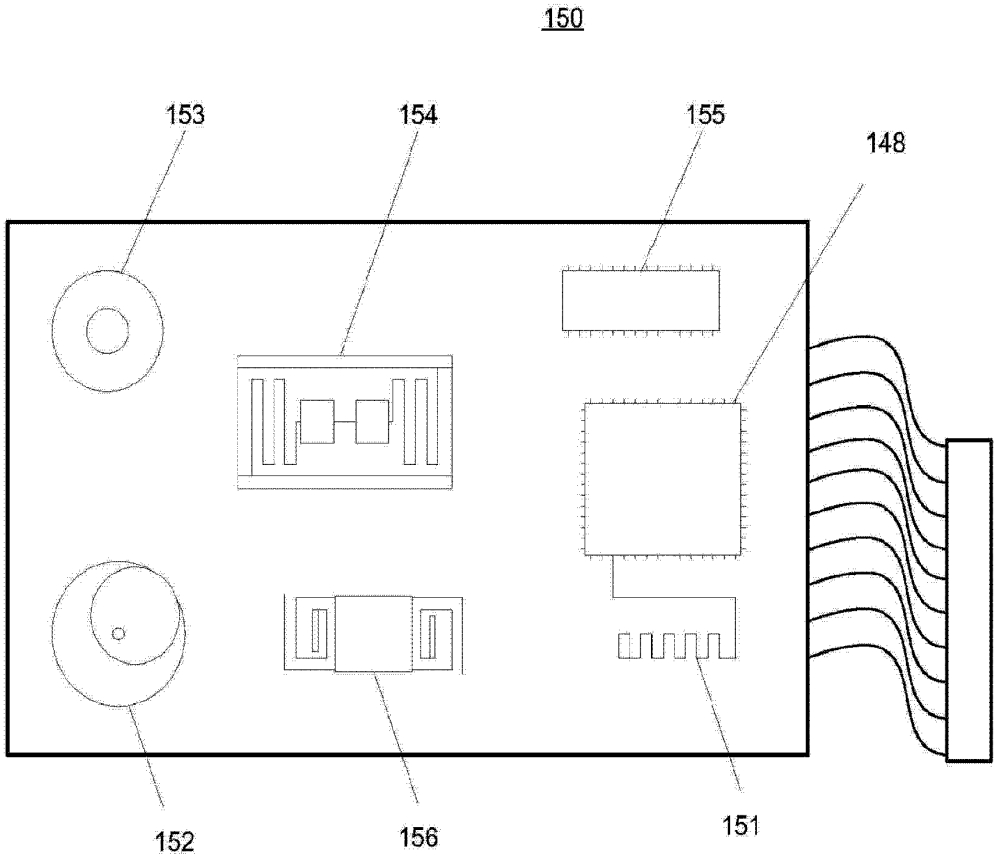


图 1I

Petitioner Samsung Ex-1004, 0731

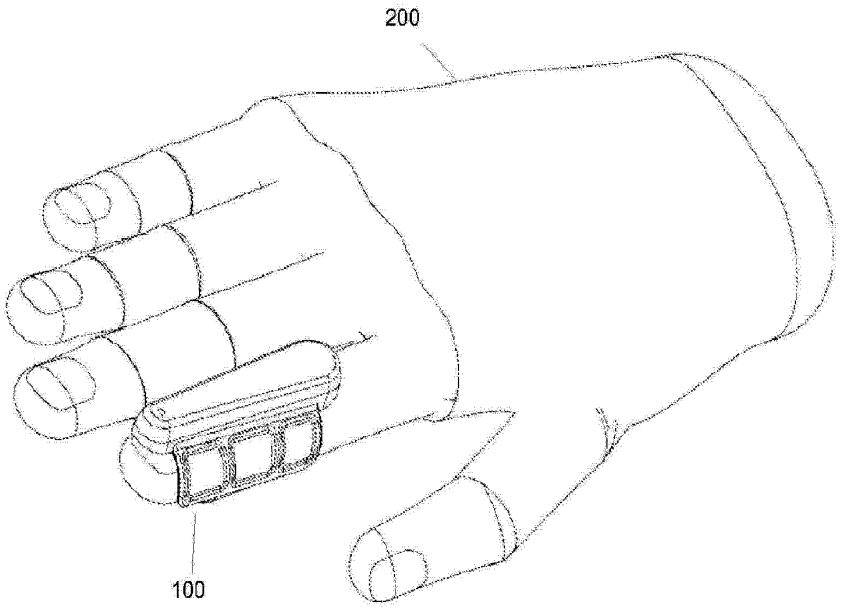


图 2

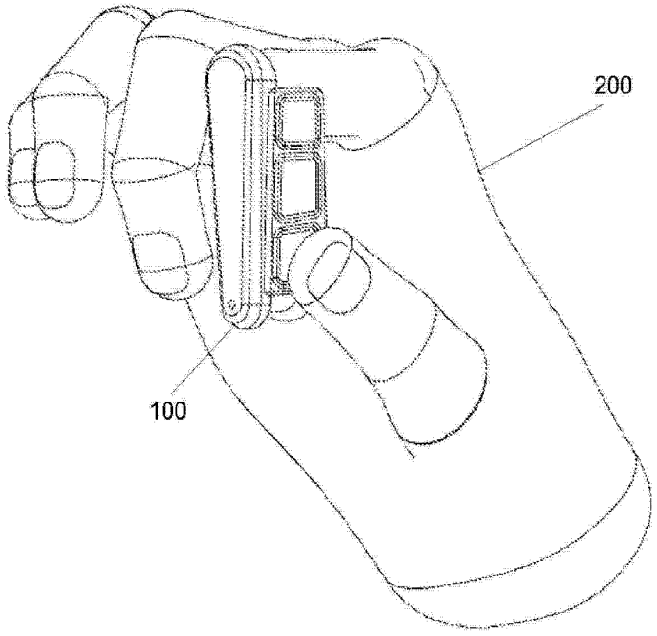


图 3A

Petitioner Samsung Ex-1004, 0732

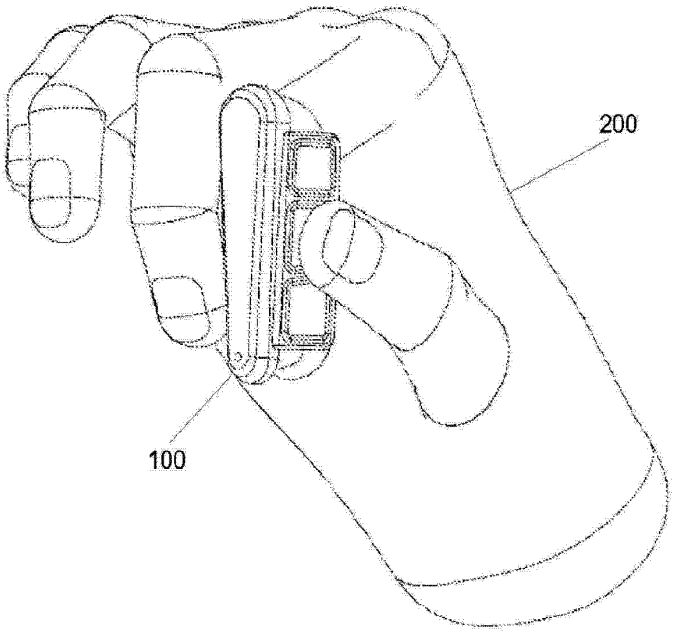


图 3B

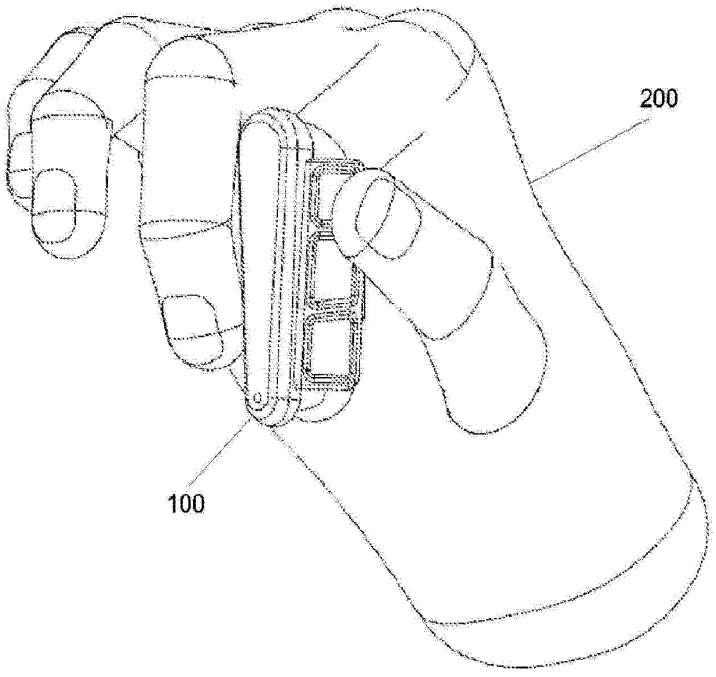


图 3C

Petitioner Samsung Ex-1004, 0733

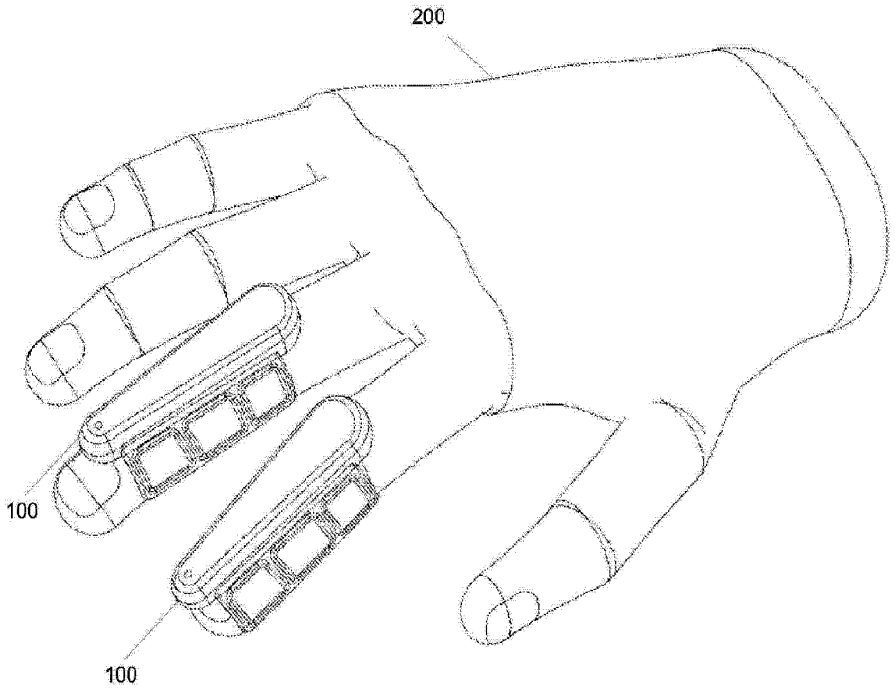


图 4

Petitioner Samsung Ex-1004, 0734

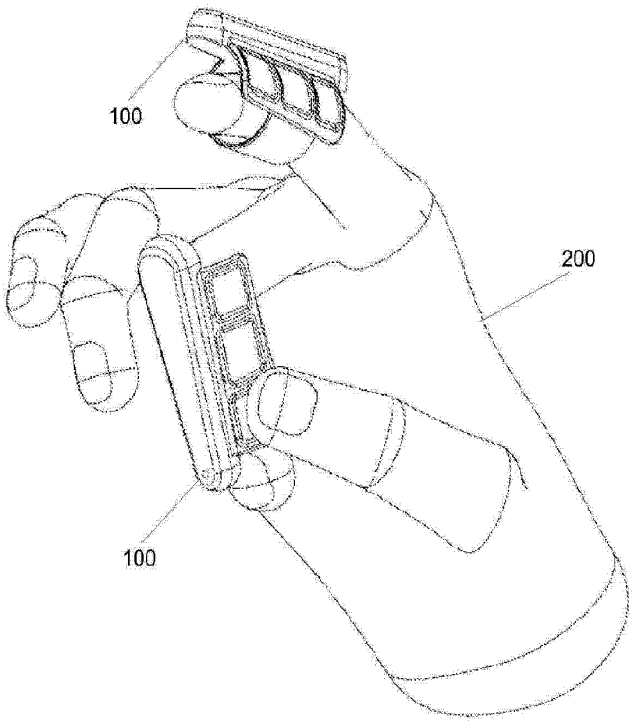


图 5A

Petitioner Samsung Ex-1004, 0735

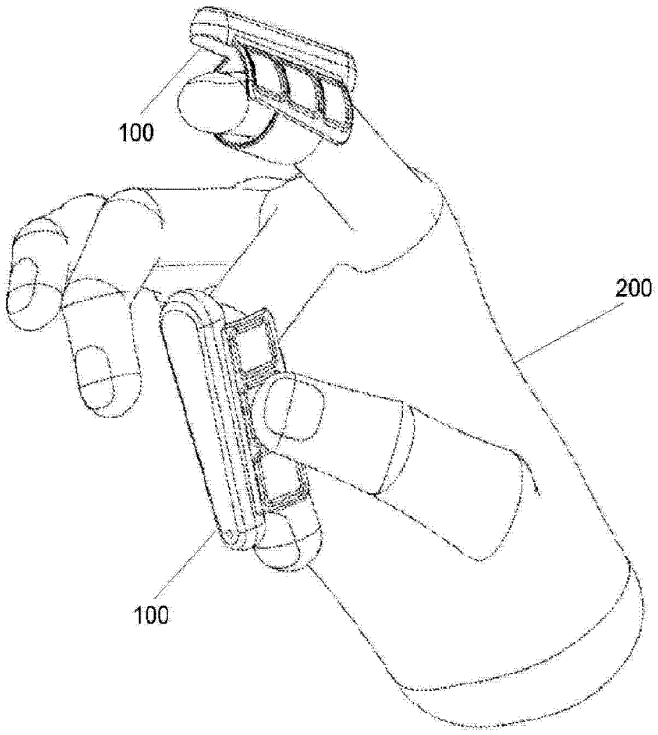


图 5B

Petitioner Samsung Ex-1004, 0736

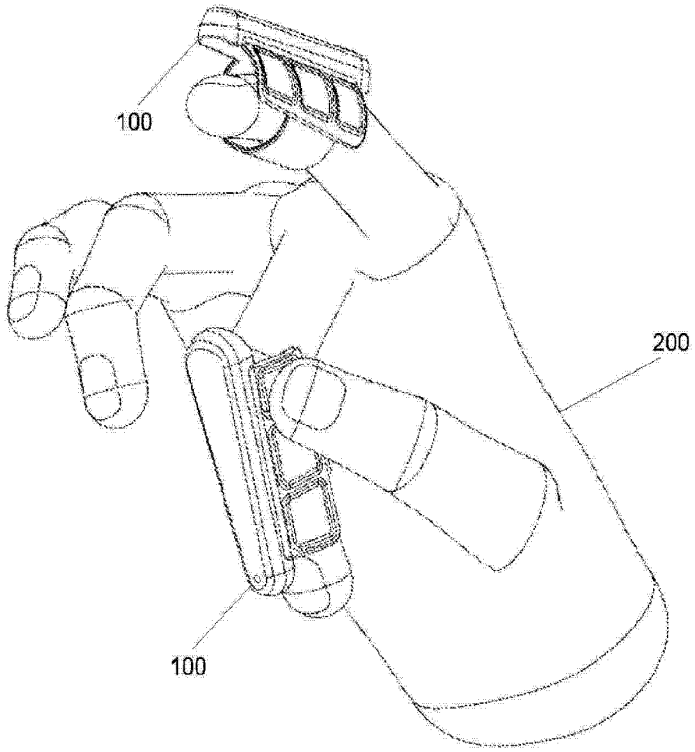


图 5C

Petitioner Samsung Ex-1004, 0737

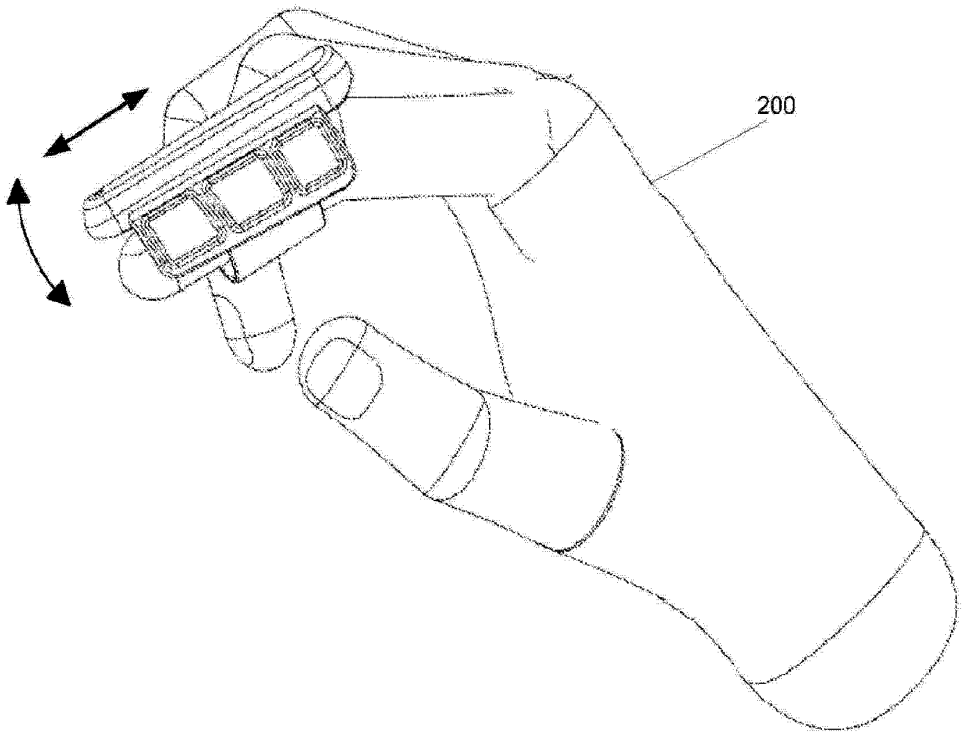


图 6

Petitioner Samsung Ex-1004, 0738

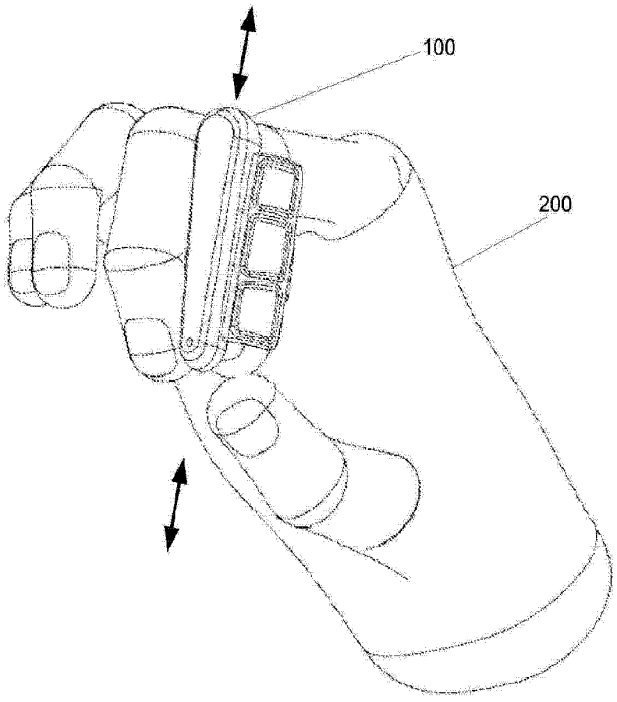


图 7

Petitioner Samsung Ex-1004, 0739

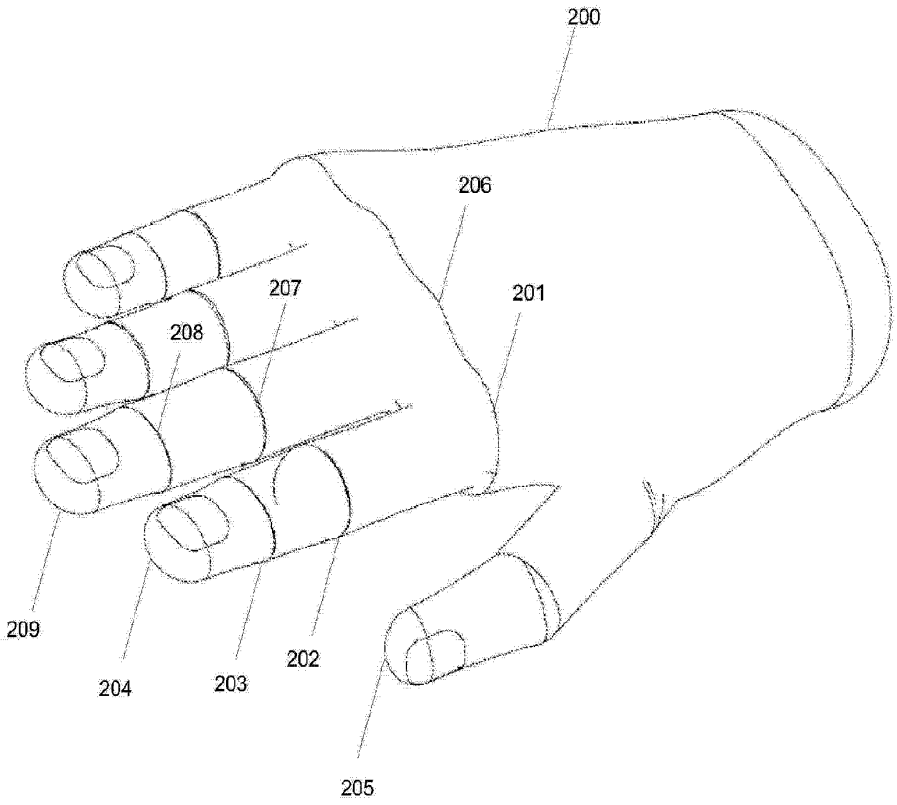


图 8（现有技术）

Petitioner Samsung Ex-1004, 0740

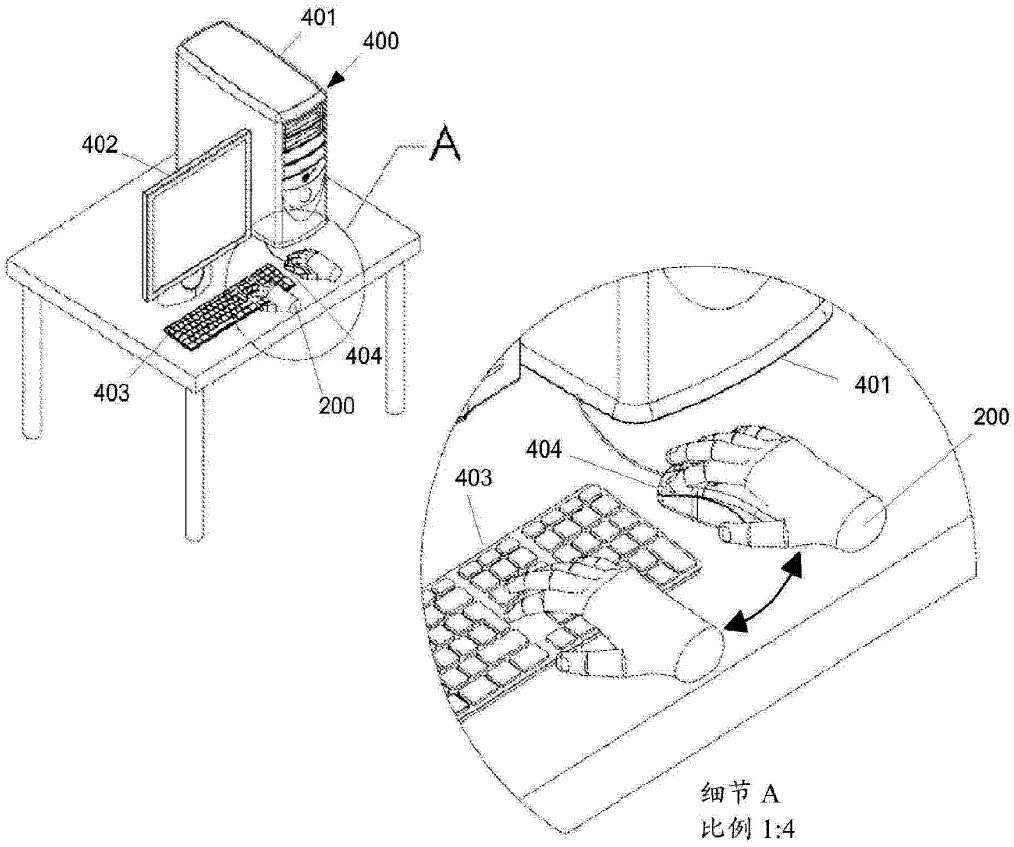
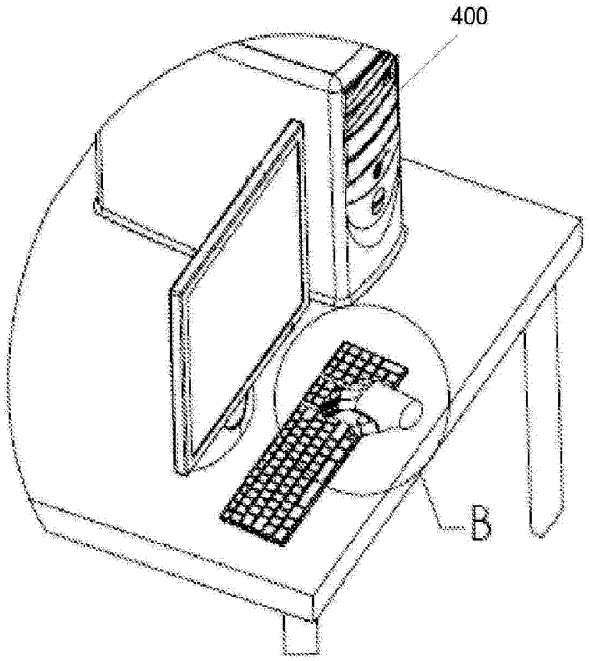


图 9（现有技术）

Petitioner Samsung Ex-1004, 0741



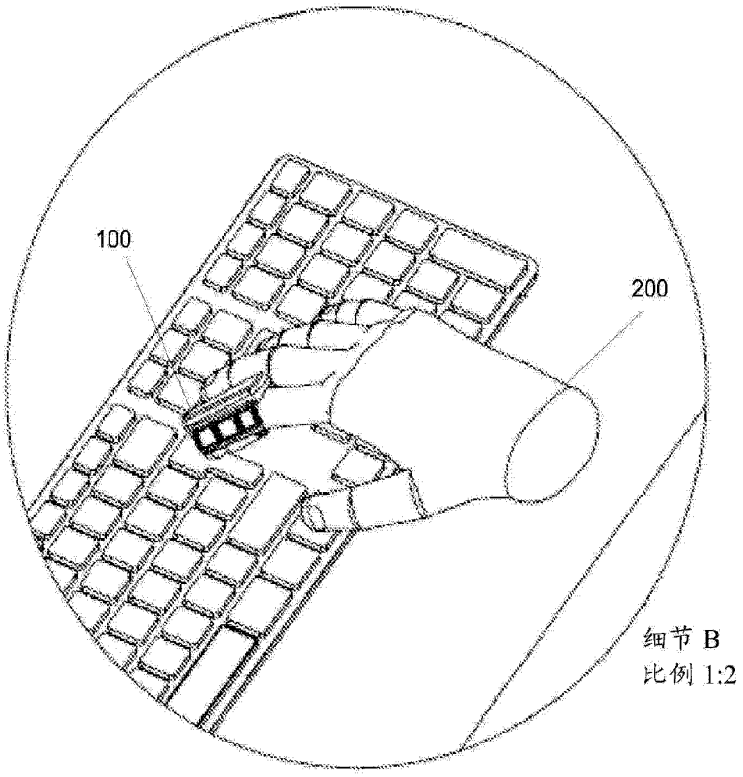


图 10

Petitioner Samsung Ex-1004, 0742

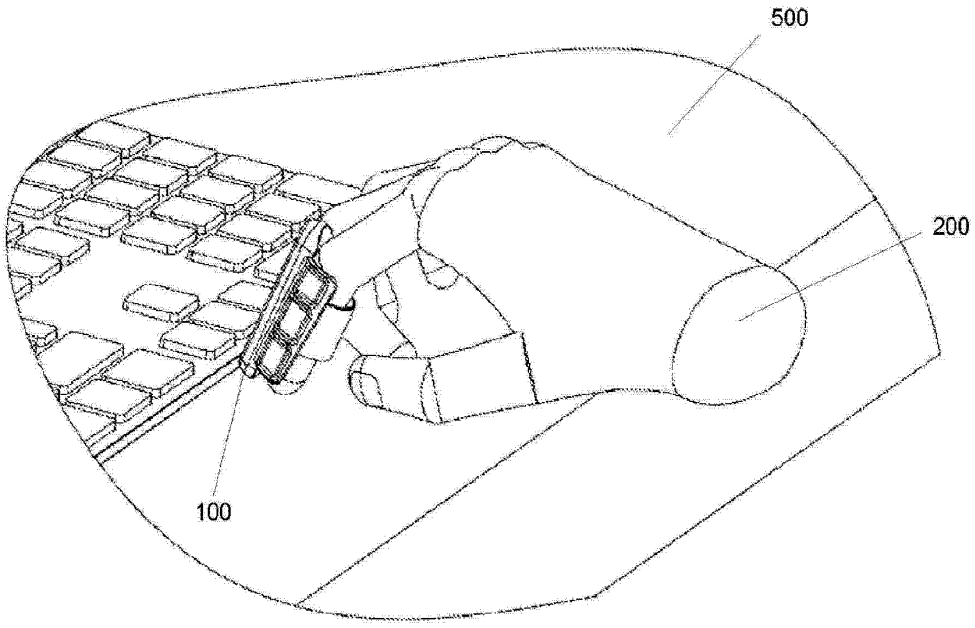


图 11

Petitioner Samsung Ex-1004, 0743

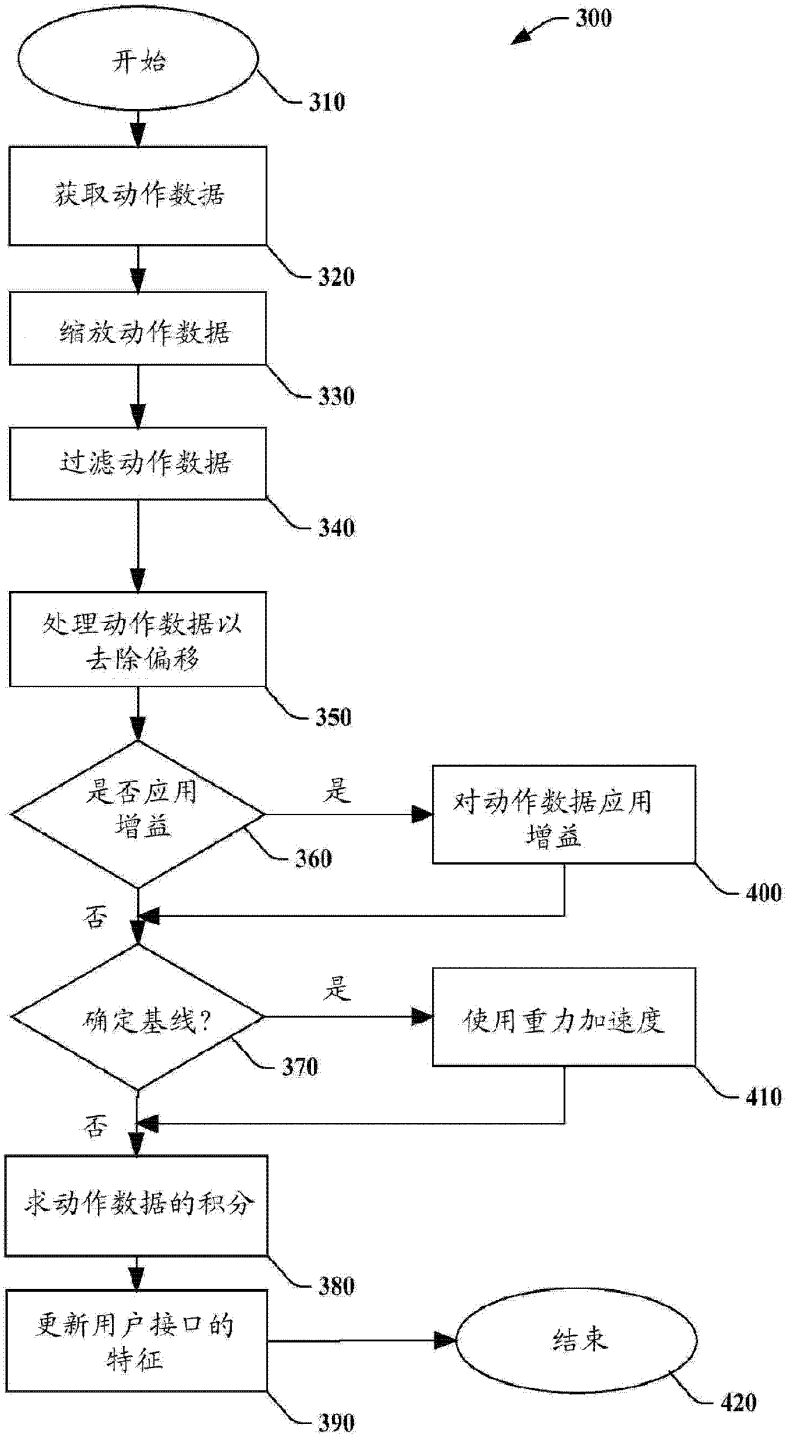


图 12

Petitioner Samsung Ex-1004, 0744

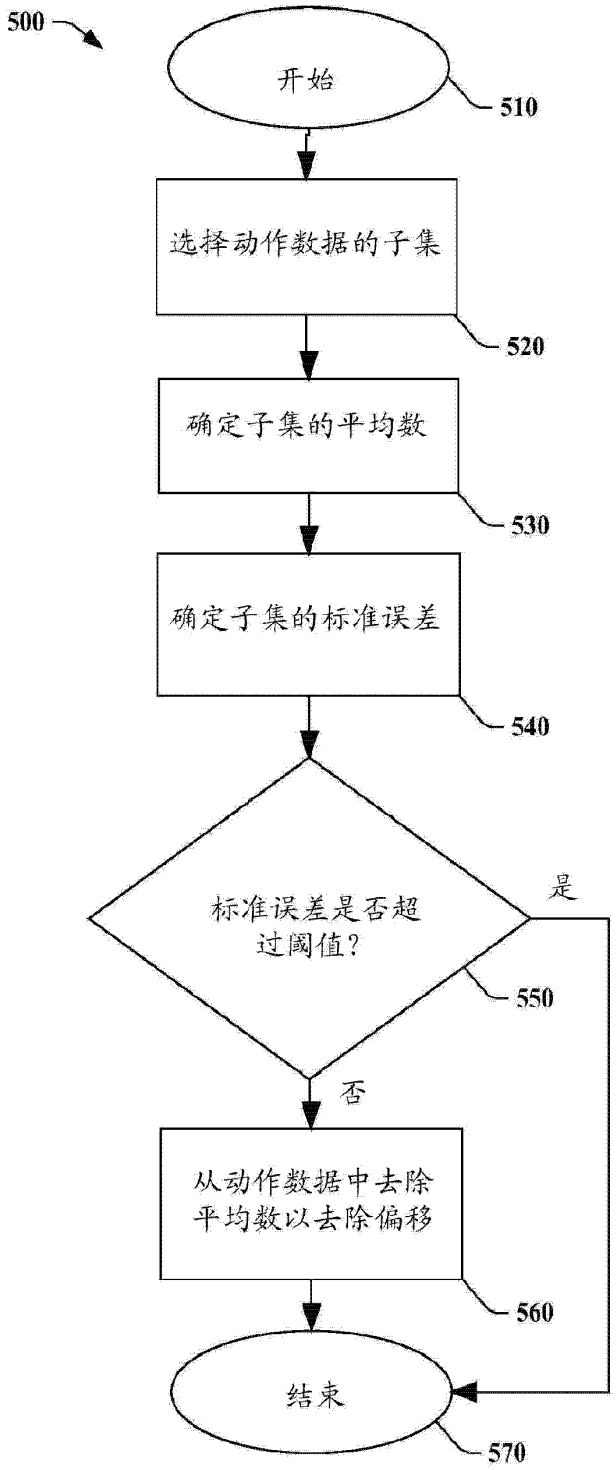


图 13

Petitioner Samsung Ex-1004, 0745

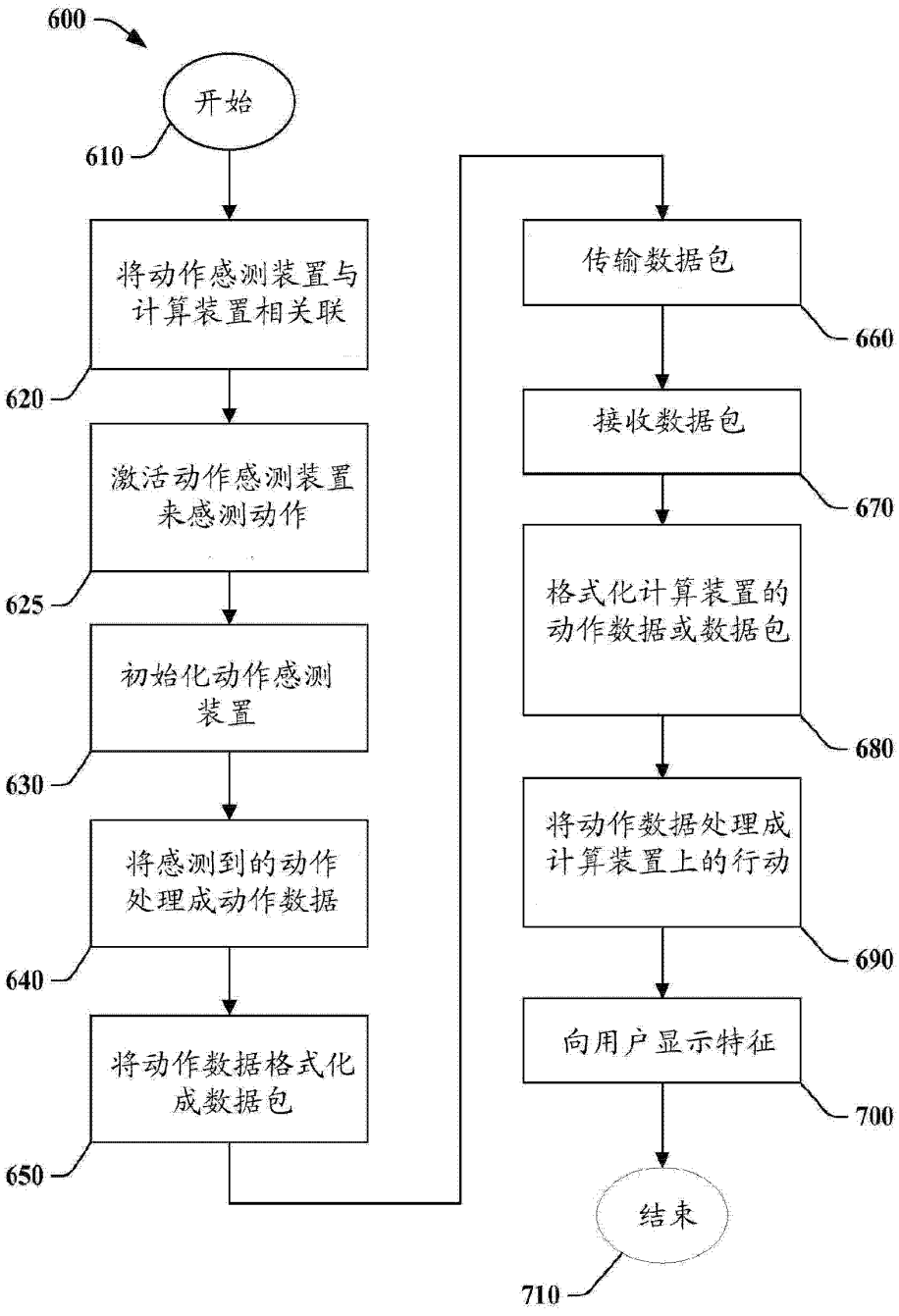


图 14

Petitioner Samsung Ex-1004, 0746

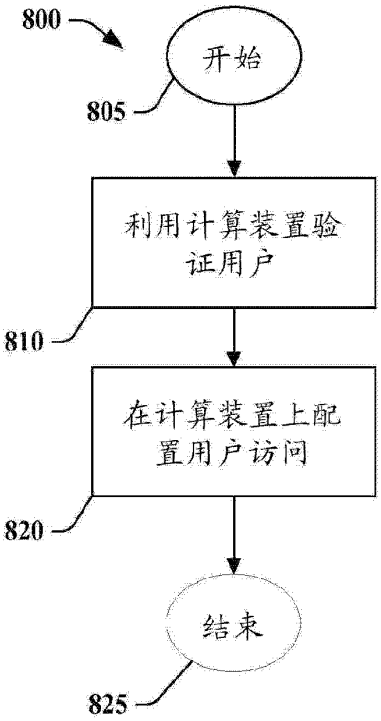


图 15A

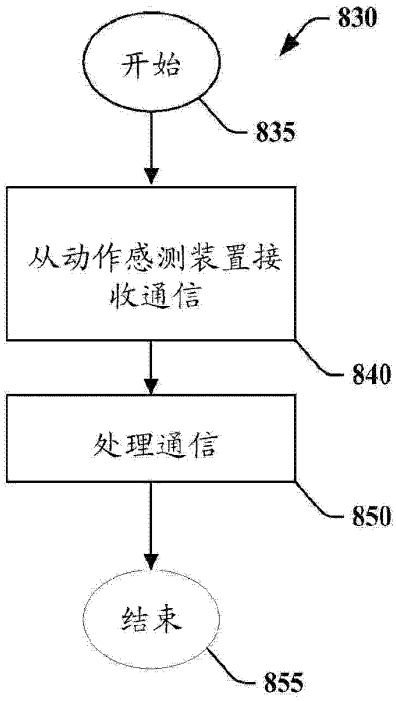


图 15B

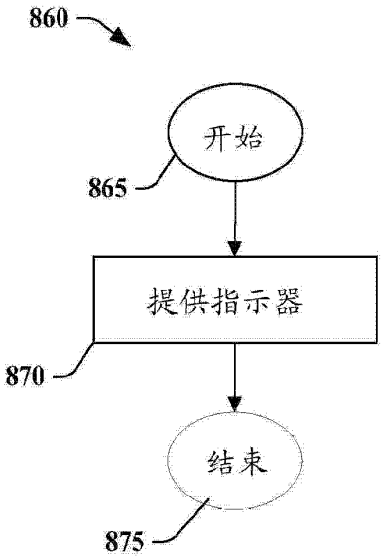


图 15C

Petitioner Samsung Ex-1004, 0747

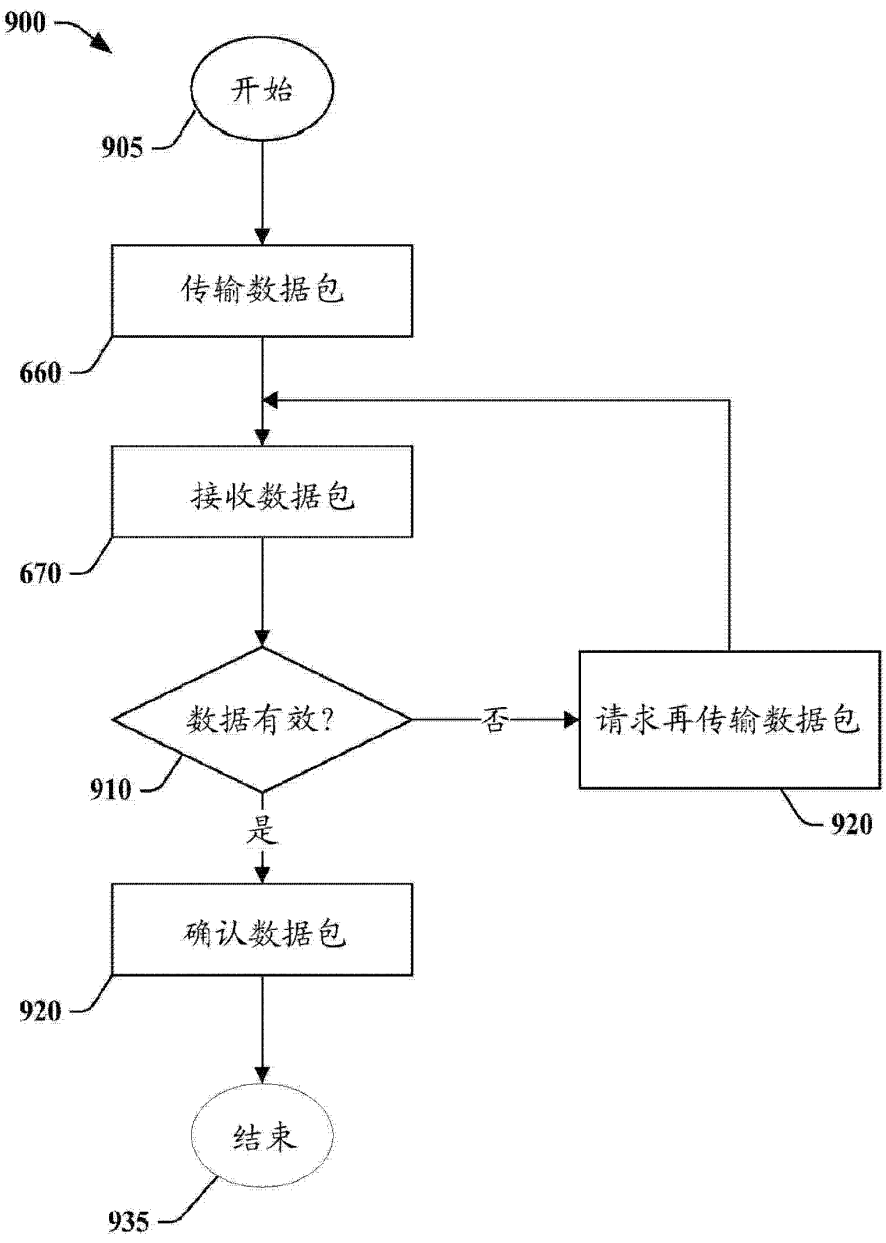


图 15D

Petitioner Samsung Ex-1004, 0748

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: von Badinski et al. Application No.: 18/323,385 Filed: May 24, 2023 For: WEARABLE COMPUTING DEVICE Docket No.: PM001.01.03.01.01.01.01.02 (112434.0517) Customer No.: 179918	Confirmation No.: 7585 Examiner: Not Yet Assigned Art Unit: Not Yet Assigned **INFORMATION DISCLOSURE STATEMENT** **CERTIFICATE OF TRANSMISSION** I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office on July 21, 2023. By: /Jamie LaFleur/ Jamie LaFleur

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

Pursuant to the duty of disclosure set forth at 37 CFR §1.56 and the requirements for filing an Information Disclosure Statement set forth at 37 CFR §§1.97-1.98, enclosed is Form PTO/SB/08 (hereinafter "the Form") with a list of all items being submitted for consideration by the Office. A legible copy of each item listed in the Form that is not a U.S. patent or a published U.S. patent application, and not identified as being cumulative, is enclosed.

The disclosure of the remaining documents identified on the Form is not to be construed as an admission that any of the documents, alone or in any combination, is considered to be material to patentability as defined in 37 CFR §1.56(b). Moreover, the disclosure of these documents is not to be construed as an admission that any of the documents are prior art as to the above-identified application.

Petitioner Samsung Ex-1004, 0749

Applicants believe that no fee is required for submission of this statement. However, if a fee is required, the Commissioner is authorized to deduct such a fee from the undersigned's Deposit Account No. 08-2623. Please deduct any additional fees from, or credit any overpayment to, the above-noted Deposit Account.

Respectfully submitted,

/ Nathan J. Mutter /

Nathan J. Mutter
Reg. No. 70,107

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Salt Lake City, UT 84147
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Fax: 303-473-2720

Petitioner Samsung Ex-1004, 0750

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 8

Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	001	1589547	1926-06-22	Novack	
	002	2048878	1936-07-28	Moldenhauer	
	003	3022648	1962-02-27	Thaler	
	004	3653051	1972-03-28	WU	
	005	3684125	1972-08-15	Laurizio	
	006	4407295	1983-08-04	Steuer et al.	
	007	4541207	1985-09-17	Antonson	
	008	5191891	1993-03-09	Righter	
	009	5382778	1995-01-17	Takahira et al.	
	010	5490523	1996-02-13	Isaacson et al.	
	011	5832296	1998-11-03	Wang et al.	
	012	5964701	1999-10-12	Asada et al.	
	013	6101843	2000-08-15	Nagano	
	014	6255800	2001-07-03	Bork	
	015	6277079	2001-08-21	Avicola et al.	
	016	6495283	2002-12-17	Yoon et al.	
	017	6502906	2003-01-07	Chen	
	018	6546749	2003-04-15	Canty	
	019	6608562	2003-08-19	Kimura et al.	
	020	7161484	2007-01-09	Tsoukalis	
	021	7375494	2008-05-20	Daniel et al.	
	022	7374540	2008-05-20	Schnall	
	023	7427979	2008-09-23	Park et al.	
	024	7444001	2008-10-28	Roberts et al.	
	025	7517222	2009-04-14	Rohrbach et al.	
	026	7526927	2009-05-05	Pinto	

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Sheet 2 of 8

Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

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	027	7555327	2009-06-30	Matlock	
	028	7637746	2009-12-29	Lindberg et al.	
	029	7733224	2010-06-08	Tran	
	030	8157161	2012-04-17	Yach	
	031	8157731	2012-04-17	Teller et al.	
	032	8270914	2012-09-18	Pascolini et al.	
	033	8346327	2013-01-01	Campbell et al.	
	034	8373656	2013-02-12	Hou et al.	
	035	8421748	2013-04-16	Tanaka	
	036	8457654	2013-06-04	Roskind	
	037	8515506	2013-08-20	Ridder et al.	
	038	8554297	2013-10-08	Moon et al.	
	039	8570372	2013-10-29	Russell	
	040	8583167	2013-11-12	Chun	
	041	8599572	2013-12-03	Neudecker et al.	
	042	8626249	2014-01-07	Ungari et al.	
	043	8638190	2014-01-28	Want et al.	
	044	8888720	2014-11-18	Hudson	
	045	8954135	2015-02-10	Yuen et al.	
	046	9076589	2015-07-07	Wright et al.	
	047	9110505	2015-08-18	Mastandrea Jr	
	048	9113793	2015-08-25	Terumoto et al.	
	049	9148717	2015-09-29	Shaffer	
	050	9197270	2015-11-24	Ying et al.	
	051	9203463	2015-12-01	Asrani et al.	
	052	9311825	2016-04-12	Lusted et al.	

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Sheet 3 of 8

Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

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	053	9313609	2016-04-12	Prencipe	
	054	9335790	2016-05-10	Stoller	
	055	9345404	2016-05-24	Proud	
	056	9414125	2016-08-09	Ferren et al.	
	057	9734477	2017-08-15	Weast et al.	
	058	9788789	2018-10-17	Bailey	
	059	10085689	2018-10-02	Giuffrida et al.	
	060	10219709	2019-03-05	Basu	
	061	10729388	2020-08-04	Reihman et al.	
	062	20020156352	2002-10-24	Eggers	
	063	20030142065	2003-07-31	Pahlavan	
	064	20050038348	2005-02-17	Avicola et al.	
	065	20050189906	2005-09-01	SUN HUEI-HSIN	
	066	20060046709	2006-03-02	Krumm et al.	
	067	20060142968	2006-06-29	Han et al.	
	068	20060202618	2006-09-14	Ishii et al.	
	069	20070100218	2007-05-03	Sweitzer et al.	
	070	20070100666	2007-05-03	STIVORIC JOHN M	
	071	20070123756	2007-05-31	Kitajima et al.	
	072	20080045806	2008-02-21	Keppler	
	073	20080048036	2008-02-28	Matsumoto et al.	
	074	2008266118	2008-10-30	Pierson et al.	
	075	20090306485	2009-12-10	Bell	
	076	20100100004	2010-04-22	van Someren	
	077	20100156624	2010-06-24	Hounsell	
	078	2010168531	2010-07-01	Shaltis et al.	

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Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	079	2010298677	2010-11-25	Lu et al.	
	080	20110038511	2011-02-17	Takiguchi	
	081	20110057901	2011-03-10	Raty et al.	
	082	20110070480	2011-03-24	Hahn et al.	
	083	20110070480	2011-03-24	Griffin et al.	
	084	20110312311	2011-12-22	Abifaker et al.	
	085	20120016793	2012-01-19	Peters et al.	
	086	20120130203	2012-05-24	Stergiou et al.	
	087	20120218184	2012-08-30	Wissmar	
	088	20120220835	2012-08-30	Chung	
	089	20120254809	2012-10-04	Yang et al.	
	090	20120293107	2012-11-22	Ajagbe; Adebowale	
	091	20120317024	2012-12-13	Rahman et al.	
	092	20130027341	2013-01-31	Masandrea	
	093	20130044215	2013-02-21	Rothkopf et al.	
	094	20130069583	2013-03-21	Lemelman et al.	
	095	20130088186	2013-04-11	Hsieth	
	096	20130106603	2013-05-02	WEAST AARON B	
	097	20130108907	2013-05-02	Bhardwaj et al.	
	098	20130131519	2013-05-23	LEBOEUF STEVEN FRANCIS	
	099	20130144176	2013-06-06	Lec	
	100	20130217326	2013-06-22	Symons	
	101	20130167221	2013-06-27	VUKOSZAVL YEV et al.	
	102	20130191789	2013-07-25	Calman et al.	
	103	20130226486	2013-08-29	Henderson et al.	
	104	20130261771	2013-10-03	Ten Kate	

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Sheet 5 of 8

Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

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	105	20130271069	2013-10-17	Partovi	
	106	20130163326	2013-10-31	Hunter et al.	
	107	20130332286	2013-12-12	Medelius et al.	
	108	20140065956	2014-03-08	Yang et al.	
	109	20140102136	2014-04-17	Warren	
	110	20150037616	2015-02-05	Wyatt et al.	
	111	20150177559	2015-10-01	Vescovi et al.	
	112	20150303722	2015-10-22	Li	
	113	20150349556	2015-12-03	Mercando et al.	
	114	20150380961	2015-12-31	Tseng et al.	
	115	20150327809	2015-11-19	Tateda et al.	
	116	2015342468	2015-12-03	Semler et al.	
	117	20160013602	2016-01-14	Strisower et al.	
	118	2017006414	2017-01-05	Tomassini	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
	119	CN-103109462-A	2013-05-15	Masntandrea et al.		☐
	120	CN-103441306-A	2013-12-11	Huizhou Techne Group Co Ltd.		
	121	CN-204440426-U	2015-07-01	Huizhou 8 MM Technology Co., Ltd.		
	122	CN-204732935-U	2015-10-28	Shi Xiong		

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Sheet 6 of 8

Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

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	123	DE-202006000119-U1	2006-04-05	TaiDoc Technology Corp.		
	124	EP-2660680-A1	2013-11-06	Alcatel Lucent		
	125	FR-2767384-B3	1997-08-14	Chen Mei Yen		
	126	JP-2003275192	2003-09-30	Citizen Watch Co Ltd		
	127	KR-200417885-Y1	2006-03-13	KIM KYUNG		
	128	KR-20100091592-A	2010-08-19	Kim Ki-jung		
	129	WO-2009079461-A	2009-06-25	NELLCOR PURITAN BENNETT LLC		
	130	WO-2004078028-A2	2004-09-16	Avicola et al.		
	131	WO-2006060949-A1	2006-06-15	We-All Patent Agent Co., LTD		
	132	WO-2009124076-A1	2009-10-08	NELLCOR PURITAN BENNETT LLC		
	133	WO-2011053235-A1	2011-05-05	Wissmar et al.		
	134	WO-2012024889-A1	2012-03-01	Wang		
	135	WO-2013104629-A1	2013-07-18	Kaptalia Monitoring		
	136	WO-2013093638-A2	2013-06-27	MASHINERY PTY LTD		
	137	WO-2013163326-A1	2013-10-31	QUALCOMM Incorporated		

Examiner Signature		Date Considered	

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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 7 of 8

Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

NON-PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	Include name of the author(in CAPITAL LETTERS),title of the article(when appropriate), title of the item (book,magazine,journal,serial,symposium,catalog,etc.),date,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
	138	SAMEDAYFLASH, "SET OF 10 2GB/4GB/8GB/16GB WOODEN BAMBOO FLASH DRIVE – BULK PACK O USB 2.0 WOOD BAMBOO STICK DESIGN – WOOD USB FLASH DRIVE", www.etsy.com/listing/248051205/set-of-10-2gb4gb8gb16gb-wooden-bamboo?ref+m", 6/2/2016, Publisher: Etsy, Published in: US	
	139	Medical Mood Ring – Anonymous- Technology Review; Apr. 2004; 107, 3; ProQuest Pg. 18	

Examiner Signature		Date Considered	

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CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Nathan J. Mutter/	Date (YYYY-MM-DD)	2023-07-21
Name/Print	Nathan J. Mutter	Registration Number	70,107

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 September 2004 (16.09.2004)

PCT

(10) International Publication Number
WO 2004/078028 A2

(51) International Patent Classification[7]: A61B

(21) International Application Number:
PCT/US2004/006014

(22) International Filing Date: 27 February 2004 (27.02.2004)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

60/451,009	28 February 2003 (28.02.2003)	US
60/516,101	30 November 2003 (30.11.2003)	US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

WO 2004/078028 A2

(54) Title: FLASHING JEWELRY HEARTBEAT MONITOR WITH MULTIPLE LIGHTS

(57) Abstract: Jewelry, such as finger rings and earrings, which flash in synchronism with the wearer's heartbeat. A pulsed IR signal is directed into the wearer's tissue and a reflected or transmitted signal is monitored to determine when the wearer's heart beats at which time one or more light emitting sources in the jewelry flashes. The monitored signal is utilized to determine the wearer's heart rate. At least two light emitting sources are provided one of which flashes with each heart beat and the other flashes when the heart rate reaches or exceeds a predetermined range or increases faster than a predetermined rate. Preferred embodiments include three visible LED's (red, green and blue) and a micro-processor which calculates pulse rate and causes the red LED to blink on each pulse, the green LED to blink on each pulse when the wearer's pulse rate is greater a first threshold and the blue LED to blink on each pulse when the wearer's pulse rate is greater than a second threshold corresponding to extreme excitement. These threshold values may correspond to increased heart rates of typical persons engaged in exercise and love-making. The monitor may also be self calibrating to adjust the thresholds based on measurements of the wearer's heart rate over extended periods which would include periods of rest as well as periods of exertion or excitement. Other preferred embodiments vary the brightness of the LED's depending on the estimated blood pressure that also increases by about the same degree as pulse rate.

Petitioner Samsung Ex-1004, 0759

FLASHING JEWELRY HEARTBEAT MONITOR WITH MULTIPLE LIGHTS

This application claims the benefit of Provisional Applications SN 60/516,101 filed 11/3/2003 and SN 60/451,009 filed 2/28/2003. The present invention relates to jewelry and heartbeat monitors.

BACKGROUND OF THE INVENTION

US Patent No. 6,277,079 issued to the present inventors discloses a flashing earring heartbeat monitor. The '079 patent is incorporated herein by reference. In the background section of that patent is disclosed a well-known technique for monitoring heartbeat. Infrared light is transmitted into tissue and the reflected light is monitored to determine heart beat. This works because changing quantities of blood in the tissue with each heartbeat will affect the amount of light reflected from the tissue. In that patent Applicants described an earring (see FIGS. 1and 2, which were FIGS. 2 and 3 in the '079 patent) which used that basic technique to make an earring which would flash with each heartbeat. Applicants summarized the invention as follows:

"The ... invention provides an earring that flashes in synchronism with the wearer's heartbeat. A pulsed IR LED/photocell combination is built into an earring along with a comparator and a visible light-emitting source. The comparator determines when the heart has beat from the variation in the signal from the photocell and transmits a signal to a solid state switch to turn on the visible light-emitting source. Thus, the light emitting source flashes once for each heart beat. In a preferred use of the ... invention a lover is able to determine when his or her partner is excited by observing the rate at which the partner's earring flashes. The invention may also be used for medical monitoring of patients."

Heart rates are known to vary substantially with age and activity. Resting heart rates are typically in the range of about 50 to 70 beats per minute. A rule of thumb is: Maximum Heart Rate = 220 – Age. The range of variation gets smaller with age. The maximum heart rate ranges from about 100 to 200 for 20 year old people and from about 75 to about

Petitioner Samsung Ex-1004, 0760

150 for 70 year old people. Heart rates increase toward the maximum rates during strenuous exercise and during periods of excitement including sexual excitement. FIGS. 4A and 4B are graphs extracted from page 596 of Sexual Behavior in the Human Female by the Staff of the Institute for Sex Research, Indiana University, Alfred C. Kinsey et al Research Associates, Published by W. B. Sanders, Philadelphia. The subjects were a married couple. The graphs show heart rate ranges for the female from about 90 during the period preceding love making to 140 during lovemaking down to about 75 during sleep. For the male the corresponding ranges were about 90, 140 and 72. The female experienced four periods of extreme excitement. The male experienced only one.

Applicants have been informed that the potential market for these flashing earring heartbeat monitors may be in the many millions and that other jewelry monitoring heartbeat my also be very popular. What is needed are an improved versions of the earring described in the '079 patent and other jewelry applications of improved versions of that invention.

SUMMARY OF THE INVENTION

The present invention provides jewelry, such as finger rings and earrings, which flash in synchronism with the wearer's heartbeat. A pulsed IR signal is directed into the wearer's tissue and a reflected or transmitted signal is monitored to determine when the wearer's heart beats at which time one or more light emitting sources in the jewelry flashes. The monitored signal is utilized to determine the wearer's heart rate. At least two light emitting sources are provided one of which flashes with each heart beat and the other flashes when the heart rate reaches or exceeds a predetermined range or increases faster than a predetermined rate. Preferred embodiments utilize inexpensive off-the-shelf reflection sensors developed for card readers each of which includes both an IR emitter and a phototransistor IR detector. Preferred embodiments include a power-up-on-skin-contact feature to preserve battery power. Embodiments include a variety of color LED's and a variety of types of jewelry are proposed as heartbeat monitors. Disclosed are detailed instructions describing working prototype earrings built by Applicants and their licensees and descriptions for low cost fabrication of embodiments of the present

Petitioner Samsung Ex-1004, 0761

invention using application specific integrated circuit (ASIC) technology and surface mount technology. Preferred embodiments include three visible LED's (red, green and blue) and a micro-processor which calculates pulse rate and causes the red LED to blink on each pulse, the green LED to blink on each pulse when the wearer's pulse rate is greater a first threshold and the blue LED to blink on each pulse when the wearer's pulse rate is greater than a second threshold corresponding to extreme excitement. These threshold values may correspond to increased heart rates of typical persons engaged in exercise and love making. The monitor may also be self calibrating to adjust the thresholds based on measurements of the wearer's heart rate over extended periods which would include periods of rest as well as periods of exertion or excitement. Other preferred embodiments vary the brightness of the LED's depending on the estimated blood pressure that also increases by about the same degree as pulse rate. Also described is a special technique for providing power to the heartbeat monitor that consists of a small diameter pin for providing an electrical connection between a battery and a circuit board comprising an IR transmitter and an IR receiver and one or more LED's. The battery unit is preferably on the inside of the earlobe and the circuit board is preferably on the outside of the earlobe. Also disclosed is a technique for charging the battery unit.

BRIEF DESCRIIPTION OF THE DRAWINGS

FIGS. 1 and 2 are drawings from the '079 patent referred to above showing feature disclosed in that prior art patent.

FIG. 3 is a circuit diagram showing features of a working prototype of the present invention.

FIG. 3A is a version of FIG.3 showing sections of the circuits shown enlarged in FIGS. 3A(1) through 3A(7)

FIGS. 3A(1) through 3A(7) each show a portion of the FIG. 3 circuit.

FIGS. 4A and 4B are prior art graphs that show heart rates of a female and male human engaged in love making.

FIGS. 5A and 5B show block diagrams of control circuits and logic for controlling a three-light embodiment of the present invention.

FIG. 6 is a drawing of an inexpensive IR transmitter and detector.

Petitioner Samsung Ex-1004, 0762

FIGS. 7A and 7B discloses a battery unit for providing power for the IR transmitter and the IR receiver and for one or more LED's.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Prototype Embodiments

Applicants and their licensee have built and tested prototype-flashing earring that has demonstrated excellent performance of features of the present invention. A prototype earring was fabricated by modifying an earring having a magnetic clasp purchased from a Target department store and using inexpensive reflection IR emitter-sensors developed for card readers. Two magnets attract each other on both sides of a wearer's ear lobe. An IR transmitter, and IR receiver of the emitter-sensor and an on/off skin contact switch was mounted along with one of two magnets on one side of the ear lobe. The electronic parts for the earring are mounted on two small circuit boards contained in a heart shaped box hanging from the attaching magnetic clasps. The box has dimensions of about 1 inch X 1 inch X ¾ inch. The earring is fitted with a red Valentine shaped heart cover in which a visible light (red) emitting diode is mounted. Three hearing aid batteries also contained in the heart shaped box power this prototype earring. Only only a single battery powers other embodiments.

Circuit Diagram

An electric circuit diagram of the prototype embodiment of the present invention actually built and tested by Applicants is shown in FIG. 3. This circuit diagram is also broken into seven parts as shown in FIG. 3A and FIGS. 3A(1) through 3A(7).

As shown in FIG. 3A(1) timer integrated circuit U1 with its associated components shown at 20 produces a pulse train of 500 microseconds pulse width pulses at a 200 Hz rate. These pulses activate the switch in IC U2 (a dual analog switch) 22 which permits current to flow in IR LED 24.

As shown in FIG. 3A(2), the emitted IR pulses enter the earlobe tissue and the light scattered back into the phototransistor 26 and is detected production a pulse amplitude

Petitioner Samsung Ex-1004, 0763

modulated signal across R3 28. The network of D1, D2, C2 and R4 form a "track and hold" amplitude insulator 30.

As shown in FIG. 3A(3), integrated circuit U3 is a quad, OP Amp 32. The first amplifier is used as a voltage follower with high input impedance and a low output impedance which isolates the track and hold circuit from the following amplifier. R5 and C3 form a low pass filter 34 to reduce the high frequency noise from the pulse signal.

In FIG. 3A(4) R6 and C4 form a high pass filter 36 and OP amp 38 provides a gain of about 500 at the frequency range centered at about 2.5 Hz which is the frequency of interest. C5 along with the feedback resistor R7 forms another low pass filter 40. All the filters together form a narrow pass band filter centered at 2.5 Hz. The pass band is wide enough to detect heart rates between 40 pulses per minute and about 250 pulses per minute. The signal at pin 8 of OP amp is now the recovered heartbeat waveform.

In FIG. 3A(5) the recovered heartbeat waveform is AC coupled into the last OP Amp 42 which acts as a threshold detector. The network 44 of R10, R11and R12 sets a threshold of about 0.2V. A signal above this amplitude causes the output (pin 14) 46 to go from 5 V to 0 V.

As shown in FIG. 3A(6) the second switch in U2 48 is closed upon detection of a beat, which causes current to flow in the visible LED 50. The decoupling network 52 comprising R14, C9 and R 16, C12 isolates the LED current transmits from the 08 Am PS.

In FIG. 3A(7) U4 is a DC-DC converter 54. A 1.4 V battery 56 is converted to a regulated 5V as shown at 60 to power the circuitry. It has a shutdown feature used to automatically turn on power upon skin contact as shown at 58.

Petitioner Samsung Ex-1004, 0764

Components of Prototype Are Off-the-Shelf

All of the electronic components of the above described prototype are off-the-shelf components available from vendors such as Radio Shack and Target with many locations, Allied Electronics with offices in Fort Worth Texas and Digi-Key with offices in Thief River Falls, MN. The IR transmitter and detector in the above embodiment is a very inexpensive device used for card reading an sells for $1.37 in quantities of 100. The unit operates at a wavelength of 940 nm which scatters well in and easily penetrates tissue as thick as the earlobe. Applicants have adopted it for their monitor with excellent results. A drawing of the IR transmitter and detector is shown in FIG. 6. Other parts are also very inexpensive so that Applicants expect to be able to produce their monitor for about $20 or less in large quantities. Therefore, Applicants expect enormous markets for the products of the present invention for medical, exercise, sports of all types and many other uses. As suggested above Applicants expect that their biggest market will be lovers.

Testing

The prototype earring has been thoroughly tested by Applicants and its excellent performance has been confirmed. One of the Applicants has tested the earring at a wide range of heart rates comparing the blinking of the LED with his own pulse with perfect match throughout the range.

Types of Jewelry Other than Earrings

Experimentation by Applicants have proven that the principals of the invention claimed in the '079 patent can be extended to other types of jewelry. Applicants have determined that heartbeat rings worn at other locations of the body perform just as well or better as compared to the earlobe. Other potential locations include the fingers, belly button, nose, toes, breast, and parts of the breast. Applicants have also determined that the flashing heartbeat monitor can be attached to skin as a patch with excellent performance. For example a heart shaped patch containing the electronic components described above can be applied on a skin region corresponding to the region of a person's heart.

Petitioner Samsung Ex-1004, 0765

Miniaturization

Although the prototype version of the invention actually built by Applicants is small enough to make a practical earring having substantial appeal, Applicants expect that much smaller earrings will have much greater appeal. Therefore, Applicants expect to have the electronics described converted to an application specific integrated circuit chip (an ASIC chip). These chips can be produced in volume production for less than $2 so that the cost of the heart monitoring jewelry could be as low a few dollars. Many ASIC manufacturers/designers are available which could convert the circuit shown in FIG. 3 into an ASIC chip mass producible for less than $2. These include Intrinsix Corp with offices in Westboro, MA; System to ASIC with offices in Bothell WA ASIC Northwest with offices in Portland, OR and Arizona Microtek, Inc with offices in Mesa, AZ. Another technique to miniaturize the jewelry of the present invention is by utilizing so called "surface mounting" techniques. These components are typically only about one-tenth to one fifth the size of conventional components. Thus, the prototype earring built and tested by applicants using off-the-shelf components, which is somewhat smaller than 1 inch cube, could be reduced in size to about one tenth or one fifth this volume using these surface mount techniques. Greater reductions are possible using the ASIC techniques but the surface mount approach generally requires a smaller front-end investment. Therefore, earrings of the present invention will be in sizes that are typical for earrings currently worn.

Three-Light Model

A preferred embodiment of the present includes an earring with three visible LED's, (red, green and blue) and a micro-processor which calculates pulse rate and causes the red LED to blink on each pulse, the green LED to blink on each pulse when the wearer's pulse rate is greater than a first threshold rate (such as 115% of normal) and the blue LED to blink on each pulse when the wearer's pulse rate reaches a second threshold corresponding to extreme excitement (such as 130% of normal). These ranges would correspond to increased heart rates of typical persons engaged in exercise and love-making. In preferred embodiments the example percentages may be adjusted to span a wider range for persons such as younger persons and athletes who have a much greater

Petitioner Samsung Ex-1004, 0766

range of heart rate. The monitor may also be self calibrating based on measurements of the wearer's heart rate over extended periods which would include periods of rest as well as periods of extreme exertion or excitement. FIG. 5A is a block diagram showing additional circuitry for the green and blue lights at 50, and FIG. 5B shows a simplified block diagram of the logic 52 for turning on the green and blue lights. In another preferred embodiment the earring is programmed to turn on the blue light when the heart rate increases by at least 15 percent within a period of 3 minutes or less. The reason for this approach will be obvious to the reader from a review of FIGS 4A and 4B.

Blood Pressure Estimation and Indication

Blood pressure in humans varies in about the same degree as heart rate. Other preferred embodiments vary the brightness of the LED's (or other visible light) depending on the estimated blood pressure which also increases by about the same degree as pulse rate. In order to do this the detector monitors the intensity of measured light transmitted through tissue or reflected out of the tissue. The light transmitted or reflected is dependent on the amount of blood in the tissue which is in turn dependent on the blood pressure. In these preferred embodiment the LED will therefore not only blink with each heart beat but the intensity of the light will be roughly proportional to the blood pressure.

Battery Unit

FIGS. 7A and 7B describe a technique for providing power to an earring heartbeat monitor. A circuit board 60 comprises an IR transmitter Tx and an IR receiver Rx and one or more LED light sources 61 as described above. The board 60 includes cylindrical pin 62 comprised of cylindrical conductor 64 having a diameter small enough to fit through the pierced ear of typical persons with pierced ears. Conductor 64 is treated as ground. The pin includes central conductor 66 that is connected to the positive terminal 68 of battery unit 70 as shown in FIG. 7A. Preferably, the board unit 60 is positioned on the outside of the earlobe and the battery unit 70 is positioned on the inside of the earlobe (i.e., between the user's earlobe and her neck). The reader should note that an advantage of this design is that power is drawn from the battery unit only when the earring is being worn. When the earring is not being worn (assuming that the battery is a rechargeable

Petitioner Samsung Ex-1004, 0767

battery) the battery unit may be recharged as shown in FIG. 7B. The reader should note that the pin element could be a part of the battery unit instead of the board unit. The pin 62 could be held in place by a pressure fit or threads could be provided so that the battery unit 70 is threaded on to pin 62. Battery 69 could be a re-chargeable battery in which case a battery charge unit could be provided with a fitting similar to pin 62 for charging battery 69 with wall power as shown in FIG. 7B. Also, techniques could be added to accommodate various thicknesses of earlobes.

Although the present invention has been described in terms of particular embodiments, persons skilled in the art will recognize that many other embodiments using the principals of the invention are possible. Such variations include IR transmitters and receivers operating at different wavelengths which penetrate tissue and are absorbed in blood to a lesser or greater extent than the 940 nm light. Visible light components other than LED's could be used so long as they are small and efficient. The earring could include a tiny transmitter to transmit a signal to a nearby receiver. In a preferred embodiment the signal energizing the blue light could be transmitted to a nearby receiver that would then activate an audio receiver that would produce sounds such as church bells. Applicants have learned through testing of prototype earrings that bright sunlight adversely affects performance of the heartbeat earrings. Placing an infrared absorber between the earlobe and the clamp on the inside of the earlobe minimizes these adverse effects. Another solution to the sunlight problem is to design the earring so that the optical components of the earring are shielded from direct or reflected rays from the sun. Therefore, the scope of the invention should be determined by the appended claims and their legal equivalents.

Petitioner Samsung Ex-1004, 0768

We claim:

1. Flashing jewelry comprising:
   A) an infrared emitter positioned to emit infrared light into tissue of a wearer,
   B) an infrared detector positioned to detect infrared light emanating from said tissue,
   C) a power source for said emitter and said detector,
   D) an electrical circuit for analyzing electrical signals from said detector to detect each beat of a wearers heart,
   E) at least two visible light emitters,
   F) a first trigger circuit for initiating electrical pulses to cause one of said visible light emitters to flash once for each heart beat,
   G) a pulse rate calculation means for calculating the wearer's pulse rate, and
   H) a second trigger circuit for initiating pulses to cause a second of said visible light emitters to flash once for each heart beat when said pulse rate exceeds a first predetermined rate.
2. Jewelry as in Claim 1 and further comprising a third trigger circuit for initiating pulses to cause a third of said at least two visible light emitters to flash once for each heart beat when said pulse rate exceeds a second predetermined rate.
3. Jewelry as in Claim 2 wherein said at least two visible light emitters are three visible light emitters emitting respectively red, green and blue light.
4. Jewelry as in Claim 1 wherein said jewelry is an earring.
5. Jewelry as in Claim 1 wherein said jewelry is a finger ring.
6. Jewelry as in Claim 1 wherein said jewelry is attached to skin of said wearer by a patch.
7. Jewelry as in Claim 1 wherein said jewelry is a patch in the shape of a heart.
8. Jewelry as in Claim 1 wherein said at least one visible light emitter is three visible light emitters.

Petitioner Samsung Ex-1004, 0769

9. Jewelry as in Claim 8 wherein said three visible light emitters are red green and blue emitters and said jewelry further comprises a means to determine heart rates of said wearer.
10. Jewelry as in Claim 9 wherein said red emitter is programmed to flash with each heart beat, said green emitter is programmed to flash with each heart beat when the heart rate of the wearer is in excess of a first threshold in excess of the wearer's rest heart rate and said blue emitter is programmed to flash with each heart beat when the heart rate of said wearer is in excess of a second threshold in excess of said first threshold.
11. Jewelry as in Claim 10 wherein said first threshold is at least 115 % of the wearer's resting heart rate and said second threshold is at least 130 % of wearer's resting heart rate.
12. Jewelry as in Claim 1 wherein said electric circuit comprises and ASIC circuit.
13. Jewelry as in Claim 1 wherein said electric circuit comprises surface mounted circuit.
14. Jewelry as in Claim 3 and further comprising a transmitter for transmitting a signal to an audio device to initiate a sound when one of said thresholds are exceeded.
15. Jewelry as in Claim 14 wherein said sound is church bells.
16. Jewelry as in Claim 1 wherein said power source is a battery unit positioned on the inside of an earlobe and connected through an earlobe to a circuit board comprising said infrared emitter, said infrared detector and said at least two visible light sources

Petitioner Samsung Ex-1004, 0770



FIG. 1
PRIOR ART

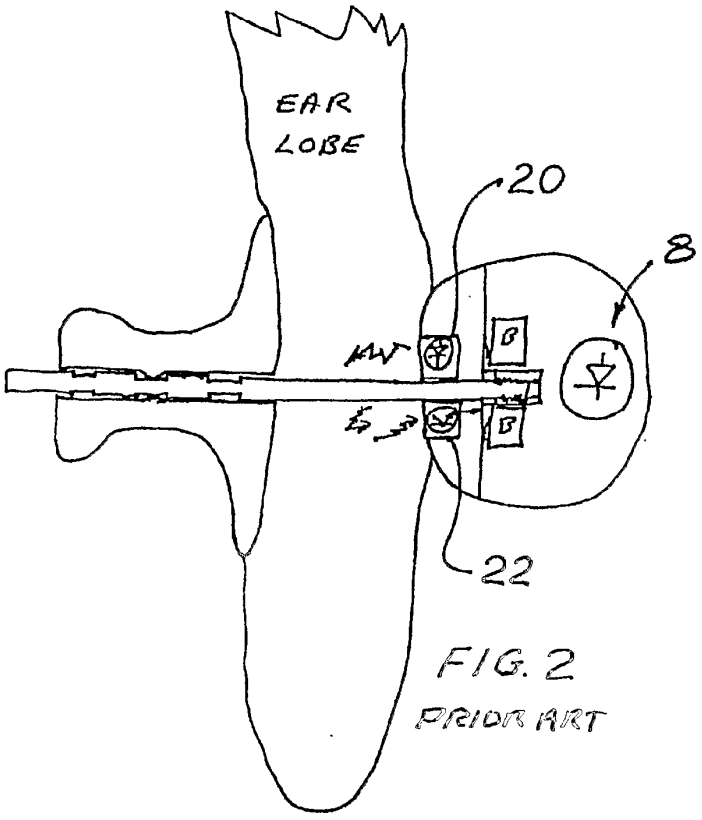


FIG. 2
PRIOR ART

Petitioner Samsung Ex-1004, 0771

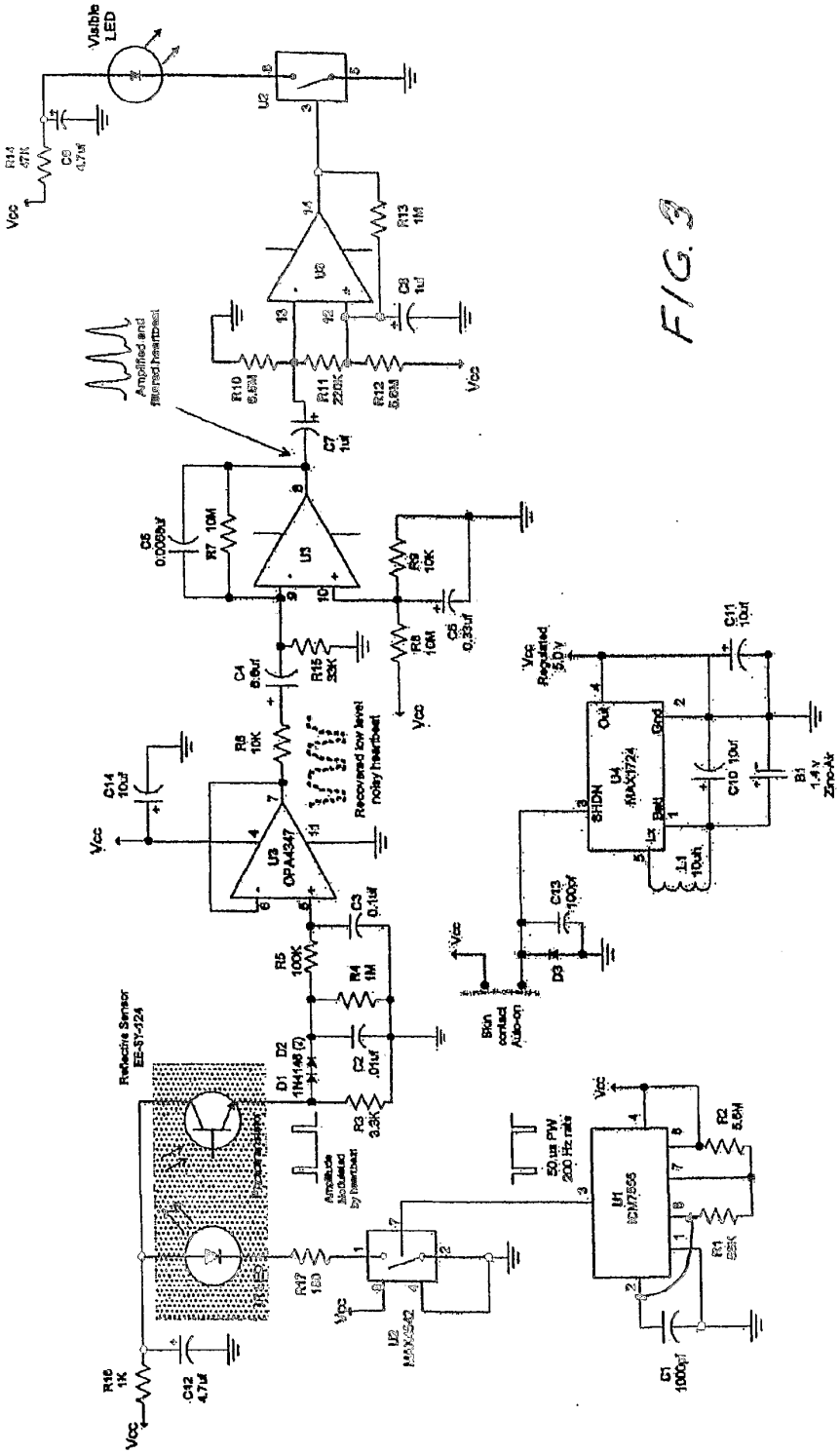


FIG. 3

Petitioner Samsung Ex-1004, 0772

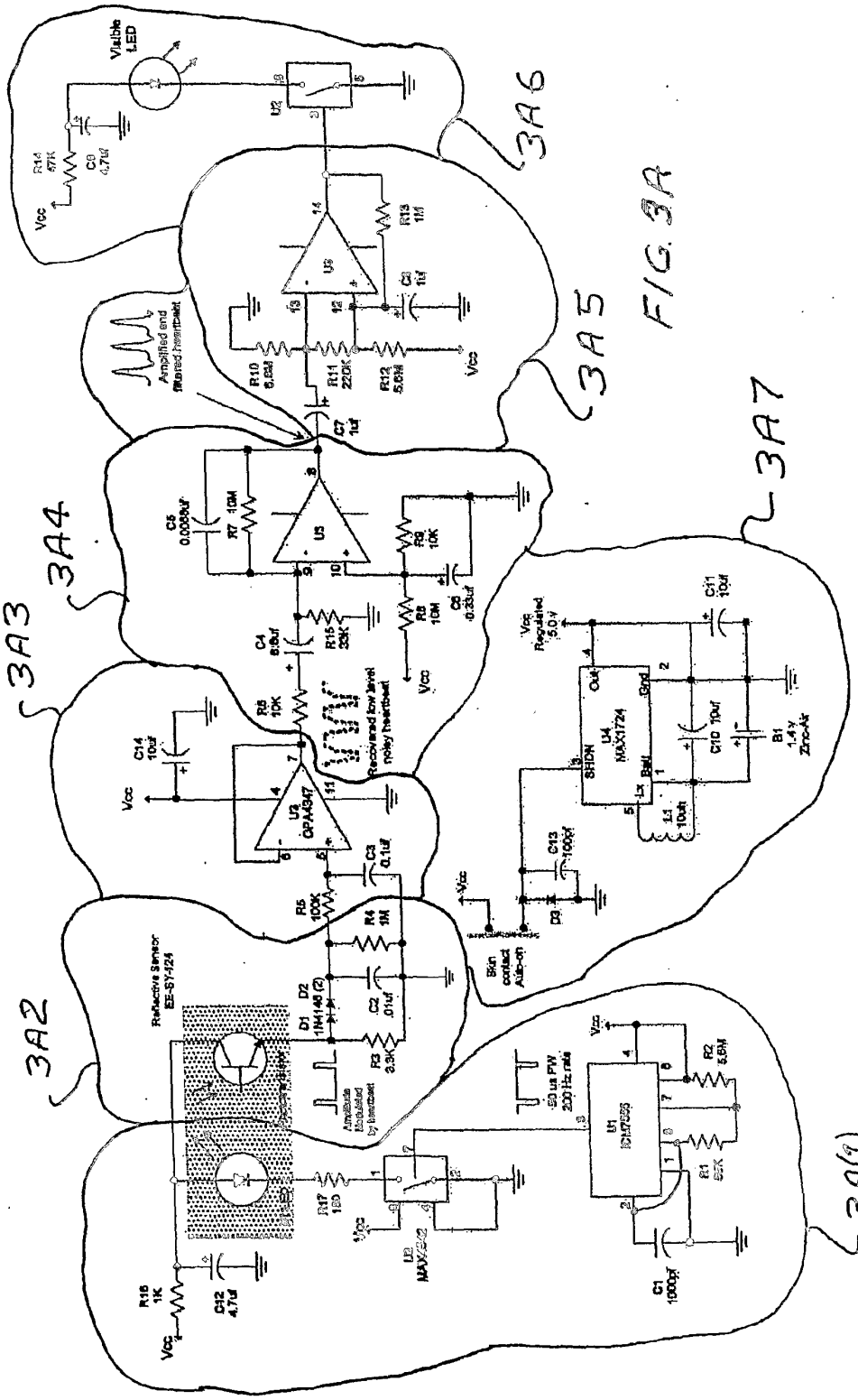
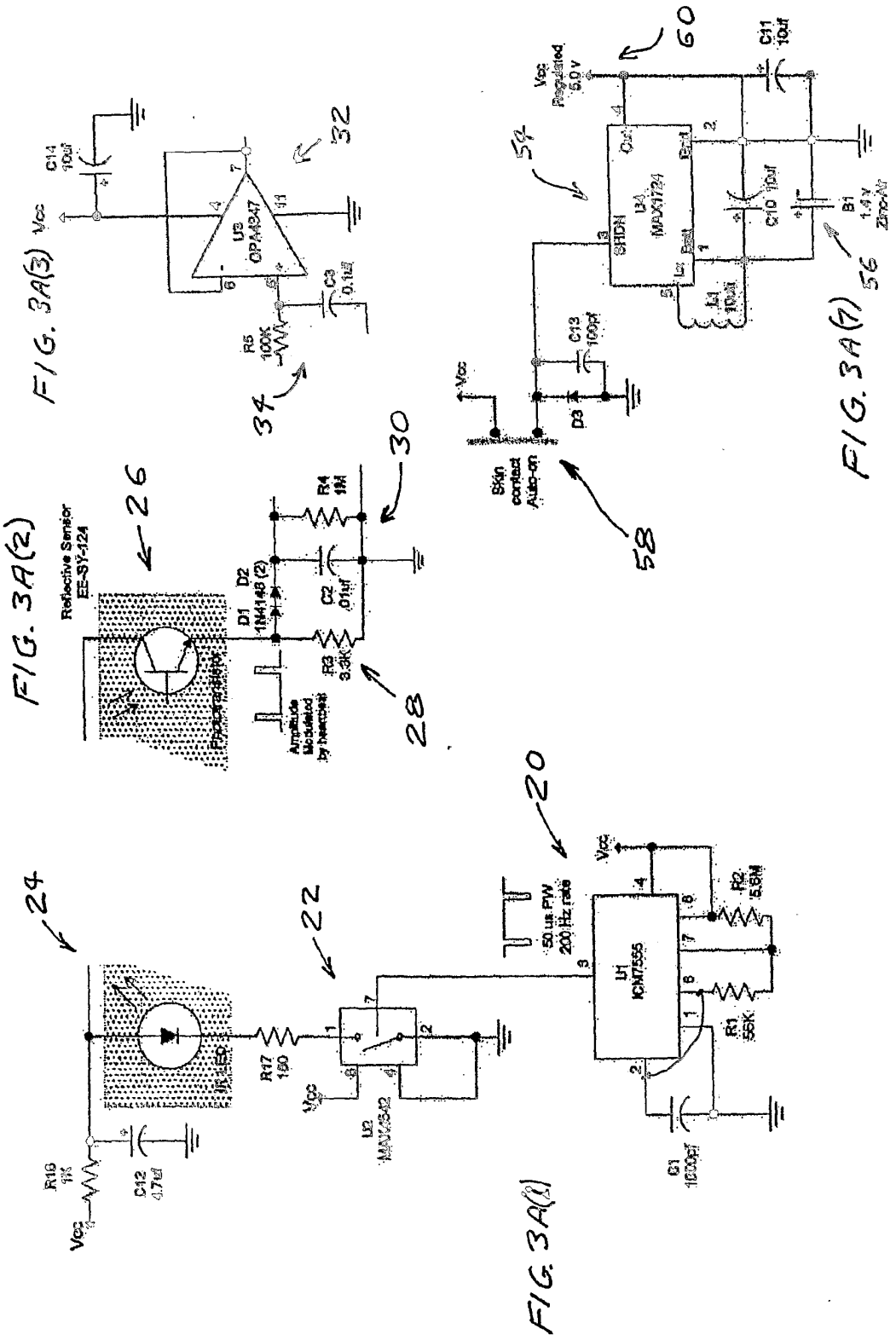


FIG. 3A

Petitioner Samsung Ex-1004, 0773



Petitioner Samsung Ex-1004, 0774

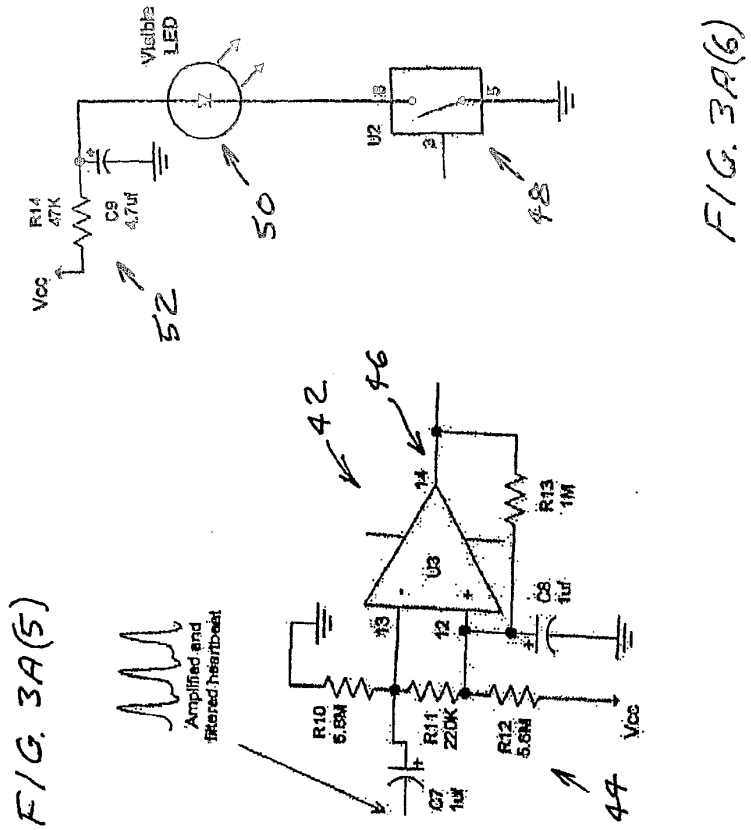
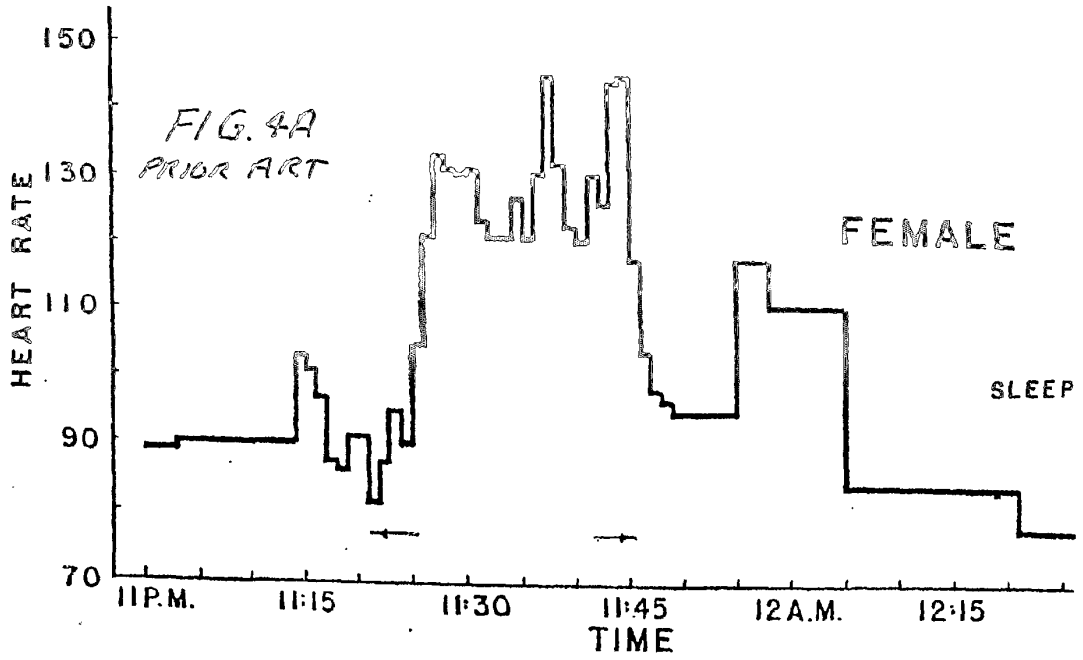


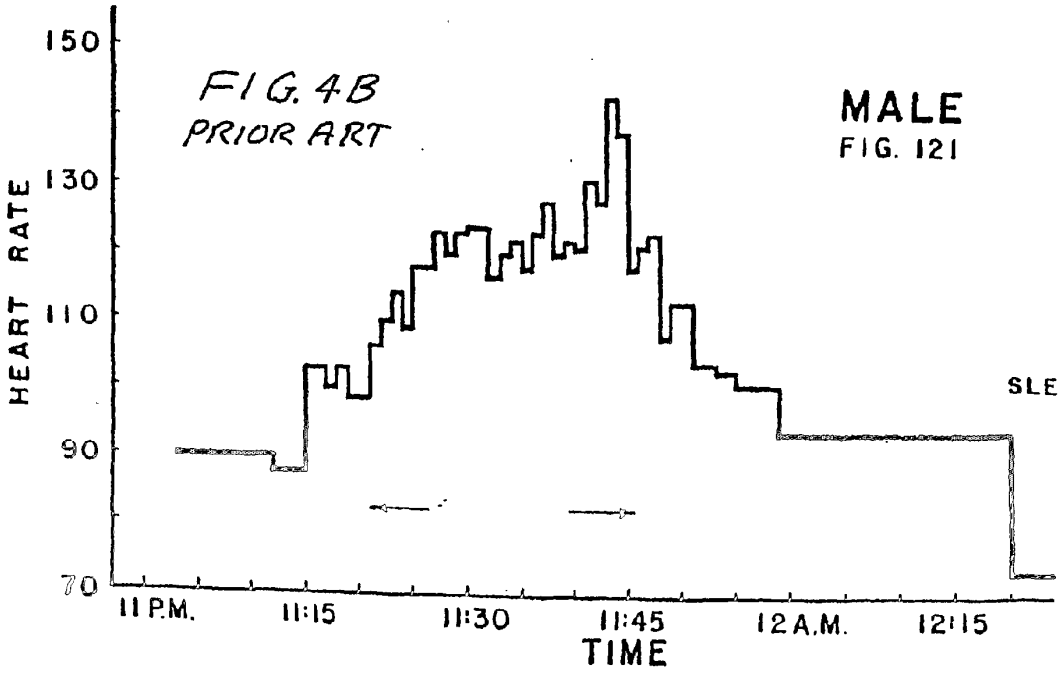
FIG. 3A(5)

FIG. 3A(6)

FIG. 3A(4)

Petitioner Samsung Ex-1004, 0775





Petitioner Samsung Ex-1004, 0776

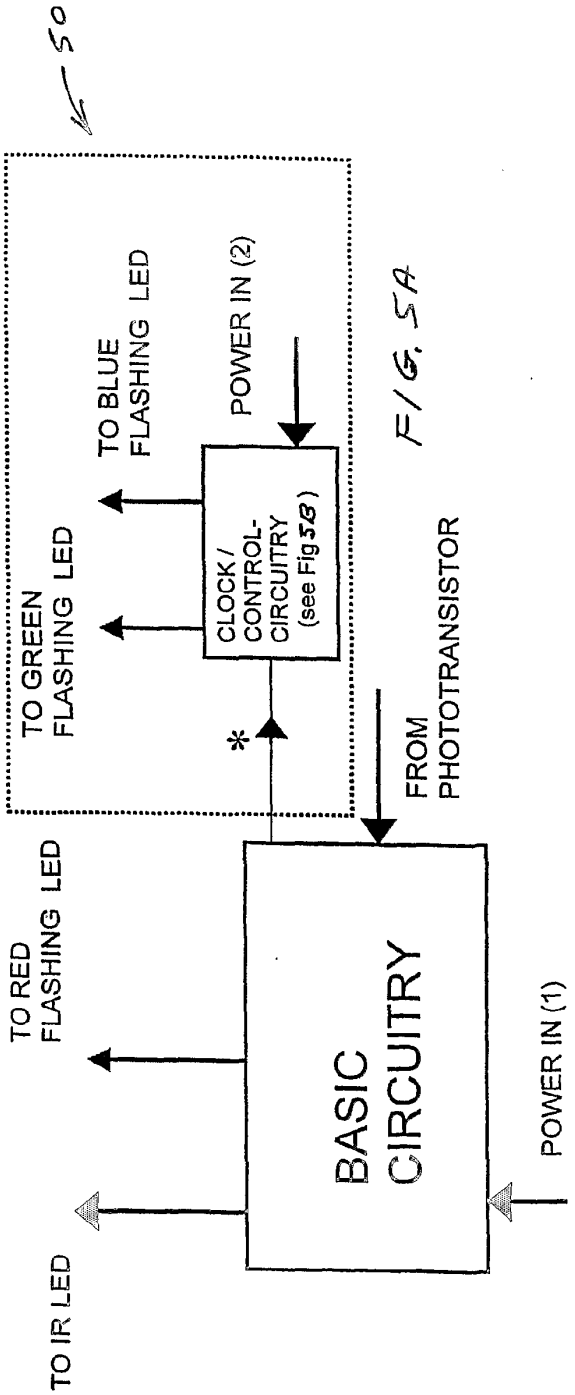


FIG. 5A

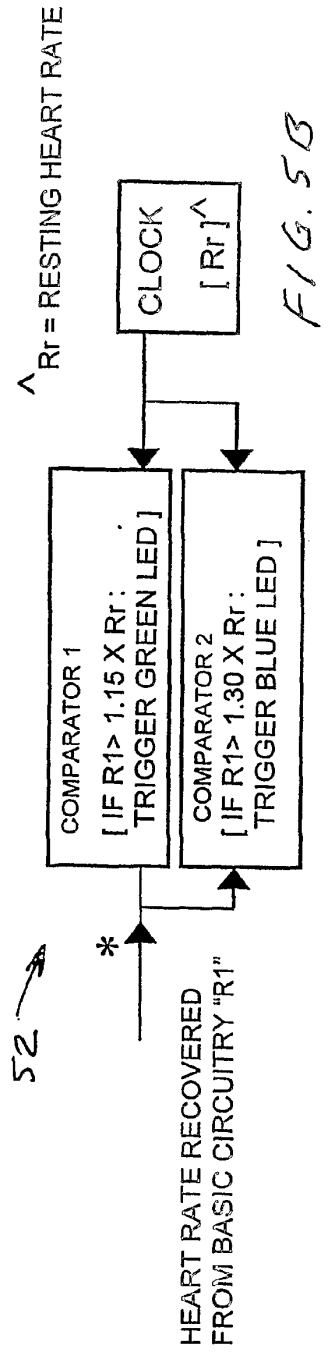


FIG. 5B

Petitioner Samsung Ex-1004, 0777

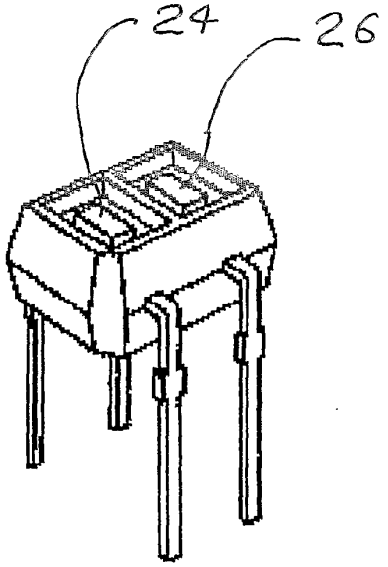


FIG. 6

Petitioner Samsung Ex-1004, 0778

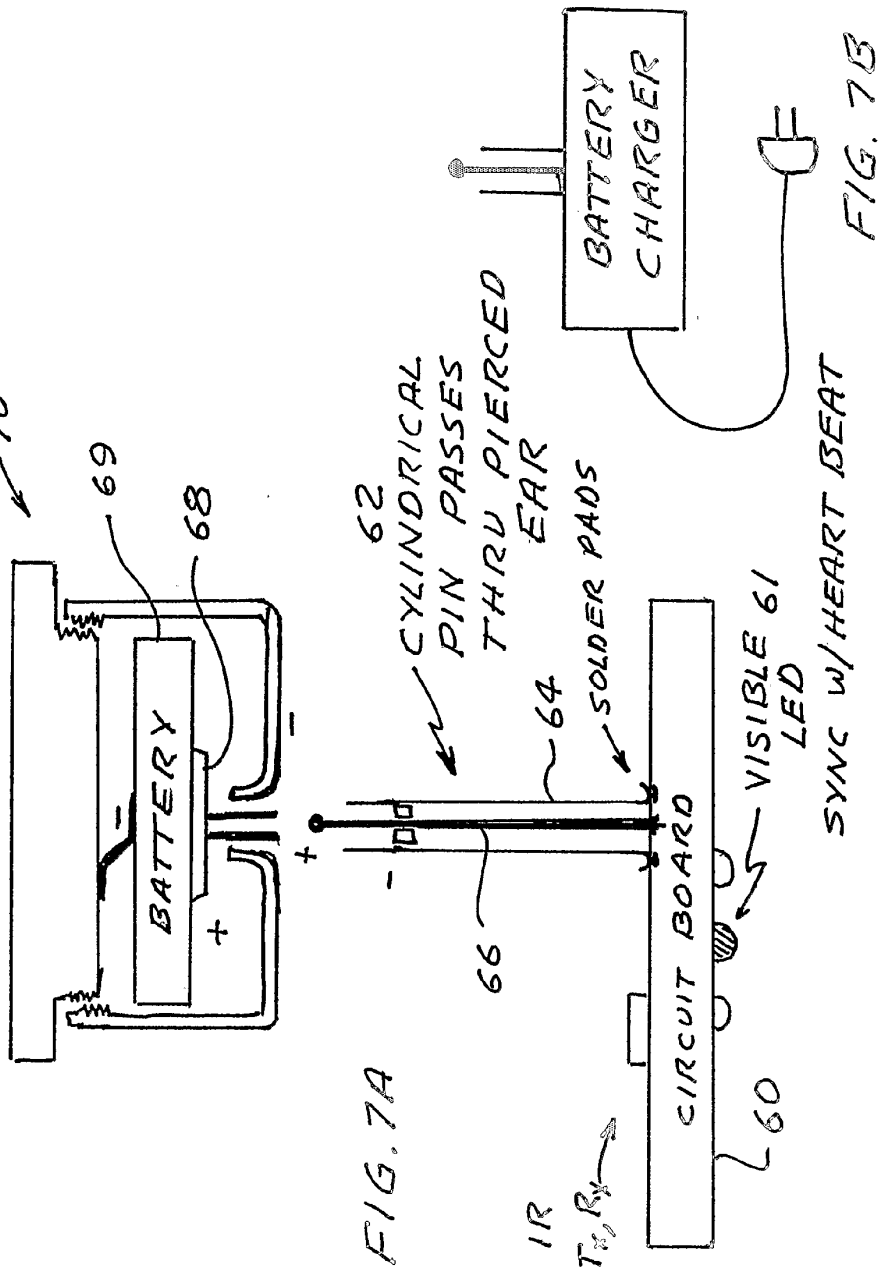


FIG. 7A FIG. 7B

Petitioner Samsung Ex-1004, 0779

Finger temperature indicating ring

List of publications

Publication date

PCT Application number 2005WO-CN02054 Date 2005-11-30 Register

WO2006/060949 A1 Published application with search report2006-06-15

English Title

Finger temperature indicating ring

French Title

Bague d'indication de temperature du doigt

Abstract - French

La présente invention concerne un bague d'indication de température du doigt à porter autour d'un doigt pour mesurer et indiquer la température du doigt de la personne qui la porte, comprenant un support de base, une carte de circuit imprimé, un indicateur et d'autres éléments courants, en outre elle comprend un socle tourné vers le bas présentant un détecteur de température qui correspond à la peau du doigt pour mesurer la température de l'emplacement spécifique.

English Abstract (Native or MT)

A finger temperature indicating ring for wearing around a finger to measure and indicate the finger temperature of the wearer includes a basic carrier, a circuit board, an indicator and other common elements, futhermore, it includes a downward facing pedestal having a temperature sensor which corresponds to the finger skin to measure temperature of the specific location.

Application Language CHINESE (CHI)

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Petitioner Samsung Ex-1004, 0780

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Application Numbers & Dates WOCN2005/002054 2005-11-30 [2005WO-CN02054]

Priority Numbers & Dates CN200420058405U 2004-12-09 [2004CN-U058405]

Technology domain Measurement

Medical technology

Other consumer goods

US codes history

IPC codes

A44C-009/00* A61B-005/16 G01K-001/14

IPC codes history

A44C-009/00* A61B-005/16 G01K-001/14

CPC codes

A61B-005/01* A61B-005/6826 A61B-005/6838 G01K-013/20

CPC codes history

A61B-005/01* A61B-005/6826 A61B-005/6838 G01K-013/20

Notes Number of Claims: 5

Extended kind: x

Cited Patents International Search Report [Examiner]

-US5813766 (A) (Cat. A) [US5813766] CHEN MEI-YEN; -CN2305166 (Y) (Cat. A) [CN2305166U] CHEN MEIYAN; -US4450843 (A) (Cat. A) [US4450843] BARNEY GEORGE M, et al; -US5362966 (A) (Cat. A) [US5362966] ROSENTHAL ROBERT D, et al; -JPS5711633 (A) (Cat. A) [JP57011633] NIPPON ELECTRIC CO; -GB2200998 (A) (Cat. A) [GB2200998] HSIEH FUNG HSING; -CN3092106 (S) (Cat. A) [CN3092106F];

Description

[0001] Finger wear field of the invention 1.

[0002] The present invention relates to a finger garment, and more particularly to a finger garment utilizing sensing finger temperature to obtain clinical indicators of emotion relaxation and data constructed measurement finger temperature to sense emotion relaxation. Background of the invention

[0003] The physical and psychological aspects of a person often interact on both sides, and physical illness can affect his or her psychological well-being can be detrimental to his or her health. Clinically, temperature is a sensitive indicator commonly used to monitor a person's relaxation. When a person relaxes, the blood vessel expands and more heat is dissipated to the surface of the body, so the hands and feet are warmer, and conversely, when the person is nervous or angry, the blood vessel shrinks and heat is dissipated to the surface of the body, so the hands and feet are cooler. Therapeutic physicians generally teach the patient to relax muscle and display finger temperature by a physiological feedback machine, understand his emotional stress by the machine, and appropriately exclude it.

[0004] Accordingly, the present inventors have been inspired by application number U. s. Pat. no. 5 , 813 , 766 "Sensing finger temperature to feed relaxed finger rings", based on years of experience in studying medical knowledge and the motivation for development.

[0005] Conventional physiological feedback machines measure finger temperature by fixing temperature sensing elements with adhesive tape or nylon fasteners, as a result of which the finger is easily pressed locally, resulting in the finger temperature being less likely to rise. Thus, even though the patient has emotion relaxed, the signal appears to be in an unrelaxed state, and therefore distortion is prone to occur.

[0006] The present invention also finds improvements in the actual manufacture and use of the previous case. The linkage of the ring to the temperature-conducting arc rod is such that the tightness cannot be adjusted arbitrarily when the patient wears, in which case the ring is easily slid away from position to destabilize the measurement state.

[0007] Further, a temperature conducting arc rod for sensing the temperature of the finger is embedded in the bicontinuous path of the finger ring, forming a seal, so that even if the finger temperature drops, it is not easy to dissipate heat to form a moping heat, resulting in a measurement distortion of another type. Background of the invention 1.

[0008] Summary of the invention It is an object of the present invention to overcome the problem of destabilizing the measuring state by providing a finger wear that measures finger temperature to sense emotion relaxation so as to achieve arbitrarily adjustable tightness when a patient wears.

[0009] In order to achieve the above object, the technical means used by the present invention are:

[0010] A finger garment for measuring finger temperature to sense emotion relaxation, comprising: a carrier having a loop around the surface of the finger portion of a human body defining a chamber therein; On one side of the circuit board, there is provided a panel provided with a plurality of sets of function selection keys corresponding to the corresponding calculation unit:

[0011] The receptacle is internally provided with a metal sleeve, the metal sleeve end engaging an insulating layer, the temperature sensing element being bare from the end of the insulating layer which prevents excessive heat conduction of the metal sleeve to affect the precise temperature of the finger;

[0012] The aforementioned seat is provided at the rear periphery of the carrier body so that it protrudes outwardly from the carrier body, the opening of which corresponds to the back of the fingers;

[0013] The aforementioned temperature sensing element is an infrared sensor for sensing the skin temperature of a finger of a specific area using infrared contactless temperature sensing characteristics in conjunction with the analysis of the computing unit;

[0014] The aforementioned temperature sensing element provided at the seat opening portion is a contact temperature sensing element that makes moderate contact with the skin surface.

[0015] The present invention has significant advantages and benefits over the prior art-since the finger wear protrudes outwardly from the periphery of the carrier body to form a downwardly open seat which is inserted with a temperature sensing element so as to make a moderate correspondence between the temperature sensing element and the skin surface to detect the state of the temperature of a particular region and to fix the temperature sensing element. Therefore, when the finger wear is tightened, vasoconstriction and blood flow at the measurement site are not affected, so that the increase in the finger temperature can occur naturally with the human body; More accurate data can be measured from the back of the finger because temperature sensing elements that sense the temperature of the finger are protruding from the carrier body, thereby forming a runaway and easily dissipating heat. Summary of the drawings

[0016] Brief description of the drawings Fig.1 is an exploded perspective view of the present invention;

[0017] Fig.2 is an assembled perspective view of the present invention;

[0018] Fig.3 is a schematic illustration of the combined plane and finger flexure of the present invention;

[0019] Fig.4 is a schematic back plan view of a contact finger of the present invention;

[0020] Fig.5 is a perspective view of a state of use of the present invention;

[0021] Fig.6 is a perspective view of an embodiment of an led signaling element of the present invention;

[0022] Fig.7 is a schematic illustration of the use of the present invention in conjunction with an infrared sensor as a temperature sensing element. Embodiments of the invention.

[0023] Specific embodiments of the present invention will now be described with reference to the accompanying drawings.

[0024] Brief description of the drawings Preferred embodiments of the present invention will now be described in the following for a further understanding of the present invention:

[0025] Detailed description of the invention Referring now to Fig.1, in conjunction with Fig.2, the present invention relates to a finger garment for measuring finger temperature to sense emotion relaxation, comprising: a finger portion (1) wound around the finger portion (1), a carrier (2) disposed on the surface of the finger portion (1) and defining a chamber therein, and a circuit board (3); The circuit board 3 is provided in the carrier 2 and comprises at least a computing unit 31 and a signal emitting element 32, as shown in Fig.4, the value of the signal transmitted by the temperature sensing element 22 in contact with the skin of the finger is calculated by the computing unit on the circuit board 3. A panel 4: the panel 4 is provided on the side of the circuit board 3-provided with a plurality of sets of function selection buttons 41 corresponding to the computing unit 31-see Fig.1 in conjunction with the embodiment shown in Fig.4: the finger wear protrudes outwardly from the periphery of the body of the

carrier 2. And forming a downwardly opening socket 21, the socket 21 is provided with a temperature sensing element 22 to allow the temperature sensing element to be in moderate contact with the skin surface because a light finger back can be performed for a preferred finger thermometric site in accordance with medical principles. In this way, the temperature sensing element 22 can be fixed.

[0026] The temperature sensing element 22 may be a soft, non-toxic material and contain a highly thermally conductive material.

[0027] The preferred embodiment of the present invention is that the socket 21 is internally provided with a metal sleeve 221 so that the metal sleeve 221 can receive the wires 220, and that there is a bearing and protection for the temperature sensing element 22, the metal sleeve 221 is engaged with an insulating layer 222, the temperature sensing element 22 being bare from the ends of the insulating layer 222 and prevents the metal sleeve 221 from conducting too much heat to affect finger temperature accuracy.

[0028] Referring now to Fig.4, in conjunction with Fig.5, when a user wears the present invention, the finger portion 1 is provided with a peripheral edge of the carrier 2 body projecting outwardly from the carrier 2 body and forming an open downwardly seat 21 provided with a temperature sensing element 22. In contact with the skin of the fingers, via wires 220, is transmitted to the computing unit 31 on the circuit board 3 to measure a change in the signal value, such as resistance, due to a change in temperature, while operating via the computing unit 31. And information is provided by a signal emitting element 32, which may be, for example, a vibration motor, an led, a buzzer, a liquid crystal screen, etc., illustrated as screens in Figs.1, 2 and 5, and Fig.6 as lights in LEDs. Even a signal-emitting element, which can change color to mood relaxation effects, can be displayed in conjunction with computer network transmission techniques or wireless communication techniques to communicate the signal to a remote location, received by a remote physician using data processing and treated by a remote physician.

[0029] In addition, it is worth mentioning that since the skin hair of the human finger varies in length, the hair is sparse and shorter, in addition to being measured directly by using the aforementioned temperature sensing element, a temperature sensing element such as that shown in Fig.7 with an infrared sensor as the temperature sensing element 22 a, is used to sense the skin temperature of the finger using infrared contactless sensing characteristics.

[0030] Usually objects emit different infrared energy because of their own temperature. The higher the temperature, the molecules of the object become more active and hence higher infrared energy emission. Accordingly, the temperature sensing element of the present invention can convert energy into electrical signals amplified and displayed as temperature readings using infrared sensors as collecting infrared energy radiated from objects and analyzing the energy by a computing unit.

[0031] Finally, it should be noted that the above examples are intended to illustrate the invention only and not to limit the embodiments described herein; It will be appreciated by those of ordinary skill in the art that modifications or equivalent substitutions may still be made to the present invention, and that all solutions and improvements thereof that do not depart from the spirit and scope of the utility model should be encompassed within the scope of the invention.

Pulse wave measuring apparatus capable of wearing on a wrist

List of publications

Publication date

- Application number 2009KR-0010865 Date 2009-02-11 Register
  - KR10-2010-0091592 A Published application 2010-08-19

English Title

Pulse wave measuring apparatus capable of wearing on a wrist

English Abstract (Native or MT)

PURPOSE: A device worn on a wrist for measuring a pulse wave is provided to improve the portability by integrating a measurement module and a detection module.
CONSTITUTION: A wrist unit(10) is worn on a wrist. A plurality of PPG(Photoplethysmography) sensors(20) is arranged on the wrist unit in an array shape. The PPG sensor is comprised of a light source and an optical detector. The PPG unit produces a PPG signal by removing the noise included in the signals inputted from the plurality of PPG sensors. The electrode measures the movement noise according to the movement of a body. A power supply unit individually supplies power into the plurality of PPG sensors.
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Other Abstracts

본 발명은 손목형 맥파 측정장치에 관한 것이다. 본 발명에 따른 손목형 맥파 측정장치는 손목에 착용 가능하게 형성된 손목착용수단; 상기 손목착용수단에 어레이 형태로 배열 및 설치된 다수의 PPG 센서; 및 상기 다수의 PPG 센서로부터 입력되는 신호들을 합산 처리하여 잡음을 제거함으로써 PPG 신호를 산출하는 PPG 측정수단을 포함한다. 이와 같이, 측정모듈과 검출모듈이 통합되어 휴대성이 뛰어나고, PPG 센서가 어레이 형태로 다수 배열되어 사람의 혈관 위치 또는 손목 두께의 변화에도 정밀한 PPG 신호의 측정이 가능하다.

Application Language	KOREAN (KOR)
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Inventor(s)	김기정 최한윤 허만승

Petitioner Samsung Ex-1004, 0787

김동우

김우영

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Application Numbers & Dates	KR20090010865 2009-02-11 [2009KR-0010865]
Priority Numbers & Dates	KR20090010865 2009-02-11 [2009KR-0010865]
Other Publication Date	2009-02-11(Examination requested)
Technology domain	Audio-visual technology
US codes history	

IPC codes H05K-005/02*
IPC codes history H05K-005/02*
CPC codes A61B-005/024* A61B-005/681
CPC codes history A61B-005/024* A61B-005/681

Notes	Number of Claims: 9 Number of Pages: 12

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Description

DISCLOSURE

TECHNICAL FIELD

[0001] The present invention relates to a wrist-type pulse wave measuring device.

BACKGROUND TECH

[0002] Photoplethysmography (PPG) is a biosignal reflecting heartbeat count, blood oxygenation, contraction and dilation of the blood vessels, and can analyze the elasticity of the blood vessels and vascular circulation, and can analyze the age of the blood vessels, and further, can diagnose arterial and peripheral vascular disorders early.

[0003] Pulse waves are measured in the finger or chest region, especially finger measurements using probes are mainly used.

[0004] Figs. 1A and 1B are schematic views provided to explain basic principles of a PPG signal measuring apparatus using a conventional probe. FIG. 1A shows a probe of a transmissive structure and FIG. 1B shows a probe of a reflective structure.

[0005] The probe of the transmissive structure of FIG. 1A transmits light to a finger inserted in the probe and measures the amount of light transmitted without being absorbed by blood, and the probe of the reflective structure of FIG. 1B reflects light and measures the amount of light reflected by blood.

[0006] In such a conventional probe-type pulse wave measuring device, a main body module for detecting a PPG signal is separately installed separately in addition to the measurement module of figs. 1A and 1B, and thus portability has decreased portability. In addition, since the light source and the sensor are separately configured, a volume is occupied.

[0007] In addition, conventional probe-type pulse wave measuring devices have difficulty measuring pulse waves when blood vessels of the wrist are not positioned in a measuring sensor. Furthermore, since there are differences in size of wrists, structure, position of blood vessels, etc., and furthermore, noise problems arising due to movement of wrists during measurement, there have been limitations on precise measurement.

INVENTION CONTENT

SOLUTION PROBLEM

[0008] Therefore, it is an object of the present invention to provide a wrist-type pulse wave measuring device in which a measuring module and a detecting module are integrated, and a plurality of PPG sensors are arranged in an array and can measure

precise PPG signals even when a change in position of blood vessels or wrist thickness of a person.

[0009] It is also an object of the present invention to detect an accurate PPG signal from among a plurality of PPG signals, and power is supplied only to a PPG sensor corresponding thereto to save energy.

[0010] It is also an object of the present invention to detect a more accurate PPG signal by separately measuring an arterior-PPG signal and a vein PPG signal and processing noise based thereon.

[0011] In addition, an accurate PPG signal is detected by separately providing an electrode sensor for measuring motion noise.

[0012] It is also an object of the present invention to construct a small volume by matching a plurality of photodetectors to one light source having a wide emission angle.

MEANS PROBLEM SOLUTION

[0013] The object of the present invention is to provide a wrist-type pulse wave measuring device, comprising: a wrist-type pulse wave measuring device formed to be wearable on a wrist; a plurality of PPG sensors arranged and installed in an array form on the wrist-type pulse wave measuring device; And PPG measurement means for calculating PPG signals by summing the signals input from the plurality of PPG sensors, thereby removing noise. As described above, the PPG signal can be measured more accurately by arranging the PPG sensor in an array and summing the same to remove noise.

[0014] The object of the present invention is to provide a wrist-type pulse wave measuring device, comprising: a wrist-type pulse wave measuring device configured to be worn on a wrist; a plurality of PPG sensors arranged and installed in an array form on the wrist-type pulse wave measuring device; a power supply unit configured to individually supply power to the plurality of PPG sensors; and a control unit configured to detect a PPG reference signal based on signals input from the plurality of PPG sensors, And PPG measurement means for analyzing the association between the PPG reference signal and signals of the plurality of PPG sensors and controlling the power supply unit to supply power only to at least one PPG sensor corresponding to the highly associated signal. Thus, power can be saved by supplying power to only the sensor corresponding to the correct PPG signal.

[0015] The object of the present invention is to provide a wrist-type pulse wave measuring device, comprising: a wrist-type pulse wave measuring device configured to be wearable on a wrist; a plurality of PPG sensors arranged and installed in an array on the wrist-type pulse wave measuring device, the PPG sensors including at least one arterior-PPG sensor configured to sense a pulse wave of an artery and at least one vein PPG sensor configured to sense a pulse wave of a vein; And PPG measuring means for

setting a signal input from the at least one vein-PPG sensor as a noise-reference of a signal input from the at least one arterior-PPG sensor to remove noise mixed with the signal input from the at least one arterior-PPG sensor to calculate a PPG signal. Thus, noise can be effectively reduced.

[0016] The PPG measurement unit detects a vein PPG signal by summing a signal input from the at least one vein PPG sensor, detects an arterial PPG signal by summing a signal input from the at least one arterial PPG sensor, and calculates the PPG signal by setting the vein PPG signal as a noise-reference of the arterial PPG signal. As described above, noise is processed by using vene-PPG signals as noise based on more stable artery-PPG signals to measure more accurate PPG signals.

[0017] In addition, the PPG measuring means may further include an electrode for measuring motion noise caused by movement of the body, and the PPG measuring means may set a signal input from the electrode sensor as a noise-reference and calculate the PPG signal, thereby effectively removing motion noise.

[0018] In addition, the PPG sensor may include a single integrated module in which the light source and the photodetector are formed by integrating the PPG sensor and PPG measurement means for calculating a PPG signal by reducing the volume thereof.

[0019] On the other hand, the artery-PPG sensor may include a module in which a light source and a photodetector are separated, and the vein-PPG sensor may include a single integrated module in which the light source and the photodetector are integrated.

[0020] Here, the vein-PPG sensor is installed on the wrist mounting means so as to be positioned on a bottom surface of the wrist when the wrist is installed, the arterior-PPG sensor is installed on the wrist mounting means so as to be positioned on both sides of the wrist, and the position of the photodetector is adjusted and installed according to the intensity and reflection angle of the light source, thereby better measuring PPG signals according to the position of the vein and the position of the artery.

[0021] The PPG sensors may include a plurality of sets of a plurality of photodetectors matched to one light source having a wide emission angle, thereby reducing the volume.

EFFECTIVENESS

[0022] As described above, according to the present disclosure, there is provided a wrist-type pulse wave measuring device in which a measuring module and a detecting module are integrated, thereby having excellent portability, and a plurality of PPG sensors are arranged in an array and capable of accurately measuring PPG signals even when changes in the position of blood vessels or wrist thickness of a person.

[0023] In addition, energy can be saved by detecting an accurate PPG signal among a plurality of PPG signals and supplying power to only a PPG sensor corresponding thereto.

[0024] In addition, the present invention can detect a more accurate PPG signal by separately measuring the artery-PPG signal and vein-PPG signal and processing noise based on the same.

[0025] In addition, an electrode sensor for measuring motion noise can be separately provided to detect an accurate PPG signal.

[0026] In addition, the present invention allows a large number of photodetectors to be matched to one light source having a wide emission angle, thereby making it possible to construct a small volume, while saving energy.

INVENT DETAIL CONTENT

[0027] Hereinafter, specific embodiments of the present disclosure will be described with reference to the drawings.

[0028] Figs. 2 and 3 are views schematically illustrating a wrist-type pulse wave measuring device according to a first embodiment of the present disclosure, wherein the wrist-type pulse wave measuring device is worn on a wrist (omitting the wrist) and an extended shape in a horizontal direction, respectively.

[0029] Referring to figs. 2 and 3, the wrist-type pulse wave measuring device according to an embodiment includes a wrist-type pulse wave measuring means 10, a plurality of PPG sensors 20, and a PPG measuring means 30.

[0030] The wrist-wearing means 10 is configured to be wearable on the wrist and may be implemented in the form of a bracelet. The wrist-worn means (10) can be made of a material having adjustable wear length or flexibility such that a plurality of PPG sensors (20) installed and arranged on the inside can be brought into contact with the wrist.

[0031] A plurality of PPG sensors (20) are arranged and installed in an array inside the wrist wearing means (10) to sense pulse waves of the wrist. Here, the PPG sensor 20 is preferably a module in which the light source and the photodetector are integrally integrated.

[0032] For example, the light source can measure blood oxygen saturation by using an led that irradiates light of two kinds of wavelength bands of 660 nm and 940 nm, and the photodetector can use a photodiode. When using a module formed by integrating the light source and the photodetector as an integrated unit as the PPG sensor 20, a larger number of sensors can be attached, thereby reducing measurement errors.

[0033] PPG measurement means (30) measures accurate PPG signals by summing the signals input from a plurality of PPG sensors (20) and removing noise.

[0034] Figure 4 conceptually illustrates an example of PPG signal measurements according to a first embodiment of the invention. Referring to FIG. 4, PPG measuring means 30 sums signals input from n PPG sensors PPG0, PPG1, PPG2,., PPGN to remove noise generated according to body movement or wear/vessel position.

[0035] As described above, when a plurality of PPG sensors 20 are installed in an array type according to the present disclosure, it is possible to reduce a signal error according to a wearing position and a PPG measurement error according to a position of a person 's blood vessel. Summing signals from multiple PPG sensors 20 arranged in an array type to measure accurate PPG signals is based on the fact that the sum becomes zero assuming noise follows a Gaussian distribution.

[0036] When measuring a pulse wave using only one PPG sensor 20 as described above, since the sensor must be placed at a pulse wave measuring position, it is not easy to fit the position and noise is mixed and difficult to measure an accurate PPG signal; According to the present invention, when a plurality of sensors are arranged in an array and a PPG signal is measured using the sum of the signals, noise is removed to measure an accurate PPG signal.

[0037] Hereinbelow, a wrist-type pulse wave measuring device according to a second exemplary embodiment will be described with reference to figs. 2, 3 and 5. Fig. 5 is a schematic illustration of a wrist-type pulse wave measuring device in accordance with a second embodiment of the present invention. Overlapping description with the exemplary embodiments described above will be omitted as necessary.

[0038] As shown in figs. 2, 3, and 5, the wrist-type pulse wave measuring device according to an embodiment includes a wrist-type pulse wave measuring device 10 configured to be wearable on the wrist, a plurality of PPG sensors 20 arranged and installed in an array on the wrist-type pulse wave measuring device 10, a power supply unit 40, and a PPG measuring device 30.

[0039] The power supply unit 40 may be installed to individually supply power to a plurality of PPG sensors 20, and may maintain a longer module operating time when implemented as a portable battery. As illustrated in FIG. 5, the power supply unit 40 may be connected to each PPG sensor 20 through a line for supplying power, and may individually supply power to each PPG sensor 20 according to a control signal input from the PPG measuring means 30.

[0040] PPG measurement means (30) detects PPG reference signals based on signals input from n PPG sensors (PPG0, PPG1, PPG2,., PPGN), analyzes the association between the detected PPG reference signals and the signals of each PPG sensor (20), and

applies a control signal to a power supply unit (40) to supply power to only PPG sensors having a high association.

[0041] For example, PPG measurement means 30 detects PPG reference signals by first summing signals input from n PPG sensors PPG0, PPG1, PPG2,..., PPGN and removing noise generated according to body movement or position of clothing/vessels.

[0042] Then, the correlation between the detected PPG reference signal and the signals of PPG sensors (20) is analyzed, and a sensor selection signal is output to a power supply unit (40) so that only PPG sensors corresponding to signals having high correlation are supplied with power. As used herein, the "PPG reference signal" refers to a high association with the PPG reference signal. when there are a plurality of PPG sensors whose similarity falls within a predetermined range, power is supplied to the corresponding plurality of PPG sensors, and power is stopped to the remaining sensors, so that only the selected PPG sensor is operated. Therefore, the PPG measuring means 30 can receive only the signal of the selected PPG sensor and measure the correct PPG signal.

[0043] As described above, only PPG sensors outputting an accurate PPG signal may be individually supplied and operated to obtain an accurate PPG signal, and the usage time of the battery used as the power supply unit 40 may be increased, thereby making it more effective.

[0044] Hereinbelow, a wrist-type pulse wave measuring device according to a third exemplary embodiment will be described with reference to figs. 6 and 7.

[0045] The wrist-type pulse wave measuring device according to the present embodiment measures a PPG signal by using a PPG signal in a vein as a noise-reference with reference to a PPG signal in an artery using that the artery is stronger than the vein and less influenced by noise.

[0046] FIG. 6 is a schematic structure of a wrist-type pulse wave measuring device according to a third embodiment of the present disclosure, and FIG. 7 is a picture conceptually describing a pulse wave measuring method according to the present embodiment.

[0047] Referring to figs. 6 and 7, the wrist-type pulse wave measuring device according to an embodiment includes a wrist-type pulse wave measuring device 10 configured to be wearable on the wrist, a plurality of PPG sensors 20 arranged and installed in an array on the wrist-type pulse wave measuring device 10, and a PPG measuring device 30. Furthermore, the PPG sensor (20) is divided into at least one artery-PPG sensor (21) for sensing a pulse wave of the artery and at least one vein PPG sensor (23) for sensing a pulse wave of the vein.

[0048] Labeled blue circles indicate veins and red circles indicate arteries in Figure 6. It can be seen that the artery is located deeper inside than the vein.

[0049] Accordingly, in the present embodiment, installation positions of the arterior-PPG sensor 21 and vein PPG sensor 23 are different from each other. For example, artery-PPG sensors 21 can be provided on both sides of the wrist, and vein-PPG sensors 23 can be arranged in an array form on the inside of the wrist. In particular, the artery-PPG sensor 21 adjusts the position of the photodetector according to the transmission intensity and reflection angle of the light source. The artery-PPG sensor 21 can utilize a module in which the light source and photodetector are separated, as shown in FIG. 5.

[0050] It is preferred that the arterial sensor uses two sensors (both sides) and an arrayed array sensor for PPG measurement in irregular vascular arrays in veins because it is generally located deep in the wrist and irregularly arranged in the vein. In the present embodiment, the artery-PPG sensors 21 are disposed one on both sides, and five vein-PPG sensors 23 are disposed therebetween.

[0051] PPG measurement means 30 sets the vein PPG signal as a noise-reference to the arterior-PPG signal input from arterior-PPG sensors 21 and measures the PPG signal after removal of noise.

[0052] For example, referring to FIG. 7, the PPG measurement means 30 includes summing processing modules 31 and 33 for summing processing the arterior-PPG signal and the vein PPG signal, respectively, and a noise removing module 35 for removing noise.

[0053] The signals input from the two artery-PPG sensors 21 are summed to remove noise primarily, and then the summed signals input from the vein PPG sensors 23 are set as a noise-reference to finally remove noise.

[0054] As described above, noise can be effectively removed by using characteristics of PPG signals of arteries and veins.

[0055] Hereinbelow, a wrist-type pulse wave measuring device according to a fourth exemplary embodiment will be described with reference to figs. **8** to 10. The wrist-type pulse wave measuring device according to the present embodiment further includes an electrode (50) for measuring noise caused by movement of the body, thereby effectively removing noise.

[0056] Figs. **8** and 9 schematically illustrate a structure when unfolded and a structure when worn on a wrist, respectively, according to a fourth embodiment of the present invention, and FIG. 10 conceptually illustrates a method for measuring a PPG signal according to the present embodiment.

[0057] As shown in figs. **8** and 9, the wrist-type pulse wave measuring device according to the present embodiment includes an electrode 50 in addition to the wrist wearing means 10, the array of PPG sensors 20, and the PPG measuring means 30.

[0058] The electrode 50 is for measuring purely moving noise due to movement of the body, and is installed so as to be placed upward during wrist wear, as shown in FIG. 9.

[0059] Referring to FIG. 10, the PPG measurement means 30 sums the signals input from the plurality of PPG sensors 20 to remove noise primarily, and then sets the signal input from the electrode 50 as a noise-reference to finally remove noise to yield an accurate PPG signal.

[0060] As described above, noise can be effectively removed by further including an electrode 50 for measuring noise due to movement.

[0061] Fig. 11 is a pictorial view schematically illustrating the structure when unfolded a wrist-type pulse wave measuring device in accordance with a fifth embodiment of the present invention. Other configurations of the wrist-type pulse wave measuring device according to the present embodiment are similar to the embodiments described above, but differ from the placement and use of the light source and photodetector.

[0062] In FIG. 11, the light source is represented by sky rectangles and the photodetector is represented by red squares. The wrist-type pulse wave measuring device according to the present embodiment measures PPG signals by arranging a plurality of detectors 20 b to correspond to one light source 20 a having a wide emission angle.

[0063] Although in the embodiments described above, a PPG sensor 20 having a light source and a photodetector integrated into one module is mainly described as an example, in the embodiments described above, the light source is configured to have a wide radiation angle, so that the light source 20a and the photodetector 20b correspond to one: a plurality of 1.

[0064] Therefore, it is possible to drive the device by a low power circuit through limiting the number of light sources.

[0065] Meanwhile, the wrist type pulse wave measuring device according to exemplary embodiments described above can be conveniently measured while the user wears on the wrist, it can be well understood by the description described above. However, since the user measures the pulse wave while wearing the wrist, characteristics of the signal can be reduced according to movement of the user. Therefore, according to another embodiment of the present invention, a reference signal and/or a noise-reference signal can be detected at a certain time period to solve a characteristic reduction phenomenon of a signal according to a sensor position, a body movement, and the like over time. For example, in the second embodiment described above, since characteristics of an initially detected PPG reference signal may decrease according to body movement, an existing PPG

reference signal and a current signal may be compared at a predetermined time interval period, and the PPG reference signal may be detected again and reset.

[0066] Although some embodiments of the invention have been shown and described, those skilled in the art will appreciate that the embodiments may be modified without departing from the principles or spirit of the invention. The scope of the invention will be defined by the appended claims and equivalents thereof.

Description

(19)中华人民共和国国家知识产权局

(12)实用新型专利

(10)授权公告号 CN 204440426 U
(45)授权公告日 2015.07.01

(21)申请号 201420835867.4

(22)申请日 2014.12.23

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(51)Int.Cl.
G06K 17/00(2006.01)
A44C 9/00(2006.01)

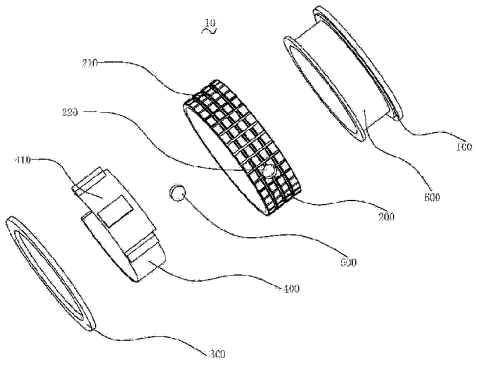
权利要求书1页 说明书3页 附图3页

(54)实用新型名称

一种NFC戒指

(57)摘要

一种NFC戒指，包括：内环、外环、边环、电子组件及磁铁。外环旋转套设于内环上，外环与内环之间形成容置腔，边环安装于内环的一端面上，外环抵持于内环与边环之间；电子组件收容并固定于容置腔内；外环的侧壁上开设有收容槽，磁铁收容于收容槽内；其中，电子组件包括：线路板、干簧管、发光二极管、芯片及天线，干簧管、发光二极管、芯片、天线布设于线路板上，发光二极管与芯片连接形成并联电路，并联电路的一端与天线的一端连接，并联电路的另一端通过干簧管与天线的另一端连接。NFC戒指通过磁铁与干簧管之间的相互配合，实现电路的断开或闭合，进而实现非工作状态与工作状态之间的切换，提高产品的使用安全性，降低用户信息被盗取的风险。



CN 204440426 U

Petitioner Samsung Ex-1004, 0798

1. 一种 NFC 戒指，其特征在于，包括：内环、外环、边环、电子组件及磁铁；

所述外环旋转套设于所述内环上，所述外环与所述内环之间形成容置腔，所述边环安装于所述内环的一端面上，所述外环抵持于所述内环与所述边环之间；

所述电子组件收容并固定于所述容置腔内；

所述外环的侧壁上开设有收容槽，所述磁铁收容于所述收容槽内；

其中，所述电子组件包括：线路板、干簧管、发光二极管、芯片及天线，所述干簧管、所述发光二极管、所述芯片、所述天线布设于所述线路板上，所述发光二极管与所述芯片连接形成并联电路，所述并联电路的一端与所述天线的一端连接，所述并联电路的另一端通过所述干簧管与所述天线的另一端连接。

2. 根据权利要求 1 所述的 NFC 戒指，其特征在于，所述外环的外侧壁上开设有防滑纹。

3. 根据权利要求 1 所述的 NFC 戒指，其特征在于，所述容置腔为环形腔体结构，所述电子组件环绕设于所述容置腔内。

4. 根据权利要求 1 所述的 NFC 戒指，其特征在于，所述干簧管及所述芯片的数量分别为两个，两个所述干簧管分别与两个芯片串联。

5. 根据权利要求 1 所述的 NFC 戒指，其特征在于，所述收容槽为圆形凹槽。

6. 根据权利要求 1 所述的 NFC 戒指，其特征在于，所述内环、所述外环、所述边环均为陶瓷。

Petitioner Samsung Ex-1004, 0799

一种 NFC 戒指

技术领域

[0001] 本实用新型涉及一种 NFC 装置，特别是涉及一种 NFC 戒指。

背景技术

[0002] NFC(Near Field Communication，近距离无线通信技术）是一种短距高频的无线电技术，其在 13.56MHz 频率运行于 20 厘米距离内，其传输速度有 106Kbit/S、212Kbit/S、424Kbit/S 三种。NFC 近场通信技术是由非接触式射频识别 (RFID) 及互联互通技术整合演变而来，在单一芯片上结合感应式读卡器、感应式卡片和点对点的功能，能在短距离内与兼容设备进行识别和数据交换。

[0003] 现有的具备 NFC 支付功能的各类产品，使用者在不注意时将此产品靠近读写器，容易导致误触发的情况发生，从而给使用者带来不必要的麻烦和财物损失。更有甚者，一些不法分子利用特制的大功率读写器，通过远距离来盗取用户信息或钱财，诸如此类情况，这给用户使用带来了安全隐患。

实用新型内容

[0004] 本实用新型的目的是克服现有技术中的不足之处，提供一种提高使用安全性的 NFC 戒指。

[0005] 本实用新型的目的是通过以下技术方案来实现的：

[0006] 一种 NFC 戒指，包括：内环、外环、边环、电子组件及磁铁；

[0007] 所述外环旋转套设于所述内环上，所述外环与所述内环之间形成容置腔，所述边环安装于所述内环的一端面上，所述外环抵持于所述内环与所述边环之间；

[0008] 所述电子组件收容并固定于所述容置腔内；

[0009] 所述外环的侧壁上开设有收容槽，所述磁铁收容于所述收容槽内；

[0010] 其中，所述电子组件包括：线路板、干簧管、发光二极管、芯片及天线，所述干簧管、所述发光二极管、所述芯片、所述天线布设于所述线路板上，所述发光二极管与所述芯片连接形成并联电路，所述并联电路的一端与所述天线的一端连接，所述并联电路的另一端通过所述干簧管与所述天线的另一端连接。

[0011] 在其中一个实施例中，所述外环的外侧壁上开设有防滑纹。

[0012] 在其中一个实施例中，所述容置腔为环形腔体结构，所述电子组件环绕设于所述容置腔内。

[0013] 在其中一个实施例中，所述干簧管及所述芯片的数量分别为两个，两个所述干簧管分别与两个芯片串联。

[0014] 在其中一个实施例中，所述收容槽为圆形凹槽。

[0015] 在其中一个实施例中，所述内环、所述外环、所述边环均为陶瓷。

[0016] 旋转外环，外环绕内环旋转，设于外环的收容槽内的磁铁随之旋转，从而实现磁铁远离或靠近位于容置腔内的干簧管。

Petitioner Samsung Ex-1004, 0800

[0017] 当磁铁远离干簧管时，干簧管上的簧片触点相互分离，此时干簧管、芯片、天线形成的电路处于断开状态；当磁铁靠近干簧管时，干簧管上的簧片触点相互接触，此时干簧管、芯片、天线形成的电路处于闭合状态。

[0018] 当干簧管、芯片、天线形成的电路处于断开状态时，芯片与天线之间断开连接，NFC戒指处于非工作状态，保证了NFC戒指的使用安全性。

[0019] 当干簧管、芯片、天线形成的电路处于闭合状态时，芯片与天线之间闭合连接，NFC戒指处于工作状态，可以进行数据传输，同时发光二极管发光指示工作状态。

[0020] NFC戒指通过磁铁与干簧管之间的相互配合，实现电路的断开或闭合，进而实现非工作状态与工作状态之间的切换，提高了产品的使用安全性能，降低了用户信息被盗取的风险。

附图说明

[0021] 图1为本实用新型一实施例的NFC戒指的结构分解图；

[0022] 图2为一实施例的干簧管、发光二极管、芯片、天线的电路连接图；

[0023] 图3为另一实施例的干簧管、发光二极管、芯片、天线的电路连接图；

[0024] 图4为磁铁远离干簧管时的状态图；

[0025] 图5为磁铁靠近干簧管时的状态图。

具体实施方式

[0026] 下面结合实施例及附图对本实用新型作进一步详细的描述，但本实用新型的实施方式不限于此。

[0027] 如图1所示，其为本实用新型一实施例的NFC戒指10的结构分解图。NFC戒指10包括：内环100、外环200、边环300、电子组件400及磁铁500。

[0028] 外环200旋转套设于内环100上，外环200与内环100之间形成容置腔600。边环300安装于内环100的一端面上，外环200抵持于内环100与边环300之间。内环100、外环200、边环300相互连接形成一环形整体结构，外环200绕内环100可旋转，边环300可从内环100上拆卸，以使得外环200可从内环100上取出。

[0029] 特别的，外环200的外侧壁上开设有防滑纹210，防滑纹210提高了外环200的防滑性能，当通过手指使外环200绕内环100旋转时，防滑纹210可增大手指与外环200之间的接触摩擦力。

[0030] 电子组件400收容并固定于容置腔600内。在本实施例中，容置腔600为环形腔体结构，电子组件400环绕设于容置腔600内。

[0031] 电子组件400包括：线路板410、干簧管420、芯片430、天线440及发光二极管450，干簧管420、芯片430、天线440、发光二极管450布设于线路板410上。请参阅图2，其为一实施例的干簧管420、芯片430、天线440、发光二极管450的电路连接图，发光二极管450与芯片430连接形成并联电路，所述并联电路的一端与天线440的一端连接，所述并联电路的另一端通过干簧管420与天线440的另一端连接。在干簧管420的作用下，干簧管420、芯片430、天线440形成的电路可以闭合或断开。

[0032] 请参阅图3，其为另一实施例的干簧管420、芯片430、天线440、发光二极管450的

Petitioner Samsung Ex-1004, 0801

电路连接图。在此实施例中，干簧管 420、芯片 430、发光二极管 450 的数量分别为两个。例如，一个干簧管 420 和一个芯片 430 的组合可以实现商务名片的数据传输，另一个干簧管 420 和另一个芯片 430 的组合可以实现移动支付功能。干簧管 420 及芯片 430 的数量不限于上述限定，还可以为多个，根据需要选择。

[0033] 还要说明的是，在电路中接入发光二极管 450，通过天线 440 切割磁力线所产生的电流来驱动发光二极管 450 发光，从而在触发芯片 430 读写的过程中可实现发光二极管 450 发光，用来指示读写工作状态，给使用者明确的互动指示。

[0034] 外环 200 的侧壁上开设有收容槽 220，磁铁 500 收容于收容槽 220 内。在本实施例中，收容槽 220 为圆形凹槽，磁铁 500 为圆形片状体。

[0035] 在本实施例中，内环 100、外环 200、边环 300 均为陶瓷。现有金、银、钛钢等金属戒指容易导致 NFC 天线读取的干扰，需加入昂贵的吸波材料来解决抗干扰问题，本实施例中通过选用陶瓷，不但解决了原来金属戒指对 NFC 信号的干扰，而且使得产品成本可以有效降低。

[0036] 请同时参阅图 4 及图 5，其分别为磁铁 500 远离和靠近干簧管 420 时的状态图。

[0037] 旋转外环 200，外环 200 绕内环 100 旋转，设于外环 200 的收容槽 220 内的磁铁 500 随之旋转，从而实现磁铁 500 远离或靠近位于容置腔 600 内的干簧管 420。

[0038] 当磁铁 500 远离干簧管 420 时，干簧管 420 上的簧片触点 422 相互分离，此时干簧管 420、芯片 430、天线 440 形成的电路处于断开状态；当磁铁 500 靠近干簧管 420 时，干簧管 420 上的簧片触点 422 相互接触，此时干簧管 420、芯片 430、天线 440 形成的电路处于闭合状态。

[0039] 当干簧管 420、芯片 430、天线 440 形成的电路处于断开状态时，芯片 430 与天线 440 之间断开连接，NFC 戒指 10 处于非工作状态，保证了 NFC 戒指 10 的使用安全性。

[0040] 当干簧管 420、芯片 430、天线 440 形成的电路处于闭合状态时，芯片 430 与天线 440 之间闭合连接，NFC 戒指 10 处于工作状态，可以进行数据传输。

[0041] 要特别说明的是，干簧管 420 为一种非接触式的密封开关，其体积小、重量轻，易于安装且不显眼，无需复杂的凸轮或曲柄，不会出现金属疲劳现象，提高了使用寿命。干簧管 420 的簧片触点 422 被密封于惰性气体中，不与外界环境接触，大大减少了簧片触点 422 在开、闭过程中由于火花而引起的氧化和碳化，并可防止外界水蒸气和灰尘等杂质对簧片触点 422 的侵蚀，提高了工作寿命长。

[0042] NFC 戒指 10 通过磁铁 500 与干簧管 420 之间的相互配合，实现电路的断开或闭合，进而实现非工作状态与工作状态之间的切换，提高了产品的使用安全性能，降低了用户信息被盗取的风险。

[0043] 上述实施例为本实用新型较佳的实施方式，但本实用新型的实施方式并不受上述实施例的限制，其他的任何未背离本实用新型的精神实质与原理下所作的改变、修饰、替代、组合、简化，均应为等效的置换方式，都包含在本实用新型的保护范围之内。

Petitioner Samsung Ex-1004, 0802

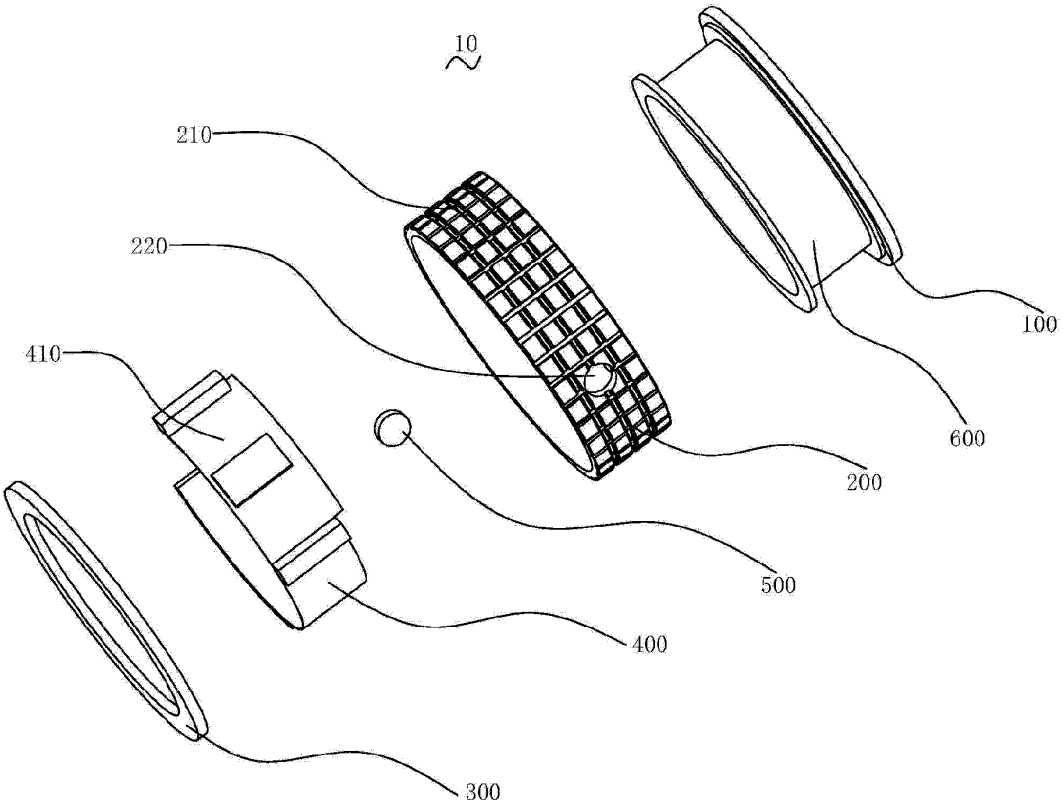


图 1

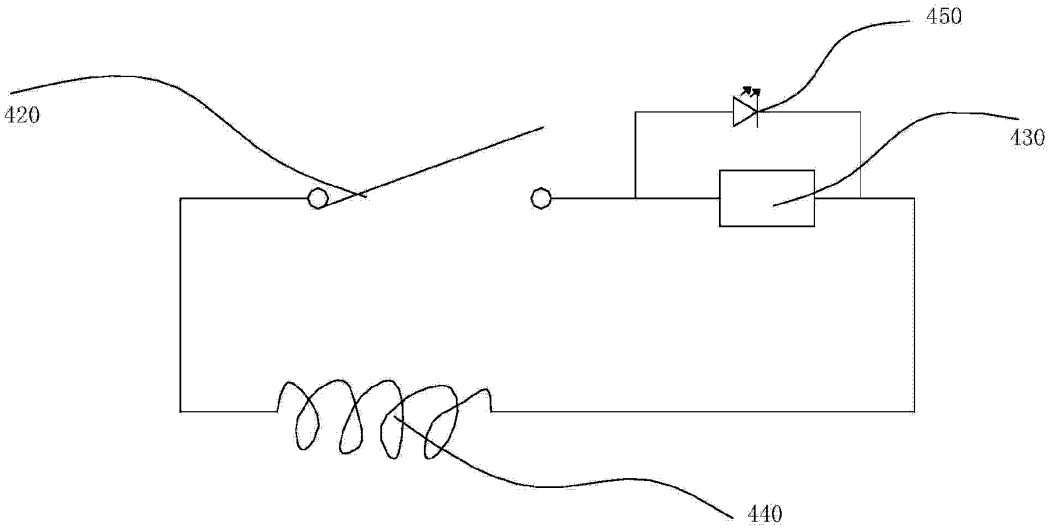


图 2

Petitioner Samsung Ex-1004, 0803

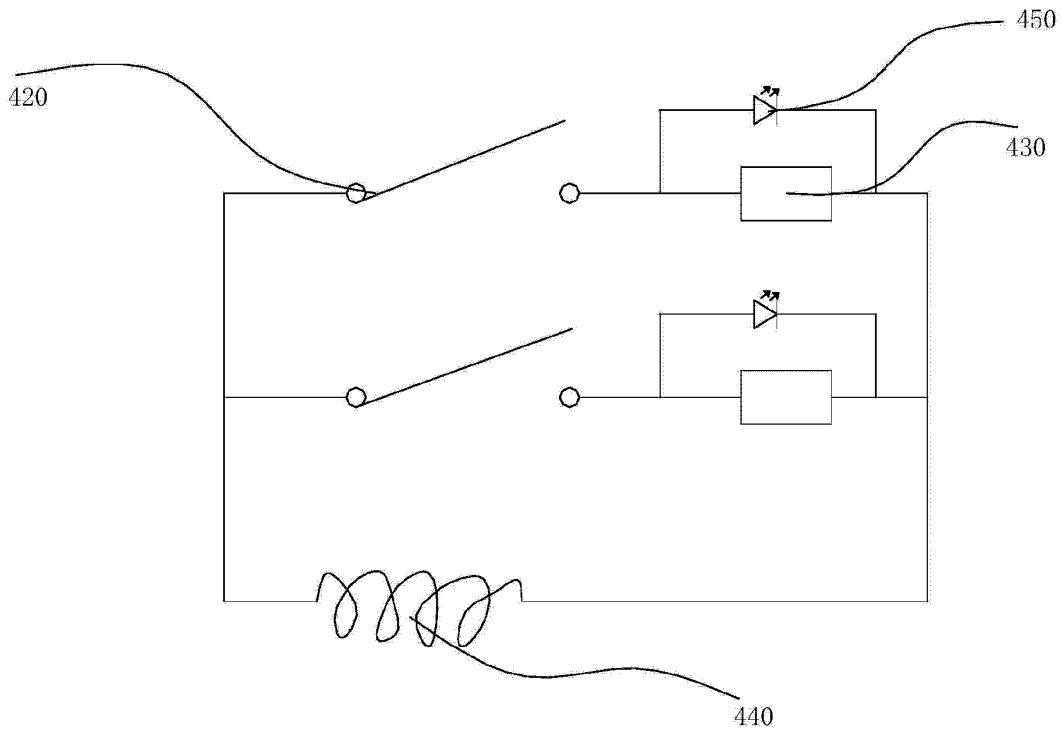


图 3

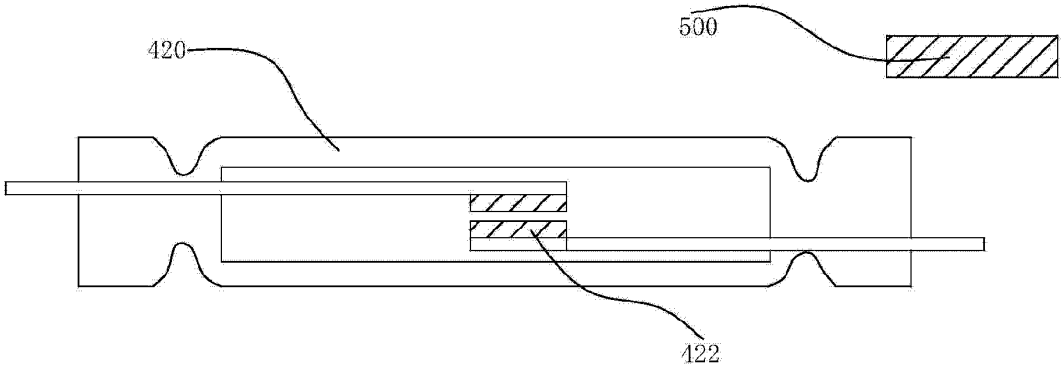


图 4

Petitioner Samsung Ex-1004, 0804

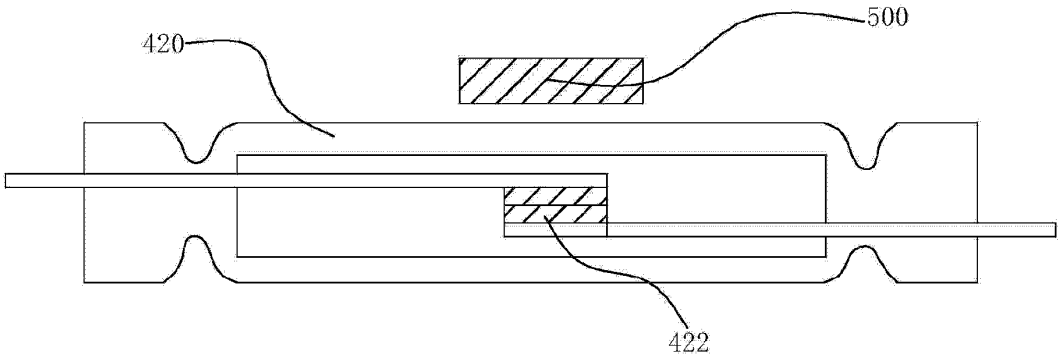


图 5

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/323,385	**07/21/2023 04:52:03 PM ET**	**PM0002**

Title of Invention

WEARABLE COMPUTING DEVICE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	7585	FILED BY	Jamie LaFleur
PATENT CENTER #	62485396	FILING DATE	05/24/2023
CUSTOMER #	179918	FIRST NAMED INVENTOR	Mr. Curt C. von Badinski
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Nathan Mutter

Documents

TOTAL DOCUMENTS: 31

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
FOR_WO2013104629_EnglishTranslation.pdf	7	Foreign Reference	112 KB
NPL_MedicalMoodRing_1.pdf	1	Non Patent Literature	507 KB
FOR_WO2013104629_A1.pdf	17	Foreign Reference	769 KB
FOR_WO2012024889A1.pdf	18	Foreign Reference	532 KB
FOR_WO2013093638A2.pdf	24	Foreign Reference	766 KB
FOR_WO2006060949_A1.pdf	16	Foreign Reference	410 KB

FOR_WO2006060949_EnglishTranslation.pdf	7	Foreign Reference	55 KB
FOR_WO2009124076A1.pdf	33	Foreign Reference	1066 KB
FOR_WO2004078028A2_21.pdf	21	Foreign Reference	887 KB
FOR_KR20100091592_A.pdf	12	Foreign Reference	453 KB
FOR_WO2011053235A1.pdf	50	Foreign Reference	2525 KB
FOR_KR200417885Y1.pdf	5	Foreign Reference	211 KB
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18323385_IDS.pdf		10	-	323 KB
18323385_IDS-TRAN.LET.pdf	(1-2)	2	Transmittal Letter	143 KB
18323385_IDS-IDS.pdf	(3-10)	8	Information Disclosure Statement (IDS) Form (SB08)	214 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
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(12) DEMANDE INTERNATIONALE PUBLIÉE EN VERTU DU TRAITÉ DE COOPÉRATION EN MATIÈRE DE BREVETS (PCT)

(19) Organisation Mondiale de la Propriété Intellectuelle
Bureau international

(43) Date de la publication internationale
18 juillet 2013 (18.07.2013)

WIPO | PCT

(10) Numéro de publication internationale
WO 2013/104629 A1

(51) Classification internationale des brevets : *A61B 5/1455* (2006.01)

(21) Numéro de la demande internationale : PCT/EP2013/050230

(22) Date de dépôt international : 8 janvier 2013 (08.01.2013)

(25) Langue de dépôt : français

(26) Langue de publication : français

(30) Données relatives à la priorité :
12/50332 13 janvier 2012 (13.01.2012) FR

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(81) États désignés *(sauf indication contraire, pour tout titre de protection nationale disponible)* : AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) États désignés *(sauf indication contraire, pour tout titre de protection régionale disponible)* : ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), eurasien (AM, AZ, BY, KG, KZ, RU, TJ, TM), européen (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,

[Suite sur la page suivante]

(54) Title : OXIMETER

(54) Titre : OXYMÈTRE

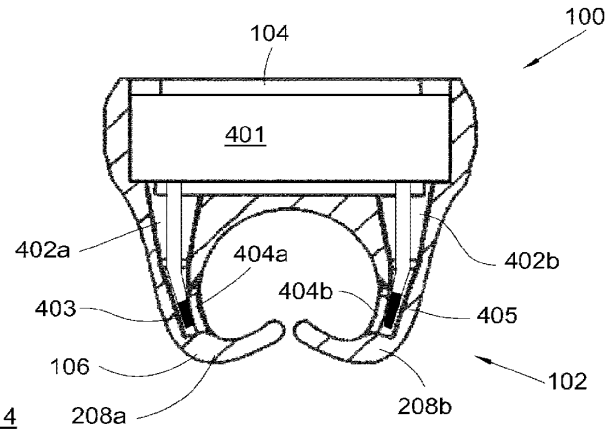


Fig. 4

(57) Abstract : The invention relates to an oximeter (100) comprising a ring (102) and an electronic module (401) attached to the ring (102), said electronic module (401) comprising at least one light-emitting diode (403) and a photoreceptor (405). The ring (102) includes a cavity (104) in which the electronic module (401) is housed and a ring band (106) to be slipped onto the finger of a patient, said band (106) being made from a flexible material. The band (106) includes two recesses (402a, 402b), each of which extends between the cavity (104) and a window (404a, 404b) provided on the inner surface of the band (106), wherein one (402a) of the recesses is intended to house the diode(s) (403) and the other recess (402b) is intended to house the photoreceptor (405). The window (404a) associated with the diode(s) (403) is arranged such that the diode(s) (403) emit light beams therethrough, and the window (404b) associated with the photoreceptor (405) is arranged such that the photoreceptor (405) receives the light beams emitted by the diode(s) (403) after said light beams have passed through the finger. The band (106) is split into two arcs (208a, 208b) and the free end of each arc (208a, 208b) is curved toward the inside of the ring band (106).

(57) Abrégé :

[Suite sur la page suivante]

WO 2013/104629 A1

Petitioner Samsung Ex-1004, 0813

MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Publiée :

— *avec rapport de recherche internationale (Art. 21(3))*

L'invention concerne un oxymètre (100) comportant une bague (102) et un module électronique (401) fixé à la bague (102), - le module électronique (401) comportant au moins une diode électroluminescente (403) et un photorécepteur (405), - la bague (102) présentant un logement (104) dans lequel loge le module électronique (401) et un anneau (106) destiné à s'enfiler sur un doigt d'un patient, ledit anneau (106) étant réalisé dans un matériau souple, l'anneau (106) présentant deux évidements (402a, 402b), chacun s'étendant entre le logement (104) et une fenêtre (404a, 404b) réalisée sur la face intérieure de l'anneau (106), l'un des évidements (402a) étant destiné à loger la ou les diodes (403), et l'autre évidement (402b) étant destiné à loger le photorécepteur (405), la fenêtre (404a) associée à la ou les diodes (403) étant disposée de manière à ce que la ou les diodes (403) émettent des faisceaux lumineux à travers elle, et la fenêtre (404b) associée au photorécepteur (405) étant disposée de manière à ce que le photorécepteur (405) reçoive les faisceaux lumineux émis par la ou les diodes (403) après qu'ils ont traversé le doigt, l'anneau (106) étant scindé en deux arcs (208a, 208b) et l'extrémité libre de chaque arc (208a, 208b) étant recourbée vers l'intérieur de l'anneau (106).

Petitioner Samsung Ex-1004, 0814

Oxymètre

La présente invention concerne un oxymètre, également appelé saturomètre.

L'oxymétrie du pouls permet de mesurer de façon non invasive et continue la saturation artérielle en oxygène de l'hémoglobine. Elle permet de détecter rapidement les carences en oxygène avant l'apparition des signes cliniques.

La mesure d'oxymétrie peut s'effectuer au niveau de différents organes du patient, et plus particulièrement au bout d'un doigt, d'un orteil, d'un lobe d'oreille, etc.

Un oxymètre comporte deux diodes électroluminescentes, l'une émettrice d'un faisceau lumineux de lumière rouge et l'autre émettrice d'un faisceau lumineux de lumière infrarouge (respectivement 660 et 994 nm), et un photorécepteur qui mesure l'absorption de ces faisceaux lumineux par le flux pulsatile. Les absorptions des faisceaux lumineux de lumières rouge et infrarouge sont variables selon que ces faisceaux lumineux rencontrent de l'hémoglobine réduite (Hb) non oxygénée ou de l'oxyhémoglobine (HbO_2).

Les informations relevées par le photorécepteur sont ensuite transmises à un centre de surveillance, tel qu'un appareil de surveillance médicale par exemple.

Petitioner Samsung Ex-1004, 0815

Il existe actuellement différents modèles d'oxymètres. Les modèles les plus répandus se fixent au niveau de l'extrémité distale d'un doigt.

Un premier modèle d'oxymètre prend la forme d'un pince-doigt qui vient serrer l'extrémité du doigt du patient. Un tel oxymètre est volumineux et reste difficilement en place si le patient est agité.

Un deuxième modèle d'oxymètre prend la forme de deux sparadraps. Dans le premier sparadrap sont intégrées les diodes électroluminescentes, et dans le deuxième sparadrap est intégré le photorécepteur. Un tel oxymètre est plus stable mais il ne peut pas être utilisé plusieurs fois.

On connaît également des oxymètres sous forme de bague.

Un objet de la présente invention est de proposer un oxymètre qui reste en place sur le patient même si celui-ci est agité, qui peut être réutilisé et qui présente de meilleures performances.

A cet effet, est proposé un oxymètre comportant une bague et un module électronique fixé à la bague,

- le module électronique comportant au moins une diode électroluminescente et un photorécepteur,

- la bague présentant un logement dans lequel loge le module électronique et un anneau destiné à s'enfiler sur un doigt d'un patient, ledit anneau étant réalisé dans un matériau souple,

l'anneau présentant deux évidements, chacun s'étendant entre le logement et une fenêtre réalisée sur la face intérieure de l'anneau, l'un des évidements étant destiné à loger la ou les diodes, et l'autre évidement étant destiné à loger le photorécepteur,

la fenêtre associée à la ou les diodes étant disposée de manière à ce que la ou les diodes émettent des faisceaux lumineux à travers elle, et la fenêtre associée au photorécepteur étant disposée de manière à ce que le photorécepteur reçoive les faisceaux lumineux émis par la ou les diodes après qu'ils ont traversé le doigt,

l'anneau étant scindé en deux arcs et l'extrémité libre de chaque arc étant recourbée vers l'intérieur de l'anneau.

Avantageusement, les fenêtres sont placées en vis-à-vis selon un axe transversal gauche-droit du doigt.

Avantageusement, la scission est réalisée au niveau de la partie inférieure de l'anneau dans le plan de symétrie de l'oxymètre passant par l'axe de l'anneau.

Petitioner Samsung Ex-1004, 0816

Avantageusement, chaque fenêtre est obturée par une plaque transparente dans les longueurs d'ondes utilisées.

Les caractéristiques de l'invention mentionnées ci-dessus, ainsi que d'autres, apparaîtront plus clairement à la lecture de la description suivante d'un exemple de réalisation, ladite description étant faite en relation avec les dessins joints, parmi lesquels :

la Fig. 1 représente un oxymètre selon l'invention,

la Fig. 2 est une vue latérale de l'oxymètre de la Fig. 1,

la Fig. 3 est une vue de dessous de l'oxymètre de la Fig. 1, et

la Fig. 4 est une coupe selon la ligne IV-IV de la Fig. 3.

La Fig. 1 montre un oxymètre 100 qui comporte une bague 102 et un module électronique (401, Fig. 4) et qui se fixe à la bague 102.

La bague 102 présente un anneau 106 destiné à s'enfiler sur le doigt d'un patient et un logement 104 dans lequel vient se loger le module électronique 401.

La Fig. 2 montre l'oxymètre 100 en vue de côté c'est-à-dire dans l'axe de la bague 102, et la Fig. 3 montre l'oxymètre 100 en vue de dessous. La Fig. 4 est une vue de côté en coupe de l'oxymètre 100.

Le module électronique 401 présente deux diodes électroluminescentes 403, l'une émettrice d'un faisceau lumineux de lumière rouge et l'autre émettrice d'un faisceau lumineux de lumière infrarouge (respectivement 660 et 994 nm) et un photorécepteur 405. Le module électronique 401 comporte également des moyens nécessaires à la commande des diodes, des moyens nécessaires à la réception des informations émises par le photorécepteur, ainsi que des moyens nécessaires à la transmission de ces informations vers un centre de surveillance, tel qu'un appareil de surveillance médicale par exemple. Le module électronique 401 comporte également une source d'énergie et les moyens nécessaires à la transmission sont par exemple des moyens de communication sans fil.

L'anneau 106 est réalisé dans un matériau souple tel que du silicone afin de s'adapter à la forme du doigt du patient sur lequel il est enfilé.

L'anneau 106 présente deux évidements 402a et 402b. L'un des évidements 402a est destiné à loger les deux diodes 403, et l'autre évidement 402b est destiné à loger le photorécepteur 405.

Petitioner Samsung Ex-1004, 0817

Chaque évidement 402a, 402b s'étend dans l'anneau 106 et débouche d'une part dans le logement 104, et d'autre part au niveau de la face intérieure de l'anneau 106 par l'intermédiaire d'une fenêtre 404a, 404b.

Les ouvertures entre les évidements 402a et 402b et le logement 104 permettent le passage des deux diodes 403, et du photorécepteur 405 lors de la mise en place du module électronique 401.

La fenêtre 404a est disposée de manière à ce que les diodes 403 émettent les faisceaux lumineux à travers elle, et la fenêtre 404b est disposée de manière à ce que le photorécepteur 405 reçoive les faisceaux lumineux la traversant. En outre, les fenêtres 404a et 404b sont disposées de manière à ce que lorsque l'oxymètre 100 est enfilé jusqu'à la phalange proximale du doigt du patient, les faisceaux lumineux émis par les diodes 403 traversent le doigt et sont captés par le photorécepteur 405 permettant ainsi la mesure de l'oxymétrie.

Un tel oxymètre 100 est donc réutilisable et est maintenu très bien en place du fait de la présence de l'anneau 106.

Pour une meilleure prise de mesure de l'oxymétrie, les fenêtres 404a et 404b et par conséquent, les diodes 403 et le photorécepteur 405 sont placés en vis-à-vis selon un axe transversal gauche-droit du doigt.

Les faisceaux lumineux sont ainsi récupérés à proximité de la phalange proximale sans distinction de doigt. Cette zone est moins irriguée que la pulpe du doigt qui est un excellent lit vasculaire pulsatile, mais elle est moins assujettie au phénomène de vasoconstriction des vaisseaux, qui est un facteur limitant de la mesure d'oxymétrie.

Pour faciliter l'adaptation de l'anneau 106 à la plupart des doigts, l'anneau 106 est scindé en deux arcs 208a et 208b. La scission de l'anneau 106 est réalisée au niveau de la partie inférieure de l'anneau 106, c'est-à-dire la partie qui se trouve sous le doigt lorsque l'oxymètre 100 est en place. La scission est réalisée dans le plan de symétrie de l'oxymètre 100 passant par l'axe de l'anneau 106.

Du fait de la souplesse du matériau utilisé, chaque arc 208a, 208b de l'anneau 106 peut librement s'écarter et ainsi épouser la forme du doigt sans risque d'ischémie pour le doigt et ceci quelles que soient les dimensions de ce dernier, tant qu'elles sont supérieures aux dimensions intérieures de l'anneau 106.

Afin de faciliter l'adhérence des arcs 208 et 208b au doigt, ils sont amincis à leurs extrémités libres afin de les assouplir.

Petitioner Samsung Ex-1004, 0818

Comme précisé ci-dessus, le matériau constituant l'anneau 106 est souple et est de préférence un silicone car il est biocompatible, transparent ou éventuellement colorable et il peut recevoir des additifs. Le silicone est également un isolant thermique et électrique et il résiste à la chaleur tout en conservant ses propriétés physico-chimiques.

En outre, la souplesse du silicone peut être modulée en fonction des besoins. Dans un mode de réalisation préféré de l'invention, le silicone présente une dureté de l'ordre de 50 Sh A qui peut varier de + ou – 20 Sh A. Un tel ordre de grandeur est adapté au confort du patient puisque le doigt n'est pas trop serré et le signal des pulsations artérielles n'est pas diminué, et au bon maintien de l'oxymètre 100 sur le doigt afin que les diodes 403 et le photorécepteur 405 restent correctement positionnés malgré les mouvements du patient.

Pour assurer que la peau du doigt est bien en contact avec les diodes 403 et le photorécepteur 405 et ainsi éviter les interférences lumineuses dues par exemple à la réception par le photorécepteur 405 de faisceaux lumineux n'ayant pas traversé le doigt, l'extrémité libre de chaque arc 208a, 208b est recourbée vers l'intérieur de l'anneau 106, c'est-à-dire vers la partie haute de l'oxymètre 100 portant le module électronique 401.

Ainsi, chaque extrémité libre exerce une pression sur la chair du doigt et tend à remonter cette chair afin de remplir l'intérieur de l'anneau 106 et la plaquer contre les diodes 403 et le photorécepteur 405 pour améliorer la prise de mesure.

Les diodes 403 sont logées dans l'un des arcs 208a et le photorécepteur 405 logé dans l'autre arc 208b.

Les orientations angulaires des diodes 403 et du photorécepteur 405 sont telles que sur les doigts de petit volume, les faisceaux lumineux émis convergent vers la chair du doigt, et pour les doigts de plus gros volume, l'écartement des deux arcs 208a et 208b permet une adaptation des orientations angulaires des diodes 403 et du photorécepteur 405 de manière à ce que les faisceaux lumineux émis restent centrés sur la chair.

Pour éviter que des salissures se déposent sur les diodes 403 et le photorécepteur 405, chaque fenêtre 404a, 404b est obturée par une plaque transparente dans les longueurs d'ondes utilisées. La plaque transparente peut être un voile issu du matériau constituant l'anneau 106 s'il est transparent, ou une plaque de plexiglas collée dans la fenêtre 404a, 404b.

Petitioner Samsung Ex-1004, 0819

Bien entendu, la présente invention n'est pas limitée aux exemples et modes de réalisation décrits et représentés, mais elle est susceptible de nombreuses variantes accessibles à l'homme de l'art.

Petitioner Samsung Ex-1004, 0820

REVENDICATIONS

1) Oxymètre (100) comportant une bague (102) et un module électronique (401) fixé à la bague (102),

- le module électronique (401) comportant au moins une diode électroluminescente (403) et un photorécepteur (405),

- la bague (102) présentant un logement (104) dans lequel loge le module électronique (401) et un anneau (106) destiné à s'enfiler sur un doigt d'un patient, ledit anneau (106) étant réalisé dans un matériau souple,

l'anneau (106) présentant deux évidements (402a, 402b), chacun s'étendant entre le logement (104) et une fenêtre (404a, 404b) réalisée sur la face intérieure de l'anneau (106), l'un des évidements (402a) étant destiné à loger la ou les diodes (403), et l'autre évidement (402b) étant destiné à loger le photorécepteur (405),

la fenêtre (404a) associée à la ou les diodes (403) étant disposée de manière à ce que la ou les diodes (403) émettent des faisceaux lumineux à travers elle, et la fenêtre (404b) associée au photorécepteur (405) étant disposée de manière à ce que le photorécepteur (405) reçoive les faisceaux lumineux émis par la ou les diodes (403) après qu'ils ont traversé le doigt,

l'anneau (106) étant scindé en deux arcs (208a, 208b) et l'extrémité libre de chaque arc (208a, 208b) étant recourbée vers l'intérieur de l'anneau (106).

2) Oxymètre (100) selon la revendication 1, caractérisé en ce que les fenêtres (404a, 404b) sont placées en vis-à-vis selon un axe transversal gauche-droit du doigt.

3) Oxymètre (100) selon l'une des revendications 1 ou 2, caractérisé en ce que la scission est réalisée au niveau de la partie inférieure de l'anneau (106) dans le plan de symétrie de l'oxymètre (100) passant par l'axe de l'anneau (106).

4) Oxymètre (100) selon l'une des revendications 1 à 3, caractérisé en ce que chaque fenêtre (404a, 404b) est obturée par une plaque transparente dans les longueurs d'ondes utilisées.

Petitioner Samsung Ex-1004, 0821

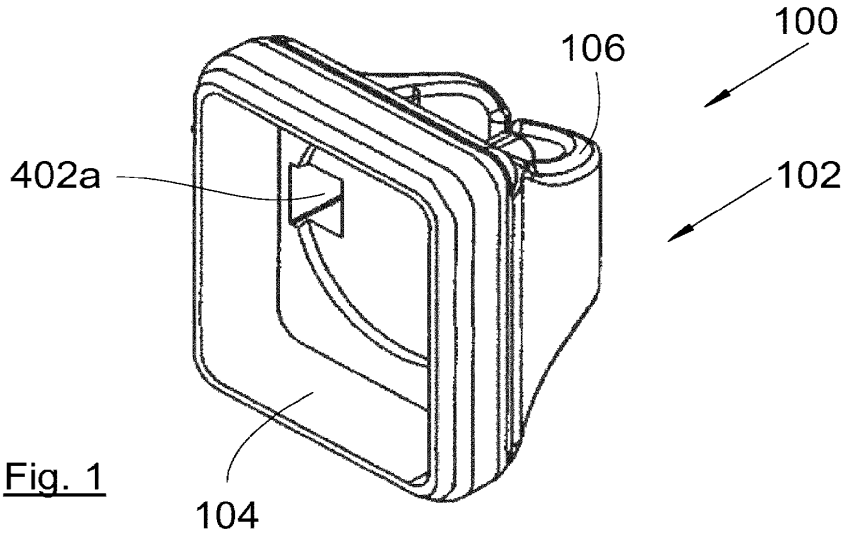


Fig. 1

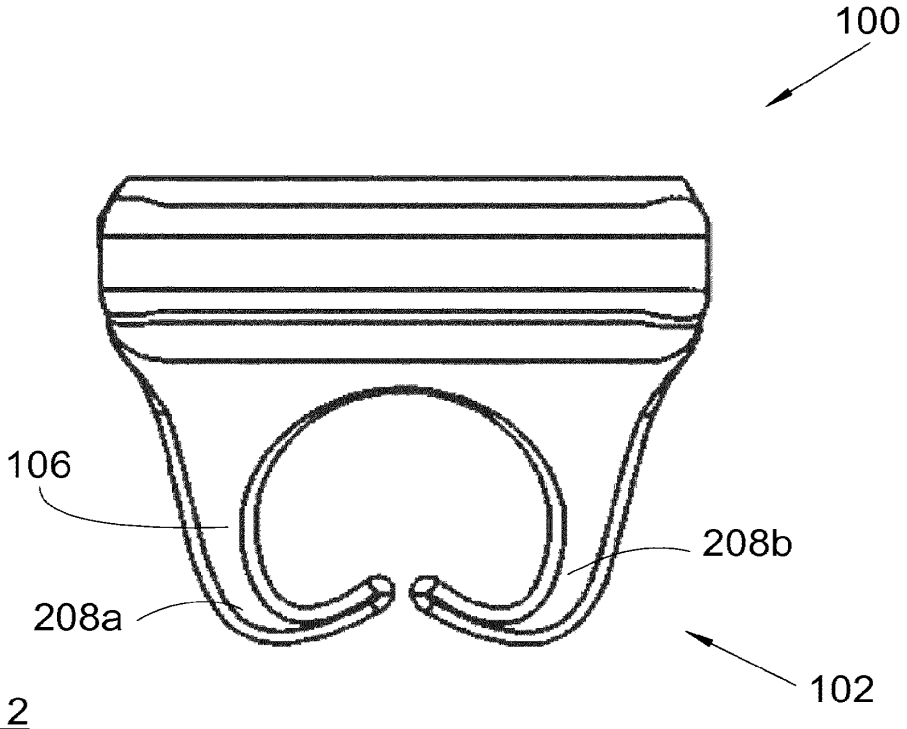


Fig. 2

Petitioner Samsung Ex-1004, 0822

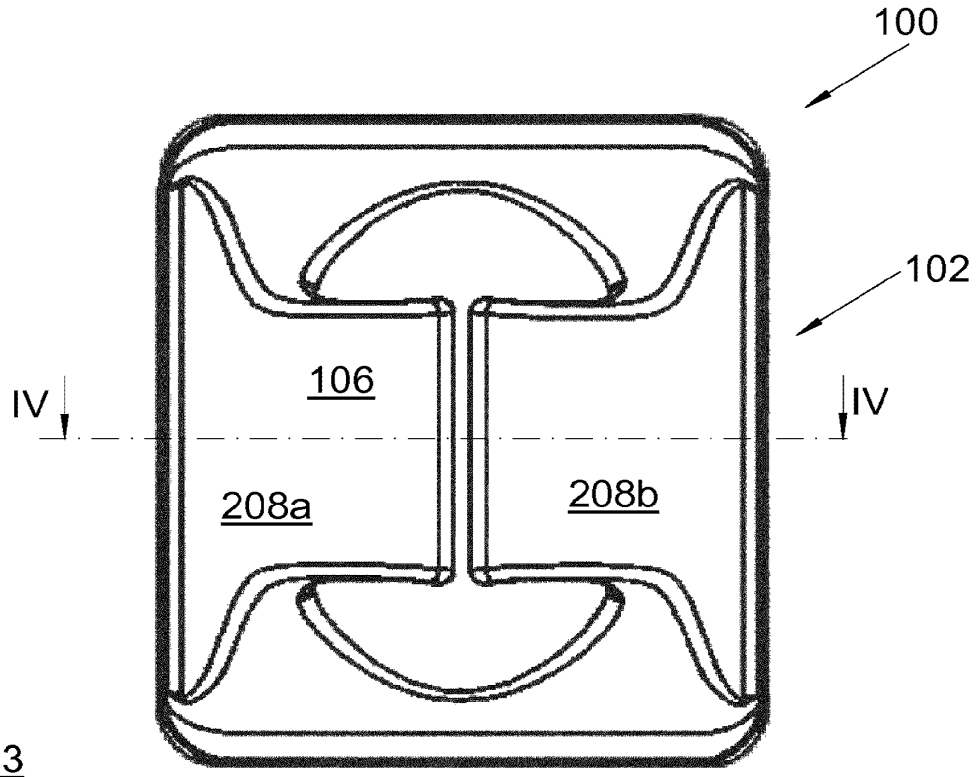

100
102
106
IV
IV
208a
208b

Fig. 3

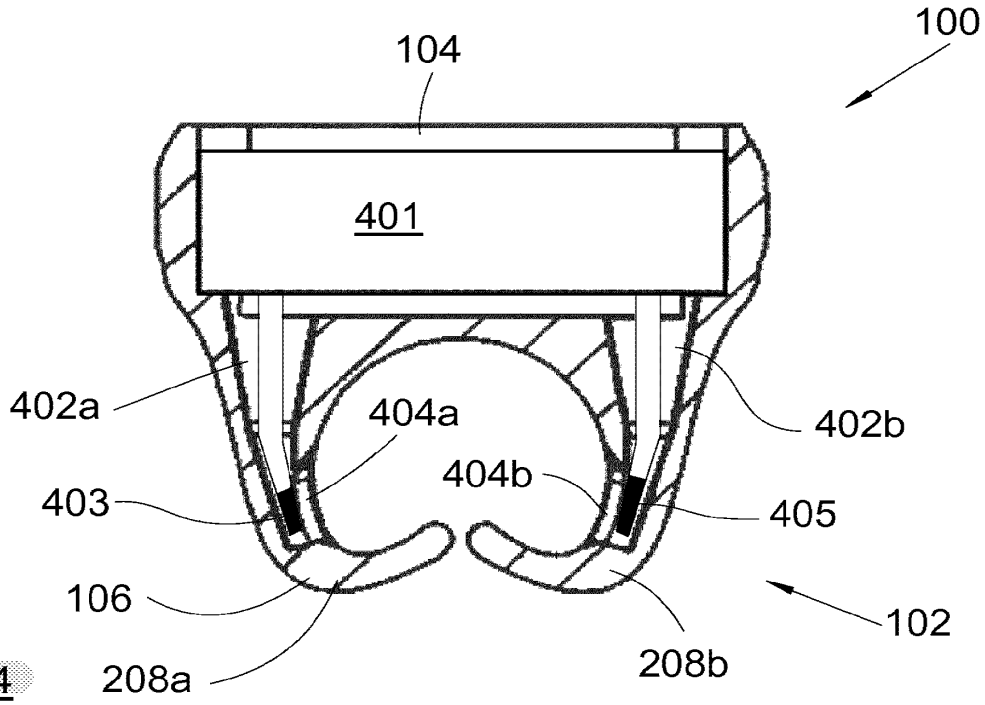

100
104
401
402a
404a
402b
404b
403
405
106
102
208a
208b

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/050230

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/1455
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/171915 A1 (KAWAJIRI MOMOE [JP] ET AL) 17 July 2008 (2008-07-17) abstract; figures 1,4-7,29 paragraphs [0062] - [0071], [0078], [0148] -----	1-4
A	WO 98/17172 A2 (MASSACHUSETTS INST TECHNOLOGY [US]) 30 April 1998 (1998-04-30) abstract; figures 1,4 -----	1
A	US 6 253 097 B1 (ARONOW KURT A [US] ET AL) 26 June 2001 (2001-06-26) abstract; figures 7-9 column 8, lines 1-39 ----- -/--	1

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 March 2013	03/04/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Jonsson, P.O.

Form PCT/ISA/210 (second sheet) (April 2005)

Petitioner Samsung Ex-1004, 0824

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/050230

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2010/168531 A1 (SHALTIS PHILLIP ANDREW [US] ET AL) 1 July 2010 (2010-07-01) abstract; figures 1-5 paragraphs [0025] - [0030]	1
A	WO 03/077761 A1 (CITIZEN WATCH CO LTD [JP]; EGAWA SHUNJI [JP]) 25 September 2003 (2003-09-25) abstract; figures 1-4	1

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

Petitioner Samsung Ex-1004, 0825

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2013/050230

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2008171915 A1	17-07-2008	EP 1859735 A1	28-11-2007
		JP 4549900 B2	22-09-2010
		JP 2006247133 A	21-09-2006
		US 2008171915 A1	17-07-2008
		WO 2006095465 A1	14-09-2006
WO 9817172 A2	30-04-1998	EP 0934021 A2	11-08-1999
		JP 3856477 B2	13-12-2006
		JP 2001504718 A	10-04-2001
		KR 20000052757 A	25-08-2000
		US 5964701 A	12-10-1999
		WO 9817172 A2	30-04-1998
US 6253097 B1	26-06-2001	NONE	
US 2010168531 A1	01-07-2010	NONE	
WO 03077761 A1	25-09-2003	JP 2005253478 A	22-09-2005
		WO 03077761 A1	25-09-2003

Petitioner Samsung Ex-1004, 0826

RAPPORT DE RECHERCHE INTERNATIONALE

Demande internationale n°
PCT/EP2013/050230

A. CLASSEMENT DE L'OBJET DE LA DEMANDE
INV. A61B5/1455
ADD.

Selon la classification internationale des brevets (CIB) ou à la fois selon la classification nationale et la CIB

B. DOMAINES SUR LESQUELS LA RECHERCHE A PORTE

Documentation minimale consultée (système de classification suivi des symboles de classement)
A61B

Documentation consultée autre que la documentation minimale dans la mesure où ces documents relèvent des domaines sur lesquels a porté la recherche

Base de données électronique consultée au cours de la recherche internationale (nom de la base de données, et si cela est réalisable, termes de recherche utilisés)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERES COMME PERTINENTS

Catégorie*	Identification des documents cités, avec, le cas échéant, l'indication des passages pertinents	no. des revendications visées
X	US 2008/171915 A1 (KAWAJIRI MOMOE [JP] ET AL) 17 juillet 2008 (2008-07-17) abrégé; figures 1,4-7,29 alinéas [0062] - [0071], [0078], [0148]	1-4
A	WO 98/17172 A2 (MASSACHUSETTS INST TECHNOLOGY [US]) 30 avril 1998 (1998-04-30) abrégé; figures 1,4	1
A	US 6 253 097 B1 (ARONOW KURT A [US] ET AL) 26 juin 2001 (2001-06-26) abrégé; figures 7-9 colonne 8, ligne 1-39	1

-/--

[X] Voir la suite du cadre C pour la fin de la liste des documents

[X] Les documents de familles de brevets sont indiqués en annexe

* Catégories spéciales de documents cités:

"A" document définissant l'état général de la technique, non considéré comme particulièrement pertinent

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Date à laquelle la recherche internationale a été effectivement achevée	Date d'expédition du présent rapport de recherche internationale
21 mars 2013	03/04/2013

Nom et adresse postale de l'administration chargée de la recherche internationale	Fonctionnaire autorisé
Office Européen des Brevets, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Jonsson, P.O.

Petitioner Samsung Ex-1004, 0827

RAPPORT DE RECHERCHE INTERNATIONALE

Demande internationale n°
PCT/EP2013/050230

C(suite). DOCUMENTS CONSIDERES COMME PERTINENTS

Catégorie*	Identification des documents cités, avec, le cas échéant, l'indication des passages pertinents	no. des revendications visées
A	US 2010/168531 A1 (SHALTIS PHILLIP ANDREW [US] ET AL) 1 juillet 2010 (2010-07-01) abrégé; figures 1-5 alinéas [0025] - [0030]	1
A	WO 03/077761 A1 (CITIZEN WATCH CO LTD [JP]; EGAWA SHUNJI [JP]) 25 septembre 2003 (2003-09-25) abrégé; figures 1-4	1

Formulaire PCT/ISA/210 (suite de la deuxième feuille) (avril 2005)

Petitioner Samsung Ex-1004, 0828

RAPPORT DE RECHERCHE INTERNATIONALE

Renseignements relatifs aux membres de familles de brevets

Demande internationale n°
PCT/EP2013/050230

Document brevet cité au rapport de recherche	Date de publication	Membre(s) de la famille de brevet(s)	Date de publication
US 2008171915 A1	17-07-2008	EP 1859735 A1	28-11-2007
		JP 4549900 B2	22-09-2010
		JP 2006247133 A	21-09-2006
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		WO 2006095465 A1	14-09-2006
WO 9817172 A2	30-04-1998	EP 0934021 A2	11-08-1999
		JP 3856477 B2	13-12-2006
		JP 2001504718 A	10-04-2001
		KR 20000052757 A	25-08-2000
		US 5964701 A	12-10-1999
		WO 9817172 A2	30-04-1998
US 6253097 B1	26-06-2001	AUCUN	
US 2010168531 A1	01-07-2010	AUCUN	
WO 03077761 A1	25-09-2003	JP 2005253478 A	22-09-2005
		WO 03077761 A1	25-09-2003

Petitioner Samsung Ex-1004, 0829

(12) 按照专利合作条约所公布的国际申请

(19) 世界知识产权组织
国 际 局

(43) 国际公布日
2006 年6 月15 日 (15.06.2006)

PCT

(10) 国际公布号
WO 2006/060949 A1

(51) 国际专利分类号:
A44C 9/00 (2006.01) G01K 1/14 (2006.01)
A61B 5/16 (2006.01)

(21) 国际申请号: PCT/CN2005/002054

(22) 国际申请日: 2005 年11 月30 日 (30.11.2005)

(25) 申请语言: 中文

(26) 公布语言: 中文

(30) 优先权:
200420058405.2
2004 年12 月9 日 (09.12.2004) CN

(71) 申请人及
(72) 发明人: 张凤麟(JANG, Fong-Lin) [CN/CN]; 中国台湾省台南市崇学路20巷2号21楼, Taiwan 701 (CN)。

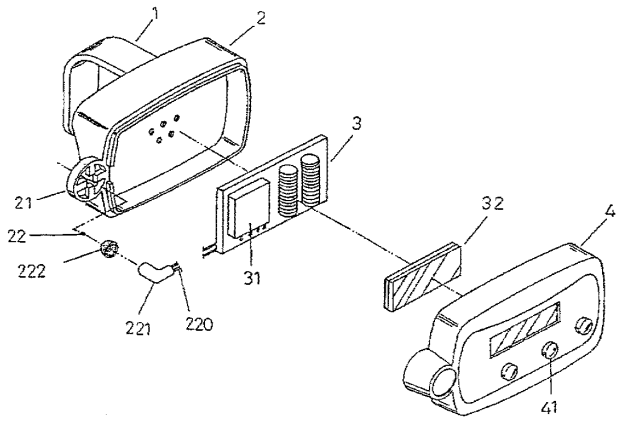
(74) 代理人: 北京维澳专利代理有限公司(WE-ALL PATENT AGENT CO., LTD.); 中国北京市建国门外大街22号赛特广场M层30112室, Beijing 100004 (CN)。

(81) 指定国 (除另有指明, 要求每一种可提供的国家保护): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD,

[见续页]

(54) Title: FINGER TEMPERATURE INDICATING RING

(54) 发明名称: 显示指温的手指佩戴件



(57) Abstract: A finger temperature indicating ring for wearing around a finger to measure and indicate the finger temperature of the wearer includes a basic carrier, a circuit board, an indicator and other common elements, futhermore, it includes a downward facing pedestal having a temperature sensor which corresponds to the finger skin to measure temperature of the specific location.

(57) 摘要:

一测量并显示手指指温的指环包括载具，电路板，显示器和其它常用元件，还进一步包括一个面朝下的承座，该承座具有一感温元件，与手指皮肤对应，能测量特定区域的温度。

WO 2006/060949 A1

Petitioner Samsung Ex-1004, 0830

MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW。

(84) 指定国 （除另有指明，要求每一种可提供的地区保护）：ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), 欧亚 (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), 欧洲 (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)。

本国际公布：

— 包括国际检索报告。

所引用双字母代码及其它缩写符号，请参考刊登在每期PCT公报期刊起始的“代码及缩写符号简要说明”。

Petitioner Samsung Ex-1004, 0831

显示指温的手指佩戴件

技术领域

本发明系涉及一种手指配戴件，尤其涉及一种利用感测指温以获得情绪放松与否的临床指标与数据构造的量测指温以感知情绪放松的手指配戴件。

背景技术

人的身体与心理往往是一体两面而互动的，身体疾病会影响心理，心理不适也会对身体健康有害。而临床上，指温是常用来监测一个人是否放松很敏感的一个指标。当一个人放松时，血管扩张，有较多热量散发到身体表面，因此手脚较温暖，相反地，当人紧张或愤怒时，血管收缩，热量散发到身体表面，因此手脚较冰冷。治疗上医师通常教导病人肌肉放松，并由生理反馈机器显示指温，通过机器了解自己的情绪压力，并予适当的排除。

缘此，本发明者基于多年钻研医疗知识的经验，及研发的动机，由申请号 U.S. Pat.No.5,813,766「感测指温以馈知情绪放松的指环」中得到启发。

传统生理反馈机器测量指温的方法，是以胶带或尼龙搭扣固定感温元件，结果容易将手指局部形成压迫，导致指温温度不易上升。因此，即使患者已情绪放松，然而讯号却显示仍属未放松的状态，因此容易产生失真。

又本发明在前案的实际制造与使用过程当中发现尚有改善之处。其指环圈与导温弧杆的连动关系，使得当患者佩戴时不能任意调整紧度，在此情况下，指环圈容易滑动走位而使测量状态不稳定。

再者，感测指温的导温弧杆埋在指环圈的二对称引道，形成密闭，因此纵有指温下降状况，也不容易散热而形成闷热，又导致另一型态的测量失真。

发明内容

本发明的目的在于通过提供一种量测指温以感知情绪放松的手指配戴件，以达到当患者佩戴时可以任意调整紧度，克服了现在指环圈容易滑动走位而使测量状态不稳定的问题。

为实现上述目的，本发明所使用的技术手段在于：

量测指温以感知情绪放松的手指配戴件，主要包括：一个圈绕人体手指部表面，内部形成一容室的载具；在载具内设有一个电路板，该电路板上至少包括一计算单元与讯号发出元件，并配合电路板而设一感温元件，与指肤适度对应，且配合计算单元而可侦测温度，并由讯号发出元件提供信息；在所述电路板的一侧面，设有一个设有

Petitioner Samsung Ex-1004, 0832

多组对应计算单元的功能选择按键的面板；

前述的承座内部设一金属套件，该金属套件端部接合一隔热层，该感温元件由阻绝金属套件导热过大而影响指温精确的隔热层端部裸出；

前述的该承座设于载具本体的后部周缘，以使其向外突出载具本体，其开口对应指背；

前述的感温元件为一种利用红外线非接触式的感温特性配合计算单元分析而感测特定区域手指皮肤温度的红外线感测器；

前述的承座开口部位所设的感温元件为一与指肤表面形成适度接触的接触式感温元件。

本发明与现有技术相比具有明显的优势和有益效果：

由于该手指配戴件由载具本体的周缘，向外突出载具本体，而形成一开口向下的承座，该承座开口插设一感温元件，以使该感温元件与指肤表面形成适度对应，以侦测特定区域温度的状态，并能固定感温元件。因此：当手指配戴件束紧时，不影响测量部位的血管收缩与血液流通，因此指温上升可随人体自然表现；可以任意调整手指配戴件的松紧度，而不影响感温元件与手指部位的对应。不易产生滑动走位而使测量状态较为稳定；由于感测指温的感温元件在突出载具本体，因此形成开放而容易散热，因此测温纯粹可由指背测得较为精准的数据。

附图概述

图 1 为本发明立体分解图；

图 2 为本发明组合立体图；

图 3 为本发明组合平面以及系指部挠曲示意图；

图 4 为本发明接触指背平面示意图；

图 5 为本发明使用状态立体图；

图 6 为本发明以 LED 为讯号发出元件的实施例立体图；

图 7 为本发明配合红外线感测器作为感温元件的使用示意图。

本发明的实施方式

下面结合附图对本发明的具体实施例加以说明：

以下由图式说明本发明的较佳实施例，以便审查人员进一步了解本案：

请参阅图 1，配合图 2 所示，本发明关于一种量测指温以感知情绪放松的手指配戴件，主要包括：一系指部 1：为圈绕人体手指部；一载具 2：设于指部 1 表面，内部形成一容室；一电路板 3：该电路板 3 设于载具 2 内，至少包括一计算单元 31 与讯号

Petitioner Samsung Ex-1004, 0833

号发出元件 32，请参阅图 4 所示，可由一感温元件 22 与指肤相触，由电路板 3 上计算单元计算指温所传递的讯号值，并由讯号发出元件 32 提供信息；一面板 4：该面板 4 设于电路板 3 一侧面，设有多组对应计算单元 31 的功能选择按键 41；

请参阅图 1 配合图 4 所示的实施例：该手指配戴件由载具 2 本体的周缘，向外突出载具本体，而形成一开口向下的承座 21，该承座 21 开口部位设一感温元件 22，以使该感温元件与指肤表面形成适度接触，因为可以按指背依据医学原理，为一较佳的指温量测部位进行轻触指背。以此并能固定感温元件 22。

该感温元件 22 可为一种软性无毒材质并含高导热材质。

其中，本发明较佳的实施例是该承座 21 内部设一金属套件 221，以该金属套件 221 可以容纳导线 220，以及对于感温元件 22 有一承载与保护，该金属套件 221 端部接合一隔热层 222，该感温元件 22 由隔热层 222 端部裸出，又可以阻绝金属套件 221 导热过大而影响指温精确。

请参阅图 4，配合图 5 所示，当使用者配戴本发明，由于指部 1 上的载具 2 本体的周缘，向外突出载具 2 本体，而形成一开口向下的承座 21 设有感温元件 22，可与指肤相触，经由导线 220，传递至电路板 3 上的计算单元 31 测得因为温度改变所导致的例如电阻的讯号值变化，同时经由计算单元 31 运算，并由讯号发出元件 32 提供信息；该讯号元件可以是，如震动马达、LED、蜂鸣器、液晶屏幕等，图 1、图 2 与图 5 图例为屏幕，图 6 则显示为以 LED 的灯光，甚至可以颜色变化为情绪放松效果的显示为讯号发出元件；且可搭配电脑网络传输技术或无线通讯技术将讯号传递至远端，利用资料处理，由远端医师接收并为诊治。

此外，值得一提的是，由于人体手指的皮肤毛发长短不一，毛发较稀疏、较短者，除可以使用前述的感温元件直接接触测得外，另可配合感温元件如图 7 所示，以一种红外线感测器作为感温元件 22A，利用红外线非接触式的感温特性感测手指皮肤温度。

一般物体都会因为本身的温度高低发出不同的红外线能量。温度越高，物体分子就愈加活泼，因此有较高的红外能量发出。因此本发明的感温元件可以利用红外线感测器作为收集物体辐射的红外能量并将能量通过计算单元分析而把能量转化为电信号，电信号经放大并显示为温度读数。

最后应说明的是：以上实施例仅用以说明本发明而并非限制本发明所描述的技术方案；因此，尽管本说明书参照上述的各个实施例对本发明已进行了详细的说明，但是，本领域的普通技术人员应当理解，仍然可以对本发明进行修改或等同替换；而一切不脱离实用新型的精神和范围的技术方案及其改进，其均应涵盖在本发明的权利要求范围当中。

Petitioner Samsung Ex-1004, 0834

权 利 要 求 书

1、量测指温以感知情绪放松的手指配戴件，主要包括：一个圈绕人体手指部表面，内部形成一容室的载具；在载具内设有一个电路板，该电路板上至少包括一计算单元与讯号发出元件，并配合电路板而设一感温元件，与指肤适度对应，且配合计算单元而可侦测温度，并由讯号发出元件提供信息；在所述电路板的一侧面，设有一个设有多组对应计算单元的功能选择按键的面板：

其特征在于：

该手指配戴件由载具本体的周缘，向外突出载具本体，形成一开口向下的承座，该承座开口部位设有一个由载具固定的感温元件，与指肤表面形成适度对应，以侦测特定区域温度的状态。

2. 根据权利要求 1 所述的量测指温以感知情绪放松的手指配戴件，其特征在于：所述的承座内部设一金属套件，该金属套件端部接合一隔热层，该感温元件由阻绝金属套件导热过大而影响指温精确的隔热层端部裸出。

3. 根据权利要求 1 所述的量测指温以感知情绪放松的手指配戴件，其特征在于：所述的该承座设于载具本体的后部周缘，以使其向外突出载具本体，其开口对应指背。

4. 根据权利要求 1 所述的量测指温以感知情绪放松的手指配戴件，其特征在于：所述感温元件为一种利用红外线非接触式的感温特性配合计算单元分析而感测特定区域手指皮肤温度的红外线感测器。

5. 根据权利要求 1 所述的量测指温以感知情绪放松的手指配戴件，其特征在于：所述承座开口部位所设的感温元件为一与指肤表面形成适度接触的接触式感温元件。

Petitioner Samsung Ex-1004, 0835

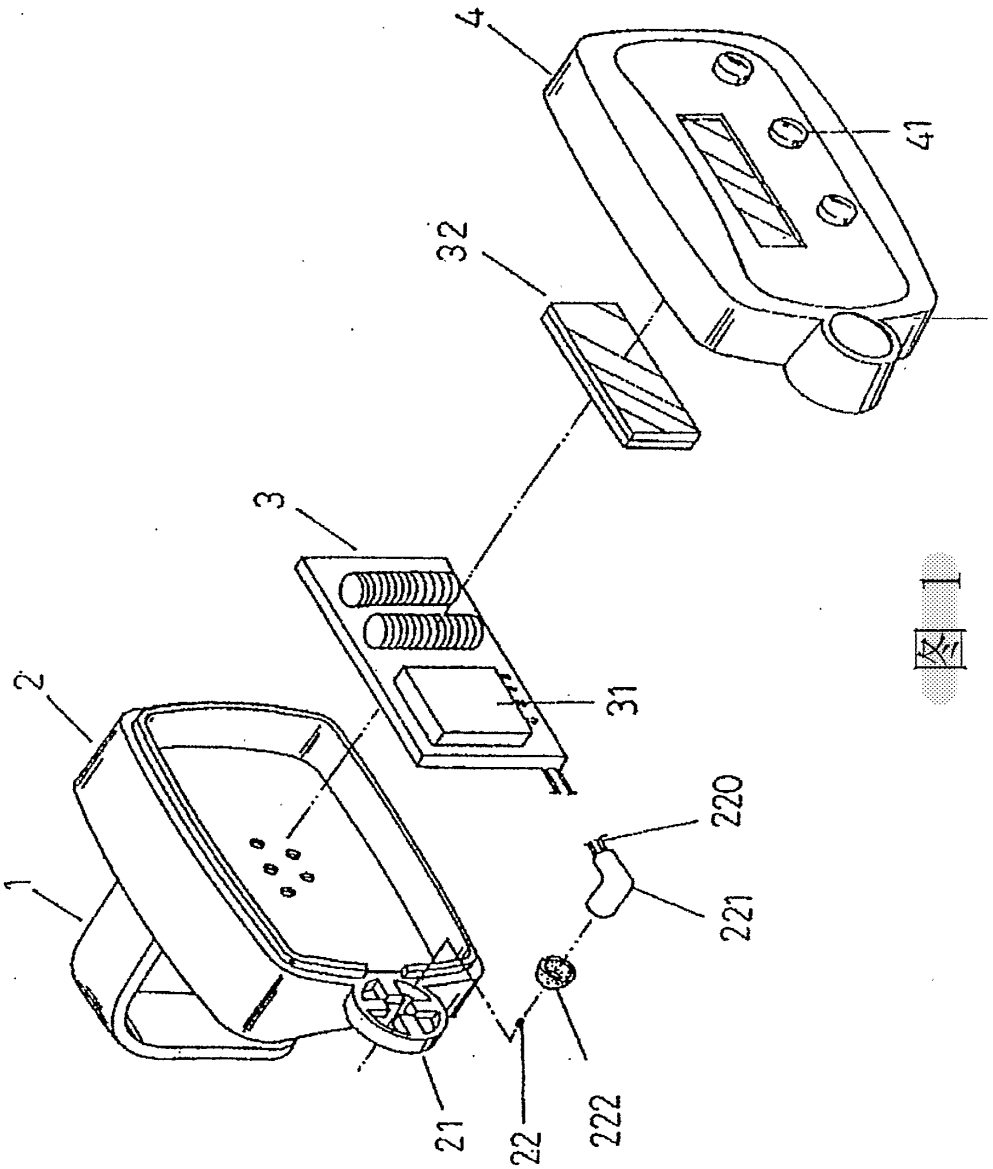


图 1

Petitioner Samsung Ex-1004, 0836

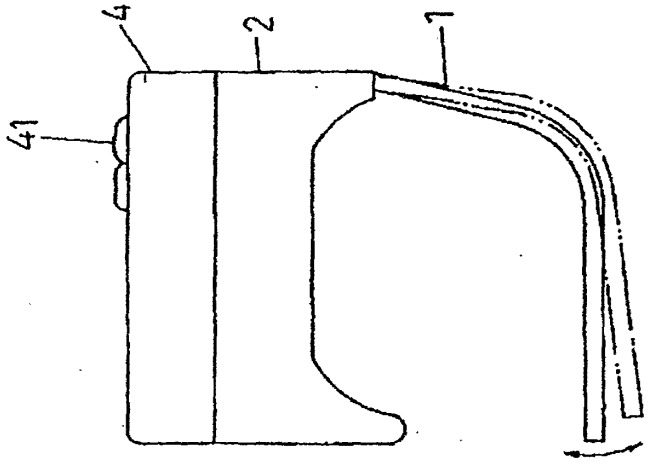


图 3

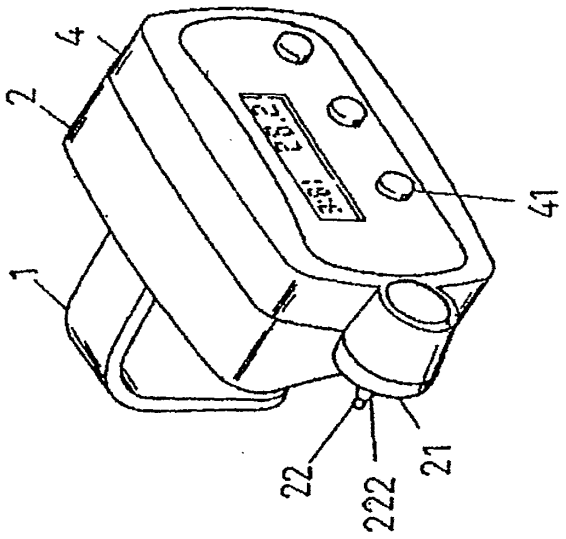


图 2

Petitioner Samsung Ex-1004, 0837

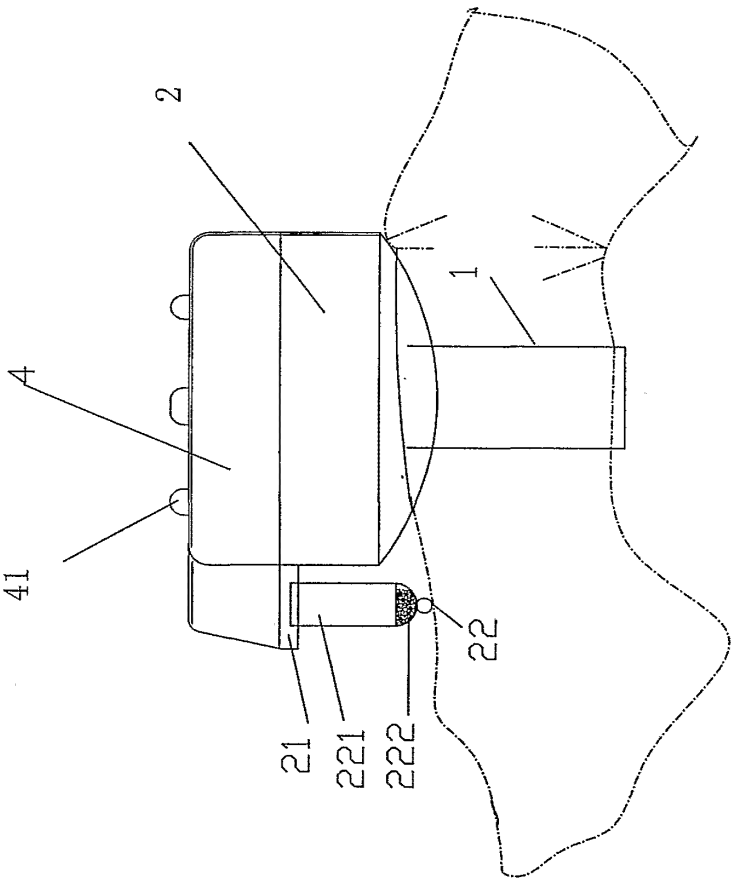


图 4

Petitioner Samsung Ex-1004, 0838

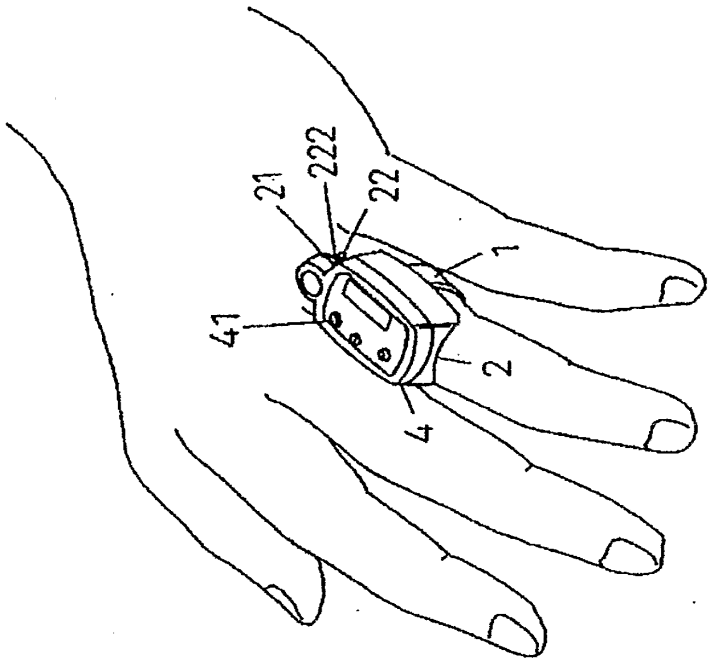


图 5

Petitioner Samsung Ex-1004, 0839

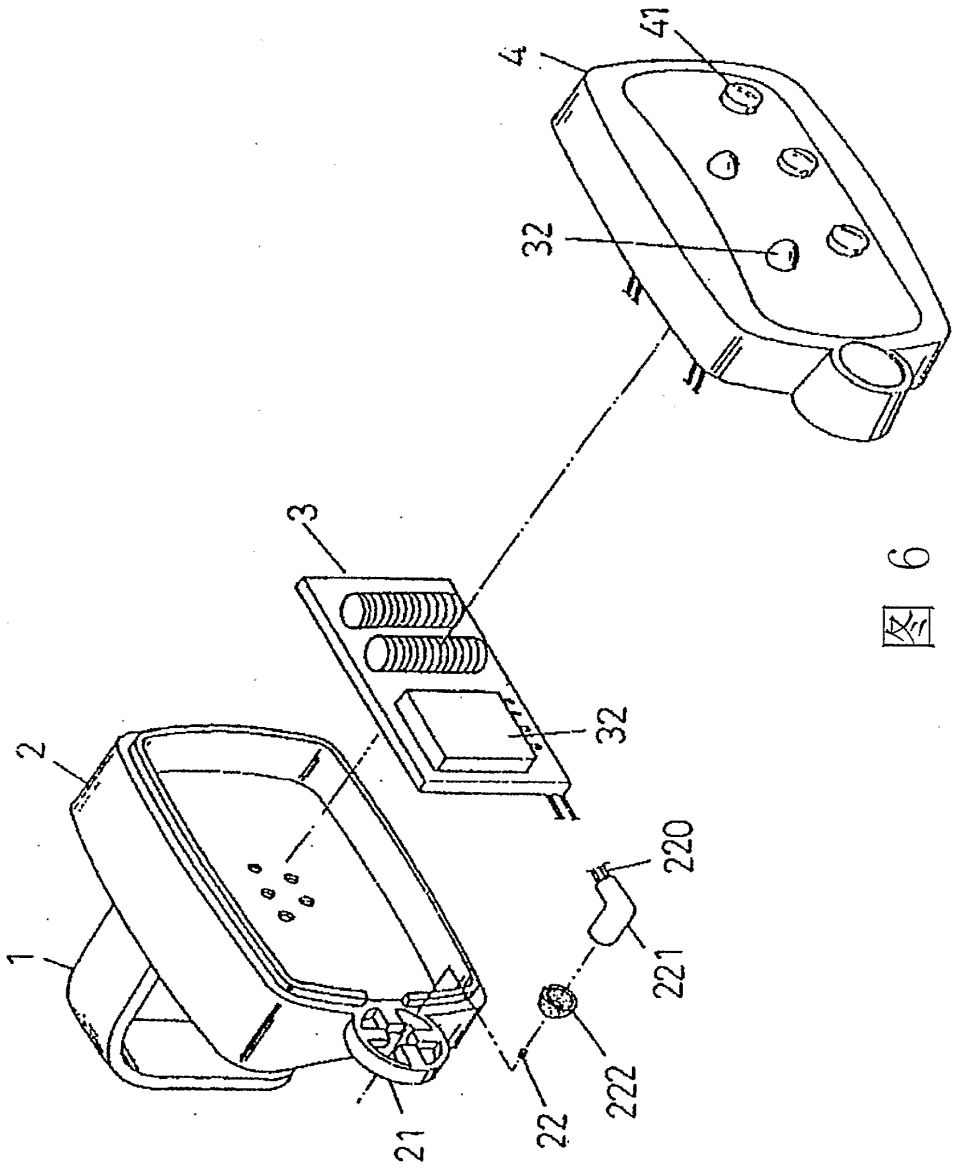


图 6

Petitioner Samsung Ex-1004, 0840

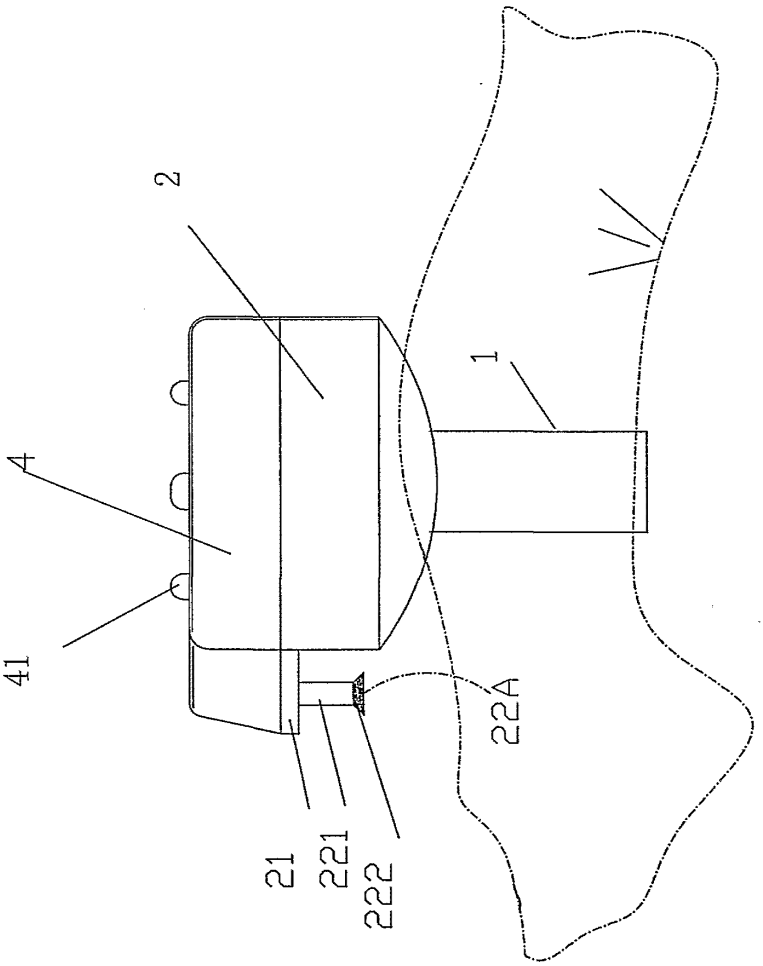


图 7

Petitioner Samsung Ex-1004, 0841

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2005/002054

A. CLASSIFICATION OF SUBJECT MATTER

A44C9/00 A61B5/16 G01K1/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC7:A44C A61B+ G01K+

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Chinese Patent Document:(1985-)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
CNPAT, WPI, EPODOC, PAJ: ring temperature finger

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US5813766A (CHEN Meiyen) 29.Sep. 1998 (29.09.1998) Col.2, line 10 to Col.3, line30, and Fig. 1-3(this document cited in the application)	1—5
A	CN2305166Y (CHEN Meiyen) 27.Jan. 1999 (27.01.1999) page 2,line 8 to page 4, line 6 and Fig. 1—3	1—5
A	US4450843A (Barney et al) 29.May. 1984 (29.05.1984) Col.2, line 26 to page 7, line 66 and Fig. 1—4	1—5
A	US5362966A (Rosenthal et al)08.Nov 1994(08.11.1994)Col. 3, line 22 to Col. 5, line 23 and Fig.1—5	1—5
A	JP57—11633A(NIPPON ELECTRIC CO)21.Jan. 1982(21.01.1982)Col. 2, line 17 to Col. 4,line 15 and Fig. 1—4	1—5
A	GB2200998A(HSIEH FUNG HSING) 17.Aug. 1988(17.08.1988)page 1,line 23 to page 3, line 28 and Fig. 1—4	1—5
A	CN3092106D (CHEN Meiyen) 02.Dec.1998(02.12.0998) all pictures	1—5

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

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"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&"document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20.Dec. 2005(12.20.2005)	05 JAN 2006 (05 · 01 · 2006)

Name and mailing address of the ISA/CN	Authorized officer
The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	NI Xiaohong Telephone No. (86-10)62085753

Form PCT/ISA /210 (second sheet) (April 2005)

Petitioner Samsung Ex-1004, 0842

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2005/002054

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
US5813766A	29.Sep. 1998	DE29715113U	30.Oct. 1997
		GB2328282A	17.Dec. 1999
		FR2767384A3	19.Feb. 1999
		CA2213145C	14.Nov. 2000
CN2305166Y	27.Jan. 1999	NONE	
US4450843A	29.May. 1984	NONE	
US5362966A	08.Nov. 1994	NONE	
JP57—11633A	21.Jan. 1982	NONE	
GB2200998A	17.Aug. 1988	NONE	
CN3092106D	02.Dec. 1998	NONE	

Form PCT/ISA /210 (patent family annex) (April 2005)

Petitioner Samsung Ex-1004, 0843

国际检索报告

国际申请号
PCT/CN2005/002054

A. 主题的分类

A44C9/00 A61B5/16 G01K1/14

按照国际专利分类表(IPC)或者同时按照国家分类和 IPC 两种分类

B. 检索领域

检索的最低限度文献(标明分类系统和分类号)

IPC7:A44C+ A61B+ G01K+

包含在检索领域中的除最低限度文献以外的检索文献

中国专利文献：（1985－）

在国际检索时查阅的电子数据库(数据库的名称，和使用的检索词（如使用）)

CNPAT：指环＋戒指 温 指

WPI， EPODOC， PAJ：ring temperature finger

C. 相关文件

类 型*	引用文件，必要时，指明相关段落	相关的权利要求
A	US5813766A (CHEN Meiyen) 29.09 月 1998（29.09.1998）说明书第 2 栏第 10 行至第 3 栏第 30 行及附图 1－3(在申请中引证)	1－5
A	CN2305166Y （陈美燕）27.01 月 1999（27.01.1999）说明书第 2 页第 8 行至第 4 页第 6 行及附图 1－3	1－5
A	US4450843A （Barney 等人）29.05 月 1984（29.05.1984）说明书第 2 栏第 26 行至第 7 页第 66 行及附图 1－4	1－5
A	US5362966A （Rosenthal 等人）08.11 月 1994（08.11.1994）说明书第 3 栏第 22 行至 5 栏第 23 行及附图 1－5	1－5
A	JP57－11633A（日本电气株式会社）21.01 月 1982（21.01.1982）说明书第 2 栏第 17 行至第 4 栏第 15 行及附图 1－4	1－5
A	GB2200998A（HSIEH FUNG HSING ） 17.08 月 1988（17.08.1988）说明书第 1 页第 23 行至第 3 页第 28 行及附图 1－4	1－5
A	CN3092106D（陈美燕 ） 02.12 月.1998(02.12.0998) 全图	1－5

☐ 其余文件在 C 栏的续页中列出。 ☒ 见同族专利附件。

* 引用文件的具体类型：

"A" 认为不特别相关的表示了现有技术一般状态的文件

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"P" 公布日先于国际申请日但迟于所要求的优先权日的文件

"T" 在申请日或优先权日之后公布，与申请不相抵触，但为了理解发明之理论或原理的在后文件

"X" 特别相关的文件，单独考虑该文件，认定要求保护的发明不是新颖的或不具有创造性

"Y" 特别相关的文件，当该文件与另一篇或者多篇该类文件结合并且这种结合对于本领域技术人员为显而易见时，要求保护的发明不具有创造性

"&" 同族专利的文件

国际检索实际完成的日期	国际检索报告邮寄日期
20. 12 月 2005（20.12.2005）	05 · 1月 2006 (05 · 01 · 2006)
中华人民共和国国家知识产权局(ISA/CN) 中国北京市海淀区蓟门桥西土城路 6 号 100088 传真号： (86-10)62019451	受权官员 倪晓红 电话号码：(86-10)62085753

Petitioner Samsung Ex-1004, 0844

国际检索报告
关于同族专利的信息

国际申请号
PCT/CN2005/002054

检索报告中引用的专利文件	公布日期	同族专利	公布日期
US5813766A	29.09 月 1998	DE29715113U	30.10 月 1997
		GB2328282A	17.12 月 1999
		FR2767384A3	19.02 月 1999
		CA2213145C	14.11 月 2000
CN2305166Y	27.01 月 1999	无	
US4450843A	29.05 月 1984	无	
US5362966A	08.11 月 1994	无	
JP57－11633A	21.01 月 1982	无	
GB2200998A	17.08 月 1988	无	
CN3092106D	02.12 月.1998	无	

Petitioner Samsung Ex-1004, 0845

(19)中华人民共和国国家知识产权局

(12)实用新型专利

(10)授权公告号 CN 204732935 U
(45)授权公告日 2015.10.28

(21)申请号 201520504255.1

(22)申请日 2015.07.13

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(51)Int.Cl.
H02J 7/00(2006.01)

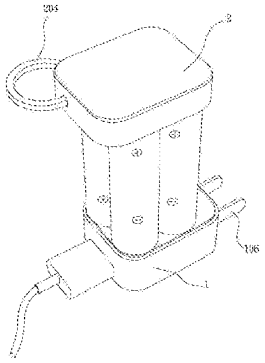
权利要求书1页 说明书3页 附图7页

(54)实用新型名称

一种微型充电器

(57)摘要

本实用新型公开了一种微型充电器，包括基座和顶盖，其中基座和顶盖均为中空结构，基座和顶盖内部均设有磁铁片和隔磁片，基座和顶盖上均嵌有电极片，基座内还设有电路板和电源插头，基座外部还设有智能设备充电插头和USB接口，基座上的电极片、电源插头、智能设备充电插头和USB接口均与电路板相连，顶盖上还设有钥匙环。本实用新型不使用时，基座和顶盖可通过磁铁片的吸附作用而合为一个整体，当需要使用干电池或充电电池时，将基座和顶盖分开，通过磁铁片将电池吸附住、固定在基座和顶盖之间，通过电极片形成通路使得电池和电路板相连，即可通过电源插头为电池或其他设备充电，或者通过电池为其他设备充电，因而不仅使用方便，而且易于携带。



CN 204732935 U

Petitioner Samsung Ex-1004, 0846

1. 一种微型充电器，其特征在于，包括基座 (1) 和顶盖 (2)，其中：所述基座 (1) 包括第一外壳 (101) 和第一内壳 (102)，所述第一外壳 (101) 和第一内壳 (102) 构成中空结构，所述基座 (1) 内设有电路板 (103)、磁铁片 (3)，所述第一内壳 (102) 上镶嵌有与电路板 (103) 相连的电极片 (4)，所述磁铁片 (3) 位于电极片 (4) 与电路板 (103) 之间，所述第一内壳 (102) 上设有与电路板 (103) 相连的智能设备充电插头 (104)；

所述基座 (1) 内设有插头滑槽 (105)，所述插头滑槽 (105) 内设有与电路板 (103) 相连的电源插头 (106)；

所述顶盖 (2) 包括第二外壳 (201) 和第二内壳 (202)，所述第二外壳 (201) 和第二内壳 (202) 构成中空结构，所述顶盖 (2) 内也设有磁铁片 (3)，所述第二外壳 (201) 上也镶嵌有电极片 (4)，所述第二内壳 (202) 上设有与智能设备充电插头 (104) 相匹配的插孔 (203)。

2. 如权利要求 1 所述的一种微型充电器，其特征在于：所述基座 (1) 和顶盖 (2) 内还均设有隔磁片 (5)，所述隔磁片 (5) 设于磁铁片 (3) 远离电极片 (4) 的一侧。

3. 如权利要求 1 所述的一种微型充电器，其特征在于：所述基座 (1) 上还设有与电路板 (103) 相连的 USB 插口 (107)。

4. 如权利要求 1 所述的一种微型充电器，其特征在于：所述电极片 (3) 为弹性接触片，所述第一内壳 (102) 和第二内壳 (202) 上设有用于放置电池正极的凹槽 (6)。

5. 如权利要求 1 所述的一种微型充电器，其特征在于：所述顶盖 (2) 上还设有钥匙环 (204)。

Petitioner Samsung Ex-1004, 0847

一种微型充电器

技术领域

[0001] 本实用新型涉及一种电子设备充电装置，尤其是一种微型充电器。

背景技术

[0002] 随着科技的发展，手机、平板电脑已成为人们生活、工作中通讯、获取信息的必备工具，其功能越来越强大，人们对其性能要求也越来越高，如电池容量和续航能力，但由于锂离子电池技术一直停滞不前，相对手机性能的几何级数增长，手机电池的续航能力却愈发捉襟见肘，人们只能简单地增加电池容量来提升手机续航能力，或者依靠额外的移动电源来应对手机长时间无法充电的状况，而当人们长时间处于野外或遇到停电等突发状况时，移动电源也将失去作用，此时人们就需要一种应急充电设备，可以将其他电源转化为手机供电电源。为此人们开发出了一些利用干电池为手机进行应急充电的装置，如申请号为CN201320139060.2的申请文件公开了一种可利用干电池充电的手机壳，其具有专门用于放置干电池的电池仓，因此具有体积较大的缺点，不利于随身携带。

实用新型内容

[0003] 针对现有技术中的上述问题，本实用新型提出了一种微型充电器。

[0004] 本实用新型的技术方案为：一种微型充电器，包括基座和顶盖，其中所述基座包括第一外壳和第一内壳，所述第一外壳和第一内壳构成中空结构，所述基座内设有电路板、磁铁片，所述第一内壳上镶嵌有与电路板相连的电极片，所述磁铁片位于电极片与电路板之间，所述第一内壳上设有与电路板相连的智能设备充电插头；

[0005] 所述基座内设有插头滑槽，所述插头滑槽内设有与电路板相连的电源插头；

[0006] 所述顶盖包括第二外壳和第二内壳，所述第二外壳和第二内壳构成中空结构，所述顶盖内也设有磁铁片，所述第二外壳上也镶嵌有电极片，所述第二内壳上设有与智能设备充电插头相匹配的插孔。

[0007] 进一步地，所述基座和顶盖内还均设有隔磁片，所述隔磁片设于磁铁片远离电极片的一侧。

[0008] 进一步地，所述基座上还设有与电路板相连的USB插口。

[0009] 进一步地，所述电极片为弹性接触片，所述第一内壳和第二内壳上设有用于放置电池正极的凹槽。

[0010] 进一步地，所述顶盖上还设有钥匙环。

[0011] 本实用新型通过设于基座和顶盖内的磁铁片可将干电池或充电电池吸附在底座和顶盖之间，并通过电极片连成通路并与电路板相连，从而可用于通过智能设备充电插头或者USB接口为其他设备充电；同时可利用电源插头连接外接电源，外接电源电压经过电路板转化后即可为充电电池充电，或者通过智能设备充电插头或USB接口为其他设备充电。

[0012] 与现有技术相比，本实用新型的有益效果是：

Petitioner Samsung Ex-1004, 0848

[0013] ①本实用新型通过在基座和顶盖内部均设置磁铁片，在不使用时，基座和顶盖可通过磁铁片的吸附作用而合为一个整体，此时基座上的智能设备充电插头可插入顶盖的插孔内，有效保护智能设备充电插头；当需要使用干电池或充电电池时，将基座和顶盖分开，通过磁铁片和电极片可将电池吸附住并固定在基座和顶盖之间，无需设置额外的导线，也无需配置放置电池的电池仓，使得本实用新型体积十分小巧、易于携带；

[0014] ②本实用新型集成了可收放的电源插头，因而可通过外接电源为设备或电池充电，功能更加全面；

[0015] ③本实用新型通过在顶盖上设置钥匙环，可用于悬挂在钥匙扣上或手提包上，便于随身携带；

[0016] ④本实用新型通过在磁铁片一侧设置隔磁片，以隔绝磁铁片对电路板或其他设备的影响，因此避免了磁铁片影响外部电子设备而导致的安全问题；

[0017] ⑤本实用新型采用弹性接触片作为连接电池的电极片，当电池长度尺寸不一时也可保证接触良好，使其正常工作，保证了产品的性能；同时通过设置凹槽使得电池固定得更加牢固。

附图说明

[0018] 图 1 为本实用新型的主视图。

[0019] 图 2 为本实用新型的立体视图。

[0020] 图 3 为本实用新型的又一立体视图。

[0021] 图 4 为本实用新型所述基座的立体视图。

[0022] 图 5 为本实用新型所述顶盖的立体视图。

[0023] 图 6 为本实用新型的内部结构示意图。

[0024] 图 7 为本实用新型的应用参考图。

[0025] 图中：1- 基座，101- 第一外壳，102- 第一内壳，103- 电路板，104- 智能设备充电插头，105- 插头滑槽，106- 电源插头，107-USB 插口，2- 顶盖，201- 第二外壳，202- 第二内壳，203- 插孔，204- 钥匙环，3- 磁铁片，4- 电极片，5- 隔磁片，6- 凹槽。

具体实施方式

[0026] 下面结合附图及实施例对本实用新型中的技术方案进一步说明。

[0027] 如图 1 ～图 7 所示，本实用新型包括基座 1 和顶盖 2，其中：所述基座 1 包括第一外壳 101 和第一内壳 102，所述第一外壳 101 和第一内壳 102 构成中空结构，所述基座 1 内设有电路板 103、磁铁片 3，所述第一内壳 101 上镶嵌有与电路板 103 相连的电极片 4，所述磁铁片 3 位于电极片 4 与电路板 103 之间，所述第一内壳 101 上设有与电路板 103 相连的智能设备充电插头 104，所述基座 1 内设有插头滑槽 105，所述插头滑槽 105 内设有与电路板 103 相连的电源插头 106；所述基座 1 上还设有与电路板 103 相连的 USB 插口 107；

[0028] 如图 5、图 6 所示，所述顶盖 2 包括第二外壳 201 和第二内壳 202，所述第二外壳 201 和第二内壳 202 构成中空结构，所述顶盖 2 内也设有磁铁片 3，所述第二外壳 201 上也镶嵌有电极片 4，所述第二内壳 202 上设有与智能设备充电插头 104 相匹配的插孔 203，所述顶盖上设有钥匙环 204；

Petitioner Samsung Ex-1004, 0849

[0029] 所述基座 1 和顶盖 2 内还均设有隔磁片 5，所述隔磁片 5 设于磁铁片 3 远离电极片 4 的一侧；所述电极片 4 为弹性接触片，所述第一内壳 102 和第二内壳 202 上设有用于放置电池正极的凹槽 6。

[0030] 以上所述仅为本实用新型的较佳实施例而已，并不用以限制本实用新型，凡在本实用新型的精神和原则之内，所作的任何修改、等同替换、改进等，均应包含在本实用新型的保护范围之内。

Petitioner Samsung Ex-1004, 0850

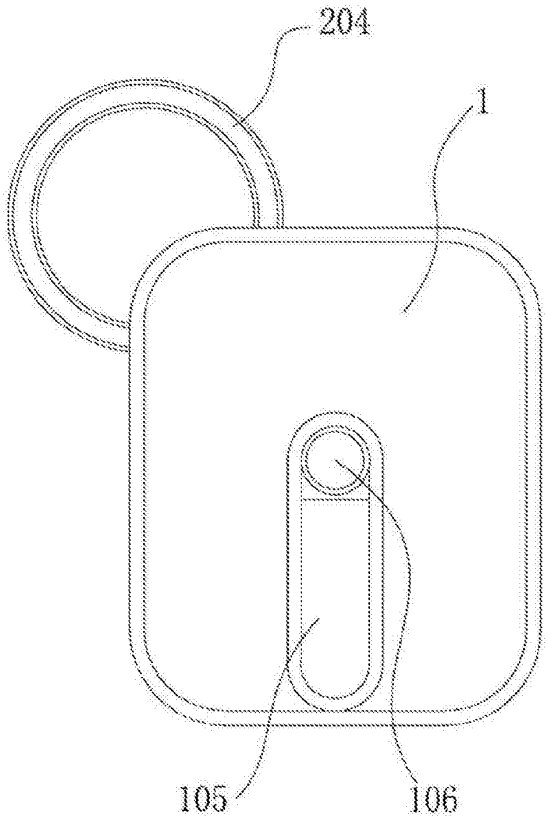


图 1

Petitioner Samsung Ex-1004, 0851

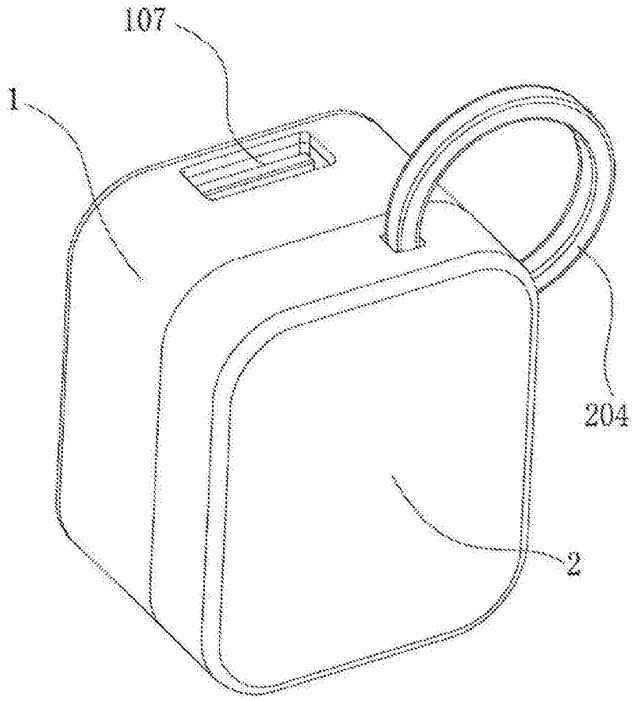


图 2

Petitioner Samsung Ex-1004, 0852

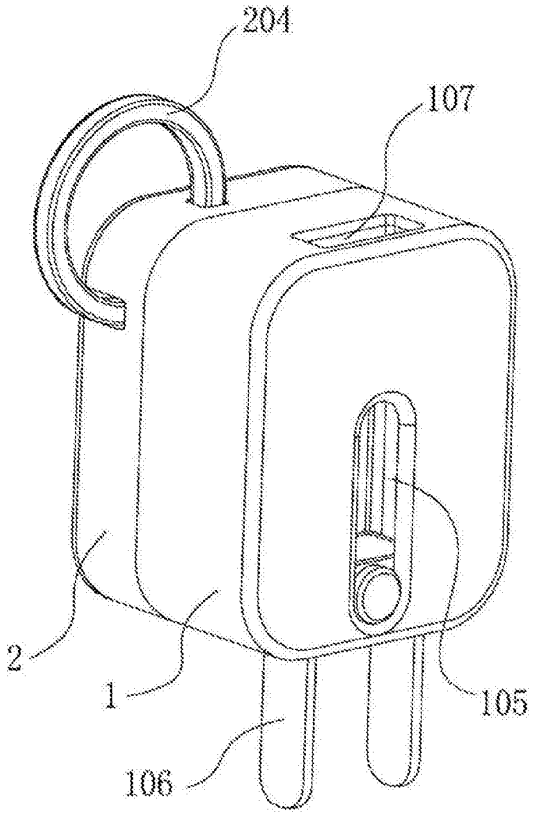


图 3

Petitioner Samsung Ex-1004, 0853

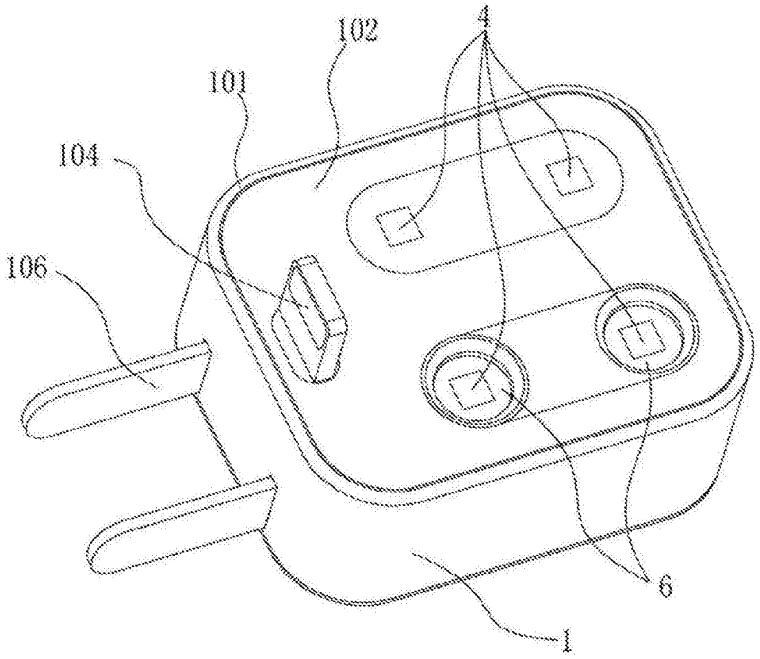


图 4

Petitioner Samsung Ex-1004, 0854

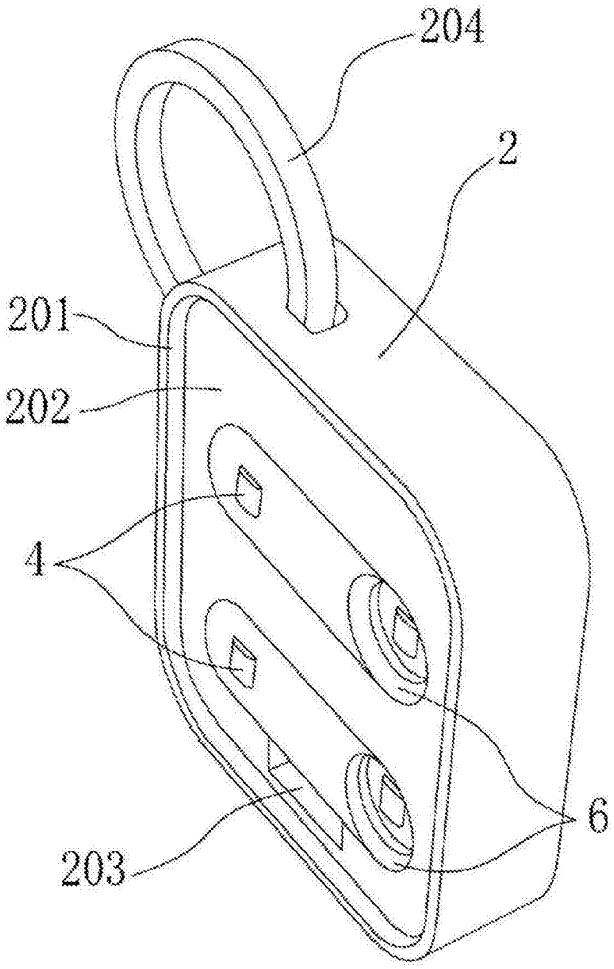


图 5

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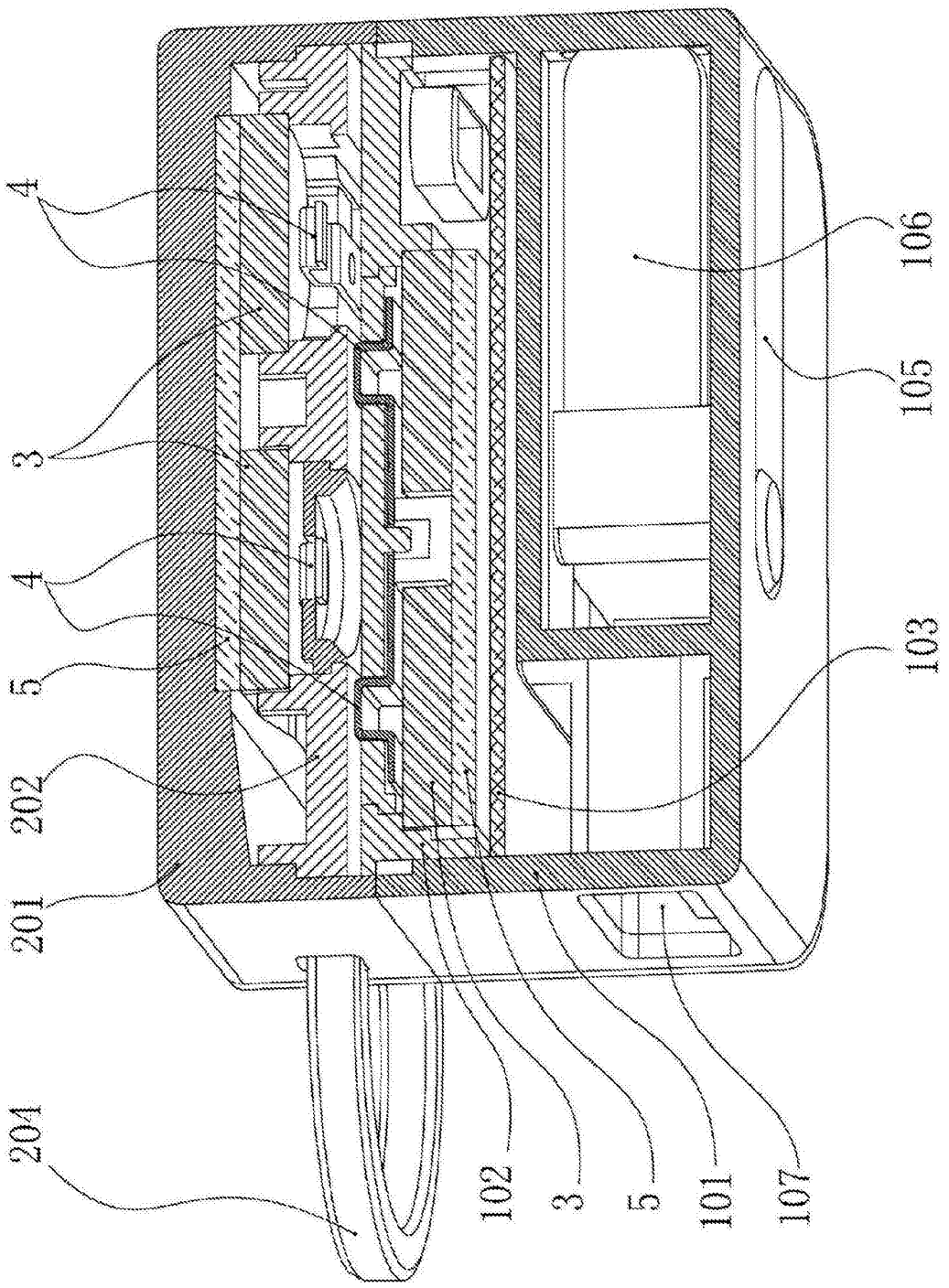


图 6

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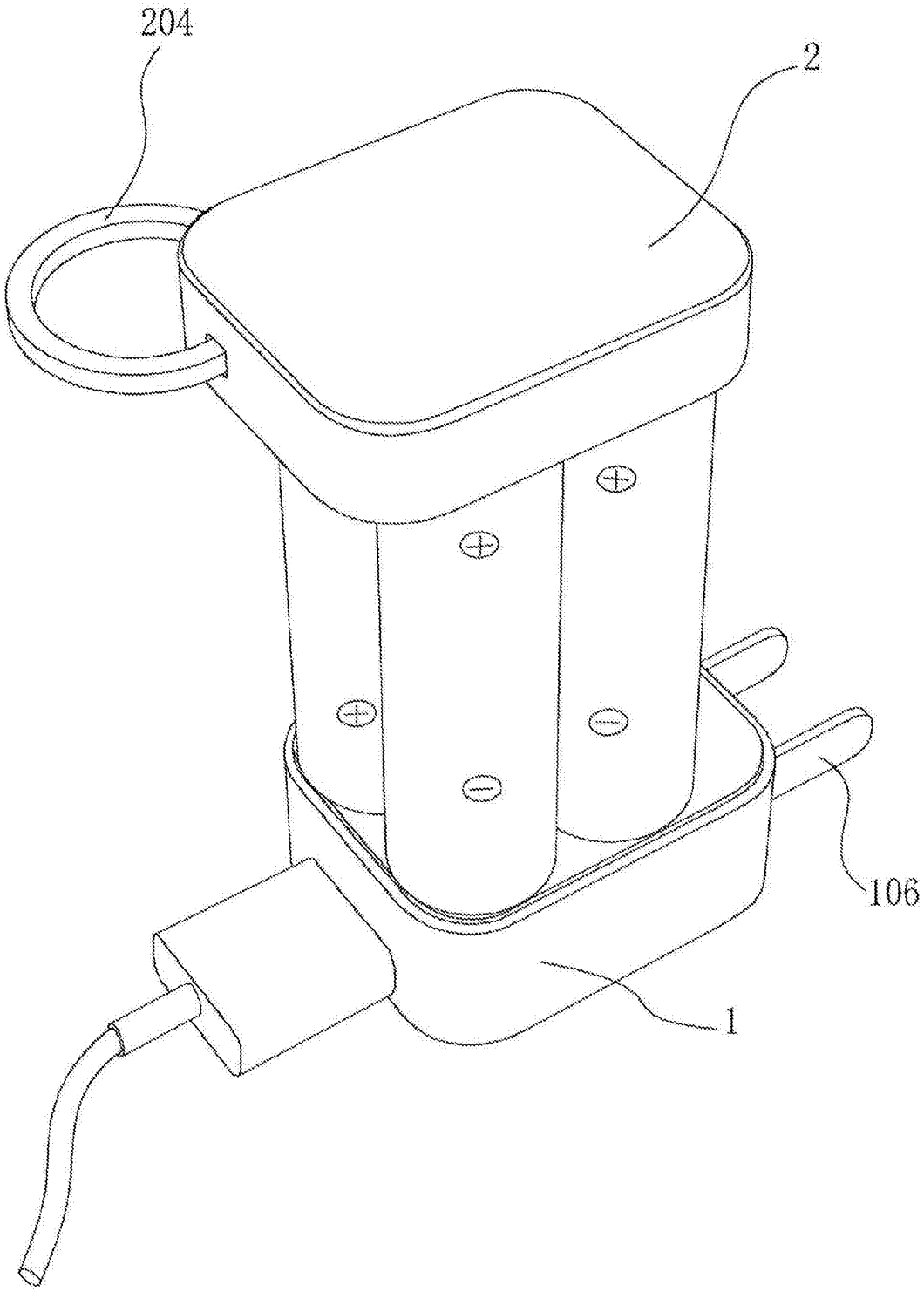


图 7

Petitioner Samsung Ex-1004, 0857

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
8 October 2009 (08.10.2009)

PCT

(10) International Publication Number
WO 2009/124076 A1

(51) International Patent Classification:
A61B 5/00 (2006.01)

(21) International Application Number:
PCT/US2009/039002

(22) International Filing Date:
31 March 2009 (31.03.2009)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/072,600 31 March 2008 (31.03.2008) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

WO 2009/124076 A1

(54) Title: MEDICAL MONITORING PATCH DEVICE AND METHODS

(57) Abstract: Embodiments described herein may include systems and methods for monitoring physiological parameters of a patient. Specifically, embodiments disclose the use of a generally self-contained pulse oximeter that is small and lightweight, such that it may be comfortably affixed to a patient to provide physiological data pertaining to the patient. Embodiments also provide methods of using and manufacturing a pulse oximetry patch.

Petitioner Samsung Ex-1004, 0858

MEDICAL MONITORING PATCH DEVICE AND METHODS

BACKGROUND

[0001] The present disclosure relates generally to medical devices and, more particularly, to medical monitoring devices.

[0002] This section is intended to introduce the reader to various aspects of art that may be related to various aspects of the present disclosure, which are described and/or claimed below. This discussion is believed to be helpful in providing the reader with background information to facilitate a better understanding of the various aspects of the present disclosure. Accordingly, it should be understood that these statements are to be read in this light, and not as admissions of prior art.

[0003] In the field of medicine, doctors often desire to monitor certain physiological characteristics of their patients. Accordingly, a wide variety of devices have been developed for monitoring physiological characteristics. Such devices provide doctors and other healthcare personnel with the information they need to provide the best possible healthcare for their patients. As a result, such monitoring devices have become an indispensable part of modern medicine.

[0004] One technique for monitoring certain physiological characteristics of a patient is commonly referred to as pulse oximetry, and the devices built based upon pulse oximetry techniques are commonly referred to as pulse oximeters. Pulse oximetry

Petitioner Samsung Ex-1004, 0859

may be used to measure various blood flow characteristics, such as the blood-oxygen saturation of hemoglobin in arterial blood, the volume of individual blood pulsations supplying the tissue, and/or the rate of blood pulsations corresponding to each heartbeat of a patient.

[0005] Pulse oximeters typically utilize a non-invasive sensor that is placed on or against a patient's tissue that is well perfused with blood, such as a patient's finger, toe, forehead or earlobe. The pulse oximeter sensor emits light and photoelectrically senses the absorption and/or scattering of the light after passage through the perfused tissue. The data collected by the sensor may then be used to calculate one or more of the above physiological characteristics based upon the absorption or scattering of the light. More specifically, the emitted light is typically selected to be of one or more wavelengths that are absorbed or scattered in an amount related to the presence of oxygenated versus de-oxygenated hemoglobin in the blood. The amount of light absorbed and/or scattered may then be used to estimate the amount of the oxygen in the tissue using various algorithms.

[0006] Pulse oximeters and other medical devices are typically mounted on stands that are positioned around a patient's bed or around an operating room table. When a caregiver desires to command the medical device (e.g., program, configure, and so-forth), the caregiver may manipulate controls or push buttons on the monitoring device itself. The monitoring device typically provides results or responses to commands on a Liquid Crystal Display ("LCD") screen mounted in an externally visible position on the medical device. Patient data, alerts, and other information may be

Petitioner Samsung Ex-1004, 0860

displayed on the monitor directly, or may be transmitted to a central computer monitored by caregivers.

[0007] This conventional configuration, however, may have several disadvantages, particularly in emergency situations which may occur remotely from a hospital or medical environment. For example, conventional monitors are too heavy and bulky to be worn or constantly moved around to follow a patient. Additionally, in emergency situations, a convenient power supply may not be readily available, and the time required to set up the monitoring system may not be available considering other pressing emergency needs of the patient. The lack of time or a convenient power source may be particularly problematic in large scale emergencies wherein several patients require prompt medical treatment from limited medical personnel working with limited resources. Additionally, the bulk and expense of conventional monitors may make it logistically and economically unfeasible to have large numbers of such monitors on-hand and ready to be transported to emergency sites. It may be desirable, therefore, to have a pulse oximeter that is small, lightweight, inexpensive and battery operated, such that it can be worn by a patient and possibly disposed of after a single use.

SUMMARY

[0008] Certain aspects commensurate in scope with the original claims are set forth below. It should be understood that these aspects are presented merely to provide the reader with a brief summary of certain embodiments and that these aspects are not intended to limit the scope of the claims. Indeed, the claims and disclosure may encompass a variety of aspects that may not be set forth below.

Petitioner Samsung Ex-1004, 0861

[0009] Some embodiments described herein are directed to a wholly contained pulse oximetry system that may be worn by a patient. Certain embodiments may include an upper layer that includes a display, a bottom layer that includes one or more light emitters and one or more light detectors for acquiring physiological data from a patient and a middle layer between the upper layer and lower layer that holds the circuitry of the pulse oximetry system, including sensor circuitry, parameter processing circuitry, and display circuitry.

[0010] Other embodiments described herein are directed to methods of generating physiological data by a pulse oximetry system that is worn by a patient in the form of a patch for example. The pulse oximetry system may perform the acts of: driving LEDs to emit a light signal into a tissue to be tested; receiving a modified light signal after it has been transmitted through or reflected from the tissue to be tested; generating a physiological parameter based on the modified light signal; and generating a display output of the physiological parameter on an outer surface of the patch.

[0011] Other embodiments described herein are directed to methods of monitoring a patient by affixing a wholly contained pulse oximeter to the tissue of a patient and observing a physiological data display included on the pulse oximeter.

[0012] Still other embodiments described herein are directed to a method of manufacturing a pulse oximeter, such as by providing pulse oximeter circuitry configured to sense, process, and display physiological data of a patient, and enclosing

Petitioner Samsung Ex-1004, 0862

the pulse oximeter circuitry within an enclosure configured to be disposed adjacent to a tissue of the patient.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] Advantages of the disclosure may become apparent upon reading the following detailed description and upon reference to the drawings in which:

[0014] Fig. 1A is a perspective view of a pulse oximetry patch in accordance with an embodiment in which the display includes a pair of light emitting diodes (LEDs);

[0015] Fig. 1B is a perspective view of a pulse oximetry patch in accordance with an embodiment in which the display includes a numerical display;

[0016] Fig. 2 is a perspective view of the back side of the pulse oximetry patch of Figs. 1A or 1B in accordance with an embodiment;

[0017] Fig. 3 is a depiction of a pulse oximetry patch of Figs. 1A or 1B disposed adjacent to the forehead of a patient in accordance with an embodiment;

[0018] Fig. 4 is a block diagram of a pulse oximeter of Figs. 1A or 1B in accordance with an embodiment;

[0019] Fig. 5 is a perspective exploded view of the pulse oximeter of Fig. 1A in accordance with an embodiment;

[0020] Fig. 6 is a perspective view of the back side of the pulse oximeter circuit board of Fig. 5 in accordance with an embodiment.

DETAILED DESCRIPTION

[0021] One or more embodiments will be described below. In an effort to provide a concise description of these embodiments, not all features of an actual

Petitioner Samsung Ex-1004, 0863

implementation are described in the specification. It should be appreciated that in the development of any such actual implementation, as in any engineering or design project, numerous implementation-specific decisions must be made to achieve the developers' specific goals, such as compliance with system-related and business-related constraints, which may vary from one implementation to another. Moreover, it should be appreciated that such a development effort might be complex and time consuming, but would nevertheless be a routine undertaking of design, fabrication, and manufacture for those of ordinary skill having the benefit of this disclosure.

[0022] Certain embodiments relate to a wholly contained pulse oximetry system that is small and lightweight such that it can be worn by a patient. Such a pulse oximetry system may be a small, battery operated, flexible patch that may be adhesively or otherwise affixed to a patient. Such a patch may be used once and thrown away. Therefore, such a pulse oximetry patch may be constructed inexpensively, having very simplified features and displays compared to a traditional pulse oximetry system.

[0023] Fig. 1A is a perspective view of a front side of pulse oximetry patch **10** in accordance with an embodiment. The front side of the pulse oximetry patch **10** is the side that would be visible to a caregiver after the pulse oximetry patch **10** is affixed to a patient. The pulse oximetry patch **10** may be small enough to be affixed to a patient and also holds circuitry utilized for sensing, processing and displaying physiological data of a patient. Because the pulse oximetry patch **10** is to be affixed to a patient, it will typically be small and lightweight. For example, it may have a surface area in the range of approximately three or four square inches, and a thickness

Petitioner Samsung Ex-1004, 0864

in the range of one-eighth of an inch. Additionally, to provide for a secure and comfortable fit, the patch **10** may be flexible. Furthermore, the patch **10** may also include various textual printing on the outer surface, such as, for example, labels, use instructions and model information. As will be explained in more detail below, the patch **10** may be made of any material known in the art such as, for example, polymeric materials.

[0024] The pulse oximetry patch **10** may also include a display, illustrated here as two displays **14** and **16**, which display certain physiological data of a patient. The displays **14** and **16** may display any data that is useful to a caregiver monitoring a patient. As example, the display **14** may include an LED that blinks correlatively with the heart beat of the patient. For another example, the display **16** may be activated or deactivated in response to the blood-oxygen saturation level of a patient. Specifically, in some embodiments the display **16** may light up when the patient's blood-oxygen level is above acceptable levels, informing the caregiver that the patient's blood-oxygen level is normal. In alternate embodiments, the display **16** may light up when the patient's blood-oxygen level is below acceptable levels, alerting the caregiver that the patient's blood-oxygen level is too low. Furthermore, the displays **14** and **16** may be color coded. For example, the display **16** may include an LED that emits green light when blood-oxygen levels are normal and emits red light when blood-oxygen levels are too low.

[0025] Referring to Fig. 1B, an embodiment that includes a numerical display **18** is shown. The numerical display **18** may be configured to display any useful numerical data corresponding to a physiological parameter of a patient, such as, for

Petitioner Samsung Ex-1004, 0865

example, a pulse rate and/or a blood-oxygen saturation level. Additionally, the numerical display **18** may be configured to display data corresponding to the pulse oximetry patch **10** itself, such as, for example, battery life and/or whether the patch **10** is transmitting a wireless signal. Furthermore, the display **18** may be configured to cycle through a set of numerical data, either on a timed basis or responsive to an input of the user.

[0026] Referring to Fig. 2, one example of the back side of the pulse oximetry patch **10** is shown. The back side **12** of the pulse oximetry patch **10** is the side that is affixed adjacent to the tissue of a patient. As will be explained further below, the pulse oximetry patch **10** detects physiological data of a patient through sensor circuitry that may include an emitter **19** and a detector **20**. The emitter **19** may include one or more LEDs, such as a red LED and an infra-red LED. The detector **20** may be, for example, any kind of photosensor known in the art, such as, for example a photodiode. When operable, both the emitter **19** and detector **20** are in contact with the skin or tissue of a patient.

[0027] To hold the pulse oximetry patch **10** against the patient, the back side **12** of the patch **10** may include an adhesive **22** that is configured to hold the pulse oximetry patch **10** against the skin of a patient. Additionally, to protect the adhesive **22** while the pulse oximetry patch **10** is not in use, a protective sheet **24** may be disposed over the adhesive **22**. The protective sheet **24** may be configured to be removed just prior to the pulse oximetry patch **10** being affixed to the skin of a patient.

Petitioner Samsung Ex-1004, 0866

[0028] The pulse oximetry patch **10** may be disposed adjacent to any part of a patient's body that is conducive to measuring physiological parameters and that can support the pulse oximetry patch **10**, such as for example, the forehead or the wrist. It should also be noted that the pulse oximetry patch **10** may be calibrated for use over a particular bodily area or tissue measurement site.

[0029] Referring to Fig. 3, an embodiment of a pulse oximetry patch **10** may be held by a headband **28** adjacent to the forehead of a patient **26** above the left eye, for example. A typical headband **28** may be affixed to the pulse oximetry patch **10** along the edges **29** of the pulse oximetry patch **10**. The headband **28** may be made of an elastic material configured to stretch to fit a wide range of head sizes. Additionally, the headband **28** may include a buckle **30** designed to adjust the fit of the headband **28**. In alternate embodiments, the pulse oximetry patch **10** may be held in place with an external adhesive bandage (not shown). In fact, many techniques will be recognized by one of ordinary skill in the art for holding the pulse oximetry patch **10** against the skin of a patient, and the examples recited above should not be considered an exhaustive list of possible embodiments.

[0030] Turning now to Fig. 4, a block diagram of a pulse oximetry patch **10** is illustrated in accordance with an embodiment. It will be understood that an actual implementation may include more or fewer components as needed for a specific application. In this embodiment, the pulse oximetry patch **10** may include a red emitter **19A** and an infra-red emitter **19B** that are configured to transmit electromagnetic radiation through the tissue of a patient **26**. In accordance with this embodiment, the emitters **19A** and **19B** may include an LED that emits

Petitioner Samsung Ex-1004, 0867

electromagnetic radiation in the respective region of the electromagnetic spectrum. The emitted radiation transmitted from the emitters **19A** and **19B** into a patient's tissue is detected by the detector **20** after the radiation has passed through or reflected from blood perfused tissue of a patient **26**. The detector **20** generates a photoelectrical signal correlative to the amount of radiation detected.

[0031] The signal generated by the detector **20** may then be amplified by an amplifier **34**, filtered by a filter **36**, and provided to one or more processor(s) **38**. The processor(s) **38** may include an analog-to-digital converter **52** that converts the analog signal provided by the detector **20** into a digital signal. The analog-to-digital converter **52** may provide the digital signal to the core **54** to be processed for computing physiological parameters related to the patient **26**. For example, the core **54** may compute a percent oxygen saturation of hemoglobin and/or a pulse rate, among other useful physiological parameters, as will be appreciated by one of ordinary skill in the art. By utilizing an analog-to-digital converter **52** within the processor(s) **38**, the size and cost of the patch may be reduced, compared to traditional pulse oximeters that use a separate analog-to-digital converter. In presently contemplated embodiments, the processor(s) **38** may include a Mixed-Signal Microcontroller such as model number C8051F353 available from Silicon Laboratories.

[0032] In addition to computing physiological parameters, the processor(s) **38** may control the timing and intensity of the emitted electromagnetic radiation of the emitters **19A** and **19B** via a light drive circuit **40**. In embodiments, the light drive circuit **40** may be driven by a digital-to-analog converter **48**, included in the

Petitioner Samsung Ex-1004, 0868

processor(s) **38**. By utilizing a digital to analog converter **48** within the microprocessor **38**, the size and cost of the patch may be reduced, compared to traditional pulse oximeters that use a separate digital-to-analog converter. In accordance with an embodiment, the light drive circuit **40** may have a low part count such as the light drive circuit discussed in detail in U.S. Provisional Patent Application No. 61/009,076, entitled "LED Drive Circuit and Method for Using Same." (TYHC:0008) which was filed December 26, 2007, and is incorporated herein by reference in its entirety for all purposes. The reduced part count of the drive circuit **40** may further reduce the size, complexity, and cost of the pulse oximetry patch **10**.

[0033] Furthermore, the processor(s) **38** may also include a RAM **56** and/or a flash memory **58** coupled to the core processor **54**. The RAM **56** may be used to store intermediate values that are generated in the process of calculating patient parameters. The flash memory **58** may store certain software routines used in the operation of the patch **10**, such as measurement algorithms, LED drive algorithms, and patient parameter calculation algorithms, for example. In certain embodiments, the patch **10** may include simplified pulse oximetry algorithms such that the computer code associated with those algorithms may be contained in the memory components of the processor(s) **38**.

[0034] In some embodiments, the pulse oximetry patch **10** may also include other memory components that are not included in the processor(s) **38**. For example, the patch **10** may include a read-only memory (ROM), which may be used to store such things as operating software for the patch **10** and algorithms for computing

Petitioner Samsung Ex-1004, 0869

physiological parameters. In other embodiments, however, all of the processing memory and measurement software is included in the processor(s) **38**.

[0035] Furthermore, in some embodiments, the patch **10** may also include a long-term memory device used for long-term storage of measured data, such as measured physiological data or calculated patient parameters. In other embodiments, however, the cost and/or part count of the pulse oximetry patch **10** may be further reduced by eliminating any long-term storage of measured data. By eliminating long-term storage of measured data, smaller, less expensive memory components may be utilized, or, alternatively, some memory components may be eliminated. This may reduce the part count and the size and complexity of the pulse oximetry patch **10**, compared to traditional pulse oximetry systems.

[0036] Also included in the pulse oximetry patch **10** is a display that may be coupled to the processor(s) **38** to allow for display of the computed physiological parameters. For example, the display may include an LED display **14**, **16** operably coupled to the processor(s) **38** and programmed to operate as described above in relation to Fig. 1. For another example, the display may include a numerical display **18**, such as a liquid crystal display, and drive circuitry configured to convert the processor **38** output into a format suitable for driving the numerical display **18**.

[0037] Embodiments may also include a wireless device **50** configured to transmit computed patient parameters such as, for example, pulse rate, blood-oxygen saturation, or the raw data. The wireless device **50** may include any wireless

Petitioner Samsung Ex-1004, 0870

technology known in the art. In an embodiment, the sensor **14** may transmit data via a wireless communication protocol such as WiFi, Bluetooth or ZigBee.

[0038] Turning now to Fig. 5, an exploded view of a pulse oximetry patch **10** is shown. In some embodiments, the pulse oximetry patch **10** may include three layers: a middle layer **60**, a top layer **62**, and a bottom layer **64**. The middle layer **60** may include all or substantially all of the circuitry of the pulse oximeter patch **10**. To operably couple the various circuitries, the middle layer **60** may include a circuit board **72**, which may be a flexible, or "flex," circuit board, and it may also be double sided. By making the circuit board **72** flexible, the pulse oximetry patch **10** can more easily conform to the contours of a patient while also preventing connection failures within the circuit board **72**.

[0039] The circuit board **72** may include the microprocessor **38**, as well as other circuit components **76**, such as the circuit components discussed above with regard to Figs. 4 and 5. The circuit board **72** may also include one or more batteries **74**. The batteries **74** may be any small, lightweight battery such as a "coin cell" or "button cell." In some embodiments, the batteries **74** may be lithium ion batteries. In yet other embodiments, the batteries **74** may be nanowire batteries, i.e., high performance lithium ion batteries made from silicon nanowires. The batteries **74** serve to power the circuitry of the pulse oximetry patch **10** and are coupled to the circuitry through contacts **75**.

Petitioner Samsung Ex-1004, 0871

[0040] In an embodiment, an electrically insulative film (not shown) may optionally be inserted between the batteries **74** and the contacts **75** during manufacture to prevent the pulse oximetry patch **10** from becoming activated prior to its intended use. In some embodiments, the electrically insulative film may be an extension of the protective sheet **24**. For example, the protective sheet **24** may include an extension that is inserted during manufacture into the patch **10** through a small opening in the side of the patch **10**. This extension may be disposed between a battery and its corresponding electrical contact to block the flow of current from the battery. In this way, removal of the protective sheet **24** would simultaneously expose the adhesive **22** and turn on the patch **10**. In some embodiments, the removal of the electrically insulative film may be the only way of actuating the circuitry of the pulse oximetry patch **10**.

In alternate embodiments, other means of activating the pulse oximetry patch **10** may be included. For example, the pulse oximetry patch **10** may include a power button or switch, or, alternatively, the pulse oximetry patch **10** may include a pressure sensitive button that may be enclosed in the patch **10** and operable through compression of the patch **10**.

[0041] The circuit board **72** may also include the display LEDs **14** and **16**. As stated above, the display LEDs **14** and **16** provide the caregiver with the patient's physiological data. As such, the display LEDs **14** and **16** align with the display windows **66**, in the top layer **62**. As discussed in relation to Fig. 1B, the middle layer may also include a numerical display **18**, rather than a set of display LEDs.

Petitioner Samsung Ex-1004, 0872

[0042] In embodiments, the middle layer **60** may also include a wireless device **50** on the circuit board **72**. As discussed above, the wireless device **50** may allow the pulse oximetry patch **10** to transmit data wirelessly to a remote monitor. As such, the wireless device **50** may include a wireless transmitter circuitry and a radio frequency antenna, such as, for example a microstrip or patch antenna.

[0043] Additionally, although not depicted, embodiments may include one or more pushbuttons coupled to the circuit board **72** of the middle layer **60**. The pushbuttons may allow a user to turn the pulse oximetry patch **10** on or off or change a mode of the pulse oximetry patch **10**. For example, a pushbutton may allow a caregiver to cycle through various physiological data displayed on the numerical display **18**.

[0044] Furthermore, embodiments may also include an alarm and supporting circuitry. The alarm may be used as another way of communicating physiological data of a patient to a caregiver. For example, the alarm may be configured to emit a beeping sound corresponding with the heartbeat of a patient, or the alarm could be configured to sound when the patient's blood-oxygen saturation level falls below a certain acceptable level.

[0045] Turning briefly to Fig. 6, the back side of the circuit board **72** is shown. The back side of the circuit board **72** may include, at least, the emitter **19** and the detector **20**. In embodiments, the emitter **19** includes a red LED and an infra-red LED. The emitter **19** and detector **20** are placed to align with the sensor window **68** in

Petitioner Samsung Ex-1004, 0873

the bottom layer **64**. In some embodiments, the bottom side of the circuit board **72** may include additional circuit components.

[0046] Returning to Fig. 5, the pulse oximetry patch **10** may include a top layer **62** and bottom layer **64** that enclose the middle layer **60** to protect the circuitry inside, thus forming a shell around the circuitry and the circuit board **72**. The top layer **62** is the layer that is visible when disposed adjacent to the skin of a patient. As such, the top layer **62** may include display windows **66** that allow display components **14**, **16**, **18** to be seen through the top layer **62**. The display windows **66** may be constructed in any manner that allows visible light to pass through the top layer **62**. For example, the display windows **66** may include holes formed in the top layer **62**. Furthermore, the display windows may include a translucent material configured to prevent fluids from entering the pulse oximetry patch **10** through the display windows **66**. Alternatively, in some embodiments, the display windows **66** may include a reduced thickness of the top layer material, such that light may pass through the top layer **62** more easily at the display window **66**.

[0047] The top layer **62** or the bottom layer **64** may also include a battery "door" for allowing access to the batteries **74**. For example, part of the top layer **62** or the bottom layer **64** may swing or slide open to expose a battery compartment, allowing batteries to be changed. Alternatively, an embodiment may be configured such that the batteries are not accessible. As such, the pulse oximetry patch **10** would be intended to be thrown away after the batteries can no longer sufficiently charge the pulse oximetry device **10**, which may be suitable for a disposable, one-use patch.

Petitioner Samsung Ex-1004, 0874

[0048] The top layer **62** and bottom layer **64** may be formed using any suitable material. In an embodiment, the top layer **62** and the bottom layer **64** may include a metal such as aluminum. In another embodiment, the top layer **62** and bottom layer **64** may include one or more polymers, such as, for example, silicon polymers, polyvinylchloride and polyolefins such as polyethylene. The polymers may be elastomeric to provide for flexibility of the pulse oximetry patch **10** such that it may conform to the tissue of a patient. Additionally, any number of ways for coupling the top layer **62** and the bottom layer **64** may be employed. For example, the layers may be glued, melted or snapped together at the edges.

[0049] In various embodiments, the middle layer **60** may be encased in a unitary outer shell through the use of injection overmolding. As will be appreciated by one of ordinary skill in the art, a typical injection overmolding technique will include placing one or more fully assembled middle layers **60** into a die and injecting a molten thermoplastic into the die to surround the middle layer **60**. The mold may be constructed so that the display windows **66** and the sensor windows **68** are not obstructed. For example, the display LEDs **14** and **16**, the emitter **19** and the detector **20** may be situated at an outer edge of the mold volume such that the molten thermoplastic will not completely cover these components.

[0050] In yet other embodiments, a clamshell style container may be formed in a sheet thermoforming method that will be understood by one of ordinary skill in the art. The clamshell container may then be folded over the middle layer **60** and sealed within the clamshell such as by melting, snapping or gluing the edges together.

Petitioner Samsung Ex-1004, 0875

[0051] In certain embodiments, the patch **10** may be configured so that the middle layer **60** can be easily removed for later recycling or reuse. In this embodiment, the top layer **62** and bottom layer **64** may be pulled apart without causing damage to the middle layer **60**. The outer layers may then be discarded, while the middle layer **60** may be refitted with new batteries and repackaged with new top and bottom layers **62** and **64**. This may allow a program of recycling to be implemented, in which customers return used pulse oximetry patches to the manufacturer, rather than discarding them. In this way, a manufacturer of the disclosed embodiment may be better able to conform to electronic waste regulations, such as those called for in the Waste Electrical and Electronic Equipment Directive recently legislated by the European Union.

[0052] Some embodiments of a pulse oximetry patch **10** may also include a disabling mechanism that prevents unauthorized manipulation or reuse of the patch **10**. In this regard, the processor(s) **38** may be programmed to recognize whether the outer layers of the patch **10** have been separated. For example, a conductive contact may be included in the patch **10** that electrically couples an input/output (I/O) port of the processor(s) **38** to a zero-voltage reference. The I/O port may also be electrically coupled to a non-zero voltage through a high-resistance pull-up resistor. Furthermore, the conductive contact may be physically coupled to the top layer **62** and/or the bottom layer **64**, such that separation of the layers will cause the conductive contact to open electrically, allowing the I/O port to float to the higher voltage level through the pull-up resistor. The processor(s) **38** may be configured such that detection of a non-zero voltage at the I/O port at start-up or during operation disables the patch **10**.

Petitioner Samsung Ex-1004, 0876

[0053] Another example of a disabling mechanism may include an small integrated circuit (IC) chip such as an Erasable Programmable Read-Only Memory (EPROM) or a 1-Wire® chip available from Dallas Semiconductor Corp. The IC chip may be communicatively coupled to the processor(s) **38** and may hold information such as manufacturer information that may be read by the processor(s) **38**. The processor(s) **38** may be programmed to read and verify the IC information as part of a start-up routine, for example. Furthermore, a contact may be electrically coupled to the IC and physically coupled to the upper layer **62** and/or lower layer **64** such that separation of the layers will cause the information stored on the IC to be erased, thereby disabling the patch **10**. In this way, the information stored on the IC would have to be reprogrammed before the middle layer **60** could be reused.

Petitioner Samsung Ex-1004, 0877

CLAIMS

What is claimed is:

1. A pulse oximetry patch adapted for placement adjacent to tissue to be tested, comprising:

an upper layer comprising a display window;

a bottom layer comprising one or more light emitters and one or more light detectors, the emitters and detectors capable of acquiring physiological data from a patient; and

a middle layer disposed between the upper layer and the bottom layer comprising:

a drive engine configured to activate the one or more light emitters;

an oximetry engine configured to receive a signal corresponding to the physiological data acquired by the detectors and generate an output corresponding to the physiological data; and

a display adapted to receive the output corresponding to the physiological data.

2. The pulse oximetry patch of claim 1, wherein the bottom layer comprises a layer of adhesive for attaching the pulse oximetry patch to the patient.

3. The pulse oximetry patch of claim 1, further comprising a band adapted to hold the pulse oximetry patch against the patient.

Petitioner Samsung Ex-1004, 0878

4. The pulse oximetry patch of claim 1, wherein the display comprises a display configured to display a numerical value.

5. The pulse oximetry patch of claim 1, wherein the display comprises one or more light emitting diodes.

6 The pulse oximetry patch of claim 5, wherein one of the one or more light emitting diodes blinks correlatively with the heartbeat of the patient.

7. The pulse oximetry patch of claim 5, wherein one of the one or more light emitting diodes is activated or deactivated in response to a comparison of a measured blood-oxygen saturation value and a programmed blood-oxygen saturation value.

8. The pulse oximetry patch of claim 7, wherein the one or more light emitting diodes are color coded.

9. The pulse oximetry patch of claim 1, comprising a wireless transmitter configured to transmit patient parameters to an external monitor, display, and/or other device.

10. The pulse oximetry patch of claim 1, wherein the patch is approximately 3 inches by 1.5 inches.

11. A method of generating physiological data, comprising:

Petitioner Samsung Ex-1004, 0879

driving one or more light emitting diodes disposed in a generally self-contained patch to emit a light signal into a tissue to be tested;

receiving a modified light signal through a light detector disposed in the patch, the modified light signal corresponding to the light signal after it has been transmitted through or reflected from the tissue to be tested; and

generating within the patch a physiological parameter by processing the modified light signal;

generating a display output on an outer surface of the patch, the display output corresponding to the physiological parameter.

12. The method of claim 11, wherein driving the light emitting diodes comprises sequentially activating a red light emitting diode and an infrared light emitting diode.

13. The method of claim 11, wherein generating a display output comprises generating a numerical display corresponding to the physiological parameter.

14. The method of claim 11, wherein generating a display output comprises causing a light emitting diode to blink correlatively with the heartbeat of the patient.

15. The method of claim 11, wherein generating a display output comprises activating or deactivating a diode in response to a comparison of a measured blood-oxygen saturation value and a programmed blood-oxygen saturation value.

Petitioner Samsung Ex-1004, 0880

16. The method of claim 11, wherein the diode is color coded to indicate whether the measured blood-oxygen saturation value is higher or lower than the programmed blood-oxygen saturation value.

17. The method of claim 11, comprising generating a wireless transmission of the physiological data from the oximetry patch to an external display.

18. A method of monitoring a patient, comprising:

affixing a generally self-contained pulse oximeter to the tissue of a patient; and

activating the pulse oximeter causing the pulse oximeter to display physiological data.

19. The method of claim 18, comprising transmitting the physiological data to an external device wirelessly.

20. A method of manufacturing a pulse oximeter, comprising:

providing a pulse oximeter circuitry capable of sensing, processing, and displaying physiological data of a patient; and

enclosing the pulse oximeter circuitry within a generally self-contained enclosure capable of being disposed directly adjacent a tissue measurement site of the patient.

21. The method of claim 20, comprising disposing a layer of adhesive on one side of the enclosure.

Petitioner Samsung Ex-1004, 0881

22. The method of claim 20, comprising:

providing a first layer configured to be disposed on the tissue measurement site of the patient;

providing a second layer configured to allow observation of output data; and

enclosing the pulse oximeter circuitry between the first layer and the second layer.

23. The method of claim 20, comprising molding an enclosure around the pulse oximeter circuitry, the enclosure configured to be disposed adjacent to a tissue of the patient and allow observation of output data.

24. A pulse oximeter comprising:

a single processor chip comprising:

one or more first converters capable of activating one or more signal emitters for transmission of an emitted signal into tissue of a patient;

one or more second converters capable of receiving a signal generally correlative to the emitted signal from the tissue of the patient from one or more signal detectors;

a core processor configured to calculate physiological parameters of the patient from the signal from the one or more signal detectors; and

a program memory operatively coupled to the core processor and configured to store operating software of the pulse oximeter.

Petitioner Samsung Ex-1004, 0882

25. The pulse oximeter of claim 24, wherein the one or more first converters is configured to activate one or more display LEDs to indicate the physiological parameters of the patient.

26. The pulse oximeter of claim 24, wherein the single processor chip is configured to transmit output data corresponding with physiological parameters of the patient to a numerical display.

Petitioner Samsung Ex-1004, 0883

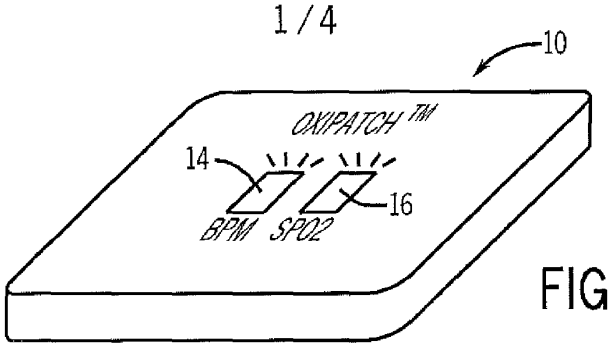


FIG. 1A

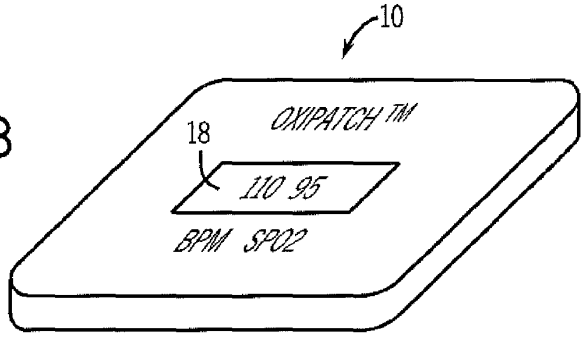


FIG. 1B

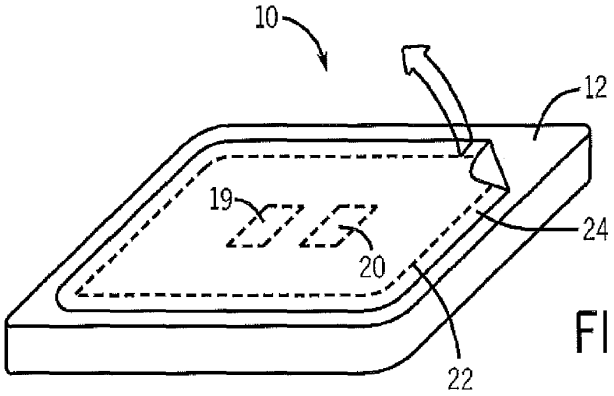


FIG. 2

Petitioner Samsung Ex-1004, 0884

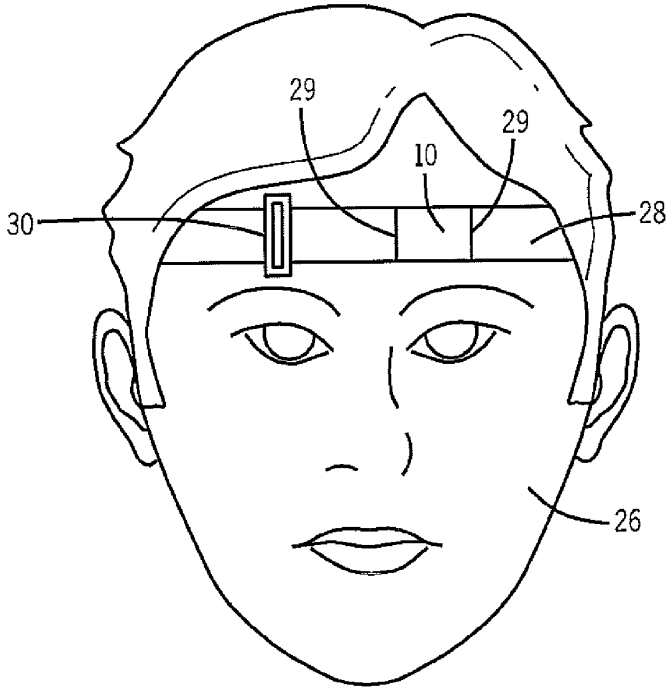


FIG. 3

Petitioner Samsung Ex-1004, 0885

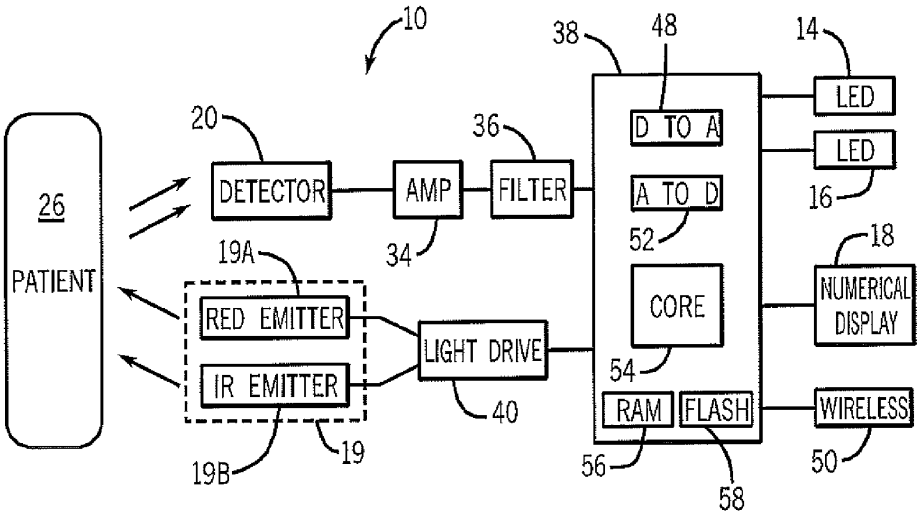

10
38
48
14
LED
D TO A
LED
16
20
36
DETECTOR
AMP
FILTER
A TO D
52
26
PATIENT
34
19A
18
NUMERICAL DISPLAY
RED EMITTER
CORE
LIGHT DRIVE
54
IR EMITTER
40
RAM
FLASH
WIRELESS
19B
19
56
58
50

FIG. 4

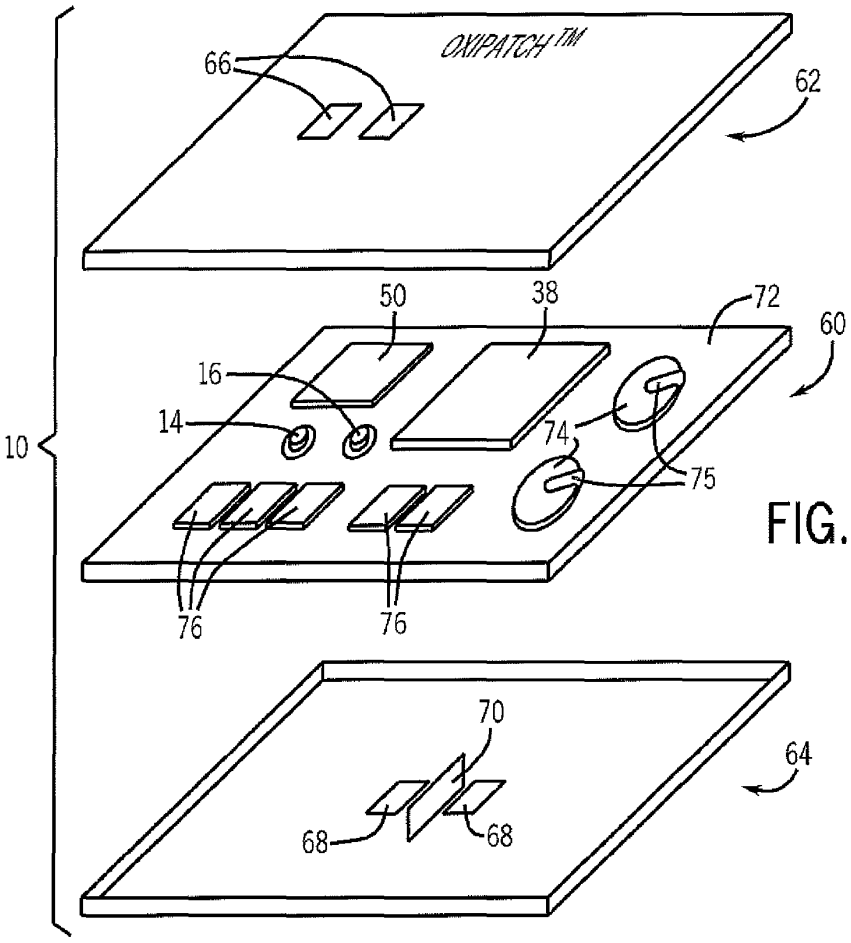


FIG. 5

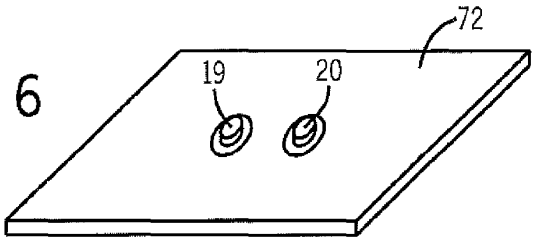


FIG. 6

Petitioner Samsung Ex-1004, 0887

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2009/039002

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/100219 A1 (SWEITZER ROBERT [US] ET AL) 3 May 2007 (2007-05-03) paragraphs [0012], [0014] paragraphs [0035] - [0039] paragraph [0044] paragraphs [0051] - [0056] figures	1-4, 9-11,13, 17-26
Y		5-8, 14-16
Y	WO 2004/078028 A (AVICOLA KEN [US]; MORTON RICHARD G [US]; ROSS JOHN R [US]) 16 September 2004 (2004-09-16) page 7, paragraph 2 - page 8, paragraph 2	5-8, 14-16

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 June 2009	29/06/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Bataille, Frédéric

Form PCT/ISA/210 (second sheet) (April 2005)

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2009/039002

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/228244 A1 (BANET MATTHEW J [US]) 13 October 2005 (2005-10-13) paragraph [0023] figures	11-13, 17-19
X	US 2005/070773 A1 (CHIN RODNEY [US] ET AL) 31 March 2005 (2005-03-31) paragraphs [0042], [0052], [0062] figure 13	11,13,18

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

Petitioner Samsung Ex-1004, 0889

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2009/039002

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2007100219 A1	03-05-2007	AU 2006306629 A1	03-05-2007
		CA 2626313 A1	03-05-2007
		CN 101330865 A	24-12-2008
		EP 1948009 A2	30-07-2008
		JP 2009513243 T	02-04-2009
		KR 20080065985 A	15-07-2008
		US 2009131774 A1	21-05-2009
		WO 2007050268 A2	03-05-2007
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US 2005228244 A1	13-10-2005	US 2006009697 A1	12-01-2006
		US 2006009698 A1	12-01-2006
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		US 2005228299 A1	13-10-2005
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		US 2005228301 A1	13-10-2005
US 2005070773 A1	31-03-2005	US 2005070775 A1	31-03-2005

Petitioner Samsung Ex-1004, 0890

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
5 May 2011 (05.05.2011)

PCT

(10) International Publication Number
WO 2011/053235 A1

(51) International Patent Classification:
G06F 3/033 (2006.01)

(21) International Application Number:
PCT/SE2010/051167

(22) International Filing Date:
27 October 2010 (27.10.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0901401-0 2 November 2009 (02.11.2009) SE

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(74) Agent: **ALBIHNS.ZACCO AB**; P.O Box 5581, Valhallavägen 117, S-114 85 Stockholm (SE).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(54) **Title**: ELECTRONIC FINGER RING AND THE FABRICATION THEREOF

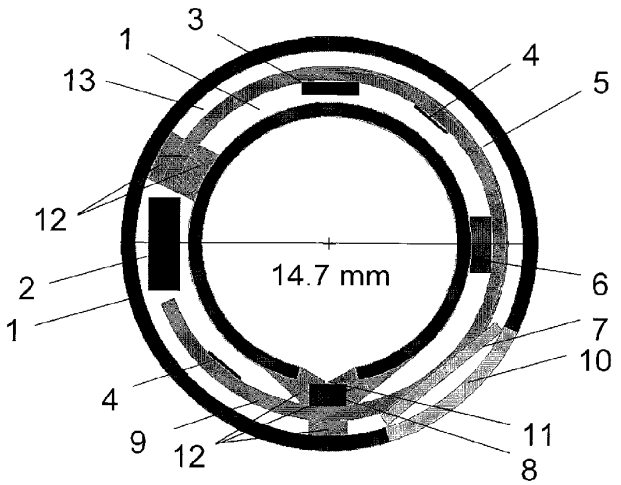


Fig. 1

(57) **Abstract**: The present invention provides an electronic finger ring (1) for wireless, 4-dimensional remote steering and/or monitoring. The electronic finger ring comprises electronic components packaged and integrated in different ways to obtain either omni- or unidirectional RF transmission dependent on its application, e.g. acting as a multiple steering device communicating with nearby electronic devices wirelessly or for wireless user medical diagnostics.

WO 2011/053235 A1

Petitioner Samsung Ex-1004, 0891

ELECTRONIC FINGER RING AND THE FABRICATION THEREOF

Technical Field of the Invention

The present invention relates to a toroidal finger ring, in particular to such an accessory comprising several electrical- and micromechanical components acting as a multiple sensor device communicating with nearby electronic devices wirelessly with e.g. bluetooth technology.

Background of the Invention

A computer mouse (or equivalent touchpad or touchscreen) is used as a steering device to control the two dimensional (horizontal and vertical) motion of an icon on a computer screen (stationary pc, laptop, pda). It takes up large space which limits the user's freedom of movement. Through the years several types of models has been developed and manufactured; mechanical-, optical-, laser- and inertial- computer mouses. The last mentioned using accelerometers to steer the mouse pointer in x- and y- directions.

Another application uses micromechanical accelerometers on top of a finger ring to control sound effects to an electric guitar (see www.sourceaudio.net/index.php).

On yet another application a finger ring is used for mobile voice communication where it is integrated with a microphone and speakers in order to transfer sonar vibrations from the speakers (see " A finger-ring shaped wearable handset based on bone-conduction", Fukumoto, M; Wearable Computers; Proceedings, Ninth IEEE International Symposium on 18-21 Oct. 2005, pages 10-13).

U.S. Pat. No. 2003/0142065 A1 describes a ring-like device which encompasses several electronic components carried on a flexible printed circuit board (FPCB).

U.S. Pat. No. 2003/0227437 A1 describes a pointing device which is characterized by a band that is mountable on a computer user's thumb.

Petitioner Samsung Ex-1004, 0892

U.S. Pat. No. 2004/0032346 A1 describes a distancing sensing unit to function primarily as a virtual keyboard.

U.S. Pat. No. 2005/0052412 A1 describes a human interface machine interface used exclusively as a computer mouse type device.

U.S. Pat. No. 2006/0001646 A1 describes an operating device which is "C" shaped.

German Pat. No. DE102005021527 A1 describes an operating device which has electronic components embodied in a structure mounted on top of the finger ring.

U.S. Pat. No. US005638092 describes a cursor control system exclusively used in connection to a keyboard.

Summary of the Invention

It is an object of the invention to solve or at least mitigate one or more problems associated with the above mentioned devices according to prior art.

In particular, it is an object of the invention to provide a user-friendly steering device for controlling an external electronic device, such as a computer.

This object is achieved by an electronic finger ring as defined by claim 1.

This electronic finger ring offers an effective and ergonomic way of steering/controlling an external electronic device in up to four dimensions.

Specific embodiments of the invention are defined in the dependent claims, the advantages of which are apparent from the detailed description following hereinafter.

The present invention is based on the understanding that an alternative steering device design, compared to an established computer mouse, can be achieved using an electronic finger ring based on a 4-dimensional steering device control integrated in the rings interior.

Petitioner Samsung Ex-1004, 0893

According to a first aspect of the present invention, there is provided an accelerometer for motion sensing, to steer in a 3-dimensional space. There is further provided a micromechanical pressure sensor in order to steer in an additional 4th dimension, i.e. a steering device design which facilitates to additionally move/control a mouse cursor in a 4th dimension on a computer screen (or equivalent). This gives the user the ability to; for example, zoom in or out of a picture on a computer screen. Additionally custom pre-configure it to the users need in different situations dependent on application; like in a home environment: turn on or off home entertainment system in 1st dimension; change to tv- music- or movie mode in a 2nd dimension; change tv channel/music- or movie track in a 3rd dimension and start-, stop- or pause track in a 4th dimension. That the pressure sensor is adapted to allow steering in an additional 4th dimension means, at least in some embodiments of the invention, that the pressure sensor is adapted to control a function of the external electronic device not relating to steering in a 3-dimensional space.

Alternatively, the micromechanical pressure sensor may function as a finger plethysmograph providing a non-invasive measurement for changes in finger blood flow reflected by pulse wave amplitude (PWA).

The above mentioned active components are combined with mixed signal microcontrollers enabling control and signal processing of these aforementioned active components. To communicate with other, external electronic devices a radio frequency (RF) transceiver is electrically connected to the previous mentioned active components. All the aforementioned electronic components are mounted on a flexible printed circuit board (FPCB) where conductor lines electrically connect the individual components. The actual order and placement of the respective components are novel in order to obtain the desired functionality and packaging inside the toroidal shaped ring. To obtain matching currents and voltages for individual active components passive components are connected. These passive components could either be mounted on the FPCB as individual physical components or be integrated in the FPCB.

To supply power to the components, they may be connected to a battery integrated in the electronic finger ring. In one embodiment, these aforementioned components constitute the internal electronic circuit of the electronic finger ring.

Petitioner Samsung Ex-1004, 0894

An alternative to provide a source of energy is integrating the conformal coating with piezoelectric nanofibers (for example, pzt – lead zirconate titanate – or zink oxide materials), which converts mechanical energy to electrical energy, which can be placed/located on both the outer- and/or inner circumference of the fpcb and connected electrically to the fpcb to provide electricity to the electrical components.

Yet an alternative power source for powering the electronic components of the finger ring is a coil for generating induced current to the components when the ring is subject to an alternating magnetic field. Such a coil may be integrated in the ring and be used instead of, or in addition to, a battery and/or piezoelectric nanofibres.

In an embodiment of the present invention, after the electrical components are mounted and electrically connected to the FPCB they are covered with nonconductive, conformal coating.

To further reduce the RF radiation on the electrical components as well as the user's finger, the conformal coating, coated on the inner circumference of the FPCB, is mixed with cenospheres, a material which functions as a RF shielding. In one embodiment, the above mentioned piezoelectric nanofibers are integrated in the conformal coating.

A great advantage of the electronic finger ring of the present invention is that the whole ring constitutes the complete electronic circuit. That is, the complete electronic circuit is integrated in the interior of the electronic finger ring. In one embodiment in which the ring is a toroidal shaped metal ring it functions as (i). an external antenna, to obtain coarse tuning to the operational frequency, connected to the internal antenna and RF transceiver located inside the ring or as an (ii) electric ground plane to the internal antenna.

In an embodiment of the present invention, constituting the top metal layer on the interfaces of the toroidal halves is a material which has two functions, (i). to enhance the welding between the joints by its chemical, adhesive properties and (ii). enhancing the hermetic encapsulation (i.e. lowering the pressure in the sealed ring cavity) by its getter properties.

In an embodiment of the present invention, the aforementioned pressure sensor is located in a cavity within the electronic finger ring where the inlet hole geometry is

Petitioner Samsung Ex-1004, 0895

shaped as a horn cone to maximize the pressure compression ratio at the pressure sensor end.

In an embodiment of the present invention, the aforementioned cenospheres can further be deposited on the exterior of the inner circumference of the ring shell in order to reduce RF radiation on the user's finger.

In an embodiment of the present invention to adapt and optimize to different applications the antenna has different designs : (i). External, omnidirectional (ii). internal integrated unidirectional (iii). internal integrated unidirectional with extended, elevated housing (iv). Dielectric integrated with folded monopole.

An intermediate metal strip layer is designed to function as a microstrip feed (transmission) line, electrically connecting an RF transceiver with the internal antenna, preferably optimized to obtain 50 Ω matching impedance. This implies limitations in how the components, the internal antenna and RF transceiver, are placed within the toroidal shaped finger ring.

In an embodiment of the present invention, to complete the design of the aforementioned antennas they are respectively combined with a ground plane located in (i). intermediate layers in the FPCB (ii). or when a portion of the toroidal shaped ring has a dielectric part integrated with folded monopole antenna, the remaining toroidal shaped outer metallic shell functions as a ground plane.

In an embodiment of the present invention, a portion of an outer metal shell is opened to function as a window housing to allow unperturbed RF radiation either (i). having a shape which is identical to the toroidal ring or (ii). Constitute of a dielectric material in said portion of ring or (iii). have a locally extended, elevated sphere shape to minimize return losses of the RF radiation.

Another object of the invention is to provide an alternative use of a finger ring apart from being an aesthetical and/or cultural valued item.

Other objects of the invention are to address the following problems:
- how to integrate an antenna having either omnidirectional or unidirectional radiation properties in a finger ring,

Petitioner Samsung Ex-1004, 0896

- how to design an electric circuit comprising various electrical- and/or micromechanical components which can be integrated in a normally sized finger ring,
- how to manufacture a finger ring comprising integrated electrical- and/or micromechanical components,
- how to manufacture such a ring in a way that increases the lifetime and/or the performance of the ring.

Yet another object of the invention is to provide an electronic finger ring design allowing the ring to be adapted for one or more of the following applications:
(i). Steer and control the functions of electronic devices which are in the users immediate vicinity
(ii). Identification – to use instead of an ordinary security pass card
(iii). Electronic payment – to use instead of an existing credit card
(iv). For continuous measurement and diagnosis of a user's health state – A person diagnosed with Parkinson disease needs his or hers finger or hand tremor movements to be continuously monitored in order to receive proper medication or treatment by medical staff
(v). For mute persons – to improve real-time communication with people who do not understand sign language
(iv). For communication – to inform the ring user about something
(vii). Assault larm – when suspecting assault the person carrying the electronic fingering can perform an immediate action with the ring and a signal is wirelessly transmitted to his or her's mobile phone which in turn automatically sends an emergency call for help
(viii). Finger Plethysmograph - to provide a non-invasive measurement for changes in finger blood flow reflected by pulse wave amplitude (PWA) for accurate data collection technique, used for example monitoring heart periods for use in heart rate variability (HRV) calculations.

All of the above objects may be achieved according to the invention by means of a toroidal shaped finger ring hermetically encapsulating electrical components allowing the ring to communicate wirelessly with electronic devices in its immediate vicinity while at the same time having the aesthetic properties of a conventional jewellery ring.

Petitioner Samsung Ex-1004, 0897

Brief description of the drawings

The above, as well as additional objects, features and advantages of the present invention, will be better understood through the following illustrative and non-limiting detailed description of preferred embodiments of the present invention, with reference to the appended drawings, wherein the same reference numerals are used for similar elements, and in which:

Fig. 1 is a schematic profile view of the electronic finger ring where the electronic components are mounted on a flexible printed circuit board packaged inside the torus shaped finger ring with a pressure sensor facing the inner boundary of the torus in accordance with an embodiment of the present invention.

Fig. 2 is a schematic top view of the electronic components mounted on both sides of a flexible printed circuit board.

Fig. 3 is a schematic profile view zoomed on the inlet hole shaped as a horn cone to maximize the pressure compression ratio at the pressure sensor end.

Fig. 4 is a schematic profile view of the electronic components mounted on a flexible printed circuit board packaged inside a torus shaped finger ring with an alternative design having the pressure sensor being placed on the outer boundary of the torus.

Fig. 5 is a schematic profile view of the electronic components mounted on a flexible printed circuit board packaged inside a torus shaped finger ring with an alternative design having a folded monopole antenna.

Fig 6. is a schematic top view of the electronic components mounted on both sides of a flexible printed circuit board having an alternative design with a folded monopole antenna.

Fig 7 is a schematic three dimensional view of the torus shaped electronic finger ring where the outer and inner metal shells are constituted of two different metals to allow unidirectional, unperturbed RF radiation in accordance with another embodiment of the present invention.

Petitioner Samsung Ex-1004, 0898

Fig. 8 is a schematic, three dimensional illustration of the cross section of the inner and outer toroidal shells showing how the different metal layers are deposited in accordance with another embodiment of the present invention.

Fig. 9 is a schematic illustration of the top and bottom halves of the ring toroidal shell where the interface (as well as inner surface) is a titanium compound in accordance with another embodiment of the present invention.

Fig. 10 is a schematic view of an external, coarse, omnidirectional design where the whole toroidal shaped metallic shell functions as an RF antenna in accordance with an embodiment of the present invention.

Fig. 11 is a schematic view of where the internal, unidirectional antenna is located where the outer shell is opened leaving the inner shell exposed (constituted of Titanium compound) to allow unperturbed RF radiation in accordance with an embodiment of the present invention.

Fig. 12 is a schematic view of an extended, unidirectional antenna housing constituted of an integrated sphere design which has no top shell material deposited leaving the inner shell exposed (constituted of Titanium compound) to allow unperturbed RF radiation transmission in accordance with an embodiment of the present invention.

Fig. 13 is a schematic illustration of a monopole antenna design integrated in a dielectric material in accordance with an embodiment of the present invention.

Fig. 14 is a schematic illustration of a monopole antenna design which is located where an outer shell is opened leaving the inner shell exposed to allow unperturbed RF radiation in accordance with an embodiment of the present invention.

Fig 15 is a schematic view of how the ground planes on the FPCB are designed. The ground plane facing the outer circumference of the ring acts as a ground plane for the RF antenna circuitry, the ground plane facing the inner circumference of the ring acts as a ground plane and optionally also a thermal heat sink for the electronic components; in accordance with an embodiment of the present invention.

Petitioner Samsung Ex-1004, 0899

Fig 16 is a schematic view showing how the microstrip is connected to the RF transceiver with the adjacent groundplanes as intermediate layers in the FPCB. Additional conductor lines, Vcc etc. are not shown; in accordance with an embodiment of the present invention.

Fig 17 is a cross sectional view of the folded monopole antenna showing how it obtains its desired geometry after integrated in the ring in accordance with an embodiment of the present invention.

Fig 18 is a top view of the folded monopole antenna in accordance with an embodiment of the present invention.

Fig. 19 is a three-dimensional illustration view of the folded monopole antenna in accordance with an embodiment of the present invention.

Detailed description of Embodiments of the Invention

The following description is of the best mode presently contemplated for carrying out the invention. This description is not to be taken in a limiting sense, but is made merely for the purpose of describing the general principles of the invention. The scope of the invention should be determined with reference to the claims.

A toroidal shaped, electronic finger ring constitutes the complete electronic circuit. The toroidal shaped metal ring functions as either (i). an external antenna, to obtain coarse tuning to the operational frequency, which is connected to the internal antenna and RF transceiver located inside the ring or as an (ii) electric ground plane to an internal antenna.

The electronic finger ring functions as a 4-dimensional steering device where an accelerometer steers in 3-dimensional space and a pressure sensor steers in an additional 4th dimension, i.e. a novel steering device design.

With reference to Fig. 1 and 2, a first embodiment of the present invention is a toroidal shaped finger ring structure 1, constituted of two different metallic shells: (i). 1a, made of gold (Au) or silver (Ag), enclosing the major parts of the finger ring structure geometrically described as radially furthest away from the toroids centre, and (ii). 1b,

Petitioner Samsung Ex-1004, 0900

made of a titanium compound (Ti, TiW), being the metal enclosing facing the inner parts of the finger ring structure. The toroidal shaped finger ring structure 1 is comprised of different electronic components: a battery 2, a RF transceiver 3 and a micro processor 4, a microstrip line 5, an accelerometer 6, an internal antenna 7, a pressure sensor 8; all mounted on a flexible printed circuit board 9. In this embodiment, there is also an outer metal shell opening 10 serving as an RF window letting through unperturbed RF radiation. In this embodiment, at the inner boundary of the toroidal shaped finger ring structure 1 located at the pressure sensor 8 there is an inlet hole shaped as a horn cone to maximize the pressure compression ratio at the pressure sensor end 11. To permanently place the pressure sensor and one end of the flexible printed circuit board in respective places, fixtures 12, are casted as part of the metallic shell. In this embodiment, there is a protective coating layer 13 located between the outer boundary of the toroidal shaped finger ring structure 1 and the flexible printed circuit board 9, and another form of protective coating (with cenospheres) 14 located between the inner boundary of the toroidal shaped finger ring structure 1 and the flexible printed circuit board 9, as explained above. The internal antenna 7 is connected to the RF transceiver 3 by a microstrip line 5, where the design of the microstrip is optimized to obtain 50 Ω matching impedance. In the case of an external antenna option, the outer shell of the toroidal shaped finger ring structure 1 serves as a coarse antenna. In the case of using exclusively an internal antenna option, the internal antenna is located at a position along the circumference of the toroidal shaped finger ring structure 1 where there is no outer metallic shell covering 10 allowing unperturbed, unidirectional radiation.

In this embodiment, the above mentioned active components are combined with micro processor 4 enabling control and signal processing of these aforementioned active components. To communicate with other, external electronic devices an RF transceiver is electrically connected to the previous mentioned active components. All the aforementioned electronic components are mounted on a flexible printed circuit board (FPCB) where conductor lines electrically connect the individual components. The actual order and placement of the respective components are optimized in order to obtain the desired functionality and packaging inside the toroidal shaped ring. To obtain matching currents and voltages for individual active components passive components are connected (not shown). These passive components could either be mounted on the FPCB as individual physical components or be integrated in the FPCB.

Petitioner Samsung Ex-1004, 0901

To supply power to the components a battery 2 is connected. These aforementioned components comprise the internal electronic circuit of the electronic finger ring.

In this embodiment of the present invention, after the electrical components are mounted and electrically connected to the FPCB they are painted with a nonconductive and preferably conformal coating 13. Commonly used conformal coatings are silicone, epoxy, acrylic, urethane and paraxylene. The function of the coating is to (i). prevent damage from rough handling, (ii). reduction of mechanical and thermal stress as well as (iii). prolonging the lifetime of the components. Also to (iv). increase the dielectric strength between conductors lines on the FPCB enabling the design of the FPCB to be more compact and small.

As the electrical components are mounted on one side of the FPCB, the inside circumference of the FPCB, the conformal coating absorbs the stress released from forming the FPCB into a toroidal/circular shape, thus reducing the risk of the respective electrical component and FPCB losing mechanical or electrical connection to each other.

In fig. 15 and 16, to reduce RF radiation generated from the antenna circuitry the FPCB has one or several intermediate ground planes 17, which serves to (i). reflect any RF radiation directed inward (ii). function as a ground plane for the antenna circuitry reducing return losses of the RF radiation and (iii). function as a circuit ground plane for the electrical components and, optionally also as a (iv). thermal heat sink. The electrical components are placed on the inner circumference of the FPCB in such an order to minimize RF radiation generated from the aforementioned antenna. Due to the design limitations inherit in the antenna circuitry, constituted of the antenna, microstrip line, RF transceiver, the order and placement of the same in respect to the ground planes are critical in order to obtain a sufficient shielding minimizing the aforementioned RF radiation. Thus the ground planes located in the FPCB are designed to stretch at least in-between from where the internal antenna is located on the outer circumference side of the FPCB and the RF transceiver located in the inner circumference side of the FPCB.

To further reduce the RF radiation on the electrical components as well as the users finger, the conformal coating 14, coated on the inner circumference of the FPCB, can be made (mixed) with such material which functions as a RF shielding. This material can be made of cenospheres (constituted of a range of nanoparticle sized metal oxides) which reflects RF radiation.

Petitioner Samsung Ex-1004, 0902

An intermediate metal strip layer 5 is designed to function as a microstrip feed (transmission) line, electrically connecting the RF transceiver with the internal antenna, preferably optimized to obtain 50 Ω matching impedance.

The range for the width and length of the microstrip feed line must be such that each dimension of the microstrip feed line radiates only the required frequency (2.4 GHz). For a toroidal shaped antenna of this invention thus requires a microstrip feed line length, $l_{transmission\_line}^{circumference}$, along the circumference of the ring described as $l_{transmission\_line}^{circumference}(max)$ = 0.30λ and $l_{transmission\_line}^{circumference}(min)$ = 0.20λ, where λ is the wavelength to the corresponding radiation frequency (λ = 125 mm @ 2.4 GHz). In analogy, the microstrip feed line width is required to be in the range of w(min) = 0.008λ and w(max) = 0.028λ.

In fig. 3, the aforementioned pressure sensor is located in a cavity within the electronic finger where the inlet hole geometry is shaped as a horn cone to maximize the pressure compression ratio at the pressure sensor end. To optimize sensitivity the inlet hole should have a minimum aspect ratio size difference of the diameter of the narrow end, x, of the horn cone to the outer end, y as 1:10; equivalently, the total height, m, of the horn cone should have an aspect ratio size to the height of the narrow end of the horn cone, n, as 6:1.

The pressure sensor can be located in two alternative positions as seen in fig. 1 and fig. 4 to steer in a 4th dimension, the former by vertical finger movement (i.e. bending) of the finger the electronic finger ring is mounted on; the later by, for example, a finger on the other hand of the user. In Fig. 1, the pressure sensor 8 and the inlet hole are located so that the cavity housing the sensor 8 faces the inner circumference of the toroidal shaped finger ring structure 1. This location makes the pressure on the pressure sensor increase when the finger carrying the ring is bended since the tissue of the lower part of the finger then becomes compressed and expanded in its radial direction. Thus, steering an external device to which the ring is connected in a 4th dimension is easily achieved by simply bending/vertically moving the finger carrying the ring. In Fig. 4, the pressure sensor 8 and the inlet hole are located so that the cavity housing the sensor 8 faces the outer circumference of the toroidal shaped finger ring structure 1. In this case, activation of the pressure sensor and hence steering of the external device in the 4th dimension may be achieved by pressing the pressure sensor 8 with either another finger of the

Petitioner Samsung Ex-1004, 0903

hand carrying the ring, or a finger of the other hand. Preferably, in this scenario, the pressure sensor 8 is activated by using the thumb of the hand on which the ring is carried.

In fig. 8 constituting the top metal layer on the interfaces of the toroidal halves (including the intermediate metal strip layer), is a material which has two functions, (i). to enhance the welding between the joints by its chemical, adhesive properties and (ii). enhancing the hermetic encapsulation (i.e. lowering the pressure in the sealed ring cavity) by its getter properties. This material could be made of titanium (Ti) compositions. Material compositions containing Ti are well known to have a low thermal conductivity as well as good getter properties (for most commonly existing gases that are out-gassing: oxygen, water vapour and hydrocarbons). The activation of the metallic getter film is done during the welding procedure by heat transfer where the metal surface reacts with gas atoms in the newly created cavity, locking them into the getter. These trapped atoms diffuses into the getter, thereby renewing the metal surface, ready to adsorb more gas atoms and hereby reducing the pressure obtaining an hermetic seal.

In fig. 9 during fabrication of the electrical finger ring, welding the respective halves 1c, 1d of the toroidal ring, excessive heat is produced. Weld pool width is an important parameter dependent on the laser spot size. The weld absorption of the material, constituting the intermediate metal layer, is dependent on its energy transfer efficiency, During the welding procedure, melting the interfaces of the respective toroidal halves, to concurrently not damage the internal electrical components the laser pulse time must be <2.2 ms.

Concurrently, the aforementioned nonconductive, conformal coating acts as a thermal heat absorber to reduce the overall thermal stress on the electrical components during the welding procedure.

The aforementioned material used for the top metal layer on the interfaces of the toroidal halves and the nonconductive, conformal coating enables a greater freedom in design regarding the respective thicknesses and patterning chosen to optimize the hermetic encapsulation and thus increase the lifetime of the internal, electrical components.

Petitioner Samsung Ex-1004, 0904

In an embodiment of the present invention, the aforementioned cenospheres can further be deposited on the exterior of the inner circumference of the ring shell in order to reduce RF radiation on the user's finger (not shown).

In an embodiment of the present invention to adapt and optimize to different applications the antenna has different designs: (i). external omnidirectional (ii). internal integrated unidirectional (iii). internal integrated unidirectional with extended, elevated housing (iv). dielectric integrated with folded monopole.

In fig. 10 the external, coarse antenna is omnidirectional and constituted of a toroidal shaped metal ring, to obtain coarse tuning to the operational frequency. The external antenna's electrical length should be one wavelength, one half wavelength (a dipole) or one quarter wavelength with a ground plane to minimize all but real antenna impedances. It is reminiscent of a circular disc monopole (CDM) antenna but without the monopole acting as a ground plane. To obtain a coarse tuning to match 2.4 – 2.5 GHz (Bluetooth frequency range) the external antenna's diameter of the toroidal ring is calculated to 12 – 15 mm. As a coarse tuning is needed, either the outer- or inner diameters of the toroidal finger ring is sufficient to obtain matching impedance. The external antenna is connected to the internal antenna by the toroidal shaped ring by a metallic wall vertical to its circumference (not shown).

In fig. 11 the second alternative is the internal integrated unidirectional antenna. The antenna could be an Inverted-F antenna (IFA), either (i). mounted on the flexible printed circuit board or (ii). integrated/printed in the flexible printed circuit board as part of its fabrication (not shown). Any other type of unidirectional antenna can also be used. The antenna is located under the portion of the ring which has no outer shell metal deposited on the toroidal shaped ring facing outwards, geometrically described as radially away from the toroids centre. The opening is a maximum of 12 mm along the circumference functioning as a window housing made of a titanium compound to allow unperturbed RF radiation. The electronic finger ring needs only to be provided with this type of opening, or RF window, when the outer shell is completely or almost completely made of a metal having substantial adverse effects on RF radiation, such as gold or silver. There is normally no need for an RF window when the outer shell or the complete ring is made of a non-RF shielding material, such as a plastic compound. The use of an RF window, however, allows the rest of the outer shell to be made of gold, silver or any other

Petitioner Samsung Ex-1004, 0905

precious metal having adverse effects on RF radiation and thereby give the user the sensation of a conventional jewellery ring.

In fig. 12 the third alternative is a toroid shaped finger ring with a locally extended, elevated sphere shape 15 to function as a housing for the internal integrated unidirectional antenna constituted of 1b, minimizing return losses of the RF radiation. The radius of the integrated sphere shape is a maximum of 7 mm. The extended housing will make it possible to place the internal antenna further away, elevated, from the ground plane of the flexible printed circuit board; as opposed to being mounted directly on the flexible printed circuit board. This significantly reduces the return losses of the RF radiation. Concurrently, the aforementioned nonconductive, conformal coating acts in this case also as a dielectric cavity in the interspace between the antenna and the ground plane.

In fig. 13 and 19 the fourth alternative is a portion of the toroidal ring constituted of a dielectric 16 integrated with a folded monopole antenna 7a. The dielectric may for example be made of ceramic or epoxy material. The dielectric may also be the protective coating layer 13 described with reference to Fig. 1. The monopole antenna is made of a wire or a strip of conductive material which is placed in the outer boundary of the dielectric portion of the toroidal shaped ring. One end of the antenna is free inside the dielectric portion and the other is electrically connected to the RF transceiver via a feed line (not shown). Alternatively, the monopole antenna 7a is integrated on the top layer of the flexible printed circuit board (fig. 5 and 17), with one end of the antenna free inside the dielectric portion (fig. 6 and 18), the other electrically connected to the RF transceiver via a feed line. The length of the antenna is determined by a quarter wavelength of the self-resonating frequency of 2.4 GHz, which corresponds to a total length, L, of the folded wire as L = 31 mm.

In an embodiment of the present invention, to complete the design of the aforementioned antenna designs are combined with a ground plane located in either (i). in intermediate layers in the FPCB (fig. 15 and 16) or (ii). when a portion of the toroidal shaped ring has a dielectric part integrated with folded monopole antenna, the remaining toroidal shaped outer metallic shell functions as a ground plane (fig. 13).

Petitioner Samsung Ex-1004, 0906

The ground plane is designed to minimize RF losses by having a length along the circumference which results in low impedance. This implies a length $l_{ground\_plane}^{circumference}$ = λ/2n, where n = 1,2,3....

The invention has mainly been described above with reference to a number of explicitly disclosed embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention.

For example, in one embodiment of the invention the toroidal shaped finger ring structure, constituted of two torodial shaped shell halves, can alternatively encapsulate non-hermetically the electrical components by fixating their respective complementary interfaces with one or more screws in order to obtain a lower cost fabrication solution.

Another example, mounting fewer amount of components than described above (i.e. only microcontroller, bluetooth, microstrip and antenna) the components may be mounted on only one side of the fpcb along the circumference of the toroidal shaped fingering structure in order to obtain a lower cost fabrication solution. Note, in this embodiment, the electronic circuit may function passively (i.e. no battery needed) communicating with near field technology (RFID, proximity cards etc.) which transfers signal via magnetic field induction using the above described antenna design.

Another example, in one embodiment the torodial ring shell can be made of plastic instead of metal wherin the above mentioned conformal coating, coated either (or both) on the (i). inner circumference of the fpcb, or (ii). be deposited on the exterior of the inner circumference of the ring shell, mixed with cenospheres to function as a RF shielding on the users finger.

Concurrently, the plastic torodial ring shell could be made of light emitting polymers (LEP) electrically connected to the fpcb. In this embodiment the ring shell could communicate visually with its immediate vicinity by emitting electromagnetic radiation, for example a red colour, in order to communicate to other people that the user belongs to the “red” debate team just created at the college seminar course. In practice, the microcontroller may be configured to, in response to a signal received internally by the pressure- or accelerometer sensor of the ring, to send the correct current to the LEP ring

Petitioner Samsung Ex-1004, 0907

shell to obtain the desired wavelength emitted. Alternatively, the microcontroller may be configured in response to a signal received from an external unit.

For example, in one embodiment, the electronic finger ring may be used as a means of communication in order to call for the attention of the ring carrier. In this embodiment, the ring may comprise a heat generating means configured to supply heat to the finger of the user in response to reception of a signal from an external unit by the RF antenna circuitry. To this end, the microcontroller may be configured to, in response to a signal received by the RF antenna circuitry, control the heat generating means to transfer heat to the inner circumference of the ring (i.e. the surface facing the finger of the user) so that the user is notified that the signal is received by the increased temperature of the ring. For example, the external unit may be a mobile phone, or a network node forwarding a signal from a mobile phone, and the signal may be any signal intended to call for the attention of the ring user. For example, the signal may be a signal indicating that the ring user has received a text message on his/her mobile phone, or a signal originating from a communication device of a friend who wants to signal to the ring user that he/she is thinking about the ring user. The heat generating means may for example be a resistive heating film in thermal contact with a metallic shell of the finger ring facing its inner circumference and contacting the finger of the user.

In one embodiment, the ring comprises a micromechanical component as part of the electronic circuit in the form of a vibration motor by means configured to supply mechanical vibrations to the finger of the user in response to reception of a signal from an external unit. To this end, the microcontroller may be configured to, in response to a signal received by an antenna of the ring, control the magnitude or time interval (frequency) generated so that the user is notified that the signal is received by the vibrations of the ring. For example, the external unit may be a mobile phone, or computer forwarding a signal adressed from an online game the ring user is connected to, which signal indicates that he or she has been hit or touched by a gaming participant at some instance during the game.

In one embodiment, the aforementioned pressure sensor is located in a cavity within the electronic finger having the inlet hole facing the inner circumference opening optimized, as above described geometry, to function as a finger plethysmograph providing a non-invasive measurement for changes in finger blood flow reflected by pulse wave

Petitioner Samsung Ex-1004, 0908

amplitude (PWA). The end application used could either be, for example, for medical, health or dating purposes.

In one embodiment, the aforementioned pressure sensor, when located in the cavity within the electronic finger having the inlet hole facing the inner circumference opening, could be replaced by a temperature sensor sensing the temperature of the fingering user. The end application used could either be, for example, for medical, health or dating purposes.

The electronic finger ring has herein been described mainly in the context of an electronic finger ring functioning as a 4-dimensional steering device for controlling an external electronic device, such as a computer. However, it should be appreciated that many of the teachings disclosed herein are advantageous also when the electronic finger ring is adapted for other applications, such as identification, electronic payment, etc., mentioned in the summary of the invention, or for "heat- or vibration or light emitting communication" as described in the above passage.

It should also be understood that the set of electronic and/or electromechanical components integrated in the ring may be easily adapted to the intended use of the ring. For example, the electronic finger ring needs not to include an accelerometer or a pressure sensor when used for identification of the user wearing it. In this case, it may be sufficient to integrate the microcontroller (programmed with an identification number or the like) and the antenna circuitry in the electronic finger ring.

Consequently, it should be understood that the following aspects of the invention are also encompassed by this disclosure:

Aspect 1: An electronic finger ring comprising:

- a toroidal shaped finger ring structure having an outer metal shell, and
- a microcontroller and RF antenna circuitry integrated in said toroidal shaped finger ring structure for communicating with an external, electronic device,

wherein an internal antenna of the RF antenna circuitry is located under an opening in said outer metal shell serving as a window for RF radiation.

Petitioner Samsung Ex-1004, 0909

Aspect 2: The electronic finger ring according to aspect 1, wherein the internal antenna is connected to the outer metal shell which is adapted to serve as an external antenna for coarse tuning to an operational frequency.

Aspect 3: The electronic finger ring according to aspect 1 or 2, further comprising an inner shell, and wherein the opening in the outer metal shell leaves the inner shell exposed, the inner shell preferably comprising a titanium compound.

Aspect 4: An electronic finger ring comprising:

- a toroidal shaped finger ring structure having an outer metal shell, and
- a microcontroller and RF antenna circuitry integrated in said toroidal shaped finger ring structure for communicating with an external, electronic device,

wherein an internal antenna of the RF antenna circuitry is connected to the outer metal shell which is adapted to serve as an external antenna for coarse tuning to an operational frequency.

Aspect 5: The electronic finger ring according to any of the preceding aspects, wherein the internal antenna is connected to an RF transceiver of the RF antenna circuitry through a metal strip layer serving as a microstrip feed line.

Aspect 6: The electronic finger ring according to any of the preceding aspects, wherein the ring further comprises at least one ground plane for reflecting RF radiation directed inwardly, the ground plane preferably stretching at least between the internal antenna and an RF transceiver of the RF antenna circuitry.

Aspect 7: The electronic finger ring according to any of the preceding aspects, further comprising an elevated sphere shape functioning as a housing for the internal integrated antenna.

Aspect 8: An electronic finger ring comprising:

- a toroidal shaped finger ring structure having an outer shell, and
- electronic components comprising at least a microcontroller and RF antenna circuitry integrated in said toroidal shaped finger ring structure for communicating with an external, electronic device,

Petitioner Samsung Ex-1004, 0910

wherein the outer shell comprises a top and bottom half that are welded together along an interface comprising a material having getter properties to enchance the hermetic encapsulation of the printed circuit board and the electric components.

Aspect 9: The electronic finger ring according to aspect 8, wherein the material also has chemical, adhesive properties.

Aspect 10: The electronic finger ring according to aspect 8 or 9, wherein the material is a metallic getter film the getter properties of which are activated by heat transfer during the welding procedure.

Aspect 11: The electronic finger ring according to any of the aspects 8 to 10, wherein the material comprises a titanium compound.

Aspect 12: Method for manufacturing an electronic finger ring comprising the steps of:

- providing a top and bottom half of a shell of a toroidal shaped finger ring structure;
- mounting inside and along the circumference of a first of said halves a flexible printed circuit board comprising electronic components;
- integrating said flexible printed circuit board and the electronic components in a toroidal finger ring structure by welding the first and the second of said halves together along an interface between the two halves, and
- before welding the two halves together, forming said interface at least partially of a material having getter properties to enhance the hermetic encapsulation of the printed circuit board and the electric components.

Aspect 13: Method according to aspect 12, wherein said interface is at least partially formed of a material having both getter properties and chemical, adhesive properties enhancing the welding between the two halves.

Aspect 14: Method according to aspect 12 or 13, wherein the interface material is a titanium composition.

Aspect 15: Method for manufacturing an electronic finger ring comprising the steps of: fixating the respective complementary top and bottom half of the toroidal shaped shell interfaces with one or more screws in order to obtain a non-hermetic encapsulation of the electrical components.

Petitioner Samsung Ex-1004, 0911

Aspect 16: An electronic finger ring comprising:

- a toroidal shaped finger ring structure having an outer shell, and
- electronic components comprising at least a microcontroller and RF antenna circuitry integrated in said toroidal shaped finger ring structure for communicating with an external, electronic device,

the electronic components being fabricated or mounted on a flexible printed circuit board which is packaged inside, along the circumference of the toroidal shaped finger ring structure, the RF antenna circuitry comprising an internal antenna being arranged either in the flexible printed circuit board or between the flexible printed circuit board and the outer boundary of the toroidal shaped finger ring structure,

wherein the electronic finger ring further comprises RF shielding coating between the inner boundary of the toroidal shaped finger ring structure and the flexible printed circuit board to shield the user's finger from RF radiation.

Aspect 17: An electronic finger ring comprising:

a torodial ring shell that is made of plastic instead of metal wherin the conformal coating, is either coated (or both) on the (i). inner circumference of the fpcb, or (ii). on the exterior of the inner circumference of the ring shell, and mixed with cenospheres to function as a RF shielding on the users finger.

Aspect 18: The electronic finger ring according to aspect 17 wherin the plastic torodial ring shell is made of a light emitting polymer (LEP) electrically connected to the fpcb to optically communicate (emitting) with others in the users immediate vicinity.

Aspect 19: The electronic finger ring according to aspect 16, wherein at least one of the electronic components is arranged between the flexible printed circuit board and the inner boundary of the toroidal shaped finger ring, and wherein the RF shielding coating is provided on the inner side of the flexible printed circuit board so that the RF shielding coating shields both the user's finger and the at least one electronic component from RF radiation.

Aspect 20: An electronic finger ring comprising:

- a toroidal shaped finger ring structure having a metal shell intended to contact a finger of a user wearing the ring, and

Petitioner Samsung Ex-1004, 0912

- electronic components integrated in said toroidal shaped finger ring structure, comprising at least a microcontroller, an RF antenna circuitry for communicating with an external, electronic device, and a heat generating means,

wherein the heat generating means is adapted to supply heat to the metal shell of the toroidal shaped finger ring structure in response to a signal received by the RF antenna circuitry from the external device.

Aspect 21: Electronic finger ring according to aspect 20, wherein the microcontroller is adapted to analyse the received signal and control the heat generating means to supply heat to the metal shell if the signal indicates that the user's attention should be called for.

Aspect 22: Electronic finger ring according to aspect 20 or 21, wherein the heat generating means is a resistive heating film arranged in thermal contact with the metal shell of the toroidal shaped finger ring structure.

Aspect 23: An electronic finger ring comprising:

- a toroidal shaped finger ring structure having a metal shell intended to contact a finger of a user wearing the ring, and
- electronic components integrated in said toroidal shaped finger ring structure, comprising at least a microcontroller, an RF antenna circuitry for communicating with an external, electronic device, and a vibrating generating means,

wherein the vibrating generating means is adapted to supply vibrations to the whole finger ring and its user in response to a signal received by the RF antenna circuitry from the external device.

Aspect 24: Electronic finger ring according to aspect 23, wherein the microcontroller is adapted to analyse the received signal and control the vibrating generating means to supply vibrations to the whole finger ring and its user if the signal indicates that the user's attention should be called for.

Aspect 25: Electronic finger ring according to aspect 23 or 24, wherein the vibrating generating means is a micromechanical vibrational motor that is connected to the electronic circuit within the toroidal shaped finger ring structure.

Aspect 26: An electronic finger ring comprising:

Petitioner Samsung Ex-1004, 0913

- a toroidal shaped finger ring structure having a metal shell intended to contact a finger of a user wearing the ring, and
- electronic components integrated in said toroidal shaped finger ring structure, comprising at least a microcontroller, an RF antenna circuitry for communicating with an external, electronic device, and a pressure sensing means located in a cavity within the electronic finger having the inlet hole facing the inner circumference opening optimized, as above described geometry, to function as a finger plethysmograph providing a non-invasive measurement

wherein the pressure sensing means is adapted to detect pressure differences from changes in finger blood flow of the user.

Aspect 27: The electronic finger ring according to any of the preceding aspects, wherein all electrical components of the electronic finger ring are fabricated or mounted on a flexible printed circuit board which is packaged inside, along the circumference of the toroidal shaped finger ring structure.

Aspect 28: The electronic finger ring according to any of the preceding aspects, wherein the electronic components of the electronic finger ring includes one or more of:

- a power source, such as a battery, an inductive coil, and/or piezoelectric nanofibers, for powering active electronic components of the finger ring;
- an accelerometer for steering the external device in a 3-dimensional space based on motions of the user's hand, and
- a pressure sensor for steering the external device in a 4th dimension.

Petitioner Samsung Ex-1004, 0914

Claims

1. An electronic finger ring for steering an external electronic device in up to four dimensions, comprising:
   - a toroidal shaped finger ring structure (1) having an outer shell (1a), and
   - electronic components comprising a micro processor (4), RF antenna circuitry (3, 5, 7), an accelerometer (6), and a pressure sensor (8), all fabricated or mounted on a flexible printed circuit board, FPCB, (9) which is packaged inside, along the circumference of the toroidal shaped finger ring structure (1).

2. The electronic finger ring according to claim 1, wherein the accelerometer (6) is configured to steer in 3-dimensional space and the pressure sensor (8) is configured to steer in an additional 4th dimension.

3. The electronic finger ring according to claim 1 or 2, wherein the pressure sensor (8) is located in a cavity within the electronic finger ring having an inlet hole.

4. The electronic finger ring according to claim 3, wherein the inlet hole is shaped as a horn cone to maximize the pressure compression ratio at the pressure sensor end (11).

5. The electronic finger ring according to claim 4, wherein to optimize sensitivity of the pressure sensor (8) the inlet hole (11) has a minimum aspect ratio size difference of the diameter of the narrow end (x) of the horn cone to the outer end (y) of the horn cone as 1:10.

6. The electronic finger ring according to claim 4 or 5, wherein the total height of the horn cone (m) should have an aspect ratio size to the height of the narrow end of the horn cone (n) as 6:1.

7. The electronic finger ring according to any of the claims 3 to 6, wherein the pressure sensor (8) and the inlet hole are located so that the cavity faces the inner circumference of the toroidal shaped finger ring structure (1) to allow pressure to be applied to the pressure sensor (8) by bending the finger carrying the ring.

Petitioner Samsung Ex-1004, 0915

8. The electronic finger ring according to any of the claims 3 to 6, wherein the pressure sensor (8) and the inlet hole are located so that the cavity faces the outer circumference of the toroidal shaped finger ring structure (1) to allow pressure to be applied to the pressure sensor (8) by using another finger not carrying the ring.

9. The electronic finger ring according to any of the preceding claims, wherein the outer shell (1a) is made of metal, and wherein the RF antenna circuitry (3, 5, 7) comprises an internal antenna (7) located under an opening (10) in the outer metal shell (1a) serving as a window for RF radiation.

10. The electronic finger ring according to claim 9, wherein the toroidal shaped finger ring structure (1) comprises a locally extended, elevated sphere shape (15) functioning as a housing for the internal antenna (7) and minimizing return losses of the RF radiation.

11. The electronic finger ring according to claim 9 or 10, further comprising an inner shell (1b), and wherein the opening in the outer metal shell (1a) leaves the inner shell (1b) exposed, the inner shell preferably comprising a titanium compound.

12. The electronic finger ring according to any of the claims 9 to 11, wherein the internal antenna (7) is connected to the outer metal shell (1a) which is adapted to serve as an external, omnidirectional antenna obtaining coarse tuning to an operational frequency.

13. The electronic finger ring according to any of the preceding claims, wherein the outer shell (1a) of the toroidal shaped finger ring structure (1) is constituted of two toroidal complementing halves (1c, 1d) which are welded together along an interface between the two halves.

Petitioner Samsung Ex-1004, 0916

14. The electronic finger ring according to claim 13, wherein the interface comprises a material having getter properties to enhance the hermetic encapsulation of the printed circuit board and the electric components.

15. The electronic finger ring according to claim 14, wherein the material also has chemical, adhesive properties enhancing the welding between the two halves (1c, 1d).

16. The electronic finger ring according to any of the preceding claims, wherein the electronic components further comprises a battery (2).

17. The electronic finger ring according to any of the preceding claims, further comprising a protective coating (14) having RF shielding properties located between the inner boundary of the toroidal shaped finger ring structure (1) and the flexible printed circuit board (9).

18. The electronic finger ring according to claim 17, wherein the protective coating (14) comprises cenospheres.

19. The electronic finger ring according to any of the preceding claims, wherein the RF antenna circuitry (3, 5, 7) comprises a microstrip feed line (5), which has a shape designed to stretch along the circumference of the toroidal shaped finger ring structure (1) and which is electrically optimized to obtain 50 Ω matching impedance.

20. The electronic finger ring according to claim 19, wherein the width and length of the microstrip feed line (5) are selected such that each dimension of the microstrip feed line radiates at 2.4 GHz.

21. The electronic finger ring according to any of the preceding claims, further comprising at least one ground plane (17) designed to minimize RF losses and having a length along the circumference of the toroidal finger ring structure (1) of $I_{ground\ \ plane}^{circumference} = \lambda/2n$, where n = 1,2,3....

Petitioner Samsung Ex-1004, 0917

22. The electronic finger ring according to claim 21, wherein the at least one ground plane (17) stretches at least in-between an internal antenna (7) of the RF antenna circuitry (3, 5, 7), located on the outer circumference side of the flexible printed circuit board (9) and an RF transceiver (3) of the RF antenna circuitry (3, 5, 7), located on the inner circumference side of the flexible printed circuit board (9).

Petitioner Samsung Ex-1004, 0918

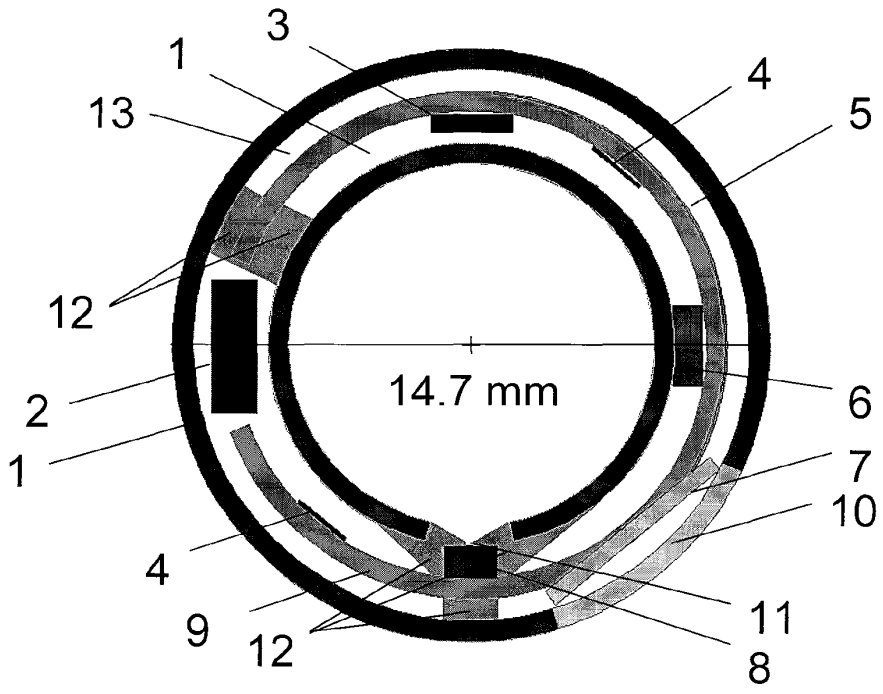


Fig. 1

Petitioner Samsung Ex-1004, 0919

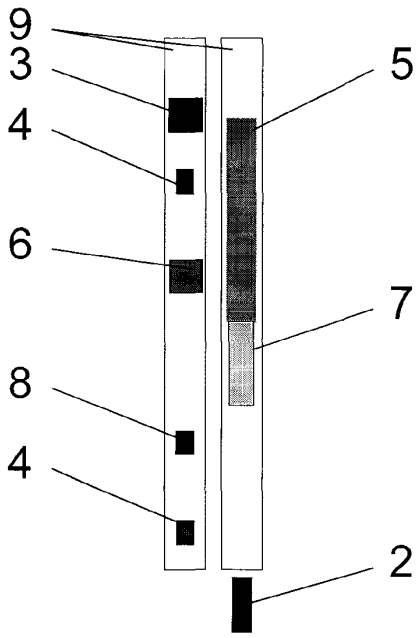


Fig. 2

Petitioner Samsung Ex-1004, 0920

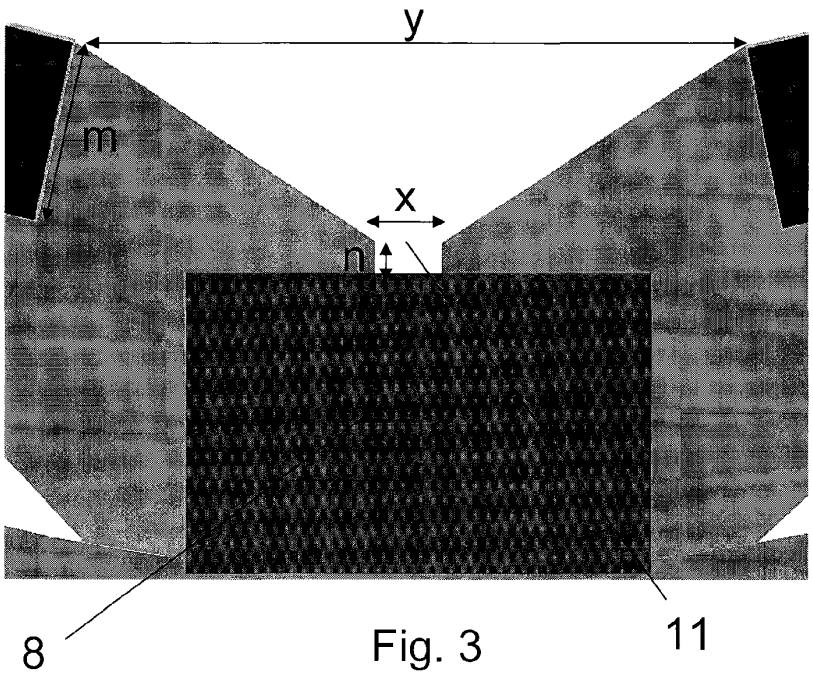


Fig. 3

Petitioner Samsung Ex-1004, 0921

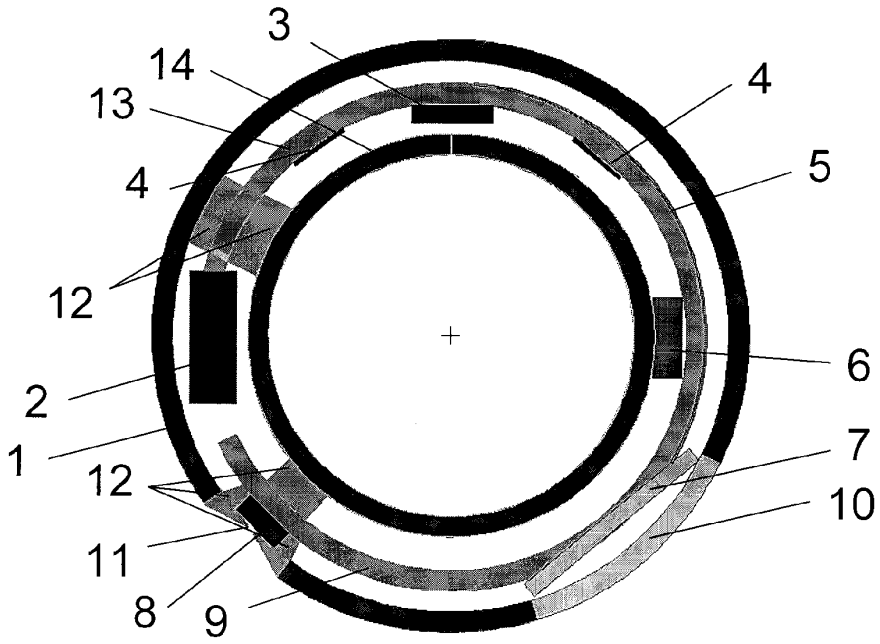


Fig. 4

Petitioner Samsung Ex-1004, 0922

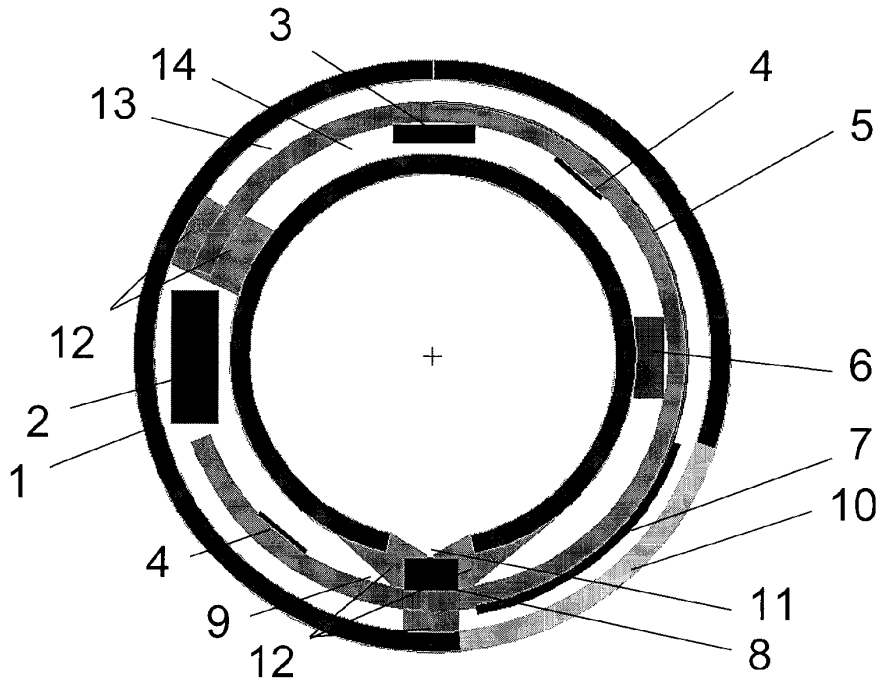


Fig. 5

Petitioner Samsung Ex-1004, 0923

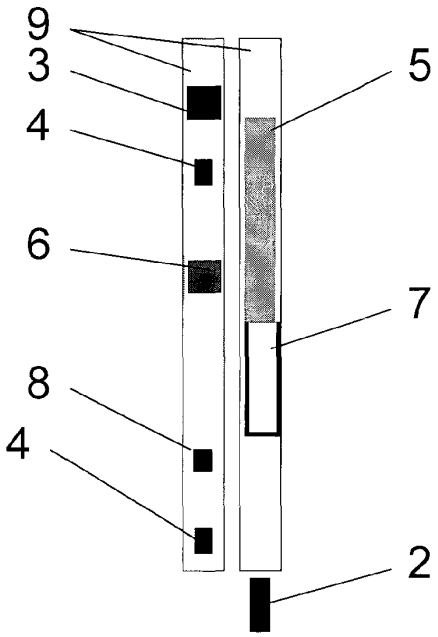


Fig. 6

Petitioner Samsung Ex-1004, 0924

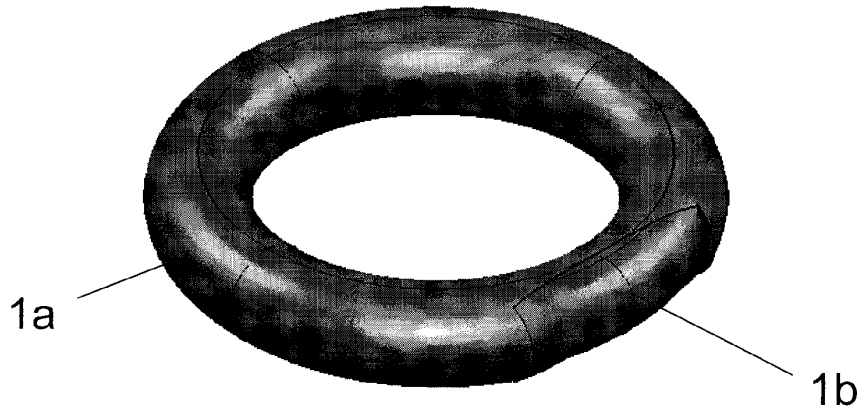


Fig. 7

Petitioner Samsung Ex-1004, 0925

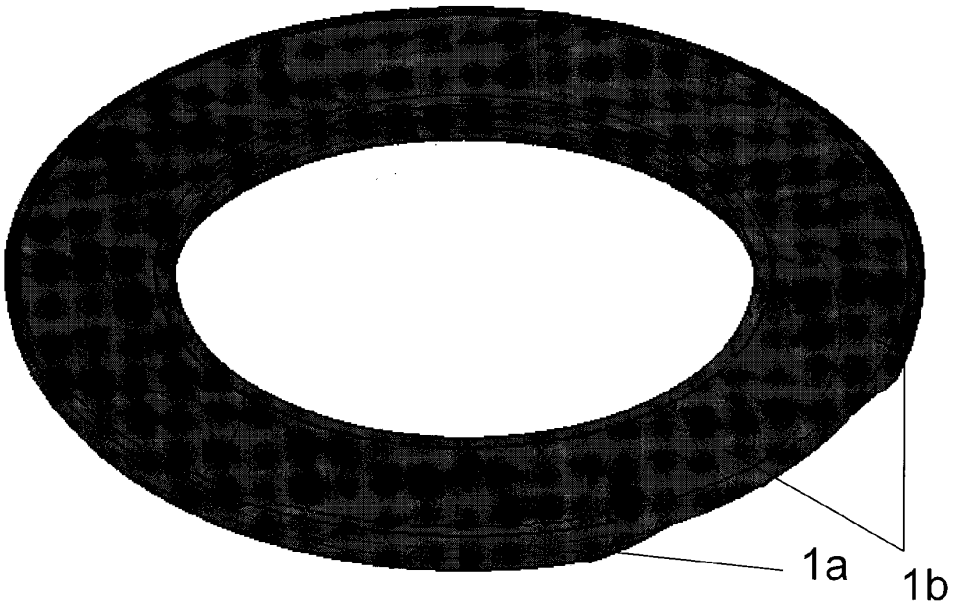


Fig. 8

Petitioner Samsung Ex-1004, 0926

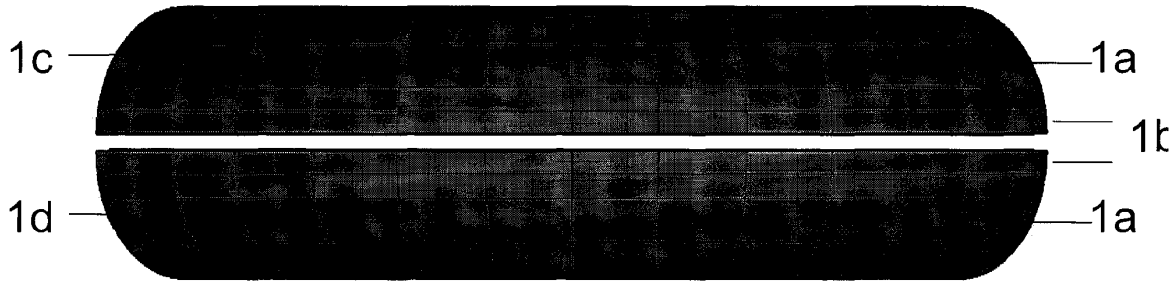


Fig. 9

Petitioner Samsung Ex-1004, 0927

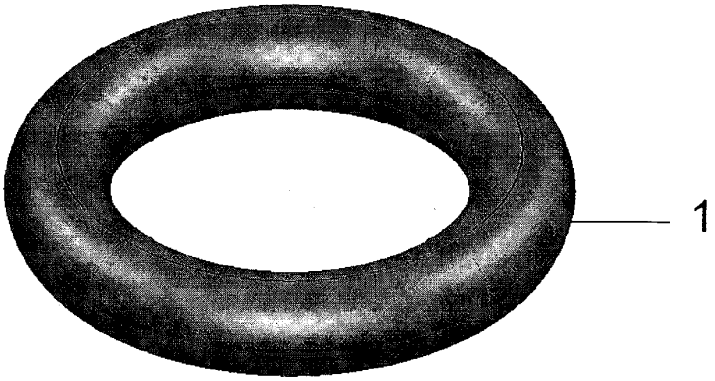


Fig. 10

Petitioner Samsung Ex-1004, 0928

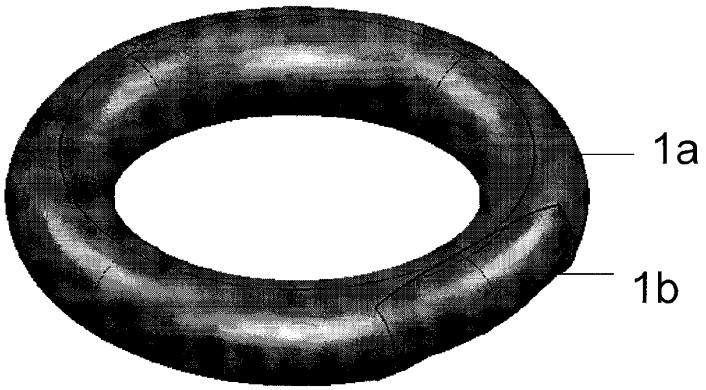


Fig. 11

Petitioner Samsung Ex-1004, 0929

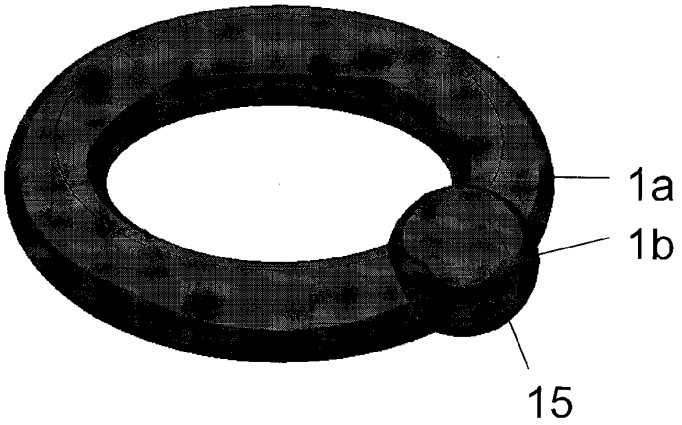


Fig. 12

Petitioner Samsung Ex-1004, 0930

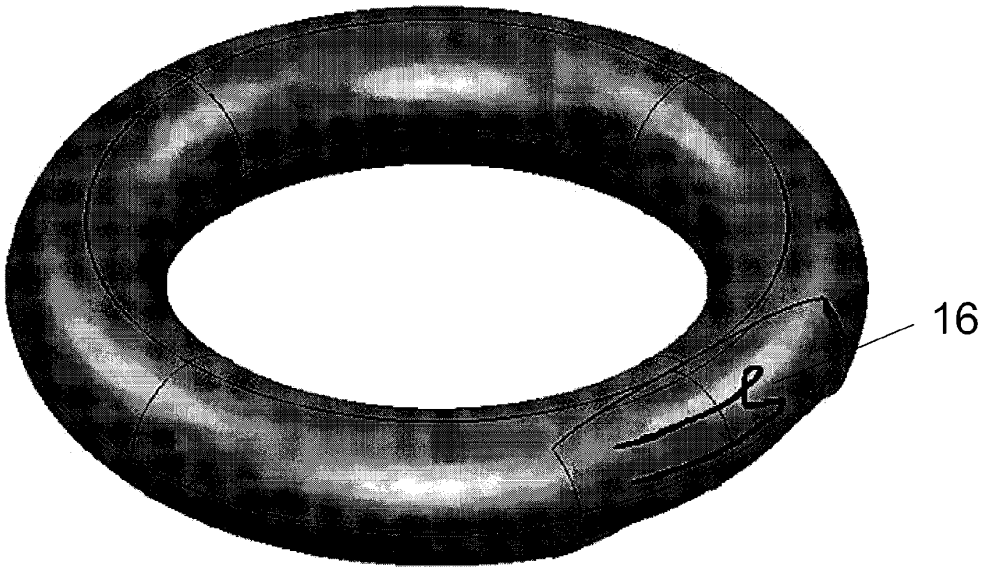


Fig. 13

Petitioner Samsung Ex-1004, 0931

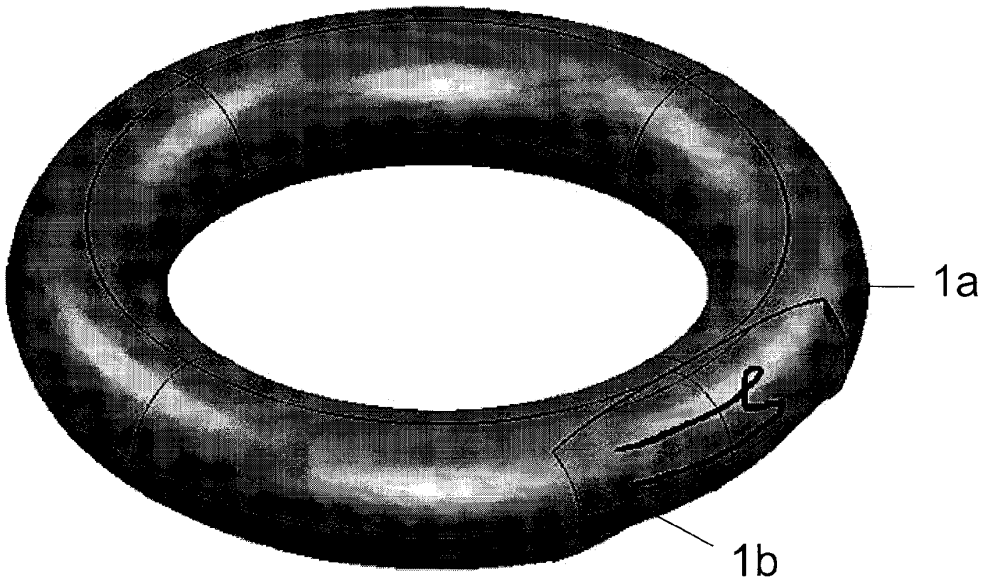


Fig. 14

Petitioner Samsung Ex-1004, 0932

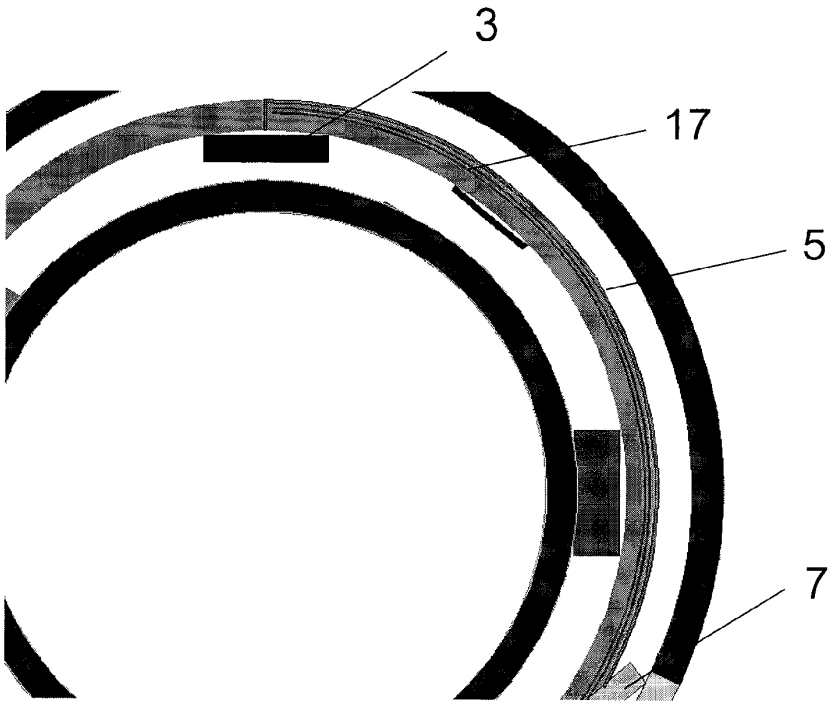


Fig. 15

Petitioner Samsung Ex-1004, 0933

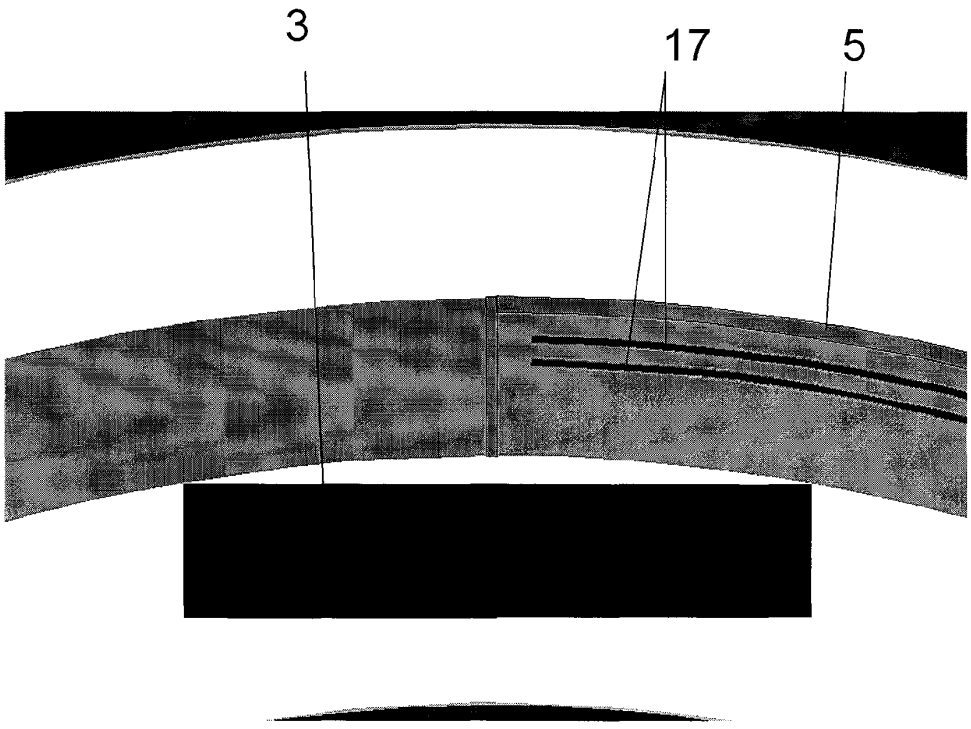


Fig. 16

Petitioner Samsung Ex-1004, 0934

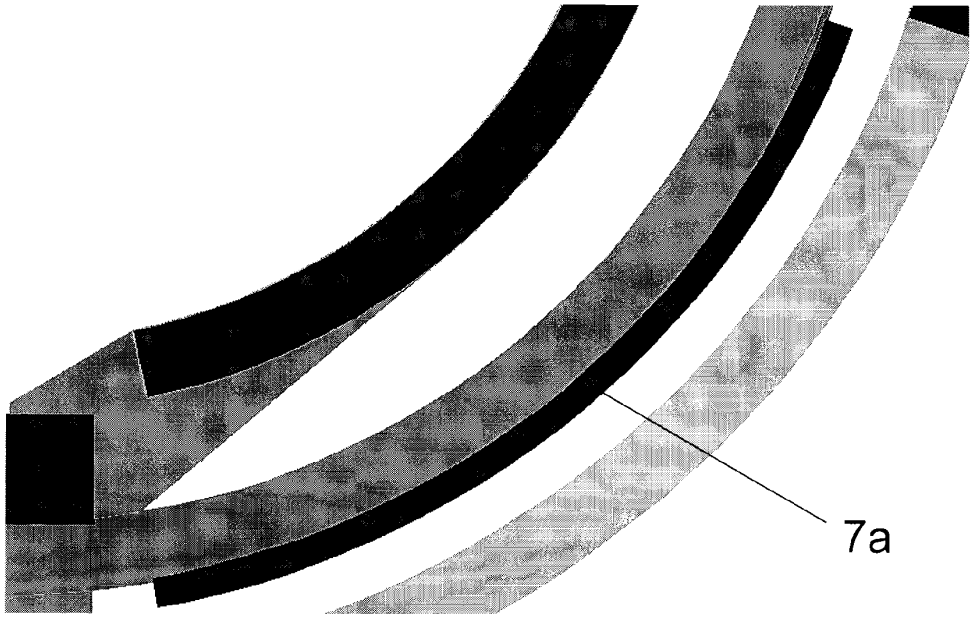


Fig. 17

Petitioner Samsung Ex-1004, 0935

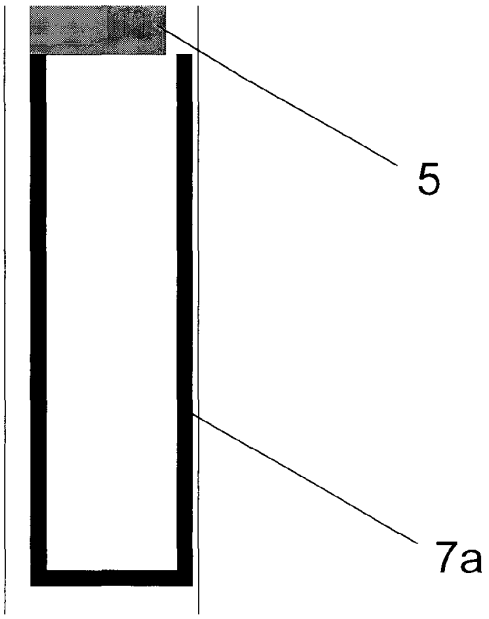


Fig. 18

Petitioner Samsung Ex-1004, 0936

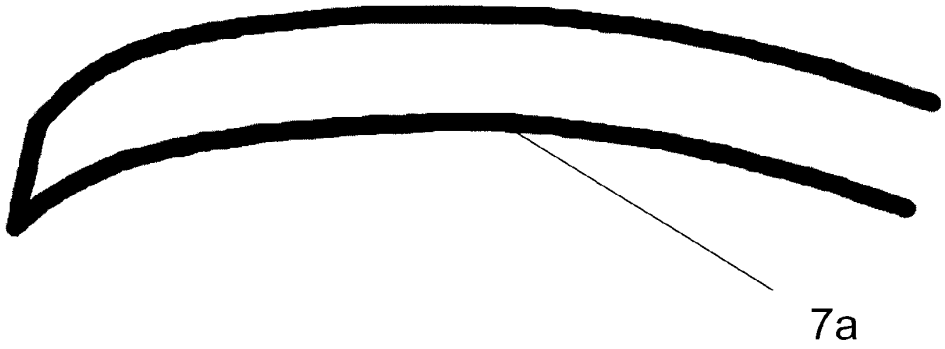


Fig. 19

Petitioner Samsung Ex-1004, 0937

INTERNATIONAL SEARCH REPORT

International application No
PCT/SE2010/051167

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F3/033
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2003/142065 A1 (PAHLAVAN KOUROSH [US]) 31 July 2003 (2003-07-31) cited in the application the whole document	1-3,7-22
X	US 2008/088468 A1 (KIM YONG-DUCK [KR]) 17 April 2008 (2008-04-17) the whole document	1-3, 13-16
A	US 2003/214481 A1 (XIONG YONGMING [US]) 20 November 2003 (2003-11-20) the whole document	1,2,9-22
A	WO 96/34333 A1 (INTERVAL RESEARCH CORP [US]) 31 October 1996 (1996-10-31) the whole document	1-3,7-9, 12,16

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 February 2011	04/03/2011

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Bravo, Piero

1

Form PCT/ISA/210 (second sheet) (April 2005)

Petitioner Samsung Ex-1004, 0938

INTERNATIONAL SEARCH REPORT

International application No
PCT/SE2010/051167

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2001 109569 A (NEC CORP) 20 April 2001 (2001-04-20) * abstract figures 1, 4	1-3,7,8
A	WO 03/103486 A1 (MASSACHUSETTS INST TECHNOLOGY [US]) 18 December 2003 (2003-12-18) the whole document	1-3,16
A	WO 2007/092239 A2 (XPRESENSE LLC [US]; BAUM ROBERT THOMAS JR [US]; CURRY JAMES EDWARD [US) 16 August 2007 (2007-08-16) paragraph [0039] - paragraph [0111]; figures 1-5, 7a-9c	1,9-22

1

Petitioner Samsung Ex-1004, 0939

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/SE2010/051167

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003142065 A1	31-07-2003	NONE	
US 2008088468 A1	17-04-2008	CN 101165642 A	23-04-2008
		KR 20080034291 A	21-04-2008
US 2003214481 A1	20-11-2003	NONE	
WO 9634333 A1	31-10-1996	AT 217986 T	15-06-2002
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		DE 69621330 T2	24-10-2002
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JP 2001109569 A	20-04-2001	NONE	
WO 03103486 A1	18-12-2003	AU 2003232450 A1	22-12-2003
WO 2007092239 A2	16-08-2007	WO 2007092238 A2	16-08-2007
		WO 2007092240 A2	16-08-2007

Petitioner Samsung Ex-1004, 0940

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 660 680 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
06.11.2013 Bulletin 2013/45

(21) Application number: **12305497.5**

(22) Date of filing: **03.05.2012**

(51) Int Cl.:
G06F 3/01 *(2006.01)* ***G06F 3/048*** *(2013.01)*
G06F 1/16 *(2006.01)* ***H04W 4/20*** *(2009.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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(54) System and method for enabling collaborative gesture-based sharing of ressources between devices

(57) A method for content sharing between a first user terminal (1) and at least a second user terminal (2), comprising the following steps:
a) identifying a first gesture involving the first user terminal (1) ;
b) identifying a content (3), comprised within the first user terminal (1), intended to be shared ;
c) sending, to the at least second user terminal (2), metadata of the content (3) and metadata of the identified first gesture;
d) identifying a second gesture involving the at least second user terminal (2) ;
e) determining if the first gesture and the second gesture relate to a predefined interaction gesture scenario aiming at content sharing;
f) triggering the content (3) sharing.

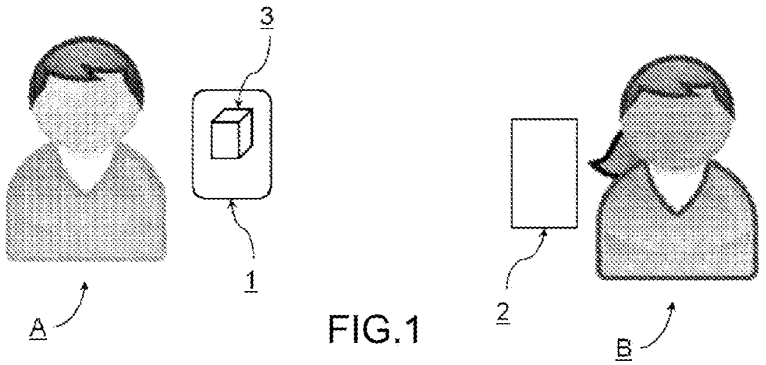


FIG.1

EP 2 660 680 A1

Printed by Jouve, 75001 PARIS (FR)

Petitioner Samsung Ex-1004, 0941

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a method and a system for digital contents sharing between user terminals.

BACKGROUND OF THE INVENTION

[0002] As used herein, the term "user terminal" is meant broadly and not restrictively, to include any electronic device which may interact through user-interfaces to transmit/receive data to/from another electronic device and/or a communications network. As non limitative examples of such user terminals, one can mention a smartphone; tablet PC, MP3 player, Personal Digital Assistant (PDA), laptop and the like.

[0003] Unquestionably, such user terminals, particularly handheld ones, are now increasingly common, because they are expected to provide a plurality of applications/services such as Internet browsing, phone-calling, messaging, photo-taking, localization, games, and content sharing. The "how-to-use" of these applications/services is generally inherited from earlier systems providing similar services (such as desktop computer, or wired telephone). However, the implementation of many of these services, even if it is apprehensible by users, is certainly inappropriate and inadequate for mobile devices.

[0004] In the following, content sharing service is taken as an illustrative example of the above problem. A "content" is intended to mean, here, any content/resource/information in a digital format, including but not limited to music, videos, photos, movies, ring tones, eBooks, contact details, Electronic Business Card, document, reminder, to-do list, notification, mobile applications, message, GPS location, URL.

[0005] In fact, in order to share content (a picture for example) with a peer, a user is generally constrained to:

- open the content on his/her terminal with an appropriate application (example: gallery application);
- request the sharing of the content with an interaction that varies from one application to another (for example: a 'share' menu option)
- among the many sharing services available on the device, pick one that all recipients also support (for example: email, Facebook®);
- select the recipients (examples: contacts chooser, Google circles®).

[0006] Each recipient will later:

- receive a message on his own terminal, in a way that is specific to the chosen sharing service(for instance, a notification for an incoming email);
- extract the content from the message (example: "save attachment as" function) before consumption.

[0007] Accordingly, for sharing content with a peer, the user experience is often complex: both the senders and the recipients need to perform a sequence of actions. Further, quite often a shared third party service provider needs to be involved.

[0008] Slightly less constraining known approach for content sharing are as follow:

- choosing a sharing service on the device that the recipients also support (example: start the Facebook® application)
- with an interaction specific to the sharing service, selecting the content to be shared (example: choose the pictures to share with the gallery);
- with an interaction specific to the sharing service, requesting the sharing of content with the chosen recipients.

[0009] From the recipient side, steps cited above are unchanged.

[0010] Accordingly, existing solutions remain of excessive complexity because they require many interactions from each participant: selection of the content, selection of the sharing service, and selection of recipients. Another problem arises in the prior art with regards to the quality of human communications through electronic devices. In fact, during known content sharing methods, users interact with their respective personal devices as if they were on remote locations, without any consideration of the quality of human communication and interaction. In other words, content sharing according to known solutions is performed in almost pure human-machine interactions without any consideration of user-friendly and human-centric.

[0011] It happens that the selection step of recipients for the sharing is simplified, as it is proposed by Bump@ application (bu.mp). In fact the Bump@ application lets two users shake their mobile phone together. Based on the location of users and other information from the devices' sensors, the Bump@ service establishes a peering between users within which information assets can be shared.

[0012] Nonetheless, Bump@ solution remains partial as it requires that each user terminal is connected to the Internet. Such drawback prevents information assets sharing where this is insufficient radio coverage, or when users choose to disable data (for cost reasons when traveling abroad for example). Yet another drawback of this solution is that the chosen interaction (i.e. shake devices simultaneously) between users is not intuitively associated with the sharing.

[0013] One object of the present invention is to make sharing as simple as a natural interaction gestures.

[0014] Another object of the present invention is to make sharing of information assets between mobile devices easier, funnier, and more intuitive, thereby enhanc-

Petitioner Samsung Ex-1004, 0942

ing the human communication between sharing users (typically, body language and emotional display).

[0015] Another object of the present invention is to find "natural" and easy-to-use user interface for content sharing among mobile user equipments.

SUMMARY

[0016] Various embodiments are directed to addressing the effects of one or more of the problems set forth above. The following presents a simplified summary of embodiments in order to provide a basic understanding of some aspects of the various embodiments. This summary is not an exhaustive overview of these various embodiments. It is not intended to identify key of critical elements or to delineate the scope of these various embodiments. Its sole purpose is to present some concepts in a simplified form as a prelude to the more detailed description that is discussed later.

[0017] Various embodiments relate to methods for content sharing between a first user terminal and at least a second user terminal, comprising the following steps:

- identifying a first gesture involving the first user terminal;
- identifying a content, comprised within the first user terminal, intended to be shared;
- sending, to the at least second user terminal, metadata of the content and metadata of the identified first gesture;
- identifying a second gesture involving the at least second user terminal;
- determining if the first gesture and the second gesture relate to a predefined interaction gesture scenario aiming at content sharing;
- triggering the content sharing.

[0018] Various embodiments relate to systems for content sharing between a first user terminal and at least a second user terminal, comprising

- means for identifying a first gesture involving the first user terminal;
- means for identifying a content, comprised within the first user terminal, intended to be shared ;
- means for sending, to the at least second user terminal, metadata of the content and metadata of the identified first gesture;
- means for identifying a gesture involving the at least second user terminal;
- means for determining if the first gesture and the second gesture relate to a predefined interaction gesture scenario aiming at content sharing;
- means for triggering the content sharing.

[0019] Various embodiments further relate to a computer program product for performing the above methods.

[0020] While the various embodiments are susceptible to various modification and alternative forms, specific embodiments thereof have been shown by way of example in the drawings. It should be understood, however, that the description herein of specific embodiments is not intended to limit the various embodiments to the particular forms disclosed.

[0021] It may of course be appreciated that in the development of any such actual embodiments, implementation-specific decisions should be made to achieve the developer's specific goal, such as compliance with system-related and business-related constraints. It will be appreciated that such a development effort might be time consuming but may nevertheless be a routine understanding for those or ordinary skill in the art having the benefit of this disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] The above and other objects and advantages of various embodiments will become apparent from the detailed description of preferred embodiments, considered in conjunction with the accompanying drawing, in which

- Fig.1 is a schematic diagram illustrating the context of content sharing;
- Fig.2 is a schematic diagram illustrating components of one embodiment;
- Fig. 3 is a schematic diagram illustrating steps of a content sharing according to one embodiment.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0023] With reference to figure **1**, a first user **A** provided with a user terminal **1** is willing to share a content **3**, held on his/her user terminal **1**, with a second user **B** provided with a user terminal **2**.

[0024] The act of sharing is to be understood, here, broadly to include sending/transferring/communicating content **3** (with or without leaving a copy of this content **3** in its original location) from one user terminal **1** to one or more other user terminals **2**.

[0025] To that end, each of the user terminals **1-2** comprises an intuitive gesture-based sharing system **20** (figure 2) enabling content sharing on the basis of natural interaction gesture of users **A** and/or **B**.

[0026] A natural interaction gesture is considered, here, as a gesture involving real-life artifacts and having a generally accepted meaning in a given context. As non exhaustive examples of such interaction gestures, one can mention

- pouring, by a first person (sender), water from a bottle into a glass of a second person (receiver), wherein water (a content) is transferred (shared) from the bottle to the glass;
- throwing (share), by a first person (sender), an apple/

Petitioner Samsung Ex-1004, 0943

ball/key (content) to a second person (receiver) willing to catch it;
- giving (share) for a while, by a first person (sender), an object (content) to a second person (receiver), then get back it;
- picking up an object (content) from one's bag and filing it (share) in the bag of the interlocutor (receiver);
- knocking marbles (content) from a first person (sender) container toward a second person container (receiver).

[0027] An interaction gesture may be identified on the basis of a combination of

- a sampling of sensors values on user terminals **1-2;**
- an optional gesture filter (set of applicable gestures/ scenario patterns with parameters for example);
- optional information about the proximity between user terminals **1-2;**
- optional sets of capabilities of user terminals **1-2** (supported communication channels, touch screen, accelerometers for example).

[0028] The gesture-based sharing system **20,** embedded on the platform **29** of the user terminal **1,** is configured to detect/track and to identify, with appropriated sensors **23,** interaction gestures involving the user terminal **1,** in order to control collaborative workflows on the basis thereof. In fact, when the gesture-based sharing system **20** recognizes/determines an interaction gesture, it, subsequently, organizes/triggers the sharing of the content **3** between user terminals **1-2** that are involved in the detected interaction gesture.

[0029] Sensors **23** are configured to capture user interaction events involving the user terminal **1,** such as touches on the sensitive screen, bring the user terminal **1** at a given speed/acceleration to a given point, maintaining the user terminal **1** in a given orientation/position/ height, a speech/gesture intended for the user terminal **1.** Examples of such sensors **23** are accelerometer, GPS (position, latitude, longitude, and height), gyroscope (pitch, roll, azimuth for example), microphone, camera, touch & multi-touch screen.

[0030] Sensors **23** are configured to communicate with the local gesture detection component **24** which is responsible for detecting fragments of local gestures based on inputs from sensors **23** (such as, the user is shaking his user terminal, a finger pick up against the screen of the user terminal, the user terminal is held in an oblique position and in a given orientation, the phone is quickly brought forward with a sudden stop). A collaborative gesture detection component **25** is programmed for

- sharing local gestures fragments detected by the local gesture detection component **24** of each participating user terminal **1-2** (i.e. participants) ; and for
- determining from the received fragments (fragments received from the local gesture detection component **24** and those shared from neighboring user terminals **2)** an interaction gesture aiming at content sharing such as

○ "a pinch-in gesture on a icon" (received from the local gesture detection component **23),** and "a pinch-out gesture against the screen of user terminal **2"** (these associated gestures are supposed to relate to an interaction gesture scenario aiming at content sharing) ;
○ "a file is selected", "the user terminal **1** is held in an oblique position and oriented to the ground at one meter height" (gesture fragments received from the local gesture detection component **23),** "a folder is selected on user terminal **2",** "the user terminal **2** is held in an approximately horizontal plane at eighty centimeter height", "the user terminals **1** and **2** are less than forty centimeter from each other" (gestures involving user terminal **2).** These associated gestures are supposed to relate to an interaction gesture scenario aiming at content sharing, in a similar way to pouring water from a bottle into a glass.

[0031] Moreover, a gesture may include the explicit selection of the content to be shared (example: touch on the icon), or the selection may be implicit for that gesture (example: last photo sequence).

[0032] It is to be noted that some gestures may be reserved for the control of the gesture-based sharing system **20.** For example, when detecting such gestures, the collaborative gesture detection component **25** can update the user preferences (for example, add the gesture of a given participant to a white-list or to a privileged user group).

[0033] Detected user events by sensors **23** as well as derived gesture by the collaborative gesture detection component **25** are handled by a workspace **21** so as to control

- the process of content sharing, between users **1-2,** through a content sharing module **27;** and
- the feedbacks provided to users regarding the progress/state of the sharing, via output and feedback means **22** (such as a display, audio output, haptic device for example). Output and feedback means **22** are configured for displaying information on the user terminal screen, or for generating an audio output, or any other feedback (such as vibrations).

[0034] The workspace **21** is also configured to enable users to organize the access to key content with shortcut icons. Accordingly, the workspace **21** may, further, comprise, among others, a content management user interface to take into account user preferences and configuration parameters (sensors **23** configuration, black-list of user terminals for example).

[0035] The content sharing module **27** is in charge of the sharing of a content **3** from a user **A** (a sender) to

Petitioner Samsung Ex-1004, 0944

one or several users **B** (receivers). The content sharing module **27** determines the appropriate sharing method, such as copy of the content **3** between user terminals **1-2,** transmit a pointer to the content **3** (which may be retrieved from another source), or order a third party to deliver to the user terminal **2** the content requested to be shared.

[0036] The content sharing module **27** relies on the user terminal **1** communications interface **28** for communicating with the other user terminals **2** involved in the sharing.

[0037] Advantageously, the communications interface **28** is further configured to control/take care of the authorization (digital rights management), and of content adaptation/translation (such as changing technical formats/ quality level, media re-encoding with different parameters or technology that better suit recipients' capabilities), as needed.

[0038] The communications interface **28** provides an abstraction layer on top of the various communication channels **281-282** available between two user terminals **1-2.** Communications channels **281-282** may comprise

- IP network interfaces **281** for conveying data over general purpose IP networks to which the user terminal **1** connects with Wi-Fi or cellular data protocols (such as 3G, 4G);
- short-range communications interfaces **282** for conveying data over short-range communication channels (such as Bluetooth or NFC).

The communications interface **28** is in charge of establishing communication channels with other mobiles participating in the sharing, further called "participants". The selection of participants may be made on the basis of proximity (as detected with sensors **23** (location), or using information from short-range communication interfaces **282** such as Bluetooth or NFC) as well as user preferences (such as white-list, black-list, user groups).

[0039] Accordingly, the sharing may take place for instance with a direct transfer of the content **3** over a short range communication network (e.g. Bluetooth, Wi-Fi, ad-hoc for example), or a public wireless data network (**3**G, **4**G). Alternatively, the sharing may take place with the transfer of information allowing the recipient (user terminal 2) to obtain the resource from a third party service provider, or with the transfer of information allowing the recipient to order the copy of the content **3** from one third party provider to another.

[0040] The content sharing module **27,** further, relies on a content manager **26** which is configured to provide an abstraction layer for the various classes of resources **261-264** such as: contacts **261,** files **262,** applications **263,** or shortcut to external resources **264.**

[0041] As an illustrative implementation of the above described gesture-based sharing system **20** and method, consider, with reference to figure 3, the case of a user **A** willing to share a mobile application **3** with a user **B,** both users **A-B** being located within the range of Bluetooth coverage and having established (step **30** in figure 3) a trusted communication channel linking their respective user terminals **1-2.** Accordingly, the user **A**

- performs (step **31** in figure 3) a **2**-finger pick gesture (pinch in) against the screen **23** of its user terminal **1** over the application 3 to be shared with the user **B** provided with user terminal **2;**
- the local gesture detection component **24** of user terminal **1** identifies (step **32** in figure 3) a pinch-in gesture from the data of sensors **23** (multi-touch screen);
- the collaborative gesture detection component **25** identifies (step **33** in figure 3) the local gesture as an intent to select a local content **3,** to possibly share it with a neighboring user terminal;
- the workspace **21** identifies (step **34** in figure 3) the content **3** targeted by the local gesture as a mobile application **3;**
- the workspace **21** updates (step **35** in figure 3) the display to show that the mobile application **3** picked by the **2** fingers-gesture has been picked ;
- the content sharing module **27** prepares (step **36** in figure 3) metadata for the selected content, to be transferred to the neighboring user terminal **2;**
- the communications interface **28** sends (step **37** in figure 3) metadata relative to the content (name, reference, type, source, size for example) and metadata relative to the local gesture to the neighboring user terminal **2** over the already established Bluetooth communication channel.

[0042] On the receiver side (i.e. user terminal **2),**

- the communications interface **28** of the user terminal **2** receives (step **41** in figure 3) the remote content and gesture metadata from the sender (i.e. user terminal **1);**
- the content sharing module **27** of the user terminal **2** handle (step **42** in figure 3) the received content metadata into;
- The user **A,** or **B** performs (step **43** in figure 3) a **2**-finger drop gesture (pinch out) against the screen of the user terminal **2;**
- the local gesture detection component **23** (i.e. that of the user terminal **2)** identifies (step **44** in figure 3) a pinch-out gesture from the sensors' data;
- with reference to predefined interaction gesture scenarios aiming at content sharing which are known by the gesture-based sharing system **20** (for example, stored within a local database), the collaborative gesture detection component **25** determines/recognizes (step **45** in figure 3) the local gesture as related/ associated to the previously remote gesture (in other words, the local gesture matches with the remote gesture), and derive a request to handle a content **3** shared by the user terminal **1 ;**

Petitioner Samsung Ex-1004, 0945

- triggered by the workspace component, the content sharing module **27** of the user terminal **2** retrieves (step **46** in figure 3) from the sender (through its communications interface **28)** additional data associated to shared content **3** by the user terminal **1;**
- the workspace component updates (step **47** in figure 3) the user terminal **2** display (output and feedback means **22)** to show the icon of the shared content at the location where the **2**-fingers pinch-out local gesture occurred.

[0043] Consequently, the content **3** (a mobile application in the above example) is shared from user terminal **1** to user terminal **2** through pick-and-drop. A notification message may be notified to user **A** and/or **B,** via output and feedback means **22,** informing him/her about the success/failure of the sharing.

[0044] Alternatively, the sharing interactions between user terminals may be performed according to any of the followings interaction gesture scenarios (in form of couples of gestures involving sender and recipients):

- sharing a content from one device to a neighboring device through drag-and-drop, using
  - ○ a point-and-slide finger gesture against the user terminal screen of the sender; and
  - ○ a slide-and-raise finger gesture against the user terminal screen of the receiver ;
- sharing of an application from one user terminal to several neighboring user terminals, using a
  - ○ pouring gesture with the sender's user terminal; and
  - ○ a give-me gesture with the receiver user terminal (palm extended forward upwards while holding the user terminal oriented facing up, and opening and closing fingers or moving hand forward-backward).

[0045] Further, a gesture may specify the location on recipients user terminal wherein a shortcut to the content will be created (on the "home screen" for example);

- establishment of a trusted communication channel between 2 user terminals, using a waving gesture while holding each user terminal;
- release of a trusted communication channel between 2 user terminals, using a waving gesture while holding each user terminal.

[0046] Representation of contents (typically icons) may be transmitted in anticipation to potential recipients so it is possible to render animations on the recipients' devices during the execution of a gesture.

[0047] Advantageously, the above described method and system reduce the number of interactions required to share a digital content between mobile devices and make it more intuitive, pleasant and user-friendly.

Claims

1. A method for content sharing between a first user terminal **(1)** and at least a second user terminal **(2),** said method comprising the following steps:

   a) identifying a first gesture involving the first user terminal **(1) ;**
   b) identifying a content **(3),** comprised within the first user terminal **(1),** intended to be shared ;
   c) sending, to the at least second user terminal **(2),** metadata of the content **(3)** and metadata of the identified first gesture;
   d) identifying a second gesture involving the at least second user terminal **(2) ;**
   e) determining if the first gesture and the second gesture relate to a predefined interaction gesture scenario aiming at content sharing;
   f) triggering the content **(3)** sharing.

2. The method of claim 1, wherein the identification of a first gesture involving the first user terminal **(1)** includes a sampling step of sensor values comprised within the first user terminal **(1).**

3. The method of claims 1 or 2, further comprising a controlling step for authorizing the sharing.

4. The method of any of the preceding claims, further comprising an adaptation step of the content **(3)** to be shared.

5. The method of any of the preceding claims, wherein the triggering step include ordering a third party to deliver the content to the at least second user terminal **(2).**

6. The method of any of the preceding claims, wherein the first gesture involving the first user terminal **(1)** is a pinch-in gesture, and the second gesture involving the at least second user terminal **(2)** is a pinch-out gesture.

7. The method of any of the preceding claims, wherein the metadata of the content and the metadata of the identified first gesture are sent over an established communication channel linking the first user terminal **(1)** to the second user terminal **(2).**

8. The method of claim 7, wherein the communication channel is a short-range communication channel.

9. A system for content sharing between a first user terminal **(1)** and at least a second user terminal **(2),**

Petitioner Samsung Ex-1004, 0946

said system comprising

a) means for identifying a first gesture involving the first user terminal **(1)**;
b) means for identifying a content **(3)**, comprised within the first user terminal **(1)**, intended to be shared ;
c) means for sending, to the at least second user terminal **(2)**, metadata of the content **(3)** and metadata of the identified first gesture;
d) means for identifying a second gesture involving the at least second user terminal **(2)**;
e) means for determining if the first gesture and the second gesture relate to a predefined interaction gesture scenario aiming at content sharing;
f) means for triggering the content **(3)** sharing.

10. The system of claim 9, wherein the means for identifying a first gesture involving the first user terminal **(1)** include at least a sensor **(23)** configured to capture user interaction events involving the user terminal **(1)**.

11. The system of claim 10, wherein the means for identifying a first gesture involving the first user terminal **(1)**, further, include a local gesture detection component **(24)** configured to detect fragments of local gestures based on inputs from the at least sensor **(23)**.

12. The system of claims 10 or 11, wherein the means for identifying a first gesture involving the first user terminal (1), further, include a collaborative gesture detection component **(5)** configured to determine from gesture fragments an interaction gesture aiming at content sharing.

13. The system of any of claims 9 to 12, wherein the sending means include a short-range communications interface **(282)**.

14. The system of any of claims 9 to 13, wherein the sending means further include an IP network interface **(281)**.

15. A computer program including instructions stored on a memory of a dedicated system for content sharing between a first user terminal **(1)** and at least a second user terminal **(2)** wherein said computer program is adapted to perform the method as claimed in any of claims 1 to 8.

Petitioner Samsung Ex-1004, 0947

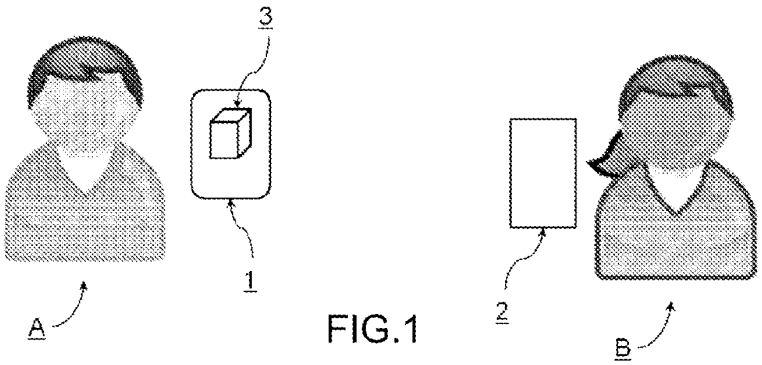


FIG.1

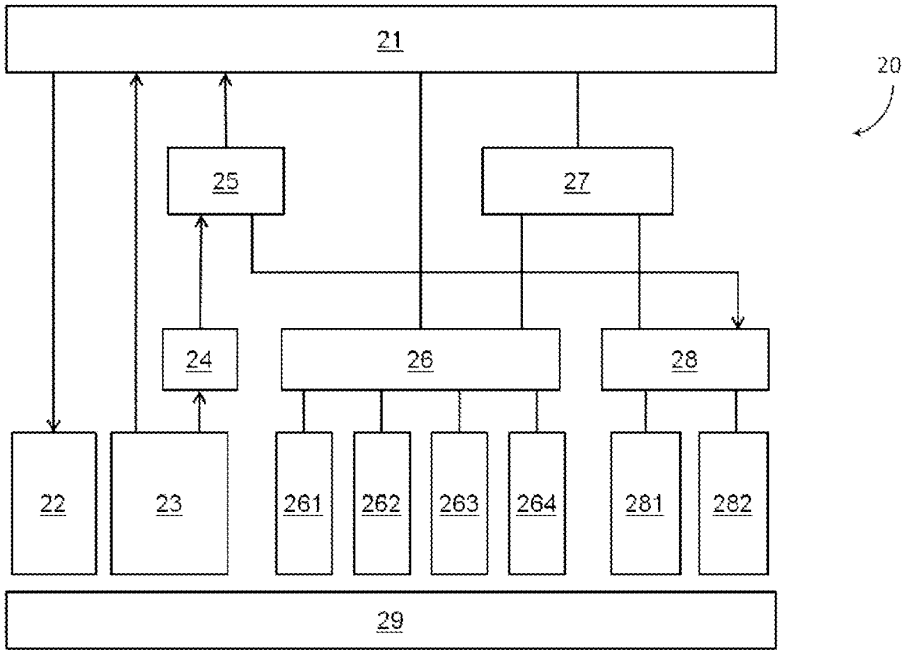


FIG.2

Petitioner Samsung Ex-1004, 0948

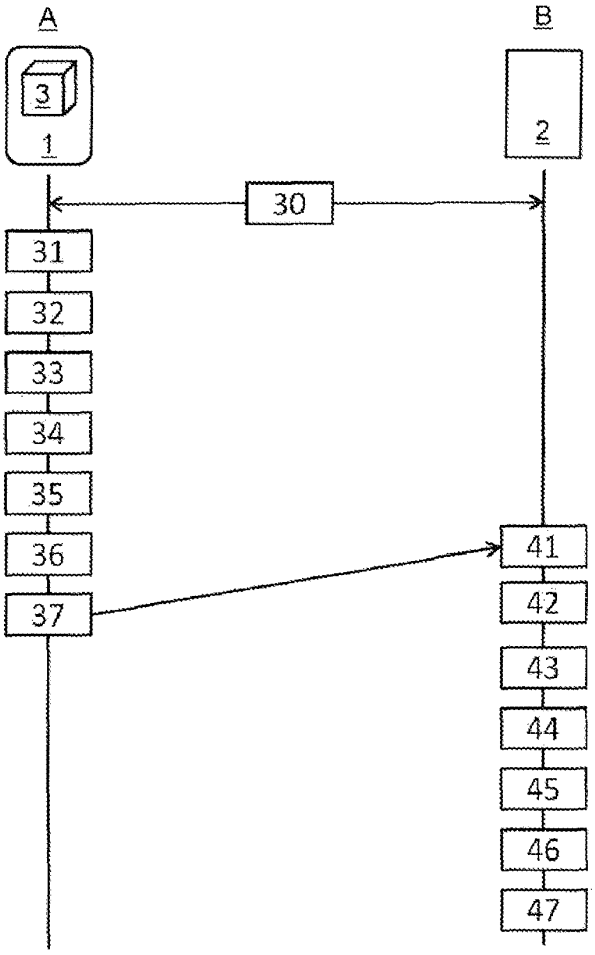


FIG.3

Petitioner Samsung Ex-1004, 0949

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 12 30 5497

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2009/140986 A1 (KARKKAINEN LEO MIKKO JOHANNES [FI] ET AL) 4 June 2009 (2009-06-04) * paragraph [0020] * * paragraph [0025]; figure 1 * * paragraph [0036] - paragraph [0049]; figures 3-5 *	1-15	INV. G06F3/01 G06F3/048 G06F1/16 H04W4/20
X	US 2011/316790 A1 (OLLILA ELINA [FI] ET AL) 29 December 2011 (2011-12-29) * paragraph [0020] - paragraph [0066]; figures 1-7 *	1-15	
X	US 2012/077436 A1 (KONDED VIKAS SHANKAR [IN] ET AL) 29 March 2012 (2012-03-29) * paragraph [0040]; figure 7 * * paragraph [0017] - paragraph [0035]; figures 1-6 *	1-15	
A	US 2010/257251 A1 (MOORING DAVID J [US] ET AL) 7 October 2010 (2010-10-07) * paragraph [0054] * * paragraph [0058] - paragraph [0062]; figure 4 *	1-15	TECHNICAL FIELDS SEARCHED (IPC) G06F H04W

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 August 2012	Ballerstein, Jens

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

Petitioner Samsung Ex-1004, 0950

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 30 5497

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

17-08-2012

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

Petitioner Samsung Ex-1004, 0951

Finger temperature indicator for indicating physical and mentally relaxed state

List of publications

Publication date

Application number 1997FR-0010366 Date 1997-08-14 Register

FR2767384 B3 Certificate of utility (second publ.)1999-07-16

English Title

Finger temperature indicator for indicating physical and mentally relaxed state

French Title

Bague d'indication de temperature de doigt a des fins principalement medicales

Abstract - French

Bague d'indication de température de doigt à des fins principalement médicales. Cette bague comprend une tige (14) conductrice de la chaleur en un matériau de forte conductibilité thermique, tel que le platine, et dont l'extrémité inférieure découverte est en contact avec le doigt de la personne portant cette bague. La température du doigt est transmise à une thermistance (41) et provoque l'actionnement d'un circuit qui convertit la valeur de la température en un signal envoyé à un élément indicateur que comporte la bague. Grâce à un bouton de commutation (31), le signal peut être présenté à la personne portant la bague sélectivement de différentes manières afin qu'il lui soit rappelé en permanence de se détendre et qu'elle soit encouragée en ce sens pour éliminer le stress physique ou mental.

English Abstract (Native or MT)

The indicator has a ring body (1) containing a band section (11) with a lower opening. Two lower ends of body (1) are formed, with curved heat conductor rod (14) and discharge rod (15) respectively embedded in two ducts (16,17) lying in opposite sides of body. The free lower ends (141,151) contact outer periphery of finger. The band section has flat recess (12) to accommodate the electronic elements of ring. The ring is provided with an on/off button (32), an LCD indicating system (33) and a LED. A PCB (4) is provided with a pyroelectric conductor (41), an indicating element (42) and other relevant electronic elements. The pyroelectric conductor is connected with the top end of the heat conducting rod (14). A finger temperature can trigger an operation of the PCB. The finger temperature detected by

the conductor (41) is converted to an electric signal and indicated by the indicating element. The person carrying the ring can select an operational mode across a button (31) e.g. to pass a small electric current to discharge rod, felt by the ring carrier, indicate finger temperature value, cause the LED to transmit light or warn the carrier.

Application Language FRENCH (FRE)

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Application Numbers & Dates FR9710366 1997-08-14 [1997FR-0010366]

Priority Numbers & Dates FR9710366 1997-08-14 [1997FR-0010366], GB9717075 1997-08-13 [1997GB-0017075], US08/909,886 1997-08-12 [1997US-08909886]

Technology domain Measurement

Medical technology

Other consumer goods

US codes history

IPC codes

A44C-009/00* A61B-005/00 A61B-005/01 A61B-005/16 G01K-013/00

IPC codes history

G01K-001/14 A44C-009/00* A61B-005/00 A61B-005/01 A61B-005/16 G01K-013/00

CPC codes

A44C-009/00/53* A61B-005/01 A61B-005/16 A61B-005/6826 A61B-005/6838 G01K-013/20 A61B-005/16/5

CPC codes history

A44C-009/00/53* A61B-005/01 A61B-005/16 A61B-005/6826 A61B-005/6838 G01K-013/20 A61B-005/16/5

Notes Number of Claims: 5

Number of Claims: 2

Description

Finger temperature indicating ring for mainly medical purposes.

Because of rapid modernization and economic development, people have to face increasingly greater stress during their daily lives. As a result, psychiatric problems such as insomnia, neurosis, psychoses, and psychosomatic disorders (including migraines, peptic ulcers, tension headaches, etc.) are disclosed are becoming more and more common among people. According to statistical data, about 5 to 15 percent of adults suffer from such problems.

There is an interaction between our physical body and our mind. Physical diseases can lead to mental disorders and mental discomfort can have a detrimental influence on physical health. When a person is subjected to stress beyond what he can withstand, physical or mental disorders can therefore occur. The mechanism resides in the fact that stress, when our brain feels it, can lead to a dysfunction or disorder of our autonomic nervous system, of our endocrine system and of our immune system by the effect of neurological pathways.

Symptoms of anxiety caused by a disorder of the autonomic nervous system can be manifested by: palpitations, dyspnea, chest tightness, dizziness, headaches, dry mouth, gastrointestinal tract disregulation, diarrhea, constipation, exaggerated frequency of urination, tremors, perspiration and limb cooling, etc. Cooling of the limbs is due to vasoconstriction of the vessels. The temperature of the fingertips has been clinically used as a general and sensitive index to monitor whether or not someone is in a relaxed state. In short, when we are in a relaxed state, our vessels expand and the tip of our fingers is hotter. If we are anxious and taut, our vessels contract and the end of our fingers is colder.

In clinical practice, medical doctors can give the patients advice on how to relax their muscles and, with the help of a biofeedback machine, they monitor the patients to see if they perform muscle relaxation in a correct manner. Of course, what is most important is to find a way of detecting a voltage of emotional origin caused by stress so that this voltage can be eliminated and it can be remedied in time.

In the conventional method of measuring the temperature of the tip of the fingers which is used clinically, the feedback machine is bulky and costly. It comprises a detector intended to come into contact with the skin of the patient in order to detect the temperature of the extremity of his fingers. The measured temperature value is converted into an electronic signal that appears on a monitor screen to tell the patient whether the patient is in a relaxed state. Since it is impossible for medical personnel or a large machine to be permanently available to patients, it is desirable to develop an auxiliary medical instrument which can be conveniently worn by persons and which can help those wearing it to relax or take measures to do so at any time.

Therefore, a main object of the present invention is to provide a ring which indicates the temperature of a finger and which can be disposed on a finger of a user at any time to serve as an auxiliary medical instrument for effectively detecting and indicating the temperature of the finger, which reflects the state of physical and/or mental relaxation of the wearer so as to assist the wearer, who may be a mental patient or an ordinary user, in controlling or controlling his emotional state in time.

In general, the ring according to the present invention comprises: A ring body comprising a band-forming portion having a lower opening forming two ends of said ring body, and two symmetrical channels formed in two opposite sides of said band portion for respectively receiving a heat conductive arcuate rod and an electric current discharge arcuate rod, said heat conducting rod and said electric current discharging rod having lower ends which respectively protrude from the inner side of both lower ends of said ring body, forming two exposed ends for contacting the outer periphery of the ring wearer's finger when the ring wearer wears said finger temperature indicating ring around a finger thereof and said band portion having a shallow upper recess for housing electronic elements Said ring; a top cover having a contour corresponding to the contour of said top recess formed in said ring body for snugly covering said ring body and fitting into said top recess, and said top cover having a plurality of openings in its top surface; An upper board being disposed in a space defined between said upper cover and said upper recess of said ring body, said board being provided in its upper surface with a switch button, an open/close button, a liquid crystal display, and a light emitting diode LED which protrude, respectively, of said openings formed in said top cover; and a circuit board comprising a thermistor, an indicator element, and other suitable electronic elements, said thermistor being connected to an upper end of said heat conducting rod and therefore capable of detecting, Via said exposed end of said conductive rod, the temperature of the finger of the person wearing the ring and initiating an operation in said circuit board to convert said temperature detected by said thermistor into a signal, Said signal being sent to said indicator element to be brought to the user's knowledge of the ring in one or more ways selected via the switch button on the top board, namely: a) causing the discharge rod to discharge a

small amount of electric current to an extent sufficient for the wearer of the ring to perceive it; b) causing the liquid crystal display to display the detected value of the finger temperature; 3) by causing the LED to emit light; or 4) by giving a warning to the wearer of the ring by means of another equivalent element.

The other equivalent means for warning the person wearing the ring may include a buzzer and/or a vibrator.

An embodiment of the present invention will now be described in detail with reference to the accompanying drawings, in which: Fig. 1 is an exploded perspective view of the ring according to the present invention; Fig. fig. 2 is a sectional view showing the ring according to the present invention in an assembled state; and fig. 3 shows a finger temperature indicating ring according to the present invention placed around a user's finger.

Reference will be made simultaneously to Figs. 1 and 2. A finger temperature indicating ring which can detect and measure the temperature of a finger of a person wearing the ring to indicate a taut or stirenegotiated mental state so that the person can relax himself in time and appropriately. The finger temperature indicating ring mainly comprises a ring body 1, an upper cover 2 fitted snugly on the top face of the ring body 1, an upper plate 3 arranged between the ring body 1 and the upper cover 2, and a circuit board 4 electrically connected to the underside of the upper board 3.

The ring body 1 includes a band portion 11 having a downwardly directed opening forming two lower ends of the ring body. Two symmetrical channels 16, 17 are formed circumferentially inside the two opposite sides of the band portion 11. **The channels 16, 17 respectively receive a heat conducting arcuate rod 14 and a current discharging arcuate rod 15.** The heat conducting rod 14 and the current discharge rod 15 have lower ends which project respectively from the inside of the two lower ends of the ring body 1, forming two exposed ends 141 and 151, respectively. The exposed ends 141 and 151 project from the inside of the band-forming portion 11 to such an extent that they can just touch the outer periphery of the person's finger when the person wears the ring of the present invention around one of his fingers. The upper part of the strip portion 11 has a shallow recess 12 in which a battery 13 or other electronic elements are placed.

The upper cover 2 has a contour corresponding to that of the recess 12 provided in the upper part of the ring body 1 and can therefore cover the ring body 1 by fitting into the recess 12. The upper cover 2 has a plurality of openings 21, 22, 23 and 24 in its upper surface.

The upper plate 3 is disposed in a space defined between the upper cover 2 and the upper recess 12 of the ring body 1 when the cover is fitted therein. A switch button 31, an open/close button 32, a liquid

crystal display 33, and a light emitting diode LED 34 are provided on the upper surface of the upper board 2 and protrude respectively through the openings 21, 22, 23 and 24 formed in the upper cover 2.

The circuit board 4 mainly comprises a thermistor 41, an indicator element 42, and other suitable common electronic elements. The thermistor 41 is connected to an upper end of the heat conducting rod 14. Because the heat conducting rod 14 has an exposed end 141 that is in contact with the skin of the finger, the temperature of the finger can be detected by the thermistor 41 via the heat conducting rod 14. The temperature of the finger detected by the thermistor 41 triggers an operation in the circuit board 4 and is converted into a signal which is sent to the indicator element 42. By using the switch button 31, one or more of the following ways can be selected to inform the user of the signal sent to the indicator element 42, namely: 1) causing the discharge rod 15 to discharge a small amount of electric current to an extent sufficient for the wearer of the ring to perceive it; 2) causing the liquid crystal display 33 to display the sensed value of the finger temperature; 3) causing the LED 34 to emit light; or

4) give a warning to the wearer of the ring by means of another equivalent element, such as a vibrator or a buzzer.

Reference will now be made to Fig. 3. In order to use the finger temperature indicating ring according to the present invention, it suffices to thread the finger through the band-forming part 11 of the ring body 1 so that the ring is carried around the finger. At this point, the exposed end 141 of the heat conducting arcuate rod 14 located near the lower inner side of the band portion 11 is slightly in contact with the user's finger. The heat conducting rod 14 may be made of a material having good conductivity, such as platinum, in order to transmit in a precise and instantaneous manner the excess or insufficiency of heat from the finger to the thermistor 41. In the circuit board 4 which is not the subject of the present invention, an operation can be triggered by the detected temperature of the finger to convert the temperature value into a signal. The signal is sent to the indicator member 42 and is presented to the ring wearer in a selected manner. **There are various ways of presenting the signal, namely displaying digits via the liquid crystal display 33, emitting light by the LED 34, discharging a small amount of electric current by the arc-shaped current discharge rod 15, or the use of any other equivalent means, such as a vibrator, a buzzer, etc. By means of this signal, the wearer of the ring can be informed objectively of the current temperature of his finger. However, it should be emphasized that the present invention is not designed to warn the wearer of the ring in a negative manner but to encourage the latter positively. Thus, when the temperature decreases (which means that the wearer of the ring is more anxious and taut), the ring is silent. However, when the temperature increases, a signal is emitted to tell the wearer of the ring that he is in a more relaxed state.**

It can be clearly seen from the foregoing description that the present invention provides a simple and advantageous solution to bulky and complicated apparatus used in clinical therapy for measuring the temperature of a patient's finger. The ring according to the present invention is suitable to be worn by a patient or an ordinary user at any time in order to remind the latter that he must relax in order to avoid any discomfort caused by physical or mental tension. The carrier of the ring can therefore permanently maintain a relaxed and stable state. For a patient who suffers from a psychiatric disease and who, consequently, needs to relax himself frequently, the ring according to the present invention provides assistance to this patient at the appropriate time.

Naturally, the above description has been given purely by way of illustration and without implying any limitation, and variants and modifications may be made thereto within the scope of the present invention.

(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号
特開2003－275192
（P2003－275192A）
(43)公開日　平成15年９月30日(2003.9.30)

(51)Int.Cl.[7]	識別記号	ＦＩ		テーマコード（参考）
Ａ６１Ｂ　5/145		Ｇ０１Ｎ　21/27	Ｚ	２Ｇ０５９
Ｇ０１Ｎ　21/27		21/35	Ｚ	４Ｃ０３８
21/35		Ａ６１Ｂ　5/14	３１０	

審査請求　未請求　請求項の数３　ＯＬ　（全　６　頁）

(21)出願番号　特願2002－83011(P2002－83011)

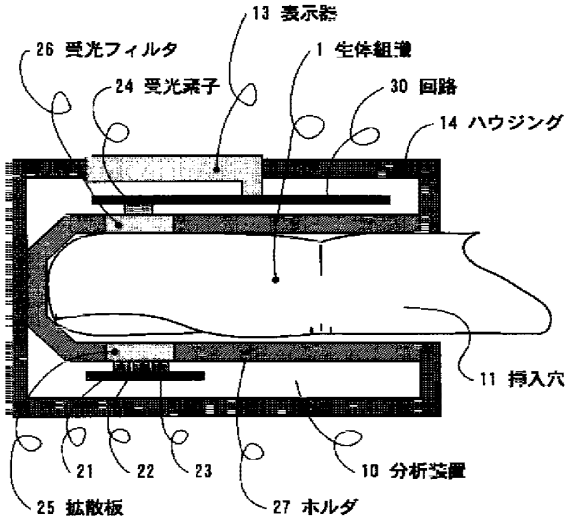
(22)出願日　平成14年３月25日(2002.3.25)

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Ｆターム(参考)　2G059 AA01 BB13 CC07 CC12 CC18
DD13 EE01 EE11 FF06 GG02
GG03 HH01 HH02 HH06 JJ02
JJ26 KK03 MM01 MM09 PP04
4C038 KK01 KL05 KL07 KX04

(54)【発明の名称】　血液分析装置

(57)【要約】
【課題】　ヘモグロビン分析装置では、正確に測定するには指を受光部に適切な力で押し当てなければならなかった。クリップタイプは圧迫感があり、オープンタイプは熟練が必要であった。また、ヘモグロビンＡ１ｃを測定するためには採血が必要で、患者には苦痛をあたえていた。
【解決手段】　指を挿入するホルダの上側に発光部を配置して、下側に発光部を配置することによって、指の腹を受光部に適切な押し当て力で押し付ける。ヘモグロビンの成分比を表示する表示器は、ホルタの上側に上を向けて配置する。



Petitioner Samsung Ex-1004, 0959

【特許請求の範囲】
【請求項１】　ハウジングと、指を挿入するホルダと、指に光を照射する発光部と、指を挟んで透過光を受光する受光部と、該受光部のなかの受光素子の光電流を電圧に変換して血液の成分比を算出する回路と、該成分比を表示する表示器を備えた血液分析装置において、前記ホルダは、手のひらが視覚に映る側にして指を挿入するように構成し、前記ハウジングの視覚に映る側と前記ホルダの間に前記受光素子を配置するとともに、前記ハウジングの視覚に映らない側と前記ホルダの間に前記発光素子を配置し、重力を利用して前記ホルダを指に押圧することを特徴とする血液分析装置。
【請求項２】　前記表示器は、前記視覚に映る側に配置したことを特徴とする請求項１に記載の血液分析装置。
【請求項３】　分析を開始させるスイッチは、前記表示器と同一面に配置したことを特徴とする請求項２に記載の血液分析装置。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、非侵襲で血液中の成分を分析する血液分析装置の装着構造に関する。
【０００２】
【従来の技術】従来から採血しないで血液成分を検査する装置としては、例えば動脈血の酸素飽和度を測定するパルスオキシメーターがある。これは動脈血中のヘモグロビンのうち酸素と結合したヘモグロビンの割合を非侵襲で測定するものであり、使いやすく装置の価格も妥当なことから、さまざまな医療現場で使われてきた。例えば、手術中や術後、集中治療室では、患者の容体を連続的に監視している。また在宅酸素療法では患者の状態把握として使われてきた。救急医療では、輸送中に患者の容体を短時間で把握するために使われてきた。さらに、高所登山での健康状態のチェックにも使われている。測定部位は手の指を使うのが一般的であるが、測定目的や環境に応じて測定部位の指に取付けるプローブと本体の構造はさまざまである。
【０００３】一般的なパルスオキシメーター構造は、本体とプローブが分かれる別体型であり、プローブは指を上下の部品で挟み込み、バネで指に押し当て力が加わるクリップタイプである。この別体型クリップタイプのパルスオキシメーターの一例が、特公昭６４－５００４９５公報に開示されている。これによれば、カバーとベースにねじりバネが取り付けられ、閉じる方向にバネ力が加わるようになっている。カバーとベースには、それぞれカップ形状の上部クッションと下部クッションが取付けられ、この両クッションを介して患者の指に軽く押し当て力が加えられている。このようにパルスオキシメーターは、測定部位となる生体組織つまり指と、受光素子との距離を一定に保ち、さらに生体組織の血流を妨げないようにしなければならなかった。このクリップタイプは、成人の指ならば太さバラツキに対応できるようになっている。そして、手術中、術後、集中治療室などの動き回らない患者の連続的な監視には適していた。しかし、クリップタイプは装着時に圧迫感があり、快適性には欠けていた。また、別体型パルスオキシメーターは携帯性が悪く、長く測る必要がない単発での測定には適していなかった。
【０００４】また、これとは違った構造として、本体とプローブを小さく一体型にして、装着したままで生活できる指輪型パルスオキシメーターがある。市販されている指輪型パルスオキシメーターとしては、指の太さに対応させるために、指輪サイズを直径２１ｍｍ、１９ｍｍ、１６ｍｍの３サイズから選べるようにしているものがある。しかし、この方法では、さまざまな指の太さに応じて、指に適切な押し当て力を加えることはできず、安定した測定はしにくかった。また、この指輪型構造では、測定部位は指尖（指の先端）ではなく指根（指の付け根）となるために、測定部位が太くなり透過光を受光しにくく、精度良い測定ができなかった。さらに、小さな指輪型パルスオキシメーターを指根に挿入して装着する操作はめんどうであり、長く測る必要がない救急の輸送中や高所登山など単発での測定にはふさわしくなかった。
【０００５】また、さらに違った構造として、プローブと本体の一体型で、指の挿入穴があるオープンタイプがある。市販されているオープンタイプのパルスオキシメーターは、右手第２指（人差し指）挿入穴１１に入れて、右手の他の指で軽く本体を握る。そして、測定対象の第２指を挿入穴の受光部に軽く押し当てる。これは単発で測定するときは１０秒程度で簡単に酸素飽和度を測定できるものであり、小型で携帯性も良いことから、緊急時の患者の容体把握や高所登山の健康状態のチェックに適していた。測定部位の装着は、挿入穴に指を入れだけの単純な操作であるが、この操作には熟練を要していた。指の押し付け方が強すぎてしまうと、脈動を妨げて血流が止まってしまい測定できなかったり、また逆に弱すぎると、指が動いて拍動と誤認識してしまうことがあった。本体を握りながら、指の腹を受光部に適切な押し当て力で押すことは、熟練を必要としたのである。
【０００６】酸素飽和度の他にもヘモグロビンの分析には、糖尿病の診断や検査にヘモグロビンＡ１ｃ（グリコヘモグロビンとも言う。）が臨床的に利用されている。これは血液中の赤血球に含まれるヘモグロビンが、血液中のグルコースと結合した状態を調べるものである。ヘモグロビンは血液中のグルコース濃度に応じてグルコースと結合する。そして、ヘモグロビンＡ１ｃは過去１から２ヵ月の平均血糖レベルを反映しているのである。このヘモグロビンA1c測定には、患者の静脈血を採血して、高速液体クロマトグラフィ法などによって分析するのが一般的であったが、この採血する方法は患者に苦痛

Petitioner Samsung Ex-1004, 0960

を与えていた。また、分析装置も大型で高価なものであった。

【０００７】

【発明が解決しようとする課題】前述のクリップタイプのヘモグロビン分析装置は、連続的なヘモグロビン成分の監視には適しているが、長く測る必要がない救急の輸送中や高所登山など単発で酸素飽和度を測定するには適していなかった。またオープンタイプのパルスオキシメーターは、単発で酸素飽和度を測定するには向いているものの、正確に測定するには指を受光部に適切な力で押し当てなければならなかった。そして、その力を適切に加えるためには熟練しなければならなかった。また、糖尿病の診断や検査でヘモグロビンＡ１ｃを測定するが、採血をして血液を分析する方法であり、患者には苦痛をあたえていた。

【０００８】本発明の目的は上記課題を解決し、指先に圧迫感を与えることなく、そして熟練する必要もなく、指の腹を受光部に適切な押し当て力で保持できることである。そして、この装着構造によって、正確でありかつ安定した分析結果が得られるヘモグロビン分析装置を提供することである。

【０００９】

【課題を解決するための手段】上記課題を解決するために本発明の特徴は、ハウジングと、指を挿入するホルダと、指に光を照射する発光部と、指を挟んで透過光を受光する受光部と、該受光部のなかの受光素子の光電流を電圧に変換して血液の成分比を算出する回路と、該成分比を表示する表示器を備えた血液分析装置において、前記ホルダは、手のひらが視覚に映る側にして指を挿入するように構成し、前記ハウジングの視覚に映る側と前記ホルダの間に前記受光素子を配置するとともに、前記ハウジングの視覚に映らない側と前記ホルダの間に前記発光素子を配置し、重力を利用して前記ホルダを指に押圧することを特徴とする。

【００１０】

【発明の実施の形態】以下、図面により本発明の実施の形態を詳述する。図２（ａ）および（ｂ）は本発明の一実施の形態によるヘモグロビンＡ１ｃ分析装置の外観図であり、（ａ）は上面図、（ｂ）は側面図である。図３は本発明の一実施の形態によるヘモグロビンＡ１ｃ分析装置の測定時の姿勢を示す装着図である。図１は本発明の一実施の形態によるヘモグロビンＡ１ｃ分析装置のセンサ部構造を示す断面図である。図４は本発明の一実施の形態によるヘモグロビンＡ１ｃ分析装置のブロック図である。

【００１１】まず図２（ａ）および（ｂ）を用いて、本実施の形態によるヘモグロビンＡ１ｃ分析装置の外観を説明する。これは糖尿病の診断や検査のためのヘモグロビンＡ１ｃ分析装置であり、分析装置１０は、血液中の赤血球に含まれるヘモグロビンが、血液中のグルコースと結合した割合を測定する。分析装置１０の側面には、測定部位を入れられる挿入穴１１があり、患者の指が入るようにほぼ円筒形状をしている。上面には電源を入れて分析を開始させるスイッチ１２と、分析結果を表示する表示器１３が設けられている。表示器１３には血糖コントロールの指標となる、ヘモグロビンＡ１ｃが表示される。ハウジング１４は、プラスチックでできた分析装置１０の外装である。

【００１２】次に図３を用いて、本実施の形態によるヘモグロビンＡ１ｃ分析装置の使用方法を説明する。挿入穴１１には指が挿入されている。標準的な指の使い方は、右手第３指（中指）を挿入穴１１に入れて、両脇の第２指（人差し指）と第４指（薬指）で軽く分析装置１０のハウジング１４を支えて、手のひらを上に向ける。これが測定時の標準的な装着姿勢である。この場合には測定対象の生体組織１は右手第３指となる。この姿勢のままで、スイッチ１２を押せば、電源が入り分析が開始される。例えば、スイッチ１２は右手第１指（親指）で押しやすいように、上面つまり上を向いて配置されている。分析結果のヘモグロビンＡ１ｃは、スイッチ１２と同じように、上を向いている表示器１３に表示されるので、簡単に読み取ることができる。つまり、手のひらが視覚に映る側にして指を挿入して、その姿勢のままで、視覚に映る側に配置した表示器１３の表示を読み取る。

【００１３】次に図１を用いて、本実施の形態によるヘモグロビンＡ１ｃ分析装置のセンサ部構造を説明する。まず挿入穴１１は先端が閉じたほぼ円筒形状のホルダ２７からなり、指である生体組織１をホルダ２７の先端に突当たるように挿入する。ホルダ２７には、指の腹が当たる部分に受光フィルタ２６と、その反対側の指の爪側には拡散板２５が備え付けられている。拡散板２５は透明なポリスチレン（ＰＳ）樹脂やアクリル（ＰＭＭＡ）樹脂を成形したものであり、その奥には発光素子２１、２２、２３が近接して配置されている。発光素子２１、２２、２３は、それぞれのピーク発光波長がλ１、λ２、λ３のチップ型発光ダイオードである。発光素子２１、２２、２３は近接して配置しているものの、同一位置から発光することは不可能である。このことによる誤差を最小限にするために、拡散板２５を挿入することによって、チップ型発光ダイオードによる点発光ではなく、拡散板２５による面発光に変換している。このことによって、発光素子２１，２２、２３の光路差による影響を解消している。なお、発光素子２１、２２、２３と拡散板２５によって発光部を構成している。

【００１４】受光フィルタ２６は、発光波長λ１、λ２、λ３を透過させるが、その他の蛍光燈や太陽光を減衰させるための光学フィルタであり、挿入穴１１と生体組織１との隙間から漏れてくる外来光の影響を少なくしている。また、受光フィルタ２６は防塵効果もあり、清掃を簡単に行なうことができる。受光フィルタ２６の奥

Petitioner Samsung Ex-1004, 0961

には受光素子２４が配置されている。受光素子２４は発光波長λ１、λ２、λ３を含んだ感度波長範囲であるフォトダイオードである。なお、受光素子２４と受光フィルタ２６によって受光部を構成している。回路３０には受光素子２４は実装されていて、それぞれの波長において脈動による光電流の変化から、ヘモグロビンＡ１ｃを算出している。その算出結果は、回路３０に接続してされた表示器１３によって表示する。表示器１３は、ホルダ２７の上側にあり、上を向いているので読み取りやすい。

【００１５】前述したように、被験者は手のひら及び表示器１３を上を向けてた姿勢をとっているので、分析装置１０の本体重量に掛かる重力を利用して、挿入穴１１に入れた指の腹を、受光フィルタ２６が自然に軽く押し当てることになる。測定時にはこのように、フィルタ２６が指の腹を軽く押し当てる姿勢を維持することが重要である。もしも強く押し当て過ぎると、血流は少なくなり拍動を正確に検出することができない。また逆に軽すぎると、指の腹と受光フィルタ２６の接触状態が変わり易くなり、血管の光学的な位置が不安定となるために、指の動きによるノイズの影響を受けて、拍動と誤認識してしまうことがある。つまり、ハウジング１４の視覚に映る側とホルダ２７の上側の間には、受光フィルタ２６と受光素子２４の受光部を配置して、ハウジング１４の視覚に映らない側とホルダ２７の下側には、発光部を配置している。そして、重力を利用してホルダ２７で指の腹に押圧しているのである。

【００１６】なお、分析装置１０の本体重量は、５０～１００グラム程度であり、指の腹を受光部の受光フィルタ２６及び近傍のホルダ２７で軽く押すのに適した本体重量となっている。また、挿入穴１１に入れる指を右手第３指としたが、この指に限るものではない。受光フィルタ２６に指の腹を軽く押し当てられるならば、どの指でもかまわない。

【００１７】次に、図４を用いて本発明の実施の形態によるヘモグロビンＡ１ｃ分析装置のブロック図を説明する。波長λ１、λ２、λ３の光を発光する発光素子２１、２２、２３は、発光駆動回路３１の出力を受けて順番に点灯する。これらの発光素子２１，２２，２３の光が、生体組織１である指に照射される。照射された光は、生体組織１の各種ヘモグロビンによって吸収されるが、また赤血球による散乱も起こす。生体組織１を挟んで対向して配置された受光素子２４によって透過光が受光される。ここで、発光波長λ１、λ２、λ３は、例えば６３０ｎｍ、６８０ｎｍ、９４０ｎｍにそれぞれ設定されている。

【００１８】受光素子２４の各波長における光電流は、生体組織１によって減衰されたあとの透過光量Ｉ１、Ｉ２、Ｉ３に対応している。増幅器３２は受光素子２４の光電流を電圧変換し、それを電圧増幅している。なお、各波長における透過光量Ｉ１、Ｉ２、Ｉ３には、脈動変動分に相当する脈動成分が含まれている。

【００１９】マルチプレクサ（ＭＰＸ）３３では、増幅器３２の出力信号が、λ１、λ２、λ３の各波長ごとに振り分けられ、バンドパスフィルタ（ＢＰＦ）３４、３５、３６に供給される。　ＢＰＦ３４、３５、３６は、各信号中に含まれる高周波のノイズ成分が除去され、さらに生体組織１における各波長λ１、λ２、λ３についての透過光の脈動成分に相当する振幅信号、つまり各波長のそれぞれの指尖容積脈波となる。

【００２０】脈波検出回路（ＤＥＴ）３７、３８、３９は、ＢＰＦ３４、３５、３６からの各出力信号がそれぞれ検波されることにより、透過光の脈動分の振幅値に相当する信号が検出される。これら検出信号は、生体組織１での各波長λ１、λ２、λ３における透過光の脈動変動分ΔＡ１、ΔＡ２、ΔＡ３に対応したものであり、アナログ／デジタル変換されたデータである。ＤＥＴ３７、３８、３９の出力信号ΔＡ１、ΔＡ２、ΔＡ３は、演算手段４０に供給されて、各ヘモグロビンの成分比が算出される。そして、表示手段４１ではヘモグロビンＡ１ｃの成分比が表示される。なお、回路３０は、増幅器３２、マルチプレクサ３３、バンドパスフィルタ３４、３５、３６、脈波検出回路３７、３８、３９、演算手段４０から構成されている。

【００２１】以上が本実施の形態によるヘモグロビンＡ１ｃ分析装置の説明である。これと同様な装着方法によって、全ヘモグロビンのうち酸素と結合したオキシヘモグロビンの割合である酸素飽和度を測定するパルスオキシメーターにも利用できる。また同様に分光分析によって、血液中のグルコース濃度の非侵襲で計測が開発されている。このような血糖値測定装置にも利用できる。さらに、血液中の脂質などの血液分析装置にも利用できる。

【００２２】

【発明の効果】以上説明したように、本発明によれば、指が太さに関係なく、太くても細くても、受光部を指の腹に適切な押し当て力で押すことができる。また、その指の装着には熟練の必要がなく、簡単に指の腹の押し当て力を一定に保つことができる。このように適切な力で指の腹を押すことによって、生体の透過光の拍動成分を正確に測定することができ、ヘモグロビンの成分比を正確に求めることができる。長く測る必要がなく単発で、救急の輸送中や高所登山などで酸素飽和度を測定するときや、在宅でヘモグロビンA1ｃを測定するときに、患者の熟練度合いに影響されずに、正確な測定ができる。また、プローブ構造が簡単になるので、小型で安価な構造となる。また圧迫感がなく快適に測定できるという効果がある。

【図面の簡単な説明】

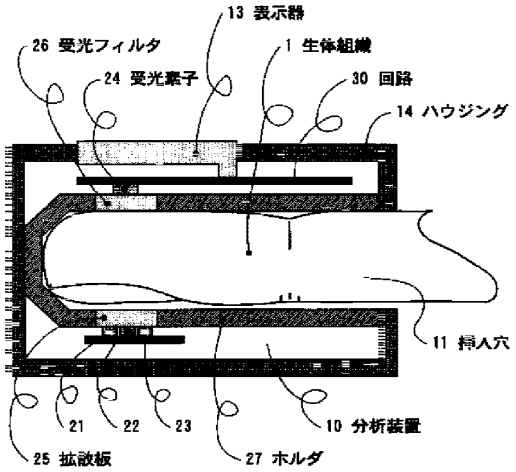
【図１】本発明の実施の形態によるヘモグロビンＡ１ｃ

Petitioner Samsung Ex-1004, 0962

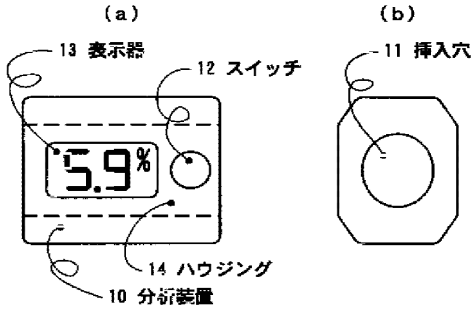
分析装置のセンサ部構造を示す断面図である。
【図２】本発明の実施の形態によるヘモグロビンＡ１ｃ分析装置の外観図であり、（ａ）は上面図、（ｂ）は側面図である。。
【図３】本発明の実施の形態によるヘモグロビンＡ１ｃ分析装置の装着図である。
【図４】本発明の実施の形態による他のヘモグロビンＡ１ｃ分析装置のブロック図である。
【符号の説明】

１　生体組織
１０　分析装置
１１　挿入穴
１３　表示器
１４　ハウジング
２１、２２、２３　発光素子
２４　受光素子
２５　拡散板

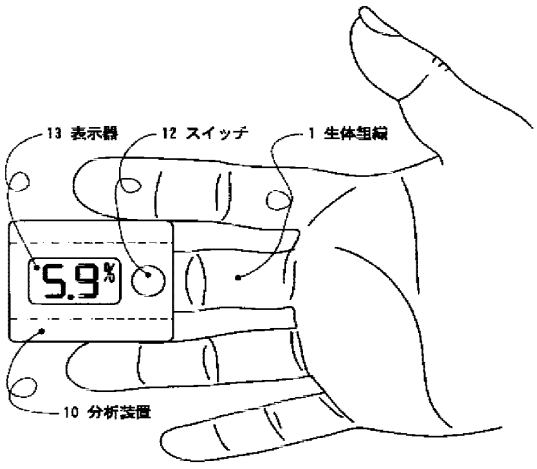
【図１】



【図２】

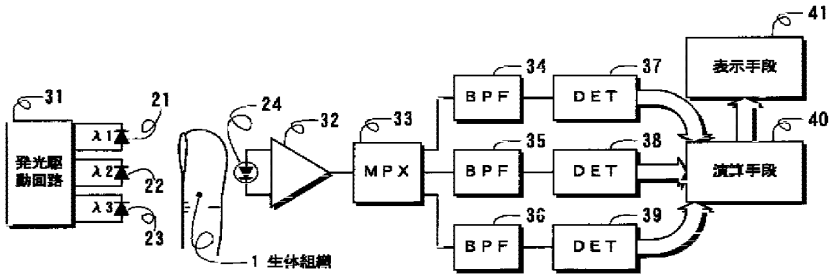


【図３】



Petitioner Samsung Ex-1004, 0963

【図4】



Petitioner Samsung Ex-1004, 0964

(12) 按照专利合作条约所公布的国际申请

(19) 世界知识产权组织
国 际 局

(43) 国际公布日
2012 年 3 月 1 日 (01.03.2012)

PCT

(10) 国际公布号
WO 2012/024889 A1

(51) 国际专利分类号:
H02J 7/00 (2006.01) *H01M 10/44* (2006.01)
H01M 10/46 (2006.01)

(21) 国际申请号: PCT/CN2011/001298

(22) 国际申请日: 2011 年 8 月 8 日 (08.08.2011)

(25) 申请语言: 中文

(26) 公布语言: 中文

(30) 优先权:
201020503502.3 2010 年 8 月 23 日 (23.08.2010) CN

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(81) 指定国 (除另有指明，要求每一种可提供的国家保护): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW。

(84) 指定国 (除另有指明，要求每一种可提供的地区保护): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), 欧亚 (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), 欧洲 (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)。

本国际公布:
— 包括国际检索报告(条约第 21 条(3))。

(54) Title: PORTABLE CHARGER

(54) 发明名称 : 便携式充电器

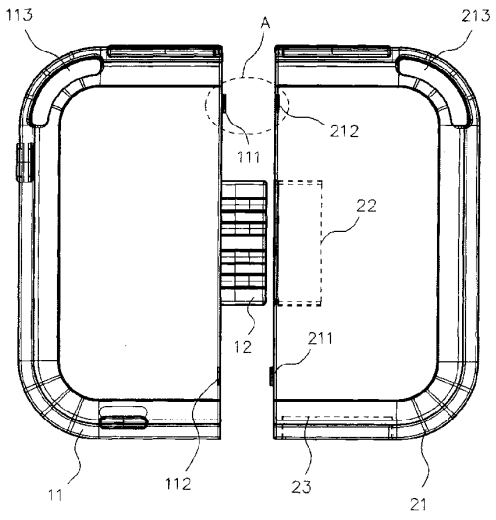


图 2 / FIG. 2

(57) Abstract: A portable charger includes a first component (1) and a second component (2) capable of being separated and having internal circuits electrically connected to each other. The first component and the second component are fixed into one by a connecting device. When the portable charger is in use, the first component and the second component are fixed into one by the connecting device, and can be used for charging an electronic product; when the portable charger is not in use, the first component and the second component may be suspended from a key-chain and a belt respectively or suspended from the neck through a lanyard. The portable charger is not only light and convenient for a user to use anytime, but also achieves a decorative effect.

[见续页]

WO 2012/024889 A1

Petitioner Samsung Ex-1004, 0965

(57) 摘要:

一种便携式充电器，其包括内部电路相互电连接且可分离的第一部件（1）及第二部件（2），第一部件与第二部件通过连接装置固定为一体。便携式充电器使用时第一部件与第二部件通过连接装置固定为一体，可用于对电子产品进行充电；不使用时第一部件与第二部件可分别悬挂在钥匙扣、腰带上或通过挂绳悬挂在脖子上等，因而不仅轻便及便于使用者随时使用，而且具有装饰效果。

Petitioner Samsung Ex-1004, 0966

便携式充电器

技术领域

本实用新型涉及一种充电器，尤其是涉及一种便携式充电器。

背景技术

随着经济和科技的发展，人与人之间的活动更加频繁。此外，随着移动商务的普及，使手机、个人数字助理、数码相机及笔记本电脑等持有率大幅提高。这些移动商务工具通常都设置有提供工作电源的可充电电池，虽然电池可进行长时间供电，但随着使用时间的推移，电池电量耗尽后必须通过充电器对电池进行充电。

先前的充电器体积较大，放在衣袋或包内均不方便，为解决上述问题，专利申请号为 200720140072 的中国专利揭示了一种便携式充电器，其包括插头护罩、充电电路外壳、充电插头、电源线和电源线护罩。所述充电插头和电源插极相对嵌合，收置于插头护罩内。所述插头护罩和充电电路外壳外壁同充电插头平行方向外侧一周设有凹槽，供电源线缠绕；所述电源线护套捆绕电源线外围将其保护，从而在一定程度上可减小体积及相对便于携带。然而，现有的便携式充电器仍然不能满足需要。

实用新型内容

本实用新型是针对上述背景技术存在的缺陷提供一种不仅轻便及便于使用者随时使用，而且具有很好的装饰效果的便携式充电器。

Petitioner Samsung Ex-1004, 0967

为实现上述目的，本实用新型公开了一种便携式充电器，其包括内部电路相互电连接且可分离的第一部件及第二部件，所述第一部件与第二部件通过连接装置固定为一体。

进一步地，所述连接装置为一快速接头。

进一步地，所述连接装置可收容于所述第一部件或第二部件内。

进一步地，所述充电器的插头位于第一部件或第二部件上。

进一步地，所述插头可转动并收容于所述第一部件或第二部件内。

进一步地，所述充电器的充电插口位于第一部件或第二部件上。

进一步地，所述充电器的第一部件或第二部件上设置有可吊挂的挂件。

进一步地，所述插头的两插脚分别设置在所述第一部件或第二部件上。

进一步地，所述插脚可分别转动收纳于第一部件或第二部件内。

进一步地，高压电路及低压电路分别设置在所述第一部件或第二部件上，高压电路及低压电路电连接。

进一步地，所述第一收纳部件或第二部件内设有锂电池及电源转换开关，所述锂电池与所述插口电连接。

综上所述，本实用新型便携式充电器通过设置成内部电路相互电连接且可分离的第一部件及第二部件的形式，使用时所述第一部件与第二部件通过连接装置固定为一体，则可对电子产品进行充电；不使用时可分别悬挂在钥匙扣、腰带或通过挂绳悬挂在脖子上等，因而不仅轻便及便于使用者随时使用，而且具有很好的装饰效果。

附图说明

图 1 为本实用新型一种实施例的结构示意图；

Petitioner Samsung Ex-1004, 0968

图 2 为图 1 所示本实用新型的分解图；

图 3 为图 2 所示本实用新型的 A 区域的放大图。

具体实施方式

为能进一步了解本实用新型的特征、技术手段以及所达到的具体目的、功能，下面结合附图与具体实施方式对本实用新型作进一步详细描述。

请参阅图 1 至图 3，本实用新型便携式充电器包括一第一部件 1 及一第二部件 2。所述第一部件 1 设置有一第一绝缘壳体 11，所述第一绝缘壳体 11 内装设有高压电路及与所述高压电路电连接的一 USB 公口 12，所述 USB 公口 12 与所述第一绝缘壳体 11 活动连接，所述 USB 公口 12 延伸到所述第一绝缘壳体 11 外并可收容于所述第一绝缘壳体 11 内。

所述第一绝缘壳体 11 位于所述 USB 公口 12 的两侧分别设置有一第一扣接柱 111 及一第一扣接槽 112，所述第一扣接柱 111 的自由端的横截面积大于所述第一扣接柱 111 中部的横截面积。所述第一扣接槽 112 的远离槽口的一端的宽度大于所述槽口的宽度。所述第一绝缘壳体 11 的一端设置有一第一穿孔 113，从而使所述第一绝缘壳体 11 形成一可吊挂的挂件。所述第一部件 1 连接有一与所述高压电路电连接的插头，所述插头设置有两插脚，所述插头可转动并收容于所述第一绝缘壳体内，从而所述插脚可收纳于所述第一绝缘壳体 11 内。

所述第二部件 2 设置有一第二绝缘壳体 21，所述第二绝缘壳体 21 内装设有低压电路及与所述低压电路电连接的一 USB 母口 22 及一充电插口 23，所述 USB 母口 22 与所述 USB 公口 12 位置相对应，所述第二绝缘壳体 21 位于所述 USB 母口 22 的两侧分别设置有一第二扣接柱 211 及一第二扣接槽 212，

Petitioner Samsung Ex-1004, 0969

所述第二扣接柱 211 及所述第二扣接槽 212 分别与所述第一扣接柱 111 及所述第一扣接槽 112 位置相对。

所述第二扣接柱 211 的自由端的横截面积大于所述第二扣接柱 211 中部的横截面积。所述第二扣接槽 212 的远离槽口的一端的宽度大于所述槽口的宽度。所述第二部件 2 的一端设置有一第二穿孔 213，从而使所述第二绝缘壳体 21 形成一可吊挂的挂件。所述第二绝缘壳体 21 内装设有锂电池及电源转换开关，所述锂电池与所述低压电路及所述充电插口 23 电连接并通过所述低压电路对所述锂电池充电。所述电源转换开关作为充电模式选择开关。

使用本实用新型时，将所述第一部件 1 及第二部件 2 对应插接，即所述第一扣接柱 111 及所述第二扣接柱 211 分别与所述第二扣接槽 212 及所述第一扣接槽 112 对应插接，所述 USB 公口 12 插设在所述 USB 母口 22 上，使高压电路及低压电路实现电连接，从而组成一个功能完整的充电器。通过将所述插头与插座插接，所述充电插口 23 与手机等可充电的电子产品电连接，便可进行充电。

在本实施例中，所述所述第一扣接柱 111 及所述第二扣接柱 211 作为所述第一部件 1 及第二部件 2 的连接装置。通过设置所述锂电池及电源转换开关，因而当在旅行等出门在外时，通过将所述电源转换开关拨为锂电池向外供电的模式，从而可通过所述锂电池对手机等进行充电。

综上所述，本实用新型便携式充电器通过设置成内部电路相互电连接且可分离的第一部件 1 及第二部件 2 的形式，使用时所述第一部件 1 与第二部件 2 通过连接装置固定为一体，则可对电子产品进行充电；不使用时可分别悬挂在

Petitioner Samsung Ex-1004, 0970

钥匙扣、腰带或通过挂绳悬挂在脖子上等，因而不仅轻便及便于使用者随时使用，而且具有很好的装饰效果。

以上所述实施例仅表达了本实用新型的一种实施方式，其描述较为具体和详细，但并不能因此而理解为对本实用新型范围的限制。应当指出的是，对于本领域的普通技术人员来说，在不脱离本实用新型构思的前提下，还可以做出若干变形和改进，例如，将所述连接装置设置为快速接头等，这些都属于本实用新型的保护范围。因此，本实用新型的保护范围应以所附权利要求为准。

Petitioner Samsung Ex-1004, 0971

权 利 要 求 书

1、一种便携式充电器，其特征在于：包括内部电路相互电连接且可分离的第一部件（1）及第二部件（2），所述第一部件（1）与第二部件（2）通过连接装置固定为一体。

2、根据权利要求 1 所述的便携式充电器，其特征在于：所述连接装置为一快速接头。

3、根据权利要求 1 所述的便携式充电器，其特征在于：所述连接装置可收容于所述第一部件（1）或第二部件（2）内。

4、根据权利要求 1 所述的便携式充电器，其特征在于：所述充电器的插头位于第一部件（1）或第二部件（2）上。

5、根据权利要求 4 所述的便携式充电器，其特征在于：所述插头可转动并收容于所述第一部件（1）或第二部件（2）内。

6、根据权利要求 1 或 2 所述的便携式充电器，其特征在于：所述充电器的充电插口（23）位于第一部件（1）或第二部件（2）上。

7、根据权利要求 1 所述的便携式充电器，其特征在于：所述充电器的第一部件（1）或第二部件（2）上设置有可吊挂的挂件。

8、根据权利要求 1 所述的便携式充电器，其特征在于：所述插头的两插脚分别设置在所述第一部件（1）或第二部件（2）上。

9、根据权利要求 8 所述的便携式充电器，其特征在于：所述插脚可分别转动收纳于第一部件（1）或第二部件（2）内。

Petitioner Samsung Ex-1004, 0972

10、根据权利要求 1 所述的便携式充电器，其特征在于：高压电路及低压电路分别设置在所述第一部件（1）或第二部件（2）上，高压电路及低压电路电连接。

11、根据权利要求 1 所述的便携式充电器，其特征在于：所述第一收纳部件或第二部件（2）内设有锂电池及电源转换开关，所述锂电池与所述插口电连接。

Petitioner Samsung Ex-1004, 0973

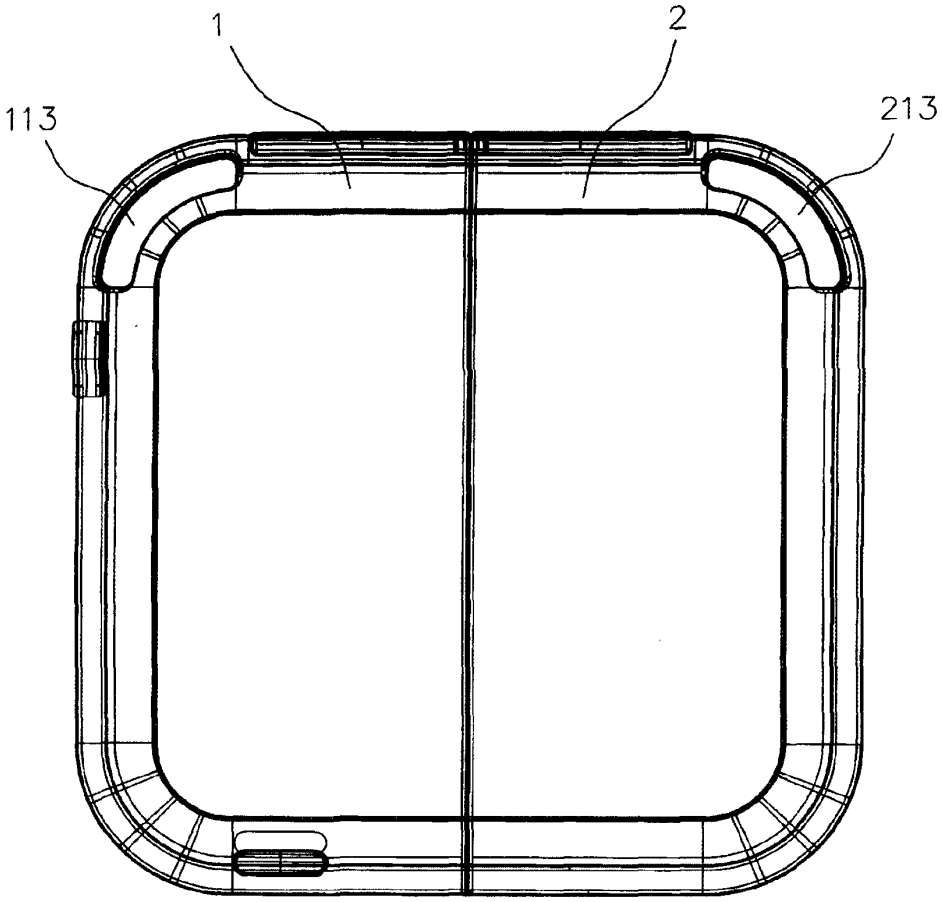


图 1

Petitioner Samsung Ex-1004, 0974

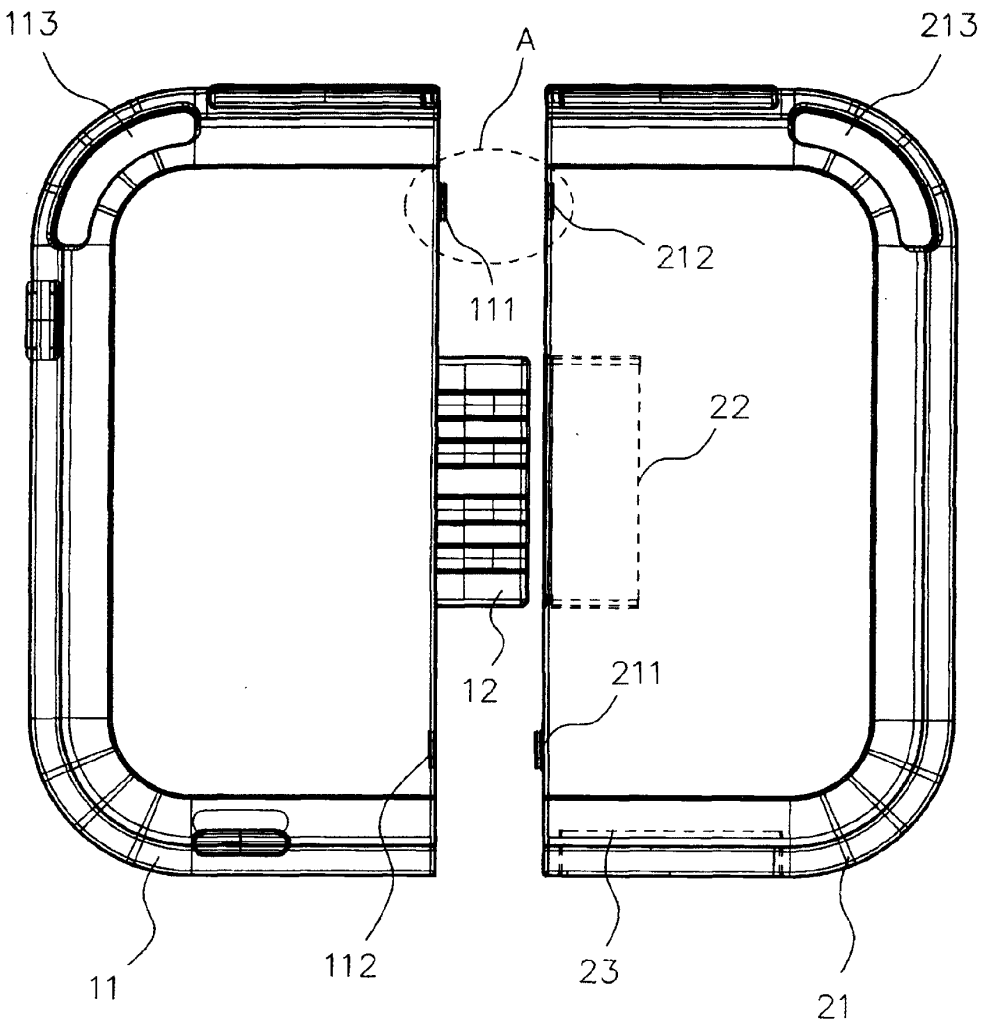


图 2

Petitioner Samsung Ex-1004, 0975

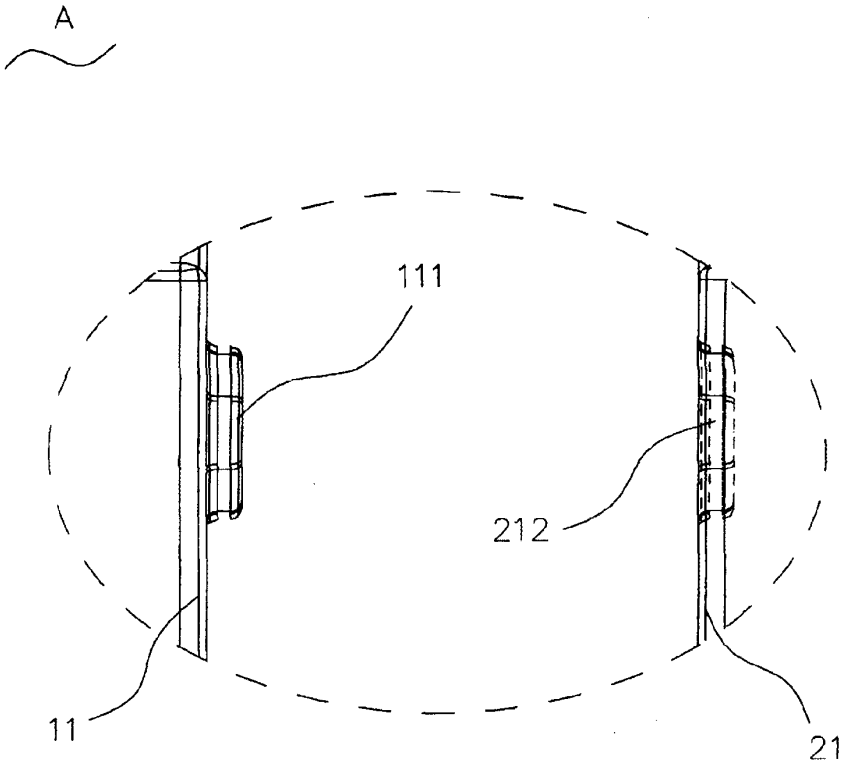


图 3

Petitioner Samsung Ex-1004, 0976

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2011/001298

A. CLASSIFICATION OF SUBJECT MATTER

See the extra sheet
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H02J, H01M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, EPODOC, WPI, CNKI: power supply, carry, spare, separate, charge, power, source, supply, portable, pocket, handy, emergency, secondary, auxiliary, combin+, detach+, remov+, assembly, plug, pin, blade, transformer, change, switch

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/0204177 A1 (PORNG DA ENTERPRISE CO., LTD.), 14 October 2004 (14.10.2004), description, paragraphs 16-19, claim 1 and figure 3	1, 2, 4-6, 8, 9
Y		11
X	CN 201509212 U (LI, Yongheng), 16 June 2010 (16.06.2010), description, paragraphs 23-25 , and figures 1-6	1, 3, 7
X	US 4211968 A (GENERAL ELECTRIC CO.), 08 July 1980 (08.07.1980), description, column 2, line 17 to column 4, line 10, and figures 1-8	1, 10
Y	CN 101009433 A (SAMYA TECHNOLOGY CO., LTD.), 01 August 2007 (01.08.2007), description, page 4, 2nd last paragraph to page 7, paragraph 3, claim 1 and figures 1-9B	11
PX	CN 201781304 U (WANG, Hong), 30 March 2011 (30.3.2011), the whole document	1-11

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 November 2011 (07.11.2011)	**17 November 2011 (17.11.2011)**
Name and mailing address of the ISA/CN State Intellectual Property Office of the P.R.China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer **FU, Qi** Telephone No. (86-10) **62411772**

Form PCT/ISA /210 (second sheet) (July 2009)

Petitioner Samsung Ex-1004, 0977

INTERNATIONAL SEARCII REPORT
Information on patent family members

International application No.
PCT/CN2011/001298

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
US2004/0204177A1	14.10.2004	None	
CN201509212U	16.06.2010	None	
US4211968A	08.07.1980	CA1130375A	24.08.1982
CN101009433A	01.08.2007	JP2007-215320A	23.08.2007
		US2007/0182368A1	09.08.2007
CN201781304U	30.03.2011	None	

Form PCT/ISA /210 (patent family annex) (July 2009)

Petitioner Samsung Ex-1004, 0978

INTERNATIONAL SEARCII REPORT

International application No.
PCT/CN2011/001298

A. CLASSIFICATION OF SUBJECT MATTER

H02J 7/00 (2006.01) i
H01M 10/46 (2006.01) i
H01M 10/44 (2006.01) i

Petitioner Samsung Ex-1004, 0979

国际检索报告

国际申请号
PCT/CN2011/001298

A. 主题的分类

参见附加页

按照国际专利分类(IPC)或者同时按照国家分类和 IPC 两种分类

B. 检索领域

检索的最低限度文献(标明分类系统和分类号)

IPC：H02J, H01M

包含在检索领域中的除最低限度文献以外的检索文献

在国际检索时查阅的电子数据库(数据库的名称，和使用的检索词（如使用）)

CNPAT，EPODOC，WPI，CNKI：充电，电源，供电，便携，携带，应急，备用，辅助，组合，分体，分离，拆，组装，插头，插脚，变压，转换，开关，charge, power, source, supply, portable, pocket, handy, emergency, secondary, auxiliary, combin+, detach+, remov+, assembly, plug, pin, blade, transformer, change, switch

C. 相关文件

类　型*	引用文件，必要时，指明相关段落	相关的权利要求
X	US2004/0204177A1（PORNG DA ENTERPRISE CO LTD）14.10 月 2004 (14.10.2004) 说明书第 16－19 段，权利要求 1，图 3	1,2,4-6,8,9
Y		11
X	CN201509212U（李永恒）16.6 月 2010 (16.06.2010) 说明书第 23－35 段，图 1－6	1,3,7
X	US4211968A（GENERAL ELECTRIC CO）08.7 月 1980 (08.07.1980) 说明书第 2 栏第 17 行－第 4 栏第 10 行，图 1－8	1,10
Y	CN101009433A（祥业科技股份有限公司）01.8 月 2007（01.08.2007） 说明书第 4 页倒数第 2 段－第 7 页第 3 段，权利要求 1，图 1－9B	11
PX	CN201781304U（王鸿）30.3 月 2011（30.03.2011）全文	1-11

☐ 其余文件在 C 栏的续页中列出。　　☒ 见同族专利附件。

* 引用文件的具体类型：

"A" 认为不特别相关的表示了现有技术一般状态的文件

"E" 在国际申请日的当天或之后公布的在先申请或专利

"L" 可能对优先权要求构成怀疑的文件，或为确定另一篇引用文件的公布日而引用的或者因其他特殊理由而引用的文件（如具体说明的）

"O" 涉及口头公开、使用、展览或其他方式公开的文件

"P" 公布日先于国际申请日但迟于所要求的优先权日的文件

"T" 在申请日或优先权日之后公布，与申请不相抵触，但为了理解发明之理论或原理的在后文件

"X" 特别相关的文件，单独考虑该文件，认定要求保护的发明不是新颖的或不具有创造性

"Y" 特别相关的文件，当该文件与另一篇或者多篇该类文件结合并且这种结合对于本领域技术人员为显而易见时，要求保护的发明不具有创造性

"&" 同族专利的文件

国际检索实际完成的日期	国际检索报告邮寄日期
07.11 月 2011（07.11.2011）	**17.11 月 2011 (17.11.2011)**
ISA/CN 的名称和邮寄地址： 中华人民共和国国家知识产权局 中国北京市海淀区蓟门桥西土城路 6 号 100088 传真号：　(86-10)62019451	受权官员 傅琦 电话号码：(86-10) **6241 1772**

Petitioner Samsung Ex-1004, 0980

国际检索报告
关于同族专利的信息

国际申请号
PCT/CN2011/001298

检索报告中引用的专利文件	公布日期	同族专利	公布日期
US2004/0204177A1	14.10.2004	无	
CN201509212U	16.06.2010	无	
US4211968A	08.07.1980	CA1130375A	24.08.1982
CN101009433A	01.08.2007	JP2007-215320A	23.08.2007
		US2007/0182368A1	09.08.2007
CN201781304U	30.03.2011	无	

Petitioner Samsung Ex-1004, 0981

国际检索报告

国际申请号
PCT/CN2011/001298

A．主题的分类：

H02J 7/00 (2006.01) i

H01M 10/46 (2006.01) i

H01M 10/44 (2006.01) i

Petitioner Samsung Ex-1004, 0982

(19) 대한민국특허청(KR)
(12) 공개특허공보(A)

(11) 공개번호 10-2010-0091592
(43) 공개일자 2010년08월19일

(51) Int. Cl.
H05K 5/02 (2006.01)
(21) 출원번호 10-2009-0010865
(22) 출원일자 2009년02월11일
심사청구일자 2009년02월11일

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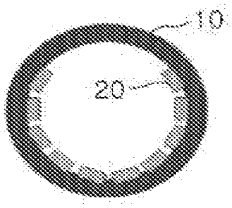
전체 청구항 수 : 총 9 항

(54) 손목형 맥파 측정장치

(57) 요 약

본 발명은 손목형 맥파 측정장치에 관한 것이다. 본 발명에 따른 손목형 맥파 측정장치는 손목에 착용 가능하게 형성된 손목착용수단; 상기 손목착용수단에 어레이 형태로 배열 및 설치된 다수의 PPG 센서; 및 상기 다수의 PPG 센서로부터 입력되는 신호들을 합산 처리하여 잡음을 제거함으로써 PPG 신호를 산출하는 PPG 측정수단을 포함한다. 이와 같이, 측정모듈과 검출모듈이 통합되어 휴대성이 뛰어나고, PPG 센서가 어레이 형태로 다수 배열되어 사람의 혈관 위치 또는 손목 두께의 변화에도 정밀한 PPG 신호의 측정이 가능하다.

대 표 도 - 도2



Petitioner Samsung Ex-1004, 0983

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Petitioner Samsung Ex-1004, 0984

Petitioner Samsung Ex-1004, 0985

특허청구의 범위

청구항 1

손목형 맥파 측정장치에 있어서,

손목에 착용 가능하게 형성된 손목착용수단;

상기 손목착용수단에 어레이 형태로 배열 및 설치된 다수의 PPG 센서; 및

상기 다수의 PPG 센서로부터 입력되는 신호들을 합산 처리하여 잡음을 제거함으로써 PPG 신호를 산출하는 PPG 측정수단을 포함하는 것을 특징으로 하는 손목형 맥파 측정장치.

청구항 2

손목형 맥파 측정장치에 있어서,

손목에 착용 가능하게 형성된 손목착용수단;

상기 손목착용수단에 어레이 형태로 배열 및 설치된 다수의 PPG 센서;

상기 다수의 PPG 센서에 개별적으로 전원을 공급하는 전원공급부; 및

상기 다수의 PPG 센서로부터 입력되는 신호들에 기초하여 PPG 레퍼런스 신호를 검출하고, 상기 PPG 레퍼런스 신호와 상기 다수의 PPG 센서의 신호들과의 연관성을 분석하여 상기 전원공급부가 상기 연관성이 높은 신호에 대응하는 적어도 하나의 PPG 센서에만 전원을 공급하도록 제어하는 PPG 측정수단을 포함하는 것을 특징으로 하는 손목형 맥파 측정장치.

청구항 3

손목형 맥파 측정장치에 있어서,

손목에 착용 가능하게 형성된 손목착용수단;

상기 손목착용수단에 어레이 형태로 배열 및 설치되는 것으로서, 동맥의 맥파를 감지하는 적어도 하나의 동맥-PPG 센서와 정맥의 맥파를 감지하는 적어도 하나의 정맥-PPG 센서를 포함하는 다수의 PPG 센서; 및

상기 적어도 하나의 정맥-PPG 센서로부터 입력되는 신호를 상기 적어도 하나의 동맥-PPG 센서로부터 입력되는 신호의 잡음-레퍼런스로 설정하여, 상기 적어도 하나의 동맥-PPG 센서로부터 입력되는 신호에 섞인 잡음을 제거하여 PPG 신호를 산출하는 PPG 측정수단을 포함하는 것을 특징으로 하는 손목형 맥파 측정장치.

청구항 4

제3항에 있어서,

상기 PPG 측정수단은 상기 적어도 하나의 정맥-PPG 센서로부터 입력되는 신호를 합산처리하여 정맥-PPG 신호를 검출하고, 상기 적어도 하나의 동맥-PPG 센서로부터 입력되는 신호를 합산처리하여 동맥-PPG 신호를 검출하며, 상기 정맥-PPG 신호를 상기 동맥-PPG 신호의 잡음-레퍼런스로 설정하여 상기 PPG 신호를 산출하는 것을 특징으로 하는 손목형 맥파 측정장치.

청구항 5

제1항 또는 제2항에 있어서,

신체의 움직임에 따른 움직임 잡음을 측정하기 위한 전극을 더 포함하고,

상기 PPG 측정수단은 상기 전극센서로부터 입력되는 신호를 잡음-레퍼런스로 설정하여, 상기 PPG 신호를 산출하는 것을 특징으로 하는 손목형 맥파 측정장치.

청구항 6

제1항 또는 제2항에 있어서,

상기 PPG 센서는 광원과 광검출기가 하나의 일체형 모듈로 구성되는 것을 특징으로 하는 손목형 맥파 측정장치.

청구항 7

제3항 또는 제4항에 있어서,

상기 동맥-PPG 센서는 광원과 광검출기가 분리된 모듈로 구성되고, 상기 정맥-PPG 센서는 상기 광원과 상기 광검출기가 하나의 일체형 모듈로 구성되는 것을 특징으로 하는 손목형 맥파 측정장치.

청구항 8

제7항에 있어서,

상기 정맥-PPG 센서는 손목 장착시 상기 손목의 저면에 위치하도록 상기 손목장착수단에 설치되고,

상기 동맥-PPG 센서는 상기 손목의 양측면에 위치하도록 상기 손목장착수단에 설치되며, 상기 광원의 강도와 반사각에 따른 상기 광검출기의 위치를 조절하여 설치되는 것을 특징으로 하는 손목형 맥파 측정장치.

청구항 9

제1항 또는 제2항에 있어서,

상기 다수의 PPG 센서는 방사각이 넓은 광원 하나에 다수의 광검출기가 매칭되는 다수의 세트로 구성되는 것을 특징으로 하는 손목형 맥파 측정장치.

명 세 서

발명의 상세한 설명

기 술 분 야

[0001] 본 발명은 손목형 맥파 측정장치에 관한 것이다.

배 경 기 술

[0002] PPG(Photoplethysmography; 광전용적맥파도)는 심장박동수, 혈중산소포화도, 혈관의 수축 및 팽창을 반영하는 생체 신호로서, 혈관의 탄력성과 혈관순환상태를 파악하고 혈관의 연령 등을 분석할 수 있고, 더 나아가 동맥혈관과 말초혈관장애를 조기에 진단할 수 있다.

[0003] 맥파는 손가락이나 가슴 부위에서 측정하는데, 특히 프로브를 이용한 손가락 측정방식이 주로 이용된다.

[0004] 도 1a 및 도 1b는 종래 프로브를 이용한 PPG 신호 측정장치의 기본적인 원리를 설명하기 위한 개략도이다. 도 1a는 투과형 구조의 프로브, 도 1b는 반사형 구조의 프로브를 나타낸다.

[0005] 도 1a의 투과형 구조의 프로브는 프로브에 삽입된 손가락에 빛을 투과하여 빛이 혈액에 흡수되지 않고 투과되는

Petitioner Samsung Ex-1004, 0986

Petitioner Samsung Ex-1004, 0987

양을 측정하는 방식이며, 도 1b의 반사형 구조의 프로브는 빛을 반사시켜 혈액에 반사되는 빛의 양을 측정하는 방식을 사용한다.

[0006] 이러한 종래의 프로브 방식의 맥파측정장치는 도 1a 및 도 1b의 측정모듈 이외에 PPG 신호를 검출하는 본체모듈이 별도로 분리 설치되어, 휴대성이 떨어지는 문제가 있었다. 또한, 광원과 센서가 별도로 구성되기 때문에 부피를 많이 차지한다.

[0007] 또한, 종래의 프로브 방식의 맥파측정장치는 손목의 혈관이 측정 센서에 정위치하지 않을 경우 맥파를 측정하는데 어려움이 발생한다. 더욱이, 사람마다 손목의 크기, 구조, 혈관의 위치 등에 차이가 있고, 더 나아가 측정시 손목의 움직임에 따른 잡음 문제가 발생하기 때문에, 정밀한 측정에 한계가 있었다.

발명의 내용

해결 하고자하는 과제

[0008] 따라서, 본 발명의 목적은 측정모듈과 검출모듈이 통합되어 휴대성이 뛰어나고, PPG 센서가 어레이 형태로 다수 배열되어 사람의 혈관 위치 또는 손목 두께의 변화에도 정밀한 PPG 신호의 측정이 가능한 손목형 맥파 측정장치를 제공하는 것이다.

[0009] 또한, 본 발명은 다수의 PPG 신호 중에서 정확한 PPG 신호를 검출하고, 이에 대응하는 PPG 센서에만 전원을 공급하여 에너지를 절약하는 것을 목적으로 한다.

[0010] 또한, 본 발명은 동맥-PPG 신호와 정맥-PPG 신호를 별도로 측정하고, 이에 기초하여 잡음을 처리함으로써 더욱 정확한 PPG 신호를 검출하는 것을 목적으로 한다.

[0011] 또한, 본 발명은 움직임 잡음을 측정하기 위한 전극센서를 별도로 설치함으로써, 정확한 PPG 신호를 검출하는 것을 목적으로 한다.

[0012] 또한, 본 발명은 방사각이 넓은 광원 하나에 다수의 광검출기가 매칭되도록 함으로써 부피를 작게 구성하는 것을 목적으로 한다.

과제 해결수단

[0013] 상기 목적은 본 발명에 따라, 손목형 맥파 측정장치에 있어서, 손목에 착용 가능하게 형성된 손목착용수단; 상기 손목착용수단에 어레이 형태로 배열 및 설치된 다수의 PPG 센서; 및 상기 다수의 PPG 센서로부터 입력되는 신호들을 합산 처리하여 잡음을 제거함으로써 PPG 신호를 산출하는 PPG 측정수단을 포함하는 것을 특징으로 하는 손목형 맥파 측정장치에 의해 달성될 수 있다. 이와 같이, PPG 센서를 어레이로 배치하여 합산하여 잡음을 제거함으로써 더욱 정확하게 PPG 신호를 측정할 수 있다.

[0014] 한편, 상기 목적은 본 발명에 따라, 손목형 맥파 측정장치에 있어서, 손목에 착용 가능하게 형성된 손목착용수단; 상기 손목착용수단에 어레이 형태로 배열 및 설치된 다수의 PPG 센서; 상기 다수의 PPG 센서에 개별적으로 전원을 공급하는 전원공급부; 및 상기 다수의 PPG 센서로부터 입력되는 신호들에 기초하여 PPG 레퍼런스 신호를 검출하고, 상기 PPG 레퍼런스 신호와 상기 다수의 PPG 센서의 신호들과의 연관성을 분석하여 상기 전원공급부가 상기 연관성이 높은 신호에 대응하는 적어도 하나의 PPG 센서에만 전원을 공급하도록 제어하는 PPG 측정수단을 포함하는 것을 특징으로 하는 손목형 맥파 측정장치에 의해 달성될 수 있다. 그리하여, 정확한 PPG 신호에 대응하는 센서에만 전원을 공급함으로써 전원을 절약할 수 있다.

[0015] 또한, 상기 목적은 본 발명에 따라, 손목형 맥파 측정장치에 있어서, 손목에 착용 가능하게 형성된 손목착용수단; 상기 손목착용수단에 어레이 형태로 배열 및 설치되는 것으로서, 동맥의 맥파를 감지하는 적어도 하나의 동맥-PPG 센서와 정맥의 맥파를 감지하는 적어도 하나의 정맥-PPG 센서를 포함하는 다수의 PPG 센서; 및 상기 적어도 하나의 정맥-PPG 센서로부터 입력되는 신호를 상기 적어도 하나의 동맥-PPG 센서로부터 입력되는 신호의 잡음-레퍼런스로 설정하여, 상기 적어도 하나의 동맥-PPG 센서로부터 입력되는 신호에 섞인 잡음을 제거하여 PPG 신호를 산출하는 PPG 측정수단을 포함하는 것을 특징으로 하는 손목형 맥파 측정장치에 의해 달성될 수 있다. 그리하여, 잡음을 효과적으로 줄일 수 있다.

Petitioner Samsung Ex-1004, 0988

[0016] 상기 PPG 측정수단은 상기 적어도 하나의 정맥-PPG 센서로부터 입력되는 신호를 합산처리하여 정맥-PPG 신호를 검출하고, 상기 적어도 하나의 동맥-PPG 센서로부터 입력되는 신호를 합산처리하여 동맥-PPG 신호를 검출하며, 상기 정맥-PPG 신호를 상기 동맥-PPG 신호의 잡음-레퍼런스로 설정하여 상기 PPG 신호를 산출할 수 있다. 이와 같이, 보다 안정적인 동맥-PPG 신호를 기준으로 정맥-PPG 신호를 잡음으로 하여 잡음을 처리함으로써 더욱 정확한 PPG 신호를 측정할 수 있다.

[0017] 또한, 신체의 움직임에 따른 움직임 잡음을 측정하기 위한 전극을 더 포함하고, 상기 PPG 측정수단은 상기 전극 센서로부터 입력되는 신호를 잡음-레퍼런스로 설정하여, 상기 PPG 신호를 산출함으로써 움직임 잡음을 효과적으로 제거할 수 있다.

[0018] 그리고, 상기 PPG 센서는 광원과 광검출기가 하나의 일체형 모듈로 구성하여, 부피를 줄여서 PPG 센서와 PPG 신호를 산출하는 PPG 측정수단을 통합하여 구성할 수 있다.

[0019] 한편, 상기 동맥-PPG 센서는 광원과 광검출기가 분리된 모듈로 구성되고, 상기 정맥-PPG 센서는 상기 광원과 상기 광검출기가 하나의 일체형 모듈로 구성될 수 있다.

[0020] 여기서, 상기 정맥-PPG 센서는 손목 장착시 상기 손목의 저면에 위치하도록 상기 손목장착수단에 설치되고, 상기 동맥-PPG 센서는 상기 손목의 양측면에 위치하도록 상기 손목장착수단에 설치되며, 상기 광원의 강도와 반사각에 따른 상기 광검출기의 위치를 조절하여 설치함으로써, 정맥의 위치와 동맥의 위치에 따라 PPG 신호를 더욱 잘 측정할 수 있다.

[0021] 상기 다수의 PPG 센서는 방사각이 넓은 광원 하나에 다수의 광검출기가 매칭되는 다수의 세트로 구성하여, 부피를 줄일 수 있다.

효 과

[0022] 이상 설명한 바와 같이, 본 발명에 따르면, 측정모듈과 검출모듈이 통합되어 휴대성이 뛰어나고, PPG 센서가 어레이 형태로 다수 배열되어 사람의 혈관 위치 또는 손목 두께의 변화에도 정밀한 PPG 신호의 측정이 가능한 손목형 맥파 측정장치가 제공된다.

[0023] 또한, 다수의 PPG 신호 중에서 정확한 PPG 신호를 검출하고, 이에 대응하는 PPG 센서에만 전원을 공급함으로써 에너지를 절약할 수 있다.

[0024] 또한, 본 발명은 동맥-PPG 신호와 정맥-PPG 신호를 별도로 측정하고, 이에 기초하여 잡음을 처리함으로써 더욱 정확한 PPG 신호를 검출할 수 있다.

[0025] 또한, 본 발명은 움직임 잡음을 측정하기 위한 전극센서를 별도로 설치함으로써, 정확한 PPG 신호를 검출할 수 있다.

[0026] 또한, 본 발명은 방사각이 넓은 광원 하나에 다수의 광검출기가 매칭되도록 함으로써 부피를 작게 구성할 수 있는 한편, 에너지를 절약할 수 있다.

발명의 실시를 위한 구체적인 내용

[0027] 이하, 도면을 참조하여 본 발명의 구체적인 실시예들에 대해 설명하기로 한다.

[0028] 도 2 및 도 3은 본 발명의 제1 실시예에 따른 손목형 맥파 측정장치를 손목에 착용한 형상(손목은 생략함)과 가로로 펼친 형상을 각각 개략적으로 도시한 그림이다.

[0029] 도 2 및 도 3을 참조하면, 본 실시예에 따른 손목형 맥파 측정장치는 손목착용수단(10), 다수의 PPG 센서(20), 및 PPG 측정수단(30)을 포함한다.

[0030] 손목착용수단(10)은 손목에 착용 가능하게 형성된 것으로, 팔찌 형태로 구현될 수 있다. 손목착용수단(10)은 안쪽에 설치 및 배열된 다수의 PPG 센서(20)가 손목에 접촉될 수 있도록, 착용 길이가 조절 가능하거나 유연성을 갖는 소재로 구성될 수 있다.

[0031] 다수의 PPG 센서(20)는 손목착용수단(10) 안쪽에 어레이 형태로 배열 및 설치되어, 손목의 맥파를 감지한다. 여

Petitioner Samsung Ex-1004, 0989

기서, PPG 센서(20)는 광원과 광검출기가 하나의 일체형으로 통합 구성된 모듈인 것이 바람직하다.

[0032] 예컨대, 광원은 660nm 와 940 nm 두 종류의 파장대의 빛을 조사하는 LED를 이용하여 혈중 산소 포화도를 측정할 수 있도록 하며, 광검출기는 포토-다이오드를 사용할 수 있다. 본 발명에서와 같이, 광원과 광검출기가 일체로 통합하여 형성된 모듈을 PPG 센서(20)로 이용하면 더 많은 수의 센서를 부착할 수 있으므로 측정오차를 줄일 수 있는 장점을 갖는다.

[0033] PPG 측정수단(30)은 다수의 PPG 센서(20)로부터 입력되는 신호들을 합산 처리하여 잡음을 제거함으로써 정확한 PPG 신호를 측정한다.

[0034] 도 4는 본 발명의 제1 실시예에 따른 PPG 신호 측정의 예를 개념적으로 도시한 것이다. 도 4를 참조하면, PPG 측정수단(30)은 N개의 PPG 센서(PPG0, PPG1, PPG2, ..., PPGN)로부터 입력되는 신호들을 합산 처리하여, 몸의 움직임이나, 착용/혈관 위치에 따라 발생하는 잡음을 제거한다.

[0035] 이와 같이, 본 발명에 따라 PPG 센서(20)를 어레이 타입으로 다수 설치하면, 착용위치에 따른 신호의 오류와 사람의 혈관 위치에 따른 PPG 측정 오류를 줄일 수 있어 효과적이다. 어레이 타입으로 배열된 다수의 PPG 센서(20)로부터의 신호를 합산하여 정확한 PPG 신호를 측정하는 것은 잡음이 가우시안 분포를 따른다고 가정할 때, 그 합이 0이 되는 사실에 기초한다.

[0036] 종래와 같이 하나의 PPG 센서(20)만을 이용하여 맥파를 측정할 때에는 센서가 정확히 맥파 측정 위치에 놓여져야 하기 때문에 그 위치를 맞추는 것이 쉽지 않고 잡음이 섞여 있어 정확한 PPG 신호를 측정하는데 어려움이 있었지만, 본 발명과 같이 다수의 센서를 어레이 형태로 배열하고 그 신호의 합을 이용하여 PPG 신호를 측정하면 잡음을 제거하여 정확한 PPG 신호를 측정할 수 있다.

[0037] 이하, 도 2, 3, 및 5를 참조하여 본 발명의 제2 실시예에 따른 손목형 맥파 측정장치에 대해 설명하기로 한다. 도 5는 본 발명의 제2 실시예에 따른 손목형 맥파 측정장치의 개략도이다. 전술한 실시예와 중복되는 설명은 필요에 따라 생략하기로 한다.

[0038] 도 2, 3, 및 5에 도시된 바와 같이, 본 실시예에 따른 손목형 맥파 측정장치는 손목에 착용 가능하게 형성된 손목착용수단(10), 손목착용수단(10)에 어레이 형태로 배열 및 설치된 다수의 PPG 센서(20), 전원공급부(40) 및 PPG 측정수단(30)을 포함한다.

[0039] 전원공급부(40)는 다수의 PPG 센서(20)에 개별적으로 전원을 공급하도록 설치되며, 휴대용 배터리로 구현될 경우, 보다 긴 모듈 운용 시간을 유지할 수 있다. 도 5에 도시된 바와 같이, 전원공급부(40)는 전원을 공급하는 라인을 통해 각 PPG 센서(20)와 연결되어 있으며, PPG 측정수단(30)으로부터 입력되는 제어신호에 따라 각 PPG 센서(20)에 전원을 개별적으로 공급 및 차단할 수 있다.

[0040] PPG 측정수단(30)은 N개의 PPG 센서(PPG0, PPG1, PPG2, ..., PPGN)로부터 입력되는 신호들에 기초하여 PPG 레퍼런스 신호를 검출한 후, 검출된 PPG 레퍼런스 신호와 각 PPG 센서(20)의 신호들의 연관성을 분석하여, 연관성이 높은 PPG 센서에만 전원을 공급하도록 전원공급부(40)에 제어신호를 인가한다.

[0041] 예컨대, PPG 측정수단(30)은 우선 N개의 PPG 센서(PPG0, PPG1, PPG2, ..., PPGN)로부터 입력되는 신호들을 합산 처리하여, 몸의 움직임이나, 착용/혈관 위치에 따라 발생하는 잡음을 제거함으로써 PPG 레퍼런스 신호를 검출한다.

[0042] 그리고, 검출한 PPG 레퍼런스 신호와 PPG 센서들(20)의 신호 간의 연관성을 분석하여, 연관성이 높은 신호에 대응하는 PPG 센서에만 전원이 공급되도록 전원공급부(40)에 센서선택신호를 출력한다. 여기서, PPG 레퍼런스 신호와 연관성이 높다는 것은 PPG 레퍼런스 신호와 유사하다는 의미하며, 유사성이 일정 범위 내에 속하는 PPG 센서의 수가 복수 개인 경우, 해당되는 복수 개의 PPG 센서에 전원을 공급하고 나머지 센서들에는 전원공급을 중단하여, 선택한 PPG 센서만 동작하도록 한다. 그리하여, PPG 측정수단(30)은 선택한 PPG 센서의 신호만을 입력받아 정확한 PPG 신호를 측정할 수 있다.

[0043] 이와 같이, 정확한 PPG 신호를 출력하는 PPG 센서에만 개별적으로 전원을 공급하여 동작시킴으로써, 정확한 PPG 신호를 얻을 수 있음은 물론이고, 전원공급부(40)로 사용되는 배터리의 사용시간을 증가시킬 수 있어 더욱 효과적이다.

[0044] 이하, 도 6 및 7을 참조하여, 본 발명의 제3 실시예에 따른 손목형 맥파 측정장치에 대해 설명하기로 한다.

[0045] 본 실시예에 따른 손목형 맥파 측정장치는 동맥이 정맥보다 강하고 잡음에 영향을 적게 받는다는 점을 이용하여

Petitioner Samsung Ex-1004, 0990

동맥에서의 PPG 신호를 기준으로 정맥에서의 PPG 신호를 잡음-레퍼런스로 하여 PPG 신호를 측정한다.

[0046] 도 6은 본 발명의 제3 실시예에 따른 손목형 맥파 측정장치의 개략적인 구조, 도 7은 본 실시예에 따른 맥파 측정 방법을 개념적으로 설명한 그림이다.

[0047] 도 6 및 도 7을 참조하면, 본 실시예에 따른 손목형 맥파 측정장치는 손목에 착용 가능하게 형성된 손목착용수단(10), 손목착용수단(10)에 어레이 형태로 배열 및 설치되는 다수의 PPG 센서(20), 및 PPG 측정수단(30)을 포함한다. 또한, PPG 센서(20)는 동맥의 맥파를 감지하는 적어도 하나의 동맥-PPG 센서(21)와 정맥의 맥파를 감지하는 적어도 하나의 정맥-PPG 센서(23)로 나뉜다.

[0048] 도 6에서 파란색 원으로 표시된 것이 정맥을 가리키며, 빨간색 원으로 표시된 것이 동맥을 가리킨다. 동맥은 정맥보다 안쪽 깊숙이 위치해 있음을 알 수 있다.

[0049] 이에 따라, 본 실시예에서는 동맥-PPG 센서(21)와 정맥-PPG 센서(23)의 설치위치를 달리한다. 예컨대, 동맥-PPG 센서(21)를 손목의 측면 양쪽에 설치하고, 정맥-PPG 센서(23)는 손목 안쪽에 어레이 형태로 배열 설치할 수 있다. 특히, 동맥-PPG 센서(21)는 광원의 투과 강도와 반사각에 따라 광검출기의 위치를 조절하여 설치한다. 동맥-PPG 센서(21)는 도 5에 도시된 바와 같이 광원과 광검출기가 분리된 형태로 된 모듈을 이용할 수 있다.

[0050] 동맥의 경우 일반적으로 손목의 양쪽 깊숙한 곳에 위치하고 정맥의 경우 피부에서 깊지 않은 곳에 불규칙적으로 배열되어 있기 때문에, 동맥센서는 두 개의 센서(양쪽)을 사용하고 정맥에서는 불규칙적인 혈관 배열에서의 PPG 측정을 위해 어레이식 배열 센서를 사용하는 것이 바람직하다. 본 실시예에서는 동맥-PPG 센서(21)가 양쪽에 하나씩 배치되고, 정맥-PPG 센서(23)가 그 사이에 5개 배치된 것을 일 예로 한다.

[0051] PPG 측정수단(30)은 정맥-PPG 신호를 동맥-PPG 센서들(21)로부터 입력된 동맥-PPG 신호의 잡음-레퍼런스로 설정하여 잡음 제거 후 PPG 신호를 측정한다.

[0052] 예컨대, 도 7을 참조하면, PPG 측정수단(30)은 동맥-PPG 신호와 정맥-PPG 신호를 각각 합산 처리하는 합산처리모듈들(31, 33)과, 잡음을 제거하는 잡음제거모듈(35)을 포함한다.

[0053] 두 개의 동맥-PPG 센서들(21)로부터 입력되는 신호를 합산처리하여 1차적으로 잡음을 제거한 후, 정맥-PPG 센서들(23)로부터 입력되는 신호를 합산처리한 것을 잡음-레퍼런스로 설정하여 최종적으로 잡음을 제거한다.

[0054] 이와 같이, 동맥과 정맥의 PPG 신호의 특성을 이용하여 효과적으로 잡음을 제거할 수 있다.

[0055] 이하, 도 8 내지 10을 참조하여, 본 발명의 제4 실시예에 따른 손목형 맥파 측정장치에 대해 설명하기로 한다. 본 실시예에 따른 손목형 맥파 측정장치는 신체의 움직임에 따른 잡음을 측정하기 위한 전극(50)을 더 구비함으로써, 잡음을 효과적으로 제거한다.

[0056] 도 8 및 도 9는 각각 본 발명의 제4 실시예에 따른 손목형 맥파 측정장치를 펼쳤을 때의 구조와 손목에 착용했을 때의 구조를 개략적으로 도시한 것이며, 도 10은 본 실시예에 따라 PPG 신호를 측정하는 방법을 개념적으로 도시한 것이다.

[0057] 도 8 및 도 9에 도시된 바와 같이, 본 실시예에 따른 손목형 맥파 측정장치는 손목착용수단(10), PPG 센서들의 어레이(20), PPG 측정수단(30) 이외에 전극(50)을 포함한다.

[0058] 전극(50)은 신체의 움직임에 따른 순수 움직임 잡음을 측정하기 위한 것으로, 도 9에 도시된 바와 같이, 손목착용 시 위쪽에 배치되도록 설치된다.

[0059] 도 10을 참조하면, PPG 측정수단(30)은 다수의 PPG 센서(20)로부터 입력되는 신호를 합산처리하여 1차적으로 잡음을 제거한 후, 전극(50)으로부터 입력되는 신호를 잡음-레퍼런스로 설정하여 최종적으로 잡음을 제거하여 정확한 PPG 신호를 산출한다.

[0060] 이와 같이, 움직임에 따른 잡음을 측정하기 위한 전극(50)을 더 구비함으로써, 잡음을 효과적으로 제거할 수 있다.

[0061] 도 11은 본 발명의 제5 실시예에 따른 손목형 맥파 측정장치를 펼쳤을 때의 구조를 개략적으로 도시한 그림이다. 본 실시예에 따른 손목형 맥파 측정장치의 다른 구성들은 전술한 실시예들과 동일 유사하지만, 광원과 광검출기의 배치와 사용에 차이가 있다.

[0062] 도 11에서, 광원을 하늘색 직사각형으로 나타내고, 광검출기를 붉은색 정사각형으로 표시하였다. 본 실시예에 따른 손목형 맥파 측정장치는 방사각이 넓은 하나의 광원(20a)에 여러 개의 검출기(20b)가 대응하도록 배치하여

Petitioner Samsung Ex-1004, 0091

PPG 신호를 측정한다.

[0063] 전술한 실시예들에서는 광원과 광검출기가 하나의 모듈에 통합된 PPG 센서(20)를 예로서 주로 설명하였으나, 본 실시예에서는 광원을 방사각이 넓게 구성하여 광원(20a)과 광검출기(20b)가 1:다수로 대응하도록 한다.

[0064] 그리하여, 광원의 개수 제한을 통해 저전력 회로로 장치를 구동할 수 있는 장점이 있다.

[0065] 한편, 전술한 실시예들에 따른 손목형 맥파 측정장치를 사용자가 손목에 착용한 상태에서 편리하게 PPG 신호를 측정할 수 있음은 전술한 기재사항에 의해 충분히 이해될 수 있다. 다만, 사용자가 손목에 착용한 상태로 맥파를 측정하기 때문에, 사용자의 움직임에 따라 신호의 특성이 감소될 수 있다. 따라서, 본 발명의 다른 실시예에 따르면, 레퍼런스 신호 및/또는 잡음-레퍼런스 신호를 일정 시간 주기로 검출하여 시간에 따른 센서 위치, 몸의 움직임 등에 따른 신호의 특성 감소 현상을 해결할 수 있다. 예컨대, 전술한 제2 실시예에서, 몸의 움직임에 따라 초기에 검출된 PPG 레퍼런스 신호의 특성이 감소할 수 있기 때문에, 일정 시간 간격 주기로 기존의 PPG 레퍼런스 신호와 현재의 신호를 비교하여 만약 연관성이 떨어진다면, PPG 레퍼런스 신호를 다시 검출하여 재설정할 수 있다.

[0066] 비록 본 발명의 몇몇 실시예들이 도시되고 설명되었지만, 본 발명이 속하는 기술분야의 통상의 지식을 가진 당업자라면 본 발명의 원칙이나 정신에서 벗어나지 않으면서 본 실시예를 변형할 수 있음을 알 수 있을 것이다. 발명의 범위는 첨부된 청구항과 그 균등물에 의해 정해질 것이다.

도면의 간단한 설명

[0067] 도 1a 및 도 1b는 종래 프로브를 이용한 PPG 신호 측정장치의 기본적인 원리를 설명하기 위한 개략도이며, 도 1a는 투과형 구조의 프로브, 도 1b는 반사형 구조의 프로브를 나타낸다.

[0068] 도 2 및 도 3은 본 발명의 제1 실시예에 따른 손목형 맥파 측정장치를 손목에 착용한 형상(손목은 생략함)과 가로로 펼친 형상을 각각 개략적으로 도시한 그림이다.

[0069] 도 4는 본 발명의 제1 실시예에 따른 PPG 신호 측정의 예를 개념적으로 도시한 것이다.

[0070] 도 5는 본 발명의 제2 실시예에 따른 손목형 맥파 측정장치의 개략도이다.

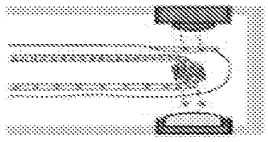
[0071] 도 6은 본 발명의 제3 실시예에 따른 손목형 맥파 측정장치의 개략적인 구조, 도 7은 본 발명의 제3 실시예에 따른 맥파 측정 방법을 개념적으로 설명한 그림이다.

[0072] 도 8 및 도 9는 각각 본 발명의 제4 실시예에 따른 손목형 맥파 측정장치를 펼쳤을 때의 구조와 손목에 착용했을 때의 구조를 개략적으로 도시한 것이며, 도 10은 본 발명의 제4 실시예에 따라 PPG 신호를 측정하는 방법을 개념적으로 도시한 것이다.

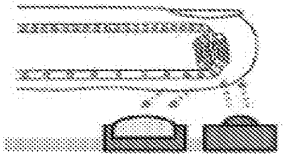
[0073] 도 11은 본 발명의 제5 실시예에 따른 손목형 맥파 측정장치를 펼쳤을 때의 구조를 개략적으로 도시한 그림이다.

도면

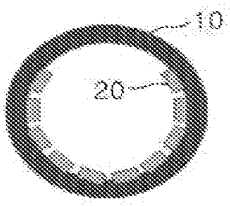
도면1a



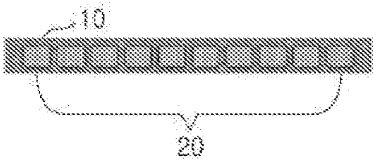
도면1b



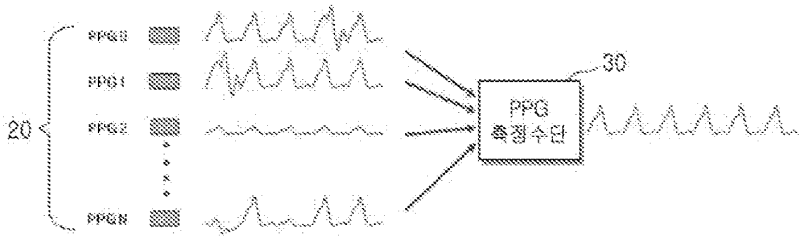
도면2



도면3

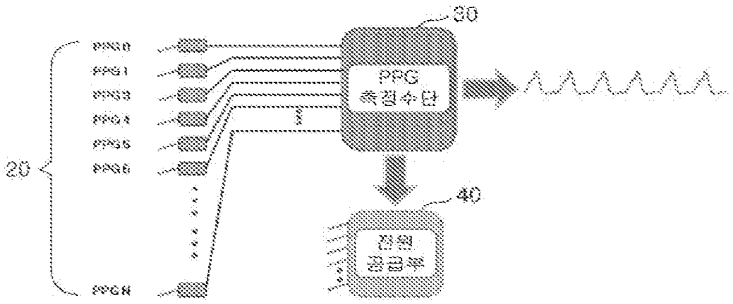


도면4

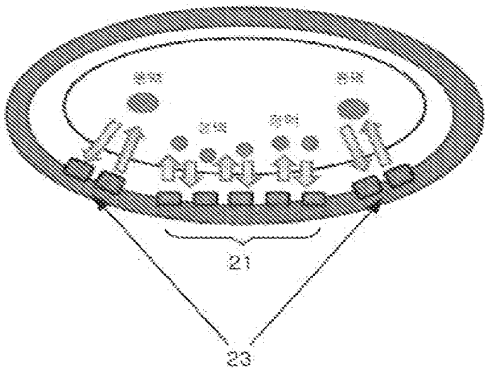


Petitioner Samsung Ex-1004, 0992

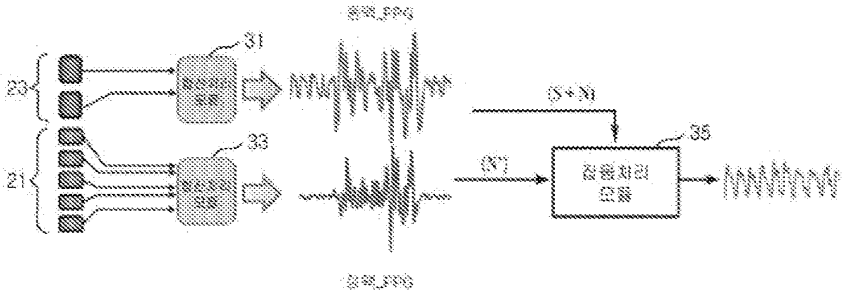
도면5



도면6

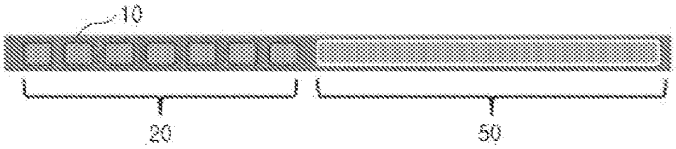


도면7

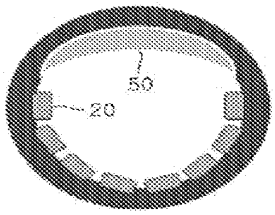


Petitioner Samsung Ex-1004, 0993

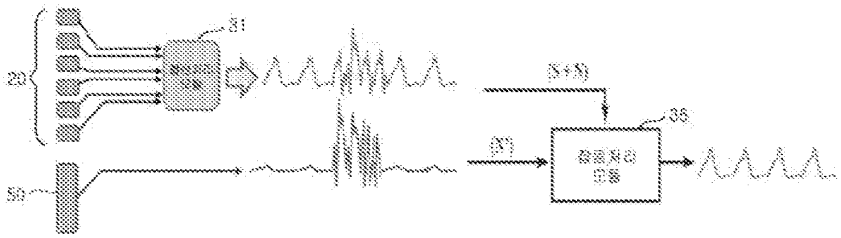
도면8



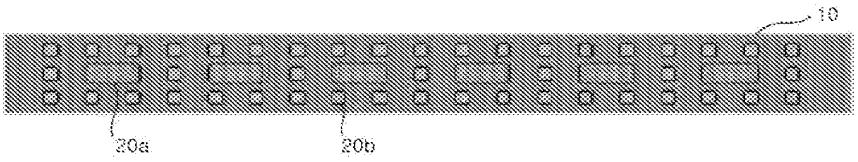
도면9



도면10



도면11



Petitioner Samsung Ex-1004, 0994

(19)대한민국특허청(KR)
(12) 등록실용신안공보(Y1)

(51) 。Int. Cl.
A44C 5/00 (2006.01)
A44C 5/12 (2006.01)

(45) 공고일자 2006년06월05일
(11) 등록번호 20-0417885
(24) 등록일자 2006년05월26일

(21) 출원번호 20-2006-0006666
(22) 출원일자 2006년03월13일

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(74) 대리인 정병호

기초적요건 심사관 : 김종규

(54)건강팔찌

요약

본 고안은 건강팔찌에 관한 것으로서, 팔찌에 있어서, 내부링과 외부링으로 구성되는 몸체와, 상기 내부링과 외부링 사이에 일정간격으로 형성되는 다수개의 레이저 다이오드와, 상기 몸체의 일측에 형성되고 상기 레이저 다이오드와는 전선으로 연결되어 전원을 공급하는 전원공급부를 포함하여 이루어지는 것을 특징으로 한다.

본 고안에 따르면, 이중으로 구성되는 몸체의 내부에 일정간격으로 레이저 다이오드 장치를 내장하여 사용자에게 레이저 열과 광선이 저출력 각도로 피부에 분산 침투하여 염증제거, 통증완화, 면역력증가, 피부염 보호 효과를 기대할 수 있다.

대표도

도 1

색인어

건강팔찌, 내부링, 외부링, 레이저 다이오드, 전원공급부

명세서

도면의 간단한 설명

도 1은 본 고안의 건강팔찌를 나타낸 사시도.

Petitioner Samsung Ex-1004, 0995

Petitioner Samsung Ex-1004, 0996

도 2는 본 고안의 건강팔찌를 나타낸 단면도.

※ 도면의 주요부분에 대한 부호의 설명

1 : 건강팔찌 10 : 몸체

11 : 내부링 12 : 외부링

13 : 홈 14 : 전선홈

20 : 레이저 다이오드 22 : 전선

30 : 전원공급부 32 : 스위치

고안의 상세한 설명

고안의 목적

고안이 속하는 기술 및 그 분야의 종래기술

본 고안은 건강팔찌에 관한 것으로서, 더욱 상세하게는 이중으로 구성되는 몸체의 내부에 일정간격으로 레이저 다이오드 장치를 내장하여 사용자에게 레이저열과 광선이 저출력 각도로 피부에 분산 침투하여 염증제거, 통증완화, 면역력증가, 피부염 보호 효과를 기대할 수 있는 건강팔찌에 관한 것이다.

최근에는 산업의 발달과 도시화로 인한 환경 오염에 따라 사람들은 생활 환경 및 건강에 대한 관심이 증대되고 있으며 최근에 들어서는 특히, 새집 증후군이라고 하여 집이나 건물을 새로 지을 때 사용하는 건축자재나 벽지 등에서 나오는 유해물질로 인해 거주자들이 느끼는 건강상 문제나 불쾌감이 사회적인 이슈로 떠오르고 있다.

이러한 사회적 이슈에 발맞추어 건강에 관련되어 항상 착용이 가능하며 미적감각이 돋보이는 액세서리 등에 접목한 제품들이 속속 출시되고 있다. 이러한 종래의 액세서리 제품 중 음이온이 다량 방사되는 토르마린과 원적외선이 다량 방사되는 게르마늄을 실리콘과 혼합하여 성형한 건강 팔찌가 실시되고 있다.

종래의 음이온이 방사되는 건강팔찌는 대한민국 등록실용신안 20-0375903호에 설명한 바와 같이, 음이온이 다량 방사되는 토르마린 또는 게르마늄 등의 원석을 미세한 가루로 분쇄하여 실리콘과 함께 성형하여 신축성 있는 건강 팔찌를 실시하고 있다.

그러나 이러한 음이온 방사 원석을 미세한 가루로 분쇄하여 실리콘과 혼합 후 성형하는 경우에는 음이온 방사 원석의 자체 색상에 의해 흰색 등 밝은 색을 명료하게 표현하는 건강 팔찌를 생산하기에는 불가능하였다.

또한, 건강 팔찌의 신축성을 부여하기 위해 실리콘의 함량에 비해 상대적으로 음이온 방사 원석의 함유량이 낮아지게 되어 음이온 및 원적외선의 방사량이 현저히 떨어지게 된다. 따라서, 음이온 및 원적외선을 방사하는 건강 팔찌의 본연의 기능을 수행하지 못하는 문제점이 있다.

이와 같은 종래의 음이온 방사 원석과 실리콘을 혼합하여 성형한 건강 팔찌의 문제점을 개선하여 대한민국 등록실용신안 20-0377551호에 실시되고 있는 실리콘 튜브에 토르마린, 게르마늄 등의 음이온 및 원적외선 방사 물질을 분쇄하여 입자 형태로 실리콘 튜브에 충전하여 형성하였다.

그러나, 개선된 종래의 건강 팔찌는 입자를 실리콘 튜브에 충전하여 사용함으로써, 입자로 된 음이온 방사물질을 실리콘튜브에 충전하는데 대단히 번거로운 문제점이 발생하게 되며 이로 인해 제품 생산시간이 현저히 늘어나게 되어 생산성 저하가 발생하고 다양한 미적 형상을 표현하는 것이 불가능하였다.

고안이 이루고자 하는 기술적 과제

본 고안은 상기와 같은 문제점을 해결하기 위하여 안출된 것으로서, 이중으로 구성되는 몸체의 내부에 일정간격으로 레이저 다이오드 장치를 내장하여 사용자에게 레이저열과 광선이 저출력 각도로 피부에 분산 침투하여 염증제거, 통증완화, 면역력증가, 피부염 보호 효과를 기대할 수 있는 건강팔찌를 제공하는데 목적이 있다.

상기와 같은 목적을 달성하기 위하여 본 고안은 팔찌에 있어서, 내부링과 외부링으로 구성되는 몸체와, 상기 내부링과 외부링 사이에 일정간격으로 형성되는 다수개의 레이저 다이오드와, 상기 몸체의 일측에 형성되고 상기 레이저 다이오드와는 전선으로 연결되어 전원을 공급하는 전원공급부를 포함하여 이루어지는 것을 특징으로 한다.

고안의 구성 및 작용

이하, 본 고안의 구성을 첨부된 도면을 참조로 설명하면 다음과 같다.

본 고안인 건강팔찌(1)는 도시된 도 1 및 2를 참조로 설명하면 상기 건강팔찌(1)는 내부링(11)과 외부링(12)으로 구성되는 몸체(10)와, 상기 내부링(11)과 외부링(12) 사이에 개재되는 레이저 다이오드(20)와, 상기 레이저 다이오드(20)에 전원을 공급하는 전원공급부(30)로 대별할 수 있다.

상기 내부링(11)과 외부링(12)으로 구성되는 몸체(10)는 합성수지 또는 탄성을 가지는 금속제 재질로 모두 제작될 수 있으며 크기는 다르게 형성될 수 있지만 효과적인 구성을 위해서는 상기 내부링(11)과 외부링(12)이 일체가 되도록 형성되는 것이 바람직하다.

상기 몸체(10)을 구성하는 있는 내부링(11)과 외부링(12)의 결합은 다수개의 볼트에 의해서 결합될 수 있을 뿐만 아니라 상기 내부링(11)과 외부링(12)의 억지끼움에 의해서 결합될 수 있으며 여기서는 억지끼움에 의해 결합되는 예를 들어 설명하기로 한다.

그리고 상기 내부링(11)과 외부링(12)이 맞닿는 면으로 상기 레이저 다이오드(20)가 삽입되는 홈(13)이 양측면에 대향되도록 형성되고 일측으로는 상기 레이저 다이오드(20)를 연결하기 위한 전선(22)이 삽입되기 위한 전선홈(14)이 형성되며 여기서는 외부링(12)에 전선홈(14)이 형성되는 예를 들어 설명하기로 한다.

상기 몸체(10) 즉, 상기 내부링(11)과 외부링(12)의 일측으로는 상기 레이저 다이오드(20)에 전원을 공급하기 위한 전원공급부(30)가 수용되는 홈(15)이 형성되며 여기서는 상기 내부링(11)에 일측면에 형성되는 예를 들어 설명하기로 한다.

상기 내부링(11)과 외부링(12) 사이에 개재되는 다수개의 레이저 다이오드(20)의 전면은 둥글게 형성하여 발생하는 열이 피부와 일정 영역으로 퍼지도록 형성한다.

상기 몸체(10)의 일측에 형성되고 상기 레이저 다이오드(20)와는 전선으로 연결되어 전원을 공급하는 전원공급부(30)는 상기 레이저 다이오드(20)에 전원을 공급 및 차단하는 역할을 하는 스위치(32)가 상부에 형성되며 여기서 상기 스위치(32)는 외주면과 일체가 되도록 형성하고 필요에 따라서는 돌출형이 되도록 형성된다.

상기 스위치(32)의 작동에 따라 상기 레이저 다이오드(20)에 전원을 공급하는 전원은 일반건전지뿐만 아니라 수은 건전지 등으로 형성된다.

상기와 같이 구성된 건강팔찌(1)의 작용 및 사용상태를 살펴보면 다음과 같다.

먼저, 상기 내부링(11)과 외부링(12) 사이에 형성되는 홈(13)에 다수개의 레이저 다이오드(20)를 삽입하고 전선(22)으로 상기 다수개의 레이저 다이오드(20)를 연결한다.

다음으로 전원공급부(30)가 형성되는 홈(15)에 건전지(34)를 공급한 후 상기 내부링(11)과 외부링(12)를 억찌끼움 맞추게 되면 조립은 완료가 된다. 그리고 이때, 건강팔찌(1)의 외주면으로 장식용 악세사리가 별도로 마련되어 사용될 수 있다.

상기와 같은 상태에서 전원공급부(30)의 스위치(32)를 작동하게 되면 레이저 다이오드(20)로는 전원이 공급되어 레이저 열과 광선이 발생하게 되고 이 광선은 저출력 각도로 피부에 분산 침투되어 피부를 마사지하게 되는 것이다.

고안의 효과

Petitioner Samsung Ex-1004, 0997

Petitioner Samsung Ex-1004, 0998

본 고안에 따르면, 이중으로 구성되는 몸체의 내부에 일정간격으로 레이저 다이오드 장치를 내장하여 사용자에게 레이저 열과 광선이 저출력 각도로 피부에 분산 침투하여 염증제거, 통증완화, 면역력증가, 피부염 보호 효과를 기대할 수 있다.

(57) 청구의 범위

청구항 1.

팔찌에 있어서,

내부링(11)과 외부링(12)으로 구성되는 몸체(10)와;

상기 내부링(11)과 외부링(12) 사이에 일정간격으로 형성되는 다수개의 레이저 다이오드(20)와;

상기 몸체(10)의 일측에 형성되고 상기 레이저 다이오드(20)와는 전선(22)으로 연결되어 전원을 공급하는 전원공급부(30) ; 를 포함하여 이루어지는 것을 특징으로 하는 건강팔찌.

청구항 2.

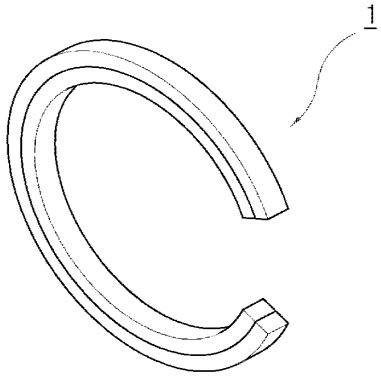
제 1항에 있어서, 상기 전원공급부(30)는,

상기 레이저 다이오드(20)에 전원의 공급 및 차단의 역할을 하는 스위치(32)와;

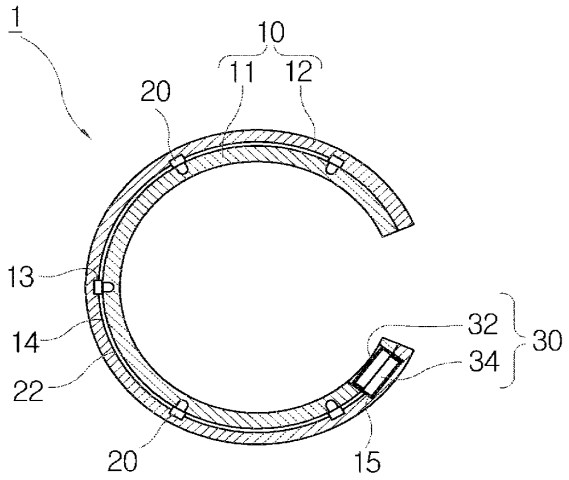
상기 스위치(32)의 작동에 따라 상기 레이저 다이오드(20)에 전원을 공급하고 교체가 가능한 건전지(34) 또는 그의 기능을 수여하는 수단으로 이루어지는 것을 특징으로 하는 건강팔찌.

도면

도면1



도면2



Petitioner Samsung Ex-1004, 0999

(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 103441306 A
(43)申请公布日 2013.12.11

(21)申请号 201310383162.3

(22)申请日 2013.08.28

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代理人 邓云鹏

(51)Int.Cl.
H01M 10/058(2010.01)

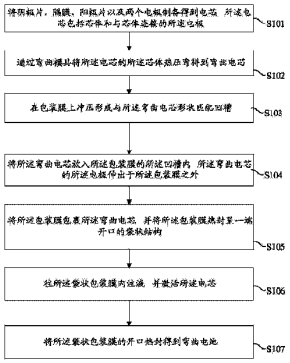
权利要求书1页 说明书5页 附图6页

(54)发明名称

弯曲电池制造方法

(57)摘要

一种弯曲电池制造方法，包括如下步骤：将阴极片、隔膜、阳极片以及两个电极制备得到电芯，电芯包括芯体和与芯体连接的电极；通过弯曲模具将电芯的芯体热压弯得到弯曲电芯；在包装膜上冲压形成与弯曲电芯形状匹配凹槽；将弯曲电芯放入包装膜的凹槽内，弯曲电芯的电极伸出于包装膜之外；将包装膜包裹弯曲电芯，并将包装膜热封呈一端开口的袋状结构；往袋状包装膜内注液，并激活电芯；将袋状包装膜的开口热封得到弯曲电池。上述方法中在电芯完成后便进行热压弯电芯，弯曲时正负极片以及隔膜之间的易于滑动形成弧形。配合成型有凹陷的包装膜，避免了弯折损伤和错位导致的电池性能不佳，电池损坏和外包装膜破损的问题，保障了弯曲电池的性能。



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Petitioner Samsung Ex-1004, 1000

1. 一种弯曲电池制造方法，其特征在于，包括如下步骤：

将阴极片、隔膜、阳极片以及两个电极制备得到电芯，所述电芯包括芯体和与所述芯体连接的所述电极；

通过弯曲模具将所述电芯的所述芯体热压弯得到弯曲电芯；

在包装膜上冲压形成与所述弯曲电芯形状匹配凹槽；

将所述弯曲电芯放入所述包装膜的所述凹槽内，所述弯曲电芯的所述电极伸出于所述包装膜之外；

将所述包装膜包裹所述弯曲电芯，并将所述包装膜热封呈一端开口的袋状结构；

往所述袋状包装膜内注液，并激活所述电芯；

将所述袋状包装膜的开口热封得到弯曲电池。

2. 根据权利要求 1 所述的弯曲电池制造方法，其特征在于，所述将所述包装膜包裹所述弯曲电芯，并将所述包装膜热封呈一端开口的袋状结构的步骤中：

热封采用的热封模具包括两个凹凸对应的热封模组，所述热封模组的凹凸形状与所述电芯的弯曲形状对应，将位于所述电芯的弯曲侧边的所述包装膜置于两个所述热封模组之间加压加热进行热封。

3. 根据权利要求 1 所述的弯曲电池制造方法，其特征在于，所述将所述袋状包装膜的开口热封得到弯曲电池的步骤中：

热封采用的热封模具包括两个凹凸对应的热封模组，所述热封模组的凹凸形状与所述电芯的弯曲形状对应，将位于所述包装膜置于两个所述热封模组之间加压加热进行热封。

4. 根据权利要求 1 所述的弯曲电池制造方法，其特征在于，所述包装膜为金属层和树脂层复合膜。

5. 根据权利要求 1 所述的弯曲电池制造方法，其特征在于，所述电芯制成方式为卷绕式或叠片式。

6. 根据权利要求 1 所述的弯曲电池制造方法，其特征在于，所述电芯和所述凹槽的弯曲形状为弧面。

7. 根据权利要求 1 所述的弯曲电池制造方法，其特征在于，所述将所述包装膜包裹所述弯曲电芯的步骤中，是将所述包装膜折叠以包裹所述弯曲电芯。

8. 根据权利要求 1 所述的弯曲电池制造方法，其特征在于，所述弯曲模具包括凹凸相对的两个模组。

Petitioner Samsung Ex-1004, 1001

弯曲电池制造方法

技术领域

[0001] 本发明涉及一种电池制造方法，特别是涉及一种弯曲电池的制造方法。

背景技术

[0002] 目前，液态 / 凝胶 / 聚合物锂离子电池绝大多数都是形状规则的矩形电池。

[0003] 近年来，便携式电子设备逐步趋向于外观形状多样化，为这些电子装置提供电力的锂离子电池也需要随设备的形状而实现多样化，以最大限度的利用设备内部的空间。一类比较有代表性的电子装置是考虑到人体工程性设计的弧形曲面电子装置，如腕表类可佩带电子装置，可佩带于手腕上测运动量。为了给这样的弧形曲面电子设备提供尽可能多的电力，最大限度利用装置内部空间，锂离子电池需要被设计为弯曲电池。

[0004] 传统制造方法是在矩形电池成型后，直接用弧形成形模型对矩形电池进行加压，加热，弯曲，形成弯曲电池。

[0005] 直接通过加压加温的方式热压弯折成型，存在以下品质问题和安全性风险：

[0006] 热压弯折成型，会导致电池内部极片相对移动，产生短路，极片之间界面也受损导致电化学性能劣化，还可能对电池的外包装膜造成破坏，引起电池漏液和气胀，导致弯曲电池损坏和引发安全性事故。

发明内容

[0007] 基于此，有必要提供一种可提高电池性能稳定性的弯曲电池制造方法。

[0008] 一种弯曲电池制造方法，包括如下步骤：

[0009] 将阴极片、隔膜、阳极片以及两个电极制备得到电芯，所述电芯包括芯体和与所述芯体连接的所述电极；

[0010] 通过弯曲模具将所述电芯的所述芯体热压弯得到弯曲电芯；

[0011] 在包装膜上冲压形成与所述弯曲电芯形状匹配凹槽；

[0012] 将所述弯曲电芯放入所述包装膜的所述凹槽内，所述弯曲电芯的所述电极伸出于所述包装膜之外；

[0013] 将所述包装膜包裹所述弯曲电芯，并将所述包装膜热封呈一端开口的袋状结构；

[0014] 往所述袋状包装膜内注液，并激活所述电芯；

[0015] 将所述袋状包装膜的开口热封得到弯曲电池。

[0016] 其中一个实施例中，所述将所述包装膜包裹所述弯曲电芯，并将所述包装膜热封呈一端开口的袋状结构的步骤中：

[0017] 热封采用的热封模具包括两个凹凸对应的热封模组，所述热封模组的凹凸形状与所述电芯的弯曲形状对应，将位于所述电芯的弯曲侧边的所述包装膜置于两个所述热封模组之间加压加热进行热封。

[0018] 其中一个实施例中，所述将所述袋状包装膜的开口热封得到弯曲电池的步骤中：

[0019] 热封采用的热封模具包括两个凹凸对应的热封模组，所述热封模组的凹凸形状与

Petitioner Samsung Ex-1004, 1002

所述电芯的弯曲形状对应，将位于所述包装膜置于两个所述热封模组之间加压加热进行热封。

[0020] 其中一个实施例中，所述包装膜为金属层和树脂层复合膜。

[0021] 其中一个实施例中，所述电芯制成方式为卷绕式或叠片式。

[0022] 其中一个实施例中，所述电芯和所述凹槽的弯曲形状为弧面。

[0023] 其中一个实施例中，所述将所述包装膜包裹所述弯曲电芯的步骤中，是将所述包装膜折叠以包裹所述弯曲电芯。

[0024] 其中一个实施例中，所述弯曲模具包括凹凸相对的两个模组。

[0025] 上述弯曲电池制造方法中在电芯完成后便进行热压弯电芯，此时的电芯没有外包装的束缚，弯曲时正负极片以及隔膜之间的易于滑动形成弧形。配合冲压成型有对应凹陷的包装膜，使得热封包装膜后直接得到弯曲电池。如此避免了传统的在电池成型后强行弯曲产生的弯折损伤和错位导致的电池性能不佳，电池损坏和外包装膜破损的问题，保障了弯曲电池和矩形电池一样的性能和高的电池合格率。此外，由于包装膜的弯曲形状为直接成型，也避免了传统方式 中热压弯的包装膜回弹形变问题。

附图说明

[0026] 图 1 为本发明一较佳实施例的弯曲电池制造方法步骤流程图；

[0027] 图 2 为本实施例的卷绕式电芯的结构示意图；

[0028] 图 3 为通过弯曲模具将图 2 所示的电芯弯曲工艺示意图；

[0029] 图 4 为弯曲后的电芯的结构示意图；

[0030] 图 5 为冲压有与与弯曲电芯形状匹配的凹槽的包装膜的结构示意图；

[0031] 图 6 为图 5 所示的包装膜另一视角的结构示意图；

[0032] 图 7 为图 4 所示的弯曲电芯放入到图 5 所示的包装膜的凹槽内后的状态示意图；

[0033] 图 8 为弯曲电芯被包装膜包裹且热封呈袋状结构的状态示意图；

[0034] 图 9 为热封模具热封位于电芯的弯曲侧边的包装膜的工艺示意图；

[0035] 图 10 为将所述袋状包装膜的开口热封后的结构示意图；

[0036] 图 11 为通过图 1 所示的方法制造的弯曲电池结构示意图。

具体实施方式

[0037] 如图 1 所示，其为本发明一较佳实施例的弯曲电池制造方法步骤流程图，包括如下步骤：

[0038] 步骤 S101，将阴极片、隔膜、阳极片以及两个电极制备得到电芯，所述电芯包括芯体和与芯体连接的所述电极。

[0039] 电芯制成方式可以是卷绕式或叠片式，如图 2 所示，其为本实施例的卷绕式电芯 20 的结构示意图，其包括芯体 201 和伸出于芯体 201 的两个电极 202。所述电芯 20 的芯体 201 为平板状。

[0040] 步骤 S102，通过弯曲模具将所述电芯的所述芯体热压弯得到弯曲电芯。

[0041] 电芯弯曲形状可以是标准弧形，也可以是非标准弧形的其他弯曲或弯折结构，此形状根据实际需要设定。

Petitioner Samsung Ex-1004, 1003

[0042] 如图 3 所示，其为通过弯曲模具 30 将图 2 所示的电芯 20 弯曲工艺示意图。弯曲模具 30 包括凹凸相对的两个弯曲模组 301 和 302，将电芯 20 置于两个弯曲模组 301 和 302 之间，加压加热后分离，得到如图 4 所示的弯曲电芯 20。图 4 中，电芯 20 的芯体 201 弯曲成弧形结构。由于弯曲过程中，电芯 20 阴极片、隔膜、阳极片由于没有外包装膜的束缚，弯曲时便于各层之间产生的相对滑动释放其张力易于形成弧形。

[0043] 步骤 S103，在包装膜上冲压形成与所述弯曲电芯形状匹配凹槽。

[0044] 本实施例的包装膜金属层和树脂层复合膜，如图 5 和图 6 所示，其为包装膜 50 冲压形成凹槽 501 的正反面结构示意图，包装膜 50 一面形成凹槽 501，另一面则为与所述凹槽 501 对应的凸起结构。凹槽 501 的底部为弯曲电芯 20 形状匹配的弯曲面，本实施例为弧面。采用的冲压模具形状和所述弯折模具的成型部分形状相同或相对应。

[0045] 步骤 S104，将所述弯曲电芯放入所述包装膜的所述凹槽内，所述弯曲电芯的所述电极伸出于所述包装膜之外。

[0046] 如图 7 所示，其为图 4 所示的弯曲电芯 20 放入到图 5 所示的包装膜 50 的凹槽 501 内后的状态示意图。由于凹槽 501 与弯曲电芯 20 的形状匹配，使得弯曲电芯 20 的外表面与所述包装膜 40 贴合。

[0047] 步骤 S105，将所述包装膜包裹所述弯曲电芯，并将所述包装膜热封呈一端开口的袋状结构。

[0048] 本实施例中，位于所述电芯弯曲侧边的所述包装膜热封后形成与所述电芯弯曲相同的形状。即采用弧形热封工艺，所述弧形可以为标准弧形或非标准弧形。

[0049] 如图 8 所示，其为弯曲电芯 20 被包装膜 50 包裹且热封呈袋状结构的状态示意图。执行步骤是，首先沿着箭头 A 方向折叠包装膜 50 使得包装膜 50 覆盖凹槽 501，然后通过热封模具，将包装膜 50 沿着电芯 20 的边缘进行热封，热封线 801 和包装膜 50 一起形成袋状结构，开后为箭头 B 所指位置。由于本实施例的包装膜 50 折叠边缘无需热封，所以此步骤中只需热封电极 202 所在侧边以及其中一个弯曲侧边，所以图 8 中热封线 801 为 L 型。所留的开口部分是为了便于烘烤、注液和预充激活产生的气体的储存。

[0050] 请同时参阅图 9，其为热封模具 90 热封位于电芯 20 的弯曲侧边的包装膜 50 的工艺示意图。热封模具 90 包括两个凹凸对应的热封模组 901 和 902，热封模组 901 和 902 的凹凸形状与所述电芯 20 的弯曲形状对应。先将位于电芯 20 的弯曲侧边包装膜 50 置于两个热封模组 901 和 902 之间加压加热后分离，即可实现弯曲热封。

[0051] 步骤 S106，往所述袋状包装膜内注液，并激活所述电芯。

[0052] 步骤 S107，将所述袋状包装膜的开口热封得到弯曲电池。

[0053] 本实施例中，所述开口位置的包装膜热封后形成与所述电芯弯曲相同的形状。同样采用上述热封模具进行热封。

[0054] 如图 10 和 11 所示，其为将所述袋状包装膜 50 的开口热封后的结构示意图，电芯 20 被包装膜 50 贴合包裹，形成弯曲电池 100。

[0055] 上述步骤 S106 的实际操作中注液后，需预热封所述袋状包装膜的开口，此时的热封位置离电芯较远，便于容纳激活时产生的气体。激活后，再执行步骤 S107，此时的热封位置则为贴近电芯的侧边位置。

[0056] 上述弯曲电池制造方法相对传统制造方法主要不同之处在于：

Petitioner Samsung Ex-1004, 1004

[0057] 传统制造方法在矩形电池成型后，热压弯整个电池。上述方法中在电芯完成后便进行热压弯电芯，此时的电芯没有外包装的束缚，弯曲时正负极片以及隔膜之间的易于滑动形成弧形。配合冲压成型有对应凹陷的包装膜，使得热封包装膜后直接得到弯曲电池。如此避免了传统的在电池成型后强行弯曲产生的弯折损伤和错位导致的电池性能不佳，电池损坏和外包装膜破损的问题，保障了弯曲电池和矩形电池一样的性能和高的电池合格率。此外，由于包装膜的弯曲形状为直接成型，也避免了传统方式中热压弯的包装膜回弹形变问题。

[0058] 以下为利用上述弯曲电池的制造方法制备电池的实验数据。

[0059] (1)配方与极片参数设计：

[0060] 最大厚度 4.50mm，最大宽度 15.5mm，最大长度 35.0mm，弧形 R25；

[0061] 最小容量 200mAh，设计中值容量 210mAh。

[0062] 按照以上参数进行配方与正负极片参数设计。

[0063] (2)正负极片制作：按照设计好的配方按照常规锂离子电池生产流程进行 配料，混料，并按照设计好的极片参数涂布，压片，分切 / 段切后制成正 / 负极极片。

[0064] (3)通过上述弯曲电池的制造方法制备电池。

[0065] (4)电池续充下线后测试容量与内阻，下线电压如下表所示；

[0066]

编号	内阻 (mΩ)	容量 (0.5C，mAh)	电压 (V)
1	111.1	212	3.83
2	110.9	212	3.827
3	114.4	210	3.829
4	111.0	208	3.827
5	108.4	214	3.827
6	112.6	210	3.828
7	109.2	209	3.827
8	111.2	209	3.829
9	110.7	209	3.828
10	111.9	208	3.829
11	110.9	209	3.825
12	111.9	208	3.828
13	107.2	213	3.828
14	107.0	211	3.829
15	112.0	210	3.829
最大值	114.4	214	3.830
最小值	107.0	208	3.825
平均值	110.7	210	3.828

[0067] 下线数据显示，按照此流程生产的弯曲电池容量能达到设计容量，内阻电压无异常。

[0068] (5)弯曲电池下线后取 15 只，45 度高温老化 3 天 + 常温静置 1 天后测试 OCV1，再 45 度高温老化 3 天 + 常温静置 1 天后测试 OCV2，取两次电压差值计算弯曲电池电压降；下线电压降测试数据下表所示：

[0069]

Petitioner Samsung Ex-1004, 1005

序号	OCV1(V)	OCV2(V)	ΔV(mV/h)
1	3.821	3.816	0.069
2	3.822	3.817	0.069
3	3.823	3.819	0.056
4	3.821	3.817	0.056
5	3.816	3.811	0.069
6	3.821	3.816	0.069
7	3.823	3.819	0.056
8	3.822	3.817	0.069
9	3.82	3.815	0.069
10	3.823	3.818	0.069
11	3.819	3.815	0.056
12	3.822	3.817	0.069
13	3.817	3.812	0.069
14	3.82	3.815	0.069
15	3.822	3.817	0.069

[0070] OCV 测试数据显示，按照此流程生产的弯曲电池的电压降测试小于常规电芯 0.1mV/h。

[0071] （6）OCV 测试后取弯曲电池 4 只，进行 0.5C 循环 300 周测试，如下表所示：

[0072]

循环倍率	不同循环次数容降（%）								
	50	75	100	125	150	175	200	250	300
0.5C	5.73	6.48	7.14	7.79	8.36	8.73	9.11	10.42	11.17
	5.51	6.73	7.76	8.79	9.72	10.47	11.03	12.99	14.39
	4.61	6.05	6.72	7.68	8.55	9.32	9.51	11.91	13.54
	5.68	6.72	7.47	8.51	9.37	10.12	10.60	12.96	14.85

[0073] 循环数据显示，按照此流程生产的弯曲电池能满足客户循环要求。

[0074] 以上所述实施例仅表达了本发明的几种实施方式，其描述较为具体和详细，但并不能因此而理解为对本发明专利范围的限制。应当指出的是，对于本领域的普通技术人员来说，在不脱离本发明构思的前提下，还可以做出若干变形和改进，这些都属于本发明的保护范围。因此，本发明专利的保护范围应以所附权利要求为准。

Petitioner Samsung Ex-1004, 1006

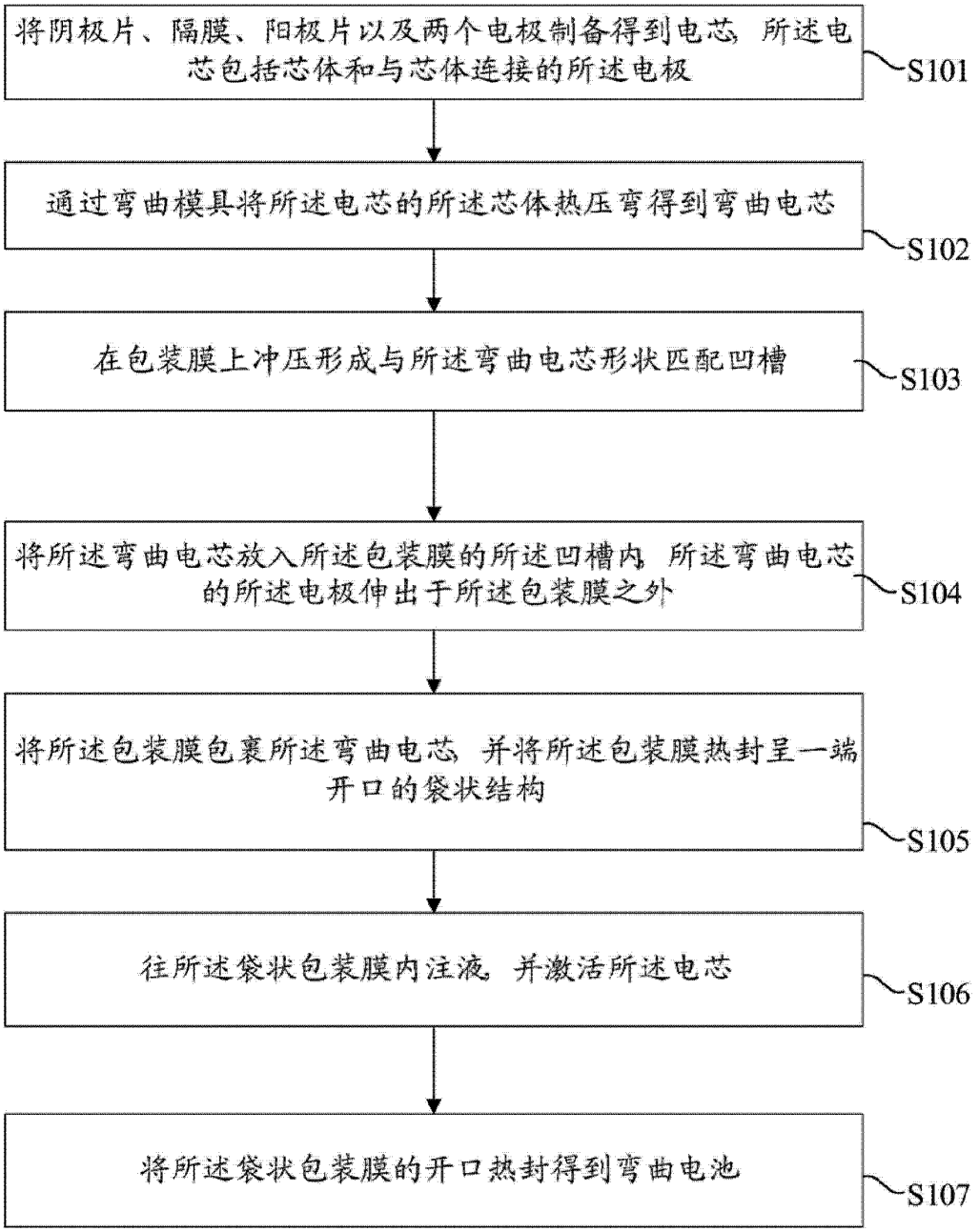


图 1

Petitioner Samsung Ex-1004, 1007

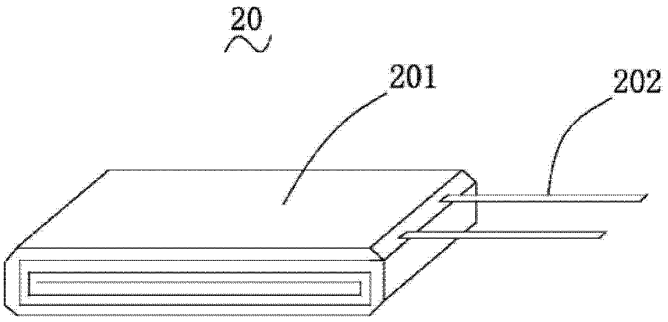


图 2

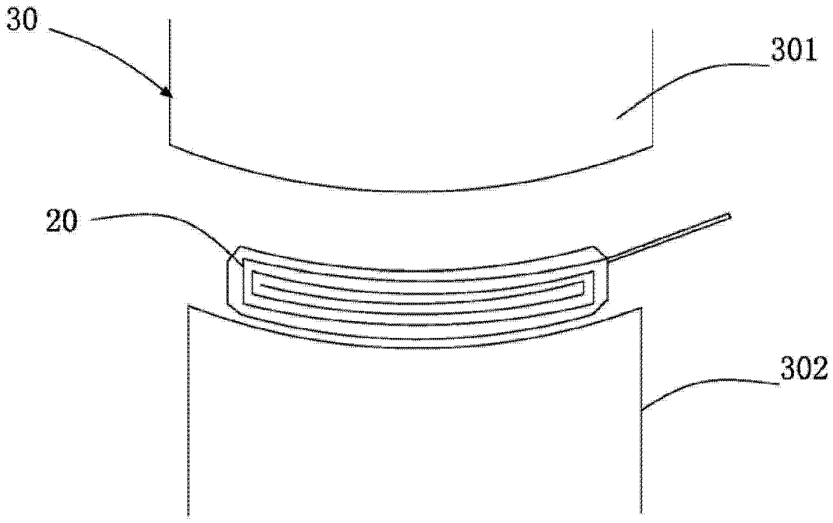


图 3

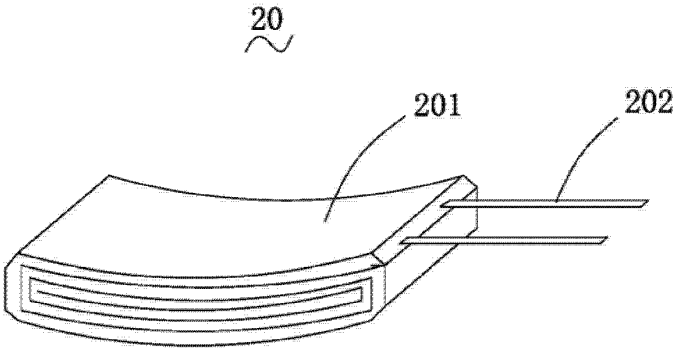


图 4

Petitioner Samsung Ex-1004, 1008

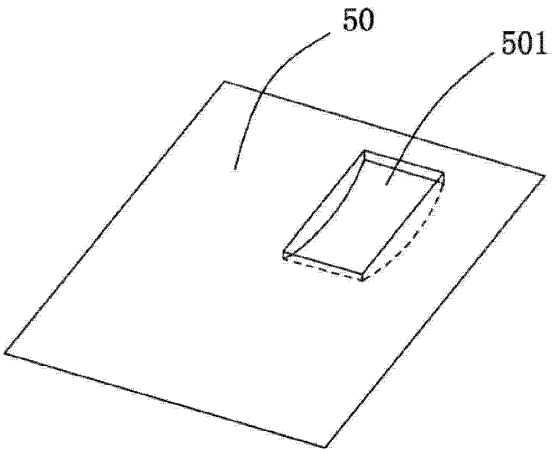


图 5

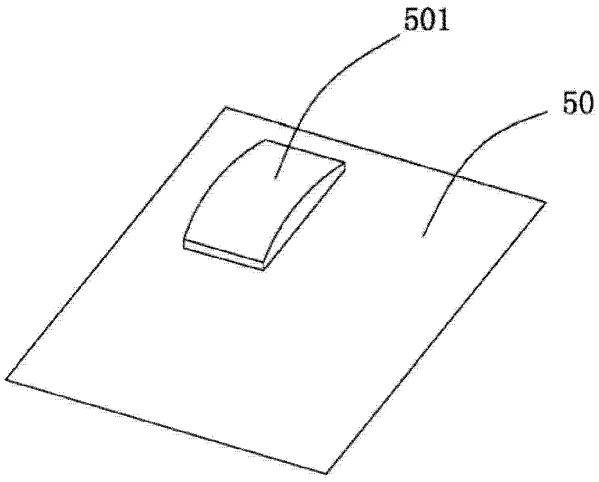


图 6

Petitioner Samsung Ex-1004, 1009

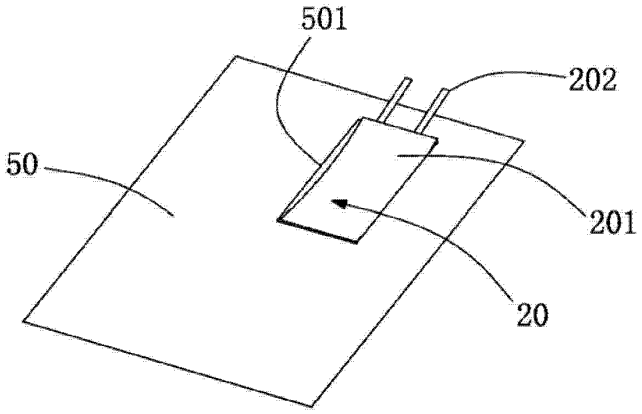


图 7

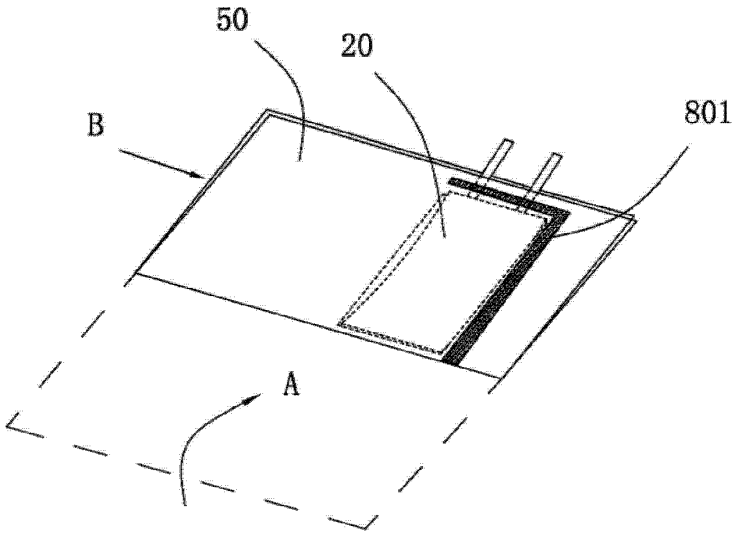


图 8

Petitioner Samsung Ex-1004, 1010

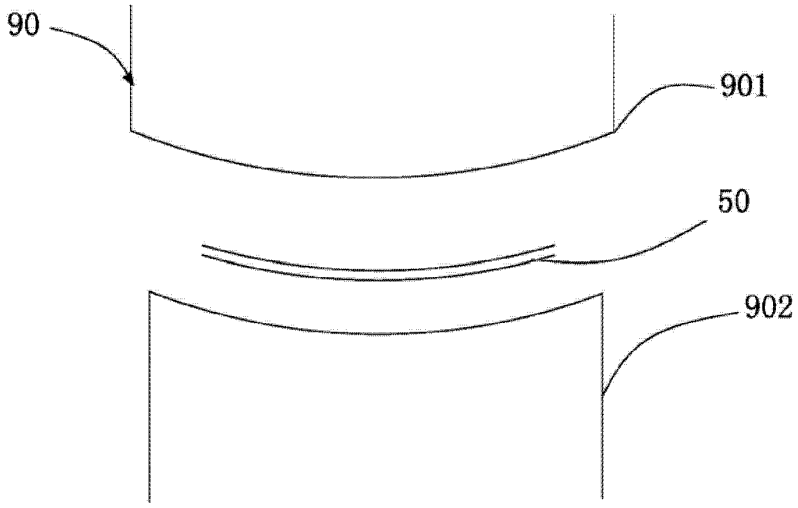


图 9

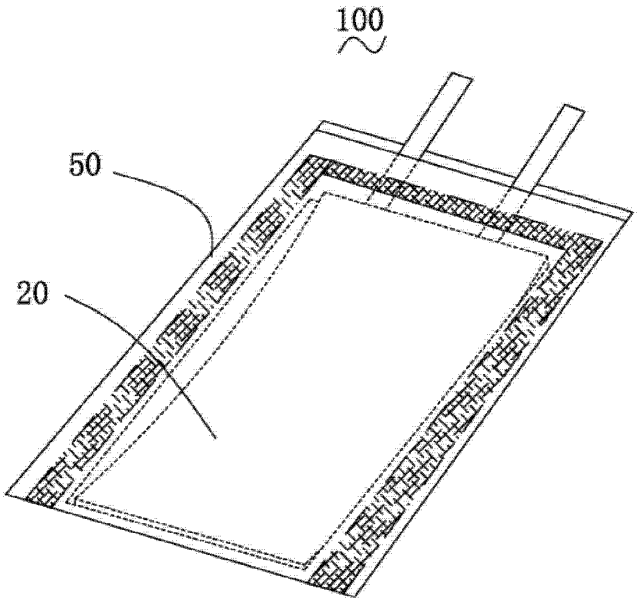


图 10

Petitioner Samsung Ex-1004, 1011

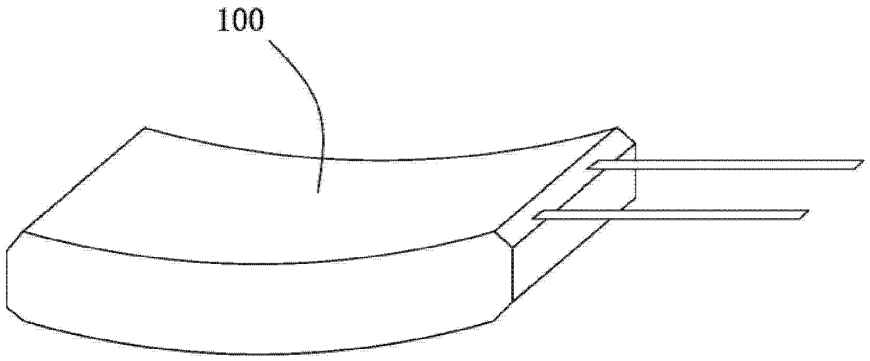


图 11

Petitioner Samsung Ex-1004, 1012

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
18/323,385	05/24/2023		832	PM001.01.03.01.01.01.01.0	18	1

CONFIRMATION NO. 7585

179918
Holland & Hart LLP/Oura Health Oy
P.O. Box 11583
Salt Lake City, UT 84147

FILING RECEIPT

OC000000059812307

Date Mailed: 07/27/2023

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Curt C. von Badinski, Valencia, CA;
Michael J. Strasser, San Francisco, CA;
Peter Twiss, Lakewood, CA;

Applicant(s)

Ouraring Inc., San Francisco, CA;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 18/179,272 03/06/2023
which is a CON of 17/519,201 11/04/2021 PAT 11,599,147
which is a CON of 17/013,348 09/04/2020 PAT 11,188,124
which is a CON of 16/224,686 12/18/2018 PAT 10,768,666
which is a DIV of 15/444,217 02/27/2017 PAT 10,156,867
which is a DIV of 14/556,062 11/28/2014 PAT 9,582,034
which claims benefit of 62/006,835 06/02/2014
and claims benefit of 61/910,201 11/29/2013

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Petitioner Samsung Ex-1004, 1013

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 06/13/2023

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 18/323,385**

Projected Publication Date: PEAR

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

WEARABLE COMPUTING DEVICE

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

Petitioner Samsung Ex-1004, 1014

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor

Petitioner Samsung Ex-1004, 1015

community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

Petitioner Samsung Ex-1004, 1016

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 18/323,385

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	64		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	280		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	320		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	18 minus 20 =	* 0	x =	0	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*	x =	0			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			168			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	832		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

Petitioner Samsung Ex-1004, 1017

UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
18/323,385	05/24/2023	Curt C. von Badinski	PM001.01.03.01.01.01.01.0

CONFIRMATION NO. 7585

179918
Holland & Hart LLP/Oura Health Oy
P.O. Box 11583
Salt Lake City, UT 84147

FORMALITIES LETTER

OC000000059812310

Date Mailed: 07/27/2023

NOTICE OF INCOMPLETE REPLY (NONPROVISIONAL)

Filing Date Granted

The U.S. Patent and Trademark Office received your reply on 07/19/2023 to the NOTICE TO FILE CORRECTED APPLICATION PAPERS (Notice) mailed 06/15/2023 and it has been entered into the application. The reply, however, is not a complete reply because all of the items required by the NOTICE TO FILE CORRECTED APPLICATION PAPERS have not been received. See "Items Required to Avoid Abandonment" section below. A complete reply must be timely filed to prevent ABANDONMENT of the above-identified application.

The period for reply continues to run from the date of the NOTICE TO FILE CORRECTED APPLICATION PAPERS mailed 06/15/2023. Applicant must submit all required items and pay any fees required below within two months from the date of the NOTICE TO FILE CORRECTED APPLICATION PAPERS to avoid abandonment. If the reply is submitted after two months from the date of the NOTICE TO FILE CORRECTED APPLICATION PAPERS, extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a). See "Time Period for Reply" section below.

Items Required to Avoid Abandonment:

The required items noted below SHOULD be filed along with any items required above.

The application is informal since it does not comply with the regulations for the reason(s) indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- A substitute specification was submitted on 07/19/2023; however, the substitute specification was not accompanied by a statement that the substitute specification includes no new matter (see 37 CFR 1.125(b)). A statement that the substitute specification filed 07/19/2023 includes no new matter is required.

Time Period for Reply:

Petitioner Samsung Ex-1004, 1018

Mail date of Notice: 06/15/2023

Last date that extension may be obtained: (Note: The petition and fee must be received by this date, or include a proper certificate of mailing under 37 CFR 1.8 with a date on or before this date, and extend the time to include this date.) 01/16/2024

The following table sets forth the possible extensions of time available, depending on when the reply and corresponding extension of time fee are received.

Length of Extension of Time	Fee under 37 CFR 1.17(a) effective March 19, 2013		
(response due on or before)	Undiscounted	Small Entity	Micro Entity
One Month (09/15/2023)	$220	$88	$44
Two Months (10/16/2023)	$640	$256	$128
Three Months (11/15/2023)	$1480	$592	$296
Four Months (12/15/2023)	$2320	$928	$464
Five Months (01/16/2024)	$3160	$1264	$632

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be addressed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

REPLY VIA ELECTRONIC FILING

A reply may be submitted via electronic filing only by registered users of the appropriate USPTO patent electronic filing system and must include:

- A separate document having the document description, "**Applicant response to Pre-Exam Formalities Notice**"; and
- the item(s) for which a reply period is set forth above.

For more information about electronic filing, contact the Patent Electronic Business Center (EBC) 1-866-217-9197 or visit https://www.uspto.gov/ebc

NOTE: If the reply is not being submitted electronically, a copy of this notice must be included.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/cnguyen/

Petitioner Samsung Ex-1004, 1019

UNITED STATES
PATENT AND TRADEMARK OFFICE

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Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/323,385	**08/10/2023 06:14:33 PM ET**	**PM001.01.03.01.01.01.01.0**

Title of Invention

WEARABLE COMPUTING DEVICE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	7585	FILED BY	Jamie LaFleur
PATENT CENTER #	62598646	FILING DATE	05/24/2023
CUSTOMER #	179918	FIRST NAMED INVENTOR	Mr. Curt C. von Badinski
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Nathan Mutter

Documents

TOTAL DOCUMENTS: 4

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
18323385_RespNoticeIncompleteReply.pdf		139	-	586 KB
18323385_RespNoticeIncompleteReply-PEFR.pdf	(1-2)	2	Applicant Response to Pre-Exam Formalities Notice	89 KB
18323385_RespNoticeIncompleteReply-SPEC.pdf	(3-70)	68	Specification	329 KB
18323385_RespNoticeIncompleteReply-SPEC.pdf	(71-138)	68	Specification	329 KB
18323385_RespNoticeIncompleteReply-ABST.pdf	(139-139)	1	Abstract	158 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
18323385_RespNoticeIncompleteReply.pdf	2D0404E9E4D505893A25E6BA6918E92A03B8129392144A2F271D8D069A8C0B58D4FEAE80A680D2DA6281A16732426EBE2FFE60FE9247AC6CB56CA10094940D82
18323385_RespNoticeIncompleteReply-PEFR.pdf	A6B36F8B636A728138AE67A8C59834AD4771591232FEA33D62090267FA14D2819998A6B00C51607AF82B561800646C6DA01B861BFE029621ACC98790BA95498C
18323385_RespNoticeIncompleteReply-SPEC.pdf	B25C74DC38071EE0290CDBAB06B680F239F32374E6FAD209A01826728A0E0DA12700069C7B6346E0FF2740C943A416925A4926B76A71B53B8E0FEDDFDFD66510
18323385_RespNoticeIncompleteReply-SPEC.pdf	096149623C13D520C78E03CD6A6E10C237D0E29C56A4B73188A781488CF3AAAAB1563F6AB85DA454F8F614D0E1849D0F08612ABAB04A049633D8884356540CDF
18323385_RespNoticeIncompleteReply-ABST.pdf	87153955AF3B59CB84AFDDCB6BA913BBD38CB7F1228E2C0A2B717266B11B72EBA85C0881CE0B243E23D4C00168ACAB6CA93493EB12B78C5EC39BDFC7A4141FEF

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Confirmation No.: 7585
von Badinski	Examiner: TBD
For: WEARABLE COMPUTING DEVICE	Art Unit: TBD
Application No.: 18/323,385	**RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS AND NOTICE OF INCOMPLETE REPLY**
Filed: May 24, 2023	**CERTIFICATE OF TRANSMISSION** I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office on: August 10, 2023.
Docket No.: PM001.01.03.01.01.01.01.02	By: / Jamie LaFleur / Jamie LaFleur
Customer No.: 179918	

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

In the Notice to File Corrected Application Papers ("Notice") dated June 15, 2023, and the Notice of Incomplete Reply it was noted that there were inconsistencies between the as-filed drawings and the drawings listed in the Brief Description of the Drawings section of the as-filed application. Attached herewith is a replacement specification that includes a revised Brief Description of the Drawings section to address these inconsistencies. It is also noted that an abstract was not included. Attached herewith is the abstract of the technical disclosure. No new matter has been added.

The Commissioner is authorized to charge any fees or underpayments that may be due with this response, or credit any overpayments, to Deposit Account No. 08-2623.

If the Examiner believes a telephone conference would expedite prosecution of this

Petitioner Samsung Ex-1004, 1022

Application, please call the undersigned at 303-473-2700.

Respectfully submitted,

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Petitioner Samsung Ex-1004, 1023

WEARABLE COMPUTING DEVICE

CROSS REFERENCE

[0001] The present Application for Patent is a Continuation of U.S. Patent Application No. 18/179,272, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed March 6, 2023, which is a Continuation of U.S. Patent Application No. 17/519,201, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed November 4, 2021, which is a Continuation of U.S. Patent Application No. 17/013,348, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed September 4, 2020, which is a Continuation of U.S. Patent Application No. 16/224,686, by von Badinski et al, entitled "WEARABLE COMPUTING DEVICE," filed December 18, 2018, which is a Division of U.S. Patent Application No. 15/444,217, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed February 27, 2017, which is a Division of U.S. Patent Application No. 14/556,062, by von Badinski et al, entitled "WEARABLE COMPUTING DEVICE," filed November 28, 2014, which claims the benefit of United States Provisional Application Serial No. 62/006,835, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed June 2, 2014, and United States Provisional Application Serial No. 61/910,201, by von Badinski et al., entitled "FINGER RING DEVICE FOR ACTIVITY MONITORING OR GESTURAL INPUT," filed November 29, 2013, each of which is expressly incorporated by reference herein.

FIELD OF TECHNOLOGY

[0002] This invention is in the field of wearable electronic devices.

BACKGROUND

[0003] Wearable electronics are an emerging technology with many applications for the wearer. They can improve lifestyles, ease access to technology and help monitor activity within the wearer's body. However, many current wearable electronics are bulky and can be intrusive or interfere with a person's daily life. In this regard, the wearer may not be comfortable wearing the device for extended periods of time.

Petitioner Samsung Ex-1004, 1024

SUMMARY OF THE INVENTION

[0004] This invention overcomes the disadvantages of the prior art by providing a wearable computing device (WCD) in the shape of a ring. The wearable computing device can be worn for extended periods of time and can take many measurements and perform various functions because of its form factor and position on the finger of a user.

[0005] One aspect of the disclosure provides a wearable computing device, comprising: an interior wall; an exterior wall; a flexible printed circuit board disposed between the interior wall and the exterior wall; at least one component disposed on the flexible printed circuit board; and wherein at least one of the interior wall and the exterior wall defines a window that facilitates at least one of data transmission, battery recharge, and status indication.

[0006] In one example, the window comprises an internal window defined by the interior wall.

[0007] In one example, the window comprises an exterior window defined by the exterior wall.

[0008] In one example, the window comprises a plurality of exterior windows defined by the exterior wall.

[0009] In one example, the plurality of exterior windows comprises a first exterior window and a second exterior window, wherein the first exterior window facilities battery charging and the second exterior window facilities data transmission.

[0010] In one example, at least one concentrated photovoltaic cell, an antenna, and at least one LED are accessible via the window.

[0011] Another aspect of the disclosure provides a wearable computing device, comprising: an internal housing portion configured to be disposed near a finger of a user; a flexible printed circuit board arranged around a portion of a circumference of an interior surface of the internal housing; at least one component disposed on the flexible printed circuit board; and an external housing portion configured to seal the at least one component and the printed circuit board in an internal space defined by the interior surface of the internal housing.

Petitioner Samsung Ex-1004, 1025

[0012] In one example, the external housing portion comprises a substantially transparent external potting.

[0013] In one example, the at least one component comprises at least one LED configured to emit at least one of visible light, infrared radiation, and ultraviolet radiation through the external potting.

[0014] In one example, the at least one component comprises a concentrated photovoltaic cell configured to receive concentrated light through the transparent external potting.

[0015] In one example, the flexible printed circuit board includes a plurality of stiffener elements configured to engage with a corresponding plurality of flanges disposed on the internal housing portion.

[0016] Another aspect of the disclosure provides a wearable computing device, comprising: an external housing portion; a flexible printed circuit board arranged around a portion of a circumference of an interior surface of the external housing; at least one component disposed on the flexible printed circuit board; and an internal housing portion configured to seal the at least one component and the printed circuit board in an internal space defined by the interior surface of the external housing.

[0017] In one example, the internal housing portion comprises a substantially transparent internal potting.

[0018] In one example, the at least one component comprises at least one LED configured to emit at least one of visible light, infrared radiation, and ultraviolet radiation through the internal potting.

[0019] In one example, the at least one component comprises a concentrated photovoltaic cell configured to receive concentrated light through the transparent internal potting.

[0020] In one example, the flexible printed circuit board includes a plurality of stiffener elements configured to engage with a corresponding plurality of flanges disposed on the external housing portion.

[0021] Another aspect of the disclosure provides a system, comprising: a wearable computing device, including a housing and a photovoltaic element disposed at least

Petitioner Samsung Ex-1004, 1026

partially within the housing; and a base assembly, the base assembly including a concentrated light source directed at the photovoltaic element.

[0022] In one example, the wearable computing device includes at least one ferrous element disposed within the housing, and wherein the base assembly includes at least one magnetic element disposed therein.

[0023] In one example, the concentrated light source is arranged circumferentially around the wearable computing device when the wearable computing device is engaged with the base assembly.

[0024] In one example, the concentrated light source comprises at least one of a laser diode and a light emitting diode (LED).

[0025] In one example, a housing of the WCD defines an opening through which the WCD is configured to receive concentrated light.

[0026] In one example, the base assembly comprises an optical element for focusing concentrated light emitted from the concentrated light source.

[0027] In one example, the optical element comprises a lens and is selected from the group consisting of concave, convex, piano-concave, piano-convex.

[0028] In one example, the WCD comprises at least one transparent potting configured to allow concentrated light to pass therethrough.

[0029] In one example, the WCD is ring-shaped and the base assembly comprises at least one post configured to engaged with a finger space of the WCD.

[0030] In one example, the photovoltaic cell comprises a plurality of photovoltaic cells.

[0031] Another aspect of the disclosure provides an enclosure for a wearable computing device, the enclosure comprising: a base defining a receptacle for receiving the wearable computing; a lid configured to engage with the base to substantially enclose the wearable computing device, the lid having an optical element configured to direct incident electromagnetic radiation to photovoltaic cell disposed on the wearable computing device to allow charging thereof.

Petitioner Samsung Ex-1004, 1027

[0032] In one example, the lid includes a plurality of vent holes that prevent overheating within the enclosure.

[0033] In one example, the optical element comprises a lens.

[0034] In one example, the lens has a focal length and wherein a distance between a central portion of the lens and the photovoltaic cell is greater than or less than the focal length.

[0035] Another aspect of the disclosure provides a timepiece system, comprising: a timepiece having a substantially planar under surface; and a timepiece computing device adhered to the planar under surface, the timepiece computing device being substantially cylindrical and comprising: a processor; a memory; and at least one sensor.

[0036] Another aspect of the disclosure provides a wearable computing device system, comprising: a wearable computing device; an attachment frame coupled to the wearable computing device; and an optical element removably coupled to the attachment frame, wherein the optical element is configured to direct electromagnetic radiation to a photovoltaic cell disposed on a surface of the wearable computing device to allow for charging of the wearable computing device.

[0037] In one example, the attachment frame is removably coupled to the wearable computing device.

[0038] In one example, the attachment frame engages with an inward-facing surface of the wearable computing device.

[0039] Another aspect of the disclosure provides a method of identifying an authorized user of a wearable computing device, comprising: illuminating a portion of a skin surface of the user; imaging the portion of the skin surface of the user to generate at least one first image; generating a reference capillary map corresponding to the user based at least in part on the at least one image.

[0040] In one example, the method further includes rotating the wearable computing device during the illuminating and imaging steps.

[0041] In one example, the method further includes imaging the portion of the skin surface of the user to generate at least one second image; and comparing the at least one second image to the reference capillary map in order to authenticate the user.

Petitioner Samsung Ex-1004, 1028

[0042] Another aspect of the disclosure provides a method of navigating, comprising: gesturing in a first direction while wearing a wearable computing device; comparing the first direction to a predetermined direction in a predetermined set of directions; providing feedback based on the comparison of the first direction of the predetermined direction.

[0043] In one example, the gesture comprises pointing a finger and the first direction comprises a first heading.

[0044] Another aspect of the disclosure provides a method of regulating temperature, comprising: measuring a skin temperature of a user via a first temperature sensor; measuring an ambient temperature via a second temperature sensor; comparing the skin temperature to a predetermined threshold temperature; and adjusting the ambient temperature based in part on the comparison.

[0045] In one example, measuring the skin temperature comprises measuring the skin temperature via a first temperature sensor disposed at an inward facing surface of a wearable computing device.

[0046] In one example, measuring the ambient temperature comprises measuring the ambient temperature via a second temperature sensor disposed at an outward facing surface of the wearable computing device.

[0047] Another aspect of the disclosure provides a method for controlling appliances, comprising: identifying a position of a first appliance in a room; gesturing a first gesture in a direction of the first appliance; identifying the direction of the first direction via a wearable computing device; issuing a controlling command to the first appliance based in part on the identified direction of the gesture.

[0048] Another aspect of the disclosure provides a method of generating an alert, comprising: authenticating a first wearer of a first wearable computing device as a first authenticated user; transmitting first biometric data associated with the first wearer; associating the first biometric data with a first profile associated with the first wearer of the first wearable computing device; comparing the first biometric data with a group profile comprising aggregated biometric data from a plurality of distinct wearers of a plurality of distinct wearable computing devices; and generating an alert if the first

Petitioner Samsung Ex-1004, 1029

biometric data falls outside of a predetermined threshold set by the aggregated biometric data.

[0049] In one example, the biometric data comprises at least one of heart rate; ECG profile; blood sugar, and blood pressure.

[0050] In one example, the plurality of distinct wearers share a common trait, resulting in their aggregation into the group profile.

[0051] In one example, the common trait comprises at least one of: age, gender, profession, and location.

[0052] Another aspect of the disclosure provides a method of determine a sampling rate of a wearable computing device, comprising: determining an activity level of a wearer of a wearable computing device based at least in part on data from at least one sensor disposed onboard the wearable computing device; comparing the activity level to a predetermined activity threshold; and increasing a first sensor sampling rate if the activity level is above a predetermined activity threshold.

[0053] In one example, the method further includes decreasing the first sensor sampling rate if the activity level is below a predetermined activity threshold.

[0054] In one example, the predetermined activity threshold comprises an acceleration measurement.

BRIEF DESCRIPTION OF THE DRAWINGS

[0055] The invention description below refers to the accompanying drawings, of which:

[0056] FIG. 1A is a perspective view of a WCD illustrating an exterior window in accordance with some embodiments;

[0057] FIG. 1B is a perspective view of the WCD of FIG. IA illustrating an interior window in accordance with some embodiments;

[0058] FIG. 1C is a perspective view of an alternative WCD design of the ring of FIG. IA in accordance with some embodiments;

Petitioner Samsung Ex-1004, 1030

[0059] FIG. 2 is an abstract functional diagram illustrating example components within the WCD in accordance with some embodiments;

[0060] FIG. 3A is a view of an exterior window of a WCD with example components exposed in accordance with some embodiments;

[0061] FIG. 3B is a view of an interior window of a WCD with example components exposed in accordance with some embodiments;

[0062] FIG. 3C is a view of the exterior windows of an alternative WCD with example components exposed in accordance with some embodiments;

[0063] FIG. 4 is an exploded view of a WCD illustrating a battery and a flexible circuit which are configured to fit inside the housing of the WCD in accordance with some embodiments;

[0064] FIG. 5 is a perspective view of the flexible circuit of FIG. 4 in accordance with some embodiments;

[0065] FIG. 6 is an exploded view of a WCD with an alternative charging mechanism in accordance with some embodiments;

[0066] FIG. 7 is a perspective view of an alternative design of a WCD in accordance with some embodiments;

[0067] FIG. 8 is an exploded view of the WCD of FIG. 7 illustrating another alternative charging mechanism in accordance with some embodiments;

[0068] FIG. 9A is a perspective view of a charging device for the ring station in accordance with some embodiments;

[0069] FIG. 9B is an abstract diagram illustrating a partial structure of the charging station of FIG. 9A in accordance with some embodiments;

[0070] FIG. 10 is an example screenshot illustrating a user interface of a mobile application coupled to the WCD and displaying fitness monitoring readings in accordance with some embodiments;

Petitioner Samsung Ex-1004, 1031

[0071] FIG. 11 is an example screenshot illustrating a user interface of a mobile application coupled to the WCD and displaying sensor readings (e.g., for calibration purposes) in accordance with some embodiments;

[0072] FIG. 12A is a perspective view of a wearable computing device (WCD) according to one or more aspects of the disclosure;

[0073] FIG. 12B is a side view of a WCD according to one or more aspects of the disclosure;

[0074] FIG. 12C is a front view of the WCD according to one or more aspects of the disclosure;

[0075] FIG. 12D is a cross section of the WCD along the line A-A of FIG. 12C;

[0076] FIG. 12E is a perspective view of the internal housing without external potting;

[0077] FIG. 12F is a perspective view of the internal housing with a portion of the external potting removed and showing one or more components and printed circuit board (PCB);

[0078] FIG. 13 is a cross section of a WCD according to another aspect of the disclosure;

[0079] FIG. 14A is a cross section of a WCD according to another aspect of the disclosure;

[0080] FIG. 14B is a perspective view of the PCB and stiffener element of FIG. 14A;

[0081] FIG. 14C is a perspective view of the PCB and stiffener element of FIG. 14A;

[0082] FIG. 14D shows a cross section of the WCD at a point in time when the PCB is being inserted into the internal space and prior to the application of potting;

[0083] FIG. 14E is a cross section of the WCD of after a potting material has been applied subsequent to the WCD of FIG. 14D;

Petitioner Samsung Ex-1004, 1032

[0084] FIG. 15A depicts a perspective view of a WCD according to another aspect of the disclosure;

[0085] FIG. 15B is a side view of the WCD of FIG. 15A;

~~**[0086] FIG. 15C is an exploded view of the WCD;**~~

[0087] **[0086]** FIG. 16A is an exploded view of a housing and a PCB of a WCD according to one or more aspects of the disclosure;

[0088] **[0087]** FIG. 16B is a cross section of FIG. 16A along line B-B;

[0089] **[0088]** FIG. 16C is a perspective view of the WCD with potting material;

[0090] **[0089]** FIG. 17A depicts a cross section of a WCD employing charging by concentrated light source according to one or more aspects of the disclosure;

[0091] **[0090]** FIG. 17B depicts a cross section of a WCD employing charging by concentrated light source according to another aspect of the disclosure;

[0092] **[0091]** FIG. 17C is a perspective view of a base assembly and WCD 700 according to one or more aspects of the disclosure;

[0093] **[0092]** FIG. 17D depicts a perspective view of internal components of the base assembly 750 and WCD 700 according to another aspect of the disclosure;

[0094] **[0093]** FIGs. 17E-F depict other CPV configurations according to one or more aspects of the disclosure;

[0095] **[0094]** FIG. 17G is perspective view of a WCD and base assembly with a lx3 CPV arrangement;

[0096] **[0095]** FIG. 18A depicts a cross section of a WCD 800 employing charging by concentrated light source according to another of the disclosure;

[0097] **[0096]** FIG. 18B depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure;

[0098] **[0097]** FIG. 19A depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure;

Petitioner Samsung Ex-1004, 1033

[0099] **[0098]** FIG. 19B depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure;

[0100] **[0099]** FIG. 19C depicts a schematic diagram of magnets that can be used in a WCD and/or base assembly according to one or more aspects of the disclosure;

[0101] **[0100]** FIG. 19D depicts a schematic diagram of magnets that can be used in a WCD and/or base assembly according to one or more aspects of the disclosure;

[0102] **[0101]** FIG. 19E is a perspective view of a WCD and a base assembly according to one or more aspects of the disclosure;

[0103] **[0102]** FIG. 20A is a cross section of a WCD engaged with a base assembly 1050 according to one or more aspects of the disclosure;

[0104] **[0103]** FIG. 20B is a perspective view of a PCB 1040b with a CPV 1030b and ferrous element 1020b configuration according to one or more aspects of the disclosure;

[0105] **[0104]** FIG. 20C is a perspective view of a PCB with a CPV 1030c and ferrous element 1020c configuration according to one or more aspects of the disclosure;

[0106] **[0105]** FIG. 20D is a perspective view of a magnet and a concentrated light source 1070d according to one or more aspects of the disclosure;

[0107] **[0106]** FIG. 21A is a schematic view of a WCD showing components used for identifying the wearer of the WCD;

[0108] **[0107]** FIGs. 21B-C are perspective views of a skin surface according to one or more aspects of the disclosure;

[0109] **[0108]** FIG. 22A is a perspective view of a user employing ECG monitoring according to one or more aspects of the disclosure;

[0110] **[0109]** FIG. 22B is a view of a human with an electric pathway though his body according to one or more aspects of the disclosure;

[0111] **[0110]** FIG. 22C is a perspective view of a WCD that can employ ECG monitoring according to one aspect of the disclosure;

Petitioner Samsung Ex-1004, 1034

[0112] **[0111]** FIG. 23A is a perspective view of the hand of a user in various positions employing the navigational features of the WCD;

[0113] **[0112]** FIG. 23B is a flow chart depicting a method of providing feedback to a user according to one or more aspects of the disclosure;

[0114] **[0113]** FIG. 24A is a schematic diagram of a system 1400 for controlling an environment of a user according to one or more aspects of the disclosure;

[0115] **[0114]** FIG. 24B is a side view of a WCD showing one or more temperatures sensors according to one or more aspects of the disclosure;

[0116] **[0115]** FIG. 24C is a system diagram of a system for controlling home appliances according to one or more aspects of the disclosure;

[0117] **[0116]** FIG. 24D is a flow chart depicting a method of controlling home appliances according to one or more aspects of the disclosure;

[0118] **[0117]** FIG. 25 is a perspective view of the hand of a user employing a two-factor authentication technique according to one or more aspects of the disclosure;

[0119] **[0118]** FIG. 26A is a schematic view of a charging apparatus for charging the WCD according to one or more aspects of the disclosure;

[0120] **[0119]** FIG. 26B shows a WCD including an RF antenna and charging circuitry;

[0121] **[0120]** FIG. 26C is a block diagram of the charging apparatus according to one aspect of the disclosure;

[0121] **FIG. 26D is a pictorial diagram showing of the WCD according to one or more aspects of the disclosure;**

[0122] FIG. 27A is a pictorial diagram and FIG. 27B is a block diagram of a WCD employing flash storage according to one or more aspects of the disclosure;

[0123] FIG. 28A is a schematic diagram of one or more WCDs performing proximity functions according to one or more aspects of the disclosure;

[0124] FIG. 28B is a schematic diagram of one or more WCDs performing proximity functions according to one or more aspects of the disclosure;

Petitioner Samsung Ex-1004, 1035

[0125] FIG. 29A is a flow chart depicting a method of initiating gesture input according to one or more aspects of the disclosure;

[0126] FIG. 29B is a chart showing acceleration vs. time as measured by the accelerometer of the WCD;

[0127] FIG. 30 is a perspective view of a WCD 2000 employing a reset function;

[0128] FIG. 31A is a perspective view of a WCD including an LED indicator according to one or more aspects of the disclosure;

[0129] FIGs. 31B and 31C are cross sections along line C-C of a WCD employing an LED indicator according to one or more aspects of the disclosure;

[0130] FIG. 32 is flow chart depicting a method of communicating with a near field communication (NFC) device according to one or more aspects of the disclosure;

[0131] FIG. 33A depicts a perspective view of a WCD assembly according to one or more aspects of the disclosure;

[0132] FIGs. 33B-D depict exploded views of the WCD assembly of FIG. 33A;

[0133] FIG. 33E depicts a cross sectional view of the WCD assembly along A-A;

[0134] FIGs. 34A-B depict a WCD assembly according to one or more aspects of the disclosure;

[0135] FIG. 35A depicts an enclosure or case for storing a WCD according to one or more aspects of the disclosure;

[0136] FIG. 35B is a cross sectional view of the assembled enclosure of FIG. 35A along the line B-B;

[0137] FIG. 35C depicts a cross sectional view of the assembled enclosure of FIG. 35B along line A-A;

[0138] FIG. 36 depicts an enclosure including air vents according to one or more aspects of the disclosure;

[0139] FIG. 37 depicts a method of sizing a finger according to one or more aspects of the disclosure;

Petitioner Samsung Ex-1004, 1036

[0140] FIG. 38 is a pictorial diagram showing a plurality of image perspectives of a user's hand;

[0141] FIG. 39 depicts a sizing tool for sizing the finger of a user;

[0142] FIG. 40 depicts a sizing tool for sizing the finger of a user according to an alternate example;

[0143] FIG. 41 depicts yet another alternate example of a sizing tool for sizing the finger of a user;

[0144] FIG. 42 depicts a method of monitoring activity according to one or more aspects of the disclosure;

[0145] FIG. 43 depicts a method of determining whether a user is wearing gloves according to one or more aspects of the disclosure;

[0146] FIG. 44 depicts a method of securing data onboard the WCD according to one or more aspects of the disclosure;

[0147] FIG. 45A is a timepiece system according to one or more aspects of the disclosure;

[0148] FIG 45B is a bottom view of the TCD;

[0149] FIG. 46 depicts a WCD with a pair of LED indicators disposed at an inward-facing portion of the WCD;

[0150] FIG. 47A is a system for generating and managing alerts according to one or more aspects of the disclosure;

[0151] FIG. 47B depicts a block process diagram for generating and managing alerts according to one or more aspects of the disclosure;

[0152] FIG. 47C is a flow chart depicting a method for generating and managing alerts according to one or more aspects of the disclosure;

[0153] FIG. 48A is a method for variable sampling according to one or more aspects of the disclosure; FIG. 48B and 48c are graphs depicting one or more aspects of the sample method of FIG. 48A; and

Petitioner Samsung Ex-1004, 1037

[0154] FIG. 49 is a diagrammatic representation of a machine in the example form of a computer system within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed.

DETAILED DESCRIPTION

[0155] The present disclosure describes a wearable computing device (WCD) that enables a wearable fitness monitor(s)/computer(s) which is suitable for prolonged usage with accurate results. The WCD can be in the form of a ring that can be worn on the finger of a human (or animal) user. Although the WCD of the present disclosure is depicted as a ring that can be worn on the finger of a user, other shapes, designs, and form factors can be utilized for the WCD. For example, the WCD can be in the form of a wrist band, bracelet, necklace, earring, or any other type of wearable accessory. In this regard, references to the finger of a user in the present application can be considered to apply to other portions of a human body depending on the form of the WCD, such as wrist, neck, ear, etc.

[0156] The term "coupled" as used herein means connected directly to or connected through one or more intervening components or circuits. Any of the signals provided over various buses described herein may be time-multiplexed with other signals and provided over one or more common buses. Additionally, the interconnection between circuit elements or software blocks may be shown as buses or as single signal lines. Each of the buses may alternatively be a single signal line, and each of the single signal lines may alternatively be buses, and a single line or bus might represent any one or more of a myriad of physical or logical mechanisms for communication (e.g., a network) between components. The present embodiments are not to be construed as limited to specific examples described herein but rather to include within their scope all embodiments defined by the appended claims.

[0157] FIG. 1A is a perspective view of 100 of a WCD 110 illustrating an exterior window 120 in accordance with some embodiments, and FIG. 1B is a perspective view 102 of the WCD 110 of FIG. 1A illustrating an interior window 130.

[0158] As previously mentioned, it is recognized in the present disclosure that conventional wearable fitness monitors such as clip-on devices, wristbands, or watch-type monitors still often suffer from inaccuracy mainly because they lack constant and

Petitioner Samsung Ex-1004, 1038

consistent ways to read from the body areas they aim to monitor. It can also be an extra burden for the person to remember and wear such conventional fitness monitors each time the person perform exercises in order to create an accurate history tracking the exercise activities.

[0159] Accordingly, the present embodiments of the WCD 110 can function as fitness monitors/computer which is suitable for prolonged usage so as to create accurate results. In addition or as an alternative to fitness monitoring, as will be discussed in more detail below, the WCD 110 can function as a remote input device through, for example, gesture recognition. In some embodiments, the WCD 110 can further function as a sleep monitor, a heart rate sensor, a cardiac monitor a body temperature detector, or the like. It is noted that, for those embodiments which can function as a cardiac monitor (e.g., that measures electrocardiogram (EKG)), it may be necessary to establish a closed loop (e.g., for the electrical measurement of EKG) across the heart. As such, in some of those embodiments, a separate conductive pad can be coupled to the WCD 110 so that a user can pinch the pad with fingers on an opposite hand,

[0160] Specifically, in some embodiments of the present disclosure, the WCD 110 can be worn by the user (e.g., on a finger) for fitness, physical activity, biological data monitoring as well as for gestural input or other suitable purposes. As shown in FIGS. 1A and 1B, the WCD 110 can include the exterior window 120 on its exterior wall for input/output data transmission and reception, battery recharge, or status indication. The WCD 110 can also include the interior window 130 on its interior wall for various monitoring or sensing activities. The form factor of the WCD 110 allows it to be worn for prolonged hours with constant and consistent contact with the skin area, thereby creating a more reliable and extended recording (e.g., as compared to aforementioned conventional fitness monitors) of the user's fitness activity, physical exercise, as well as health information such as heart rates and body temperature. More implementation details regarding the WCD 110 are discussed below.

[0161] FIG. 1C is a perspective view of an alternative design of the WCD 110 of FIG. IA in accordance with some embodiments. As shown in FIG. IC, the WCD 112 includes a second exterior window 124 in addition to a first exterior window 122. The two exterior windows 122 and 124 can include spacing between the two windows 122 and 124 so that the mechanical strength of the housing structure of the WCD 112 may

Petitioner Samsung Ex-1004, 1039

be stronger than that of the WCD 110, which is shown to include one single exterior window 120. Further, in some embodiments, radio antennas (e.g., Bluetooth) or other sensitive circuitry can be positioned in the second exterior window 124 away from the first exterior window 122 so that quality of reception may be improved.

[0162] FIG. 2 is an abstract functional diagram 200 illustrating example components within the WCD (e.g., WCD 110) in accordance with some embodiments. As shown in diagram 200, the WCD 110 can include a processor module 210, a plurality of sensor modules 220, a status indicator module 230, a power generation and management module 240, a communication module 250, a memory 260, and miscellaneous modules 270 (e.g., a real-time clock (RTC) crystal oscillator as illustrated in FIG. 2). The WCD 110 can also include a battery 280 module that provides electrical power for the WCD 110. In some embodiments, the battery 280 can be of a lithium-polymer type or a zinc-polymer type. It is noted that modules illustrated in diagram 200 are for purposes of facilitating a better understanding of the present embodiments; other suitable modules may be included in the WCD 110 and are not shown for simplicity. As used herein, the term "components" is considered to generally include any of the modules depicted and/or described in FIG. 2, as well as any other modules described herein.

[0163] It is noted that the aforementioned modules are intended for purposes of enabling the present embodiments, rather than limiting. As such, a person of ordinary skill in the art will understand that the present disclosure covers apparent alternatives, modifications, and equivalents (e.g., combining or separating the modules) made to the techniques described herein. For example, in some embodiments, a portion of the communication module 250 (e.g., the Bluetooth Chip as shown in FIG. 2) can be combined into the processor module 210. For another example, one or more modules herein can be combined into one to form a system-on-the-chip (SOC).

[0164] The processor module 210 can have generic characteristics similar to general purpose processors or may be application specific integrated circuitry that provides arithmetic and control functions to the WCD 110. The processor can be any type of processor, such as a processor manufactured by AMtel, Freescale, Nordic Semiconductor, Intel®, AMD®, or an ARM® type processor. The processor module 210 can include a dedicated cache memory (not shown for simplicity). The processor

Petitioner Samsung Ex-1004, 1040

module 210 is coupled to all modules 220-270 in the WCD 110, either directly or indirectly, for data and control signal transmission.

[0165] The memory 260 may include any suitable type of storage device including, for example, ROM, such as Mask ROM, PROM, EPROM, EEPROM; NVRAM, such as Flash memory; Early stage NVRAM, such as nvSRAM, FeRAM, MRAM, or PRAM, or any other type, such as, CBRAM, SONOS, RRAM, Racetrack memory, NRAM, Millipede memory, or FJG. Other types of data memory can be employed as such are available in the form factor desired.

[0166] In addition to storing instructions which can be executed by the processor module 210, the memory 260 can also store data generated from the processor module 210. It is noted that the memory 260 can be an abstract representation of a generic storage environment. According to some embodiments, the memory 260 may be comprised of one or more actual memory chips or modules. In some embodiments, the memory 260 can function as a temporary storage (e.g., for firmware updates, and/or for avoiding accidental malfunctions (such as so-called "bricking")).

[0167] In accordance with one or more embodiments, the sensor modules 220 can include various sub-modules for the WCD 110 to perform different monitoring or sensing activities. A view 302 of the interior window (e.g., window 130) of a WCD (e.g., WCD 110) with example components exposed is shown in FIG. 3B. As shown in the example of FIG. 3B, the sensor modules 220 can include a temperature sensor 320a, a red light emitting diode (LED) 320b, a light sensor 320c, and an infra-red LED 320d. Among the sensors in the sensor modules 220, those sensors (e.g., sensors 320a-320d) which are directly related to biological sign monitoring can be configured and positioned in a way that is close to the skin (e.g., facing the interior window 130 of the WCD 110). Although not shown in FIG. 3B for simplicity, the sensor modules 220 can further include sensors that are not directly related to biological sign monitoring; some examples of these sensors include accelerometers, gyroscopes, vibration, sensors (e.g., a magnetometer or a digital compass), or other suitable sensors (e.g., for gesture recognition). The magnetometer can measure the strength and/or direction of a prevailing magnetic field. In this regard, the magnetometer can be used during global positioning and/or navigation. In particular, the magnetometer can be used to measure a directional heading when the WCD is in motion and can supplement position data

Petitioner Samsung Ex-1004, 1041

where the WCD is out of communication range. In one or more embodiments, the accelerometers in the sensor modules 220 can detect movements in multiple (e.g., 3) dimensions or axes. The accelerometer can measure force of acceleration of the WCD and can measure gestures performed by a user while wearing the WCD. In other examples, the accelerometer can detect acceleration of the user while wearing the WCD. This can permit tracking of activity level, such as steps taken or number of laps swum in a pool.

[0168] The temperature sensor can be any type of sensor that detects temperature, such as a thermistor, PTC, NTC, etc. In another example, the temperature sensor can use IR light emitted from an object to calculate a surface temperature of the object in a manner clear to those of ordinary skill in the art.

[0169] Together, the processor module 210 and the sensor modules 220 can enable the WCD 110 to perform multiple functions including, for example, pedometer, sleep monitor (e.g., which monitors sleep quality), heart rate sensor, pulse oximetry, skin (and in select embodiments, ambient) temperature. In addition, some embodiments of the WCD 110 can further function as a gesture input device. In particular, the present embodiments recognize that the WCD 110 can detect finger motions or gestures which may be difficult for conventional fitness sensors to detect, such as a tap, a snap, a knock on the table, and the like. In some embodiments, the WCD 110 can utilize the accelerometer to measure the activity level (e.g., arm movement) in conjunction with the measured heart rate to determine if the user is walking horizontally, running, swimming, or climbing stairs. Other activities can be identified by the WCD 110 may include biking or sleeping.

[0170] In some embodiments, the WCD 110 can also be programmed to learn particular gestures or physical exercise from the user using, for example, a training mode. For example, the user can instruct (e.g., using a computer or a mobile device of the user) the WCD 110 to enter the training mode and perform the gesture or physical exercise; the WCD 110 can record the readings from the sensor modules 220, recognize patterns therefrom, and store the result in, for example the memory 260, so that such gesture or exercise can be recognized by the WCD 110 after the training. The WCD 110 can be configured (e.g., via a mobile application running on a mobile device of the user) so that the recognized gestures can perform functions designated by the user, such as

Petitioner Samsung Ex-1004, 1042

clicks, swipes, unlocks, or media player controls. In one embodiment, the WCD 110 can include near field communication (NFC) chips so that certain functions (e.g., unlocking a smart phone) can be performed when the WCD 110 touches upon or otherwise be detected by another NFC device. In some embodiments, the unlocking function of the WCD 110 can also unlock a user device (e.g., a phone) via the communication module 250 (e.g., Bluetooth) by the WCD 110 transmitting a proper unlock code.

[0171] Moreover, the WCD 110 can function as a key or a control device for keyless access to home, automobile, or other suitable user authentication processes. The WCD 110 can also be integrated with games and game consoles so that it can function as an input device to those games and consoles. In some embodiments, the WCD 110 can be adapted for use in medical and home health monitoring, or as a transportation safety device (e.g., that broadcasts emergency messages to relevant authorities). Additional examples of sensors/functionalities of the WCD 110 can include an inertial measurement unit (IMU) (e.g., for more complex gesture recognition, a near-infrared (NIR) spectrometer (e.g., for measuring light absorption and deriving blood glucose/ blood alcohol/ CO2 content), a Galvanic skin response sensor (e.g., for measuring sweat/ nervousness), an electrocardiogram (ECG or EKG), and so forth.

[0172] In some embodiments, the processor module 210 can determine (e.g., based on identified physical activities, routine pattern, and/or time) a frequency at which one or more sensors in the sensor modules 220 should operate. Because it is recognized in the present disclosure that the heart rate of a human being typically does not vary too widely (e.g., beyond a certain percentage of what has been previously measured), in some embodiments, the WCD 110 can automatically adjust the sensor modules 220 (e.g., to slow down) so as to save power. More specifically, some embodiments of the WCD 110 can include a phase-locked loop or logic to predict the pulse width by determining lower and upper ranges in which the heart rate is predicted to be, thus only powering up the sensor modules 220 at the time of the predicted heartbeats. For one example, if the WCD 110 determines that the user is at sleep (e.g., based on the heart rate, the body temperature, together with the movements detected by the accelerometer and/or the vibration detector), the WCD 110 can slow down its heart rate detection frequency (e.g., from 1 measurement per second to 1 measurement per 10 seconds) and skip the measurement of several heartbeats because it is unlikely that the heart rate will

Petitioner Samsung Ex-1004, 1043

change drastically during that period. Conversely, if the WCD 110 determines that the user is performing a high intensity physical exercise, the WCD 110 can increase the frequency of monitoring and recording of the sensor modules 220.

[0173] In accordance with one or more embodiments, the WCD 110 also includes various modules coupled to the processor module 210 for, by way of example but not limitation, input/output data transmission, battery recharge, or status indication. A view 300 of the exterior window (e.g., window 120) of a WCD (e.g., WCD 110) with example components exposed is shown in FIG. 3A. As shown in the example of FIG. 3A, the modules configured to face the exterior window 120 of the WCD 110 can include parts from the status indicator module 230, the power generation and management module 240, and the communication module 250.

[0174] Specifically, one embodiment of the WCD 110 includes the status indicator module 230 coupled to the processor module 210 to indicate various statuses. In some embodiments, the status indicator module 230 includes a light emitting diode (LED) 330, such as shown in FIG. 3A. The LED 330 can be a single red/green/blue (RGB) LED. In other embodiments, the status indicator module 230 can include other suitable types of indicator devices including, for example, a single color LED, an electrophoretic ink (or "e-ink") display, a persistent display, or the like. In accordance with some embodiments, the WCD 110 can utilize the indicator module 230 (e.g., via the RGB LED 330 through the exterior window 120) to visually communicate with the user. For example, a red color can be displayed (e.g., for a predetermined period of time) by the LED 330 that the WCD 110 needs to be recharged, and a green color can be displayed to indicate that the WCD 110 is fully charged. For another example, a blue color can be displayed when the communication module 250 is in use. In one or more embodiments, the user can program a fitness goal (e.g., a target heart rate) to the WCD 110 so that, for example, a green color can be displayed when the heart rate is below the target, a yellow color can be displayed when the target is reached, and a red color can be displayed when the heart rate is above a certain percentage of the set target. Some embodiments of the WCD 110 include the communication module 250 for wireless data transmission. Particularly, in some embodiments, the communication module 250 includes one Bluetooth chip and a Bluetooth antenna 350, such as shown in FIG. 3A. One or more embodiments of the WCD 110 also provides the capability of storing activity logs (e.g.,

Petitioner Samsung Ex-1004, 1044

in the memory 260). More specifically, fitness activities, exercise histories, as well as recorded biological signs such as heart rate and body temperature, can be stored onboard in the memory 260 of the WCD 110. Each data entry in the activity logs can be time- stamped using, for example, an onboard real-time clock (e.g., which may be included in miscellaneous modules 270). For power saving and other purposes, the activity log can be downloaded (e.g., via the communication module 250) when requested by the user. In other embodiments, the activity log can be pushed (e.g., via email or other suitable means) by the WCD 110 to a user device at a time designated by the user. In some embodiments, the memory 260 can store up to a full week worth of activity logs.

[0175] The WCD 110 can include the power generation and management module 240 for recharging the battery 280 and for providing electrical power to various modules 210-270 in the WCD 110. Particularly, in some embodiments, the power generation and management module 240 includes one or more concentrated photovoltaic (CPV) cells 340, such as shown in FIG. 3A. The CPV cells 340 can be high-efficiency tandem solar cells and can be attached on the flexible printed circuit (e.g., circuit 415,515). Because the small form factor of the embodiments of the WCD 110, CPV cells 340, which can absorb more light energy from a wider spectrum of light than the traditional solar cells, are used. In some embodiments, multiple (e.g., 3) CPV cells 340 can be configured in series to provide sufficient voltage and/or current for charging the battery 280.

[0176] According to some embodiments, the WCD can include one or more sensing or imaging devices that can be any type of device capable of detecting electromagnetic radiation, such as visible light, IR, NIR, UV, etc. In one example, the device is an imaging device, such as a CMOS or CCD camera.

[0177] According to some embodiments, the WCD 110 can be placed or docked into a charging station for recharging. A perspective view 900 of an example charging station 910 for the WCD 110 is shown in FIG. 9A. The charging station 910 can have concentrated light source circumferentially around the WCD 110 so that the user does not have to be concerned with whether the WCD 110 is facing the right direction for charging. Some embodiments of the charging station 910 can include a light distribution means that takes a single light source and distributes the light all around. An abstract

Petitioner Samsung Ex-1004, 1045

diagram illustrating a partial structure of the light distribution means inside the charging device of FIG. 9A is shown in FIG. 9B. It is noted that, even with the charging station 910, for some embodiments, regular outdoor sunlight or other ambient light source can still function as a secondary source of energy so that the CPV cells 340 on the WCD 110 can extend the operational time provided by the battery 280.

[0178] Additionally or alternatively, energy source attached to the power generation and management module 240 can be passive; for example, some embodiments provides that a clip with a concentrator lens can be attached to the WCD 110 in a way such that the power generation and management module 240 can charge the battery 280 using natural sunlight. In an alternative embodiment, gemstone(s) (e.g., sapphire, diamond, or other suitable materials) in the shape of a dome or with faceted protrusion can be configured to concentrate/magnify light energy while also serving as a decorative feature.

[0179] In some alternative embodiments, the power generation and management module 240 can include electromagnetic induction charging coil so that a WCD (e.g., ring 610) can be charged using an inductive charger. FIG. 6 shows an exploded view 600 of such alternative embodiment of WCD with the inductive charging mechanism including the charging coil 640, as well as battery 680, housing 612, and rigid-flex PCBA 615. However, it is noted that there may be a need to manufacture the inductive charging coil 640 in different sizes that correspond to different ring sizes. Further, it is noted that the efficiency of the electromagnetic induction charging mechanism may be adversely affected by the adoption of a metallic housing. Additionally or alternatively, to avoid multiple sized coils mounted to the edge of the ring, the coil can be placed on the inner or outer sides of the ring by positioning the coil beneath a window in the metal housing of the ring.

[0180] In order to achieve optimal power management of the WCD, one or more of the components can be selected to minimize power usage. For example, a processor, memory, or any other component can be selected based on rated power usage. In one example, it may be desirable to select components that draw current on the order of microamps in order to extend the battery life of the WCD and to allow the WCD to perform health/activity monitoring functions between charging sessions.

Petitioner Samsung Ex-1004, 1046

[0181] In still some other alternative embodiments, the power generation and management module 240 can include thermoelectric generator (TEG) modules so that a WCD (e.g., WCD 710,810) can be charged by the difference between the body temperature and the ambient temperature. FIG. 7 is a perspective view 700 of such alternative design, and FIG. 8 is an exploded view 800 of the WCD 710 of FIG. 7. Also shown in FIGS. 7 and 8 is an alternative design of the housing for the WCD where the ring includes an outer ring 812a, an inner ring 812b, and insulators 814a and 814b. However, it is noted that utilizing TEGs for charging the battery may be less than ideal since the difference between body temperature and ambient temperature might not be great enough to fully charge the battery, and that in many occasions (e.g., during sleep), the temperature difference needed for TEG to generate electricity may quickly disappear (e.g., since the WCD 710, 810 may be covered inside the comforter).

[0182] The battery can be any type of battery, such as a rechargeable battery. The battery can be a thin, flexible lithium ceramic chemistry battery. In another example, the battery can be a circular formed lithium polymer or lithium ion battery. The battery can provide power to any of the components described above. In one example, the battery can be a lithium cell integrated directly with the flexible PCB described above. Other implementations can integrated the battery directly onto the housing to reduce the volume of space taken up by battery packaging.

[0183] The WCD can also include one or more polymer or piezo actuators for providing appropriate haptic or physical feedback and alerts to a user while the user is wearing the ring. The piezo actuator can also provide audible feedback to a user.

[0184] As previously mentioned, the WCD 110 can be used with a software application (e.g., a mobile phone application for the Apple iOS or the Google Android OS) which can run on the user's computing device (e.g., a mobile device such as a smart phone). Specifically, the software application can facilitate the mobile device of the user to couple to the WCD 110 (e.g., via the communication module 250) for data communication, such as downloading activity logs, changing configuration and preferences, training the WCD. The software application can also generate a user interface showing the results or readings from the health and fitness tracking performed by the WCD 110. FIG. 10 is an example screenshot illustrating such user interface 1000 displaying fitness monitoring readings in accordance with some embodiments.

Petitioner Samsung Ex-1004, 1047

[0185] Further, the WCD 110 can be used for gesture input, and the software application can facilitate the user to customize gesture input and control. FIG. 11 is an example screenshot illustrating such user interface 1100 displaying sensor readings (e.g., for calibration purposes) in accordance with some embodiments. In one or more embodiments, the WCD 110 can also be used directly with other Bluetooth enabled devices such as electronic locks or keyless car entry. In other examples, the WCD 110 can also control other devices via a smartphone and other Wireless LAN enabled devices such as home automation systems.

[0186] FIG. 3C is a view 304 of two exterior windows of an alternative WCD (e.g., WCD 112 of FIG. 3C) with example components exposed in accordance with some embodiments. The components 330, 340, and 350 shown in FIG. 3C function similarly to those components described in FIG. 3A. However, some components (e.g., antenna 350) can be positioned to face a different exterior window than the exterior window the rest of the components face. This may increase the mechanical strength of the housing structure of the ring, and/or may reduce signal interference among the components.

[0187] FIG. 4 is an exploded view 400 showing an exemplary WCD 410 (e.g., WCD 110) illustrating a battery 480 and a flexible circuit 415 which are configured to fit inside a housing 412 of the WCD 410. It is recognized by the present disclosure that a human being's finger can come in various different sizes and so should the WCD 410. In order to reduce the cost of manufacturing different sizes of printed circuits, in some embodiments, the modules 210-270 (of FIG. 2) are formed on a flexible or rigid-flex printed circuit (FPC) board, an example 500 of which is shown as FPC 515 in FIG. 5. In particular, one or more embodiments provide that the FPC 515 and the battery 480 are not specific to a ring size, and that the same circuitry and/or battery can fit a multitude of sizes.

[0188] According to some embodiments, the WCD 410 provides a desirable form factor for a user to wear it for a prolonged period of time. The edges and the shape of the WCD 410 can be configured in a way that is comfortable and ergonomic; for example, the finished parts of the embodiments are to be free from burrs and sharp edges. The material which forms the housing portion of the WCD 410 can include medical grade metallic alloys that reduce the likelihood of allergic reactions. Examples

Petitioner Samsung Ex-1004, 1048

of the housing material include stainless steel, tungsten carbide, titanium alloy, silver, platinum or gold.

[0189] In the examples shown in FIG. 4, the U-shape of the ring housing 412 allows for the flexible PCB 415 to be inserted into the edge of the WCD 410. The windows (e.g., windows 120, 130) on the walls of the WCD 410 can align with the operating circuitry to allow, for example, battery charging, Bluetooth connection, and user feedback LED/micro display on the outer wall, and biological feedback sensors (e.g., pulse oximetry, temperature sensor) on the inner wall. In one or more embodiments, the WCD 410 can be completely sealed using potting epoxy. The sealing epoxy can be transparent to allow light to pass through for the CPVs and sensors. In some embodiments, the WCD 410 can be potted with two different compounds. In these embodiments, the body of the WCD 410 can be filled with clear material, and the edge of the WCD 410 can be filled with an opaque material so that different colors can be incorporated (e.g., as a decorative element). It is noted that sealing the assembly using potting epoxy can also bring the additional benefit of making the WCD 410 completely or almost completely waterproof as well as increasing the structural rigidity of the WCD 410.

[0190] **I. Internal Housing/External Potting**

[0191] FIG. 12A is a perspective view and FIG. 12B is a side view of a WCD 1200 according to one or more aspects of the disclosure. The WCD 1200 can be in the shape of a ring and can be worn on any of the five fingers (including the thumb) of (typically) a human user. In this regard, the WCD 1200 can define an interior diameter d1 and exterior diameter d2. The interior diameter d1 can be defined as the distance between opposing points on the interior surface of the ring, with the interior surface being the portion of the WCD facing the finger of a user while the device is worn by the user. The interior surface of the WCD can generally define a finger space for receiving the finger of the user. The exterior diameter d2 can be defined as the diameter between opposing points on the exterior surface of the ring, with the exterior surface being the portion of the WCD opposed to the interior surface and facing away from the finger of the user.

[0192] The interior diameter d1 and exterior diameter d2 can be any size to accommodate any finger size. In one example, d2 is determined by d1 plus a thickness

Petitioner Samsung Ex-1004, 1049

of any components and/or flexible circuit boards disposed within the WCD. Additionally, although depicted as being circular, the finger space of the WCD 1200 can be any shape, such as ovular, elliptical, or the like, to accommodate users with atypical finger profiles. In these examples, the dimensions of the interior and/or exterior diameter may be measured according to other variables, such as length, width, major diameter, minor diameter, etc. By way of non-limiting example, the WCD interior diameter d1 (the diameter generally defining the ring size) can be in an approximate range of 12mm to 24mm so as to accommodate finger sizes ranging from a small child to a larger adult, and on any acceptable finger, including the thumb. The exterior diameter d2 can also be any reasonable size or shape, and can define an approximate range of between 18mm and 30mm. Likewise, the thickness between diameters d1 and d2 can vary widely, but can typically reside in an approximate range of 1.5mm to 3 mm. The width WR of the WCD along the direction of finger extension (finger longitudinal direction) is widely variable, and can be selected, in part to accommodate internal and external components. In a non-limiting example, the width WR is in a range of approximately 3mm to 8mm.

[0193] The WCD 1200 can include an overall housing 1210 that includes an internal housing 1212 and an external potting or encapsulant 1214. Together, the internal housing 1212 and external potting 1214 combine to form the overall form factor of the WCD 1200, in addition to providing a housing for one or more electronic components stored within the housing 1210 of the WCD 1200, as will be described in greater detail below.

[0194] The internal housing 1212 can be formed of any material, such as a nonconductive material, a conductive material, a ferrous material and/or a nonferrous metal, composite material (e.g. carbon-fiber and/or glass fiber composite) a dielectric material, or a combination of any of the above. In one example, the material of the inner housing 1212 is conductive and nonferrous, such as aluminum, titanium, or stainless steel. In other examples, the internal housing can be formed of a polymer, such as plastic. The external potting 1214 can be formed of any material, solid or gelatinous, that can provide resistance to shock and/or vibration and can prevent moisture and/or debris from entering the housing 1210 of the WCD 1200, such as silicone, epoxy, polyester resin or any other polymer.

Petitioner Samsung Ex-1004, 1050

[0195] In one example, the external potting 1214 can be transparent. In this regard, the transparent external potting can allow electromagnetic radiation, such as visible, IR, or UV light sources from inside the housing 1210 to pass through the external potting 1214 without the need of a window or discontinuity in the external potting 1214 and without changing the optical properties of the radiation. In the same vein, electromagnetic radiation sources, such as visible, IR, or UV light, external to the housing can pass through the external potting 1214 and can be detected by, sensed by, or fall incident upon internal components of the WCD 1200 without the need for a window or discontinuity in the housing and without changing the optical properties of the radiation. In another example, the external potting 1214 can be tinted. The tint can be cosmetic and can prevent the internal components of the WCD to be visible by the user. In this regard, depending on the tint, optical properties of light passing therethough may be slightly changed. For example, certain colors of the light can be filtered and can result in decreased power transmission. The above description regarding external potting 1214 can be applied to any of the pottings described below.

[0196] The internal housing 1212 can define a window 1216. In one example, the internal housing is formed of a material that completely or partially prevents light (or other electromagnetic radiation) from passing through the internal housing 1212. In this regard, the internal housing 1212 can define the window 1216 to allow for such radiation to pass through the housing 1212. As shown, the window 1216 can be generally elliptical-shaped, but can be any other suitable shape according to other examples, such as rectangular, circular, ovular, etc. Since the window 116 is defined by the internal housing 1212, the window 1216 can face the finger of the user while the user is wearing the WCD 1200, which can provide many advantageous features and implementations, as will be described in greater detail below.

[0197] FIG. 12C is a front view of the WCD and FIG. 12D is a cross section of the WCD 1200 along the line A-A of FIG. 12C. As shown, the internal housing 1212 can have a generally U-shaped internal surface 1212a to accommodate one or more internal components and can define a pair of flanges 1212b and 1212c. The external potting 1214 can extend between the flanges 1212b and 1212c of the internal housing to provide an internal space 1220 to accommodate one or more components. By virtue of the external potting 1214, the internal space 1220 defined by the internal surface 1212a

Petitioner Samsung Ex-1004, 1051

and the external potting 1214 can be hermetically sealed, thereby preventing debris, dust, moisture, or any other unwanted fluids or materials from interacting with the internal components of the WCD 1200. Although not depicted, the internal components can reside within the internal space 1220, and the external potting 1214 can be disposed immediately atop the components to provide the seal.

[0198] FIG. 12E is a perspective view of the internal housing 1212 without external potting 1214. As shown, the internal surface 1212a defines a generally U- shaped surface for receiving the components.

[0199] FIG. 12F is a perspective view of the internal housing 1212 with a portion of the external potting 1214 removed and showing one or more components 1230 and printed circuit board (PCB) 1240. The components and PCB can be constructed as flex circuits, thereby allowing the components 1230 and PCB 1240 to be geometrically configured within the ring shaped internal space 1220. The PCB 1240 can be any type of flexible material clear to those of skill, such as polyimide, PEEK, etc. Additionally, the PCB could be rigid-flex whereby panels of RF4 are connected together with a flexible substrate.

[0200] As shown, the PCB 1240 and the components 1230 can be disposed within the internal space 1220 generally defined by the internal surface 1220a and the flanges 1220b-c. The PCB 1240 can define one or more folding regions 1242 that allow the PCB 1240 to conform to the circumference and/or perimeter of the internal surface 1212a. The PCB 1240 can extend around at least a portion, or up to an entire circumference, of the internal surface 1212a. In one example, the size of the internal diameter d1 of the WCD can determine the portion of the internal surface 1212a around which the PCB 1240 extends. Illustratively, for a larger ring size and a larger internal diameter d1, the PCB 1240 can extend only a portion (an arc) of the overall circumference, while for smaller ring sizes a greater portion (arc) of the circumference can be employed to accommodate PCB 1240 and the internal components 1230. The adjacent portions of PCB can form an arc angle therebetween by virtue of the folding regions disposed therebetween, allowing for the PCB to be conform to the internal surface 1212a.

[0201] **II. External Housing/Internal Potting**

Petitioner Samsung Ex-1004, 1052

[0202] FIG. 13 is a cross section of a WCD 1300 according to another aspect of the disclosure and illustrative embodiments. In this example, the WCD 1300 includes a housing 1310 that includes an external housing 1312 and an internal potting or encapsulant 1314. The external housing 1312 includes an internal surface 1312a that has a generally C-shaped cross section-but alternate cross section shapes, such shapes with an external notch or groove. The external housing includes flanges 1312b-c that extend toward each other, beyond portions of the internal surface 1312a, to define a partially enclosed internal space 1320. In an assembled state, the WCD 1300 can include a battery 1330, a PCB 1340, and components 1350, which can be at least partially or completely disposed within the partially enclosed internal space 1320. The internal potting 1314 can extend between the flanges 1312b-c and can seal the partially enclosed internal space 1320. The components can be encapsulated by the internal potting 1314. The PCB 1340 and components 1350 can extend along an inner circumference of the internal surface 1312a.

[0203] Illustratively, the external housing 1312 can be formed of the same materials as the internal housing 1212 described above, and the internal potting 1314 can be formed of the same materials as the external potting 1214 described above. As also described above, the internal potting 1314 can be transparent and the external housing 1312 can define one or more windows according to one or more aspects of the disclosure.

[0204] FIG. 14A is a cross section of a WCD according to another aspect of the disclosure and illustrative embodiment. In this example, the WCD 1400 includes a housing 1410,internal surface 1412a, an internal or external housing 1412, an internal or external potting 1414, an internal space 1420, a battery 1430, a flexible circuit 1440, and one or more components 1450. This example is similar to the examples described above with respect to FIGs. 12 and 13, except the addition of a stiffener element 1442 and the flanges 1412b-c extend further into the space 1420 toward one another such that the flanges 1412b-c overlap with the stiffener element 1442.

[0205] FIG. 14B is a perspective view of the PCB and stiffener element of FIG. 14A. As shown in FIG. 14B, the stiffener element 1442 extends beyond an overall width w of the PCB 1440 and extends wider than a distance between flanges 1412b-c. The stiffener element is disposed between folding regions 1444. The PCB 1440 can

Petitioner Samsung Ex-1004, 1053

include one or more stiffener elements 1442 attached thereto, and the elements 1442 can be disposed periodically (in separated intervals) along a length l of the PCB 1440. As shown in FIG. 14C, the stiffener element 1442 can be disposed underneath the flexible circuit 1440, e.g., on a face of the flexible circuit 1440 opposed to the face on which the components 1450 are disposed, and can be permanently or semi-permanently attached thereto. The stiffener element can be implemented in any of the configurations described, and in particular, with either the internal housing/external potting arrangement or the external housing/internal potting arrangement.

[0206] The stiffener element 1442 can be formed of any material, such as polyamide or thin FR4, depending on construction of the PCB 1440. In particular, the material of the stiffener can be chosen to be more or less flexible than the PCB 1440. In one example, the stiffener element 1442 can be a polyamide stiffener disposed on a back surface of a flexible PCB. In another example, the stiffener element 1442 can be FR4 and can be substantially flush with respect to the flanges 1412b-c. In this regard, the stiffener element can extend substantially the distance between flanges 1412b-c and may not deform upon insertion into the space 1420. The stiffener element can include surface features disposed on an edge thereof, with the edge facing one of the flanges 1412b-c. The surface features can include a sawtooth profile (e.g., intersecting straight lines at acute angles), or any other type of feature capable of providing an interference fit between flanges 1412b-c.

[0207] FIG. 14D shows a cross section of the WCD at a point in time during assembly/manufacture when the PCB 1440 is being inserted into the internal space 1420 and prior to the application of potting 1414. As shown, the stiffener 1442 contacts the flanges 1412b-c of the housing 1410 by virtue of the width w of the stiffener element 1442. Upon an application of force, the PCB 1440 and stiffener 1442 assembly can be inserted into the internal space 1420. In this regard, the stiffener element has a predetermined flexibility that allows for a certain amount of flexion, as shown in FIG. 14D. The flexion allows for the flexible circuit 1440 to be inserted within the internal space 1420 and can prevent the flexible circuit 1440 from being removed or from accidentally falling out once inserted. In this regard, the flexible circuit 1440 is held in place within the space 1420 by virtue of the width of the stiffener element 1442 and the

Petitioner Samsung Ex-1004, 1054

distance between the flanges 1412b-c. Once inserted, the potting 1414 can be applied free of the concern of improper positioning of the flexible circuit 1440.

[0208] FIG. 14E is a cross section of the WCD of after a potting material 1414 has been applied subsequent to the WCD of FIG. 14D.

[0209] **III. Inner/outer bands**

[0210] FIG. 15A depicts a perspective view of a WCD 1500 according to another aspect of the disclosure. In this example, the WCD includes a housing 1510 that includes an internal housing 1512 and an external housing 1514. The internal housing 1512 can be similar to the internal housing described above with respect to internal housing 1212, and the external housing can be similar to the external housing described above with respect to external housing 1312. The internal housing 1512 can include one or more windows 1516 that can allow electromagnetic radiation (e.g. visible and near-visible light) to pass therethrough, allowing it to fall incident upon components disposed within the housing 1510 and allowing EM radiation sources (e.g. visible light, RF, IR, etc.) within the housing to exit the housing.

[0211] FIG.15B is an exploded view of the WCD 1500. As shown, the WCD can include internal housing and external housing 1512 and1514. The WCD can further include a PCB 1540 and components 1550. Once the housings 1512-1514 are assembled and the PCB 1540 and components 1550 are assembled within space defined between the housings 1512-414, potting layers 1502 and 1504 can be applied to seal the WCD at both sides thereof to ensure a secure seal.

[0212] **IV. Inner/outer bands with U shaped window**

[0213] FIG. 16A is an exploded view of a housing 1610 and a PCB of a WCD according to one or more aspects of the disclosure. The WCD 1600 comprises a housing 1610 with an integral inner wall and outer wall 1612 and 1614. The housing can be made of any material, such as any material described above with respect to the internal/external housing structures. In this example, the inner and outer walls 1612,1614 each define a window in the shape cutaway portions 1616. The cutaway portions are bounded on three sides by the walls 1612 and 1614 and unbounded at the other side thereof. The cutaway portions 1616 can be aligned with one another to ensure

Petitioner Samsung Ex-1004, 1055

transmission of radiation into/out of the housing 1610. The space1620 between the inner and outer walls 1612,1614 can receive a PCB 1640, battery, components, etc.

[0214] FIG.16B is a cross section ofFIG.16A along line B-B. As shown, the inner and outer walls 1612,1614 are directly connected by a floor 1618. The space 1620 is defined by the space between the inner and outer walls 1612,1614 and the floor 1618.

[0215] FIG.16C is a perspective view of the WCD with potting material 1630. As described above, the PCB, battery, and components can be disposed within the space. Once disposed therein, a potting 1630 can be provided atop the components and within the cutaway portion 1616. The potting 1630 can be transparent to allow for transmission of light through the cutaway portions 1616.

[0216] **V. Charging By Concentrated Light Source**

[0217] According to one aspect of the disclosure, the WCD can be charged by an external concentrated light source, e.g., laser light, laser diode, etc. In this regard, the photovoltaic device described above can include a concentrated photovoltaic element (CPV) that is constructed and arranged to receive concentrated light from the concentrated light source, e.g., laser light from a laser diode, light from a light emitting diode (LED), etc., and converting the received concentrated light into an electric current. The photovoltaic device can also generate power from nonconcentrated light sources, such as office lighting and ambient sunlight. The electric current can be used to charge one or more batteries stored within the housing of the WCD.

[0218] FIG.17A depicts a cross section of a WCD employing charging by concentrated light source according to one or more aspects of the disclosure. In this example, the WCD 1700 can include a housing material 1710. The WCD can include a PCB 1720 and a concentrated photovoltaic cell 1730. The WCD can be positioned adjacent a base assembly or base station 1750. The base assembly 1750 can be connected to an external power source 1765 and can have internal circuitry 1760 to power one or more concentrated light sources 1770, e.g., one or more laser diodes and/or one or more LEDs, disposed within the base assembly 1750. In this example, the concentrated light source 1770 comprises one or more laser diodes.

[0219] The base assembly 1750 can define a first opening 1752 at one portion thereof to allow the concentrated light 1780 to exit the housing of the base assembly I

Petitioner Samsung Ex-1004, 1056

750. As shown in the diagram of FIG.17A, the concentrated light 1780 is generated by the concentrated light source 1770 and exits the housing of the base assembly 1750 via a first opening 1752. The concentrated light 1780 then enters into the WCD by a second opening 1712 in the housing of the WCD 1700 where it can fall upon the CPV 1730. Once the concentrated laser light falls upon the CPV 1730, the CPV 1730 can convert the incident concentrated light into a current that can be used to directly power one or more components within the WCD and/or can be used to charge one or more rechargeable batteries onboard the WCD.

[0220] The concentrated light source 1770, as described above, can be any type of light source that is arranged to generate concentrated light, such as an LED or a laser diode. The concentrated light can be any type of concentrated and/or coherent electromagnetic radiation, such as laser light and/or LED light. The concentrated light can have any desired intensity or wavelength, according to the characteristics of the CPV 1730.

[0221] In one example, the source 1770 can be a 200 mW laser diode that produces red or green laser light. This can generate approximately 80mW (or typically less) of power in the WCD where the CPV 1730 includes a plurality of groups of photovoltaics configured in series or in parallel with one another. Each group of photovoltaics can include one or more CPV cells. In another example, the CPV can include a single group of photovoltaics.

[0222] The base assembly 1750 described above can include additional components that can interact with the WCD 1700. For example, the base assembly can include one or more antennas that can communicate according to one or more wireless protocols, such as 3G, 4G, WiFi, Bluetooth®, NFC, or the like, for direct or indirect wired or wireless communication with the WCD or mobile device. In addition to the charging methods above, the base assembly can employ inductive charging techniques.

[0223] FIG.17B depicts a cross section of a WCD employing charging by concentrated light source according to another aspect of the disclosure. In this example, the concentrated light source 1770 comprises an LED. Further, the base assembly comprises an optical element 1790 positioned adjacent to the concentrated light source I 770 for focusing the LED light onto the CPV inside the WCD. The optical element 1790

Petitioner Samsung Ex-1004, 1057

can be any type of optical element, such as a lens. The lens can be formed of any material, such as glass, plastic, etc., and can be any type of lens, such as concave, convex, piano-concave, piano-convex, etc. In this example, the optical element 1790 includes a piano-concave, with the concave portion facing the concentrated light source 1770. In the example where the source 1770 is an LED, the LED emits light in many directions. The optical element 1790 can focus the emitted LED light to focus as much of the LED light as possible onto the CPV of the WCD. The optical element 1790 can be disposed at least partially or completely within the first opening 1752. In some implementations, the optical element may not be necessary due to LEDs with substantially focused light.

[0224] FIG.17C is a perspective view of a base assembly 1750 and WCD 1700 according to one or more aspects of the disclosure. As shown, the WCD 1700 is in the shape of a ring and the base assembly 1750 includes a post 1754 for receiving the ring. The post 1754 can be cylindrical and can be sized and shaped according to an internal diameter of the WCD in order for the WCD to be received on an external surface of the post. The first opening 1752 of the base assembly 1750 is formed on a portion of the post 1754 such that, when the WCD 1700 is stored on the post, the second opening 1712 can be aligned with the first opening 1752 to ensure alignment of the CPV and the concentrated light source. The base assembly can receive/transmit power and/or data via external input/output 1795, which can be a DC power input, a USB input connection or any other acceptable connection/form factor.

[0225] FIG.17D depicts a perspective view of internal components of the base assembly 1750 and WCD 1700 according to another aspect of the disclosure. In this figure, the respective housings of the base assembly and WCD have been omitted, thereby showing a plurality of concentrated light sources 1770, optical elements 1790, and a plurality of CPVs 1730 disposed on mounting substrates 1775 on a PCB. In this example, the WCD can include a plurality of CPVs and the base assembly can include a plurality of sources. This allows for a greater current to be generated during charging and for faster charging times of the WCD. The CPVs and concentrated light sources can correspondingly be disposed in a line, with a constant or variable pitch between respective elements. In this regard, the optical element can include corresponding concavities with the same pitch.

Petitioner Samsung Ex-1004, 1058

[0226] FIGs.17E-F depicts other CPV configurations according to one or more aspects of the disclosure. As shown in FIG.17E, the CPVs 1730 can be arranged in a lx4 array, while FIG.17F depicts the CPVs arranged in a 2x2 array. In addition to the examples shown in the above figures, the WCD can include any number of CPVs according to any number of geometric configurations.

[0227] FIG.17G is perspective view of a WCD and base assembly with a lx3 CPV arrangement. As shown, the WCD can include a lx3 array of CPVs and the base assembly can include a corresponding lx3 array of concentrated light sources. As indicated by the arrow, a user can then rotate the WCD on the base assembly in order to align the respective first and second openings, as well as the CPV and concentrated light sources.

[0228] FIG.18A depicts a cross section of a WCD 1800 employing charging by concentrated light source 1870 according to another aspect of the disclosure. In this example, the WCD includes an internal/external housing portion 1810 and an internal/external potting portion 1820, as described above. In this regard, the base assembly 1850 includes a first opening 1852, but is free of a second opening on the WCD. The concentrated light 1880 passes through the transparent potting portion and falls incident upon the CPV cell 1830. In this example, the source can be a laser diode.

[0229] FIG.18B depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure. In this example, the concentrated light source 1870 includes one or more LEDs and the base includes one or more optical elements 1890 for focusing the concentrated light 1880. The LEDs may be of different wavelengths to provide power to two or more junctions in the triple junction CPV cell.

[0230] FIG.19A depicts a cross section of a WCD 1900 employing charging by concentrated light source 1970 according to another of the disclosure. In this example, the WCD and/or the base assembly 1950 can employ one or more magnetic and/or ferrous materials to ensure alignment between the concentrated light source and the CPV cell. Such alignment can improve charging efficiency of the WCD.

[0231] The base assembly includes a first opening 1952 and the WCD includes a second opening 1912 to allow for concentrated light to fall incident upon the CPV 1930.

Petitioner Samsung Ex-1004, 1059

In this example, the second opening is formed on an external housing portion of the WCD. In this arrangement, the base assembly can charge the WCD from an exterior of the WCD, rather than an internal charging method as identified above.

[0232] The WCD can include a ferrous or other suitable (e.g. ferromagnetic) material 1920, such as steel, disposed within the housing 1910. In this example, the ferrous material is disposed in a space defined between an internal housing and an external housing. The ferrous material can surround the CPV.

[0233] The base assembly can include corresponding magnets 1960 that can cause an attractive force between the WCD and the base assembly into an optimal configuration for charging. The magnets can be disposed within the base assembly and can surround the concentrated light source. The magnets 1960 can be formed of a rare earth material, such as neodymium or any other acceptable material that provides a requisite magnetic field strength.

[0234] FIG.19B depicts a cross section of a WCD 1900b employing charging by concentrated light source 1980b according to another of the disclosure. The CPV 1930b of the WCD1900 is charged from an interior portion, such as by a base assembly 1950b with a post 1954b. Similarly, the WCD can include a ferrous material 1920b disposed within the housing1910b and the base assembly1950b can include a magnet 1960b.

[0235] FIG.19C depicts a schematic diagram of magnets 1920c,1960c that can be used in a WCD and/or base assembly, including a CPV 1930d and concentrated light source 1930d, according to one or more aspects of the disclosure. As shown, the magnets and/or ferrous/ferromagnetic materials can be axially polarized, with each having a respective north pole and south pole. In this regard, the WCD can have axially polarized magnets 1920c with a south pole S facing toward the base assembly, and the base assembly can have axially polarized magnets 1960c with a north pole N facing toward the WCD. The attractive force between the north and south poles can ensure alignment of the CPV 1930c of the WCD and the source 1970c base.

[0236] FIG.19D depicts a schematic diagram of magnets that can be used in a WCD and/or base assembly according to one or more aspects of the disclosure. In this example, the base assembly includes axially polarized magnet 1960d, with a north pole

Petitioner Samsung Ex-1004, 1060

N facing toward the WCD. The WCD can include ferrous steel 1920d, with an attractive force between the ferrous steel and the north pole of the base assembly magnet.

[0237] FIG.19E is a perspective view of a WCD and a base assembly according to one or more aspects of the disclosure. As shown, the WCD 1900e can be received by a post 1954e of a base assembly 1950e. The respective magnets I960e and/or ferrous materials 1920e are shown in phantom to illustrate their positioning with respect to the WCD and base assembly devices and the CPV1930e as well as the concentrated light source 1970e.

[0238] FIG. 20A is a cross section of a WCD 2000 engaged with a base assembly 2050 according to one or more aspects of the disclosure. In this example, the magnets 2060 can surround the concentrated light source 2070, and the WCD can include a ferrous steel 2020, CPV 2022, and battery 2024 disposed within an internal/external potting 2014 of the WCD. The ferrous steel 2020 can be disposed on a face of the PCB 2040 and can be encapsulated by the internal/external potting 2014. The base assembly can include one or more optical elements 2090 for focusing the concentrated light 2080.

[0239] FIG. 20B is a perspective view of a PCB 2040b with a CPV 2030b and ferrous element 2020b configuration according to one or more aspects of the disclosure. In this example, the ferrous element 2020b comprises a steel ring that can surround a CPV 2030b and can be disposed on the PCB 2040b.

[0240] FIG.20C is a perspective view of a PCB 2040c with a CPV 2030c and ferrous element 2020c configuration according to one or more aspects of the disclosure. In this example, the ferrous element 2020c comprises a plurality of rectangular bars disposed on the PCB. In this way, the ferrous element 2020c can be coated to be reflowed onto the PCB.

[0241] FIG.20D is a perspective view of a magnet 2060d and a concentrated light source 2070d according to one or more aspects of the disclosure. As shown, the magnet 2060d can include a ring that can extend around a circumference of the concentrated light source 2070d. The magnetic ring can be attracted to the ferrous steel ring and/or the rectangular ferrous steel examples set forth in 20A-C above.

[0242] In some examples, the WCD can be adapted to uniquely identify the wearer of the WCD using, for example biometric features unique to the user.

Petitioner Samsung Ex-1004, 1061

[0243] FIG.21A is a schematic view of a WCD 2100 showing components used for identifying the wearer of the WCD. As shown, the WCD2100 can include one or more infrared illumination sources 2110 and an infrared CMOS imaging device 2120. The finger 2190 can extend through the finger space of the WCD and the IR source 2110 can illuminate a portion of the skin of the finger 2190. The IR CMOS imaging device 2120 can receive light that has been reflected from the skin surface and produce an image of the skin of the finger 2190. As shown, the IR source2110 and the imaging device 2120 are positioned near the interior surface of the WCD, e.g., the surface facing the skin of the finger. The IR illumination can pass through a window provided on the interior housing or can pass through a transparent potting material.

[0244] During the imaging process, the WCD 2100 can be rotated about an axis passing through the center of the finger space and along the longitudinal direction of the finger. In this regard, the imager 2120 can capture a larger swath of the skin surface than if the WCD 2100 were held stationary with respect to the finger during the imaging process.

[0245] At the time of first use, or any time thereafter, the user can generate a reference capillary map in order to identify himself/herself as the authorized user of the WCD. As described above, the user can rotate the WCD around the finger to capture image data of an analyzed section of skin 2192 and on or more capillaries 2194 of the user currently wearing the WCD. The image data can correspond to an overall analyzed section of the skin 2196 of the wearer. The image data of the capillaries can be used to generate a reference capillary map of the wearer, which can be stored in the memory, such as flash memory or EEPROM, of the WCD.

[0246] When the same user puts the WCD on his or her finger after generation of the reference capillary map, the WCD can capture image data of the wearer's skin surface that can be compared to the reference capillary map stored in the memory. In this regard, the user need not rotate the device around the finger. Instead, the WCD can compare a subset of the gathered image data to a corresponding subset of reference capillary map. If there a match, within a predetermine error tolerance, the WCD can uniquely identify the wearer as an authorized user of the WCD and as the unique individual who generated the reference capillary map. Once authorized, the wearer can have access to certain functions, features, data, or other content that is not otherwise

Petitioner Samsung Ex-1004, 1062

available without authorization. In another example, the identification can be a step in a transaction or other type of authorization, such as an electronic payment, bank transaction, etc. If the gathered data does not match the reference capillary map, then the user may be prevented from accessing certain features on the WCD.

[0247] Illustratively, the comparison process between sensed capillaries and some or all of the capillary map can be implemented using basic pattern recognition algorithms (processes) instantiated in the electronics of the WCD. Such processes can rely on edge detection and similar techniques that should be clear to those of skill in the art and can be sourced from various commercial vendors of biometric recognition software.

[0248] In another example, the illumination can include NIR illumination and can project radiation into the skin of the finger. The reflected NIR illumination can then be analyzed to determine one or more characteristics of the blood, such as blood alcohol levels, blood glucose levels, and blood oxygenation levels. In this regard, the WCD analyzes the reflected radiation to identify wavelengths that were absorbed from the projected radiation by the blood of the user. Techniques and processed used in conjunction with commercially available venous oximeters (for example) can be employed to undertake certain readings.

[0249] FIG. 22A is a perspective view of a user employing ECG monitoring according to one or more aspects of the disclosure. In this example, the user can wear the WCD2200 on a first finger 2210 of first hand 2220, and can touch a second finger 2230 of a second hand 2240 to an exterior surface of the WCD 2200. This can provide an electric pathway 2250 through the body, as shown in FIG. 22B, allowing for the transmission of electrical current between distant portions of the body.

[0250] FIG. 22C is a perspective view of a WCD that can employ ECG monitoring according to one aspect of the disclosure. In this example, the WCD 2200 includes an internal/external housing 2250 with a conductive pad2260. The conductive pad 2260 can be electrically isolated from the external/internal housing 2250 of the WCD, thereby providing distinct and isolated electrical contacts on the WCD. The internal/external housing 2250 can be in electrical communication with the first finger2210 of the first hand, while the conductive pad 2260 can be in electrical communication with the

Petitioner Samsung Ex-1004, 1063

second finger 2230 of the second hand. In this regard, an electrical path 2250 is formed through the respective hands 2220, 2240 and through the rest of the user's body, particularly through the chest. In this regard, the WCD can take various electrical measurements of the user, such as ECG. The ECG measurement can include measurements of the various waveforms, such as P-U waveforms. The WCD can store such ECG data in a memory and/or can communicate the data to a wirelessly connected mobile device. In another example, the WCD can employ electrically isolated internal and external housings, such as those described above. In this regard, the conductive pad may not be utilized, and the user can wear the WCD on a first finger and apply the second finger anywhere on the external housing.

[0251] The WCD can also serve as a monitor for those who are mobility impaired or who are prone to falls, such as disabled persons and/or retired persons. The accelerometer onboard the WCD detect a fall of the user via a sudden change in acceleration data. The WCD, in conjunction with a mobile device and/or one or more base stations positioned around the home of the user, can determine the position of the user within the house. For example, the mobile device can employ GPS capabilities, and either the mobile device or the base stations can use GPS in combination with WiFi signal strengths to determine the location of the user within the house. The WCD can then issue an alert, either directly or indirectly (via the mobile device or base station) to a third party that a fall has occurred. The alert can be a phone call, text message, e-mail, or any other type of communication. The third party can then take appropriate measures to aid the fallen user.

[0252] The WCD can also monitor heart rate and/or temperature, in addition to the other monitored characteristics described above. If any of the monitored characteristics is abnormal, e.g., measured parameters outside of a predetermined threshold range, an alert can be sent to a third party. In some examples, the third party can be a medical health professional, such as a doctor, nurse, caretaker, etc. It is noted that, for those embodiments which can function as a cardiac monitor (e.g., that measures electrocardiogram (EKG)), it can be necessary to establish a closed loop (e.g., for the electrical measurement of EKG) across the heart. As such, in some of those embodiments, a separate conductive pad or other skin-contacting structure/probe can be coupled to the WCD so that a user can pinch the pad with fingers on an opposite hand.

Petitioner Samsung Ex-1004, 1064

[0253] Since the WCD has the form factor of a ring, the WCD is designed to be worn over long periods of time by a user with little to no discomfort or interference. In this regard, the WCD can monitor the above-described, monitored characteristics over long periods of time (e.g. weeks, months, etc.), and determine trends in the data. For example, the WCD can measure heart rate over a long period of time and determine a unique resting heart rate for a user. If the user's heart rate deviates from the resting heart rate, the WCD can be arranged to issue an alert to a third party. In one specific example, the WCD can use appropriate processes to analyze both the trends of monitored characteristics, as well as current accelerometer data. In this way, if a person's heart rate deviates from a resting heart rate, but the accelerometer indicates that the user is exercising and/or engaging in strenuous activity that provides an equivalent workout, then the WCD may not issue an alert in this circumstance.

[0254] FIG.23A is a perspective view of the hand of a user in various positions employing the navigational features of the WCD. As described above, the WCD can communicate with a mobile device though one or more wireless communication protocols. The mobile device can include a processor and a memory and can execute a map application/process that can provide tum-by-tum walking or driving directions to the user based on the user's GPS location. A portion of those directions can include information regarding heading, distance to travel at that heading, waypoints, and the direction of next tum. By way of the wireless communication, the mobile device can communicate one or more of pieces of information relating to directions, such as the heading. Once the heading is received the WCD, the WCD can give feedback to the user regarding the actual heading measured by the onboard magnetometer and the heading set forth in the direction information. In one example, the feedback can be haptic or physical feedback provided by one or more actuators, such as the actuators 670 described above.

[0255] FIG. 23A depicts a user's hand in various positions of navigation, each hand including a WCD worn thereon. In this example, the heading provided by the mobile device is the heading 2335, which represents the direction in front of the hand position2330. In this regard, if the user gestures, e.g., points a ring finger, in the direction of the correct heading, the WCD 2300 can give feedback to the user indicating the correct heading. The feedback can include, for example, an LED indicator 2310

Petitioner Samsung Ex-1004, 1065

showing a green visible light. In the example of hand position2320, the finger is gesturing in a direction to the left of the correct course 2325. In this way, the WCD 2300 can provide feedback to correct the heading of the user. Such feedback can include illumination of an LED indicator showing (e.g.) a red visible light. Similarly, hand 2340 is gesturing in direction 2345, which is to the right of the correct/appropriate direction. The WCD can provide (e.g.) a blue indicator informing the user to change heading.

[0256] FIG.23B is a flow chart 2300B depicting a method of providing feedback to a user according to one or more aspects of the disclosure. At block 231OB, a user can establish a communication link between a WCD and a mobile device. At block2320B, the user can generate or request a set of directions at the mobile device, including information/data regarding heading, distance to travel at that heading, and the direction of next tum. At block 2330B, the mobile device can transmit at least one of the information items/datum regarding heading, distance to travel at that heading, and the direction of next tum. At 2340B, the WCD can take a measurement of heading by measuring a heading associated with an explicit gesture by the user's finger donning the ring. Such gesture can include pointing in a proposed heading of travel. At block 2350B, the WCD can compare the measured or proposed heading to the correct heading provided by the mobile device. At 2360B, the WCD can provide feedback to the user based on the comparison at 2350B, e.g., if the user is gesturing in the correct direction, a green LED indicator may appear. In other examples, if the gesture is in a direction that does not correspond with the correct direction, a (e.g.) blue or red indicator can appear. In one specific example, indicators representing left and right course alterations can be different so a user can easily discern a correct direction of travel.

[0257] FIG. 24A is a schematic diagram of a system 2400 for controlling an environment of a user according to one or more aspects of the disclosure. As shown, the WCD can be connected, wired or wirelessly, to one or more appliances in the home of a user. The system 2400 can include a WCD 2410, a thermostat 2420, a wireless access point (e.g., WiFi router) 2430, and a mobile device 2440. The WCD can be wirelessly connected (e.g., link 2415) to both the thermostat and the mobile device by any type of wireless communication protocol, such as Bluetooth. The access point can be wirelessly connected to the thermostat and the mobile device by any type of wireless communication protocol, such as WiFi. It is noted that a wide range of commercially

Petitioner Samsung Ex-1004, 1066

available appliances, thermostats, lighting controllers, home controllers, and the like, can interface with the WCD using WiFi or another conventional/proprietary communication protocol, as described further below.

[0258] The WCD 2410 can include one or more temperature sensors. In one example, the WCD can include at least one internal facing temperature sensor 2410a and an at least one outward facing temperature sensor 2410b, as shown at FIG. 24B. The inward facing temperature sensor 2410a can be near the skin of a user when the user is wearing the ring, and can therefore measure the skin temperature of the user. The outward facing temperature sensors 2410b can be disposed away from the finger of the user, and can therefore be arranged to measure an ambient temperature of the room in which the user currently resides with sufficient thermal isolation from the user's hand and his/her body heat. In particular, in order to ensure accurate ambient temperature measurements, the WCD can employ a combination of multiple light sensors 2410c and outward facing temperature sensors 2410b. In this regard, the temperature sensor 2410b associated with the light sensor 2410c that receives the most light can be the most accurate, as it is most likely that this sensor is furthest from the finger or palm of the user. In another example, the WCD can employ multiple outwardly facing temperature sensors 2410b and compare the temperature values of each to the inward facing sensor 2410a. The WCD can then select the most accurate temperature value from the outward facing sensors.

[0259] Based on the measured skin temperature and measured ambient temperature, the WCD can automatically adjust the thermostat 2420 to alter the ambient temperature of the room. In this regard, if a user's skin temperature is too high, the WCD can instruct the thermostat 2420 to lower the ambient temperature. Similarly, if the user's skin temperature is too cold, the WCD can instruct the thermostat 2420 to raise the temperature. The WCD 2410 can instruct the thermostat (and/or an HVAC controller) directly, e.g., via a direct wireless link 2415, or indirectly, e.g., via one or more of the mobile device 2440 and the access point 2430. The WCD can also use historic temperature data to develop trend temperature data.

[0260] In another example, the WCD can be part of a system 2400C for controlling home appliances. The system 2400C can include a WCD 2410C, one or more home appliances 2420C, and an access point 2430C. Such home appliances 2420C can

Petitioner Samsung Ex-1004, 1067

include, for example, a television, lights, speakers, microwave, range, stove, oven, etc. Each of the home appliances can include an antenna that allows the respective home appliances to communicate wirelessly with one or more access points 2430C. In one example, the appliances can include a ScenSor DWIO00 chip provided by DecaWave. In this way, the locations of the appliances in the room can be determined to an accuracy of approximately 10 cm. The location of the WCD 2410C can also be determined, using the above-referenced chip, or by using signal strengths of one or more base stations.

[0261] Having established the position of one or more home appliances and the user in a room, the user can make a gesture to control such home appliances 2420C. For example, the user can point at the TV (while wearing the WCD) in order to tum it on/off. Knowing the position of the user and the position of the TV, the direction of the gesture and the type of gesture can indicate what action to take on which device. The accelerometer and/or magnetometer on the WCD can be used to create a vector to the object to control, and a wireless packet can bet sent to a wireless access point to control the respective appliance.

[0262] FIG. 24D is a flow chart depicting a method 2400D of controlling home appliances according to one or more aspects of the disclosure. At block 241OD, the locations of one or more home appliances in a room and/or house can be ascertained/determined. As described above, the appliances can include a processor configured to identify location within a room. At block 2420D, the location of the WCD is determined. At block 2430D, the user can make a gesture toward a home appliance to exert control over the home appliance. Such gesture can include a snap, a point, etc. At block 2440D, the accelerometer and/or magnetometer on the WCD can be used to create a vector to the object to control. At block 2450D, a wireless packet can bet sent to a wireless access point to control the respective appliance. The access point can then issue the command to the respective appliance.

[0263] FIG.25 is a perspective view of the hand of a user employing a two-factor authentication technique according to one or more aspects of the disclosure.

[0264] As shown, the user 2500 is wearing a WCD 2510 and is approaching a locked door 2520 with an access node 2530 associated therewith. The access node 2530

Petitioner Samsung Ex-1004, 1068

can be a wireless access node of a conventional or custom arrangement, and can communicate wirelessly according to any type of wireless protocol, such as WiFi or Bluetooth. As the user approaches the door 2520, the WCD 2510 can initiate a communication link, e.g., Bluetooth or WiFi, with the access node 2530. In this way, the WCD and the access node can engage in one or more handshaking or query procedures to verify the WCD. For example, the access node 2530 can detect a MAC address, IP address, or other alphanumeric identifier associated with the WCD and compare it to a list of authorized users. Such network-based communication processes should also be clear to those of skill.

[0265] Once the MAC address or other identifier is verified, the user can engage in a pre-defined gesture 2550 to complete the authentication procedure. The gesture 2550 can be any type of hand and/or finger motion that can be performed by the user. In this regard, the accelerometer or magnetometer can detect the gesture 2550 performed by the user and provide the gesture information to the access node. If the provided gesture information corresponds with an authorized gesture stored at or accessible by the access node, then the user may be granted authorization and the door can be unlocked. The authorized gesture can be a general authorized gesture for all users, or can be a specific gesture authorized only for the particular MAC address.

[0266] In addition to a door, the method above can be used to gain access to other features, such as unlocking a mobile phone, unlocking a car door, starting a car. The authentication technique above is advantageous in that it can eliminate extraneous authentication devices, such as key fobs for a car, a door, keypads for entry control, etc., and can provide a secure two-factor authentication technique to avoid unwanted access. More generally any type of keyless entry system (e.g. a keypad, card-reader, keyless lock, etc.) can be equipped with appropriate communication interfaces (RF, IR, etc.) to communicate with the WCD and operate based on a gesture and/or proximity of the user using the techniques described above. The WCD can also be employed generally in this manner to activate or deactivate a residential or commercial alarm system-substituting, for example, for a key fob used for this purpose.

[0267] FIG. 26A is a schematic view of a charging apparatus for charging the WCD according to one or more aspects of the disclosure. As shown, a mobile device 2610 can be received within a case 2620. The mobile device 2610 can be electrically connected to

Petitioner Samsung Ex-1004, 1069

the case 2620 via a port 2610a on the mobile device 2610 and a connector 2620a on the case 2620. As shown in phantom, the case 2620 can include an integrated battery 2630 within the case that can charge the mobile device via the connector or can charge a WCD, as will be described in greater detail below.

[0268] The integrated battery can be connected to an antenna 2640 disposed on or within the case 2620 that can emit an RF signal, as shown in the block diagram in FIG. 26C. The RF signal can have a power of less than 500mW and a frequency of 13.56MHz. The RF signal can be emitted in all directions around the case such that it can be received by a WCD in proximity to the case.

[0269] FIG. 26B shows a WCD 2650 including an RF antenna 2660 and charging circuitry 2670. The RF antenna 2640 can be disposed within the housing 2680 and can receive the RF signal emitted by the case 2620 and convert it to a current that can be used to charge the WCD battery (not shown). This can advantageously allow the user to charge the WCD without removing the WCD from the finger. As shown in FIG. 26D, the charging can occur whenever the WCD is in close proximity to the case, such as when a user talking on the phone or merely handling the phone. In another implementation, the case can utilize inductive charging to charge the WCD. In this regard, the case can include an induction coil subjected to a predetermined current to produce a magnetic field. A corresponding induction coil within the housing of the WCD can be subjected to the magnetic field to produce a current that can charge the onboard battery in accordance with known electromagnetic principles.

[0270] FIG. 27A is a pictorial diagram and FIG. 27B is a block diagram of a WCD employing flash storage according to one or more aspects of the disclosure. As described above, the WCD 2700 can include a housing 2710, an antenna 2720, and an integrated circuit (IC) 2730 including a flash memory 2740. The IC and the flash memory can be disposed within the housing 2710. The flash memory 2740 can be powered by a battery 2750 and connected to the IC 2730, which can be implemented as a system-on-a-chip (SoC) IC 2760. The IC can include Bluetooth Low Energy (BLE) capability to allow for communication with another device. The flash memory can be used to store data, or can be used in any of the authentication techniques described above. The WCD can transmit data stored on the flash memory to another device 2780 via the BLE connection, or can receive data and store the data on the flash memory.

Petitioner Samsung Ex-1004, 1070

[0271] FIG. 28A is a schematic diagram of one or more WCDs performing proximity functions according to one or more aspects of the disclosure. The WCD can detect a strength of an RF signal received by its antenna, and calculate a distance to the source of the RF signal using a Received Signal Strength Indicator (RSSI). In one example, the RF signal can be from a mobile device, an access point, or another WCD. The use of RSSI can have many applications in proximity detection. For example, the WCD can be placed on a child and can be connected to mobile device held by a parent. If the WCD travels a predetermined distance from the mobile device, the WCD can issue an alert to the mobile device, thereby alerting the parent that the child has wandered too far. In another example, the parent can wear a first WCD and the child can wear a second WCD. The first WCD can alert the parent that a child has wandered too far.

[0272] A single user can wear a first WCD 2800 on a first finger on a first hand and a second WCD 2810 on a second finger on a second hand. In this regard, the user can measure the relative distance between the first and second fingers using an RSSI via a wireless link 2830 between the WCDs 2800, 2810, such as a BLE connection. This can be used to measure an approximate dimension of an object held in both hands or to estimate a mid-air measurement.

[0273] In some examples, a first user can wear a first WCD 2800 and a second user can wear a second WCD 2810. The RSSI can be collected over a period of time and the processor can analyze the data to develop trends or statistics. For example, the RSSI data can indicate that the first and second users have spent a certain amount of time together and can serve as a relationship monitor.

[0274] The WCD can also detect when the first user and second user are holding hands. FIG. 28B is a schematic diagram of one or more WCDs 2800, 2810 performing proximity functions according to one or more aspects of the disclosure. Similar to the ECG monitoring techniques described above, a circuit can be formed when the users hold hands 2840 (with the respective hands wearing the WCDs). The circuit can be used to transmit data and/or electrical impulses between the respective WCDs via the circuit. The WCDs can collect data regarding the length of time that the users are holding hands and, in combination with the amount of time spent together, monitor the relationship of the two users. In addition, the WCD can collect data regarding communication between

Petitioner Samsung Ex-1004, 1071

the users, e.g., e-mail, social media, etc. Based on all of the above factors, the WCD can develop a relationship score between respective WCD users, with a higher relationship score indicating more and more frequent interactions.

[0275] FIG.29A is a flow chart depicting a method of initiating gesture input according to one or more aspects of the disclosure. The WCD can be used to perform one or more commands, or to instruct another device, such as a mobile device, to perform one or more commands. Such commands can include, initiate sleep state of WCD, initiate sleep mode or default mode of WCD, powering off/on of the WCD, turning on/off an LED light of the WCD, powering on/off of a mobile device, placing a phone call on the mobile device, etc. The user can establish one or more custom gestures to initiate any of the commands above. For example, the user can select a command to be customized from a number of commands. Once selected, the user can perform a custom gesture to be associated with that command. In some examples, the user can perform the custom gesture multiple times to allow the WCD to better identify the gesture and to develop error tolerances for registering the gesture.

[0276] At block 2910, the user can perform a first gesture. In this example, the user can perform a finger snap. At block 2920, WCD can register the gesture, via the accelerometer and/or the magnetometer. At block 2930, the accelerometer can send an interrupt signal to the processor. At block 2940, the processor can wake from a sleep or default system state. At block 2950, the processor can monitor the accelerometer for a second gesture, at which point the user can perform a second gesture. If the second gesture matches a gesture in the gesture command database, then the WCD can perform the associated command. If not, the WCD can return to the sleep state.

[0277] FIG.29B is a chart 2900B showing an exemplary graph of acceleration vs. time as measured by the accelerometer of the WCD. As shown at peak2910B, the gesture can only be registered if it reaches a predetermined acceleration threshold. If the gesture performed at 2910 meets the threshold, it can proceed to block2930 where the interrupt procedure is performed.

[0278] FIG. 30 is a perspective view of a WCD 3000 employing an illustrative reset function and associated procedure/process. As shown, the WCD 3000 can be removed from the finger of the user in order to initiate a system reset of the WCD. In one

Petitioner Samsung Ex-1004, 1072

example, the system reset can be initiated by spinning about a rotation axis R at a predetermined speed. The predetermined speed can be any value, and in one example is a rotational velocity. Upon performing the reset procedure at the predetermined speed, operation of the WCD 3000 can be interrupted and the onboard components of the 3000 can power off, and revert to factory default settings. Additionally, a series of movements can initiate a rest, such as putting the ring on a table and turning it over several times.

[0279] FIG. 3lA is a perspective view of a WCD including an LED indicator according to one or more aspects of the disclosure. As shown, the WCD 3100 can include an internal/external housing 3112 and an internal/external potting 3114. The WCD can include an LED 3120 that can be visible through the internal/external potting 3114.

[0280] FIGs. 31B and 31C are cross sections along line C-C of a WCD employing an LED indicator according to one or more aspects of the disclosure. As described above, the WCD 3100 can have an internal and/or external potting 3114 that can be transparent. This allows light sources within the housing to pass through the potting without changing, or with minimal change to, the optical properties of the light. In this way, a light source 3120, such as an LED, can be disposed on the PCB 3140 and can be powered at least partially by battery 3130. The LED can be encapsulated by the potting 3112 and can project light through the potting 3112. As shown in FIG. 31B, the LED 3120 can include a vertical LED, while 31C depicts a right angle LED. The vertical LED can project light along direction L1, while the right angle LED can project light along direction L2. When light is projected along L2, the light can travel around a circumference of the finger of the user.. Note that, according to aspects of the disclosure, the potting can be generally adapted in whole or in part to condition, filter or modify the wavelengths and/or projection qualities of light by for example, embedding lensmatic components, applying light-diffusive additives, light attenuating filter materials, etc.

[0281] FIG. 32 is flow chart depicting a method 3200 of communicating with a near field communication (NFC) device according to one or more aspects of the disclosure.

Petitioner Samsung Ex-1004, 1073

[0282] In some examples, the WCD can enable or disable NFC or change the functionality of a NFC device. For example, the WCD can itself engage in NFC with another computing device, or the WCD can be connected via wireless link to a computing device that engages in NFC with a different computing device. In certain existing NFC devices, NFC will connect and begin transmitting data as soon as it is queried. In the present example, NFC is enabled or begin transmitting data exclusively upon performing of a pre-determined gesture. However, a variety of other transmission processes can be implemented-for example a periodic chirp or handshake request by the WCD for communication with appropriate devices.

[0283] At block 3210, a NFC capable device is provided. The device can be any type of device, such as a laptop, tablet, mobile device, or dedicated NFC device.

[0284] At block 3220, the WCD initiates a connection with the NFC device. The connection can be a direct connection via NFC, or an indirection connection via an intermediate device. At this point, no data has yet been transmitted between the WCD and the NFC device.

[0285] At block 3230, a user performs a predetermined gesture that is registered by the WCD. The gesture can be any type of gesture, such as a point, a snap, waving the hand, etc.

[0286] At block 3240, data transmission begins between the NFC device and the WCD.

[0287] In other examples, the user can perform another gesture to cease NFC communication. The gesture can be the same gesture as described above or a different gesture. Additionally, the user can remove the ring to disable the NFC. Upon donning the ring the user will be prompted by the application on the mobile device to re-authenticate by entering a PIN, whereby the proper PIN results in re-enabling the NFC functionality.

[0288] In yet another example, the WCD device employing NFC can be configured on the fly to map to different data sets stored thereon. For example, the WCD device employing NFC can employ data thereon to make purchases, e.g., account information, data to access a building, e.g., a key fob, and data thereon to board public transportation, e.g., smart card, metro card, etc. A user can perform a predetermined different gesture

Petitioner Samsung Ex-1004, 1074

for each of the above data sets to access the data. Once accessed, the WCD device employing NFC can initiate a link with another computing device to initiate a transaction, to open a door, or to board public transportation, etc.

[0289] **VI. Optical Element and Attachment Frame**

[0290] FIG. 33A depicts a perspective view of a WCD assembly 3300 according to one or more aspects of the disclosure, while FIGs. 33B-D depict exploded views of the WCD assembly and 33E depicts a cross sectional view of the WCD assembly along A-A. In this example, the WCD assembly 3300 includes a WCD 3310, an attachment frame 3320, and an optical element 3330. The WCD 3310 can be any of the WCD examples described above or below in the present application.

[0291] The attachment frame 3320 is releasably attached to the WCD3310. The optical element 3330 is itself releasably attachable to the attachment frame 3320. In this regard, the attachment frame 3320 provides an attachment interface between the WCD 3310 and the optical element 3330, thereby allowing the optical element 3330 to be at a fixed position in space with respect to the WCD 3310 or any portion thereof. The attachment frame3320 can be made of any material, such as a metal, polymer, etc. Any type of polymer can be used, such as thermosetting plastics, thermoplastics, PETE, polycarbonate, polyethylene, LDPE, or any other type of plastic.

[0292] The attachment frame can be sized and shaped to fit along the curved surface of the WCD. For example, the attachment frame can have a curved undersurface to allow a flush fit with the curved surface of the WCD. The attachment frame can have any shape, size, or radius of curvature depending on the size and shape of the WCD.

[0293] The attachment frame 3320 includes a first retaining a portion 3322 and a pair of second retaining portions 3324. The first retaining portion 3322 defines a conical recess 3322a configured to receive the optical element 3330, and provides a generally unoccluded pathway for light to pass through the optical element and onto the WCD. Although depicted as defining a conical or frustoconical shape, the recess 3322a can be any other shape depending on the shape of the optical element 3330. Each of the second retaining portions3324 includes a respective locking feature 3324a. The respective locking features3324 and a extend from the second it retaining portion3324 toward one another such that a distance between the respective locking features is greater than a

Petitioner Samsung Ex-1004, 1075

distance between the remaining portions of the second retaining portions. As shown in FIG. 33E, the locking features engage with an inward-facing surface 3350 of the WCD to ensure a secure fit. In one example, the inward-facing surface of the WCD may itself have one or more features 3360 to engage with the locking features of the second retaining portions. Such one or more WCD features can include projected surfaces, recesses, or any other type a feature to allow for engagement with the attachment frame.

[0294] The optical element 3330 can be made of any material capable of modifying, e.g., focusing, incident electromagnetic radiation, such as visible light, ultraviolet light, infrared light, or any other type of electromagnetic radiation. In some examples, the optical element 3330 can be constructed from a polymer, such as any of the polymers identified above. In another example, the optical element can be made of glass, quartz, diamond, zirconium, or any other material capable of focusing light. More generally, the optical element 3330 is formed with a general outward appearance simulative of a faceted jewel with an appropriate tint or coloration (including clear/white). The term "jewel" can also be used in the alternative to describe the optical element 3330 herein.

[0295] The WCD can include CPV cell 3312 that can be disposed directly underneath the attachment frame 3320 and optical element 3330 when assembled. In other examples, the CPV can be positioned within the housing and can receive electromagnetic radiation via a transparent potting material. In this regard, incident light striking the optical element 3330 can be focused on to the CPV cell to allow for charging of the internal battery of the WCD. The optical element 3330 provides an increased charging efficiency when compared to the CPV exclusively receiving ambient light, since the ambient light is collected/gathered from a wider field, and then focused onto the CPV by the optical element 3330. In one example, a focal length of the optical element 3330 is different than a distance between the optical element and the CPV. For example, the focal length can be greater than or less than the distance between the optical element and the CPV. This can be advantageous in various aspects of the disclosure so as to avoid the light from focusing at a focal point directly on the CPV, which could cause damage to the CPV itself by over-concentrating the light at that single point of the overall CPV surface.

[0296] FIGs.34A-B depict a WCD assembly 3400 according to one or more aspects of the disclosure. In this example, the attachment frame 3420 does not extend to an

Petitioner Samsung Ex-1004, 1076

inward-facing surface of the WCD 3410, but is instead form entirely on the outside-facing surface of the WCD. In some examples, the attachment frame 3420 can be semi-permanently or permanently affixed to the outward-facing surface of the WCD and can have a plurality of retaining portions (mounting prongs) 3422 that at least partially define a recess 3422a for receiving the optical element. As shown in FIG.34B, the optical element 3430 is releasably attached to the attachment frame 3420. This configuration can be particularly desirable, as it exhibits ornamental similarities to a traditional engagement ring while still having the increased functionality of the WCD. Note that while not shown, the mounting prongs can include small hook ends that springably retain the optical element 3430 when attached, but that can release the optical element based upon a prying motion. A customized grasping tool (not shown) can also be employed to remove (and attach) the optical element in this example.

[0297] **VII. Enclosure/Packaging**

[0298] FIG. 35A depicts an enclosure or case 3500 for storing a WCD according to one or more aspects of the disclosure. As shown, the enclosure3500 includes a lid 3510 and a base 3520. The lid 3510 and base 3520 can engage via a recessed portion 3522 formed in the base 3520 to provide a substantially sealed interior environment.

[0299] The lid 3510 can be cuboidal in external dimensions, or define any other type of geometric shape that allows sufficient internal volume to contain the WCD. For example a custom design shape (polyhedral, etc.) can be employed. In this example, the top portion3510 is substantially cuboidal as shown, including rounded edges rather than vertices. The lid can be substantially transparent to allow viewing of the WCD while enclosed therein, and can be made of any type of material, such as a polymer, glass, etc. The lid can also be mounted with pins on a hinge.

[0300] The base 3520 can be cuboidal, or any other type of geometric shape. In this example, the bottom portion is substantially cuboidal, including rounded edges rather than vertices as shown. The bottom portion can be made of any material and can be transparent or opaque.

[0301] The base 3520 can define a receptacle 3524 for receiving the WCD3505. The receptacle 3524 can be sized and shaped to receive the WCD 3505 and in this example is semicylindrical, e.g., a portion of a cylinder. The radius of the semicylinder

Petitioner Samsung Ex-1004, 1077

can be slightly larger than a radius of the WCD in order to accommodate the WCD securely. The receptacle can lined with a soft material to allow for a soft, safe material to receive the WCD, such as a silicone, thermoplastic, fabric, felt, or other material.

[0302] FIG.35B is a cross sectional view of the assembled enclosure3500 shown above along the line B-B. As shown, when assembled, the WCD 3505 fits securely within the receptacle 3524. The interior of the lid3510 can be sized and shaped to conform to the shape of the WCD such that the WCD is completely surrounded and enclosed by the lid 3510, while in other examples, the lid3510 can be sized and shaped to allow for airspace 3514 between the lid surface and the WCD.

[0303] FIG.35C is a cross section of the enclosure along line A-A. As shown, the lid 3510 can include an integral optical element 3512. The optical element3512 can be a lens or any other device to modify, e.g. focus, light that passes therethrough. In this example, the optical element 3512 can be disposed at a predetermined distance away from one or more CPV cells 3507 disposed on the WCD 3505. This distance *d* can be measured from the center of the optical element to the CPV cells 3507, and the optical element can itself have a focal length *f*. In one example, the distance *d* can be greater than the focal length *f*, such that the optical element focuses light at a point above the WCD in the enclosure. In this regard, the light will not focus directly on the CPV cells disposed at the surface of the WCD, thereby avoiding overheating or damage to the CPV cells. In other examples, the distance *d* can be less than the focal length, which can also prevent light from focusing at a surface of the WCD.

[0304] FIG. 36 depicts an enclosure 3600 including air vents 3650 according to one or more aspects of the disclosure. In this example, the enclosure 3600 includes a plurality of vent holes 3650. The vent holes can be arranged on one or more faces of the lid. The vent holes 3650 can prevent overheating within the enclosure during charging of the WCD by allowing for circulation of convective air current. During shipping, the vent holes3650 can be covered by an adhesive and/or adhering (peel-off) polymer sheet of conventional arrangement to prevent debris or moisture from entering the enclosure. The enclosure can include a lid 3610, base 3620, receptacle 3624, and optical element 3612 as in the examples set forth above.

[0305] **VIII. Sizing**

Petitioner Samsung Ex-1004, 1078

[0306] FIG. 37 depicts a method 3700 of sizing a finger according to one or more aspects of the disclosure. At block 3710, the hand of a user can be provided. The hand can be held still in mid-air or alternatively can be resting on a surface.

[0307] At block 3720, a first image is taken of the user's hand from a first perspective. The image can be taken by any type of imaging apparatus, such as a CCD or CMOS camera, a digital camera, a camera associated with a mobile phone, etc. The first image can be stored in a memory.

[0308] At block 3730, a second image is taken of the user's hand at a second perspective. In this regard, the second perspective is different from the first perspective so as to provide a distinct view in the second image of the user's hand. Block 3730 can be repeated any number of times. For example, a third image can be taken of the user's hand at a third perspective. In this regard, the third perspective is different from both the first and second perspectives so as to provide a distinct view in the third image of the user's hand, and so on.

[0309] At block 3740, a size of the user's finger can be derived from the plurality of images taken above. In some examples, as few as two images may be required, while in other scenarios, more than three images may be required, depending on a number of circumstances including image quality, selected perspectives, etc. The size can be derived from the plurality of images by any number of techniques, such as stitching the plurality of images together to generate a 3D typography of the fingers, then using photogrammetry algorithms to identify features on the fingers to determine the appropriate ring size. Furthermore, the touch screen of the smart phone can be used to measure the hardness of tissue by measuring the footprint/impression the fingers make while pressing a finger against the touch screen of a mobile phone.

[0310] FIG. 38 is a pictorial diagram showing a plurality of image perspectives of a user's hand 3802. As shown, perspectives 3810, 3820, and 3830, as well as the other perspectives, produce corresponding images (in a strip) 3812, 3822, and 3832. The images can be used to derive a size of the user's finger according to the methods described above.

Petitioner Samsung Ex-1004, 1079

[0311] FIG. 39 depicts a sizing tool for sizing the finger of a user. As shown, the tool 2900 can include a plurality of finger holes 3910-3950. The tool 3900 can be made of any material, such as plastic, metal, or cardboard.

[0312] FIG. 40 depicts a sizing tool for sizing the finger of a user according to an alternate example. As shown, the tool 4000 can include a plurality of finger holes 4010-4050. The tool 4000 can be made of any material, such as plastic, metal, or cardboard.

[0313] FIG. 41 depicts yet another alternate example of a sizing tool for sizing the finger of a user. As shown, the tool 4100 can include a plurality of finger holes 4110-4150. The tool 4100 can be made of any material, such as plastic, metal, or cardboard. The thickness of the card reflects the thickness of the ring to ensure proper fit. Additionally, the sizing tool is designed such that it can be easily mailed to the user with a standard mail service such as USPS.

[0314] Any of the tools 3900, 4000, or 4100 can be provided to a user prior to purchase of the ring in order to obtain accurate sizing information prior to purchase. The tools include holes, as shown above, that can come in a plurality of predetermined finger sizes to allow a user to match his or her finger size with the tool. The best match, e.g., closest size that ensures a comfortable fit, can be identified using the tools. Alternatively, the tools can be provided at retail locations to size the finger of the user on site prior to purchase. More generally, a variety of other sizing techniques, such as those employed by conventional jewelers can be employed according to further aspects of the disclosure.

[0315] In another embodiment, a packaging or enclosure of the WCD can include a sizing diagram or interface embodied therein to allow a user to size a finger during the purchase process.

[0316] FIG. 42 depicts a method 4200 of monitoring activity according to one or more aspects of the disclosure.

[0317] At block 4210, a user can don or place the WCD onto the finger to secure it in the wearing position.

[0318] At block 4220, a user can perform any number of daily activities, such as running on a treadmill, walking, exercising, typing, etc.

Petitioner Samsung Ex-1004, 1080

[0319] At block 4230, the WCD, contemporaneous with block 3220, can use one or more sensors to sense the activities of the user. For example, the sensors can detect location, speed, acceleration, orientation, heart rate, etc.

[0320] At block 4240, the WCD, or another computing device, can generate an entry in an activity log at the conclusion of a detected activity. If the activity detected by the sensors has a profile that has not yet been identified, the WCD can prompt the user to identify the activity. For example, the user can identify profiles such as "Run in Central Park," "Typing," "Run on Treadmill," etc. The WCD can associate the identity provided by the user with the activity profile identified by the sensors and store the identified activity in the WCD memory, or any other memory. Later, if the user performs the same activity and the WCD detects the activity profile as being similar to a saved activity, the WCD can identify the activity while the user is performing the activity and save the activity in the activity log. Each of the activities performed can be saved in the overall activity log and can be stored in a memory on the WCD, or other device, for later v1ewmg.

[0321] FIG.43 depicts a method 4300 of determining whether a user is wearing gloves according to one or more aspects of the disclosure. At block 4310, a user is provided while wearing the WCD, where such user may or may not be wearing gloves.

[0322] At block 4320, one or more light sensors on board the WCD can detect surrounding ambient light. Such light sensors could include, for example, a CPV or other light sensitive element.

[0323] At block 4330, one or more additional measurements maybe made. Such additional measurements can include, for example, an ambient temperature measurement and or a proximity measurement, e.g., detecting proximity of an object to the WCD via reflected electromagnetic radiation in the form of IR light.

[0324] At block 4340, a measured ambient temperature and ambient light measurements are compared to predetermined thresholds. If the ambient temperature measurement is above a certain predetermined temperature threshold and the ambient light measurement is below a certain threshold, it can be determined that the user is wearing a glove over the WCD.

Petitioner Samsung Ex-1004, 1081

[0325] At block 4350, a measured proximity and ambient light measurements are compared to respective predetermined thresholds. If the proximity measurement is below a certain distance threshold (e.g., determines an item is in close proximity to the WCD) and the ambient light measurement is below threshold, it can determined that the user is wearing a glove over the WCD. In any of the above examples, an intensity of LED indicators of the WCD can be adjusted according to a detected ambient light using an appropriate algorithm or process that compares the ambient light to a scale and adjusts a desired driving current/voltage for the LEDs according to a predetermined formula (e.g. a proportional adjustment using an adjustment coefficient) or scale (e.g. a lookup table). For example, where there is abundant ambient light (e.g., detected ambient light above a predetermined threshold), the intensity of the LED indicators can be increased. In the same way, where there is little ambient light (detected ambient light below a predetermined threshold), the intensity of the LED indicators can be decreased.

[0326] In one example, the WCD can detect whether it is removed and or installed on the finger of the user. In this regard, as mentioned above, the WCD can have inward-facing light sensors, CPV, or temperature sensors. When a user installs a ring on his finger the measure of ambient light may decrease or the temperature may increase. Such changes in ambient light and/or temperature can be detected by one or more sensors onboard the WCD and a determination can be made that the user has removed and or installed the ring on his finger.

[0327] FIG.44 depicts a method 4400 of securing data onboard the WCD according to one or more aspects of the disclosure. At block 4410, a user may don the WCD on the finger. At block 4420, a user may execute an application on a mobile device, or other computing device, that can be previously associated and authenticated with the WCD. At block 4430, the user can enter an authorization code into the application running on the mobile device, such as a PIN code. At block 4440 the mobile device may transmit the authorization code to the WCD by any means of communication, such as, wired, wireless, Bluetooth, NFC, etc. At block 4450, the user wearing the WCD can now be again authenticated and associated with the WCD and can be granted access to certain functions and/or data storage of the WCD. At block 4460 a user may remove the WCD. At block4470 the WCD can detect that it is removed such as bio detection (including e.g., biometric identification) techniques described above with respect to inward facing

Petitioner Samsung Ex-1004, 1082

sensor changes, temperature changes, or heart rate decreasing to zero. At block 4480, the authorization code previously stored on the WCD can be automatically deleted upon detection of removal to avoid unauthorized access to such information by a subsequent wearer or other querying party. Further or alternatively, additional information can be automatically deleted upon removal of the WCD, for example any data and or instructions stored on the onboard memory of the WCD such as personal information, banking information, confidential information, or other sensitive data.

[0328] **IX. Timepiece System**

[0329] FIG. 45A is a timepiece system 4500 according to one or more aspects of the disclosure. As shown, the timepiece system 4500 can include a conventional timepiece 4510 and a timepiece computing device (TCD) 4520. The TCD can be any shape, and in this example is in the shape of a cylinder. The radius can be significantly greater than a height of the TCD to provide the shape of a puck. The TCD can have one or more structural and/or functional components, and can be similar to the WCD described above with respect to hardware features, components, sensors, etc. Although depicted as cylindrical, the TCD can have any shape depending on the shape of the conventional timepiece. For example, where the timepiece has a rectangular or square face, the TCD can similarly have a rectangular or square profile.

[0330] A top surface 4520a of the TCD can include a pressure sensitive adhesive (PSA) layer 4522 to allow for adhesion of the TCD to the under surface of the timepiece 4510. The TCD 4520 can have a radius or circumference that does not exceed radius or circumference of the face of the conventional timepiece so as not to be seen when a user is wearing the timepiece system 4500. The TCD can enhance the conventional timepiece with many of the features described above with respect to the WCD such as, heart rate sensing, temperature sensing pedometer, activity sensing, gesture sensing and control, without having to alter the look of the conventional timepiece.

[0331] Fig 45B is a bottom view of the TCD. As shown, the TCD can include a battery 4540, any printed circuit board 4550 with one or more components attached thereto (not shown) such as motion sensors, power management circuitry, charging circuitry, etc. As with the WCD, the printed circuit board of the TCD can be overmolded 4560. The overmold can be transparent or substantially transparent to allow

Petitioner Samsung Ex-1004, 1083

electromagnetic radiation to pass through to be incident upon one or more components of the TCD.

[0332] As shown, the TCD can include a light pipe 4524 around the perimeter thereof. The light pipe 4524 can be substantially annular in shape and can be formed in part by the overmold of the TCD. The light pipe can be constructed from a conventional transparent or translucent moldable material (e.g. acrylic, polycarbonate, etc.), and can be arranged to focus ambient light onto a CPV disposed onboard the TCD for additional charging capability. The optical arrangement/geometry of the light pipe can be implemented using skill in the art to achieve the desired optical characteristics. In another example, excess heat generated by the TCD or excess body heat emitted from the skin of the user can be converted to electrical energy via a thermoelectric (TEG) module, such as a Peltier module, disposed onboard the TCD.

[0333] The TCD can also include any number of CPV cells, either on a top surface or bottom surface, to allow for charging. For example, a CPV cell can be placed on the underside of the TCD to allow for docking with a charging/docking station.

[0334] FIG.46 depicts a WCD 4600 with a pair of LED indicators 4610-4620 disposed at an inward-facing portion of the WCD. As shown, the WCD 4600 can include a pair of transparent regions 4640-3650 and an opaque region 4630. The LEDs 4610- 3620 can be positioned under the transparent regions 4640-3650 to allow light from the LEDs to exit the WCD. In one example, the LEDs 4610-3620 can create a subtle diffuse glow to the skin to provide a desirable visual effect to user. In another example, a user feedback LED can be placed at an inward facing surface and a second can be placed at an outward facing surface of the WCD. Depending on the circumstances, one of the LEDs may be disabled to save battery life. For example, LEDs that are facing away from a user e.g. facing down or away from user's line of sight, may be disabled. As described above, the WCD can determine its orientation based on onboard sensors, such as the magnetometer, accelerometer, GPS, etc.

[0335] FIG. 47A is a system for generating and managing alerts according to one or more aspects of the disclosure. As shown, the system can include a WCD 4710A, one or more networks 4720A, and one or more server computers 4730A according to one or more aspects of the disclosure. The WCD 4710A can communicate directly and/or

Petitioner Samsung Ex-1004, 1084

indirectly with the server 4730A via the network 4720A. In this regard, data generated and/or stored at the WCD 4710A can be transmitted to the server 4730A and vice versa. In one example, such data can include biometric data pertaining to a user wearing the WCD that is detected and stored by the WCD.

[0336] FIG. 47B depicts a block process diagram for generating and managing alerts according to one or more aspects of the disclosure and FIG. 47C is a flow chart depicting a method for generating and managing alerts according to one or more aspects of the disclosure.

[0337] At block 4710C, and as shown at process block 4710B, the user is authenticated with respect to the WCD. In this regard, a single user can be associated with a single WCD and can be associated with a predetermine identifier, such as an alphanumeric number. If the user is not authenticated or the authentication process is not conclusive, the WCD may invite the user to retry authentication at block 4715C until the user is successfully authenticated. In some examples, the WCD may timeout the authentication process, lock the WCD, or place the WCD in safe mode in the event of too many unsuccessful authentication attempts as a security measure.

[0338] The user can be authenticated according to any of the authentication methods described in the present application, such as via a unique capillary map, a unique ECG profile, etc.

[0339] If the user is authenticated, biometric data can be transmitted to the server at block 4720C. The captured biometric data 4720B can be transmitted to the server via network 4720A, 47222B

[0340] Once received at the server, the biometric data can be aggregated, sorted, categorized, or profiled at block 4730C and as shown at process block 4730B. In this regard, a profile (corresponding to the alphanumeric identifier) may be created at a database at the server that stores data for a particular user. The profile can store transmitted biometric data, as well as other data, such as user gender, height, weight, age, family history, disease information, location, etc.

[0341] In some examples, identifying information may be removed from the data and/or not transmitted to allow for anonymity and/or to comply with regulations regarding transmission of medical data. The transmitted biometric data can be

Petitioner Samsung Ex-1004, 1085

normalized in order to comply with predetermined data requirements in order to be added to the profile. In one example, a minimum amount of data may be required in order to be considered viable for association with the profile. The biometric data of a single profile can be aggregated, or in other examples multiple profiles can be aggregated simultaneously.

[0342] Aggregation of the user's biometric data into a single profile allows for the profile to be visualized or analyzed according to any number of methods. For example, a timeline can be created showing biometric data over a period of time. The data can also be synthesized or analyzed to calculate trend data, or other mathematical features.

[0343] Although only one WCD is depicted, it is contemplated that a plurality of WCDs can exist, with each WCD corresponding to a distinct user (and distinct alphanumeric identifier) and therefore resulting in a plurality of distinct profiles at the server. Accordingly, each of the distinct users/WCDs may be authenticated separately according to the methods described herein.

[0344] At block 4740C, once the transmitted data has been associated with the user profile, the updated profile can be correlated with one or more other profiles stored at the server as shown as process block 4740B. The profiles may be correlated according to any number of correlation standards, such as correlating users with similar traits such as age, gender, location, profession, or by any other data stored at the server. In some examples, one or more of the traits can be used to make such a correlation. The biometric data from the one or more users that are correlated with one another can be combined to form a group profile. The group profile can be the aggregation, average, range, or sum of individual profiles that form the group profile. For example, for a particular group profile, a range of resting heart can be generated by taking the maximum and minimum values of resting heart from the individual profiles. In other examples, an average (and standard deviation or standard deviation of the mean) can be generated for each trait, such as average resting heart rate, average active heart rate, average blood pressure, average blood sugar, average skin temperature, ECG profiles, as well as any other features capable of being detected by the WCD as described above.

[0345] At block 4750C, transmitted biometric data can be compared to the established values from the group profile. In this way, if a user's heart rate deviates by a

Petitioner Samsung Ex-1004, 1086

predetermined threshold (such as by predetermined magnitude or standard deviation), an alert can be generated at process block 4750B. The comparison process can occur at the server after transmission of the biometric data. In another example, the group profile data can be transmitted to the WCD for comparison at the WCD. This advantageously allows the comparison to be made where the WCD cannot establish a network link. The group profile can be updated on a continuous basis or a predetermined time interval or at each transmission of biometric data.

[0346] At block 4760C, the alert is transmitted to the WCD and displayed to the user at process block 4760B. The alert can indicate that the user's biometric data has deviated from the profile group and may advise the user to seek medical attention. In another example, the server can directly contact a medical health professional. In the example where block 4750C occurs at the WCD, transmission of alert information from the server may not be necessary.

[0347] The alert at the WCD can be any type of audio or visual indicator, such as an LED, haptic feedback, audible alarm, etc. The indicator may also invite the user to rest, make an appointment with a medical health professional, recommend a particular medication, or suggest certain physical activities that may health condition that caused the alert.

[0348] As shown in FIG. 47B, the authentication 4710B, aggregation 4730B, and correlation 4740B can occur at server 4730A, which can include a process, memory, and any other features of a general purpose computer. The authentication 471OB, aggregation 4730B, and correlation 4740B can access a database stored at the memory, where profiles, group profiles, and biometric data can be stored.

[0349] FIG. 48A is a method for variable sampling according to one or more aspects of the disclosure. As described above, the processor module of the WCD can determine (e.g., based on identified physical activities, routine pattern, and/or time) a frequency at which one or more sensors in the sensor modules should operate.

[0350] At block 4810A, one or more sensors of the WCD may take one or more measurements. For example, the WCD can detect temperature, heart rate, acceleration, as described above.

Petitioner Samsung Ex-1004, 1087

[0351] At block 4820A, the WCD can calculate an activity level of a user. For example, the WCD can compare to a number of stored activity profiles (as described above) stored by the user, or can compare the sensor measurements to sensor threshold values corresponding to different activities, such as sitting, running, sleeping etc. In one example, the WCD detect acceleration values over time to generate an activity level for a particular time period.

[0352] At block 4830A, the WCD may compare the identified activity level to a predetermine activity threshold value. In one example, the WCD may categorize the detected activity as either a high level activity or a low level activity. High level activities can include running, swimming, biking etc., while low level activities may include sitting, standing still, or sleeping.

[0353] At block 4840A, the WCD can set a first sample rate for high level activities and at block 4850A, the WCD can set a second sample rate for low level activities. The first sample rate can be a shorter time interval than the second sample rate, resulting in more data being detected and generated during a set amount of time while the user is active. This allows for increased power efficiency of the WCD while also providing the advantage of generating more data when a user is more active, thereby providing added biometric data for later analysis.

[0354] In another example, the sample rate can be scaled according to activity level. For example, the sample rate can be scaled to be directly proportional to heart rate. This results in a shorter time interval for sampling (more frequent data gather) for running than for walking.

[0355] As activity level changes, the method above can be repeated a plurality of times at certain intervals in order to quick or abrupt activity changes.

[0356] FIG. 48B and 48c are graphs depicting one or more aspects of the sample method of FIG. 48A. As shown in FIG. 48B, the WCD may determine a user is engaging in a high level activity by detecting acceleration values that are above a predetermined threshold value. In this regard, a shorter time interval (more frequent data gathering) can be set. As shown in FIG. 48C, the user is engaging in a low level activity since the acceleration values are below a predetermined threshold. A longer sample rate (less frequent data gathering) can be set in this instance.

Petitioner Samsung Ex-1004, 1088

[0357] FIG. 49 a diagrammatic representation of a machine in the example form of a computer system 4900 within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed. Specifically, FIG. 49 shows a diagrammatic representation of a machine in the example form of a computer system within which instructions (e.g., software or program code) for causing the machine to perform any one or more of the methodologies discussed herein may be executed. In alternative embodiments, the machine operates as a standalone device or may be connected (e.g., networked) to other machines. In a networked deployment, the machine may operate in the capacity of a server machine or a client machine in a server-client network environment, or as a peer machine in a peer-to-peer (or distributed) network environment.

[0358] The machine may be a server computer, a client computer, a personal computer (PC), a tablet PC, a set-top box (STB), a personal digital assistant (PDA), a cellular telephone, a smartphone, a web appliance, a network router, switch or bridge, or any machine capable of executing instructions (sequential or otherwise) that specify actions to be taken by that machine. Further, while only a single machine is illustrated, the term "machine" shall also be taken to include any collection of machines that individually or jointly execute instructions to perform any one or more of the methodologies discussed herein.

[0359] The example computer system includes a processor (e.g., a central processing unit (CPU), a graphics processing unit (GPU), a digital signal processor (DSP), one or more application specific integrated circuits (ASICs), one or more radio-frequency integrated circuits (RFICs), or any combination of these), a main memory, and a non-volatile memory, which are configured to communicate with each other via a bus. The computer system may further include graphics display unit (e.g., a plasma display panel (PDP), a liquid crystal display (LCD), a projector, or a cathode ray tube (CRT)). The computer system may also include alphanumeric input device (e.g., a keyboard), a cursor control device (e.g., a mouse, a trackball, a joystick, a motion sensor, a touch screen, or other pointing instrument), a storage unit, a signal generation device (e.g., a speaker), and a network interface device, which also are configured to communicate via the bus.

Petitioner Samsung Ex-1004, 1089

[0360] The storage unit includes a non-transitory machine-readable medium on which is stored instructions embodying any one or more of the methodologies or functions described herein. The instructions may also reside, completely or at least partially, within the main memory or within the processor (e.g., within a processor's cache memory) during execution thereof by the computer system, the main memory and the processor also constituting machine-readable media. The instructions may be transmitted or received over a network via the network interface device.

[0361] While machine-readable medium is shown in an example embodiment to be a single medium, the term "machine-readable medium" should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, or associated caches and servers) able to store instructions. The term "machine-readable medium" shall also be taken to include any medium that is capable of storing instructions for execution by the machine and that cause the machine to perform any one or more of the methodologies disclosed herein. The term "machine-readable medium" includes, but not be limited to, data repositories in the form of solid-state memories, optical media, magnetic media, or other non-transitory machine readable medium.

[0362] **X. Conclusion**

[0363] It should be clear that the WCD and TCD arrangements described according to various aspects of the disclosure provide a highly versatile and useful item of wearable electronics that is comfortable and convenient to wear, conveniently charged, and weatherproof for all-purpose and all-condition wearing. Various options for style and appearance can be implemented, as well as a variety of storage options. The functions and structure of the device lend themselves to both a ring version and a wrist-worn version. All versions are designed for long-life with minimal maintenance, and are adaptable to interoperate with a variety of networked devices including computers, smartphones, home controllers, security systems, and virtually any other device capable of communicating over a wireless link-including another WCD or TCD.

[0364] The foregoing has been a detailed description of illustrative embodiments of the invention. Various modifications and additions can be made without departing from the spirit and scope of this invention. Features of each of the various embodiments

Petitioner Samsung Ex-1004, 1090

described above may be combined with features of other described embodiments as appropriate in order to provide a multiplicity of feature combinations in associated new embodiments. Furthermore, while the foregoing describes a number of separate embodiments of the apparatus and method of the present invention, what has been described herein is merely illustrative of the application of the principles of the present invention. For example, as used herein various directional and orientational terms such as "vertical", "horizontal", "up", "down", "bottom", "top", "side", "front", "rear", "left", "right", and the like, are used only as relative conventions and not as absolute orientations with respect to a fixed coordinate system, such as the acting direction of gravity. Note also, as used herein the terms "process" and/or "processor" should be taken broadly to include a variety of electronic hardware and/or software based functions and components. Moreover, a depicted process or processor can be combined with other processes and/or processors or divided into various sub-processes or processors. Such sub-processes and/or sub-processors can be variously combined according to embodiments herein. Likewise, it is expressly contemplated that any function, process, application, and/or processor here herein can be implemented using electronic hardware, software consisting of a non-transitory computer-readable medium of program instructions, or a combination of hardware and software. Also, while a variety of visible and near-visible radiation sources are described as LEDs, it is expressly contemplated that other types of sources can be employed according to aspects of the disclosure-for example plasma discharge sources and bioluminescent sources, as well as sources that are based upon developing technologies. Electronic circuits and RF components can similarly be based on alternate and/or developing technologies. Accordingly, this description is meant to be taken only by way of example, and not to otherwise limit the scope of this invention.

Petitioner Samsung Ex-1004, 1091

WEARABLE COMPUTING DEVICE

CROSS REFERENCE

[0001] The present Application for Patent is a Continuation of U.S. Patent Application No. 18/179,272, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed March 6, 2023, which is a Continuation of U.S. Patent Application No. 17/519,201, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed November 4, 2021, which is a Continuation of U.S. Patent Application No. 17/013,348, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed September 4, 2020, which is a Continuation of U.S. Patent Application No. 16/224,686, by von Badinski et al, entitled "WEARABLE COMPUTING DEVICE," filed December 18, 2018, which is a Division of U.S. Patent Application No. 15/444,217, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed February 27, 2017, which is a Division of U.S. Patent Application No. 14/556,062, by von Badinski et al, entitled "WEARABLE COMPUTING DEVICE," filed November 28, 2014, which claims the benefit of United States Provisional Application Serial No. 62/006,835, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed June 2, 2014, and United States Provisional Application Serial No. 61/910,201, by von Badinski et al., entitled "FINGER RING DEVICE FOR ACTIVITY MONITORING OR GESTURAL INPUT," filed November 29, 2013, each of which is expressly incorporated by reference herein.

FIELD OF TECHNOLOGY

[0002] This invention is in the field of wearable electronic devices.

BACKGROUND

[0003] Wearable electronics are an emerging technology with many applications for the wearer. They can improve lifestyles, ease access to technology and help monitor activity within the wearer's body. However, many current wearable electronics are bulky and can be intrusive or interfere with a person's daily life. In this regard, the wearer may not be comfortable wearing the device for extended periods of time.

Petitioner Samsung Ex-1004, 1092

SUMMARY OF THE INVENTION

[0004] This invention overcomes the disadvantages of the prior art by providing a wearable computing device (WCD) in the shape of a ring. The wearable computing device can be worn for extended periods of time and can take many measurements and perform various functions because of its form factor and position on the finger of a user.

[0005] One aspect of the disclosure provides a wearable computing device, comprising: an interior wall; an exterior wall; a flexible printed circuit board disposed between the interior wall and the exterior wall; at least one component disposed on the flexible printed circuit board; and wherein at least one of the interior wall and the exterior wall defines a window that facilitates at least one of data transmission, battery recharge, and status indication.

[0006] In one example, the window comprises an internal window defined by the interior wall.

[0007] In one example, the window comprises an exterior window defined by the exterior wall.

[0008] In one example, the window comprises a plurality of exterior windows defined by the exterior wall.

[0009] In one example, the plurality of exterior windows comprises a first exterior window and a second exterior window, wherein the first exterior window facilities battery charging and the second exterior window facilities data transmission.

[0010] In one example, at least one concentrated photovoltaic cell, an antenna, and at least one LED are accessible via the window.

[0011] Another aspect of the disclosure provides a wearable computing device, comprising: an internal housing portion configured to be disposed near a finger of a user; a flexible printed circuit board arranged around a portion of a circumference of an interior surface of the internal housing; at least one component disposed on the flexible printed circuit board; and an external housing portion configured to seal the at least one component and the printed circuit board in an internal space defined by the interior surface of the internal housing.

Petitioner Samsung Ex-1004, 1093

[0012] In one example, the external housing portion comprises a substantially transparent external potting.

[0013] In one example, the at least one component comprises at least one LED configured to emit at least one of visible light, infrared radiation, and ultraviolet radiation through the external potting.

[0014] In one example, the at least one component comprises a concentrated photovoltaic cell configured to receive concentrated light through the transparent external potting.

[0015] In one example, the flexible printed circuit board includes a plurality of stiffener elements configured to engage with a corresponding plurality of flanges disposed on the internal housing portion.

[0016] Another aspect of the disclosure provides a wearable computing device, comprising: an external housing portion; a flexible printed circuit board arranged around a portion of a circumference of an interior surface of the external housing; at least one component disposed on the flexible printed circuit board; and an internal housing portion configured to seal the at least one component and the printed circuit board in an internal space defined by the interior surface of the external housing.

[0017] In one example, the internal housing portion comprises a substantially transparent internal potting.

[0018] In one example, the at least one component comprises at least one LED configured to emit at least one of visible light, infrared radiation, and ultraviolet radiation through the internal potting.

[0019] In one example, the at least one component comprises a concentrated photovoltaic cell configured to receive concentrated light through the transparent internal potting.

[0020] In one example, the flexible printed circuit board includes a plurality of stiffener elements configured to engage with a corresponding plurality of flanges disposed on the external housing portion.

[0021] Another aspect of the disclosure provides a system, comprising: a wearable computing device, including a housing and a photovoltaic element disposed at least

Petitioner Samsung Ex-1004, 1094

partially within the housing; and a base assembly, the base assembly including a concentrated light source directed at the photovoltaic element.

[0022] In one example, the wearable computing device includes at least one ferrous element disposed within the housing, and wherein the base assembly includes at least one magnetic element disposed therein.

[0023] In one example, the concentrated light source is arranged circumferentially around the wearable computing device when the wearable computing device is engaged with the base assembly.

[0024] In one example, the concentrated light source comprises at least one of a laser diode and a light emitting diode (LED).

[0025] In one example, a housing of the WCD defines an opening through which the WCD is configured to receive concentrated light.

[0026] In one example, the base assembly comprises an optical element for focusing concentrated light emitted from the concentrated light source.

[0027] In one example, the optical element comprises a lens and is selected from the group consisting of concave, convex, piano-concave, piano-convex.

[0028] In one example, the WCD comprises at least one transparent potting configured to allow concentrated light to pass therethrough.

[0029] In one example, the WCD is ring-shaped and the base assembly comprises at least one post configured to engaged with a finger space of the WCD.

[0030] In one example, the photovoltaic cell comprises a plurality of photovoltaic cells.

[0031] Another aspect of the disclosure provides an enclosure for a wearable computing device, the enclosure comprising: a base defining a receptacle for receiving the wearable computing; a lid configured to engage with the base to substantially enclose the wearable computing device, the lid having an optical element configured to direct incident electromagnetic radiation to photovoltaic cell disposed on the wearable computing device to allow charging thereof.

Petitioner Samsung Ex-1004, 1095

[0032] In one example, the lid includes a plurality of vent holes that prevent overheating within the enclosure.

[0033] In one example, the optical element comprises a lens.

[0034] In one example, the lens has a focal length and wherein a distance between a central portion of the lens and the photovoltaic cell is greater than or less than the focal length.

[0035] Another aspect of the disclosure provides a timepiece system, comprising: a timepiece having a substantially planar under surface; and a timepiece computing device adhered to the planar under surface, the timepiece computing device being substantially cylindrical and comprising: a processor; a memory; and at least one sensor.

[0036] Another aspect of the disclosure provides a wearable computing device system, comprising: a wearable computing device; an attachment frame coupled to the wearable computing device; and an optical element removably coupled to the attachment frame, wherein the optical element is configured to direct electromagnetic radiation to a photovoltaic cell disposed on a surface of the wearable computing device to allow for charging of the wearable computing device.

[0037] In one example, the attachment frame is removably coupled to the wearable computing device.

[0038] In one example, the attachment frame engages with an inward-facing surface of the wearable computing device.

[0039] Another aspect of the disclosure provides a method of identifying an authorized user of a wearable computing device, comprising: illuminating a portion of a skin surface of the user; imaging the portion of the skin surface of the user to generate at least one first image; generating a reference capillary map corresponding to the user based at least in part on the at least one image.

[0040] In one example, the method further includes rotating the wearable computing device during the illuminating and imaging steps.

[0041] In one example, the method further includes imaging the portion of the skin surface of the user to generate at least one second image; and comparing the at least one second image to the reference capillary map in order to authenticate the user.

Petitioner Samsung Ex-1004, 1096

[0042] Another aspect of the disclosure provides a method of navigating, comprising: gesturing in a first direction while wearing a wearable computing device; comparing the first direction to a predetermined direction in a predetermined set of directions; providing feedback based on the comparison of the first direction of the predetermined direction.

[0043] In one example, the gesture comprises pointing a finger and the first direction comprises a first heading.

[0044] Another aspect of the disclosure provides a method of regulating temperature, comprising: measuring a skin temperature of a user via a first temperature sensor; measuring an ambient temperature via a second temperature sensor; comparing the skin temperature to a predetermined threshold temperature; and adjusting the ambient temperature based in part on the comparison.

[0045] In one example, measuring the skin temperature comprises measuring the skin temperature via a first temperature sensor disposed at an inward facing surface of a wearable computing device.

[0046] In one example, measuring the ambient temperature comprises measuring the ambient temperature via a second temperature sensor disposed at an outward facing surface of the wearable computing device.

[0047] Another aspect of the disclosure provides a method for controlling appliances, comprising: identifying a position of a first appliance in a room; gesturing a first gesture in a direction of the first appliance; identifying the direction of the first direction via a wearable computing device; issuing a controlling command to the first appliance based in part on the identified direction of the gesture.

[0048] Another aspect of the disclosure provides a method of generating an alert, comprising: authenticating a first wearer of a first wearable computing device as a first authenticated user; transmitting first biometric data associated with the first wearer; associating the first biometric data with a first profile associated with the first wearer of the first wearable computing device; comparing the first biometric data with a group profile comprising aggregated biometric data from a plurality of distinct wearers of a plurality of distinct wearable computing devices; and generating an alert if the first

Petitioner Samsung Ex-1004, 1097

biometric data falls outside of a predetermined threshold set by the aggregated biometric data.

[0049] In one example, the biometric data comprises at least one of heart rate; ECG profile; blood sugar, and blood pressure.

[0050] In one example, the plurality of distinct wearers share a common trait, resulting in their aggregation into the group profile.

[0051] In one example, the common trait comprises at least one of: age, gender, profession, and location.

[0052] Another aspect of the disclosure provides a method of determine a sampling rate of a wearable computing device, comprising: determining an activity level of a wearer of a wearable computing device based at least in part on data from at least one sensor disposed onboard the wearable computing device; comparing the activity level to a predetermined activity threshold; and increasing a first sensor sampling rate if the activity level is above a predetermined activity threshold.

[0053] In one example, the method further includes decreasing the first sensor sampling rate if the activity level is below a predetermined activity threshold.

[0054] In one example, the predetermined activity threshold comprises an acceleration measurement.

BRIEF DESCRIPTION OF THE DRAWINGS

[0055] The invention description below refers to the accompanying drawings, of which:

[0056] FIG. 1A is a perspective view of a WCD illustrating an exterior window in accordance with some embodiments;

[0057] FIG. 1B is a perspective view of the WCD of FIG. IA illustrating an interior window in accordance with some embodiments;

[0058] FIG. 1C is a perspective view of an alternative WCD design of the ring of FIG. IA in accordance with some embodiments;

Petitioner Samsung Ex-1004, 1098

[0059] FIG. 2 is an abstract functional diagram illustrating example components within the WCD in accordance with some embodiments;

[0060] FIG. 3A is a view of an exterior window of a WCD with example components exposed in accordance with some embodiments;

[0061] FIG. 3B is a view of an interior window of a WCD with example components exposed in accordance with some embodiments;

[0062] FIG. 3C is a view of the exterior windows of an alternative WCD with example components exposed in accordance with some embodiments;

[0063] FIG. 4 is an exploded view of a WCD illustrating a battery and a flexible circuit which are configured to fit inside the housing of the WCD in accordance with some embodiments;

[0064] FIG. 5 is a perspective view of the flexible circuit of FIG. 4 in accordance with some embodiments;

[0065] FIG. 6 is an exploded view of a WCD with an alternative charging mechanism in accordance with some embodiments;

[0066] FIG. 7 is a perspective view of an alternative design of a WCD in accordance with some embodiments;

[0067] FIG. 8 is an exploded view of the WCD of FIG. 7 illustrating another alternative charging mechanism in accordance with some embodiments;

[0068] FIG. 9A is a perspective view of a charging device for the ring station in accordance with some embodiments;

[0069] FIG. 9B is an abstract diagram illustrating a partial structure of the charging station of FIG. 9A in accordance with some embodiments;

[0070] FIG. 10 is an example screenshot illustrating a user interface of a mobile application coupled to the WCD and displaying fitness monitoring readings in accordance with some embodiments;

Petitioner Samsung Ex-1004, 1099

[0071] FIG. 11 is an example screenshot illustrating a user interface of a mobile application coupled to the WCD and displaying sensor readings (e.g., for calibration purposes) in accordance with some embodiments;

[0072] FIG. 12A is a perspective view of a wearable computing device (WCD) according to one or more aspects of the disclosure;

[0073] FIG. 12B is a side view of a WCD according to one or more aspects of the disclosure;

[0074] FIG. 12C is a front view of the WCD according to one or more aspects of the disclosure;

[0075] FIG. 12D is a cross section of the WCD along the line A-A of FIG. 12C;

[0076] FIG. 12E is a perspective view of the internal housing without external potting;

[0077] FIG. 12F is a perspective view of the internal housing with a portion of the external potting removed and showing one or more components and printed circuit board (PCB);

[0078] FIG. 13 is a cross section of a WCD according to another aspect of the disclosure;

[0079] FIG. 14A is a cross section of a WCD according to another aspect of the disclosure;

[0080] FIG. 14B is a perspective view of the PCB and stiffener element of FIG. 14A;

[0081] FIG. 14C is a perspective view of the PCB and stiffener element of FIG. 14A;

[0082] FIG. 14D shows a cross section of the WCD at a point in time when the PCB is being inserted into the internal space and prior to the application of potting;

[0083] FIG. 14E is a cross section of the WCD of after a potting material has been applied subsequent to the WCD of FIG. 14D;

Petitioner Samsung Ex-1004, 1100

[0084] FIG. 15A depicts a perspective view of a WCD according to another aspect of the disclosure;

[0085] FIG. 15B is a side view of the WCD of FIG. 15A;

[0086] FIG. 16A is an exploded view of a housing and a PCB of a WCD according to one or more aspects of the disclosure;

[0087] FIG. 16B is a cross section of FIG. 16A along line B-B;

[0088] FIG. 16C is a perspective view of the WCD with potting material;

[0089] FIG. 17A depicts a cross section of a WCD employing charging by concentrated light source according to one or more aspects of the disclosure;

[0090] FIG. 17B depicts a cross section of a WCD employing charging by concentrated light source according to another aspect of the disclosure;

[0091] FIG. 17C is a perspective view of a base assembly and WCD 700 according to one or more aspects of the disclosure;

[0092] FIG. 17D depicts a perspective view of internal components of the base assembly 750 and WCD 700 according to another aspect of the disclosure;

[0093] FIGs. 17E-F depict other CPV configurations according to one or more aspects of the disclosure;

[0094] FIG. 17G is perspective view of a WCD and base assembly with a lx3 CPV arrangement;

[0095] FIG. 18A depicts a cross section of a WCD 800 employing charging by concentrated light source according to another of the disclosure;

[0096] FIG. 18B depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure;

[0097] FIG. 19A depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure;

[0098] FIG. 19B depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure;

Petitioner Samsung Ex-1004, 1101

[0099] FIG. 19C depicts a schematic diagram of magnets that can be used in a WCD and/or base assembly according to one or more aspects of the disclosure;

[0100] FIG. 19D depicts a schematic diagram of magnets that can be used in a WCD and/or base assembly according to one or more aspects of the disclosure;

[0101] FIG. 19E is a perspective view of a WCD and a base assembly according to one or more aspects of the disclosure;

[0102] FIG. 20A is a cross section of a WCD engaged with a base assembly 1050 according to one or more aspects of the disclosure;

[0103] FIG. 20B is a perspective view of a PCB 1040b with a CPV 1030b and ferrous element 1020b configuration according to one or more aspects of the disclosure;

[0104] FIG. 20C is a perspective view of a PCB with a CPV 1030c and ferrous element 1020c configuration according to one or more aspects of the disclosure;

[0105] FIG. 20D is a perspective view of a magnet and a concentrated light source 1070d according to one or more aspects of the disclosure;

[0106] FIG. 21A is a schematic view of a WCD showing components used for identifying the wearer of the WCD;

[0107] FIGs. 21B-C are perspective views of a skin surface according to one or more aspects of the disclosure;

[0108] FIG. 22A is a perspective view of a user employing ECG monitoring according to one or more aspects of the disclosure;

[0109] FIG. 22B is a view of a human with an electric pathway though his body according to one or more aspects of the disclosure;

[0110] FIG. 22C is a perspective view of a WCD that can employ ECG monitoring according to one aspect of the disclosure;

[0111] FIG. 23A is a perspective view of the hand of a user in various positions employing the navigational features of the WCD;

[0112] FIG. 23B is a flow chart depicting a method of providing feedback to a user according to one or more aspects of the disclosure;

Petitioner Samsung Ex-1004, 1102

[0113] FIG. 24A is a schematic diagram of a system 1400 for controlling an environment of a user according to one or more aspects of the disclosure;

[0114] FIG. 24B is a side view of a WCD showing one or more temperatures sensors according to one or more aspects of the disclosure;

[0115] FIG. 24C is a system diagram of a system for controlling home appliances according to one or more aspects of the disclosure;

[0116] FIG. 24D is a flow chart depicting a method of controlling home appliances according to one or more aspects of the disclosure;

[0117] FIG. 25 is a perspective view of the hand of a user employing a two-factor authentication technique according to one or more aspects of the disclosure;

[0118] FIG. 26A is a schematic view of a charging apparatus for charging the WCD according to one or more aspects of the disclosure;

[0119] FIG. 26B shows a WCD including an RF antenna and charging circuitry;

[0120] FIG. 26C is a block diagram of the charging apparatus according to one aspect of the disclosure;

[0121] FIG. 26D is a pictorial diagram showing of the WCD according to one or more aspects of the disclosure;

[0122] FIG. 27A is a pictorial diagram and FIG. 27B is a block diagram of a WCD employing flash storage according to one or more aspects of the disclosure;

[0123] FIG. 28A is a schematic diagram of one or more WCDs performing proximity functions according to one or more aspects of the disclosure;

[0124] FIG. 28B is a schematic diagram of one or more WCDs performing proximity functions according to one or more aspects of the disclosure;

[0125] FIG. 29A is a flow chart depicting a method of initiating gesture input according to one or more aspects of the disclosure;

[0126] FIG. 29B is a chart showing acceleration vs. time as measured by the accelerometer of the WCD;

[0127] FIG. 30 is a perspective view of a WCD 2000 employing a reset function;

Petitioner Samsung Ex-1004, 1103

[0128] FIG. 31A is a perspective view of a WCD including an LED indicator according to one or more aspects of the disclosure;

[0129] FIGs. 31B and 31C are cross sections along line C-C of a WCD employing an LED indicator according to one or more aspects of the disclosure;

[0130] FIG. 32 is flow chart depicting a method of communicating with a near field communication (NFC) device according to one or more aspects of the disclosure;

[0131] FIG. 33A depicts a perspective view of a WCD assembly according to one or more aspects of the disclosure;

[0132] FIGs. 33B-D depict exploded views of the WCD assembly of FIG. 33A;

[0133] FIG. 33E depicts a cross sectional view of the WCD assembly along A-A;

[0134] FIGs. 34A-B depict a WCD assembly according to one or more aspects of the disclosure;

[0135] FIG. 35A depicts an enclosure or case for storing a WCD according to one or more aspects of the disclosure;

[0136] FIG. 35B is a cross sectional view of the assembled enclosure of FIG. 35A along the line B-B;

[0137] FIG. 35C depicts a cross sectional view of the assembled enclosure of FIG. 35B along line A-A;

[0138] FIG. 36 depicts an enclosure including air vents according to one or more aspects of the disclosure;

[0139] FIG. 37 depicts a method of sizing a finger according to one or more aspects of the disclosure;

[0140] FIG. 38 is a pictorial diagram showing a plurality of image perspectives of a user's hand;

[0141] FIG. 39 depicts a sizing tool for sizing the finger of a user;

[0142] FIG. 40 depicts a sizing tool for sizing the finger of a user according to an alternate example;

Petitioner Samsung Ex-1004, 1104

[0143] FIG. 41 depicts yet another alternate example of a sizing tool for sizing the finger of a user;

[0144] FIG. 42 depicts a method of monitoring activity according to one or more aspects of the disclosure;

[0145] FIG. 43 depicts a method of determining whether a user is wearing gloves according to one or more aspects of the disclosure;

[0146] FIG. 44 depicts a method of securing data onboard the WCD according to one or more aspects of the disclosure;

[0147] FIG. 45A is a timepiece system according to one or more aspects of the disclosure;

[0148] FIG 45B is a bottom view of the TCD;

[0149] FIG. 46 depicts a WCD with a pair of LED indicators disposed at an inward-facing portion of the WCD;

[0150] FIG. 47A is a system for generating and managing alerts according to one or more aspects of the disclosure;

[0151] FIG. 47B depicts a block process diagram for generating and managing alerts according to one or more aspects of the disclosure;

[0152] FIG. 47C is a flow chart depicting a method for generating and managing alerts according to one or more aspects of the disclosure;

[0153] FIG. 48A is a method for variable sampling according to one or more aspects of the disclosure; FIG. 48B and 48c are graphs depicting one or more aspects of the sample method of FIG. 48A; and

[0154] FIG. 49 is a diagrammatic representation of a machine in the example form of a computer system within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed.

DETAILED DESCRIPTION

[0155] The present disclosure describes a wearable computing device (WCD) that enables a wearable fitness monitor(s)/computer(s) which is suitable for prolonged usage

Petitioner Samsung Ex-1004, 1105

with accurate results. The WCD can be in the form of a ring that can be worn on the finger of a human (or animal) user. Although the WCD of the present disclosure is depicted as a ring that can be worn on the finger of a user, other shapes, designs, and form factors can be utilized for the WCD. For example, the WCD can be in the form of a wrist band, bracelet, necklace, earring, or any other type of wearable accessory. In this regard, references to the finger of a user in the present application can be considered to apply to other portions of a human body depending on the form of the WCD, such as wrist, neck, ear, etc.

[0156] The term "coupled" as used herein means connected directly to or connected through one or more intervening components or circuits. Any of the signals provided over various buses described herein may be time-multiplexed with other signals and provided over one or more common buses. Additionally, the interconnection between circuit elements or software blocks may be shown as buses or as single signal lines. Each of the buses may alternatively be a single signal line, and each of the single signal lines may alternatively be buses, and a single line or bus might represent any one or more of a myriad of physical or logical mechanisms for communication (e.g., a network) between components. The present embodiments are not to be construed as limited to specific examples described herein but rather to include within their scope all embodiments defined by the appended claims.

[0157] FIG. 1A is a perspective view of 100 of a WCD 110 illustrating an exterior window 120 in accordance with some embodiments, and FIG. 1B is a perspective view 102 of the WCD 110 of FIG. 1A illustrating an interior window 130.

[0158] As previously mentioned, it is recognized in the present disclosure that conventional wearable fitness monitors such as clip-on devices, wristbands, or watch-type monitors still often suffer from inaccuracy mainly because they lack constant and consistent ways to read from the body areas they aim to monitor. It can also be an extra burden for the person to remember and wear such conventional fitness monitors each time the person perform exercises in order to create an accurate history tracking the exercise activities.

[0159] Accordingly, the present embodiments of the WCD 110 can function as fitness monitors/computer which is suitable for prolonged usage so as to create accurate

Petitioner Samsung Ex-1004, 1106

results. In addition or as an alternative to fitness monitoring, as will be discussed in more detail below, the WCD 110 can function as a remote input device through, for example, gesture recognition. In some embodiments, the WCD 110 can further function as a sleep monitor, a heart rate sensor, a cardiac monitor a body temperature detector, or the like. It is noted that, for those embodiments which can function as a cardiac monitor (e.g., that measures electrocardiogram (EKG)), it may be necessary to establish a closed loop (e.g., for the electrical measurement of EKG) across the heart. As such, in some of those embodiments, a separate conductive pad can be coupled to the WCD 110 so that a user can pinch the pad with fingers on an opposite hand,

[0160] Specifically, in some embodiments of the present disclosure, the WCD 110 can be worn by the user (e.g., on a finger) for fitness, physical activity, biological data monitoring as well as for gestural input or other suitable purposes. As shown in FIGS. 1A and 1B, the WCD 110 can include the exterior window 120 on its exterior wall for input/output data transmission and reception, battery recharge, or status indication. The WCD 110 can also include the interior window 130 on its interior wall for various monitoring or sensing activities. The form factor of the WCD 110 allows it to be worn for prolonged hours with constant and consistent contact with the skin area, thereby creating a more reliable and extended recording (e.g., as compared to aforementioned conventional fitness monitors) of the user's fitness activity, physical exercise, as well as health information such as heart rates and body temperature. More implementation details regarding the WCD 110 are discussed below.

[0161] FIG. 1C is a perspective view of an alternative design of the WCD 110 of FIG. IA in accordance with some embodiments. As shown in FIG. IC, the WCD 112 includes a second exterior window 124 in addition to a first exterior window 122. The two exterior windows 122 and 124 can include spacing between the two windows 122 and 124 so that the mechanical strength of the housing structure of the WCD 112 may be stronger than that of the WCD 110, which is shown to include one single exterior window 120. Further, in some embodiments, radio antennas (e.g., Bluetooth) or other sensitive circuitry can be positioned in the second exterior window 124 away from the first exterior window 122 so that quality of reception may be improved.

[0162] FIG. 2 is an abstract functional diagram 200 illustrating example components within the WCD (e.g., WCD 110) in accordance with some embodiments.

Petitioner Samsung Ex-1004, 1107

As shown in diagram 200, the WCD 110 can include a processor module 210, a plurality of sensor modules 220, a status indicator module 230, a power generation and management module 240, a communication module 250, a memory 260, and miscellaneous modules 270 (e.g., a real-time clock (RTC) crystal oscillator as illustrated in FIG. 2). The WCD 110 can also include a battery 280 module that provides electrical power for the WCD 110. In some embodiments, the battery 280 can be of a lithium-polymer type or a zinc-polymer type. It is noted that modules illustrated in diagram 200 are for purposes of facilitating a better understanding of the present embodiments; other suitable modules may be included in the WCD 110 and are not shown for simplicity. As used herein, the term "components" is considered to generally include any of the modules depicted and/or described in FIG. 2, as well as any other modules described herein.

[0163] It is noted that the aforementioned modules are intended for purposes of enabling the present embodiments, rather than limiting. As such, a person of ordinary skill in the art will understand that the present disclosure covers apparent alternatives, modifications, and equivalents (e.g., combining or separating the modules) made to the techniques described herein. For example, in some embodiments, a portion of the communication module 250 (e.g., the Bluetooth Chip as shown in FIG. 2) can be combined into the processor module 210. For another example, one or more modules herein can be combined into one to form a system-on-the-chip (SOC).

[0164] The processor module 210 can have generic characteristics similar to general purpose processors or may be application specific integrated circuitry that provides arithmetic and control functions to the WCD 110. The processor can be any type of processor, such as a processor manufactured by AMtel, Freescale, Nordic Semiconductor, Intel®, AMD®, or an ARM® type processor. The processor module 210 can include a dedicated cache memory (not shown for simplicity). The processor module 210 is coupled to all modules 220-270 in the WCD 110, either directly or indirectly, for data and control signal transmission.

[0165] The memory 260 may include any suitable type of storage device including, for example, ROM, such as Mask ROM, PROM, EPROM, EEPROM; NVRAM, such as Flash memory; Early stage NVRAM, such as nvSRAM, FeRAM, MRAM, or PRAM, or any other type, such as, CBRAM, SONOS, RRAM, Racetrack memory, NRAM,

Petitioner Samsung Ex-1004, 1108

Millipede memory, or FJG. Other types of data memory can be employed as such are available in the form factor desired.

[0166] In addition to storing instructions which can be executed by the processor module 210, the memory 260 can also store data generated from the processor module 210. It is noted that the memory 260 can be an abstract representation of a generic storage environment. According to some embodiments, the memory 260 may be comprised of one or more actual memory chips or modules. In some embodiments, the memory 260 can function as a temporary storage (e.g., for firmware updates, and/or for avoiding accidental malfunctions (such as so-called "bricking")).

[0167] In accordance with one or more embodiments, the sensor modules 220 can include various sub-modules for the WCD 110 to perform different monitoring or sensing activities. A view 302 of the interior window (e.g., window 130) of a WCD (e.g., WCD 110) with example components exposed is shown in FIG. 3B. As shown in the example of FIG. 3B, the sensor modules 220 can include a temperature sensor 320a, a red light emitting diode (LED) 320b, a light sensor 320c, and an infra-red LED 320d. Among the sensors in the sensor modules 220, those sensors (e.g., sensors 320a-320d) which are directly related to biological sign monitoring can be configured and positioned in a way that is close to the skin (e.g., facing the interior window 130 of the WCD 110). Although not shown in FIG. 3B for simplicity, the sensor modules 220 can further include sensors that are not directly related to biological sign monitoring; some examples of these sensors include accelerometers, gyroscopes, vibration, sensors (e.g., a magnetometer or a digital compass), or other suitable sensors (e.g., for gesture recognition). The magnetometer can measure the strength and/or direction of a prevailing magnetic field. In this regard, the magnetometer can be used during global positioning and/or navigation. In particular, the magnetometer can be used to measure a directional heading when the WCD is in motion and can supplement position data where the WCD is out of communication range. In one or more embodiments, the accelerometers in the sensor modules 220 can detect movements in multiple (e.g., 3) dimensions or axes. The accelerometer can measure force of acceleration of the WCD and can measure gestures performed by a user while wearing the WCD. In other examples, the accelerometer can detect acceleration of the user while wearing the WCD.

Petitioner Samsung Ex-1004, 1109

This can permit tracking of activity level, such as steps taken or number of laps swum in a pool.

[0168] The temperature sensor can be any type of sensor that detects temperature, such as a thermistor, PTC, NTC, etc. In another example, the temperature sensor can use IR light emitted from an object to calculate a surface temperature of the object in a manner clear to those of ordinary skill in the art.

[0169] Together, the processor module 210 and the sensor modules 220 can enable the WCD 110 to perform multiple functions including, for example, pedometer, sleep monitor (e.g., which monitors sleep quality), heart rate sensor, pulse oximetry, skin (and in select embodiments, ambient) temperature. In addition, some embodiments of the WCD 110 can further function as a gesture input device. In particular, the present embodiments recognize that the WCD 110 can detect finger motions or gestures which may be difficult for conventional fitness sensors to detect, such as a tap, a snap, a knock on the table, and the like. In some embodiments, the WCD 110 can utilize the accelerometer to measure the activity level (e.g., arm movement) in conjunction with the measured heart rate to determine if the user is walking horizontally, running, swimming, or climbing stairs. Other activities can be identified by the WCD 110 may include biking or sleeping.

[0170] In some embodiments, the WCD 110 can also be programmed to learn particular gestures or physical exercise from the user using, for example, a training mode. For example, the user can instruct (e.g., using a computer or a mobile device of the user) the WCD 110 to enter the training mode and perform the gesture or physical exercise; the WCD 110 can record the readings from the sensor modules 220, recognize patterns therefrom, and store the result in, for example the memory 260, so that such gesture or exercise can be recognized by the WCD 110 after the training. The WCD 110 can be configured (e.g., via a mobile application running on a mobile device of the user) so that the recognized gestures can perform functions designated by the user, such as clicks, swipes, unlocks, or media player controls. In one embodiment, the WCD 110 can include near field communication (NFC) chips so that certain functions (e.g., unlocking a smart phone) can be performed when the WCD 110 touches upon or otherwise be detected by another NFC device. In some embodiments, the unlocking function of the

Petitioner Samsung Ex-1004, 1110

WCD 110 can also unlock a user device (e.g., a phone) via the communication module 250 (e.g., Bluetooth) by the WCD 110 transmitting a proper unlock code.

[0171] Moreover, the WCD 110 can function as a key or a control device for keyless access to home, automobile, or other suitable user authentication processes. The WCD 110 can also be integrated with games and game consoles so that it can function as an input device to those games and consoles. In some embodiments, the WCD 110 can be adapted for use in medical and home health monitoring, or as a transportation safety device (e.g., that broadcasts emergency messages to relevant authorities). Additional examples of sensors/functionalities of the WCD 110 can include an inertial measurement unit (IMU) (e.g., for more complex gesture recognition, a near-infrared (NIR) spectrometer (e.g., for measuring light absorption and deriving blood glucose/ blood alcohol/ CO2 content), a Galvanic skin response sensor (e.g., for measuring sweat/ nervousness), an electrocardiogram (ECG or EKG), and so forth.

[0172] In some embodiments, the processor module 210 can determine (e.g., based on identified physical activities, routine pattern, and/or time) a frequency at which one or more sensors in the sensor modules 220 should operate. Because it is recognized in the present disclosure that the heart rate of a human being typically does not vary too widely (e.g., beyond a certain percentage of what has been previously measured), in some embodiments, the WCD 110 can automatically adjust the sensor modules 220 (e.g., to slow down) so as to save power. More specifically, some embodiments of the WCD 110 can include a phase-locked loop or logic to predict the pulse width by determining lower and upper ranges in which the heart rate is predicted to be, thus only powering up the sensor modules 220 at the time of the predicted heartbeats. For one example, if the WCD 110 determines that the user is at sleep (e.g., based on the heart rate, the body temperature, together with the movements detected by the accelerometer and/or the vibration detector), the WCD 110 can slow down its heart rate detection frequency (e.g., from 1 measurement per second to 1 measurement per 10 seconds) and skip the measurement of several heartbeats because it is unlikely that the heart rate will change drastically during that period. Conversely, if the WCD 110 determines that the user is performing a high intensity physical exercise, the WCD 110 can increase the frequency of monitoring and recording of the sensor modules 220.

Petitioner Samsung Ex-1004, 1111

[0173] In accordance with one or more embodiments, the WCD 110 also includes various modules coupled to the processor module 210 for, by way of example but not limitation, input/output data transmission, battery recharge, or status indication. A view 300 of the exterior window (e.g., window 120) of a WCD (e.g., WCD 110) with example components exposed is shown in FIG. 3A. As shown in the example of FIG. 3A, the modules configured to face the exterior window 120 of the WCD 110 can include parts from the status indicator module 230, the power generation and management module 240, and the communication module 250.

[0174] Specifically, one embodiment of the WCD 110 includes the status indicator module 230 coupled to the processor module 210 to indicate various statuses. In some embodiments, the status indicator module 230 includes a light emitting diode (LED) 330, such as shown in FIG. 3A. The LED 330 can be a single red/green/blue (RGB) LED. In other embodiments, the status indicator module 230 can include other suitable types of indicator devices including, for example, a single color LED, an electrophoretic ink (or "e-ink") display, a persistent display, or the like. In accordance with some embodiments, the WCD 110 can utilize the indicator module 230 (e.g., via the RGB LED 330 through the exterior window 120) to visually communicate with the user. For example, a red color can be displayed (e.g., for a predetermined period of time) by the LED 330 that the WCD 110 needs to be recharged, and a green color can be displayed to indicate that the WCD 110 is fully charged. For another example, a blue color can be displayed when the communication module 250 is in use. In one or more embodiments, the user can program a fitness goal (e.g., a target heart rate) to the WCD 110 so that, for example, a green color can be displayed when the heart rate is below the target, a yellow color can be displayed when the target is reached, and a red color can be displayed when the heart rate is above a certain percentage of the set target. Some embodiments of the WCD 110 include the communication module 250 for wireless data transmission. Particularly, in some embodiments, the communication module 250 includes one Bluetooth chip and a Bluetooth antenna 350, such as shown in FIG. 3A. One or more embodiments of the WCD 110 also provides the capability of storing activity logs (e.g., in the memory 260). More specifically, fitness activities, exercise histories, as well as recorded biological signs such as heart rate and body temperature, can be stored onboard in the memory 260 of the WCD 110. Each data entry in the activity logs can be time- stamped using, for example, an onboard real-time clock (e.g., which may be

Petitioner Samsung Ex-1004, 1112

included in miscellaneous modules 270). For power saving and other purposes, the activity log can be downloaded (e.g., via the communication module 250) when requested by the user. In other embodiments, the activity log can be pushed (e.g., via email or other suitable means) by the WCD 110 to a user device at a time designated by the user. In some embodiments, the memory 260 can store up to a full week worth of activity logs.

[0175] The WCD 110 can include the power generation and management module 240 for recharging the battery 280 and for providing electrical power to various modules 210-270 in the WCD 110. Particularly, in some embodiments, the power generation and management module 240 includes one or more concentrated photovoltaic (CPV) cells 340, such as shown in FIG. 3A. The CPV cells 340 can be high-efficiency tandem solar cells and can be attached on the flexible printed circuit (e.g., circuit 415,515). Because the small form factor of the embodiments of the WCD 110, CPV cells 340, which can absorb more light energy from a wider spectrum of light than the traditional solar cells, are used. In some embodiments, multiple (e.g., 3) CPV cells 340 can be configured in series to provide sufficient voltage and/or current for charging the battery 280.

[0176] According to some embodiments, the WCD can include one or more sensing or imaging devices that can be any type of device capable of detecting electromagnetic radiation, such as visible light, IR, NIR, UV, etc. In one example, the device is an imaging device, such as a CMOS or CCD camera.

[0177] According to some embodiments, the WCD 110 can be placed or docked into a charging station for recharging. A perspective view 900 of an example charging station 910 for the WCD 110 is shown in FIG. 9A. The charging station 910 can have concentrated light source circumferentially around the WCD 110 so that the user does not have to be concerned with whether the WCD 110 is facing the right direction for charging. Some embodiments of the charging station 910 can include a light distribution means that takes a single light source and distributes the light all around. An abstract diagram illustrating a partial structure of the light distribution means inside the charging device of FIG. 9A is shown in FIG. 9B. It is noted that, even with the charging station 910, for some embodiments, regular outdoor sunlight or other ambient light source can

Petitioner Samsung Ex-1004, 1113

still function as a secondary source of energy so that the CPV cells 340 on the WCD 110 can extend the operational time provided by the battery 280.

[0178] Additionally or alternatively, energy source attached to the power generation and management module 240 can be passive; for example, some embodiments provides that a clip with a concentrator lens can be attached to the WCD 110 in a way such that the power generation and management module 240 can charge the battery 280 using natural sunlight. In an alternative embodiment, gemstone(s) (e.g., sapphire, diamond, or other suitable materials) in the shape of a dome or with faceted protrusion can be configured to concentrate/magnify light energy while also serving as a decorative feature.

[0179] In some alternative embodiments, the power generation and management module 240 can include electromagnetic induction charging coil so that a WCD (e.g., ring 610) can be charged using an inductive charger. FIG. 6 shows an exploded view 600 of such alternative embodiment of WCD with the inductive charging mechanism including the charging coil 640, as well as battery 680, housing 612, and rigid-flex PCBA 615. However, it is noted that there may be a need to manufacture the inductive charging coil 640 in different sizes that correspond to different ring sizes. Further, it is noted that the efficiency of the electromagnetic induction charging mechanism may be adversely affected by the adoption of a metallic housing. Additionally or alternatively, to avoid multiple sized coils mounted to the edge of the ring, the coil can be placed on the inner or outer sides of the ring by positioning the coil beneath a window in the metal housing of the ring.

[0180] In order to achieve optimal power management of the WCD, one or more of the components can be selected to minimize power usage. For example, a processor, memory, or any other component can be selected based on rated power usage. In one example, it may be desirable to select components that draw current on the order of microamps in order to extend the battery life of the WCD and to allow the WCD to perform health/activity monitoring functions between charging sessions.

[0181] In still some other alternative embodiments, the power generation and management module 240 can include thermoelectric generator (TEG) modules so that a WCD (e.g., WCD 710,810) can be charged by the difference between the body

Petitioner Samsung Ex-1004, 1114

temperature and the ambient temperature. FIG. 7 is a perspective view 700 of such alternative design, and FIG. 8 is an exploded view 800 of the WCD 710 of FIG. 7. Also shown in FIGS. 7 and 8 is an alternative design of the housing for the WCD where the ring includes an outer ring 812a, an inner ring 812b, and insulators 814a and 814b. However, it is noted that utilizing TEGs for charging the battery may be less than ideal since the difference between body temperature and ambient temperature might not be great enough to fully charge the battery, and that in many occasions (e.g., during sleep), the temperature difference needed for TEG to generate electricity may quickly disappear (e.g., since the WCD 710, 810 may be covered inside the comforter).

[0182] The battery can be any type of battery, such as a rechargeable battery. The battery can be a thin, flexible lithium ceramic chemistry battery. In another example, the battery can be a circular formed lithium polymer or lithium ion battery. The battery can provide power to any of the components described above. In one example, the battery can be a lithium cell integrated directly with the flexible PCB described above. Other implementations can integrated the battery directly onto the housing to reduce the volume of space taken up by battery packaging.

[0183] The WCD can also include one or more polymer or piezo actuators for providing appropriate haptic or physical feedback and alerts to a user while the user is wearing the ring. The piezo actuator can also provide audible feedback to a user.

[0184] As previously mentioned, the WCD 110 can be used with a software application (e.g., a mobile phone application for the Apple iOS or the Google Android OS) which can run on the user's computing device (e.g., a mobile device such as a smart phone). Specifically, the software application can facilitate the mobile device of the user to couple to the WCD 110 (e.g., via the communication module 250) for data communication, such as downloading activity logs, changing configuration and preferences, training the WCD. The software application can also generate a user interface showing the results or readings from the health and fitness tracking performed by the WCD 110. FIG. 10 is an example screenshot illustrating such user interface 1000 displaying fitness monitoring readings in accordance with some embodiments.

[0185] Further, the WCD 110 can be used for gesture input, and the software application can facilitate the user to customize gesture input and control. FIG. 11 is an

Petitioner Samsung Ex-1004, 1115

example screenshot illustrating such user interface 1100 displaying sensor readings (e.g., for calibration purposes) in accordance with some embodiments. In one or more embodiments, the WCD 110 can also be used directly with other Bluetooth enabled devices such as electronic locks or keyless car entry. In other examples, the WCD 110 can also control other devices via a smartphone and other Wireless LAN enabled devices such as home automation systems.

[0186] FIG. 3C is a view 304 of two exterior windows of an alternative WCD (e.g., WCD 112 of FIG. 3C) with example components exposed in accordance with some embodiments. The components 330, 340, and 350 shown in FIG. 3C function similarly to those components described in FIG. 3A. However, some components (e.g., antenna 350) can be positioned to face a different exterior window than the exterior window the rest of the components face. This may increase the mechanical strength of the housing structure of the ring, and/or may reduce signal interference among the components.

[0187] FIG. 4 is an exploded view 400 showing an exemplary WCD 410 (e.g., WCD 110) illustrating a battery 480 and a flexible circuit 415 which are configured to fit inside a housing 412 of the WCD 410. It is recognized by the present disclosure that a human being's finger can come in various different sizes and so should the WCD 410. In order to reduce the cost of manufacturing different sizes of printed circuits, in some embodiments, the modules 210-270 (of FIG. 2) are formed on a flexible or rigid-flex printed circuit (FPC) board, an example 500 of which is shown as FPC 515 in FIG. 5. In particular, one or more embodiments provide that the FPC 515 and the battery 480 are not specific to a ring size, and that the same circuitry and/or battery can fit a multitude of sizes.

[0188] According to some embodiments, the WCD 410 provides a desirable form factor for a user to wear it for a prolonged period of time. The edges and the shape of the WCD 410 can be configured in a way that is comfortable and ergonomic; for example, the finished parts of the embodiments are to be free from burrs and sharp edges. The material which forms the housing portion of the WCD 410 can include medical grade metallic alloys that reduce the likelihood of allergic reactions. Examples of the housing material include stainless steel, tungsten carbide, titanium alloy, silver, platinum or gold.

Petitioner Samsung Ex-1004, 1116

[0189] In the examples shown in FIG. 4, the U-shape of the ring housing 412 allows for the flexible PCB 415 to be inserted into the edge of the WCD 410. The windows (e.g., windows 120, 130) on the walls of the WCD 410 can align with the operating circuitry to allow, for example, battery charging, Bluetooth connection, and user feedback LED/micro display on the outer wall, and biological feedback sensors (e.g., pulse oximetry, temperature sensor) on the inner wall. In one or more embodiments, the WCD 410 can be completely sealed using potting epoxy. The sealing epoxy can be transparent to allow light to pass through for the CPVs and sensors. In some embodiments, the WCD 410 can be potted with two different compounds. In these embodiments, the body of the WCD 410 can be filled with clear material, and the edge of the WCD 410 can be filled with an opaque material so that different colors can be incorporated (e.g., as a decorative element). It is noted that sealing the assembly using potting epoxy can also bring the additional benefit of making the WCD 410 completely or almost completely waterproof as well as increasing the structural rigidity of the WCD 410.

[0190] **I. Internal Housing/External Potting**

[0191] FIG. 12A is a perspective view and FIG. 12B is a side view of a WCD 1200 according to one or more aspects of the disclosure. The WCD 1200 can be in the shape of a ring and can be worn on any of the five fingers (including the thumb) of (typically) a human user. In this regard, the WCD 1200 can define an interior diameter d1 and exterior diameter d2. The interior diameter d1 can be defined as the distance between opposing points on the interior surface of the ring, with the interior surface being the portion of the WCD facing the finger of a user while the device is worn by the user. The interior surface of the WCD can generally define a finger space for receiving the finger of the user. The exterior diameter d2 can be defined as the diameter between opposing points on the exterior surface of the ring, with the exterior surface being the portion of the WCD opposed to the interior surface and facing away from the finger of the user.

[0192] The interior diameter d1 and exterior diameter d2 can be any size to accommodate any finger size. In one example, d2 is determined by d1 plus a thickness of any components and/or flexible circuit boards disposed within the WCD. Additionally, although depicted as being circular, the finger space of the WCD 1200 can be any shape, such as ovular, elliptical, or the like, to accommodate users with atypical

Petitioner Samsung Ex-1004, 1117

finger profiles. In these examples, the dimensions of the interior and/or exterior diameter may be measured according to other variables, such as length, width, major diameter, minor diameter, etc. By way of non-limiting example, the WCD interior diameter d1 (the diameter generally defining the ring size) can be in an approximate range of 12mm to 24mm so as to accommodate finger sizes ranging from a small child to a larger adult, and on any acceptable finger, including the thumb. The exterior diameter d2 can also be any reasonable size or shape, and can define an approximate range of between 18mm and 30mm. Likewise, the thickness between diameters d1 and d2 can vary widely, but can typically reside in an approximate range of 1.5mm to 3 mm. The width WR of the WCD along the direction of finger extension (finger longitudinal direction) is widely variable, and can be selected, in part to accommodate internal and external components. In a non-limiting example, the width WR is in a range of approximately 3mm to 8mm.

[0193] The WCD 1200 can include an overall housing 1210 that includes an internal housing 1212 and an external potting or encapsulant 1214. Together, the internal housing 1212 and external potting 1214 combine to form the overall form factor of the WCD 1200, in addition to providing a housing for one or more electronic components stored within the housing 1210 of the WCD 1200, as will be described in greater detail below.

[0194] The internal housing 1212 can be formed of any material, such as a nonconductive material, a conductive material, a ferrous material and/or a nonferrous metal, composite material (e.g. carbon-fiber and/or glass fiber composite) a dielectric material, or a combination of any of the above. In one example, the material of the inner housing 1212 is conductive and nonferrous, such as aluminum, titanium, or stainless steel. In other examples, the internal housing can be formed of a polymer, such as plastic. The external potting 1214 can be formed of any material, solid or gelatinous, that can provide resistance to shock and/or vibration and can prevent moisture and/or debris from entering the housing 1210 of the WCD 1200, such as silicone, epoxy, polyester resin or any other polymer.

[0195] In one example, the external potting 1214 can be transparent. In this regard, the transparent external potting can allow electromagnetic radiation, such as visible, IR, or UV light sources from inside the housing 1210 to pass through the external potting

Petitioner Samsung Ex-1004, 1118

1214 without the need of a window or discontinuity in the external potting 1214 and without changing the optical properties of the radiation. In the same vein, electromagnetic radiation sources, such as visible, IR, or UV light, external to the housing can pass through the external potting 1214 and can be detected by, sensed by, or fall incident upon internal components of the WCD 1200 without the need for a window or discontinuity in the housing and without changing the optical properties of the radiation. In another example, the external potting 1214 can be tinted. The tint can be cosmetic and can prevent the internal components of the WCD to be visible by the user. In this regard, depending on the tint, optical properties of light passing therethough may be slightly changed. For example, certain colors of the light can be filtered and can result in decreased power transmission. The above description regarding external potting 1214 can be applied to any of the pottings described below.

[0196] The internal housing 1212 can define a window 1216. In one example, the internal housing is formed of a material that completely or partially prevents light (or other electromagnetic radiation) from passing through the internal housing 1212. In this regard, the internal housing 1212 can define the window 1216 to allow for such radiation to pass through the housing 1212. As shown, the window 1216 can be generally elliptical-shaped, but can be any other suitable shape according to other examples, such as rectangular, circular, ovular, etc. Since the window 116 is defined by the internal housing 1212, the window 1216 can face the finger of the user while the user is wearing the WCD 1200, which can provide many advantageous features and implementations, as will be described in greater detail below.

[0197] FIG. 12C is a front view of the WCD and FIG. 12D is a cross section of the WCD 1200 along the line A-A of FIG. 12C. As shown, the internal housing 1212 can have a generally U-shaped internal surface 1212a to accommodate one or more internal components and can define a pair of flanges 1212b and 1212c. The external potting 1214 can extend between the flanges 1212b and 1212c of the internal housing to provide an internal space 1220 to accommodate one or more components. By virtue of the external potting 1214, the internal space 1220 defined by the internal surface 1212a and the external potting 1214 can be hermetically sealed, thereby preventing debris, dust, moisture, or any other unwanted fluids or materials from interacting with the internal components of the WCD 1200. Although not depicted, the internal components

Petitioner Samsung Ex-1004, 1119

can reside within the internal space 1220, and the external potting 1214 can be disposed immediately atop the components to provide the seal.

[0198] FIG. 12E is a perspective view of the internal housing 1212 without external potting 1214. As shown, the internal surface 1212a defines a generally U- shaped surface for receiving the components.

[0199] FIG. 12F is a perspective view of the internal housing 1212 with a portion of the external potting 1214 removed and showing one or more components 1230 and printed circuit board (PCB) 1240. The components and PCB can be constructed as flex circuits, thereby allowing the components 1230 and PCB 1240 to be geometrically configured within the ring shaped internal space 1220. The PCB 1240 can be any type of flexible material clear to those of skill, such as polyimide, PEEK, etc. Additionally, the PCB could be rigid-flex whereby panels of RF4 are connected together with a flexible substrate.

[0200] As shown, the PCB 1240 and the components 1230 can be disposed within the internal space 1220 generally defined by the internal surface 1220a and the flanges 1220b-c. The PCB 1240 can define one or more folding regions 1242 that allow the PCB 1240 to conform to the circumference and/or perimeter of the internal surface 1212a. The PCB 1240 can extend around at least a portion, or up to an entire circumference, of the internal surface 1212a. In one example, the size of the internal diameter d1 of the WCD can determine the portion of the internal surface 1212a around which the PCB 1240 extends. Illustratively, for a larger ring size and a larger internal diameter d1, the PCB 1240 can extend only a portion (an arc) of the overall circumference, while for smaller ring sizes a greater portion (arc) of the circumference can be employed to accommodate PCB 1240 and the internal components 1230. The adjacent portions of PCB can form an arc angle therebetween by virtue of the folding regions disposed therebetween, allowing for the PCB to be conform to the internal surface 1212a.

[0201] **II. External Housing/Internal Potting**

[0202] FIG. 13 is a cross section of a WCD 1300 according to another aspect of the disclosure and illustrative embodiments. In this example, the WCD 1300 includes a housing 1310 that includes an external housing 1312 and an internal potting or

Petitioner Samsung Ex-1004, 1120

encapsulant 1314. The external housing 1312 includes an internal surface 1312a that has a generally C-shaped cross section-but alternate cross section shapes, such shapes with an external notch or groove. The external housing includes flanges 1312b-c that extend toward each other, beyond portions of the internal surface 1312a, to define a partially enclosed internal space 1320. In an assembled state, the WCD 1300 can include a battery 1330, a PCB 1340, and components 1350, which can be at least partially or completely disposed within the partially enclosed internal space 1320. The internal potting 1314 can extend between the flanges 1312b-c and can seal the partially enclosed internal space 1320. The components can be encapsulated by the internal potting 1314. The PCB 1340 and components 1350 can extend along an inner circumference of the internal surface 1312a.

[0203] Illustratively, the external housing 1312 can be formed of the same materials as the internal housing 1212 described above, and the internal potting 1314 can be formed of the same materials as the external potting 1214 described above. As also described above, the internal potting 1314 can be transparent and the external housing 1312 can define one or more windows according to one or more aspects of the disclosure.

[0204] FIG. 14A is a cross section of a WCD according to another aspect of the disclosure and illustrative embodiment. In this example, the WCD 1400 includes a housing 1410,internal surface 1412a, an internal or external housing 1412, an internal or external potting 1414, an internal space 1420, a battery 1430, a flexible circuit 1440, and one or more components 1450. This example is similar to the examples described above with respect to FIGs. 12 and 13, except the addition of a stiffener element 1442 and the flanges 1412b-c extend further into the space 1420 toward one another such that the flanges 1412b-c overlap with the stiffener element 1442.

[0205] FIG. 14B is a perspective view of the PCB and stiffener element of FIG. 14A. As shown in FIG. 14B, the stiffener element 1442 extends beyond an overall width w of the PCB 1440 and extends wider than a distance between flanges 1412b-c. The stiffener element is disposed between folding regions 1444. The PCB 1440 can include one or more stiffener elements 1442 attached thereto, and the elements 1442 can be disposed periodically (in separated intervals) along a length l of the PCB 1440. As shown in FIG. 14C, the stiffener element 1442 can be disposed underneath the flexible

Petitioner Samsung Ex-1004, 1121

circuit 1440, e.g., on a face of the flexible circuit 1440 opposed to the face on which the components 1450 are disposed, and can be permanently or semi-permanently attached thereto. The stiffener element can be implemented in any of the configurations described, and in particular, with either the internal housing/external potting arrangement or the external housing/internal potting arrangement.

[0206] The stiffener element 1442 can be formed of any material, such as polyamide or thin FR4, depending on construction of the PCB 1440. In particular, the material of the stiffener can be chosen to be more or less flexible than the PCB 1440. In one example, the stiffener element 1442 can be a polyamide stiffener disposed on a back surface of a flexible PCB. In another example, the stiffener element 1442 can be FR4 and can be substantially flush with respect to the flanges 1412b-c. In this regard, the stiffener element can extend substantially the distance between flanges 1412b-c and may not deform upon insertion into the space 1420. The stiffener element can include surface features disposed on an edge thereof, with the edge facing one of the flanges 1412b-c. The surface features can include a sawtooth profile (e.g., intersecting straight lines at acute angles), or any other type of feature capable of providing an interference fit between flanges 1412b-c.

[0207] FIG. 14D shows a cross section of the WCD at a point in time during assembly/manufacture when the PCB 1440 is being inserted into the internal space 1420 and prior to the application of potting 1414. As shown, the stiffener 1442 contacts the flanges 1412b-c of the housing 1410 by virtue of the width w of the stiffener element 1442. Upon an application of force, the PCB 1440 and stiffener 1442 assembly can be inserted into the internal space 1420. In this regard, the stiffener element has a predetermined flexibility that allows for a certain amount of flexion, as shown in FIG. 14D. The flexion allows for the flexible circuit 1440 to be inserted within the internal space 1420 and can prevent the flexible circuit 1440 from being removed or from accidentally falling out once inserted. In this regard, the flexible circuit 1440 is held in place within the space 1420 by virtue of the width of the stiffener element 1442 and the distance between the flanges 1412b-c. Once inserted, the potting 1414 can be applied free of the concern of improper positioning of the flexible circuit 1440.

[0208] FIG. 14E is a cross section of the WCD of after a potting material 1414 has been applied subsequent to the WCD of FIG. 14D.

Petitioner Samsung Ex-1004, 1122

[0209] **III. Inner/outer bands**

[0210] FIG. 15A depicts a perspective view of a WCD 1500 according to another aspect of the disclosure. In this example, the WCD includes a housing 1510 that includes an internal housing 1512 and an external housing 1514. The internal housing 1512 can be similar to the internal housing described above with respect to internal housing 1212, and the external housing can be similar to the external housing described above with respect to external housing 1312. The internal housing 1512 can include one or more windows 1516 that can allow electromagnetic radiation (e.g. visible and near-visible light) to pass therethrough, allowing it to fall incident upon components disposed within the housing 1510 and allowing EM radiation sources (e.g. visible light, RF, IR, etc.) within the housing to exit the housing.

[0211] FIG.15B is an exploded view of the WCD 1500. As shown, the WCD can include internal housing and external housing 1512 and1514. The WCD can further include a PCB 1540 and components 1550. Once the housings 1512-1514 are assembled and the PCB 1540 and components 1550 are assembled within space defined between the housings 1512-414, potting layers 1502 and 1504 can be applied to seal the WCD at both sides thereof to ensure a secure seal.

[0212] **IV. Inner/outer bands with U shaped window**

[0213] FIG. 16A is an exploded view of a housing 1610 and a PCB of a WCD according to one or more aspects of the disclosure. The WCD 1600 comprises a housing 1610 with an integral inner wall and outer wall 1612 and 1614. The housing can be made of any material, such as any material described above with respect to the internal/external housing structures. In this example, the inner and outer walls 1612,1614 each define a window in the shape cutaway portions 1616. The cutaway portions are bounded on three sides by the walls 1612 and 1614 and unbounded at the other side thereof. The cutaway portions 1616 can be aligned with one another to ensure transmission of radiation into/out of the housing 1610. The space1620 between the inner and outer walls 1612,1614 can receive a PCB 1640, battery, components, etc.

[0214] FIG.16B is a cross section ofFIG.16A along line B-B. As shown, the inner and outer walls 1612,1614 are directly connected by a floor 1618. The space 1620 is defined by the space between the inner and outer walls 1612,1614 and the floor 1618.

Petitioner Samsung Ex-1004, 1123

[0215] FIG.16C is a perspective view of the WCD with potting material 1630. As described above, the PCB, battery, and components can be disposed within the space. Once disposed therein, a potting 1630 can be provided atop the components and within the cutaway portion 1616. The potting 1630 can be transparent to allow for transmission of light through the cutaway portions 1616.

[0216] **V. Charging By Concentrated Light Source**

[0217] According to one aspect of the disclosure, the WCD can be charged by an external concentrated light source, e.g., laser light, laser diode, etc. In this regard, the photovoltaic device described above can include a concentrated photovoltaic element (CPV) that is constructed and arranged to receive concentrated light from the concentrated light source, e.g., laser light from a laser diode, light from a light emitting diode (LED), etc., and converting the received concentrated light into an electric current. The photovoltaic device can also generate power from nonconcentrated light sources, such as office lighting and ambient sunlight. The electric current can be used to charge one or more batteries stored within the housing of the WCD.

[0218] FIG.17A depicts a cross section of a WCD employing charging by concentrated light source according to one or more aspects of the disclosure. In this example, the WCD 1700 can include a housing material 1710. The WCD can include a PCB 1720 and a concentrated photovoltaic cell 1730. The WCD can be positioned adjacent a base assembly or base station 1750. The base assembly 1750 can be connected to an external power source 1765 and can have internal circuitry 1760 to power one or more concentrated light sources 1770, e.g., one or more laser diodes and/or one or more LEDs, disposed within the base assembly 1750. In this example, the concentrated light source 1770 comprises one or more laser diodes.

[0219] The base assembly 1750 can define a first opening 1752 at one portion thereof to allow the concentrated light 1780 to exit the housing of the base assembly I 750. As shown in the diagram of FIG.17A, the concentrated light 1780 is generated by the concentrated light source 1770 and exits the housing of the base assembly 1750 via a first opening 1752. The concentrated light 1780 then enters into the WCD by a second opening 1712 in the housing of the WCD 1700 where it can fall upon the CPV 1730. Once the concentrated laser light falls upon the CPV 1730, the CPV 1730 can convert

Petitioner Samsung Ex-1004, 1124

the incident concentrated light into a current that can be used to directly power one or more components within the WCD and/or can be used to charge one or more rechargeable batteries onboard the WCD.

[0220] The concentrated light source 1770, as described above, can be any type of light source that is arranged to generate concentrated light, such as an LED or a laser diode. The concentrated light can be any type of concentrated and/or coherent electromagnetic radiation, such as laser light and/or LED light. The concentrated light can have any desired intensity or wavelength, according to the characteristics of the CPV 1730.

[0221] In one example, the source 1770 can be a 200 mW laser diode that produces red or green laser light. This can generate approximately 80mW (or typically less) of power in the WCD where the CPV 1730 includes a plurality of groups of photovoltaics configured in series or in parallel with one another. Each group of photovoltaics can include one or more CPV cells. In another example, the CPV can include a single group of photovoltaics.

[0222] The base assembly 1750 described above can include additional components that can interact with the WCD 1700. For example, the base assembly can include one or more antennas that can communicate according to one or more wireless protocols, such as 3G, 4G, WiFi, Bluetooth®, NFC, or the like, for direct or indirect wired or wireless communication with the WCD or mobile device. In addition to the charging methods above, the base assembly can employ inductive charging techniques.

[0223] FIG.17B depicts a cross section of a WCD employing charging by concentrated light source according to another aspect of the disclosure. In this example, the concentrated light source 1770 comprises an LED. Further, the base assembly comprises an optical element 1790 positioned adjacent to the concentrated light source I 770 for focusing the LED light onto the CPV inside the WCD. The optical element 1790 can be any type of optical element, such as a lens. The lens can be formed of any material, such as glass, plastic, etc., and can be any type of lens, such as concave, convex, piano-concave, piano-convex, etc. In this example, the optical element 1790 includes a piano-concave, with the concave portion facing the concentrated light source 1770. In the example where the source 1770 is an LED, the LED emits light in many

Petitioner Samsung Ex-1004, 1125

directions. The optical element 1790 can focus the emitted LED light to focus as much of the LED light as possible onto the CPV of the WCD. The optical element 1790 can be disposed at least partially or completely within the first opening 1752. In some implementations, the optical element may not be necessary due to LEDs with substantially focused light.

[0224] FIG.17C is a perspective view of a base assembly 1750 and WCD 1700 according to one or more aspects of the disclosure. As shown, the WCD 1700 is in the shape of a ring and the base assembly 1750 includes a post 1754 for receiving the ring. The post 1754 can be cylindrical and can be sized and shaped according to an internal diameter of the WCD in order for the WCD to be received on an external surface of the post. The first opening 1752 of the base assembly 1750 is formed on a portion of the post 1754 such that, when the WCD 1700 is stored on the post, the second opening 1712 can be aligned with the first opening 1752 to ensure alignment of the CPV and the concentrated light source. The base assembly can receive/transmit power and/or data via external input/output 1795, which can be a DC power input, a USB input connection or any other acceptable connection/form factor.

[0225] FIG.17D depicts a perspective view of internal components of the base assembly 1750 and WCD 1700 according to another aspect of the disclosure. In this figure, the respective housings of the base assembly and WCD have been omitted, thereby showing a plurality of concentrated light sources 1770, optical elements 1790, and a plurality of CPVs 1730 disposed on mounting substrates 1775 on a PCB. In this example, the WCD can include a plurality of CPVs and the base assembly can include a plurality of sources. This allows for a greater current to be generated during charging and for faster charging times of the WCD. The CPVs and concentrated light sources can correspondingly be disposed in a line, with a constant or variable pitch between respective elements. In this regard, the optical element can include corresponding concavities with the same pitch.

[0226] FIGs.17E-F depicts other CPV configurations according to one or more aspects of the disclosure. As shown in FIG.17E, the CPVs 1730 can be arranged in a lx4 array, while FIG.17F depicts the CPVs arranged in a 2x2 array. In addition to the examples shown in the above figures, the WCD can include any number of CPVs according to any number of geometric configurations.

Petitioner Samsung Ex-1004, 1126

[0227] FIG.17G is perspective view of a WCD and base assembly with a lx3 CPV arrangement. As shown, the WCD can include a lx3 array of CPVs and the base assembly can include a corresponding lx3 array of concentrated light sources. As indicated by the arrow, a user can then rotate the WCD on the base assembly in order to align the respective first and second openings, as well as the CPV and concentrated light sources.

[0228] FIG.18A depicts a cross section of a WCD 1800 employing charging by concentrated light source 1870 according to another aspect of the disclosure. In this example, the WCD includes an internal/external housing portion 1810 and an internal/external potting portion 1820, as described above. In this regard, the base assembly 1850 includes a first opening 1852, but is free of a second opening on the WCD. The concentrated light 1880 passes through the transparent potting portion and falls incident upon the CPV cell 1830. In this example, the source can be a laser diode.

[0229] FIG.18B depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure. In this example, the concentrated light source 1870 includes one or more LEDs and the base includes one or more optical elements 1890 for focusing the concentrated light 1880. The LEDs may be of different wavelengths to provide power to two or more junctions in the triple junction CPV cell.

[0230] FIG.19A depicts a cross section of a WCD 1900 employing charging by concentrated light source 1970 according to another of the disclosure. In this example, the WCD and/or the base assembly 1950 can employ one or more magnetic and/or ferrous materials to ensure alignment between the concentrated light source and the CPV cell. Such alignment can improve charging efficiency of the WCD.

[0231] The base assembly includes a first opening 1952 and the WCD includes a second opening 1912 to allow for concentrated light to fall incident upon the CPV 1930. In this example, the second opening is formed on an external housing portion of the WCD. In this arrangement, the base assembly can charge the WCD from an exterior of the WCD, rather than an internal charging method as identified above.

[0232] The WCD can include a ferrous or other suitable (e.g. ferromagnetic) material 1920, such as steel, disposed within the housing 1910. In this example, the

Petitioner Samsung Ex-1004, 1127

ferrous material is disposed in a space defined between an internal housing and an external housing. The ferrous material can surround the CPV.

[0233] The base assembly can include corresponding magnets 1960 that can cause an attractive force between the WCD and the base assembly into an optimal configuration for charging. The magnets can be disposed within the base assembly and can surround the concentrated light source. The magnets 1960 can be formed of a rare earth material, such as neodymium or any other acceptable material that provides a requisite magnetic field strength.

[0234] FIG.19B depicts a cross section of a WCD 1900b employing charging by concentrated light source 1980b according to another of the disclosure. The CPV 1930b of the WCD1900 is charged from an interior portion, such as by a base assembly 1950b with a post 1954b. Similarly, the WCD can include a ferrous material 1920b disposed within the housing1910b and the base assembly1950b can include a magnet 1960b.

[0235] FIG.19C depicts a schematic diagram of magnets 1920c,1960c that can be used in a WCD and/or base assembly, including a CPV 1930d and concentrated light source 1930d, according to one or more aspects of the disclosure. As shown, the magnets and/or ferrous/ferromagnetic materials can be axially polarized, with each having a respective north pole and south pole. In this regard, the WCD can have axially polarized magnets 1920c with a south pole S facing toward the base assembly, and the base assembly can have axially polarized magnets 1960c with a north pole N facing toward the WCD. The attractive force between the north and south poles can ensure alignment of the CPV 1930c of the WCD and the source 1970c base.

[0236] FIG.19D depicts a schematic diagram of magnets that can be used in a WCD and/or base assembly according to one or more aspects of the disclosure. In this example, the base assembly includes axially polarized magnet 1960d, with a north pole N facing toward the WCD. The WCD can include ferrous steel 1920d, with an attractive force between the ferrous steel and the north pole of the base assembly magnet.

[0237] FIG.19E is a perspective view of a WCD and a base assembly according to one or more aspects of the disclosure. As shown, the WCD 1900e can be received by a post 1954e of a base assembly 1950e. The respective magnets I960e and/or ferrous materials 1920e are shown in phantom to illustrate their positioning with respect to the

Petitioner Samsung Ex-1004, 1128

WCD and base assembly devices and the CPV1930e as well as the concentrated light source 1970e.

[0238] FIG. 20A is a cross section of a WCD 2000 engaged with a base assembly 2050 according to one or more aspects of the disclosure. In this example, the magnets 2060 can surround the concentrated light source 2070, and the WCD can include a ferrous steel 2020, CPV 2022, and battery 2024 disposed within an internal/external potting 2014 of the WCD. The ferrous steel 2020 can be disposed on a face of the PCB 2040 and can be encapsulated by the internal/external potting 2014. The base assembly can include one or more optical elements 2090 for focusing the concentrated light 2080.

[0239] FIG. 20B is a perspective view of a PCB 2040b with a CPV 2030b and ferrous element 2020b configuration according to one or more aspects of the disclosure. In this example, the ferrous element 2020b comprises a steel ring that can surround a CPV 2030b and can be disposed on the PCB 2040b.

[0240] FIG.20C is a perspective view of a PCB 2040c with a CPV 2030c and ferrous element 2020c configuration according to one or more aspects of the disclosure. In this example, the ferrous element 2020c comprises a plurality of rectangular bars disposed on the PCB. In this way, the ferrous element 2020c can be coated to be reflowed onto the PCB.

[0241] FIG.20D is a perspective view of a magnet 2060d and a concentrated light source 2070d according to one or more aspects of the disclosure. As shown, the magnet 2060d can include a ring that can extend around a circumference of the concentrated light source 2070d. The magnetic ring can be attracted to the ferrous steel ring and/or the rectangular ferrous steel examples set forth in 20A-C above.

[0242] In some examples, the WCD can be adapted to uniquely identify the wearer of the WCD using, for example biometric features unique to the user.

[0243] FIG.21A is a schematic view of a WCD 2100 showing components used for identifying the wearer of the WCD. As shown, the WCD2100 can include one or more infrared illumination sources 2110 and an infrared CMOS imaging device 2120. The finger 2190 can extend through the finger space of the WCD and the IR source 2110 can illuminate a portion of the skin of the finger 2190. The IR CMOS imaging device 2120 can receive light that has been reflected from the skin surface and produce an image of

Petitioner Samsung Ex-1004, 1129

the skin of the finger 2190. As shown, the IR source2110 and the imaging device 2120 are positioned near the interior surface of the WCD, e.g., the surface facing the skin of the finger. The IR illumination can pass through a window provided on the interior housing or can pass through a transparent potting material.

[0244] During the imaging process, the WCD 2100 can be rotated about an axis passing through the center of the finger space and along the longitudinal direction of the finger. In this regard, the imager 2120 can capture a larger swath of the skin surface than if the WCD 2100 were held stationary with respect to the finger during the imaging process.

[0245] At the time of first use, or any time thereafter, the user can generate a reference capillary map in order to identify himself/herself as the authorized user of the WCD. As described above, the user can rotate the WCD around the finger to capture image data of an analyzed section of skin 2192 and on or more capillaries 2194 of the user currently wearing the WCD. The image data can correspond to an overall analyzed section of the skin 2196 of the wearer. The image data of the capillaries can be used to generate a reference capillary map of the wearer, which can be stored in the memory, such as flash memory or EEPROM, of the WCD.

[0246] When the same user puts the WCD on his or her finger after generation of the reference capillary map, the WCD can capture image data of the wearer's skin surface that can be compared to the reference capillary map stored in the memory. In this regard, the user need not rotate the device around the finger. Instead, the WCD can compare a subset of the gathered image data to a corresponding subset of reference capillary map. If there a match, within a predetermine error tolerance, the WCD can uniquely identify the wearer as an authorized user of the WCD and as the unique individual who generated the reference capillary map. Once authorized, the wearer can have access to certain functions, features, data, or other content that is not otherwise available without authorization. In another example, the identification can be a step in a transaction or other type of authorization, such as an electronic payment, bank transaction, etc. If the gathered data does not match the reference capillary map, then the user may be prevented from accessing certain features on the WCD.

Petitioner Samsung Ex-1004, 1130

[0247] Illustratively, the comparison process between sensed capillaries and some or all of the capillary map can be implemented using basic pattern recognition algorithms (processes) instantiated in the electronics of the WCD. Such processes can rely on edge detection and similar techniques that should be clear to those of skill in the art and can be sourced from various commercial vendors of biometric recognition software.

[0248] In another example, the illumination can include NIR illumination and can project radiation into the skin of the finger. The reflected NIR illumination can then be analyzed to determine one or more characteristics of the blood, such as blood alcohol levels, blood glucose levels, and blood oxygenation levels. In this regard, the WCD analyzes the reflected radiation to identify wavelengths that were absorbed from the projected radiation by the blood of the user. Techniques and processed used in conjunction with commercially available venous oximeters (for example) can be employed to undertake certain readings.

[0249] FIG. 22A is a perspective view of a user employing ECG monitoring according to one or more aspects of the disclosure. In this example, the user can wear the WCD2200 on a first finger 2210 of first hand 2220, and can touch a second finger 2230 of a second hand 2240 to an exterior surface of the WCD 2200. This can provide an electric pathway 2250 through the body, as shown in FIG. 22B, allowing for the transmission of electrical current between distant portions of the body.

[0250] FIG. 22C is a perspective view of a WCD that can employ ECG monitoring according to one aspect of the disclosure. In this example, the WCD 2200 includes an internal/external housing 2250 with a conductive pad2260. The conductive pad 2260 can be electrically isolated from the external/internal housing 2250 of the WCD, thereby providing distinct and isolated electrical contacts on the WCD. The internal/external housing 2250 can be in electrical communication with the first finger2210 of the first hand, while the conductive pad 2260 can be in electrical communication with the second finger 2230 of the second hand. In this regard, an electrical path 2250 is formed through the respective hands 2220, 2240 and through the rest of the user's body, particularly through the chest. In this regard, the WCD can take various electrical measurements of the user, such as ECG. The ECG measurement can include measurements of the various waveforms, such as P-U waveforms. The WCD can store

Petitioner Samsung Ex-1004, 1131

such ECG data in a memory and/or can communicate the data to a wirelessly connected mobile device. In another example, the WCD can employ electrically isolated internal and external housings, such as those described above. In this regard, the conductive pad may not be utilized, and the user can wear the WCD on a first finger and apply the second finger anywhere on the external housing.

[0251] The WCD can also serve as a monitor for those who are mobility impaired or who are prone to falls, such as disabled persons and/or retired persons. The accelerometer onboard the WCD detect a fall of the user via a sudden change in acceleration data. The WCD, in conjunction with a mobile device and/or one or more base stations positioned around the home of the user, can determine the position of the user within the house. For example, the mobile device can employ GPS capabilities, and either the mobile device or the base stations can use GPS in combination with WiFi signal strengths to determine the location of the user within the house. The WCD can then issue an alert, either directly or indirectly (via the mobile device or base station) to a third party that a fall has occurred. The alert can be a phone call, text message, e-mail, or any other type of communication. The third party can then take appropriate measures to aid the fallen user.

[0252] The WCD can also monitor heart rate and/or temperature, in addition to the other monitored characteristics described above. If any of the monitored characteristics is abnormal, e.g., measured parameters outside of a predetermined threshold range, an alert can be sent to a third party. In some examples, the third party can be a medical health professional, such as a doctor, nurse, caretaker, etc. It is noted that, for those embodiments which can function as a cardiac monitor (e.g., that measures electrocardiogram (EKG)), it can be necessary to establish a closed loop (e.g., for the electrical measurement of EKG) across the heart. As such, in some of those embodiments, a separate conductive pad or other skin-contacting structure/probe can be coupled to the WCD so that a user can pinch the pad with fingers on an opposite hand.

[0253] Since the WCD has the form factor of a ring, the WCD is designed to be worn over long periods of time by a user with little to no discomfort or interference. In this regard, the WCD can monitor the above-described, monitored characteristics over long periods of time (e.g. weeks, months, etc.), and determine trends in the data. For example, the WCD can measure heart rate over a long period of time and determine a

Petitioner Samsung Ex-1004, 1132

unique resting heart rate for a user. If the user's heart rate deviates from the resting heart rate, the WCD can be arranged to issue an alert to a third party. In one specific example, the WCD can use appropriate processes to analyze both the trends of monitored characteristics, as well as current accelerometer data. In this way, if a person's heart rate deviates from a resting heart rate, but the accelerometer indicates that the user is exercising and/or engaging in strenuous activity that provides an equivalent workout, then the WCD may not issue an alert in this circumstance.

[0254] FIG.23A is a perspective view of the hand of a user in various positions employing the navigational features of the WCD. As described above, the WCD can communicate with a mobile device though one or more wireless communication protocols. The mobile device can include a processor and a memory and can execute a map application/process that can provide tum-by-tum walking or driving directions to the user based on the user's GPS location. A portion of those directions can include information regarding heading, distance to travel at that heading, waypoints, and the direction of next tum. By way of the wireless communication, the mobile device can communicate one or more of pieces of information relating to directions, such as the heading. Once the heading is received the WCD, the WCD can give feedback to the user regarding the actual heading measured by the onboard magnetometer and the heading set forth in the direction information. In one example, the feedback can be haptic or physical feedback provided by one or more actuators, such as the actuators 670 described above.

[0255] FIG. 23A depicts a user's hand in various positions of navigation, each hand including a WCD worn thereon. In this example, the heading provided by the mobile device is the heading 2335, which represents the direction in front of the hand position2330. In this regard, if the user gestures, e.g., points a ring finger, in the direction of the correct heading, the WCD 2300 can give feedback to the user indicating the correct heading. The feedback can include, for example, an LED indicator 2310 showing a green visible light. In the example of hand position2320, the finger is gesturing in a direction to the left of the correct course 2325. In this way, the WCD 2300 can provide feedback to correct the heading of the user. Such feedback can include illumination of an LED indicator showing (e.g.) a red visible light. Similarly, hand 2340

Petitioner Samsung Ex-1004, 1133

is gesturing in direction 2345, which is to the right of the correct/appropriate direction. The WCD can provide (e.g.) a blue indicator informing the user to change heading.

[0256] FIG.23B is a flow chart 2300B depicting a method of providing feedback to a user according to one or more aspects of the disclosure. At block 231OB, a user can establish a communication link between a WCD and a mobile device. At block2320B, the user can generate or request a set of directions at the mobile device, including information/data regarding heading, distance to travel at that heading, and the direction of next tum. At block 2330B, the mobile device can transmit at least one of the information items/datum regarding heading, distance to travel at that heading, and the direction of next tum. At 2340B, the WCD can take a measurement of heading by measuring a heading associated with an explicit gesture by the user's finger donning the ring. Such gesture can include pointing in a proposed heading of travel. At block 2350B, the WCD can compare the measured or proposed heading to the correct heading provided by the mobile device. At 2360B, the WCD can provide feedback to the user based on the comparison at 2350B, e.g., if the user is gesturing in the correct direction, a green LED indicator may appear. In other examples, if the gesture is in a direction that does not correspond with the correct direction, a (e.g.) blue or red indicator can appear. In one specific example, indicators representing left and right course alterations can be different so a user can easily discern a correct direction of travel.

[0257] FIG. 24A is a schematic diagram of a system 2400 for controlling an environment of a user according to one or more aspects of the disclosure. As shown, the WCD can be connected, wired or wirelessly, to one or more appliances in the home of a user. The system 2400 can include a WCD 2410, a thermostat 2420, a wireless access point (e.g., WiFi router) 2430, and a mobile device 2440. The WCD can be wirelessly connected (e.g., link 2415) to both the thermostat and the mobile device by any type of wireless communication protocol, such as Bluetooth. The access point can be wirelessly connected to the thermostat and the mobile device by any type of wireless communication protocol, such as WiFi. It is noted that a wide range of commercially available appliances, thermostats, lighting controllers, home controllers, and the like, can interface with the WCD using WiFi or another conventional/proprietary communication protocol, as described further below.

Petitioner Samsung Ex-1004, 1134

[0258] The WCD 2410 can include one or more temperature sensors. In one example, the WCD can include at least one internal facing temperature sensor 2410a and an at least one outward facing temperature sensor 2410b, as shown at FIG. 24B. The inward facing temperature sensor 2410a can be near the skin of a user when the user is wearing the ring, and can therefore measure the skin temperature of the user. The outward facing temperature sensors 2410b can be disposed away from the finger of the user, and can therefore be arranged to measure an ambient temperature of the room in which the user currently resides with sufficient thermal isolation from the user's hand and his/her body heat. In particular, in order to ensure accurate ambient temperature measurements, the WCD can employ a combination of multiple light sensors 2410c and outward facing temperature sensors 2410b. In this regard, the temperature sensor 2410b associated with the light sensor 2410c that receives the most light can be the most accurate, as it is most likely that this sensor is furthest from the finger or palm of the user. In another example, the WCD can employ multiple outwardly facing temperature sensors 2410b and compare the temperature values of each to the inward facing sensor 2410a. The WCD can then select the most accurate temperature value from the outward facing sensors.

[0259] Based on the measured skin temperature and measured ambient temperature, the WCD can automatically adjust the thermostat 2420 to alter the ambient temperature of the room. In this regard, if a user's skin temperature is too high, the WCD can instruct the thermostat 2420 to lower the ambient temperature. Similarly, if the user's skin temperature is too cold, the WCD can instruct the thermostat 2420 to raise the temperature. The WCD 2410 can instruct the thermostat (and/or an HVAC controller) directly, e.g., via a direct wireless link 2415, or indirectly, e.g., via one or more of the mobile device 2440 and the access point 2430. The WCD can also use historic temperature data to develop trend temperature data.

[0260] In another example, the WCD can be part of a system 2400C for controlling home appliances. The system 2400C can include a WCD 2410C, one or more home appliances 2420C, and an access point 2430C. Such home appliances 2420C can include, for example, a television, lights, speakers, microwave, range, stove, oven, etc. Each of the home appliances can include an antenna that allows the respective home appliances to communicate wirelessly with one or more access points 2430C. In one

Petitioner Samsung Ex-1004, 1135

example, the appliances can include a ScenSor DWIO00 chip provided by DecaWave. In this way, the locations of the appliances in the room can be determined to an accuracy of approximately 10 cm. The location of the WCD 2410C can also be determined, using the above-referenced chip, or by using signal strengths of one or more base stations.

[0261] Having established the position of one or more home appliances and the user in a room, the user can make a gesture to control such home appliances 2420C. For example, the user can point at the TV (while wearing the WCD) in order to tum it on/off. Knowing the position of the user and the position of the TV, the direction of the gesture and the type of gesture can indicate what action to take on which device. The accelerometer and/or magnetometer on the WCD can be used to create a vector to the object to control, and a wireless packet can bet sent to a wireless access point to control the respective appliance.

[0262] FIG. 24D is a flow chart depicting a method 2400D of controlling home appliances according to one or more aspects of the disclosure. At block 241OD, the locations of one or more home appliances in a room and/or house can be ascertained/determined. As described above, the appliances can include a processor configured to identify location within a room. At block 2420D, the location of the WCD is determined. At block 2430D, the user can make a gesture toward a home appliance to exert control over the home appliance. Such gesture can include a snap, a point, etc. At block 2440D, the accelerometer and/or magnetometer on the WCD can be used to create a vector to the object to control. At block 2450D, a wireless packet can bet sent to a wireless access point to control the respective appliance. The access point can then issue the command to the respective appliance.

[0263] FIG.25 is a perspective view of the hand of a user employing a two-factor authentication technique according to one or more aspects of the disclosure.

[0264] As shown, the user 2500 is wearing a WCD 2510 and is approaching a locked door 2520 with an access node 2530 associated therewith. The access node 2530 can be a wireless access node of a conventional or custom arrangement, and can communicate wirelessly according to any type of wireless protocol, such as WiFi or Bluetooth. As the user approaches the door 2520, the WCD 2510 can initiate a

Petitioner Samsung Ex-1004, 1136

communication link, e.g., Bluetooth or WiFi, with the access node 2530. In this way, the WCD and the access node can engage in one or more handshaking or query procedures to verify the WCD. For example, the access node 2530 can detect a MAC address, IP address, or other alphanumeric identifier associated with the WCD and compare it to a list of authorized users. Such network-based communication processes should also be clear to those of skill.

[0265] Once the MAC address or other identifier is verified, the user can engage in a pre-defined gesture 2550 to complete the authentication procedure. The gesture 2550 can be any type of hand and/or finger motion that can be performed by the user. In this regard, the accelerometer or magnetometer can detect the gesture 2550 performed by the user and provide the gesture information to the access node. If the provided gesture information corresponds with an authorized gesture stored at or accessible by the access node, then the user may be granted authorization and the door can be unlocked. The authorized gesture can be a general authorized gesture for all users, or can be a specific gesture authorized only for the particular MAC address.

[0266] In addition to a door, the method above can be used to gain access to other features, such as unlocking a mobile phone, unlocking a car door, starting a car. The authentication technique above is advantageous in that it can eliminate extraneous authentication devices, such as key fobs for a car, a door, keypads for entry control, etc., and can provide a secure two-factor authentication technique to avoid unwanted access. More generally any type of keyless entry system (e.g. a keypad, card-reader, keyless lock, etc.) can be equipped with appropriate communication interfaces (RF, IR, etc.) to communicate with the WCD and operate based on a gesture and/or proximity of the user using the techniques described above. The WCD can also be employed generally in this manner to activate or deactivate a residential or commercial alarm system-substituting, for example, for a key fob used for this purpose.

[0267] FIG. 26A is a schematic view of a charging apparatus for charging the WCD according to one or more aspects of the disclosure. As shown, a mobile device 2610 can be received within a case 2620. The mobile device 2610 can be electrically connected to the case 2620 via a port 2610a on the mobile device 2610 and a connector 2620a on the case 2620. As shown in phantom, the case 2620 can include an integrated battery 2630

Petitioner Samsung Ex-1004, 1137

within the case that can charge the mobile device via the connector or can charge a WCD, as will be described in greater detail below.

[0268] The integrated battery can be connected to an antenna 2640 disposed on or within the case 2620 that can emit an RF signal, as shown in the block diagram in FIG. 26C. The RF signal can have a power of less than 500mW and a frequency of 13.56MHz. The RF signal can be emitted in all directions around the case such that it can be received by a WCD in proximity to the case.

[0269] FIG. 26B shows a WCD 2650 including an RF antenna 2660 and charging circuitry 2670. The RF antenna 2640 can be disposed within the housing 2680 and can receive the RF signal emitted by the case 2620 and convert it to a current that can be used to charge the WCD battery (not shown). This can advantageously allow the user to charge the WCD without removing the WCD from the finger. As shown in FIG. 26D, the charging can occur whenever the WCD is in close proximity to the case, such as when a user talking on the phone or merely handling the phone. In another implementation, the case can utilize inductive charging to charge the WCD. In this regard, the case can include an induction coil subjected to a predetermined current to produce a magnetic field. A corresponding induction coil within the housing of the WCD can be subjected to the magnetic field to produce a current that can charge the onboard battery in accordance with known electromagnetic principles.

[0270] FIG. 27A is a pictorial diagram and FIG. 27B is a block diagram of a WCD employing flash storage according to one or more aspects of the disclosure. As described above, the WCD 2700 can include a housing 2710, an antenna 2720, and an integrated circuit (IC) 2730 including a flash memory 2740. The IC and the flash memory can be disposed within the housing 2710. The flash memory 2740 can be powered by a battery 2750 and connected to the IC 2730, which can be implemented as a system-on-a-chip (SoC) IC 2760. The IC can include Bluetooth Low Energy (BLE) capability to allow for communication with another device. The flash memory can be used to store data, or can be used in any of the authentication techniques described above. The WCD can transmit data stored on the flash memory to another device 2780 via the BLE connection, or can receive data and store the data on the flash memory.

Petitioner Samsung Ex-1004, 1138

[0271] FIG. 28A is a schematic diagram of one or more WCDs performing proximity functions according to one or more aspects of the disclosure. The WCD can detect a strength of an RF signal received by its antenna, and calculate a distance to the source of the RF signal using a Received Signal Strength Indicator (RSSI). In one example, the RF signal can be from a mobile device, an access point, or another WCD. The use of RSSI can have many applications in proximity detection. For example, the WCD can be placed on a child and can be connected to mobile device held by a parent. If the WCD travels a predetermined distance from the mobile device, the WCD can issue an alert to the mobile device, thereby alerting the parent that the child has wandered too far. In another example, the parent can wear a first WCD and the child can wear a second WCD. The first WCD can alert the parent that a child has wandered too far.

[0272] A single user can wear a first WCD 2800 on a first finger on a first hand and a second WCD 2810 on a second finger on a second hand. In this regard, the user can measure the relative distance between the first and second fingers using an RSSI via a wireless link 2830 between the WCDs 2800, 2810, such as a BLE connection. This can be used to measure an approximate dimension of an object held in both hands or to estimate a mid-air measurement.

[0273] In some examples, a first user can wear a first WCD 2800 and a second user can wear a second WCD 2810. The RSSI can be collected over a period of time and the processor can analyze the data to develop trends or statistics. For example, the RSSI data can indicate that the first and second users have spent a certain amount of time together and can serve as a relationship monitor.

[0274] The WCD can also detect when the first user and second user are holding hands. FIG. 28B is a schematic diagram of one or more WCDs 2800, 2810 performing proximity functions according to one or more aspects of the disclosure. Similar to the ECG monitoring techniques described above, a circuit can be formed when the users hold hands 2840 (with the respective hands wearing the WCDs). The circuit can be used to transmit data and/or electrical impulses between the respective WCDs via the circuit. The WCDs can collect data regarding the length of time that the users are holding hands and, in combination with the amount of time spent together, monitor the relationship of the two users. In addition, the WCD can collect data regarding communication between

Petitioner Samsung Ex-1004, 1139

the users, e.g., e-mail, social media, etc. Based on all of the above factors, the WCD can develop a relationship score between respective WCD users, with a higher relationship score indicating more and more frequent interactions.

[0275] FIG.29A is a flow chart depicting a method of initiating gesture input according to one or more aspects of the disclosure. The WCD can be used to perform one or more commands, or to instruct another device, such as a mobile device, to perform one or more commands. Such commands can include, initiate sleep state of WCD, initiate sleep mode or default mode of WCD, powering off/on of the WCD, turning on/off an LED light of the WCD, powering on/off of a mobile device, placing a phone call on the mobile device, etc. The user can establish one or more custom gestures to initiate any of the commands above. For example, the user can select a command to be customized from a number of commands. Once selected, the user can perform a custom gesture to be associated with that command. In some examples, the user can perform the custom gesture multiple times to allow the WCD to better identify the gesture and to develop error tolerances for registering the gesture.

[0276] At block 2910, the user can perform a first gesture. In this example, the user can perform a finger snap. At block 2920, WCD can register the gesture, via the accelerometer and/or the magnetometer. At block 2930, the accelerometer can send an interrupt signal to the processor. At block 2940, the processor can wake from a sleep or default system state. At block 2950, the processor can monitor the accelerometer for a second gesture, at which point the user can perform a second gesture. If the second gesture matches a gesture in the gesture command database, then the WCD can perform the associated command. If not, the WCD can return to the sleep state.

[0277] FIG.29B is a chart 2900B showing an exemplary graph of acceleration vs. time as measured by the accelerometer of the WCD. As shown at peak2910B, the gesture can only be registered if it reaches a predetermined acceleration threshold. If the gesture performed at 2910 meets the threshold, it can proceed to block2930 where the interrupt procedure is performed.

[0278] FIG. 30 is a perspective view of a WCD 3000 employing an illustrative reset function and associated procedure/process. As shown, the WCD 3000 can be removed from the finger of the user in order to initiate a system reset of the WCD. In one

Petitioner Samsung Ex-1004, 1140

example, the system reset can be initiated by spinning about a rotation axis R at a predetermined speed. The predetermined speed can be any value, and in one example is a rotational velocity. Upon performing the reset procedure at the predetermined speed, operation of the WCD 3000 can be interrupted and the onboard components of the 3000 can power off, and revert to factory default settings. Additionally, a series of movements can initiate a rest, such as putting the ring on a table and turning it over several times.

[0279] FIG. 3lA is a perspective view of a WCD including an LED indicator according to one or more aspects of the disclosure. As shown, the WCD 3100 can include an internal/external housing 3112 and an internal/external potting 3114. The WCD can include an LED 3120 that can be visible through the internal/external potting 3114.

[0280] FIGs. 31B and 31C are cross sections along line C-C of a WCD employing an LED indicator according to one or more aspects of the disclosure. As described above, the WCD 3100 can have an internal and/or external potting 3114 that can be transparent. This allows light sources within the housing to pass through the potting without changing, or with minimal change to, the optical properties of the light. In this way, a light source 3120, such as an LED, can be disposed on the PCB 3140 and can be powered at least partially by battery 3130. The LED can be encapsulated by the potting 3112 and can project light through the potting 3112. As shown in FIG. 31B, the LED 3120 can include a vertical LED, while 31C depicts a right angle LED. The vertical LED can project light along direction L1, while the right angle LED can project light along direction L2. When light is projected along L2, the light can travel around a circumference of the finger of the user.. Note that, according to aspects of the disclosure, the potting can be generally adapted in whole or in part to condition, filter or modify the wavelengths and/or projection qualities of light by for example, embedding lensmatic components, applying light-diffusive additives, light attenuating filter materials, etc.

[0281] FIG. 32 is flow chart depicting a method 3200 of communicating with a near field communication (NFC) device according to one or more aspects of the disclosure.

Petitioner Samsung Ex-1004, 1141

[0282] In some examples, the WCD can enable or disable NFC or change the functionality of a NFC device. For example, the WCD can itself engage in NFC with another computing device, or the WCD can be connected via wireless link to a computing device that engages in NFC with a different computing device. In certain existing NFC devices, NFC will connect and begin transmitting data as soon as it is queried. In the present example, NFC is enabled or begin transmitting data exclusively upon performing of a pre-determined gesture. However, a variety of other transmission processes can be implemented-for example a periodic chirp or handshake request by the WCD for communication with appropriate devices.

[0283] At block 3210, a NFC capable device is provided. The device can be any type of device, such as a laptop, tablet, mobile device, or dedicated NFC device.

[0284] At block 3220, the WCD initiates a connection with the NFC device. The connection can be a direct connection via NFC, or an indirection connection via an intermediate device. At this point, no data has yet been transmitted between the WCD and the NFC device.

[0285] At block 3230, a user performs a predetermined gesture that is registered by the WCD. The gesture can be any type of gesture, such as a point, a snap, waving the hand, etc.

[0286] At block 3240, data transmission begins between the NFC device and the WCD.

[0287] In other examples, the user can perform another gesture to cease NFC communication. The gesture can be the same gesture as described above or a different gesture. Additionally, the user can remove the ring to disable the NFC. Upon donning the ring the user will be prompted by the application on the mobile device to re-authenticate by entering a PIN, whereby the proper PIN results in re-enabling the NFC functionality.

[0288] In yet another example, the WCD device employing NFC can be configured on the fly to map to different data sets stored thereon. For example, the WCD device employing NFC can employ data thereon to make purchases, e.g., account information, data to access a building, e.g., a key fob, and data thereon to board public transportation, e.g., smart card, metro card, etc. A user can perform a predetermined different gesture

Petitioner Samsung Ex-1004, 1142

for each of the above data sets to access the data. Once accessed, the WCD device employing NFC can initiate a link with another computing device to initiate a transaction, to open a door, or to board public transportation, etc.

[0289] **VI. Optical Element and Attachment Frame**

[0290] FIG. 33A depicts a perspective view of a WCD assembly 3300 according to one or more aspects of the disclosure, while FIGs. 33B-D depict exploded views of the WCD assembly and 33E depicts a cross sectional view of the WCD assembly along A-A. In this example, the WCD assembly 3300 includes a WCD 3310, an attachment frame 3320, and an optical element 3330. The WCD 3310 can be any of the WCD examples described above or below in the present application.

[0291] The attachment frame 3320 is releasably attached to the WCD3310. The optical element 3330 is itself releasably attachable to the attachment frame 3320. In this regard, the attachment frame 3320 provides an attachment interface between the WCD 3310 and the optical element 3330, thereby allowing the optical element 3330 to be at a fixed position in space with respect to the WCD 3310 or any portion thereof. The attachment frame3320 can be made of any material, such as a metal, polymer, etc. Any type of polymer can be used, such as thermosetting plastics, thermoplastics, PETE, polycarbonate, polyethylene, LDPE, or any other type of plastic.

[0292] The attachment frame can be sized and shaped to fit along the curved surface of the WCD. For example, the attachment frame can have a curved undersurface to allow a flush fit with the curved surface of the WCD. The attachment frame can have any shape, size, or radius of curvature depending on the size and shape of the WCD.

[0293] The attachment frame 3320 includes a first retaining a portion 3322 and a pair of second retaining portions 3324. The first retaining portion 3322 defines a conical recess 3322a configured to receive the optical element 3330, and provides a generally unoccluded pathway for light to pass through the optical element and onto the WCD. Although depicted as defining a conical or frustoconical shape, the recess 3322a can be any other shape depending on the shape of the optical element 3330. Each of the second retaining portions3324 includes a respective locking feature 3324a. The respective locking features3324 and a extend from the second it retaining portion3324 toward one another such that a distance between the respective locking features is greater than a

Petitioner Samsung Ex-1004, 1143

distance between the remaining portions of the second retaining portions. As shown in FIG. 33E, the locking features engage with an inward-facing surface 3350 of the WCD to ensure a secure fit. In one example, the inward-facing surface of the WCD may itself have one or more features 3360 to engage with the locking features of the second retaining portions. Such one or more WCD features can include projected surfaces, recesses, or any other type a feature to allow for engagement with the attachment frame.

[0294] The optical element 3330 can be made of any material capable of modifying, e.g., focusing, incident electromagnetic radiation, such as visible light, ultraviolet light, infrared light, or any other type of electromagnetic radiation. In some examples, the optical element 3330 can be constructed from a polymer, such as any of the polymers identified above. In another example, the optical element can be made of glass, quartz, diamond, zirconium, or any other material capable of focusing light. More generally, the optical element 3330 is formed with a general outward appearance simulative of a faceted jewel with an appropriate tint or coloration (including clear/white). The term "jewel" can also be used in the alternative to describe the optical element 3330 herein.

[0295] The WCD can include CPV cell 3312 that can be disposed directly underneath the attachment frame 3320 and optical element 3330 when assembled. In other examples, the CPV can be positioned within the housing and can receive electromagnetic radiation via a transparent potting material. In this regard, incident light striking the optical element 3330 can be focused on to the CPV cell to allow for charging of the internal battery of the WCD. The optical element 3330 provides an increased charging efficiency when compared to the CPV exclusively receiving ambient light, since the ambient light is collected/gathered from a wider field, and then focused onto the CPV by the optical element 3330. In one example, a focal length of the optical element 3330 is different than a distance between the optical element and the CPV. For example, the focal length can be greater than or less than the distance between the optical element and the CPV. This can be advantageous in various aspects of the disclosure so as to avoid the light from focusing at a focal point directly on the CPV, which could cause damage to the CPV itself by over-concentrating the light at that single point of the overall CPV surface.

[0296] FIGs.34A-B depict a WCD assembly 3400 according to one or more aspects of the disclosure. In this example, the attachment frame 3420 does not extend to an

Petitioner Samsung Ex-1004, 1144

inward-facing surface of the WCD 3410, but is instead form entirely on the outside-facing surface of the WCD. In some examples, the attachment frame 3420 can be semi-permanently or permanently affixed to the outward-facing surface of the WCD and can have a plurality of retaining portions (mounting prongs) 3422 that at least partially define a recess 3422a for receiving the optical element. As shown in FIG.34B, the optical element 3430 is releasably attached to the attachment frame 3420. This configuration can be particularly desirable, as it exhibits ornamental similarities to a traditional engagement ring while still having the increased functionality of the WCD. Note that while not shown, the mounting prongs can include small hook ends that springably retain the optical element 3430 when attached, but that can release the optical element based upon a prying motion. A customized grasping tool (not shown) can also be employed to remove (and attach) the optical element in this example.

[0297] **VII. Enclosure/Packaging**

[0298] FIG. 35A depicts an enclosure or case 3500 for storing a WCD according to one or more aspects of the disclosure. As shown, the enclosure3500 includes a lid 3510 and a base 3520. The lid 3510 and base 3520 can engage via a recessed portion 3522 formed in the base 3520 to provide a substantially sealed interior environment.

[0299] The lid 3510 can be cuboidal in external dimensions, or define any other type of geometric shape that allows sufficient internal volume to contain the WCD. For example a custom design shape (polyhedral, etc.) can be employed. In this example, the top portion3510 is substantially cuboidal as shown, including rounded edges rather than vertices. The lid can be substantially transparent to allow viewing of the WCD while enclosed therein, and can be made of any type of material, such as a polymer, glass, etc. The lid can also be mounted with pins on a hinge.

[0300] The base 3520 can be cuboidal, or any other type of geometric shape. In this example, the bottom portion is substantially cuboidal, including rounded edges rather than vertices as shown. The bottom portion can be made of any material and can be transparent or opaque.

[0301] The base 3520 can define a receptacle 3524 for receiving the WCD3505. The receptacle 3524 can be sized and shaped to receive the WCD 3505 and in this example is semicylindrical, e.g., a portion of a cylinder. The radius of the semicylinder

Petitioner Samsung Ex-1004, 1145

can be slightly larger than a radius of the WCD in order to accommodate the WCD securely. The receptacle can lined with a soft material to allow for a soft, safe material to receive the WCD, such as a silicone, thermoplastic, fabric, felt, or other material.

[0302] FIG.35B is a cross sectional view of the assembled enclosure3500 shown above along the line B-B. As shown, when assembled, the WCD 3505 fits securely within the receptacle 3524. The interior of the lid3510 can be sized and shaped to conform to the shape of the WCD such that the WCD is completely surrounded and enclosed by the lid 3510, while in other examples, the lid3510 can be sized and shaped to allow for airspace 3514 between the lid surface and the WCD.

[0303] FIG.35C is a cross section of the enclosure along line A-A. As shown, the lid 3510 can include an integral optical element 3512. The optical element3512 can be a lens or any other device to modify, e.g. focus, light that passes therethrough. In this example, the optical element 3512 can be disposed at a predetermined distance away from one or more CPV cells 3507 disposed on the WCD 3505. This distance *d* can be measured from the center of the optical element to the CPV cells 3507, and the optical element can itself have a focal length *f*. In one example, the distance *d* can be greater than the focal length *f*, such that the optical element focuses light at a point above the WCD in the enclosure. In this regard, the light will not focus directly on the CPV cells disposed at the surface of the WCD, thereby avoiding overheating or damage to the CPV cells. In other examples, the distance *d* can be less than the focal length, which can also prevent light from focusing at a surface of the WCD.

[0304] FIG. 36 depicts an enclosure 3600 including air vents 3650 according to one or more aspects of the disclosure. In this example, the enclosure 3600 includes a plurality of vent holes 3650. The vent holes can be arranged on one or more faces of the lid. The vent holes 3650 can prevent overheating within the enclosure during charging of the WCD by allowing for circulation of convective air current. During shipping, the vent holes3650 can be covered by an adhesive and/or adhering (peel-off) polymer sheet of conventional arrangement to prevent debris or moisture from entering the enclosure. The enclosure can include a lid 3610, base 3620, receptacle 3624, and optical element 3612 as in the examples set forth above.

[0305] **VIII. Sizing**

Petitioner Samsung Ex-1004, 1146

[0306] FIG. 37 depicts a method 3700 of sizing a finger according to one or more aspects of the disclosure. At block 3710, the hand of a user can be provided. The hand can be held still in mid-air or alternatively can be resting on a surface.

[0307] At block 3720, a first image is taken of the user's hand from a first perspective. The image can be taken by any type of imaging apparatus, such as a CCD or CMOS camera, a digital camera, a camera associated with a mobile phone, etc. The first image can be stored in a memory.

[0308] At block 3730, a second image is taken of the user's hand at a second perspective. In this regard, the second perspective is different from the first perspective so as to provide a distinct view in the second image of the user's hand. Block 3730 can be repeated any number of times. For example, a third image can be taken of the user's hand at a third perspective. In this regard, the third perspective is different from both the first and second perspectives so as to provide a distinct view in the third image of the user's hand, and so on.

[0309] At block 3740, a size of the user's finger can be derived from the plurality of images taken above. In some examples, as few as two images may be required, while in other scenarios, more than three images may be required, depending on a number of circumstances including image quality, selected perspectives, etc. The size can be derived from the plurality of images by any number of techniques, such as stitching the plurality of images together to generate a 3D typography of the fingers, then using photogrammetry algorithms to identify features on the fingers to determine the appropriate ring size. Furthermore, the touch screen of the smart phone can be used to measure the hardness of tissue by measuring the footprint/impression the fingers make while pressing a finger against the touch screen of a mobile phone.

[0310] FIG. 38 is a pictorial diagram showing a plurality of image perspectives of a user's hand 3802. As shown, perspectives 3810, 3820, and 3830, as well as the other perspectives, produce corresponding images (in a strip) 3812, 3822, and 3832. The images can be used to derive a size of the user's finger according to the methods described above.

Petitioner Samsung Ex-1004, 1147

[0311] FIG. 39 depicts a sizing tool for sizing the finger of a user. As shown, the tool 2900 can include a plurality of finger holes 3910-3950. The tool 3900 can be made of any material, such as plastic, metal, or cardboard.

[0312] FIG. 40 depicts a sizing tool for sizing the finger of a user according to an alternate example. As shown, the tool 4000 can include a plurality of finger holes 4010-4050. The tool 4000 can be made of any material, such as plastic, metal, or cardboard.

[0313] FIG. 41 depicts yet another alternate example of a sizing tool for sizing the finger of a user. As shown, the tool 4100 can include a plurality of finger holes 4110-4150. The tool 4100 can be made of any material, such as plastic, metal, or cardboard. The thickness of the card reflects the thickness of the ring to ensure proper fit. Additionally, the sizing tool is designed such that it can be easily mailed to the user with a standard mail service such as USPS.

[0314] Any of the tools 3900, 4000, or 4100 can be provided to a user prior to purchase of the ring in order to obtain accurate sizing information prior to purchase. The tools include holes, as shown above, that can come in a plurality of predetermined finger sizes to allow a user to match his or her finger size with the tool. The best match, e.g., closest size that ensures a comfortable fit, can be identified using the tools. Alternatively, the tools can be provided at retail locations to size the finger of the user on site prior to purchase. More generally, a variety of other sizing techniques, such as those employed by conventional jewelers can be employed according to further aspects of the disclosure.

[0315] In another embodiment, a packaging or enclosure of the WCD can include a sizing diagram or interface embodied therein to allow a user to size a finger during the purchase process.

[0316] FIG. 42 depicts a method 4200 of monitoring activity according to one or more aspects of the disclosure.

[0317] At block 4210, a user can don or place the WCD onto the finger to secure it in the wearing position.

[0318] At block 4220, a user can perform any number of daily activities, such as running on a treadmill, walking, exercising, typing, etc.

Petitioner Samsung Ex-1004, 1148

[0319] At block 4230, the WCD, contemporaneous with block 3220, can use one or more sensors to sense the activities of the user. For example, the sensors can detect location, speed, acceleration, orientation, heart rate, etc.

[0320] At block 4240, the WCD, or another computing device, can generate an entry in an activity log at the conclusion of a detected activity. If the activity detected by the sensors has a profile that has not yet been identified, the WCD can prompt the user to identify the activity. For example, the user can identify profiles such as "Run in Central Park," "Typing," "Run on Treadmill," etc. The WCD can associate the identity provided by the user with the activity profile identified by the sensors and store the identified activity in the WCD memory, or any other memory. Later, if the user performs the same activity and the WCD detects the activity profile as being similar to a saved activity, the WCD can identify the activity while the user is performing the activity and save the activity in the activity log. Each of the activities performed can be saved in the overall activity log and can be stored in a memory on the WCD, or other device, for later v1ewmg.

[0321] FIG.43 depicts a method 4300 of determining whether a user is wearing gloves according to one or more aspects of the disclosure. At block 4310, a user is provided while wearing the WCD, where such user may or may not be wearing gloves.

[0322] At block 4320, one or more light sensors on board the WCD can detect surrounding ambient light. Such light sensors could include, for example, a CPV or other light sensitive element.

[0323] At block 4330, one or more additional measurements maybe made. Such additional measurements can include, for example, an ambient temperature measurement and or a proximity measurement, e.g., detecting proximity of an object to the WCD via reflected electromagnetic radiation in the form of IR light.

[0324] At block 4340, a measured ambient temperature and ambient light measurements are compared to predetermined thresholds. If the ambient temperature measurement is above a certain predetermined temperature threshold and the ambient light measurement is below a certain threshold, it can be determined that the user is wearing a glove over the WCD.

Petitioner Samsung Ex-1004, 1149

[0325] At block 4350, a measured proximity and ambient light measurements are compared to respective predetermined thresholds. If the proximity measurement is below a certain distance threshold (e.g., determines an item is in close proximity to the WCD) and the ambient light measurement is below threshold, it can determined that the user is wearing a glove over the WCD. In any of the above examples, an intensity of LED indicators of the WCD can be adjusted according to a detected ambient light using an appropriate algorithm or process that compares the ambient light to a scale and adjusts a desired driving current/voltage for the LEDs according to a predetermined formula (e.g. a proportional adjustment using an adjustment coefficient) or scale (e.g. a lookup table). For example, where there is abundant ambient light (e.g., detected ambient light above a predetermined threshold), the intensity of the LED indicators can be increased. In the same way, where there is little ambient light (detected ambient light below a predetermined threshold), the intensity of the LED indicators can be decreased.

[0326] In one example, the WCD can detect whether it is removed and or installed on the finger of the user. In this regard, as mentioned above, the WCD can have inward-facing light sensors, CPV, or temperature sensors. When a user installs a ring on his finger the measure of ambient light may decrease or the temperature may increase. Such changes in ambient light and/or temperature can be detected by one or more sensors onboard the WCD and a determination can be made that the user has removed and or installed the ring on his finger.

[0327] FIG.44 depicts a method 4400 of securing data onboard the WCD according to one or more aspects of the disclosure. At block 4410, a user may don the WCD on the finger. At block 4420, a user may execute an application on a mobile device, or other computing device, that can be previously associated and authenticated with the WCD. At block 4430, the user can enter an authorization code into the application running on the mobile device, such as a PIN code. At block 4440 the mobile device may transmit the authorization code to the WCD by any means of communication, such as, wired, wireless, Bluetooth, NFC, etc. At block 4450, the user wearing the WCD can now be again authenticated and associated with the WCD and can be granted access to certain functions and/or data storage of the WCD. At block 4460 a user may remove the WCD. At block4470 the WCD can detect that it is removed such as bio detection (including e.g., biometric identification) techniques described above with respect to inward facing

Petitioner Samsung Ex-1004, 1150

sensor changes, temperature changes, or heart rate decreasing to zero. At block 4480, the authorization code previously stored on the WCD can be automatically deleted upon detection of removal to avoid unauthorized access to such information by a subsequent wearer or other querying party. Further or alternatively, additional information can be automatically deleted upon removal of the WCD, for example any data and or instructions stored on the onboard memory of the WCD such as personal information, banking information, confidential information, or other sensitive data.

[0328] **IX. Timepiece System**

[0329] FIG. 45A is a timepiece system 4500 according to one or more aspects of the disclosure. As shown, the timepiece system 4500 can include a conventional timepiece 4510 and a timepiece computing device (TCD) 4520. The TCD can be any shape, and in this example is in the shape of a cylinder. The radius can be significantly greater than a height of the TCD to provide the shape of a puck. The TCD can have one or more structural and/or functional components, and can be similar to the WCD described above with respect to hardware features, components, sensors, etc. Although depicted as cylindrical, the TCD can have any shape depending on the shape of the conventional timepiece. For example, where the timepiece has a rectangular or square face, the TCD can similarly have a rectangular or square profile.

[0330] A top surface 4520a of the TCD can include a pressure sensitive adhesive (PSA) layer 4522 to allow for adhesion of the TCD to the under surface of the timepiece 4510. The TCD 4520 can have a radius or circumference that does not exceed radius or circumference of the face of the conventional timepiece so as not to be seen when a user is wearing the timepiece system 4500. The TCD can enhance the conventional timepiece with many of the features described above with respect to the WCD such as, heart rate sensing, temperature sensing pedometer, activity sensing, gesture sensing and control, without having to alter the look of the conventional timepiece.

[0331] Fig 45B is a bottom view of the TCD. As shown, the TCD can include a battery 4540, any printed circuit board 4550 with one or more components attached thereto (not shown) such as motion sensors, power management circuitry, charging circuitry, etc. As with the WCD, the printed circuit board of the TCD can be overmolded 4560. The overmold can be transparent or substantially transparent to allow

Petitioner Samsung Ex-1004, 1151

electromagnetic radiation to pass through to be incident upon one or more components of the TCD.

[0332] As shown, the TCD can include a light pipe 4524 around the perimeter thereof. The light pipe 4524 can be substantially annular in shape and can be formed in part by the overmold of the TCD. The light pipe can be constructed from a conventional transparent or translucent moldable material (e.g. acrylic, polycarbonate, etc.), and can be arranged to focus ambient light onto a CPV disposed onboard the TCD for additional charging capability. The optical arrangement/geometry of the light pipe can be implemented using skill in the art to achieve the desired optical characteristics. In another example, excess heat generated by the TCD or excess body heat emitted from the skin of the user can be converted to electrical energy via a thermoelectric (TEG) module, such as a Peltier module, disposed onboard the TCD.

[0333] The TCD can also include any number of CPV cells, either on a top surface or bottom surface, to allow for charging. For example, a CPV cell can be placed on the underside of the TCD to allow for docking with a charging/docking station.

[0334] FIG.46 depicts a WCD 4600 with a pair of LED indicators 4610-4620 disposed at an inward-facing portion of the WCD. As shown, the WCD 4600 can include a pair of transparent regions 4640-3650 and an opaque region 4630. The LEDs 4610- 3620 can be positioned under the transparent regions 4640-3650 to allow light from the LEDs to exit the WCD. In one example, the LEDs 4610-3620 can create a subtle diffuse glow to the skin to provide a desirable visual effect to user. In another example, a user feedback LED can be placed at an inward facing surface and a second can be placed at an outward facing surface of the WCD. Depending on the circumstances, one of the LEDs may be disabled to save battery life. For example, LEDs that are facing away from a user e.g. facing down or away from user's line of sight, may be disabled. As described above, the WCD can determine its orientation based on onboard sensors, such as the magnetometer, accelerometer, GPS, etc.

[0335] FIG. 47A is a system for generating and managing alerts according to one or more aspects of the disclosure. As shown, the system can include a WCD 4710A, one or more networks 4720A, and one or more server computers 4730A according to one or more aspects of the disclosure. The WCD 4710A can communicate directly and/or

Petitioner Samsung Ex-1004, 1152

indirectly with the server 4730A via the network 4720A. In this regard, data generated and/or stored at the WCD 4710A can be transmitted to the server 4730A and vice versa. In one example, such data can include biometric data pertaining to a user wearing the WCD that is detected and stored by the WCD.

[0336] FIG. 47B depicts a block process diagram for generating and managing alerts according to one or more aspects of the disclosure and FIG. 47C is a flow chart depicting a method for generating and managing alerts according to one or more aspects of the disclosure.

[0337] At block 4710C, and as shown at process block 4710B, the user is authenticated with respect to the WCD. In this regard, a single user can be associated with a single WCD and can be associated with a predetermine identifier, such as an alphanumeric number. If the user is not authenticated or the authentication process is not conclusive, the WCD may invite the user to retry authentication at block 4715C until the user is successfully authenticated. In some examples, the WCD may timeout the authentication process, lock the WCD, or place the WCD in safe mode in the event of too many unsuccessful authentication attempts as a security measure.

[0338] The user can be authenticated according to any of the authentication methods described in the present application, such as via a unique capillary map, a unique ECG profile, etc.

[0339] If the user is authenticated, biometric data can be transmitted to the server at block 4720C. The captured biometric data 4720B can be transmitted to the server via network 4720A, 47222B

[0340] Once received at the server, the biometric data can be aggregated, sorted, categorized, or profiled at block 4730C and as shown at process block 4730B. In this regard, a profile (corresponding to the alphanumeric identifier) may be created at a database at the server that stores data for a particular user. The profile can store transmitted biometric data, as well as other data, such as user gender, height, weight, age, family history, disease information, location, etc.

[0341] In some examples, identifying information may be removed from the data and/or not transmitted to allow for anonymity and/or to comply with regulations regarding transmission of medical data. The transmitted biometric data can be

Petitioner Samsung Ex-1004, 1153

normalized in order to comply with predetermined data requirements in order to be added to the profile. In one example, a minimum amount of data may be required in order to be considered viable for association with the profile. The biometric data of a single profile can be aggregated, or in other examples multiple profiles can be aggregated simultaneously.

[0342] Aggregation of the user's biometric data into a single profile allows for the profile to be visualized or analyzed according to any number of methods. For example, a timeline can be created showing biometric data over a period of time. The data can also be synthesized or analyzed to calculate trend data, or other mathematical features.

[0343] Although only one WCD is depicted, it is contemplated that a plurality of WCDs can exist, with each WCD corresponding to a distinct user (and distinct alphanumeric identifier) and therefore resulting in a plurality of distinct profiles at the server. Accordingly, each of the distinct users/WCDs may be authenticated separately according to the methods described herein.

[0344] At block 4740C, once the transmitted data has been associated with the user profile, the updated profile can be correlated with one or more other profiles stored at the server as shown as process block 4740B. The profiles may be correlated according to any number of correlation standards, such as correlating users with similar traits such as age, gender, location, profession, or by any other data stored at the server. In some examples, one or more of the traits can be used to make such a correlation. The biometric data from the one or more users that are correlated with one another can be combined to form a group profile. The group profile can be the aggregation, average, range, or sum of individual profiles that form the group profile. For example, for a particular group profile, a range of resting heart can be generated by taking the maximum and minimum values of resting heart from the individual profiles. In other examples, an average (and standard deviation or standard deviation of the mean) can be generated for each trait, such as average resting heart rate, average active heart rate, average blood pressure, average blood sugar, average skin temperature, ECG profiles, as well as any other features capable of being detected by the WCD as described above.

[0345] At block 4750C, transmitted biometric data can be compared to the established values from the group profile. In this way, if a user's heart rate deviates by a

Petitioner Samsung Ex-1004, 1154

predetermined threshold (such as by predetermined magnitude or standard deviation), an alert can be generated at process block 4750B. The comparison process can occur at the server after transmission of the biometric data. In another example, the group profile data can be transmitted to the WCD for comparison at the WCD. This advantageously allows the comparison to be made where the WCD cannot establish a network link. The group profile can be updated on a continuous basis or a predetermined time interval or at each transmission of biometric data.

[0346] At block 4760C, the alert is transmitted to the WCD and displayed to the user at process block 4760B. The alert can indicate that the user's biometric data has deviated from the profile group and may advise the user to seek medical attention. In another example, the server can directly contact a medical health professional. In the example where block 4750C occurs at the WCD, transmission of alert information from the server may not be necessary.

[0347] The alert at the WCD can be any type of audio or visual indicator, such as an LED, haptic feedback, audible alarm, etc. The indicator may also invite the user to rest, make an appointment with a medical health professional, recommend a particular medication, or suggest certain physical activities that may health condition that caused the alert.

[0348] As shown in FIG. 47B, the authentication 4710B, aggregation 4730B, and correlation 4740B can occur at server 4730A, which can include a process, memory, and any other features of a general purpose computer. The authentication 471OB, aggregation 4730B, and correlation 4740B can access a database stored at the memory, where profiles, group profiles, and biometric data can be stored.

[0349] FIG. 48A is a method for variable sampling according to one or more aspects of the disclosure. As described above, the processor module of the WCD can determine (e.g., based on identified physical activities, routine pattern, and/or time) a frequency at which one or more sensors in the sensor modules should operate.

[0350] At block 4810A, one or more sensors of the WCD may take one or more measurements. For example, the WCD can detect temperature, heart rate, acceleration, as described above.

Petitioner Samsung Ex-1004, 1155

[0351] At block 4820A, the WCD can calculate an activity level of a user. For example, the WCD can compare to a number of stored activity profiles (as described above) stored by the user, or can compare the sensor measurements to sensor threshold values corresponding to different activities, such as sitting, running, sleeping etc. In one example, the WCD detect acceleration values over time to generate an activity level for a particular time period.

[0352] At block 4830A, the WCD may compare the identified activity level to a predetermine activity threshold value. In one example, the WCD may categorize the detected activity as either a high level activity or a low level activity. High level activities can include running, swimming, biking etc., while low level activities may include sitting, standing still, or sleeping.

[0353] At block 4840A, the WCD can set a first sample rate for high level activities and at block 4850A, the WCD can set a second sample rate for low level activities. The first sample rate can be a shorter time interval than the second sample rate, resulting in more data being detected and generated during a set amount of time while the user is active. This allows for increased power efficiency of the WCD while also providing the advantage of generating more data when a user is more active, thereby providing added biometric data for later analysis.

[0354] In another example, the sample rate can be scaled according to activity level. For example, the sample rate can be scaled to be directly proportional to heart rate. This results in a shorter time interval for sampling (more frequent data gather) for running than for walking.

[0355] As activity level changes, the method above can be repeated a plurality of times at certain intervals in order to quick or abrupt activity changes.

[0356] FIG. 48B and 48c are graphs depicting one or more aspects of the sample method of FIG. 48A. As shown in FIG. 48B, the WCD may determine a user is engaging in a high level activity by detecting acceleration values that are above a predetermined threshold value. In this regard, a shorter time interval (more frequent data gathering) can be set. As shown in FIG. 48C, the user is engaging in a low level activity since the acceleration values are below a predetermined threshold. A longer sample rate (less frequent data gathering) can be set in this instance.

Petitioner Samsung Ex-1004, 1156

[0357] FIG. 49 a diagrammatic representation of a machine in the example form of a computer system 4900 within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed. Specifically, FIG. 49 shows a diagrammatic representation of a machine in the example form of a computer system within which instructions (e.g., software or program code) for causing the machine to perform any one or more of the methodologies discussed herein may be executed. In alternative embodiments, the machine operates as a standalone device or may be connected (e.g., networked) to other machines. In a networked deployment, the machine may operate in the capacity of a server machine or a client machine in a server-client network environment, or as a peer machine in a peer-to-peer (or distributed) network environment.

[0358] The machine may be a server computer, a client computer, a personal computer (PC), a tablet PC, a set-top box (STB), a personal digital assistant (PDA), a cellular telephone, a smartphone, a web appliance, a network router, switch or bridge, or any machine capable of executing instructions (sequential or otherwise) that specify actions to be taken by that machine. Further, while only a single machine is illustrated, the term "machine" shall also be taken to include any collection of machines that individually or jointly execute instructions to perform any one or more of the methodologies discussed herein.

[0359] The example computer system includes a processor (e.g., a central processing unit (CPU), a graphics processing unit (GPU), a digital signal processor (DSP), one or more application specific integrated circuits (ASICs), one or more radio-frequency integrated circuits (RFICs), or any combination of these), a main memory, and a non-volatile memory, which are configured to communicate with each other via a bus. The computer system may further include graphics display unit (e.g., a plasma display panel (PDP), a liquid crystal display (LCD), a projector, or a cathode ray tube (CRT)). The computer system may also include alphanumeric input device (e.g., a keyboard), a cursor control device (e.g., a mouse, a trackball, a joystick, a motion sensor, a touch screen, or other pointing instrument), a storage unit, a signal generation device (e.g., a speaker), and a network interface device, which also are configured to communicate via the bus.

Petitioner Samsung Ex-1004, 1157

[0360] The storage unit includes a non-transitory machine-readable medium on which is stored instructions embodying any one or more of the methodologies or functions described herein. The instructions may also reside, completely or at least partially, within the main memory or within the processor (e.g., within a processor's cache memory) during execution thereof by the computer system, the main memory and the processor also constituting machine-readable media. The instructions may be transmitted or received over a network via the network interface device.

[0361] While machine-readable medium is shown in an example embodiment to be a single medium, the term "machine-readable medium" should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, or associated caches and servers) able to store instructions. The term "machine-readable medium" shall also be taken to include any medium that is capable of storing instructions for execution by the machine and that cause the machine to perform any one or more of the methodologies disclosed herein. The term "machine-readable medium" includes, but not be limited to, data repositories in the form of solid-state memories, optical media, magnetic media, or other non-transitory machine readable medium.

[0362] **X. Conclusion**

[0363] It should be clear that the WCD and TCD arrangements described according to various aspects of the disclosure provide a highly versatile and useful item of wearable electronics that is comfortable and convenient to wear, conveniently charged, and weatherproof for all-purpose and all-condition wearing. Various options for style and appearance can be implemented, as well as a variety of storage options. The functions and structure of the device lend themselves to both a ring version and a wrist-worn version. All versions are designed for long-life with minimal maintenance, and are adaptable to interoperate with a variety of networked devices including computers, smartphones, home controllers, security systems, and virtually any other device capable of communicating over a wireless link-including another WCD or TCD.

[0364] The foregoing has been a detailed description of illustrative embodiments of the invention. Various modifications and additions can be made without departing from the spirit and scope of this invention. Features of each of the various embodiments

Petitioner Samsung Ex-1004, 1158

described above may be combined with features of other described embodiments as appropriate in order to provide a multiplicity of feature combinations in associated new embodiments. Furthermore, while the foregoing describes a number of separate embodiments of the apparatus and method of the present invention, what has been described herein is merely illustrative of the application of the principles of the present invention. For example, as used herein various directional and orientational terms such as "vertical", "horizontal", "up", "down", "bottom", "top", "side", "front", "rear", "left", "right", and the like, are used only as relative conventions and not as absolute orientations with respect to a fixed coordinate system, such as the acting direction of gravity. Note also, as used herein the terms "process" and/or "processor" should be taken broadly to include a variety of electronic hardware and/or software based functions and components. Moreover, a depicted process or processor can be combined with other processes and/or processors or divided into various sub-processes or processors. Such sub-processes and/or sub-processors can be variously combined according to embodiments herein. Likewise, it is expressly contemplated that any function, process, application, and/or processor here herein can be implemented using electronic hardware, software consisting of a non-transitory computer-readable medium of program instructions, or a combination of hardware and software. Also, while a variety of visible and near-visible radiation sources are described as LEDs, it is expressly contemplated that other types of sources can be employed according to aspects of the disclosure-for example plasma discharge sources and bioluminescent sources, as well as sources that are based upon developing technologies. Electronic circuits and RF components can similarly be based on alternate and/or developing technologies. Accordingly, this description is meant to be taken only by way of example, and not to otherwise limit the scope of this invention.

Petitioner Samsung Ex-1004, 1159

ABSTRACT

A smart ring includes a curved housing having a U-shape interior storing components including: a curved battery approximately conforming to the curved housing, a semi-flexible PCB approximately conforming to the curved housing and having mounted theron: a motion sensor for generating motion data from physical perturbations of the smart ring, a memory for storing executable instructions, a transceiver for sending data to a client computer, a temperature sensor, and a processor for receiving motion data and performing executable instructions in response thereto, and a potting material disposed in the interior, forming an interior wall of the smart ring, wherein the potting material encapsulates the components and is substantially transparent to visible light, infrared light, and/or ultraviolet light.

Petitioner Samsung Ex-1004, 1160

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Confirmation No.: 7585
von Badinski	Examiner: TBD
For: WEARABLE COMPUTING DEVICE	Art Unit: TBD
Application No.: 18/323,385	**RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS AND NOTICE OF INCOMPLETE REPLY**
Filed: May 24, 2023	
Docket No.: PM001.01.03.01.01.01.01.02	**CERTIFICATE OF TRANSMISSION** I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office on: August 14, 2023.
Customer No.: 179918	By: /Carmen E. Simon/ Carmen E. Simon

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

In the Notice to File Corrected Application Papers ("Notice") dated June 15, 2023, it was noted that there were inconsistencies between the as-filed drawings and the drawings listed in the Brief Description of the Drawings section of the as-filed application. Applicant submitted a substitute specification on July 19, 2023, which included a replacement specification that included a revised Brief Description of the Drawings section to address these inconsistencies.

Further, in the Notice of Incomplete Reply dated July 27, 2023, it was noted that the substitute specification submitted on July 19, 2023, was not accompanied by a statement that the substitute specification includes no new matter. Accordingly, Applicant re-submits the substitute specification along with this response. Applicant submits that the substitute specification

Petitioner Samsung Ex-1004, 1161

attached herewith includes no new matter.

The Commissioner is authorized to charge any fees or underpayments that may be due with this response, or credit any overpayments, to Deposit Account No. 08-2623.

If the Examiner believes a telephone conference would expedite prosecution of this Application, please call the undersigned at 303-473-2700.

Respectfully submitted,

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Petitioner Samsung Ex-1004, 1162

WEARABLE COMPUTING DEVICE

CROSS REFERENCE

[0001] The present Application for Patent is a Continuation of U.S. Patent Application No. 18/179,272, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed March 6, 2023, which is a Continuation of U.S. Patent Application No. 17/519,201, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed November 4, 2021, which is a Continuation of U.S. Patent Application No. 17/013,348, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed September 4, 2020, which is a Continuation of U.S. Patent Application No. 16/224,686, by von Badinski et al, entitled "WEARABLE COMPUTING DEVICE," filed December 18, 2018, which is a Division of U.S. Patent Application No. 15/444,217, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed February 27, 2017, which is a Division of U.S. Patent Application No. 14/556,062, by von Badinski et al, entitled "WEARABLE COMPUTING DEVICE," filed November 28, 2014, which claims the benefit of United States Provisional Application Serial No. 62/006,835, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed June 2, 2014, and United States Provisional Application Serial No. 61/910,201, by von Badinski et al., entitled "FINGER RING DEVICE FOR ACTIVITY MONITORING OR GESTURAL INPUT," filed November 29, 2013, each of which is expressly incorporated by reference herein.

FIELD OF TECHNOLOGY

[0002] This invention is in the field of wearable electronic devices.

BACKGROUND

[0003] Wearable electronics are an emerging technology with many applications for the wearer. They can improve lifestyles, ease access to technology and help monitor activity within the wearer's body. However, many current wearable electronics are bulky and can be intrusive or interfere with a person's daily life. In this regard, the wearer may not be comfortable wearing the device for extended periods of time.

Petitioner Samsung Ex-1004, 1163

SUMMARY OF THE INVENTION

[0004] This invention overcomes the disadvantages of the prior art by providing a wearable computing device (WCD) in the shape of a ring. The wearable computing device can be worn for extended periods of time and can take many measurements and perform various functions because of its form factor and position on the finger of a user.

[0005] One aspect of the disclosure provides a wearable computing device, comprising: an interior wall; an exterior wall; a flexible printed circuit board disposed between the interior wall and the exterior wall; at least one component disposed on the flexible printed circuit board; and wherein at least one of the interior wall and the exterior wall defines a window that facilitates at least one of data transmission, battery recharge, and status indication.

[0006] In one example, the window comprises an internal window defined by the interior wall.

[0007] In one example, the window comprises an exterior window defined by the exterior wall.

[0008] In one example, the window comprises a plurality of exterior windows defined by the exterior wall.

[0009] In one example, the plurality of exterior windows comprises a first exterior window and a second exterior window, wherein the first exterior window facilities battery charging and the second exterior window facilities data transmission.

[0010] In one example, at least one concentrated photovoltaic cell, an antenna, and at least one LED are accessible via the window.

[0011] Another aspect of the disclosure provides a wearable computing device, comprising: an internal housing portion configured to be disposed near a finger of a user; a flexible printed circuit board arranged around a portion of a circumference of an interior surface of the internal housing; at least one component disposed on the flexible printed circuit board; and an external housing portion configured to seal the at least one component and the printed circuit board in an internal space defined by the interior surface of the internal housing.

Petitioner Samsung Ex-1004, 1164

[0012] In one example, the external housing portion comprises a substantially transparent external potting.

[0013] In one example, the at least one component comprises at least one LED configured to emit at least one of visible light, infrared radiation, and ultraviolet radiation through the external potting.

[0014] In one example, the at least one component comprises a concentrated photovoltaic cell configured to receive concentrated light through the transparent external potting.

[0015] In one example, the flexible printed circuit board includes a plurality of stiffener elements configured to engage with a corresponding plurality of flanges disposed on the internal housing portion.

[0016] Another aspect of the disclosure provides a wearable computing device, comprising: an external housing portion; a flexible printed circuit board arranged around a portion of a circumference of an interior surface of the external housing; at least one component disposed on the flexible printed circuit board; and an internal housing portion configured to seal the at least one component and the printed circuit board in an internal space defined by the interior surface of the external housing.

[0017] In one example, the internal housing portion comprises a substantially transparent internal potting.

[0018] In one example, the at least one component comprises at least one LED configured to emit at least one of visible light, infrared radiation, and ultraviolet radiation through the internal potting.

[0019] In one example, the at least one component comprises a concentrated photovoltaic cell configured to receive concentrated light through the transparent internal potting.

[0020] In one example, the flexible printed circuit board includes a plurality of stiffener elements configured to engage with a corresponding plurality of flanges disposed on the external housing portion.

[0021] Another aspect of the disclosure provides a system, comprising: a wearable computing device, including a housing and a photovoltaic element disposed at least

Petitioner Samsung Ex-1004, 1165

partially within the housing; and a base assembly, the base assembly including a concentrated light source directed at the photovoltaic element.

[0022] In one example, the wearable computing device includes at least one ferrous element disposed within the housing, and wherein the base assembly includes at least one magnetic element disposed therein.

[0023] In one example, the concentrated light source is arranged circumferentially around the wearable computing device when the wearable computing device is engaged with the base assembly.

[0024] In one example, the concentrated light source comprises at least one of a laser diode and a light emitting diode (LED).

[0025] In one example, a housing of the WCD defines an opening through which the WCD is configured to receive concentrated light.

[0026] In one example, the base assembly comprises an optical element for focusing concentrated light emitted from the concentrated light source.

[0027] In one example, the optical element comprises a lens and is selected from the group consisting of concave, convex, piano-concave, piano-convex.

[0028] In one example, the WCD comprises at least one transparent potting configured to allow concentrated light to pass therethrough.

[0029] In one example, the WCD is ring-shaped and the base assembly comprises at least one post configured to engaged with a finger space of the WCD.

[0030] In one example, the photovoltaic cell comprises a plurality of photovoltaic cells.

[0031] Another aspect of the disclosure provides an enclosure for a wearable computing device, the enclosure comprising: a base defining a receptacle for receiving the wearable computing; a lid configured to engage with the base to substantially enclose the wearable computing device, the lid having an optical element configured to direct incident electromagnetic radiation to photovoltaic cell disposed on the wearable computing device to allow charging thereof.

Petitioner Samsung Ex-1004, 1166

[0032] In one example, the lid includes a plurality of vent holes that prevent overheating within the enclosure.

[0033] In one example, the optical element comprises a lens.

[0034] In one example, the lens has a focal length and wherein a distance between a central portion of the lens and the photovoltaic cell is greater than or less than the focal length.

[0035] Another aspect of the disclosure provides a timepiece system, comprising: a timepiece having a substantially planar under surface; and a timepiece computing device adhered to the planar under surface, the timepiece computing device being substantially cylindrical and comprising: a processor; a memory; and at least one sensor.

[0036] Another aspect of the disclosure provides a wearable computing device system, comprising: a wearable computing device; an attachment frame coupled to the wearable computing device; and an optical element removably coupled to the attachment frame, wherein the optical element is configured to direct electromagnetic radiation to a photovoltaic cell disposed on a surface of the wearable computing device to allow for charging of the wearable computing device.

[0037] In one example, the attachment frame is removably coupled to the wearable computing device.

[0038] In one example, the attachment frame engages with an inward-facing surface of the wearable computing device.

[0039] Another aspect of the disclosure provides a method of identifying an authorized user of a wearable computing device, comprising: illuminating a portion of a skin surface of the user; imaging the portion of the skin surface of the user to generate at least one first image; generating a reference capillary map corresponding to the user based at least in part on the at least one image.

[0040] In one example, the method further includes rotating the wearable computing device during the illuminating and imaging steps.

[0041] In one example, the method further includes imaging the portion of the skin surface of the user to generate at least one second image; and comparing the at least one second image to the reference capillary map in order to authenticate the user.

Petitioner Samsung Ex-1004, 1167

[0042] Another aspect of the disclosure provides a method of navigating, comprising: gesturing in a first direction while wearing a wearable computing device; comparing the first direction to a predetermined direction in a predetermined set of directions; providing feedback based on the comparison of the first direction of the predetermined direction.

[0043] In one example, the gesture comprises pointing a finger and the first direction comprises a first heading.

[0044] Another aspect of the disclosure provides a method of regulating temperature, comprising: measuring a skin temperature of a user via a first temperature sensor; measuring an ambient temperature via a second temperature sensor; comparing the skin temperature to a predetermined threshold temperature; and adjusting the ambient temperature based in part on the comparison.

[0045] In one example, measuring the skin temperature comprises measuring the skin temperature via a first temperature sensor disposed at an inward facing surface of a wearable computing device.

[0046] In one example, measuring the ambient temperature comprises measuring the ambient temperature via a second temperature sensor disposed at an outward facing surface of the wearable computing device.

[0047] Another aspect of the disclosure provides a method for controlling appliances, comprising: identifying a position of a first appliance in a room; gesturing a first gesture in a direction of the first appliance; identifying the direction of the first direction via a wearable computing device; issuing a controlling command to the first appliance based in part on the identified direction of the gesture.

[0048] Another aspect of the disclosure provides a method of generating an alert, comprising: authenticating a first wearer of a first wearable computing device as a first authenticated user; transmitting first biometric data associated with the first wearer; associating the first biometric data with a first profile associated with the first wearer of the first wearable computing device; comparing the first biometric data with a group profile comprising aggregated biometric data from a plurality of distinct wearers of a plurality of distinct wearable computing devices; and generating an alert if the first

Petitioner Samsung Ex-1004, 1168

biometric data falls outside of a predetermined threshold set by the aggregated biometric data.

[0049] In one example, the biometric data comprises at least one of heart rate; ECG profile; blood sugar, and blood pressure.

[0050] In one example, the plurality of distinct wearers share a common trait, resulting in their aggregation into the group profile.

[0051] In one example, the common trait comprises at least one of: age, gender, profession, and location.

[0052] Another aspect of the disclosure provides a method of determine a sampling rate of a wearable computing device, comprising: determining an activity level of a wearer of a wearable computing device based at least in part on data from at least one sensor disposed onboard the wearable computing device; comparing the activity level to a predetermined activity threshold; and increasing a first sensor sampling rate if the activity level is above a predetermined activity threshold.

[0053] In one example, the method further includes decreasing the first sensor sampling rate if the activity level is below a predetermined activity threshold.

[0054] In one example, the predetermined activity threshold comprises an acceleration measurement.

BRIEF DESCRIPTION OF THE DRAWINGS

[0055] The invention description below refers to the accompanying drawings, of which:

[0056] FIG. 1A is a perspective view of a WCD illustrating an exterior window in accordance with some embodiments;

[0057] FIG. 1B is a perspective view of the WCD of FIG. IA illustrating an interior window in accordance with some embodiments;

[0058] FIG. 1C is a perspective view of an alternative WCD design of the ring of FIG. IA in accordance with some embodiments;

Petitioner Samsung Ex-1004, 1169

[0059] FIG. 2 is an abstract functional diagram illustrating example components within the WCD in accordance with some embodiments;

[0060] FIG. 3A is a view of an exterior window of a WCD with example components exposed in accordance with some embodiments;

[0061] FIG. 3B is a view of an interior window of a WCD with example components exposed in accordance with some embodiments;

[0062] FIG. 3C is a view of the exterior windows of an alternative WCD with example components exposed in accordance with some embodiments;

[0063] FIG. 4 is an exploded view of a WCD illustrating a battery and a flexible circuit which are configured to fit inside the housing of the WCD in accordance with some embodiments;

[0064] FIG. 5 is a perspective view of the flexible circuit of FIG. 4 in accordance with some embodiments;

[0065] FIG. 6 is an exploded view of a WCD with an alternative charging mechanism in accordance with some embodiments;

[0066] FIG. 7 is a perspective view of an alternative design of a WCD in accordance with some embodiments;

[0067] FIG. 8 is an exploded view of the WCD of FIG. 7 illustrating another alternative charging mechanism in accordance with some embodiments;

[0068] FIG. 9A is a perspective view of a charging device for the ring station in accordance with some embodiments;

[0069] FIG. 9B is an abstract diagram illustrating a partial structure of the charging station of FIG. 9A in accordance with some embodiments;

[0070] FIG. 10 is an example screenshot illustrating a user interface of a mobile application coupled to the WCD and displaying fitness monitoring readings in accordance with some embodiments;

Petitioner Samsung Ex-1004, 1170

[0071] FIG. 11 is an example screenshot illustrating a user interface of a mobile application coupled to the WCD and displaying sensor readings (e.g., for calibration purposes) in accordance with some embodiments;

[0072] FIG. 12A is a perspective view of a wearable computing device (WCD) according to one or more aspects of the disclosure;

[0073] FIG. 12B is a side view of a WCD according to one or more aspects of the disclosure;

[0074] FIG. 12C is a front view of the WCD according to one or more aspects of the disclosure;

[0075] FIG. 12D is a cross section of the WCD along the line A-A of FIG. 12C;

[0076] FIG. 12E is a perspective view of the internal housing without external potting;

[0077] FIG. 12F is a perspective view of the internal housing with a portion of the external potting removed and showing one or more components and printed circuit board (PCB);

[0078] FIG. 13 is a cross section of a WCD according to another aspect of the disclosure;

[0079] FIG. 14A is a cross section of a WCD according to another aspect of the disclosure;

[0080] FIG. 14B is a perspective view of the PCB and stiffener element of FIG. 14A;

[0081] FIG. 14C is a perspective view of the PCB and stiffener element of FIG. 14A;

[0082] FIG. 14D shows a cross section of the WCD at a point in time when the PCB is being inserted into the internal space and prior to the application of potting;

[0083] FIG. 14E is a cross section of the WCD of after a potting material has been applied subsequent to the WCD of FIG. 14D;

Petitioner Samsung Ex-1004, 1171

[0084] FIG. 15A depicts a perspective view of a WCD according to another aspect of the disclosure;

[0085] FIG. 15B is a side view of the WCD of FIG. 15A;

~~**[0086] FIG. 15C is an exploded view of the WCD;**~~

~~**[0087]**~~ **[0086]** FIG. 16A is an exploded view of a housing and a PCB of a WCD according to one or more aspects of the disclosure;

~~**[0088]**~~ **[0087]** FIG. 16B is a cross section of FIG. 16A along line B-B;

~~**[0089]**~~ **[0088]** FIG. 16C is a perspective view of the WCD with potting material;

~~**[0090]**~~ **[0089]** FIG. 17A depicts a cross section of a WCD employing charging by concentrated light source according to one or more aspects of the disclosure;

~~**[0091]**~~ **[0090]** FIG. 17B depicts a cross section of a WCD employing charging by concentrated light source according to another aspect of the disclosure;

~~**[0092]**~~ **[0091]** FIG. 17C is a perspective view of a base assembly and WCD 700 according to one or more aspects of the disclosure;

~~**[0093]**~~ **[0092]** FIG. 17D depicts a perspective view of internal components of the base assembly 750 and WCD 700 according to another aspect of the disclosure;

~~**[0094]**~~ **[0093]** FIGs. 17E-F depict other CPV configurations according to one or more aspects of the disclosure;

~~**[0095]**~~ **[0094]** FIG. 17G is perspective view of a WCD and base assembly with a lx3 CPV arrangement;

~~**[0096]**~~ **[0095]** FIG. 18A depicts a cross section of a WCD 800 employing charging by concentrated light source according to another of the disclosure;

~~**[0097]**~~ **[0096]** FIG. 18B depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure;

~~**[0098]**~~ **[0097]** FIG. 19A depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure;

Petitioner Samsung Ex-1004, 1172

~~[0099]~~ **[0098]** FIG. 19B depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure;

~~[0100]~~ **[0099]** FIG. 19C depicts a schematic diagram of magnets that can be used in a WCD and/or base assembly according to one or more aspects of the disclosure;

~~[0101]~~ **[0100]** FIG. 19D depicts a schematic diagram of magnets that can be used in a WCD and/or base assembly according to one or more aspects of the disclosure;

~~[0102]~~ **[0101]** FIG. 19E is a perspective view of a WCD and a base assembly according to one or more aspects of the disclosure;

~~[0103]~~ **[0102]** FIG. 20A is a cross section of a WCD engaged with a base assembly 1050 according to one or more aspects of the disclosure;

~~[0104]~~ **[0103]** FIG. 20B is a perspective view of a PCB 1040b with a CPV 1030b and ferrous element 1020b configuration according to one or more aspects of the disclosure;

~~[0105]~~ **[0104]** FIG. 20C is a perspective view of a PCB with a CPV 1030c and ferrous element 1020c configuration according to one or more aspects of the disclosure;

~~[0106]~~ **[0105]** FIG. 20D is a perspective view of a magnet and a concentrated light source 1070d according to one or more aspects of the disclosure;

~~[0107]~~ **[0106]** FIG. 21A is a schematic view of a WCD showing components used for identifying the wearer of the WCD;

~~[0108]~~ **[0107]** FIGs. 21B-C are perspective views of a skin surface according to one or more aspects of the disclosure;

~~[0109]~~ **[0108]** FIG. 22A is a perspective view of a user employing ECG monitoring according to one or more aspects of the disclosure;

~~[0110]~~ **[0109]** FIG. 22B is a view of a human with an electric pathway though his body according to one or more aspects of the disclosure;

~~[0111]~~ **[0110]** FIG. 22C is a perspective view of a WCD that can employ ECG monitoring according to one aspect of the disclosure;

Petitioner Samsung Ex-1004, 1173

~~[0112]~~ **[0111]** FIG. 23A is a perspective view of the hand of a user in various positions employing the navigational features of the WCD;

~~[0113]~~ **[0112]** FIG. 23B is a flow chart depicting a method of providing feedback to a user according to one or more aspects of the disclosure;

~~[0114]~~ **[0113]** FIG. 24A is a schematic diagram of a system 1400 for controlling an environment of a user according to one or more aspects of the disclosure;

~~[0115]~~ **[0114]** FIG. 24B is a side view of a WCD showing one or more temperatures sensors according to one or more aspects of the disclosure;

~~[0116]~~ **[0115]** FIG. 24C is a system diagram of a system for controlling home appliances according to one or more aspects of the disclosure;

~~[0117]~~ **[0116]** FIG. 24D is a flow chart depicting a method of controlling home appliances according to one or more aspects of the disclosure;

~~[0118]~~ **[0117]** FIG. 25 is a perspective view of the hand of a user employing a two-factor authentication technique according to one or more aspects of the disclosure;

~~[0119]~~ **[0118]** FIG. 26A is a schematic view of a charging apparatus for charging the WCD according to one or more aspects of the disclosure;

~~[0120]~~ **[0119]** FIG. 26B shows a WCD including an RF antenna and charging circuitry;

~~[0121]~~ **[0120]** FIG. 26C is a block diagram of the charging apparatus according to one aspect of the disclosure;

[0121] **FIG. 26D is a pictorial diagram showing the WCD according to one or more aspects of the disclosure;**

[0122] FIG. 27A is a pictorial diagram and FIG. 27B is a block diagram of a WCD employing flash storage according to one or more aspects of the disclosure;

[0123] FIG. 28A is a schematic diagram of one or more WCDs performing proximity functions according to one or more aspects of the disclosure;

[0124] FIG. 28B is a schematic diagram of one or more WCDs performing proximity functions according to one or more aspects of the disclosure;

Petitioner Samsung Ex-1004, 1174

[0125] FIG. 29A is a flow chart depicting a method of initiating gesture input according to one or more aspects of the disclosure;

[0126] FIG. 29B is a chart showing acceleration vs. time as measured by the accelerometer of the WCD;

[0127] FIG. 30 is a perspective view of a WCD 2000 employing a reset function;

[0128] FIG. 31A is a perspective view of a WCD including an LED indicator according to one or more aspects of the disclosure;

[0129] FIGs. 31B and 31C are cross sections along line C-C of a WCD employing an LED indicator according to one or more aspects of the disclosure;

[0130] FIG. 32 is flow chart depicting a method of communicating with a near field communication (NFC) device according to one or more aspects of the disclosure;

[0131] FIG. 33A depicts a perspective view of a WCD assembly according to one or more aspects of the disclosure;

[0132] FIGs. 33B-D depict exploded views of the WCD assembly of FIG. 33A;

[0133] FIG. 33E depicts a cross sectional view of the WCD assembly along A-A;

[0134] FIGs. 34A-B depict a WCD assembly according to one or more aspects of the disclosure;

[0135] FIG. 35A depicts an enclosure or case for storing a WCD according to one or more aspects of the disclosure;

[0136] FIG. 35B is a cross sectional view of the assembled enclosure of FIG. 35A along the line B-B;

[0137] FIG. 35C depicts a cross sectional view of the assembled enclosure of FIG. 35B along line A-A;

[0138] FIG. 36 depicts an enclosure including air vents according to one or more aspects of the disclosure;

[0139] FIG. 37 depicts a method of sizing a finger according to one or more aspects of the disclosure;

Petitioner Samsung Ex-1004, 1175

[0140] FIG. 38 is a pictorial diagram showing a plurality of image perspectives of a user's hand;

[0141] FIG. 39 depicts a sizing tool for sizing the finger of a user;

[0142] FIG. 40 depicts a sizing tool for sizing the finger of a user according to an alternate example;

[0143] FIG. 41 depicts yet another alternate example of a sizing tool for sizing the finger of a user;

[0144] FIG. 42 depicts a method of monitoring activity according to one or more aspects of the disclosure;

[0145] FIG. 43 depicts a method of determining whether a user is wearing gloves according to one or more aspects of the disclosure;

[0146] FIG. 44 depicts a method of securing data onboard the WCD according to one or more aspects of the disclosure;

[0147] FIG. 45A is a timepiece system according to one or more aspects of the disclosure;

[0148] FIG 45B is a bottom view of the TCD;

[0149] FIG. 46 depicts a WCD with a pair of LED indicators disposed at an inward-facing portion of the WCD;

[0150] FIG. 47A is a system for generating and managing alerts according to one or more aspects of the disclosure;

[0151] FIG. 47B depicts a block process diagram for generating and managing alerts according to one or more aspects of the disclosure;

[0152] FIG. 47C is a flow chart depicting a method for generating and managing alerts according to one or more aspects of the disclosure;

[0153] FIG. 48A is a method for variable sampling according to one or more aspects of the disclosure; FIG. 48B and 48c are graphs depicting one or more aspects of the sample method of FIG. 48A; and

Petitioner Samsung Ex-1004, 1176

[0154] FIG. 49 is a diagrammatic representation of a machine in the example form of a computer system within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed.

DETAILED DESCRIPTION

[0155] The present disclosure describes a wearable computing device (WCD) that enables a wearable fitness monitor(s)/computer(s) which is suitable for prolonged usage with accurate results. The WCD can be in the form of a ring that can be worn on the finger of a human (or animal) user. Although the WCD of the present disclosure is depicted as a ring that can be worn on the finger of a user, other shapes, designs, and form factors can be utilized for the WCD. For example, the WCD can be in the form of a wrist band, bracelet, necklace, earring, or any other type of wearable accessory. In this regard, references to the finger of a user in the present application can be considered to apply to other portions of a human body depending on the form of the WCD, such as wrist, neck, ear, etc.

[0156] The term "coupled" as used herein means connected directly to or connected through one or more intervening components or circuits. Any of the signals provided over various buses described herein may be time-multiplexed with other signals and provided over one or more common buses. Additionally, the interconnection between circuit elements or software blocks may be shown as buses or as single signal lines. Each of the buses may alternatively be a single signal line, and each of the single signal lines may alternatively be buses, and a single line or bus might represent any one or more of a myriad of physical or logical mechanisms for communication (e.g., a network) between components. The present embodiments are not to be construed as limited to specific examples described herein but rather to include within their scope all embodiments defined by the appended claims.

[0157] FIG. 1A is a perspective view of 100 of a WCD 110 illustrating an exterior window 120 in accordance with some embodiments, and FIG. 1B is a perspective view 102 of the WCD 110 of FIG. 1A illustrating an interior window 130.

[0158] As previously mentioned, it is recognized in the present disclosure that conventional wearable fitness monitors such as clip-on devices, wristbands, or watch-type monitors still often suffer from inaccuracy mainly because they lack constant and

Petitioner Samsung Ex-1004, 1177

consistent ways to read from the body areas they aim to monitor. It can also be an extra burden for the person to remember and wear such conventional fitness monitors each time the person perform exercises in order to create an accurate history tracking the exercise activities.

[0159] Accordingly, the present embodiments of the WCD 110 can function as fitness monitors/computer which is suitable for prolonged usage so as to create accurate results. In addition or as an alternative to fitness monitoring, as will be discussed in more detail below, the WCD 110 can function as a remote input device through, for example, gesture recognition. In some embodiments, the WCD 110 can further function as a sleep monitor, a heart rate sensor, a cardiac monitor a body temperature detector, or the like. It is noted that, for those embodiments which can function as a cardiac monitor (e.g., that measures electrocardiogram (EKG)), it may be necessary to establish a closed loop (e.g., for the electrical measurement of EKG) across the heart. As such, in some of those embodiments, a separate conductive pad can be coupled to the WCD 110 so that a user can pinch the pad with fingers on an opposite hand,

[0160] Specifically, in some embodiments of the present disclosure, the WCD 110 can be worn by the user (e.g., on a finger) for fitness, physical activity, biological data monitoring as well as for gestural input or other suitable purposes. As shown in FIGS. 1A and 1B, the WCD 110 can include the exterior window 120 on its exterior wall for input/output data transmission and reception, battery recharge, or status indication. The WCD 110 can also include the interior window 130 on its interior wall for various monitoring or sensing activities. The form factor of the WCD 110 allows it to be worn for prolonged hours with constant and consistent contact with the skin area, thereby creating a more reliable and extended recording (e.g., as compared to aforementioned conventional fitness monitors) of the user's fitness activity, physical exercise, as well as health information such as heart rates and body temperature. More implementation details regarding the WCD 110 are discussed below.

[0161] FIG. 1C is a perspective view of an alternative design of the WCD 110 of FIG. IA in accordance with some embodiments. As shown in FIG. IC, the WCD 112 includes a second exterior window 124 in addition to a first exterior window 122. The two exterior windows 122 and 124 can include spacing between the two windows 122 and 124 so that the mechanical strength of the housing structure of the WCD 112 may

Petitioner Samsung Ex-1004, 1178

be stronger than that of the WCD 110, which is shown to include one single exterior window 120. Further, in some embodiments, radio antennas (e.g., Bluetooth) or other sensitive circuitry can be positioned in the second exterior window 124 away from the first exterior window 122 so that quality of reception may be improved.

[0162] FIG. 2 is an abstract functional diagram 200 illustrating example components within the WCD (e.g., WCD 110) in accordance with some embodiments. As shown in diagram 200, the WCD 110 can include a processor module 210, a plurality of sensor modules 220, a status indicator module 230, a power generation and management module 240, a communication module 250, a memory 260, and miscellaneous modules 270 (e.g., a real-time clock (RTC) crystal oscillator as illustrated in FIG. 2). The WCD 110 can also include a battery 280 module that provides electrical power for the WCD 110. In some embodiments, the battery 280 can be of a lithium-polymer type or a zinc-polymer type. It is noted that modules illustrated in diagram 200 are for purposes of facilitating a better understanding of the present embodiments; other suitable modules may be included in the WCD 110 and are not shown for simplicity. As used herein, the term "components" is considered to generally include any of the modules depicted and/or described in FIG. 2, as well as any other modules described herein.

[0163] It is noted that the aforementioned modules are intended for purposes of enabling the present embodiments, rather than limiting. As such, a person of ordinary skill in the art will understand that the present disclosure covers apparent alternatives, modifications, and equivalents (e.g., combining or separating the modules) made to the techniques described herein. For example, in some embodiments, a portion of the communication module 250 (e.g., the Bluetooth Chip as shown in FIG. 2) can be combined into the processor module 210. For another example, one or more modules herein can be combined into one to form a system-on-the-chip (SOC).

[0164] The processor module 210 can have generic characteristics similar to general purpose processors or may be application specific integrated circuitry that provides arithmetic and control functions to the WCD 110. The processor can be any type of processor, such as a processor manufactured by AMtel, Freescale, Nordic Semiconductor, Intel®, AMD®, or an ARM® type processor. The processor module 210 can include a dedicated cache memory (not shown for simplicity). The processor

Petitioner Samsung Ex-1004, 1179

module 210 is coupled to all modules 220-270 in the WCD 110, either directly or indirectly, for data and control signal transmission.

[0165] The memory 260 may include any suitable type of storage device including, for example, ROM, such as Mask ROM, PROM, EPROM, EEPROM; NVRAM, such as Flash memory; Early stage NVRAM, such as nvSRAM, FeRAM, MRAM, or PRAM, or any other type, such as, CBRAM, SONOS, RRAM, Racetrack memory, NRAM, Millipede memory, or FJG. Other types of data memory can be employed as such are available in the form factor desired.

[0166] In addition to storing instructions which can be executed by the processor module 210, the memory 260 can also store data generated from the processor module 210. It is noted that the memory 260 can be an abstract representation of a generic storage environment. According to some embodiments, the memory 260 may be comprised of one or more actual memory chips or modules. In some embodiments, the memory 260 can function as a temporary storage (e.g., for firmware updates, and/or for avoiding accidental malfunctions (such as so-called "bricking")).

[0167] In accordance with one or more embodiments, the sensor modules 220 can include various sub-modules for the WCD 110 to perform different monitoring or sensing activities. A view 302 of the interior window (e.g., window 130) of a WCD (e.g., WCD 110) with example components exposed is shown in FIG. 3B. As shown in the example of FIG. 3B, the sensor modules 220 can include a temperature sensor 320a, a red light emitting diode (LED) 320b, a light sensor 320c, and an infra-red LED 320d. Among the sensors in the sensor modules 220, those sensors (e.g., sensors 320a-320d) which are directly related to biological sign monitoring can be configured and positioned in a way that is close to the skin (e.g., facing the interior window 130 of the WCD 110). Although not shown in FIG. 3B for simplicity, the sensor modules 220 can further include sensors that are not directly related to biological sign monitoring; some examples of these sensors include accelerometers, gyroscopes, vibration, sensors (e.g., a magnetometer or a digital compass), or other suitable sensors (e.g., for gesture recognition). The magnetometer can measure the strength and/or direction of a prevailing magnetic field. In this regard, the magnetometer can be used during global positioning and/or navigation. In particular, the magnetometer can be used to measure a directional heading when the WCD is in motion and can supplement position data

Petitioner Samsung Ex-1004, 1180

where the WCD is out of communication range. In one or more embodiments, the accelerometers in the sensor modules 220 can detect movements in multiple (e.g., 3) dimensions or axes. The accelerometer can measure force of acceleration of the WCD and can measure gestures performed by a user while wearing the WCD. In other examples, the accelerometer can detect acceleration of the user while wearing the WCD. This can permit tracking of activity level, such as steps taken or number of laps swum in a pool.

[0168] The temperature sensor can be any type of sensor that detects temperature, such as a thermistor, PTC, NTC, etc. In another example, the temperature sensor can use IR light emitted from an object to calculate a surface temperature of the object in a manner clear to those of ordinary skill in the art.

[0169] Together, the processor module 210 and the sensor modules 220 can enable the WCD 110 to perform multiple functions including, for example, pedometer, sleep monitor (e.g., which monitors sleep quality), heart rate sensor, pulse oximetry, skin (and in select embodiments, ambient) temperature. In addition, some embodiments of the WCD 110 can further function as a gesture input device. In particular, the present embodiments recognize that the WCD 110 can detect finger motions or gestures which may be difficult for conventional fitness sensors to detect, such as a tap, a snap, a knock on the table, and the like. In some embodiments, the WCD 110 can utilize the accelerometer to measure the activity level (e.g., arm movement) in conjunction with the measured heart rate to determine if the user is walking horizontally, running, swimming, or climbing stairs. Other activities can be identified by the WCD 110 may include biking or sleeping.

[0170] In some embodiments, the WCD 110 can also be programmed to learn particular gestures or physical exercise from the user using, for example, a training mode. For example, the user can instruct (e.g., using a computer or a mobile device of the user) the WCD 110 to enter the training mode and perform the gesture or physical exercise; the WCD 110 can record the readings from the sensor modules 220, recognize patterns therefrom, and store the result in, for example the memory 260, so that such gesture or exercise can be recognized by the WCD 110 after the training. The WCD 110 can be configured (e.g., via a mobile application running on a mobile device of the user) so that the recognized gestures can perform functions designated by the user, such as

Petitioner Samsung Ex-1004, 1181

clicks, swipes, unlocks, or media player controls. In one embodiment, the WCD 110 can include near field communication (NFC) chips so that certain functions (e.g., unlocking a smart phone) can be performed when the WCD 110 touches upon or otherwise be detected by another NFC device. In some embodiments, the unlocking function of the WCD 110 can also unlock a user device (e.g., a phone) via the communication module 250 (e.g., Bluetooth) by the WCD 110 transmitting a proper unlock code.

[0171] Moreover, the WCD 110 can function as a key or a control device for keyless access to home, automobile, or other suitable user authentication processes. The WCD 110 can also be integrated with games and game consoles so that it can function as an input device to those games and consoles. In some embodiments, the WCD 110 can be adapted for use in medical and home health monitoring, or as a transportation safety device (e.g., that broadcasts emergency messages to relevant authorities). Additional examples of sensors/functionalities of the WCD 110 can include an inertial measurement unit (IMU) (e.g., for more complex gesture recognition, a near-infrared (NIR) spectrometer (e.g., for measuring light absorption and deriving blood glucose/ blood alcohol/ CO2 content), a Galvanic skin response sensor (e.g., for measuring sweat/ nervousness), an electrocardiogram (ECG or EKG), and so forth.

[0172] In some embodiments, the processor module 210 can determine (e.g., based on identified physical activities, routine pattern, and/or time) a frequency at which one or more sensors in the sensor modules 220 should operate. Because it is recognized in the present disclosure that the heart rate of a human being typically does not vary too widely (e.g., beyond a certain percentage of what has been previously measured), in some embodiments, the WCD 110 can automatically adjust the sensor modules 220 (e.g., to slow down) so as to save power. More specifically, some embodiments of the WCD 110 can include a phase-locked loop or logic to predict the pulse width by determining lower and upper ranges in which the heart rate is predicted to be, thus only powering up the sensor modules 220 at the time of the predicted heartbeats. For one example, if the WCD 110 determines that the user is at sleep (e.g., based on the heart rate, the body temperature, together with the movements detected by the accelerometer and/or the vibration detector), the WCD 110 can slow down its heart rate detection frequency (e.g., from 1 measurement per second to 1 measurement per 10 seconds) and skip the measurement of several heartbeats because it is unlikely that the heart rate will

Petitioner Samsung Ex-1004, 1182

change drastically during that period. Conversely, if the WCD 110 determines that the user is performing a high intensity physical exercise, the WCD 110 can increase the frequency of monitoring and recording of the sensor modules 220.

[0173] In accordance with one or more embodiments, the WCD 110 also includes various modules coupled to the processor module 210 for, by way of example but not limitation, input/output data transmission, battery recharge, or status indication. A view 300 of the exterior window (e.g., window 120) of a WCD (e.g., WCD 110) with example components exposed is shown in FIG. 3A. As shown in the example of FIG. 3A, the modules configured to face the exterior window 120 of the WCD 110 can include parts from the status indicator module 230, the power generation and management module 240, and the communication module 250.

[0174] Specifically, one embodiment of the WCD 110 includes the status indicator module 230 coupled to the processor module 210 to indicate various statuses. In some embodiments, the status indicator module 230 includes a light emitting diode (LED) 330, such as shown in FIG. 3A. The LED 330 can be a single red/green/blue (RGB) LED. In other embodiments, the status indicator module 230 can include other suitable types of indicator devices including, for example, a single color LED, an electrophoretic ink (or "e-ink") display, a persistent display, or the like. In accordance with some embodiments, the WCD 110 can utilize the indicator module 230 (e.g., via the RGB LED 330 through the exterior window 120) to visually communicate with the user. For example, a red color can be displayed (e.g., for a predetermined period of time) by the LED 330 that the WCD 110 needs to be recharged, and a green color can be displayed to indicate that the WCD 110 is fully charged. For another example, a blue color can be displayed when the communication module 250 is in use. In one or more embodiments, the user can program a fitness goal (e.g., a target heart rate) to the WCD 110 so that, for example, a green color can be displayed when the heart rate is below the target, a yellow color can be displayed when the target is reached, and a red color can be displayed when the heart rate is above a certain percentage of the set target. Some embodiments of the WCD 110 include the communication module 250 for wireless data transmission. Particularly, in some embodiments, the communication module 250 includes one Bluetooth chip and a Bluetooth antenna 350, such as shown in FIG. 3A. One or more embodiments of the WCD 110 also provides the capability of storing activity logs (e.g.,

Petitioner Samsung Ex-1004, 1183

in the memory 260). More specifically, fitness activities, exercise histories, as well as recorded biological signs such as heart rate and body temperature, can be stored onboard in the memory 260 of the WCD 110. Each data entry in the activity logs can be time- stamped using, for example, an onboard real-time clock (e.g., which may be included in miscellaneous modules 270). For power saving and other purposes, the activity log can be downloaded (e.g., via the communication module 250) when requested by the user. In other embodiments, the activity log can be pushed (e.g., via email or other suitable means) by the WCD 110 to a user device at a time designated by the user. In some embodiments, the memory 260 can store up to a full week worth of activity logs.

[0175] The WCD 110 can include the power generation and management module 240 for recharging the battery 280 and for providing electrical power to various modules 210-270 in the WCD 110. Particularly, in some embodiments, the power generation and management module 240 includes one or more concentrated photovoltaic (CPV) cells 340, such as shown in FIG. 3A. The CPV cells 340 can be high-efficiency tandem solar cells and can be attached on the flexible printed circuit (e.g., circuit 415,515). Because the small form factor of the embodiments of the WCD 110, CPV cells 340, which can absorb more light energy from a wider spectrum of light than the traditional solar cells, are used. In some embodiments, multiple (e.g., 3) CPV cells 340 can be configured in series to provide sufficient voltage and/or current for charging the battery 280.

[0176] According to some embodiments, the WCD can include one or more sensing or imaging devices that can be any type of device capable of detecting electromagnetic radiation, such as visible light, IR, NIR, UV, etc. In one example, the device is an imaging device, such as a CMOS or CCD camera.

[0177] According to some embodiments, the WCD 110 can be placed or docked into a charging station for recharging. A perspective view 900 of an example charging station 910 for the WCD 110 is shown in FIG. 9A. The charging station 910 can have concentrated light source circumferentially around the WCD 110 so that the user does not have to be concerned with whether the WCD 110 is facing the right direction for charging. Some embodiments of the charging station 910 can include a light distribution means that takes a single light source and distributes the light all around. An abstract

Petitioner Samsung Ex-1004, 1184

diagram illustrating a partial structure of the light distribution means inside the charging device of FIG. 9A is shown in FIG. 9B. It is noted that, even with the charging station 910, for some embodiments, regular outdoor sunlight or other ambient light source can still function as a secondary source of energy so that the CPV cells 340 on the WCD 110 can extend the operational time provided by the battery 280.

[0178] Additionally or alternatively, energy source attached to the power generation and management module 240 can be passive; for example, some embodiments provides that a clip with a concentrator lens can be attached to the WCD 110 in a way such that the power generation and management module 240 can charge the battery 280 using natural sunlight. In an alternative embodiment, gemstone(s) (e.g., sapphire, diamond, or other suitable materials) in the shape of a dome or with faceted protrusion can be configured to concentrate/magnify light energy while also serving as a decorative feature.

[0179] In some alternative embodiments, the power generation and management module 240 can include electromagnetic induction charging coil so that a WCD (e.g., ring 610) can be charged using an inductive charger. FIG. 6 shows an exploded view 600 of such alternative embodiment of WCD with the inductive charging mechanism including the charging coil 640, as well as battery 680, housing 612, and rigid-flex PCBA 615. However, it is noted that there may be a need to manufacture the inductive charging coil 640 in different sizes that correspond to different ring sizes. Further, it is noted that the efficiency of the electromagnetic induction charging mechanism may be adversely affected by the adoption of a metallic housing. Additionally or alternatively, to avoid multiple sized coils mounted to the edge of the ring, the coil can be placed on the inner or outer sides of the ring by positioning the coil beneath a window in the metal housing of the ring.

[0180] In order to achieve optimal power management of the WCD, one or more of the components can be selected to minimize power usage. For example, a processor, memory, or any other component can be selected based on rated power usage. In one example, it may be desirable to select components that draw current on the order of microamps in order to extend the battery life of the WCD and to allow the WCD to perform health/activity monitoring functions between charging sessions.

Petitioner Samsung Ex-1004, 1185

[0181] In still some other alternative embodiments, the power generation and management module 240 can include thermoelectric generator (TEG) modules so that a WCD (e.g., WCD 710,810) can be charged by the difference between the body temperature and the ambient temperature. FIG. 7 is a perspective view 700 of such alternative design, and FIG. 8 is an exploded view 800 of the WCD 710 of FIG. 7. Also shown in FIGS. 7 and 8 is an alternative design of the housing for the WCD where the ring includes an outer ring 812a, an inner ring 812b, and insulators 814a and 814b. However, it is noted that utilizing TEGs for charging the battery may be less than ideal since the difference between body temperature and ambient temperature might not be great enough to fully charge the battery, and that in many occasions (e.g., during sleep), the temperature difference needed for TEG to generate electricity may quickly disappear (e.g., since the WCD 710, 810 may be covered inside the comforter).

[0182] The battery can be any type of battery, such as a rechargeable battery. The battery can be a thin, flexible lithium ceramic chemistry battery. In another example, the battery can be a circular formed lithium polymer or lithium ion battery. The battery can provide power to any of the components described above. In one example, the battery can be a lithium cell integrated directly with the flexible PCB described above. Other implementations can integrated the battery directly onto the housing to reduce the volume of space taken up by battery packaging.

[0183] The WCD can also include one or more polymer or piezo actuators for providing appropriate haptic or physical feedback and alerts to a user while the user is wearing the ring. The piezo actuator can also provide audible feedback to a user.

[0184] As previously mentioned, the WCD 110 can be used with a software application (e.g., a mobile phone application for the Apple iOS or the Google Android OS) which can run on the user's computing device (e.g., a mobile device such as a smart phone). Specifically, the software application can facilitate the mobile device of the user to couple to the WCD 110 (e.g., via the communication module 250) for data communication, such as downloading activity logs, changing configuration and preferences, training the WCD. The software application can also generate a user interface showing the results or readings from the health and fitness tracking performed by the WCD 110. FIG. 10 is an example screenshot illustrating such user interface 1000 displaying fitness monitoring readings in accordance with some embodiments.

Petitioner Samsung Ex-1004, 1186

[0185] Further, the WCD 110 can be used for gesture input, and the software application can facilitate the user to customize gesture input and control. FIG. 11 is an example screenshot illustrating such user interface 1100 displaying sensor readings (e.g., for calibration purposes) in accordance with some embodiments. In one or more embodiments, the WCD 110 can also be used directly with other Bluetooth enabled devices such as electronic locks or keyless car entry. In other examples, the WCD 110 can also control other devices via a smartphone and other Wireless LAN enabled devices such as home automation systems.

[0186] FIG. 3C is a view 304 of two exterior windows of an alternative WCD (e.g., WCD 112 of FIG. 3C) with example components exposed in accordance with some embodiments. The components 330, 340, and 350 shown in FIG. 3C function similarly to those components described in FIG. 3A. However, some components (e.g., antenna 350) can be positioned to face a different exterior window than the exterior window the rest of the components face. This may increase the mechanical strength of the housing structure of the ring, and/or may reduce signal interference among the components.

[0187] FIG. 4 is an exploded view 400 showing an exemplary WCD 410 (e.g., WCD 110) illustrating a battery 480 and a flexible circuit 415 which are configured to fit inside a housing 412 of the WCD 410. It is recognized by the present disclosure that a human being's finger can come in various different sizes and so should the WCD 410. In order to reduce the cost of manufacturing different sizes of printed circuits, in some embodiments, the modules 210-270 (of FIG. 2) are formed on a flexible or rigid-flex printed circuit (FPC) board, an example 500 of which is shown as FPC 515 in FIG. 5. In particular, one or more embodiments provide that the FPC 515 and the battery 480 are not specific to a ring size, and that the same circuitry and/or battery can fit a multitude of sizes.

[0188] According to some embodiments, the WCD 410 provides a desirable form factor for a user to wear it for a prolonged period of time. The edges and the shape of the WCD 410 can be configured in a way that is comfortable and ergonomic; for example, the finished parts of the embodiments are to be free from burrs and sharp edges. The material which forms the housing portion of the WCD 410 can include medical grade metallic alloys that reduce the likelihood of allergic reactions. Examples

Petitioner Samsung Ex-1004, 1187

of the housing material include stainless steel, tungsten carbide, titanium alloy, silver, platinum or gold.

[0189] In the examples shown in FIG. 4, the U-shape of the ring housing 412 allows for the flexible PCB 415 to be inserted into the edge of the WCD 410. The windows (e.g., windows 120, 130) on the walls of the WCD 410 can align with the operating circuitry to allow, for example, battery charging, Bluetooth connection, and user feedback LED/micro display on the outer wall, and biological feedback sensors (e.g., pulse oximetry, temperature sensor) on the inner wall. In one or more embodiments, the WCD 410 can be completely sealed using potting epoxy. The sealing epoxy can be transparent to allow light to pass through for the CPVs and sensors. In some embodiments, the WCD 410 can be potted with two different compounds. In these embodiments, the body of the WCD 410 can be filled with clear material, and the edge of the WCD 410 can be filled with an opaque material so that different colors can be incorporated (e.g., as a decorative element). It is noted that sealing the assembly using potting epoxy can also bring the additional benefit of making the WCD 410 completely or almost completely waterproof as well as increasing the structural rigidity of the WCD 410.

[0190] **I. Internal Housing/External Potting**

[0191] FIG. 12A is a perspective view and FIG. 12B is a side view of a WCD 1200 according to one or more aspects of the disclosure. The WCD 1200 can be in the shape of a ring and can be worn on any of the five fingers (including the thumb) of (typically) a human user. In this regard, the WCD 1200 can define an interior diameter d1 and exterior diameter d2. The interior diameter d1 can be defined as the distance between opposing points on the interior surface of the ring, with the interior surface being the portion of the WCD facing the finger of a user while the device is worn by the user. The interior surface of the WCD can generally define a finger space for receiving the finger of the user. The exterior diameter d2 can be defined as the diameter between opposing points on the exterior surface of the ring, with the exterior surface being the portion of the WCD opposed to the interior surface and facing away from the finger of the user.

[0192] The interior diameter d1 and exterior diameter d2 can be any size to accommodate any finger size. In one example, d2 is determined by d1 plus a thickness

Petitioner Samsung Ex-1004, 1188

of any components and/or flexible circuit boards disposed within the WCD. Additionally, although depicted as being circular, the finger space of the WCD 1200 can be any shape, such as ovular, elliptical, or the like, to accommodate users with atypical finger profiles. In these examples, the dimensions of the interior and/or exterior diameter may be measured according to other variables, such as length, width, major diameter, minor diameter, etc. By way of non-limiting example, the WCD interior diameter d1 (the diameter generally defining the ring size) can be in an approximate range of 12mm to 24mm so as to accommodate finger sizes ranging from a small child to a larger adult, and on any acceptable finger, including the thumb. The exterior diameter d2 can also be any reasonable size or shape, and can define an approximate range of between 18mm and 30mm. Likewise, the thickness between diameters d1 and d2 can vary widely, but can typically reside in an approximate range of 1.5mm to 3 mm. The width WR of the WCD along the direction of finger extension (finger longitudinal direction) is widely variable, and can be selected, in part to accommodate internal and external components. In a non-limiting example, the width WR is in a range of approximately 3mm to 8mm.

[0193] The WCD 1200 can include an overall housing 1210 that includes an internal housing 1212 and an external potting or encapsulant 1214. Together, the internal housing 1212 and external potting 1214 combine to form the overall form factor of the WCD 1200, in addition to providing a housing for one or more electronic components stored within the housing 1210 of the WCD 1200, as will be described in greater detail below.

[0194] The internal housing 1212 can be formed of any material, such as a nonconductive material, a conductive material, a ferrous material and/or a nonferrous metal, composite material (e.g. carbon-fiber and/or glass fiber composite) a dielectric material, or a combination of any of the above. In one example, the material of the inner housing 1212 is conductive and nonferrous, such as aluminum, titanium, or stainless steel. In other examples, the internal housing can be formed of a polymer, such as plastic. The external potting 1214 can be formed of any material, solid or gelatinous, that can provide resistance to shock and/or vibration and can prevent moisture and/or debris from entering the housing 1210 of the WCD 1200, such as silicone, epoxy, polyester resin or any other polymer.

Petitioner Samsung Ex-1004, 1189

[0195] In one example, the external potting 1214 can be transparent. In this regard, the transparent external potting can allow electromagnetic radiation, such as visible, IR, or UV light sources from inside the housing 1210 to pass through the external potting 1214 without the need of a window or discontinuity in the external potting 1214 and without changing the optical properties of the radiation. In the same vein, electromagnetic radiation sources, such as visible, IR, or UV light, external to the housing can pass through the external potting 1214 and can be detected by, sensed by, or fall incident upon internal components of the WCD 1200 without the need for a window or discontinuity in the housing and without changing the optical properties of the radiation. In another example, the external potting 1214 can be tinted. The tint can be cosmetic and can prevent the internal components of the WCD to be visible by the user. In this regard, depending on the tint, optical properties of light passing therethough may be slightly changed. For example, certain colors of the light can be filtered and can result in decreased power transmission. The above description regarding external potting 1214 can be applied to any of the pottings described below.

[0196] The internal housing 1212 can define a window 1216. In one example, the internal housing is formed of a material that completely or partially prevents light (or other electromagnetic radiation) from passing through the internal housing 1212. In this regard, the internal housing 1212 can define the window 1216 to allow for such radiation to pass through the housing 1212. As shown, the window 1216 can be generally elliptical-shaped, but can be any other suitable shape according to other examples, such as rectangular, circular, ovular, etc. Since the window 116 is defined by the internal housing 1212, the window 1216 can face the finger of the user while the user is wearing the WCD 1200, which can provide many advantageous features and implementations, as will be described in greater detail below.

[0197] FIG. 12C is a front view of the WCD and FIG. 12D is a cross section of the WCD 1200 along the line A-A of FIG. 12C. As shown, the internal housing 1212 can have a generally U-shaped internal surface 1212a to accommodate one or more internal components and can define a pair of flanges 1212b and 1212c. The external potting 1214 can extend between the flanges 1212b and 1212c of the internal housing to provide an internal space 1220 to accommodate one or more components. By virtue of the external potting 1214, the internal space 1220 defined by the internal surface 1212a

Petitioner Samsung Ex-1004, 1190

and the external potting 1214 can be hermetically sealed, thereby preventing debris, dust, moisture, or any other unwanted fluids or materials from interacting with the internal components of the WCD 1200. Although not depicted, the internal components can reside within the internal space 1220, and the external potting 1214 can be disposed immediately atop the components to provide the seal.

[0198] FIG. 12E is a perspective view of the internal housing 1212 without external potting 1214. As shown, the internal surface 1212a defines a generally U- shaped surface for receiving the components.

[0199] FIG. 12F is a perspective view of the internal housing 1212 with a portion of the external potting 1214 removed and showing one or more components 1230 and printed circuit board (PCB) 1240. The components and PCB can be constructed as flex circuits, thereby allowing the components 1230 and PCB 1240 to be geometrically configured within the ring shaped internal space 1220. The PCB 1240 can be any type of flexible material clear to those of skill, such as polyimide, PEEK, etc. Additionally, the PCB could be rigid-flex whereby panels of RF4 are connected together with a flexible substrate.

[0200] As shown, the PCB 1240 and the components 1230 can be disposed within the internal space 1220 generally defined by the internal surface 1220a and the flanges 1220b-c. The PCB 1240 can define one or more folding regions 1242 that allow the PCB 1240 to conform to the circumference and/or perimeter of the internal surface 1212a. The PCB 1240 can extend around at least a portion, or up to an entire circumference, of the internal surface 1212a. In one example, the size of the internal diameter d1 of the WCD can determine the portion of the internal surface 1212a around which the PCB 1240 extends. Illustratively, for a larger ring size and a larger internal diameter d1, the PCB 1240 can extend only a portion (an arc) of the overall circumference, while for smaller ring sizes a greater portion (arc) of the circumference can be employed to accommodate PCB 1240 and the internal components 1230. The adjacent portions of PCB can form an arc angle therebetween by virtue of the folding regions disposed therebetween, allowing for the PCB to be conform to the internal surface 1212a.

[0201] **II. External Housing/Internal Potting**

Petitioner Samsung Ex-1004, 1191

[0202] FIG. 13 is a cross section of a WCD 1300 according to another aspect of the disclosure and illustrative embodiments. In this example, the WCD 1300 includes a housing 1310 that includes an external housing 1312 and an internal potting or encapsulant 1314. The external housing 1312 includes an internal surface 1312a that has a generally C-shaped cross section-but alternate cross section shapes, such shapes with an external notch or groove. The external housing includes flanges 1312b-c that extend toward each other, beyond portions of the internal surface 1312a, to define a partially enclosed internal space 1320. In an assembled state, the WCD 1300 can include a battery 1330, a PCB 1340, and components 1350, which can be at least partially or completely disposed within the partially enclosed internal space 1320. The internal potting 1314 can extend between the flanges 1312b-c and can seal the partially enclosed internal space 1320. The components can be encapsulated by the internal potting 1314. The PCB 1340 and components 1350 can extend along an inner circumference of the internal surface 1312a.

[0203] Illustratively, the external housing 1312 can be formed of the same materials as the internal housing 1212 described above, and the internal potting 1314 can be formed of the same materials as the external potting 1214 described above. As also described above, the internal potting 1314 can be transparent and the external housing 1312 can define one or more windows according to one or more aspects of the disclosure.

[0204] FIG. 14A is a cross section of a WCD according to another aspect of the disclosure and illustrative embodiment. In this example, the WCD 1400 includes a housing 1410,internal surface 1412a, an internal or external housing 1412, an internal or external potting 1414, an internal space 1420, a battery 1430, a flexible circuit 1440, and one or more components 1450. This example is similar to the examples described above with respect to FIGs. 12 and 13, except the addition of a stiffener element 1442 and the flanges 1412b-c extend further into the space 1420 toward one another such that the flanges 1412b-c overlap with the stiffener element 1442.

[0205] FIG. 14B is a perspective view of the PCB and stiffener element of FIG. 14A. As shown in FIG. 14B, the stiffener element 1442 extends beyond an overall width w of the PCB 1440 and extends wider than a distance between flanges 1412b-c. The stiffener element is disposed between folding regions 1444. The PCB 1440 can

Petitioner Samsung Ex-1004, 1192

include one or more stiffener elements 1442 attached thereto, and the elements 1442 can be disposed periodically (in separated intervals) along a length l of the PCB 1440. As shown in FIG. 14C, the stiffener element 1442 can be disposed underneath the flexible circuit 1440, e.g., on a face of the flexible circuit 1440 opposed to the face on which the components 1450 are disposed, and can be permanently or semi-permanently attached thereto. The stiffener element can be implemented in any of the configurations described, and in particular, with either the internal housing/external potting arrangement or the external housing/internal potting arrangement.

[0206] The stiffener element 1442 can be formed of any material, such as polyamide or thin FR4, depending on construction of the PCB 1440. In particular, the material of the stiffener can be chosen to be more or less flexible than the PCB 1440. In one example, the stiffener element 1442 can be a polyamide stiffener disposed on a back surface of a flexible PCB. In another example, the stiffener element 1442 can be FR4 and can be substantially flush with respect to the flanges 1412b-c. In this regard, the stiffener element can extend substantially the distance between flanges 1412b-c and may not deform upon insertion into the space 1420. The stiffener element can include surface features disposed on an edge thereof, with the edge facing one of the flanges 1412b-c. The surface features can include a sawtooth profile (e.g., intersecting straight lines at acute angles), or any other type of feature capable of providing an interference fit between flanges 1412b-c.

[0207] FIG. 14D shows a cross section of the WCD at a point in time during assembly/manufacture when the PCB 1440 is being inserted into the internal space 1420 and prior to the application of potting 1414. As shown, the stiffener 1442 contacts the flanges 1412b-c of the housing 1410 by virtue of the width w of the stiffener element 1442. Upon an application of force, the PCB 1440 and stiffener 1442 assembly can be inserted into the internal space 1420. In this regard, the stiffener element has a predetermined flexibility that allows for a certain amount of flexion, as shown in FIG. 14D. The flexion allows for the flexible circuit 1440 to be inserted within the internal space 1420 and can prevent the flexible circuit 1440 from being removed or from accidentally falling out once inserted. In this regard, the flexible circuit 1440 is held in place within the space 1420 by virtue of the width of the stiffener element 1442 and the

Petitioner Samsung Ex-1004, 1193

distance between the flanges 1412b-c. Once inserted, the potting 1414 can be applied free of the concern of improper positioning of the flexible circuit 1440.

[0208] FIG. 14E is a cross section of the WCD of after a potting material 1414 has been applied subsequent to the WCD of FIG. 14D.

[0209] **III. Inner/outer bands**

[0210] FIG. 15A depicts a perspective view of a WCD 1500 according to another aspect of the disclosure. In this example, the WCD includes a housing 1510 that includes an internal housing 1512 and an external housing 1514. The internal housing 1512 can be similar to the internal housing described above with respect to internal housing 1212, and the external housing can be similar to the external housing described above with respect to external housing 1312. The internal housing 1512 can include one or more windows 1516 that can allow electromagnetic radiation (e.g. visible and near-visible light) to pass therethrough, allowing it to fall incident upon components disposed within the housing 1510 and allowing EM radiation sources (e.g. visible light, RF, IR, etc.) within the housing to exit the housing.

[0211] FIG.15B is an exploded view of the WCD 1500. As shown, the WCD can include internal housing and external housing 1512 and1514. The WCD can further include a PCB 1540 and components 1550. Once the housings 1512-1514 are assembled and the PCB 1540 and components 1550 are assembled within space defined between the housings 1512-414, potting layers 1502 and 1504 can be applied to seal the WCD at both sides thereof to ensure a secure seal.

[0212] **IV. Inner/outer bands with U shaped window**

[0213] FIG. 16A is an exploded view of a housing 1610 and a PCB of a WCD according to one or more aspects of the disclosure. The WCD 1600 comprises a housing 1610 with an integral inner wall and outer wall 1612 and 1614. The housing can be made of any material, such as any material described above with respect to the internal/external housing structures. In this example, the inner and outer walls 1612,1614 each define a window in the shape cutaway portions 1616. The cutaway portions are bounded on three sides by the walls 1612 and 1614 and unbounded at the other side thereof. The cutaway portions 1616 can be aligned with one another to ensure

Petitioner Samsung Ex-1004, 1194

transmission of radiation into/out of the housing 1610. The space1620 between the inner and outer walls 1612,1614 can receive a PCB 1640, battery, components, etc.

[0214] FIG.16B is a cross section ofFIG.16A along line B-B. As shown, the inner and outer walls 1612,1614 are directly connected by a floor 1618. The space 1620 is defined by the space between the inner and outer walls 1612,1614 and the floor 1618.

[0215] FIG.16C is a perspective view of the WCD with potting material 1630. As described above, the PCB, battery, and components can be disposed within the space. Once disposed therein, a potting 1630 can be provided atop the components and within the cutaway portion 1616. The potting 1630 can be transparent to allow for transmission of light through the cutaway portions 1616.

[0216] **V. Charging By Concentrated Light Source**

[0217] According to one aspect of the disclosure, the WCD can be charged by an external concentrated light source, e.g., laser light, laser diode, etc. In this regard, the photovoltaic device described above can include a concentrated photovoltaic element (CPV) that is constructed and arranged to receive concentrated light from the concentrated light source, e.g., laser light from a laser diode, light from a light emitting diode (LED), etc., and converting the received concentrated light into an electric current. The photovoltaic device can also generate power from nonconcentrated light sources, such as office lighting and ambient sunlight. The electric current can be used to charge one or more batteries stored within the housing of the WCD.

[0218] FIG.17A depicts a cross section of a WCD employing charging by concentrated light source according to one or more aspects of the disclosure. In this example, the WCD 1700 can include a housing material 1710. The WCD can include a PCB 1720 and a concentrated photovoltaic cell 1730. The WCD can be positioned adjacent a base assembly or base station 1750. The base assembly 1750 can be connected to an external power source 1765 and can have internal circuitry 1760 to power one or more concentrated light sources 1770, e.g., one or more laser diodes and/or one or more LEDs, disposed within the base assembly 1750. In this example, the concentrated light source 1770 comprises one or more laser diodes.

[0219] The base assembly 1750 can define a first opening 1752 at one portion thereof to allow the concentrated light 1780 to exit the housing of the base assembly I

Petitioner Samsung Ex-1004, 1195

750. As shown in the diagram of FIG.17A, the concentrated light 1780 is generated by the concentrated light source 1770 and exits the housing of the base assembly 1750 via a first opening 1752. The concentrated light 1780 then enters into the WCD by a second opening 1712 in the housing of the WCD 1700 where it can fall upon the CPV 1730. Once the concentrated laser light falls upon the CPV 1730, the CPV 1730 can convert the incident concentrated light into a current that can be used to directly power one or more components within the WCD and/or can be used to charge one or more rechargeable batteries onboard the WCD.

[0220] The concentrated light source 1770, as described above, can be any type of light source that is arranged to generate concentrated light, such as an LED or a laser diode. The concentrated light can be any type of concentrated and/or coherent electromagnetic radiation, such as laser light and/or LED light. The concentrated light can have any desired intensity or wavelength, according to the characteristics of the CPV 1730.

[0221] In one example, the source 1770 can be a 200 mW laser diode that produces red or green laser light. This can generate approximately 80mW (or typically less) of power in the WCD where the CPV 1730 includes a plurality of groups of photovoltaics configured in series or in parallel with one another. Each group of photovoltaics can include one or more CPV cells. In another example, the CPV can include a single group of photovoltaics.

[0222] The base assembly 1750 described above can include additional components that can interact with the WCD 1700. For example, the base assembly can include one or more antennas that can communicate according to one or more wireless protocols, such as 3G, 4G, WiFi, Bluetooth®, NFC, or the like, for direct or indirect wired or wireless communication with the WCD or mobile device. In addition to the charging methods above, the base assembly can employ inductive charging techniques.

[0223] FIG.17B depicts a cross section of a WCD employing charging by concentrated light source according to another aspect of the disclosure. In this example, the concentrated light source 1770 comprises an LED. Further, the base assembly comprises an optical element 1790 positioned adjacent to the concentrated light source I 770 for focusing the LED light onto the CPV inside the WCD. The optical element 1790

Petitioner Samsung Ex-1004, 1196

can be any type of optical element, such as a lens. The lens can be formed of any material, such as glass, plastic, etc., and can be any type of lens, such as concave, convex, piano-concave, piano-convex, etc. In this example, the optical element 1790 includes a piano-concave, with the concave portion facing the concentrated light source 1770. In the example where the source 1770 is an LED, the LED emits light in many directions. The optical element 1790 can focus the emitted LED light to focus as much of the LED light as possible onto the CPV of the WCD. The optical element 1790 can be disposed at least partially or completely within the first opening 1752. In some implementations, the optical element may not be necessary due to LEDs with substantially focused light.

[0224] FIG.17C is a perspective view of a base assembly 1750 and WCD 1700 according to one or more aspects of the disclosure. As shown, the WCD 1700 is in the shape of a ring and the base assembly 1750 includes a post 1754 for receiving the ring. The post 1754 can be cylindrical and can be sized and shaped according to an internal diameter of the WCD in order for the WCD to be received on an external surface of the post. The first opening 1752 of the base assembly 1750 is formed on a portion of the post 1754 such that, when the WCD 1700 is stored on the post, the second opening 1712 can be aligned with the first opening 1752 to ensure alignment of the CPV and the concentrated light source. The base assembly can receive/transmit power and/or data via external input/output 1795, which can be a DC power input, a USB input connection or any other acceptable connection/form factor.

[0225] FIG.17D depicts a perspective view of internal components of the base assembly 1750 and WCD 1700 according to another aspect of the disclosure. In this figure, the respective housings of the base assembly and WCD have been omitted, thereby showing a plurality of concentrated light sources 1770, optical elements 1790, and a plurality of CPVs 1730 disposed on mounting substrates 1775 on a PCB. In this example, the WCD can include a plurality of CPVs and the base assembly can include a plurality of sources. This allows for a greater current to be generated during charging and for faster charging times of the WCD. The CPVs and concentrated light sources can correspondingly be disposed in a line, with a constant or variable pitch between respective elements. In this regard, the optical element can include corresponding concavities with the same pitch.

Petitioner Samsung Ex-1004, 1197

[0226] FIGs.17E-F depicts other CPV configurations according to one or more aspects of the disclosure. As shown in FIG.17E, the CPVs 1730 can be arranged in a lx4 array, while FIG.17F depicts the CPVs arranged in a 2x2 array. In addition to the examples shown in the above figures, the WCD can include any number of CPVs according to any number of geometric configurations.

[0227] FIG.17G is perspective view of a WCD and base assembly with a lx3 CPV arrangement. As shown, the WCD can include a lx3 array of CPVs and the base assembly can include a corresponding lx3 array of concentrated light sources. As indicated by the arrow, a user can then rotate the WCD on the base assembly in order to align the respective first and second openings, as well as the CPV and concentrated light sources.

[0228] FIG.18A depicts a cross section of a WCD 1800 employing charging by concentrated light source 1870 according to another aspect of the disclosure. In this example, the WCD includes an internal/external housing portion 1810 and an internal/external potting portion 1820, as described above. In this regard, the base assembly 1850 includes a first opening 1852, but is free of a second opening on the WCD. The concentrated light 1880 passes through the transparent potting portion and falls incident upon the CPV cell 1830. In this example, the source can be a laser diode.

[0229] FIG.18B depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure. In this example, the concentrated light source 1870 includes one or more LEDs and the base includes one or more optical elements 1890 for focusing the concentrated light 1880. The LEDs may be of different wavelengths to provide power to two or more junctions in the triple junction CPV cell.

[0230] FIG.19A depicts a cross section of a WCD 1900 employing charging by concentrated light source 1970 according to another of the disclosure. In this example, the WCD and/or the base assembly 1950 can employ one or more magnetic and/or ferrous materials to ensure alignment between the concentrated light source and the CPV cell. Such alignment can improve charging efficiency of the WCD.

[0231] The base assembly includes a first opening 1952 and the WCD includes a second opening 1912 to allow for concentrated light to fall incident upon the CPV 1930.

Petitioner Samsung Ex-1004, 1198

In this example, the second opening is formed on an external housing portion of the WCD. In this arrangement, the base assembly can charge the WCD from an exterior of the WCD, rather than an internal charging method as identified above.

[0232] The WCD can include a ferrous or other suitable (e.g. ferromagnetic) material 1920, such as steel, disposed within the housing 1910. In this example, the ferrous material is disposed in a space defined between an internal housing and an external housing. The ferrous material can surround the CPV.

[0233] The base assembly can include corresponding magnets 1960 that can cause an attractive force between the WCD and the base assembly into an optimal configuration for charging. The magnets can be disposed within the base assembly and can surround the concentrated light source. The magnets 1960 can be formed of a rare earth material, such as neodymium or any other acceptable material that provides a requisite magnetic field strength.

[0234] FIG.19B depicts a cross section of a WCD 1900b employing charging by concentrated light source 1980b according to another of the disclosure. The CPV 1930b of the WCD1900 is charged from an interior portion, such as by a base assembly 1950b with a post 1954b. Similarly, the WCD can include a ferrous material 1920b disposed within the housing1910b and the base assembly1950b can include a magnet 1960b.

[0235] FIG.19C depicts a schematic diagram of magnets 1920c,1960c that can be used in a WCD and/or base assembly, including a CPV 1930d and concentrated light source 1930d, according to one or more aspects of the disclosure. As shown, the magnets and/or ferrous/ferromagnetic materials can be axially polarized, with each having a respective north pole and south pole. In this regard, the WCD can have axially polarized magnets 1920c with a south pole S facing toward the base assembly, and the base assembly can have axially polarized magnets 1960c with a north pole N facing toward the WCD. The attractive force between the north and south poles can ensure alignment of the CPV 1930c of the WCD and the source 1970c base.

[0236] FIG.19D depicts a schematic diagram of magnets that can be used in a WCD and/or base assembly according to one or more aspects of the disclosure. In this example, the base assembly includes axially polarized magnet 1960d, with a north pole

Petitioner Samsung Ex-1004, 1199

N facing toward the WCD. The WCD can include ferrous steel 1920d, with an attractive force between the ferrous steel and the north pole of the base assembly magnet.

[0237] FIG.19E is a perspective view of a WCD and a base assembly according to one or more aspects of the disclosure. As shown, the WCD 1900e can be received by a post 1954e of a base assembly 1950e. The respective magnets I960e and/or ferrous materials 1920e are shown in phantom to illustrate their positioning with respect to the WCD and base assembly devices and the CPV1930e as well as the concentrated light source 1970e.

[0238] FIG. 20A is a cross section of a WCD 2000 engaged with a base assembly 2050 according to one or more aspects of the disclosure. In this example, the magnets 2060 can surround the concentrated light source 2070, and the WCD can include a ferrous steel 2020, CPV 2022, and battery 2024 disposed within an internal/external potting 2014 of the WCD. The ferrous steel 2020 can be disposed on a face of the PCB 2040 and can be encapsulated by the internal/external potting 2014. The base assembly can include one or more optical elements 2090 for focusing the concentrated light 2080.

[0239] FIG. 20B is a perspective view of a PCB 2040b with a CPV 2030b and ferrous element 2020b configuration according to one or more aspects of the disclosure. In this example, the ferrous element 2020b comprises a steel ring that can surround a CPV 2030b and can be disposed on the PCB 2040b.

[0240] FIG.20C is a perspective view of a PCB 2040c with a CPV 2030c and ferrous element 2020c configuration according to one or more aspects of the disclosure. In this example, the ferrous element 2020c comprises a plurality of rectangular bars disposed on the PCB. In this way, the ferrous element 2020c can be coated to be reflowed onto the PCB.

[0241] FIG.20D is a perspective view of a magnet 2060d and a concentrated light source 2070d according to one or more aspects of the disclosure. As shown, the magnet 2060d can include a ring that can extend around a circumference of the concentrated light source 2070d. The magnetic ring can be attracted to the ferrous steel ring and/or the rectangular ferrous steel examples set forth in 20A-C above.

[0242] In some examples, the WCD can be adapted to uniquely identify the wearer of the WCD using, for example biometric features unique to the user.

Petitioner Samsung Ex-1004, 1200

[0243] FIG.21A is a schematic view of a WCD 2100 showing components used for identifying the wearer of the WCD. As shown, the WCD2100 can include one or more infrared illumination sources 2110 and an infrared CMOS imaging device 2120. The finger 2190 can extend through the finger space of the WCD and the IR source 2110 can illuminate a portion of the skin of the finger 2190. The IR CMOS imaging device 2120 can receive light that has been reflected from the skin surface and produce an image of the skin of the finger 2190. As shown, the IR source2110 and the imaging device 2120 are positioned near the interior surface of the WCD, e.g., the surface facing the skin of the finger. The IR illumination can pass through a window provided on the interior housing or can pass through a transparent potting material.

[0244] During the imaging process, the WCD 2100 can be rotated about an axis passing through the center of the finger space and along the longitudinal direction of the finger. In this regard, the imager 2120 can capture a larger swath of the skin surface than if the WCD 2100 were held stationary with respect to the finger during the imaging process.

[0245] At the time of first use, or any time thereafter, the user can generate a reference capillary map in order to identify himself/herself as the authorized user of the WCD. As described above, the user can rotate the WCD around the finger to capture image data of an analyzed section of skin 2192 and on or more capillaries 2194 of the user currently wearing the WCD. The image data can correspond to an overall analyzed section of the skin 2196 of the wearer. The image data of the capillaries can be used to generate a reference capillary map of the wearer, which can be stored in the memory, such as flash memory or EEPROM, of the WCD.

[0246] When the same user puts the WCD on his or her finger after generation of the reference capillary map, the WCD can capture image data of the wearer's skin surface that can be compared to the reference capillary map stored in the memory. In this regard, the user need not rotate the device around the finger. Instead, the WCD can compare a subset of the gathered image data to a corresponding subset of reference capillary map. If there a match, within a predetermine error tolerance, the WCD can uniquely identify the wearer as an authorized user of the WCD and as the unique individual who generated the reference capillary map. Once authorized, the wearer can have access to certain functions, features, data, or other content that is not otherwise

Petitioner Samsung Ex-1004, 1201

available without authorization. In another example, the identification can be a step in a transaction or other type of authorization, such as an electronic payment, bank transaction, etc. If the gathered data does not match the reference capillary map, then the user may be prevented from accessing certain features on the WCD.

[0247] Illustratively, the comparison process between sensed capillaries and some or all of the capillary map can be implemented using basic pattern recognition algorithms (processes) instantiated in the electronics of the WCD. Such processes can rely on edge detection and similar techniques that should be clear to those of skill in the art and can be sourced from various commercial vendors of biometric recognition software.

[0248] In another example, the illumination can include NIR illumination and can project radiation into the skin of the finger. The reflected NIR illumination can then be analyzed to determine one or more characteristics of the blood, such as blood alcohol levels, blood glucose levels, and blood oxygenation levels. In this regard, the WCD analyzes the reflected radiation to identify wavelengths that were absorbed from the projected radiation by the blood of the user. Techniques and processed used in conjunction with commercially available venous oximeters (for example) can be employed to undertake certain readings.

[0249] FIG. 22A is a perspective view of a user employing ECG monitoring according to one or more aspects of the disclosure. In this example, the user can wear the WCD2200 on a first finger 2210 of first hand 2220, and can touch a second finger 2230 of a second hand 2240 to an exterior surface of the WCD 2200. This can provide an electric pathway 2250 through the body, as shown in FIG. 22B, allowing for the transmission of electrical current between distant portions of the body.

[0250] FIG. 22C is a perspective view of a WCD that can employ ECG monitoring according to one aspect of the disclosure. In this example, the WCD 2200 includes an internal/external housing 2250 with a conductive pad2260. The conductive pad 2260 can be electrically isolated from the external/internal housing 2250 of the WCD, thereby providing distinct and isolated electrical contacts on the WCD. The internal/external housing 2250 can be in electrical communication with the first finger2210 of the first hand, while the conductive pad 2260 can be in electrical communication with the

Petitioner Samsung Ex-1004, 1202

second finger 2230 of the second hand. In this regard, an electrical path 2250 is formed through the respective hands 2220, 2240 and through the rest of the user's body, particularly through the chest. In this regard, the WCD can take various electrical measurements of the user, such as ECG. The ECG measurement can include measurements of the various waveforms, such as P-U waveforms. The WCD can store such ECG data in a memory and/or can communicate the data to a wirelessly connected mobile device. In another example, the WCD can employ electrically isolated internal and external housings, such as those described above. In this regard, the conductive pad may not be utilized, and the user can wear the WCD on a first finger and apply the second finger anywhere on the external housing.

[0251] The WCD can also serve as a monitor for those who are mobility impaired or who are prone to falls, such as disabled persons and/or retired persons. The accelerometer onboard the WCD detect a fall of the user via a sudden change in acceleration data. The WCD, in conjunction with a mobile device and/or one or more base stations positioned around the home of the user, can determine the position of the user within the house. For example, the mobile device can employ GPS capabilities, and either the mobile device or the base stations can use GPS in combination with WiFi signal strengths to determine the location of the user within the house. The WCD can then issue an alert, either directly or indirectly (via the mobile device or base station) to a third party that a fall has occurred. The alert can be a phone call, text message, e-mail, or any other type of communication. The third party can then take appropriate measures to aid the fallen user.

[0252] The WCD can also monitor heart rate and/or temperature, in addition to the other monitored characteristics described above. If any of the monitored characteristics is abnormal, e.g., measured parameters outside of a predetermined threshold range, an alert can be sent to a third party. In some examples, the third party can be a medical health professional, such as a doctor, nurse, caretaker, etc. It is noted that, for those embodiments which can function as a cardiac monitor (e.g., that measures electrocardiogram (EKG)), it can be necessary to establish a closed loop (e.g., for the electrical measurement of EKG) across the heart. As such, in some of those embodiments, a separate conductive pad or other skin-contacting structure/probe can be coupled to the WCD so that a user can pinch the pad with fingers on an opposite hand.

Petitioner Samsung Ex-1004, 1203

[0253] Since the WCD has the form factor of a ring, the WCD is designed to be worn over long periods of time by a user with little to no discomfort or interference. In this regard, the WCD can monitor the above-described, monitored characteristics over long periods of time (e.g. weeks, months, etc.), and determine trends in the data. For example, the WCD can measure heart rate over a long period of time and determine a unique resting heart rate for a user. If the user's heart rate deviates from the resting heart rate, the WCD can be arranged to issue an alert to a third party. In one specific example, the WCD can use appropriate processes to analyze both the trends of monitored characteristics, as well as current accelerometer data. In this way, if a person's heart rate deviates from a resting heart rate, but the accelerometer indicates that the user is exercising and/or engaging in strenuous activity that provides an equivalent workout, then the WCD may not issue an alert in this circumstance.

[0254] FIG.23A is a perspective view of the hand of a user in various positions employing the navigational features of the WCD. As described above, the WCD can communicate with a mobile device though one or more wireless communication protocols. The mobile device can include a processor and a memory and can execute a map application/process that can provide tum-by-tum walking or driving directions to the user based on the user's GPS location. A portion of those directions can include information regarding heading, distance to travel at that heading, waypoints, and the direction of next tum. By way of the wireless communication, the mobile device can communicate one or more of pieces of information relating to directions, such as the heading. Once the heading is received the WCD, the WCD can give feedback to the user regarding the actual heading measured by the onboard magnetometer and the heading set forth in the direction information. In one example, the feedback can be haptic or physical feedback provided by one or more actuators, such as the actuators 670 described above.

[0255] FIG. 23A depicts a user's hand in various positions of navigation, each hand including a WCD worn thereon. In this example, the heading provided by the mobile device is the heading 2335, which represents the direction in front of the hand position2330. In this regard, if the user gestures, e.g., points a ring finger, in the direction of the correct heading, the WCD 2300 can give feedback to the user indicating the correct heading. The feedback can include, for example, an LED indicator 2310

Petitioner Samsung Ex-1004, 1204

showing a green visible light. In the example of hand position2320, the finger is gesturing in a direction to the left of the correct course 2325. In this way, the WCD 2300 can provide feedback to correct the heading of the user. Such feedback can include illumination of an LED indicator showing (e.g.) a red visible light. Similarly, hand 2340 is gesturing in direction 2345, which is to the right of the correct/appropriate direction. The WCD can provide (e.g.) a blue indicator informing the user to change heading.

[0256] FIG.23B is a flow chart 2300B depicting a method of providing feedback to a user according to one or more aspects of the disclosure. At block 231OB, a user can establish a communication link between a WCD and a mobile device. At block2320B, the user can generate or request a set of directions at the mobile device, including information/data regarding heading, distance to travel at that heading, and the direction of next tum. At block 2330B, the mobile device can transmit at least one of the information items/datum regarding heading, distance to travel at that heading, and the direction of next tum. At 2340B, the WCD can take a measurement of heading by measuring a heading associated with an explicit gesture by the user's finger donning the ring. Such gesture can include pointing in a proposed heading of travel. At block 2350B, the WCD can compare the measured or proposed heading to the correct heading provided by the mobile device. At 2360B, the WCD can provide feedback to the user based on the comparison at 2350B, e.g., if the user is gesturing in the correct direction, a green LED indicator may appear. In other examples, if the gesture is in a direction that does not correspond with the correct direction, a (e.g.) blue or red indicator can appear. In one specific example, indicators representing left and right course alterations can be different so a user can easily discern a correct direction of travel.

[0257] FIG. 24A is a schematic diagram of a system 2400 for controlling an environment of a user according to one or more aspects of the disclosure. As shown, the WCD can be connected, wired or wirelessly, to one or more appliances in the home of a user. The system 2400 can include a WCD 2410, a thermostat 2420, a wireless access point (e.g., WiFi router) 2430, and a mobile device 2440. The WCD can be wirelessly connected (e.g., link 2415) to both the thermostat and the mobile device by any type of wireless communication protocol, such as Bluetooth. The access point can be wirelessly connected to the thermostat and the mobile device by any type of wireless communication protocol, such as WiFi. It is noted that a wide range of commercially

Petitioner Samsung Ex-1004, 1205

available appliances, thermostats, lighting controllers, home controllers, and the like, can interface with the WCD using WiFi or another conventional/proprietary communication protocol, as described further below.

[0258] The WCD 2410 can include one or more temperature sensors. In one example, the WCD can include at least one internal facing temperature sensor 2410a and an at least one outward facing temperature sensor 2410b, as shown at FIG. 24B. The inward facing temperature sensor 2410a can be near the skin of a user when the user is wearing the ring, and can therefore measure the skin temperature of the user. The outward facing temperature sensors 2410b can be disposed away from the finger of the user, and can therefore be arranged to measure an ambient temperature of the room in which the user currently resides with sufficient thermal isolation from the user's hand and his/her body heat. In particular, in order to ensure accurate ambient temperature measurements, the WCD can employ a combination of multiple light sensors 2410c and outward facing temperature sensors 2410b. In this regard, the temperature sensor 2410b associated with the light sensor 2410c that receives the most light can be the most accurate, as it is most likely that this sensor is furthest from the finger or palm of the user. In another example, the WCD can employ multiple outwardly facing temperature sensors 2410b and compare the temperature values of each to the inward facing sensor 2410a. The WCD can then select the most accurate temperature value from the outward facing sensors.

[0259] Based on the measured skin temperature and measured ambient temperature, the WCD can automatically adjust the thermostat 2420 to alter the ambient temperature of the room. In this regard, if a user's skin temperature is too high, the WCD can instruct the thermostat 2420 to lower the ambient temperature. Similarly, if the user's skin temperature is too cold, the WCD can instruct the thermostat 2420 to raise the temperature. The WCD 2410 can instruct the thermostat (and/or an HVAC controller) directly, e.g., via a direct wireless link 2415, or indirectly, e.g., via one or more of the mobile device 2440 and the access point 2430. The WCD can also use historic temperature data to develop trend temperature data.

[0260] In another example, the WCD can be part of a system 2400C for controlling home appliances. The system 2400C can include a WCD 2410C, one or more home appliances 2420C, and an access point 2430C. Such home appliances 2420C can

Petitioner Samsung Ex-1004, 1206

include, for example, a television, lights, speakers, microwave, range, stove, oven, etc. Each of the home appliances can include an antenna that allows the respective home appliances to communicate wirelessly with one or more access points 2430C. In one example, the appliances can include a ScenSor DWIO00 chip provided by DecaWave. In this way, the locations of the appliances in the room can be determined to an accuracy of approximately 10 cm. The location of the WCD 2410C can also be determined, using the above-referenced chip, or by using signal strengths of one or more base stations.

[0261] Having established the position of one or more home appliances and the user in a room, the user can make a gesture to control such home appliances 2420C. For example, the user can point at the TV (while wearing the WCD) in order to tum it on/off. Knowing the position of the user and the position of the TV, the direction of the gesture and the type of gesture can indicate what action to take on which device. The accelerometer and/or magnetometer on the WCD can be used to create a vector to the object to control, and a wireless packet can bet sent to a wireless access point to control the respective appliance.

[0262] FIG. 24D is a flow chart depicting a method 2400D of controlling home appliances according to one or more aspects of the disclosure. At block 241OD, the locations of one or more home appliances in a room and/or house can be ascertained/determined. As described above, the appliances can include a processor configured to identify location within a room. At block 2420D, the location of the WCD is determined. At block 2430D, the user can make a gesture toward a home appliance to exert control over the home appliance. Such gesture can include a snap, a point, etc. At block 2440D, the accelerometer and/or magnetometer on the WCD can be used to create a vector to the object to control. At block 2450D, a wireless packet can bet sent to a wireless access point to control the respective appliance. The access point can then issue the command to the respective appliance.

[0263] FIG.25 is a perspective view of the hand of a user employing a two-factor authentication technique according to one or more aspects of the disclosure.

[0264] As shown, the user 2500 is wearing a WCD 2510 and is approaching a locked door 2520 with an access node 2530 associated therewith. The access node 2530

Petitioner Samsung Ex-1004, 1207

can be a wireless access node of a conventional or custom arrangement, and can communicate wirelessly according to any type of wireless protocol, such as WiFi or Bluetooth. As the user approaches the door 2520, the WCD 2510 can initiate a communication link, e.g., Bluetooth or WiFi, with the access node 2530. In this way, the WCD and the access node can engage in one or more handshaking or query procedures to verify the WCD. For example, the access node 2530 can detect a MAC address, IP address, or other alphanumeric identifier associated with the WCD and compare it to a list of authorized users. Such network-based communication processes should also be clear to those of skill.

[0265] Once the MAC address or other identifier is verified, the user can engage in a pre-defined gesture 2550 to complete the authentication procedure. The gesture 2550 can be any type of hand and/or finger motion that can be performed by the user. In this regard, the accelerometer or magnetometer can detect the gesture 2550 performed by the user and provide the gesture information to the access node. If the provided gesture information corresponds with an authorized gesture stored at or accessible by the access node, then the user may be granted authorization and the door can be unlocked. The authorized gesture can be a general authorized gesture for all users, or can be a specific gesture authorized only for the particular MAC address.

[0266] In addition to a door, the method above can be used to gain access to other features, such as unlocking a mobile phone, unlocking a car door, starting a car. The authentication technique above is advantageous in that it can eliminate extraneous authentication devices, such as key fobs for a car, a door, keypads for entry control, etc., and can provide a secure two-factor authentication technique to avoid unwanted access. More generally any type of keyless entry system (e.g. a keypad, card-reader, keyless lock, etc.) can be equipped with appropriate communication interfaces (RF, IR, etc.) to communicate with the WCD and operate based on a gesture and/or proximity of the user using the techniques described above. The WCD can also be employed generally in this manner to activate or deactivate a residential or commercial alarm system-substituting, for example, for a key fob used for this purpose.

[0267] FIG. 26A is a schematic view of a charging apparatus for charging the WCD according to one or more aspects of the disclosure. As shown, a mobile device 2610 can be received within a case 2620. The mobile device 2610 can be electrically connected to

Petitioner Samsung Ex-1004, 1208

the case 2620 via a port 2610a on the mobile device 2610 and a connector 2620a on the case 2620. As shown in phantom, the case 2620 can include an integrated battery 2630 within the case that can charge the mobile device via the connector or can charge a WCD, as will be described in greater detail below.

[0268] The integrated battery can be connected to an antenna 2640 disposed on or within the case 2620 that can emit an RF signal, as shown in the block diagram in FIG. 26C. The RF signal can have a power of less than 500mW and a frequency of 13.56MHz. The RF signal can be emitted in all directions around the case such that it can be received by a WCD in proximity to the case.

[0269] FIG. 26B shows a WCD 2650 including an RF antenna 2660 and charging circuitry 2670. The RF antenna 2640 can be disposed within the housing 2680 and can receive the RF signal emitted by the case 2620 and convert it to a current that can be used to charge the WCD battery (not shown). This can advantageously allow the user to charge the WCD without removing the WCD from the finger. As shown in FIG. 26D, the charging can occur whenever the WCD is in close proximity to the case, such as when a user talking on the phone or merely handling the phone. In another implementation, the case can utilize inductive charging to charge the WCD. In this regard, the case can include an induction coil subjected to a predetermined current to produce a magnetic field. A corresponding induction coil within the housing of the WCD can be subjected to the magnetic field to produce a current that can charge the onboard battery in accordance with known electromagnetic principles.

[0270] FIG. 27A is a pictorial diagram and FIG. 27B is a block diagram of a WCD employing flash storage according to one or more aspects of the disclosure. As described above, the WCD 2700 can include a housing 2710, an antenna 2720, and an integrated circuit (IC) 2730 including a flash memory 2740. The IC and the flash memory can be disposed within the housing 2710. The flash memory 2740 can be powered by a battery 2750 and connected to the IC 2730, which can be implemented as a system-on-a-chip (SoC) IC 2760. The IC can include Bluetooth Low Energy (BLE) capability to allow for communication with another device. The flash memory can be used to store data, or can be used in any of the authentication techniques described above. The WCD can transmit data stored on the flash memory to another device 2780 via the BLE connection, or can receive data and store the data on the flash memory.

Petitioner Samsung Ex-1004, 1209

[0271] FIG. 28A is a schematic diagram of one or more WCDs performing proximity functions according to one or more aspects of the disclosure. The WCD can detect a strength of an RF signal received by its antenna, and calculate a distance to the source of the RF signal using a Received Signal Strength Indicator (RSSI). In one example, the RF signal can be from a mobile device, an access point, or another WCD. The use of RSSI can have many applications in proximity detection. For example, the WCD can be placed on a child and can be connected to mobile device held by a parent. If the WCD travels a predetermined distance from the mobile device, the WCD can issue an alert to the mobile device, thereby alerting the parent that the child has wandered too far. In another example, the parent can wear a first WCD and the child can wear a second WCD. The first WCD can alert the parent that a child has wandered too far.

[0272] A single user can wear a first WCD 2800 on a first finger on a first hand and a second WCD 2810 on a second finger on a second hand. In this regard, the user can measure the relative distance between the first and second fingers using an RSSI via a wireless link 2830 between the WCDs 2800, 2810, such as a BLE connection. This can be used to measure an approximate dimension of an object held in both hands or to estimate a mid-air measurement.

[0273] In some examples, a first user can wear a first WCD 2800 and a second user can wear a second WCD 2810. The RSSI can be collected over a period of time and the processor can analyze the data to develop trends or statistics. For example, the RSSI data can indicate that the first and second users have spent a certain amount of time together and can serve as a relationship monitor.

[0274] The WCD can also detect when the first user and second user are holding hands. FIG. 28B is a schematic diagram of one or more WCDs 2800, 2810 performing proximity functions according to one or more aspects of the disclosure. Similar to the ECG monitoring techniques described above, a circuit can be formed when the users hold hands 2840 (with the respective hands wearing the WCDs). The circuit can be used to transmit data and/or electrical impulses between the respective WCDs via the circuit. The WCDs can collect data regarding the length of time that the users are holding hands and, in combination with the amount of time spent together, monitor the relationship of the two users. In addition, the WCD can collect data regarding communication between

Petitioner Samsung Ex-1004, 1210

the users, e.g., e-mail, social media, etc. Based on all of the above factors, the WCD can develop a relationship score between respective WCD users, with a higher relationship score indicating more and more frequent interactions.

[0275] FIG.29A is a flow chart depicting a method of initiating gesture input according to one or more aspects of the disclosure. The WCD can be used to perform one or more commands, or to instruct another device, such as a mobile device, to perform one or more commands. Such commands can include, initiate sleep state of WCD, initiate sleep mode or default mode of WCD, powering off/on of the WCD, turning on/off an LED light of the WCD, powering on/off of a mobile device, placing a phone call on the mobile device, etc. The user can establish one or more custom gestures to initiate any of the commands above. For example, the user can select a command to be customized from a number of commands. Once selected, the user can perform a custom gesture to be associated with that command. In some examples, the user can perform the custom gesture multiple times to allow the WCD to better identify the gesture and to develop error tolerances for registering the gesture.

[0276] At block 2910, the user can perform a first gesture. In this example, the user can perform a finger snap. At block 2920, WCD can register the gesture, via the accelerometer and/or the magnetometer. At block 2930, the accelerometer can send an interrupt signal to the processor. At block 2940, the processor can wake from a sleep or default system state. At block 2950, the processor can monitor the accelerometer for a second gesture, at which point the user can perform a second gesture. If the second gesture matches a gesture in the gesture command database, then the WCD can perform the associated command. If not, the WCD can return to the sleep state.

[0277] FIG.29B is a chart 2900B showing an exemplary graph of acceleration vs. time as measured by the accelerometer of the WCD. As shown at peak2910B, the gesture can only be registered if it reaches a predetermined acceleration threshold. If the gesture performed at 2910 meets the threshold, it can proceed to block2930 where the interrupt procedure is performed.

[0278] FIG. 30 is a perspective view of a WCD 3000 employing an illustrative reset function and associated procedure/process. As shown, the WCD 3000 can be removed from the finger of the user in order to initiate a system reset of the WCD. In one

Petitioner Samsung Ex-1004, 1211

example, the system reset can be initiated by spinning about a rotation axis R at a predetermined speed. The predetermined speed can be any value, and in one example is a rotational velocity. Upon performing the reset procedure at the predetermined speed, operation of the WCD 3000 can be interrupted and the onboard components of the 3000 can power off, and revert to factory default settings. Additionally, a series of movements can initiate a rest, such as putting the ring on a table and turning it over several times.

[0279] FIG. 3lA is a perspective view of a WCD including an LED indicator according to one or more aspects of the disclosure. As shown, the WCD 3100 can include an internal/external housing 3112 and an internal/external potting 3114. The WCD can include an LED 3120 that can be visible through the internal/external potting 3114.

[0280] FIGs. 31B and 31C are cross sections along line C-C of a WCD employing an LED indicator according to one or more aspects of the disclosure. As described above, the WCD 3100 can have an internal and/or external potting 3114 that can be transparent. This allows light sources within the housing to pass through the potting without changing, or with minimal change to, the optical properties of the light. In this way, a light source 3120, such as an LED, can be disposed on the PCB 3140 and can be powered at least partially by battery 3130. The LED can be encapsulated by the potting 3112 and can project light through the potting 3112. As shown in FIG. 31B, the LED 3120 can include a vertical LED, while 31C depicts a right angle LED. The vertical LED can project light along direction L1, while the right angle LED can project light along direction L2. When light is projected along L2, the light can travel around a circumference of the finger of the user.. Note that, according to aspects of the disclosure, the potting can be generally adapted in whole or in part to condition, filter or modify the wavelengths and/or projection qualities of light by for example, embedding lensmatic components, applying light-diffusive additives, light attenuating filter materials, etc.

[0281] FIG. 32 is flow chart depicting a method 3200 of communicating with a near field communication (NFC) device according to one or more aspects of the disclosure.

Petitioner Samsung Ex-1004, 1212

[0282] In some examples, the WCD can enable or disable NFC or change the functionality of a NFC device. For example, the WCD can itself engage in NFC with another computing device, or the WCD can be connected via wireless link to a computing device that engages in NFC with a different computing device. In certain existing NFC devices, NFC will connect and begin transmitting data as soon as it is queried. In the present example, NFC is enabled or begin transmitting data exclusively upon performing of a pre-determined gesture. However, a variety of other transmission processes can be implemented-for example a periodic chirp or handshake request by the WCD for communication with appropriate devices.

[0283] At block 3210, a NFC capable device is provided. The device can be any type of device, such as a laptop, tablet, mobile device, or dedicated NFC device.

[0284] At block 3220, the WCD initiates a connection with the NFC device. The connection can be a direct connection via NFC, or an indirection connection via an intermediate device. At this point, no data has yet been transmitted between the WCD and the NFC device.

[0285] At block 3230, a user performs a predetermined gesture that is registered by the WCD. The gesture can be any type of gesture, such as a point, a snap, waving the hand, etc.

[0286] At block 3240, data transmission begins between the NFC device and the WCD.

[0287] In other examples, the user can perform another gesture to cease NFC communication. The gesture can be the same gesture as described above or a different gesture. Additionally, the user can remove the ring to disable the NFC. Upon donning the ring the user will be prompted by the application on the mobile device to re-authenticate by entering a PIN, whereby the proper PIN results in re-enabling the NFC functionality.

[0288] In yet another example, the WCD device employing NFC can be configured on the fly to map to different data sets stored thereon. For example, the WCD device employing NFC can employ data thereon to make purchases, e.g., account information, data to access a building, e.g., a key fob, and data thereon to board public transportation, e.g., smart card, metro card, etc. A user can perform a predetermined different gesture

Petitioner Samsung Ex-1004, 1213

for each of the above data sets to access the data. Once accessed, the WCD device employing NFC can initiate a link with another computing device to initiate a transaction, to open a door, or to board public transportation, etc.

[0289] **VI. Optical Element and Attachment Frame**

[0290] FIG. 33A depicts a perspective view of a WCD assembly 3300 according to one or more aspects of the disclosure, while FIGs. 33B-D depict exploded views of the WCD assembly and 33E depicts a cross sectional view of the WCD assembly along A-A. In this example, the WCD assembly 3300 includes a WCD 3310, an attachment frame 3320, and an optical element 3330. The WCD 3310 can be any of the WCD examples described above or below in the present application.

[0291] The attachment frame 3320 is releasably attached to the WCD3310. The optical element 3330 is itself releasably attachable to the attachment frame 3320. In this regard, the attachment frame 3320 provides an attachment interface between the WCD 3310 and the optical element 3330, thereby allowing the optical element 3330 to be at a fixed position in space with respect to the WCD 3310 or any portion thereof. The attachment frame3320 can be made of any material, such as a metal, polymer, etc. Any type of polymer can be used, such as thermosetting plastics, thermoplastics, PETE, polycarbonate, polyethylene, LDPE, or any other type of plastic.

[0292] The attachment frame can be sized and shaped to fit along the curved surface of the WCD. For example, the attachment frame can have a curved undersurface to allow a flush fit with the curved surface of the WCD. The attachment frame can have any shape, size, or radius of curvature depending on the size and shape of the WCD.

[0293] The attachment frame 3320 includes a first retaining a portion 3322 and a pair of second retaining portions 3324. The first retaining portion 3322 defines a conical recess 3322a configured to receive the optical element 3330, and provides a generally unoccluded pathway for light to pass through the optical element and onto the WCD. Although depicted as defining a conical or frustoconical shape, the recess 3322a can be any other shape depending on the shape of the optical element 3330. Each of the second retaining portions3324 includes a respective locking feature 3324a. The respective locking features3324 and a extend from the second it retaining portion3324 toward one another such that a distance between the respective locking features is greater than a

Petitioner Samsung Ex-1004, 1214

distance between the remaining portions of the second retaining portions. As shown in FIG. 33E, the locking features engage with an inward-facing surface 3350 of the WCD to ensure a secure fit. In one example, the inward-facing surface of the WCD may itself have one or more features 3360 to engage with the locking features of the second retaining portions. Such one or more WCD features can include projected surfaces, recesses, or any other type a feature to allow for engagement with the attachment frame.

[0294] The optical element 3330 can be made of any material capable of modifying, e.g., focusing, incident electromagnetic radiation, such as visible light, ultraviolet light, infrared light, or any other type of electromagnetic radiation. In some examples, the optical element 3330 can be constructed from a polymer, such as any of the polymers identified above. In another example, the optical element can be made of glass, quartz, diamond, zirconium, or any other material capable of focusing light. More generally, the optical element 3330 is formed with a general outward appearance simulative of a faceted jewel with an appropriate tint or coloration (including clear/white). The term "jewel" can also be used in the alternative to describe the optical element 3330 herein.

[0295] The WCD can include CPV cell 3312 that can be disposed directly underneath the attachment frame 3320 and optical element 3330 when assembled. In other examples, the CPV can be positioned within the housing and can receive electromagnetic radiation via a transparent potting material. In this regard, incident light striking the optical element 3330 can be focused on to the CPV cell to allow for charging of the internal battery of the WCD. The optical element 3330 provides an increased charging efficiency when compared to the CPV exclusively receiving ambient light, since the ambient light is collected/gathered from a wider field, and then focused onto the CPV by the optical element 3330. In one example, a focal length of the optical element 3330 is different than a distance between the optical element and the CPV. For example, the focal length can be greater than or less than the distance between the optical element and the CPV. This can be advantageous in various aspects of the disclosure so as to avoid the light from focusing at a focal point directly on the CPV, which could cause damage to the CPV itself by over-concentrating the light at that single point of the overall CPV surface.

[0296] FIGs.34A-B depict a WCD assembly 3400 according to one or more aspects of the disclosure. In this example, the attachment frame 3420 does not extend to an

Petitioner Samsung Ex-1004, 1215

inward-facing surface of the WCD 3410, but is instead form entirely on the outside-facing surface of the WCD. In some examples, the attachment frame 3420 can be semi-permanently or permanently affixed to the outward-facing surface of the WCD and can have a plurality of retaining portions (mounting prongs) 3422 that at least partially define a recess 3422a for receiving the optical element. As shown in FIG.34B, the optical element 3430 is releasably attached to the attachment frame 3420. This configuration can be particularly desirable, as it exhibits ornamental similarities to a traditional engagement ring while still having the increased functionality of the WCD. Note that while not shown, the mounting prongs can include small hook ends that springably retain the optical element 3430 when attached, but that can release the optical element based upon a prying motion. A customized grasping tool (not shown) can also be employed to remove (and attach) the optical element in this example.

[0297] **VII. Enclosure/Packaging**

[0298] FIG. 35A depicts an enclosure or case 3500 for storing a WCD according to one or more aspects of the disclosure. As shown, the enclosure3500 includes a lid 3510 and a base 3520. The lid 3510 and base 3520 can engage via a recessed portion 3522 formed in the base 3520 to provide a substantially sealed interior environment.

[0299] The lid 3510 can be cuboidal in external dimensions, or define any other type of geometric shape that allows sufficient internal volume to contain the WCD. For example a custom design shape (polyhedral, etc.) can be employed. In this example, the top portion3510 is substantially cuboidal as shown, including rounded edges rather than vertices. The lid can be substantially transparent to allow viewing of the WCD while enclosed therein, and can be made of any type of material, such as a polymer, glass, etc. The lid can also be mounted with pins on a hinge.

[0300] The base 3520 can be cuboidal, or any other type of geometric shape. In this example, the bottom portion is substantially cuboidal, including rounded edges rather than vertices as shown. The bottom portion can be made of any material and can be transparent or opaque.

[0301] The base 3520 can define a receptacle 3524 for receiving the WCD3505. The receptacle 3524 can be sized and shaped to receive the WCD 3505 and in this example is semicylindrical, e.g., a portion of a cylinder. The radius of the semicylinder

Petitioner Samsung Ex-1004, 1216

can be slightly larger than a radius of the WCD in order to accommodate the WCD securely. The receptacle can lined with a soft material to allow for a soft, safe material to receive the WCD, such as a silicone, thermoplastic, fabric, felt, or other material.

[0302] FIG.35B is a cross sectional view of the assembled enclosure3500 shown above along the line B-B. As shown, when assembled, the WCD 3505 fits securely within the receptacle 3524. The interior of the lid3510 can be sized and shaped to conform to the shape of the WCD such that the WCD is completely surrounded and enclosed by the lid 3510, while in other examples, the lid3510 can be sized and shaped to allow for airspace 3514 between the lid surface and the WCD.

[0303] FIG.35C is a cross section of the enclosure along line A-A. As shown, the lid 3510 can include an integral optical element 3512. The optical element3512 can be a lens or any other device to modify, e.g. focus, light that passes therethrough. In this example, the optical element 3512 can be disposed at a predetermined distance away from one or more CPV cells 3507 disposed on the WCD 3505. This distance *d* can be measured from the center of the optical element to the CPV cells 3507, and the optical element can itself have a focal length *f*. In one example, the distance *d* can be greater than the focal length *f*, such that the optical element focuses light at a point above the WCD in the enclosure. In this regard, the light will not focus directly on the CPV cells disposed at the surface of the WCD, thereby avoiding overheating or damage to the CPV cells. In other examples, the distance *d* can be less than the focal length, which can also prevent light from focusing at a surface of the WCD.

[0304] FIG. 36 depicts an enclosure 3600 including air vents 3650 according to one or more aspects of the disclosure. In this example, the enclosure 3600 includes a plurality of vent holes 3650. The vent holes can be arranged on one or more faces of the lid. The vent holes 3650 can prevent overheating within the enclosure during charging of the WCD by allowing for circulation of convective air current. During shipping, the vent holes3650 can be covered by an adhesive and/or adhering (peel-off) polymer sheet of conventional arrangement to prevent debris or moisture from entering the enclosure. The enclosure can include a lid 3610, base 3620, receptacle 3624, and optical element 3612 as in the examples set forth above.

[0305] **VIII. Sizing**

Petitioner Samsung Ex-1004, 1217

[0306] FIG. 37 depicts a method 3700 of sizing a finger according to one or more aspects of the disclosure. At block 3710, the hand of a user can be provided. The hand can be held still in mid-air or alternatively can be resting on a surface.

[0307] At block 3720, a first image is taken of the user's hand from a first perspective. The image can be taken by any type of imaging apparatus, such as a CCD or CMOS camera, a digital camera, a camera associated with a mobile phone, etc. The first image can be stored in a memory.

[0308] At block 3730, a second image is taken of the user's hand at a second perspective. In this regard, the second perspective is different from the first perspective so as to provide a distinct view in the second image of the user's hand. Block 3730 can be repeated any number of times. For example, a third image can be taken of the user's hand at a third perspective. In this regard, the third perspective is different from both the first and second perspectives so as to provide a distinct view in the third image of the user's hand, and so on.

[0309] At block 3740, a size of the user's finger can be derived from the plurality of images taken above. In some examples, as few as two images may be required, while in other scenarios, more than three images may be required, depending on a number of circumstances including image quality, selected perspectives, etc. The size can be derived from the plurality of images by any number of techniques, such as stitching the plurality of images together to generate a 3D typography of the fingers, then using photogrammetry algorithms to identify features on the fingers to determine the appropriate ring size. Furthermore, the touch screen of the smart phone can be used to measure the hardness of tissue by measuring the footprint/impression the fingers make while pressing a finger against the touch screen of a mobile phone.

[0310] FIG. 38 is a pictorial diagram showing a plurality of image perspectives of a user's hand 3802. As shown, perspectives 3810, 3820, and 3830, as well as the other perspectives, produce corresponding images (in a strip) 3812, 3822, and 3832. The images can be used to derive a size of the user's finger according to the methods described above.

Petitioner Samsung Ex-1004, 1218

[0311] FIG. 39 depicts a sizing tool for sizing the finger of a user. As shown, the tool 2900 can include a plurality of finger holes 3910-3950. The tool 3900 can be made of any material, such as plastic, metal, or cardboard.

[0312] FIG. 40 depicts a sizing tool for sizing the finger of a user according to an alternate example. As shown, the tool 4000 can include a plurality of finger holes 4010-4050. The tool 4000 can be made of any material, such as plastic, metal, or cardboard.

[0313] FIG. 41 depicts yet another alternate example of a sizing tool for sizing the finger of a user. As shown, the tool 4100 can include a plurality of finger holes 4110-4150. The tool 4100 can be made of any material, such as plastic, metal, or cardboard. The thickness of the card reflects the thickness of the ring to ensure proper fit. Additionally, the sizing tool is designed such that it can be easily mailed to the user with a standard mail service such as USPS.

[0314] Any of the tools 3900, 4000, or 4100 can be provided to a user prior to purchase of the ring in order to obtain accurate sizing information prior to purchase. The tools include holes, as shown above, that can come in a plurality of predetermined finger sizes to allow a user to match his or her finger size with the tool. The best match, e.g., closest size that ensures a comfortable fit, can be identified using the tools. Alternatively, the tools can be provided at retail locations to size the finger of the user on site prior to purchase. More generally, a variety of other sizing techniques, such as those employed by conventional jewelers can be employed according to further aspects of the disclosure.

[0315] In another embodiment, a packaging or enclosure of the WCD can include a sizing diagram or interface embodied therein to allow a user to size a finger during the purchase process.

[0316] FIG. 42 depicts a method 4200 of monitoring activity according to one or more aspects of the disclosure.

[0317] At block 4210, a user can don or place the WCD onto the finger to secure it in the wearing position.

[0318] At block 4220, a user can perform any number of daily activities, such as running on a treadmill, walking, exercising, typing, etc.

Petitioner Samsung Ex-1004, 1219

[0319] At block 4230, the WCD, contemporaneous with block 3220, can use one or more sensors to sense the activities of the user. For example, the sensors can detect location, speed, acceleration, orientation, heart rate, etc.

[0320] At block 4240, the WCD, or another computing device, can generate an entry in an activity log at the conclusion of a detected activity. If the activity detected by the sensors has a profile that has not yet been identified, the WCD can prompt the user to identify the activity. For example, the user can identify profiles such as "Run in Central Park," "Typing," "Run on Treadmill," etc. The WCD can associate the identity provided by the user with the activity profile identified by the sensors and store the identified activity in the WCD memory, or any other memory. Later, if the user performs the same activity and the WCD detects the activity profile as being similar to a saved activity, the WCD can identify the activity while the user is performing the activity and save the activity in the activity log. Each of the activities performed can be saved in the overall activity log and can be stored in a memory on the WCD, or other device, for later v1ewmg.

[0321] FIG.43 depicts a method 4300 of determining whether a user is wearing gloves according to one or more aspects of the disclosure. At block 4310, a user is provided while wearing the WCD, where such user may or may not be wearing gloves.

[0322] At block 4320, one or more light sensors on board the WCD can detect surrounding ambient light. Such light sensors could include, for example, a CPV or other light sensitive element.

[0323] At block 4330, one or more additional measurements maybe made. Such additional measurements can include, for example, an ambient temperature measurement and or a proximity measurement, e.g., detecting proximity of an object to the WCD via reflected electromagnetic radiation in the form of IR light.

[0324] At block 4340, a measured ambient temperature and ambient light measurements are compared to predetermined thresholds. If the ambient temperature measurement is above a certain predetermined temperature threshold and the ambient light measurement is below a certain threshold, it can be determined that the user is wearing a glove over the WCD.

Petitioner Samsung Ex-1004, 1220

[0325] At block 4350, a measured proximity and ambient light measurements are compared to respective predetermined thresholds. If the proximity measurement is below a certain distance threshold (e.g., determines an item is in close proximity to the WCD) and the ambient light measurement is below threshold, it can determined that the user is wearing a glove over the WCD. In any of the above examples, an intensity of LED indicators of the WCD can be adjusted according to a detected ambient light using an appropriate algorithm or process that compares the ambient light to a scale and adjusts a desired driving current/voltage for the LEDs according to a predetermined formula (e.g. a proportional adjustment using an adjustment coefficient) or scale (e.g. a lookup table). For example, where there is abundant ambient light (e.g., detected ambient light above a predetermined threshold), the intensity of the LED indicators can be increased. In the same way, where there is little ambient light (detected ambient light below a predetermined threshold), the intensity of the LED indicators can be decreased.

[0326] In one example, the WCD can detect whether it is removed and or installed on the finger of the user. In this regard, as mentioned above, the WCD can have inward-facing light sensors, CPV, or temperature sensors. When a user installs a ring on his finger the measure of ambient light may decrease or the temperature may increase. Such changes in ambient light and/or temperature can be detected by one or more sensors onboard the WCD and a determination can be made that the user has removed and or installed the ring on his finger.

[0327] FIG.44 depicts a method 4400 of securing data onboard the WCD according to one or more aspects of the disclosure. At block 4410, a user may don the WCD on the finger. At block 4420, a user may execute an application on a mobile device, or other computing device, that can be previously associated and authenticated with the WCD. At block 4430, the user can enter an authorization code into the application running on the mobile device, such as a PIN code. At block 4440 the mobile device may transmit the authorization code to the WCD by any means of communication, such as, wired, wireless, Bluetooth, NFC, etc. At block 4450, the user wearing the WCD can now be again authenticated and associated with the WCD and can be granted access to certain functions and/or data storage of the WCD. At block 4460 a user may remove the WCD. At block4470 the WCD can detect that it is removed such as bio detection (including e.g., biometric identification) techniques described above with respect to inward facing

Petitioner Samsung Ex-1004, 1221

sensor changes, temperature changes, or heart rate decreasing to zero. At block 4480, the authorization code previously stored on the WCD can be automatically deleted upon detection of removal to avoid unauthorized access to such information by a subsequent wearer or other querying party. Further or alternatively, additional information can be automatically deleted upon removal of the WCD, for example any data and or instructions stored on the onboard memory of the WCD such as personal information, banking information, confidential information, or other sensitive data.

[0328] **IX. Timepiece System**

[0329] FIG. 45A is a timepiece system 4500 according to one or more aspects of the disclosure. As shown, the timepiece system 4500 can include a conventional timepiece 4510 and a timepiece computing device (TCD) 4520. The TCD can be any shape, and in this example is in the shape of a cylinder. The radius can be significantly greater than a height of the TCD to provide the shape of a puck. The TCD can have one or more structural and/or functional components, and can be similar to the WCD described above with respect to hardware features, components, sensors, etc. Although depicted as cylindrical, the TCD can have any shape depending on the shape of the conventional timepiece. For example, where the timepiece has a rectangular or square face, the TCD can similarly have a rectangular or square profile.

[0330] A top surface 4520a of the TCD can include a pressure sensitive adhesive (PSA) layer 4522 to allow for adhesion of the TCD to the under surface of the timepiece 4510. The TCD 4520 can have a radius or circumference that does not exceed radius or circumference of the face of the conventional timepiece so as not to be seen when a user is wearing the timepiece system 4500. The TCD can enhance the conventional timepiece with many of the features described above with respect to the WCD such as, heart rate sensing, temperature sensing pedometer, activity sensing, gesture sensing and control, without having to alter the look of the conventional timepiece.

[0331] Fig 45B is a bottom view of the TCD. As shown, the TCD can include a battery 4540, any printed circuit board 4550 with one or more components attached thereto (not shown) such as motion sensors, power management circuitry, charging circuitry, etc. As with the WCD, the printed circuit board of the TCD can be overmolded 4560. The overmold can be transparent or substantially transparent to allow

Petitioner Samsung Ex-1004, 1222

electromagnetic radiation to pass through to be incident upon one or more components of the TCD.

[0332] As shown, the TCD can include a light pipe 4524 around the perimeter thereof. The light pipe 4524 can be substantially annular in shape and can be formed in part by the overmold of the TCD. The light pipe can be constructed from a conventional transparent or translucent moldable material (e.g. acrylic, polycarbonate, etc.), and can be arranged to focus ambient light onto a CPV disposed onboard the TCD for additional charging capability. The optical arrangement/geometry of the light pipe can be implemented using skill in the art to achieve the desired optical characteristics. In another example, excess heat generated by the TCD or excess body heat emitted from the skin of the user can be converted to electrical energy via a thermoelectric (TEG) module, such as a Peltier module, disposed onboard the TCD.

[0333] The TCD can also include any number of CPV cells, either on a top surface or bottom surface, to allow for charging. For example, a CPV cell can be placed on the underside of the TCD to allow for docking with a charging/docking station.

[0334] FIG.46 depicts a WCD 4600 with a pair of LED indicators 4610-4620 disposed at an inward-facing portion of the WCD. As shown, the WCD 4600 can include a pair of transparent regions 4640-3650 and an opaque region 4630. The LEDs 4610- 3620 can be positioned under the transparent regions 4640-3650 to allow light from the LEDs to exit the WCD. In one example, the LEDs 4610-3620 can create a subtle diffuse glow to the skin to provide a desirable visual effect to user. In another example, a user feedback LED can be placed at an inward facing surface and a second can be placed at an outward facing surface of the WCD. Depending on the circumstances, one of the LEDs may be disabled to save battery life. For example, LEDs that are facing away from a user e.g. facing down or away from user's line of sight, may be disabled. As described above, the WCD can determine its orientation based on onboard sensors, such as the magnetometer, accelerometer, GPS, etc.

[0335] FIG. 47A is a system for generating and managing alerts according to one or more aspects of the disclosure. As shown, the system can include a WCD 4710A, one or more networks 4720A, and one or more server computers 4730A according to one or more aspects of the disclosure. The WCD 4710A can communicate directly and/or

Petitioner Samsung Ex-1004, 1223

indirectly with the server 4730A via the network 4720A. In this regard, data generated and/or stored at the WCD 4710A can be transmitted to the server 4730A and vice versa. In one example, such data can include biometric data pertaining to a user wearing the WCD that is detected and stored by the WCD.

[0336] FIG. 47B depicts a block process diagram for generating and managing alerts according to one or more aspects of the disclosure and FIG. 47C is a flow chart depicting a method for generating and managing alerts according to one or more aspects of the disclosure.

[0337] At block 4710C, and as shown at process block 4710B, the user is authenticated with respect to the WCD. In this regard, a single user can be associated with a single WCD and can be associated with a predetermine identifier, such as an alphanumeric number. If the user is not authenticated or the authentication process is not conclusive, the WCD may invite the user to retry authentication at block 4715C until the user is successfully authenticated. In some examples, the WCD may timeout the authentication process, lock the WCD, or place the WCD in safe mode in the event of too many unsuccessful authentication attempts as a security measure.

[0338] The user can be authenticated according to any of the authentication methods described in the present application, such as via a unique capillary map, a unique ECG profile, etc.

[0339] If the user is authenticated, biometric data can be transmitted to the server at block 4720C. The captured biometric data 4720B can be transmitted to the server via network 4720A, 47222B

[0340] Once received at the server, the biometric data can be aggregated, sorted, categorized, or profiled at block 4730C and as shown at process block 4730B. In this regard, a profile (corresponding to the alphanumeric identifier) may be created at a database at the server that stores data for a particular user. The profile can store transmitted biometric data, as well as other data, such as user gender, height, weight, age, family history, disease information, location, etc.

[0341] In some examples, identifying information may be removed from the data and/or not transmitted to allow for anonymity and/or to comply with regulations regarding transmission of medical data. The transmitted biometric data can be

Petitioner Samsung Ex-1004, 1224

normalized in order to comply with predetermined data requirements in order to be added to the profile. In one example, a minimum amount of data may be required in order to be considered viable for association with the profile. The biometric data of a single profile can be aggregated, or in other examples multiple profiles can be aggregated simultaneously.

[0342] Aggregation of the user's biometric data into a single profile allows for the profile to be visualized or analyzed according to any number of methods. For example, a timeline can be created showing biometric data over a period of time. The data can also be synthesized or analyzed to calculate trend data, or other mathematical features.

[0343] Although only one WCD is depicted, it is contemplated that a plurality of WCDs can exist, with each WCD corresponding to a distinct user (and distinct alphanumeric identifier) and therefore resulting in a plurality of distinct profiles at the server. Accordingly, each of the distinct users/WCDs may be authenticated separately according to the methods described herein.

[0344] At block 4740C, once the transmitted data has been associated with the user profile, the updated profile can be correlated with one or more other profiles stored at the server as shown as process block 4740B. The profiles may be correlated according to any number of correlation standards, such as correlating users with similar traits such as age, gender, location, profession, or by any other data stored at the server. In some examples, one or more of the traits can be used to make such a correlation. The biometric data from the one or more users that are correlated with one another can be combined to form a group profile. The group profile can be the aggregation, average, range, or sum of individual profiles that form the group profile. For example, for a particular group profile, a range of resting heart can be generated by taking the maximum and minimum values of resting heart from the individual profiles. In other examples, an average (and standard deviation or standard deviation of the mean) can be generated for each trait, such as average resting heart rate, average active heart rate, average blood pressure, average blood sugar, average skin temperature, ECG profiles, as well as any other features capable of being detected by the WCD as described above.

[0345] At block 4750C, transmitted biometric data can be compared to the established values from the group profile. In this way, if a user's heart rate deviates by a

Petitioner Samsung Ex-1004, 1225

predetermined threshold (such as by predetermined magnitude or standard deviation), an alert can be generated at process block 4750B. The comparison process can occur at the server after transmission of the biometric data. In another example, the group profile data can be transmitted to the WCD for comparison at the WCD. This advantageously allows the comparison to be made where the WCD cannot establish a network link. The group profile can be updated on a continuous basis or a predetermined time interval or at each transmission of biometric data.

[0346] At block 4760C, the alert is transmitted to the WCD and displayed to the user at process block 4760B. The alert can indicate that the user's biometric data has deviated from the profile group and may advise the user to seek medical attention. In another example, the server can directly contact a medical health professional. In the example where block 4750C occurs at the WCD, transmission of alert information from the server may not be necessary.

[0347] The alert at the WCD can be any type of audio or visual indicator, such as an LED, haptic feedback, audible alarm, etc. The indicator may also invite the user to rest, make an appointment with a medical health professional, recommend a particular medication, or suggest certain physical activities that may health condition that caused the alert.

[0348] As shown in FIG. 47B, the authentication 4710B, aggregation 4730B, and correlation 4740B can occur at server 4730A, which can include a process, memory, and any other features of a general purpose computer. The authentication 471OB, aggregation 4730B, and correlation 4740B can access a database stored at the memory, where profiles, group profiles, and biometric data can be stored.

[0349] FIG. 48A is a method for variable sampling according to one or more aspects of the disclosure. As described above, the processor module of the WCD can determine (e.g., based on identified physical activities, routine pattern, and/or time) a frequency at which one or more sensors in the sensor modules should operate.

[0350] At block 4810A, one or more sensors of the WCD may take one or more measurements. For example, the WCD can detect temperature, heart rate, acceleration, as described above.

Petitioner Samsung Ex-1004, 1226

[0351] At block 4820A, the WCD can calculate an activity level of a user. For example, the WCD can compare to a number of stored activity profiles (as described above) stored by the user, or can compare the sensor measurements to sensor threshold values corresponding to different activities, such as sitting, running, sleeping etc. In one example, the WCD detect acceleration values over time to generate an activity level for a particular time period.

[0352] At block 4830A, the WCD may compare the identified activity level to a predetermine activity threshold value. In one example, the WCD may categorize the detected activity as either a high level activity or a low level activity. High level activities can include running, swimming, biking etc., while low level activities may include sitting, standing still, or sleeping.

[0353] At block 4840A, the WCD can set a first sample rate for high level activities and at block 4850A, the WCD can set a second sample rate for low level activities. The first sample rate can be a shorter time interval than the second sample rate, resulting in more data being detected and generated during a set amount of time while the user is active. This allows for increased power efficiency of the WCD while also providing the advantage of generating more data when a user is more active, thereby providing added biometric data for later analysis.

[0354] In another example, the sample rate can be scaled according to activity level. For example, the sample rate can be scaled to be directly proportional to heart rate. This results in a shorter time interval for sampling (more frequent data gather) for running than for walking.

[0355] As activity level changes, the method above can be repeated a plurality of times at certain intervals in order to quick or abrupt activity changes.

[0356] FIG. 48B and 48c are graphs depicting one or more aspects of the sample method of FIG. 48A. As shown in FIG. 48B, the WCD may determine a user is engaging in a high level activity by detecting acceleration values that are above a predetermined threshold value. In this regard, a shorter time interval (more frequent data gathering) can be set. As shown in FIG. 48C, the user is engaging in a low level activity since the acceleration values are below a predetermined threshold. A longer sample rate (less frequent data gathering) can be set in this instance.

Petitioner Samsung Ex-1004, 1227

[0357] FIG. 49 a diagrammatic representation of a machine in the example form of a computer system 4900 within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed. Specifically, FIG. 49 shows a diagrammatic representation of a machine in the example form of a computer system within which instructions (e.g., software or program code) for causing the machine to perform any one or more of the methodologies discussed herein may be executed. In alternative embodiments, the machine operates as a standalone device or may be connected (e.g., networked) to other machines. In a networked deployment, the machine may operate in the capacity of a server machine or a client machine in a server-client network environment, or as a peer machine in a peer-to-peer (or distributed) network environment.

[0358] The machine may be a server computer, a client computer, a personal computer (PC), a tablet PC, a set-top box (STB), a personal digital assistant (PDA), a cellular telephone, a smartphone, a web appliance, a network router, switch or bridge, or any machine capable of executing instructions (sequential or otherwise) that specify actions to be taken by that machine. Further, while only a single machine is illustrated, the term "machine" shall also be taken to include any collection of machines that individually or jointly execute instructions to perform any one or more of the methodologies discussed herein.

[0359] The example computer system includes a processor (e.g., a central processing unit (CPU), a graphics processing unit (GPU), a digital signal processor (DSP), one or more application specific integrated circuits (ASICs), one or more radio-frequency integrated circuits (RFICs), or any combination of these), a main memory, and a non-volatile memory, which are configured to communicate with each other via a bus. The computer system may further include graphics display unit (e.g., a plasma display panel (PDP), a liquid crystal display (LCD), a projector, or a cathode ray tube (CRT)). The computer system may also include alphanumeric input device (e.g., a keyboard), a cursor control device (e.g., a mouse, a trackball, a joystick, a motion sensor, a touch screen, or other pointing instrument), a storage unit, a signal generation device (e.g., a speaker), and a network interface device, which also are configured to communicate via the bus.

Petitioner Samsung Ex-1004, 1228

[0360] The storage unit includes a non-transitory machine-readable medium on which is stored instructions embodying any one or more of the methodologies or functions described herein. The instructions may also reside, completely or at least partially, within the main memory or within the processor (e.g., within a processor's cache memory) during execution thereof by the computer system, the main memory and the processor also constituting machine-readable media. The instructions may be transmitted or received over a network via the network interface device.

[0361] While machine-readable medium is shown in an example embodiment to be a single medium, the term "machine-readable medium" should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, or associated caches and servers) able to store instructions. The term "machine-readable medium" shall also be taken to include any medium that is capable of storing instructions for execution by the machine and that cause the machine to perform any one or more of the methodologies disclosed herein. The term "machine-readable medium" includes, but not be limited to, data repositories in the form of solid-state memories, optical media, magnetic media, or other non-transitory machine readable medium.

[0362] **X. Conclusion**

[0363] It should be clear that the WCD and TCD arrangements described according to various aspects of the disclosure provide a highly versatile and useful item of wearable electronics that is comfortable and convenient to wear, conveniently charged, and weatherproof for all-purpose and all-condition wearing. Various options for style and appearance can be implemented, as well as a variety of storage options. The functions and structure of the device lend themselves to both a ring version and a wrist-worn version. All versions are designed for long-life with minimal maintenance, and are adaptable to interoperate with a variety of networked devices including computers, smartphones, home controllers, security systems, and virtually any other device capable of communicating over a wireless link-including another WCD or TCD.

[0364] The foregoing has been a detailed description of illustrative embodiments of the invention. Various modifications and additions can be made without departing from the spirit and scope of this invention. Features of each of the various embodiments

Petitioner Samsung Ex-1004, 1229

described above may be combined with features of other described embodiments as appropriate in order to provide a multiplicity of feature combinations in associated new embodiments. Furthermore, while the foregoing describes a number of separate embodiments of the apparatus and method of the present invention, what has been described herein is merely illustrative of the application of the principles of the present invention. For example, as used herein various directional and orientational terms such as "vertical", "horizontal", "up", "down", "bottom", "top", "side", "front", "rear", "left", "right", and the like, are used only as relative conventions and not as absolute orientations with respect to a fixed coordinate system, such as the acting direction of gravity. Note also, as used herein the terms "process" and/or "processor" should be taken broadly to include a variety of electronic hardware and/or software based functions and components. Moreover, a depicted process or processor can be combined with other processes and/or processors or divided into various sub-processes or processors. Such sub-processes and/or sub-processors can be variously combined according to embodiments herein. Likewise, it is expressly contemplated that any function, process, application, and/or processor here herein can be implemented using electronic hardware, software consisting of a non-transitory computer-readable medium of program instructions, or a combination of hardware and software. Also, while a variety of visible and near-visible radiation sources are described as LEDs, it is expressly contemplated that other types of sources can be employed according to aspects of the disclosure-for example plasma discharge sources and bioluminescent sources, as well as sources that are based upon developing technologies. Electronic circuits and RF components can similarly be based on alternate and/or developing technologies. Accordingly, this description is meant to be taken only by way of example, and not to otherwise limit the scope of this invention.

Petitioner Samsung Ex-1004, 1230

WEARABLE COMPUTING DEVICE

CROSS REFERENCE

[0001] The present Application for Patent is a Continuation of U.S. Patent Application No. 18/179,272, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed March 6, 2023, which is a Continuation of U.S. Patent Application No. 17/519,201, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed November 4, 2021, which is a Continuation of U.S. Patent Application No. 17/013,348, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed September 4, 2020, which is a Continuation of U.S. Patent Application No. 16/224,686, by von Badinski et al, entitled "WEARABLE COMPUTING DEVICE," filed December 18, 2018, which is a Division of U.S. Patent Application No. 15/444,217, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed February 27, 2017, which is a Division of U.S. Patent Application No. 14/556,062, by von Badinski et al, entitled "WEARABLE COMPUTING DEVICE," filed November 28, 2014, which claims the benefit of United States Provisional Application Serial No. 62/006,835, by von Badinski et al., entitled "WEARABLE COMPUTING DEVICE," filed June 2, 2014, and United States Provisional Application Serial No. 61/910,201, by von Badinski et al., entitled "FINGER RING DEVICE FOR ACTIVITY MONITORING OR GESTURAL INPUT," filed November 29, 2013, each of which is expressly incorporated by reference herein.

FIELD OF TECHNOLOGY

[0002] This invention is in the field of wearable electronic devices.

BACKGROUND

[0003] Wearable electronics are an emerging technology with many applications for the wearer. They can improve lifestyles, ease access to technology and help monitor activity within the wearer's body. However, many current wearable electronics are bulky and can be intrusive or interfere with a person's daily life. In this regard, the wearer may not be comfortable wearing the device for extended periods of time.

Petitioner Samsung Ex-1004, 1231

SUMMARY OF THE INVENTION

[0004] This invention overcomes the disadvantages of the prior art by providing a wearable computing device (WCD) in the shape of a ring. The wearable computing device can be worn for extended periods of time and can take many measurements and perform various functions because of its form factor and position on the finger of a user.

[0005] One aspect of the disclosure provides a wearable computing device, comprising: an interior wall; an exterior wall; a flexible printed circuit board disposed between the interior wall and the exterior wall; at least one component disposed on the flexible printed circuit board; and wherein at least one of the interior wall and the exterior wall defines a window that facilitates at least one of data transmission, battery recharge, and status indication.

[0006] In one example, the window comprises an internal window defined by the interior wall.

[0007] In one example, the window comprises an exterior window defined by the exterior wall.

[0008] In one example, the window comprises a plurality of exterior windows defined by the exterior wall.

[0009] In one example, the plurality of exterior windows comprises a first exterior window and a second exterior window, wherein the first exterior window facilities battery charging and the second exterior window facilities data transmission.

[0010] In one example, at least one concentrated photovoltaic cell, an antenna, and at least one LED are accessible via the window.

[0011] Another aspect of the disclosure provides a wearable computing device, comprising: an internal housing portion configured to be disposed near a finger of a user; a flexible printed circuit board arranged around a portion of a circumference of an interior surface of the internal housing; at least one component disposed on the flexible printed circuit board; and an external housing portion configured to seal the at least one component and the printed circuit board in an internal space defined by the interior surface of the internal housing.

Petitioner Samsung Ex-1004, 1232

[0012] In one example, the external housing portion comprises a substantially transparent external potting.

[0013] In one example, the at least one component comprises at least one LED configured to emit at least one of visible light, infrared radiation, and ultraviolet radiation through the external potting.

[0014] In one example, the at least one component comprises a concentrated photovoltaic cell configured to receive concentrated light through the transparent external potting.

[0015] In one example, the flexible printed circuit board includes a plurality of stiffener elements configured to engage with a corresponding plurality of flanges disposed on the internal housing portion.

[0016] Another aspect of the disclosure provides a wearable computing device, comprising: an external housing portion; a flexible printed circuit board arranged around a portion of a circumference of an interior surface of the external housing; at least one component disposed on the flexible printed circuit board; and an internal housing portion configured to seal the at least one component and the printed circuit board in an internal space defined by the interior surface of the external housing.

[0017] In one example, the internal housing portion comprises a substantially transparent internal potting.

[0018] In one example, the at least one component comprises at least one LED configured to emit at least one of visible light, infrared radiation, and ultraviolet radiation through the internal potting.

[0019] In one example, the at least one component comprises a concentrated photovoltaic cell configured to receive concentrated light through the transparent internal potting.

[0020] In one example, the flexible printed circuit board includes a plurality of stiffener elements configured to engage with a corresponding plurality of flanges disposed on the external housing portion.

[0021] Another aspect of the disclosure provides a system, comprising: a wearable computing device, including a housing and a photovoltaic element disposed at least

Petitioner Samsung Ex-1004, 1233

partially within the housing; and a base assembly, the base assembly including a concentrated light source directed at the photovoltaic element.

[0022] In one example, the wearable computing device includes at least one ferrous element disposed within the housing, and wherein the base assembly includes at least one magnetic element disposed therein.

[0023] In one example, the concentrated light source is arranged circumferentially around the wearable computing device when the wearable computing device is engaged with the base assembly.

[0024] In one example, the concentrated light source comprises at least one of a laser diode and a light emitting diode (LED).

[0025] In one example, a housing of the WCD defines an opening through which the WCD is configured to receive concentrated light.

[0026] In one example, the base assembly comprises an optical element for focusing concentrated light emitted from the concentrated light source.

[0027] In one example, the optical element comprises a lens and is selected from the group consisting of concave, convex, piano-concave, piano-convex.

[0028] In one example, the WCD comprises at least one transparent potting configured to allow concentrated light to pass therethrough.

[0029] In one example, the WCD is ring-shaped and the base assembly comprises at least one post configured to engaged with a finger space of the WCD.

[0030] In one example, the photovoltaic cell comprises a plurality of photovoltaic cells.

[0031] Another aspect of the disclosure provides an enclosure for a wearable computing device, the enclosure comprising: a base defining a receptacle for receiving the wearable computing; a lid configured to engage with the base to substantially enclose the wearable computing device, the lid having an optical element configured to direct incident electromagnetic radiation to photovoltaic cell disposed on the wearable computing device to allow charging thereof.

Petitioner Samsung Ex-1004, 1234

[0032] In one example, the lid includes a plurality of vent holes that prevent overheating within the enclosure.

[0033] In one example, the optical element comprises a lens.

[0034] In one example, the lens has a focal length and wherein a distance between a central portion of the lens and the photovoltaic cell is greater than or less than the focal length.

[0035] Another aspect of the disclosure provides a timepiece system, comprising: a timepiece having a substantially planar under surface; and a timepiece computing device adhered to the planar under surface, the timepiece computing device being substantially cylindrical and comprising: a processor; a memory; and at least one sensor.

[0036] Another aspect of the disclosure provides a wearable computing device system, comprising: a wearable computing device; an attachment frame coupled to the wearable computing device; and an optical element removably coupled to the attachment frame, wherein the optical element is configured to direct electromagnetic radiation to a photovoltaic cell disposed on a surface of the wearable computing device to allow for charging of the wearable computing device.

[0037] In one example, the attachment frame is removably coupled to the wearable computing device.

[0038] In one example, the attachment frame engages with an inward-facing surface of the wearable computing device.

[0039] Another aspect of the disclosure provides a method of identifying an authorized user of a wearable computing device, comprising: illuminating a portion of a skin surface of the user; imaging the portion of the skin surface of the user to generate at least one first image; generating a reference capillary map corresponding to the user based at least in part on the at least one image.

[0040] In one example, the method further includes rotating the wearable computing device during the illuminating and imaging steps.

[0041] In one example, the method further includes imaging the portion of the skin surface of the user to generate at least one second image; and comparing the at least one second image to the reference capillary map in order to authenticate the user.

Petitioner Samsung Ex-1004, 1235

[0042] Another aspect of the disclosure provides a method of navigating, comprising: gesturing in a first direction while wearing a wearable computing device; comparing the first direction to a predetermined direction in a predetermined set of directions; providing feedback based on the comparison of the first direction of the predetermined direction.

[0043] In one example, the gesture comprises pointing a finger and the first direction comprises a first heading.

[0044] Another aspect of the disclosure provides a method of regulating temperature, comprising: measuring a skin temperature of a user via a first temperature sensor; measuring an ambient temperature via a second temperature sensor; comparing the skin temperature to a predetermined threshold temperature; and adjusting the ambient temperature based in part on the comparison.

[0045] In one example, measuring the skin temperature comprises measuring the skin temperature via a first temperature sensor disposed at an inward facing surface of a wearable computing device.

[0046] In one example, measuring the ambient temperature comprises measuring the ambient temperature via a second temperature sensor disposed at an outward facing surface of the wearable computing device.

[0047] Another aspect of the disclosure provides a method for controlling appliances, comprising: identifying a position of a first appliance in a room; gesturing a first gesture in a direction of the first appliance; identifying the direction of the first direction via a wearable computing device; issuing a controlling command to the first appliance based in part on the identified direction of the gesture.

[0048] Another aspect of the disclosure provides a method of generating an alert, comprising: authenticating a first wearer of a first wearable computing device as a first authenticated user; transmitting first biometric data associated with the first wearer; associating the first biometric data with a first profile associated with the first wearer of the first wearable computing device; comparing the first biometric data with a group profile comprising aggregated biometric data from a plurality of distinct wearers of a plurality of distinct wearable computing devices; and generating an alert if the first

Petitioner Samsung Ex-1004, 1236

biometric data falls outside of a predetermined threshold set by the aggregated biometric data.

[0049] In one example, the biometric data comprises at least one of heart rate; ECG profile; blood sugar, and blood pressure.

[0050] In one example, the plurality of distinct wearers share a common trait, resulting in their aggregation into the group profile.

[0051] In one example, the common trait comprises at least one of: age, gender, profession, and location.

[0052] Another aspect of the disclosure provides a method of determine a sampling rate of a wearable computing device, comprising: determining an activity level of a wearer of a wearable computing device based at least in part on data from at least one sensor disposed onboard the wearable computing device; comparing the activity level to a predetermined activity threshold; and increasing a first sensor sampling rate if the activity level is above a predetermined activity threshold.

[0053] In one example, the method further includes decreasing the first sensor sampling rate if the activity level is below a predetermined activity threshold.

[0054] In one example, the predetermined activity threshold comprises an acceleration measurement.

BRIEF DESCRIPTION OF THE DRAWINGS

[0055] The invention description below refers to the accompanying drawings, of which:

[0056] FIG. 1A is a perspective view of a WCD illustrating an exterior window in accordance with some embodiments;

[0057] FIG. 1B is a perspective view of the WCD of FIG. IA illustrating an interior window in accordance with some embodiments;

[0058] FIG. 1C is a perspective view of an alternative WCD design of the ring of FIG. IA in accordance with some embodiments;

Petitioner Samsung Ex-1004, 1237

[0059] FIG. 2 is an abstract functional diagram illustrating example components within the WCD in accordance with some embodiments;

[0060] FIG. 3A is a view of an exterior window of a WCD with example components exposed in accordance with some embodiments;

[0061] FIG. 3B is a view of an interior window of a WCD with example components exposed in accordance with some embodiments;

[0062] FIG. 3C is a view of the exterior windows of an alternative WCD with example components exposed in accordance with some embodiments;

[0063] FIG. 4 is an exploded view of a WCD illustrating a battery and a flexible circuit which are configured to fit inside the housing of the WCD in accordance with some embodiments;

[0064] FIG. 5 is a perspective view of the flexible circuit of FIG. 4 in accordance with some embodiments;

[0065] FIG. 6 is an exploded view of a WCD with an alternative charging mechanism in accordance with some embodiments;

[0066] FIG. 7 is a perspective view of an alternative design of a WCD in accordance with some embodiments;

[0067] FIG. 8 is an exploded view of the WCD of FIG. 7 illustrating another alternative charging mechanism in accordance with some embodiments;

[0068] FIG. 9A is a perspective view of a charging device for the ring station in accordance with some embodiments;

[0069] FIG. 9B is an abstract diagram illustrating a partial structure of the charging station of FIG. 9A in accordance with some embodiments;

[0070] FIG. 10 is an example screenshot illustrating a user interface of a mobile application coupled to the WCD and displaying fitness monitoring readings in accordance with some embodiments;

Petitioner Samsung Ex-1004, 1238

[0071] FIG. 11 is an example screenshot illustrating a user interface of a mobile application coupled to the WCD and displaying sensor readings (e.g., for calibration purposes) in accordance with some embodiments;

[0072] FIG. 12A is a perspective view of a wearable computing device (WCD) according to one or more aspects of the disclosure;

[0073] FIG. 12B is a side view of a WCD according to one or more aspects of the disclosure;

[0074] FIG. 12C is a front view of the WCD according to one or more aspects of the disclosure;

[0075] FIG. 12D is a cross section of the WCD along the line A-A of FIG. 12C;

[0076] FIG. 12E is a perspective view of the internal housing without external potting;

[0077] FIG. 12F is a perspective view of the internal housing with a portion of the external potting removed and showing one or more components and printed circuit board (PCB);

[0078] FIG. 13 is a cross section of a WCD according to another aspect of the disclosure;

[0079] FIG. 14A is a cross section of a WCD according to another aspect of the disclosure;

[0080] FIG. 14B is a perspective view of the PCB and stiffener element of FIG. 14A;

[0081] FIG. 14C is a perspective view of the PCB and stiffener element of FIG. 14A;

[0082] FIG. 14D shows a cross section of the WCD at a point in time when the PCB is being inserted into the internal space and prior to the application of potting;

[0083] FIG. 14E is a cross section of the WCD of after a potting material has been applied subsequent to the WCD of FIG. 14D;

Petitioner Samsung Ex-1004, 1239

[0084] FIG. 15A depicts a perspective view of a WCD according to another aspect of the disclosure;

[0085] FIG. 15B is a side view of the WCD of FIG. 15A;

[0086] FIG. 16A is an exploded view of a housing and a PCB of a WCD according to one or more aspects of the disclosure;

[0087] FIG. 16B is a cross section of FIG. 16A along line B-B;

[0088] FIG. 16C is a perspective view of the WCD with potting material;

[0089] FIG. 17A depicts a cross section of a WCD employing charging by concentrated light source according to one or more aspects of the disclosure;

[0090] FIG. 17B depicts a cross section of a WCD employing charging by concentrated light source according to another aspect of the disclosure;

[0091] FIG. 17C is a perspective view of a base assembly and WCD 700 according to one or more aspects of the disclosure;

[0092] FIG. 17D depicts a perspective view of internal components of the base assembly 750 and WCD 700 according to another aspect of the disclosure;

[0093] FIGs. 17E-F depict other CPV configurations according to one or more aspects of the disclosure;

[0094] FIG. 17G is perspective view of a WCD and base assembly with a lx3 CPV arrangement;

[0095] FIG. 18A depicts a cross section of a WCD 800 employing charging by concentrated light source according to another of the disclosure;

[0096] FIG. 18B depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure;

[0097] FIG. 19A depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure;

[0098] FIG. 19B depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure;

Petitioner Samsung Ex-1004, 1240

[0099] FIG. 19C depicts a schematic diagram of magnets that can be used in a WCD and/or base assembly according to one or more aspects of the disclosure;

[0100] FIG. 19D depicts a schematic diagram of magnets that can be used in a WCD and/or base assembly according to one or more aspects of the disclosure;

[0101] FIG. 19E is a perspective view of a WCD and a base assembly according to one or more aspects of the disclosure;

[0102] FIG. 20A is a cross section of a WCD engaged with a base assembly 1050 according to one or more aspects of the disclosure;

[0103] FIG. 20B is a perspective view of a PCB 1040b with a CPV 1030b and ferrous element 1020b configuration according to one or more aspects of the disclosure;

[0104] FIG. 20C is a perspective view of a PCB with a CPV 1030c and ferrous element 1020c configuration according to one or more aspects of the disclosure;

[0105] FIG. 20D is a perspective view of a magnet and a concentrated light source 1070d according to one or more aspects of the disclosure;

[0106] FIG. 21A is a schematic view of a WCD showing components used for identifying the wearer of the WCD;

[0107] FIGs. 21B-C are perspective views of a skin surface according to one or more aspects of the disclosure;

[0108] FIG. 22A is a perspective view of a user employing ECG monitoring according to one or more aspects of the disclosure;

[0109] FIG. 22B is a view of a human with an electric pathway though his body according to one or more aspects of the disclosure;

[0110] FIG. 22C is a perspective view of a WCD that can employ ECG monitoring according to one aspect of the disclosure;

[0111] FIG. 23A is a perspective view of the hand of a user in various positions employing the navigational features of the WCD;

[0112] FIG. 23B is a flow chart depicting a method of providing feedback to a user according to one or more aspects of the disclosure;

Petitioner Samsung Ex-1004, 1241

[0113] FIG. 24A is a schematic diagram of a system 1400 for controlling an environment of a user according to one or more aspects of the disclosure;

[0114] FIG. 24B is a side view of a WCD showing one or more temperatures sensors according to one or more aspects of the disclosure;

[0115] FIG. 24C is a system diagram of a system for controlling home appliances according to one or more aspects of the disclosure;

[0116] FIG. 24D is a flow chart depicting a method of controlling home appliances according to one or more aspects of the disclosure;

[0117] FIG. 25 is a perspective view of the hand of a user employing a two-factor authentication technique according to one or more aspects of the disclosure;

[0118] FIG. 26A is a schematic view of a charging apparatus for charging the WCD according to one or more aspects of the disclosure;

[0119] FIG. 26B shows a WCD including an RF antenna and charging circuitry;

[0120] FIG. 26C is a block diagram of the charging apparatus according to one aspect of the disclosure;

[0121] FIG. 26D is a pictorial diagram showing of the WCD according to one or more aspects of the disclosure;

[0122] FIG. 27A is a pictorial diagram and FIG. 27B is a block diagram of a WCD employing flash storage according to one or more aspects of the disclosure;

[0123] FIG. 28A is a schematic diagram of one or more WCDs performing proximity functions according to one or more aspects of the disclosure;

[0124] FIG. 28B is a schematic diagram of one or more WCDs performing proximity functions according to one or more aspects of the disclosure;

[0125] FIG. 29A is a flow chart depicting a method of initiating gesture input according to one or more aspects of the disclosure;

[0126] FIG. 29B is a chart showing acceleration vs. time as measured by the accelerometer of the WCD;

[0127] FIG. 30 is a perspective view of a WCD 2000 employing a reset function;

Petitioner Samsung Ex-1004, 1242

[0128] FIG. 31A is a perspective view of a WCD including an LED indicator according to one or more aspects of the disclosure;

[0129] FIGs. 31B and 31C are cross sections along line C-C of a WCD employing an LED indicator according to one or more aspects of the disclosure;

[0130] FIG. 32 is flow chart depicting a method of communicating with a near field communication (NFC) device according to one or more aspects of the disclosure;

[0131] FIG. 33A depicts a perspective view of a WCD assembly according to one or more aspects of the disclosure;

[0132] FIGs. 33B-D depict exploded views of the WCD assembly of FIG. 33A;

[0133] FIG. 33E depicts a cross sectional view of the WCD assembly along A-A;

[0134] FIGs. 34A-B depict a WCD assembly according to one or more aspects of the disclosure;

[0135] FIG. 35A depicts an enclosure or case for storing a WCD according to one or more aspects of the disclosure;

[0136] FIG. 35B is a cross sectional view of the assembled enclosure of FIG. 35A along the line B-B;

[0137] FIG. 35C depicts a cross sectional view of the assembled enclosure of FIG. 35B along line A-A;

[0138] FIG. 36 depicts an enclosure including air vents according to one or more aspects of the disclosure;

[0139] FIG. 37 depicts a method of sizing a finger according to one or more aspects of the disclosure;

[0140] FIG. 38 is a pictorial diagram showing a plurality of image perspectives of a user's hand;

[0141] FIG. 39 depicts a sizing tool for sizing the finger of a user;

[0142] FIG. 40 depicts a sizing tool for sizing the finger of a user according to an alternate example;

Petitioner Samsung Ex-1004, 1243

[0143] FIG. 41 depicts yet another alternate example of a sizing tool for sizing the finger of a user;

[0144] FIG. 42 depicts a method of monitoring activity according to one or more aspects of the disclosure;

[0145] FIG. 43 depicts a method of determining whether a user is wearing gloves according to one or more aspects of the disclosure;

[0146] FIG. 44 depicts a method of securing data onboard the WCD according to one or more aspects of the disclosure;

[0147] FIG. 45A is a timepiece system according to one or more aspects of the disclosure;

[0148] FIG 45B is a bottom view of the TCD;

[0149] FIG. 46 depicts a WCD with a pair of LED indicators disposed at an inward-facing portion of the WCD;

[0150] FIG. 47A is a system for generating and managing alerts according to one or more aspects of the disclosure;

[0151] FIG. 47B depicts a block process diagram for generating and managing alerts according to one or more aspects of the disclosure;

[0152] FIG. 47C is a flow chart depicting a method for generating and managing alerts according to one or more aspects of the disclosure;

[0153] FIG. 48A is a method for variable sampling according to one or more aspects of the disclosure; FIG. 48B and 48c are graphs depicting one or more aspects of the sample method of FIG. 48A; and

[0154] FIG. 49 is a diagrammatic representation of a machine in the example form of a computer system within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed.

DETAILED DESCRIPTION

[0155] The present disclosure describes a wearable computing device (WCD) that enables a wearable fitness monitor(s)/computer(s) which is suitable for prolonged usage

Petitioner Samsung Ex-1004, 1244

with accurate results. The WCD can be in the form of a ring that can be worn on the finger of a human (or animal) user. Although the WCD of the present disclosure is depicted as a ring that can be worn on the finger of a user, other shapes, designs, and form factors can be utilized for the WCD. For example, the WCD can be in the form of a wrist band, bracelet, necklace, earring, or any other type of wearable accessory. In this regard, references to the finger of a user in the present application can be considered to apply to other portions of a human body depending on the form of the WCD, such as wrist, neck, ear, etc.

[0156] The term "coupled" as used herein means connected directly to or connected through one or more intervening components or circuits. Any of the signals provided over various buses described herein may be time-multiplexed with other signals and provided over one or more common buses. Additionally, the interconnection between circuit elements or software blocks may be shown as buses or as single signal lines. Each of the buses may alternatively be a single signal line, and each of the single signal lines may alternatively be buses, and a single line or bus might represent any one or more of a myriad of physical or logical mechanisms for communication (e.g., a network) between components. The present embodiments are not to be construed as limited to specific examples described herein but rather to include within their scope all embodiments defined by the appended claims.

[0157] FIG. 1A is a perspective view of 100 of a WCD 110 illustrating an exterior window 120 in accordance with some embodiments, and FIG. 1B is a perspective view 102 of the WCD 110 of FIG. 1A illustrating an interior window 130.

[0158] As previously mentioned, it is recognized in the present disclosure that conventional wearable fitness monitors such as clip-on devices, wristbands, or watch-type monitors still often suffer from inaccuracy mainly because they lack constant and consistent ways to read from the body areas they aim to monitor. It can also be an extra burden for the person to remember and wear such conventional fitness monitors each time the person perform exercises in order to create an accurate history tracking the exercise activities.

[0159] Accordingly, the present embodiments of the WCD 110 can function as fitness monitors/computer which is suitable for prolonged usage so as to create accurate

Petitioner Samsung Ex-1004, 1245

results. In addition or as an alternative to fitness monitoring, as will be discussed in more detail below, the WCD 110 can function as a remote input device through, for example, gesture recognition. In some embodiments, the WCD 110 can further function as a sleep monitor, a heart rate sensor, a cardiac monitor a body temperature detector, or the like. It is noted that, for those embodiments which can function as a cardiac monitor (e.g., that measures electrocardiogram (EKG)), it may be necessary to establish a closed loop (e.g., for the electrical measurement of EKG) across the heart. As such, in some of those embodiments, a separate conductive pad can be coupled to the WCD 110 so that a user can pinch the pad with fingers on an opposite hand,

[0160] Specifically, in some embodiments of the present disclosure, the WCD 110 can be worn by the user (e.g., on a finger) for fitness, physical activity, biological data monitoring as well as for gestural input or other suitable purposes. As shown in FIGS. 1A and 1B, the WCD 110 can include the exterior window 120 on its exterior wall for input/output data transmission and reception, battery recharge, or status indication. The WCD 110 can also include the interior window 130 on its interior wall for various monitoring or sensing activities. The form factor of the WCD 110 allows it to be worn for prolonged hours with constant and consistent contact with the skin area, thereby creating a more reliable and extended recording (e.g., as compared to aforementioned conventional fitness monitors) of the user's fitness activity, physical exercise, as well as health information such as heart rates and body temperature. More implementation details regarding the WCD 110 are discussed below.

[0161] FIG. 1C is a perspective view of an alternative design of the WCD 110 of FIG. IA in accordance with some embodiments. As shown in FIG. IC, the WCD 112 includes a second exterior window 124 in addition to a first exterior window 122. The two exterior windows 122 and 124 can include spacing between the two windows 122 and 124 so that the mechanical strength of the housing structure of the WCD 112 may be stronger than that of the WCD 110, which is shown to include one single exterior window 120. Further, in some embodiments, radio antennas (e.g., Bluetooth) or other sensitive circuitry can be positioned in the second exterior window 124 away from the first exterior window 122 so that quality of reception may be improved.

[0162] FIG. 2 is an abstract functional diagram 200 illustrating example components within the WCD (e.g., WCD 110) in accordance with some embodiments.

Petitioner Samsung Ex-1004, 1246

As shown in diagram 200, the WCD 110 can include a processor module 210, a plurality of sensor modules 220, a status indicator module 230, a power generation and management module 240, a communication module 250, a memory 260, and miscellaneous modules 270 (e.g., a real-time clock (RTC) crystal oscillator as illustrated in FIG. 2). The WCD 110 can also include a battery 280 module that provides electrical power for the WCD 110. In some embodiments, the battery 280 can be of a lithium-polymer type or a zinc-polymer type. It is noted that modules illustrated in diagram 200 are for purposes of facilitating a better understanding of the present embodiments; other suitable modules may be included in the WCD 110 and are not shown for simplicity. As used herein, the term "components" is considered to generally include any of the modules depicted and/or described in FIG. 2, as well as any other modules described herein.

[0163] It is noted that the aforementioned modules are intended for purposes of enabling the present embodiments, rather than limiting. As such, a person of ordinary skill in the art will understand that the present disclosure covers apparent alternatives, modifications, and equivalents (e.g., combining or separating the modules) made to the techniques described herein. For example, in some embodiments, a portion of the communication module 250 (e.g., the Bluetooth Chip as shown in FIG. 2) can be combined into the processor module 210. For another example, one or more modules herein can be combined into one to form a system-on-the-chip (SOC).

[0164] The processor module 210 can have generic characteristics similar to general purpose processors or may be application specific integrated circuitry that provides arithmetic and control functions to the WCD 110. The processor can be any type of processor, such as a processor manufactured by AMtel, Freescale, Nordic Semiconductor, Intel®, AMD®, or an ARM® type processor. The processor module 210 can include a dedicated cache memory (not shown for simplicity). The processor module 210 is coupled to all modules 220-270 in the WCD 110, either directly or indirectly, for data and control signal transmission.

[0165] The memory 260 may include any suitable type of storage device including, for example, ROM, such as Mask ROM, PROM, EPROM, EEPROM; NVRAM, such as Flash memory; Early stage NVRAM, such as nvSRAM, FeRAM, MRAM, or PRAM, or any other type, such as, CBRAM, SONOS, RRAM, Racetrack memory, NRAM,

Petitioner Samsung Ex-1004, 1247

Millipede memory, or FJG. Other types of data memory can be employed as such are available in the form factor desired.

[0166] In addition to storing instructions which can be executed by the processor module 210, the memory 260 can also store data generated from the processor module 210. It is noted that the memory 260 can be an abstract representation of a generic storage environment. According to some embodiments, the memory 260 may be comprised of one or more actual memory chips or modules. In some embodiments, the memory 260 can function as a temporary storage (e.g., for firmware updates, and/or for avoiding accidental malfunctions (such as so-called "bricking")).

[0167] In accordance with one or more embodiments, the sensor modules 220 can include various sub-modules for the WCD 110 to perform different monitoring or sensing activities. A view 302 of the interior window (e.g., window 130) of a WCD (e.g., WCD 110) with example components exposed is shown in FIG. 3B. As shown in the example of FIG. 3B, the sensor modules 220 can include a temperature sensor 320a, a red light emitting diode (LED) 320b, a light sensor 320c, and an infra-red LED 320d. Among the sensors in the sensor modules 220, those sensors (e.g., sensors 320a-320d) which are directly related to biological sign monitoring can be configured and positioned in a way that is close to the skin (e.g., facing the interior window 130 of the WCD 110). Although not shown in FIG. 3B for simplicity, the sensor modules 220 can further include sensors that are not directly related to biological sign monitoring; some examples of these sensors include accelerometers, gyroscopes, vibration, sensors (e.g., a magnetometer or a digital compass), or other suitable sensors (e.g., for gesture recognition). The magnetometer can measure the strength and/or direction of a prevailing magnetic field. In this regard, the magnetometer can be used during global positioning and/or navigation. In particular, the magnetometer can be used to measure a directional heading when the WCD is in motion and can supplement position data where the WCD is out of communication range. In one or more embodiments, the accelerometers in the sensor modules 220 can detect movements in multiple (e.g., 3) dimensions or axes. The accelerometer can measure force of acceleration of the WCD and can measure gestures performed by a user while wearing the WCD. In other examples, the accelerometer can detect acceleration of the user while wearing the WCD.

Petitioner Samsung Ex-1004, 1248

This can permit tracking of activity level, such as steps taken or number of laps swum in a pool.

[0168] The temperature sensor can be any type of sensor that detects temperature, such as a thermistor, PTC, NTC, etc. In another example, the temperature sensor can use IR light emitted from an object to calculate a surface temperature of the object in a manner clear to those of ordinary skill in the art.

[0169] Together, the processor module 210 and the sensor modules 220 can enable the WCD 110 to perform multiple functions including, for example, pedometer, sleep monitor (e.g., which monitors sleep quality), heart rate sensor, pulse oximetry, skin (and in select embodiments, ambient) temperature. In addition, some embodiments of the WCD 110 can further function as a gesture input device. In particular, the present embodiments recognize that the WCD 110 can detect finger motions or gestures which may be difficult for conventional fitness sensors to detect, such as a tap, a snap, a knock on the table, and the like. In some embodiments, the WCD 110 can utilize the accelerometer to measure the activity level (e.g., arm movement) in conjunction with the measured heart rate to determine if the user is walking horizontally, running, swimming, or climbing stairs. Other activities can be identified by the WCD 110 may include biking or sleeping.

[0170] In some embodiments, the WCD 110 can also be programmed to learn particular gestures or physical exercise from the user using, for example, a training mode. For example, the user can instruct (e.g., using a computer or a mobile device of the user) the WCD 110 to enter the training mode and perform the gesture or physical exercise; the WCD 110 can record the readings from the sensor modules 220, recognize patterns therefrom, and store the result in, for example the memory 260, so that such gesture or exercise can be recognized by the WCD 110 after the training. The WCD 110 can be configured (e.g., via a mobile application running on a mobile device of the user) so that the recognized gestures can perform functions designated by the user, such as clicks, swipes, unlocks, or media player controls. In one embodiment, the WCD 110 can include near field communication (NFC) chips so that certain functions (e.g., unlocking a smart phone) can be performed when the WCD 110 touches upon or otherwise be detected by another NFC device. In some embodiments, the unlocking function of the

Petitioner Samsung Ex-1004, 1249

WCD 110 can also unlock a user device (e.g., a phone) via the communication module 250 (e.g., Bluetooth) by the WCD 110 transmitting a proper unlock code.

[0171] Moreover, the WCD 110 can function as a key or a control device for keyless access to home, automobile, or other suitable user authentication processes. The WCD 110 can also be integrated with games and game consoles so that it can function as an input device to those games and consoles. In some embodiments, the WCD 110 can be adapted for use in medical and home health monitoring, or as a transportation safety device (e.g., that broadcasts emergency messages to relevant authorities). Additional examples of sensors/functionalities of the WCD 110 can include an inertial measurement unit (IMU) (e.g., for more complex gesture recognition, a near-infrared (NIR) spectrometer (e.g., for measuring light absorption and deriving blood glucose/ blood alcohol/ CO2 content), a Galvanic skin response sensor (e.g., for measuring sweat/ nervousness), an electrocardiogram (ECG or EKG), and so forth.

[0172] In some embodiments, the processor module 210 can determine (e.g., based on identified physical activities, routine pattern, and/or time) a frequency at which one or more sensors in the sensor modules 220 should operate. Because it is recognized in the present disclosure that the heart rate of a human being typically does not vary too widely (e.g., beyond a certain percentage of what has been previously measured), in some embodiments, the WCD 110 can automatically adjust the sensor modules 220 (e.g., to slow down) so as to save power. More specifically, some embodiments of the WCD 110 can include a phase-locked loop or logic to predict the pulse width by determining lower and upper ranges in which the heart rate is predicted to be, thus only powering up the sensor modules 220 at the time of the predicted heartbeats. For one example, if the WCD 110 determines that the user is at sleep (e.g., based on the heart rate, the body temperature, together with the movements detected by the accelerometer and/or the vibration detector), the WCD 110 can slow down its heart rate detection frequency (e.g., from 1 measurement per second to 1 measurement per 10 seconds) and skip the measurement of several heartbeats because it is unlikely that the heart rate will change drastically during that period. Conversely, if the WCD 110 determines that the user is performing a high intensity physical exercise, the WCD 110 can increase the frequency of monitoring and recording of the sensor modules 220.

Petitioner Samsung Ex-1004, 1250

[0173] In accordance with one or more embodiments, the WCD 110 also includes various modules coupled to the processor module 210 for, by way of example but not limitation, input/output data transmission, battery recharge, or status indication. A view 300 of the exterior window (e.g., window 120) of a WCD (e.g., WCD 110) with example components exposed is shown in FIG. 3A. As shown in the example of FIG. 3A, the modules configured to face the exterior window 120 of the WCD 110 can include parts from the status indicator module 230, the power generation and management module 240, and the communication module 250.

[0174] Specifically, one embodiment of the WCD 110 includes the status indicator module 230 coupled to the processor module 210 to indicate various statuses. In some embodiments, the status indicator module 230 includes a light emitting diode (LED) 330, such as shown in FIG. 3A. The LED 330 can be a single red/green/blue (RGB) LED. In other embodiments, the status indicator module 230 can include other suitable types of indicator devices including, for example, a single color LED, an electrophoretic ink (or "e-ink") display, a persistent display, or the like. In accordance with some embodiments, the WCD 110 can utilize the indicator module 230 (e.g., via the RGB LED 330 through the exterior window 120) to visually communicate with the user. For example, a red color can be displayed (e.g., for a predetermined period of time) by the LED 330 that the WCD 110 needs to be recharged, and a green color can be displayed to indicate that the WCD 110 is fully charged. For another example, a blue color can be displayed when the communication module 250 is in use. In one or more embodiments, the user can program a fitness goal (e.g., a target heart rate) to the WCD 110 so that, for example, a green color can be displayed when the heart rate is below the target, a yellow color can be displayed when the target is reached, and a red color can be displayed when the heart rate is above a certain percentage of the set target. Some embodiments of the WCD 110 include the communication module 250 for wireless data transmission. Particularly, in some embodiments, the communication module 250 includes one Bluetooth chip and a Bluetooth antenna 350, such as shown in FIG. 3A. One or more embodiments of the WCD 110 also provides the capability of storing activity logs (e.g., in the memory 260). More specifically, fitness activities, exercise histories, as well as recorded biological signs such as heart rate and body temperature, can be stored onboard in the memory 260 of the WCD 110. Each data entry in the activity logs can be time- stamped using, for example, an onboard real-time clock (e.g., which may be

Petitioner Samsung Ex-1004, 1251

included in miscellaneous modules 270). For power saving and other purposes, the activity log can be downloaded (e.g., via the communication module 250) when requested by the user. In other embodiments, the activity log can be pushed (e.g., via email or other suitable means) by the WCD 110 to a user device at a time designated by the user. In some embodiments, the memory 260 can store up to a full week worth of activity logs.

[0175] The WCD 110 can include the power generation and management module 240 for recharging the battery 280 and for providing electrical power to various modules 210-270 in the WCD 110. Particularly, in some embodiments, the power generation and management module 240 includes one or more concentrated photovoltaic (CPV) cells 340, such as shown in FIG. 3A. The CPV cells 340 can be high-efficiency tandem solar cells and can be attached on the flexible printed circuit (e.g., circuit 415,515). Because the small form factor of the embodiments of the WCD 110, CPV cells 340, which can absorb more light energy from a wider spectrum of light than the traditional solar cells, are used. In some embodiments, multiple (e.g., 3) CPV cells 340 can be configured in series to provide sufficient voltage and/or current for charging the battery 280.

[0176] According to some embodiments, the WCD can include one or more sensing or imaging devices that can be any type of device capable of detecting electromagnetic radiation, such as visible light, IR, NIR, UV, etc. In one example, the device is an imaging device, such as a CMOS or CCD camera.

[0177] According to some embodiments, the WCD 110 can be placed or docked into a charging station for recharging. A perspective view 900 of an example charging station 910 for the WCD 110 is shown in FIG. 9A. The charging station 910 can have concentrated light source circumferentially around the WCD 110 so that the user does not have to be concerned with whether the WCD 110 is facing the right direction for charging. Some embodiments of the charging station 910 can include a light distribution means that takes a single light source and distributes the light all around. An abstract diagram illustrating a partial structure of the light distribution means inside the charging device of FIG. 9A is shown in FIG. 9B. It is noted that, even with the charging station 910, for some embodiments, regular outdoor sunlight or other ambient light source can

Petitioner Samsung Ex-1004, 1252

still function as a secondary source of energy so that the CPV cells 340 on the WCD 110 can extend the operational time provided by the battery 280.

[0178] Additionally or alternatively, energy source attached to the power generation and management module 240 can be passive; for example, some embodiments provides that a clip with a concentrator lens can be attached to the WCD 110 in a way such that the power generation and management module 240 can charge the battery 280 using natural sunlight. In an alternative embodiment, gemstone(s) (e.g., sapphire, diamond, or other suitable materials) in the shape of a dome or with faceted protrusion can be configured to concentrate/magnify light energy while also serving as a decorative feature.

[0179] In some alternative embodiments, the power generation and management module 240 can include electromagnetic induction charging coil so that a WCD (e.g., ring 610) can be charged using an inductive charger. FIG. 6 shows an exploded view 600 of such alternative embodiment of WCD with the inductive charging mechanism including the charging coil 640, as well as battery 680, housing 612, and rigid-flex PCBA 615. However, it is noted that there may be a need to manufacture the inductive charging coil 640 in different sizes that correspond to different ring sizes. Further, it is noted that the efficiency of the electromagnetic induction charging mechanism may be adversely affected by the adoption of a metallic housing. Additionally or alternatively, to avoid multiple sized coils mounted to the edge of the ring, the coil can be placed on the inner or outer sides of the ring by positioning the coil beneath a window in the metal housing of the ring.

[0180] In order to achieve optimal power management of the WCD, one or more of the components can be selected to minimize power usage. For example, a processor, memory, or any other component can be selected based on rated power usage. In one example, it may be desirable to select components that draw current on the order of microamps in order to extend the battery life of the WCD and to allow the WCD to perform health/activity monitoring functions between charging sessions.

[0181] In still some other alternative embodiments, the power generation and management module 240 can include thermoelectric generator (TEG) modules so that a WCD (e.g., WCD 710,810) can be charged by the difference between the body

Petitioner Samsung Ex-1004, 1253

temperature and the ambient temperature. FIG. 7 is a perspective view 700 of such alternative design, and FIG. 8 is an exploded view 800 of the WCD 710 of FIG. 7. Also shown in FIGS. 7 and 8 is an alternative design of the housing for the WCD where the ring includes an outer ring 812a, an inner ring 812b, and insulators 814a and 814b. However, it is noted that utilizing TEGs for charging the battery may be less than ideal since the difference between body temperature and ambient temperature might not be great enough to fully charge the battery, and that in many occasions (e.g., during sleep), the temperature difference needed for TEG to generate electricity may quickly disappear (e.g., since the WCD 710, 810 may be covered inside the comforter).

[0182] The battery can be any type of battery, such as a rechargeable battery. The battery can be a thin, flexible lithium ceramic chemistry battery. In another example, the battery can be a circular formed lithium polymer or lithium ion battery. The battery can provide power to any of the components described above. In one example, the battery can be a lithium cell integrated directly with the flexible PCB described above. Other implementations can integrated the battery directly onto the housing to reduce the volume of space taken up by battery packaging.

[0183] The WCD can also include one or more polymer or piezo actuators for providing appropriate haptic or physical feedback and alerts to a user while the user is wearing the ring. The piezo actuator can also provide audible feedback to a user.

[0184] As previously mentioned, the WCD 110 can be used with a software application (e.g., a mobile phone application for the Apple iOS or the Google Android OS) which can run on the user's computing device (e.g., a mobile device such as a smart phone). Specifically, the software application can facilitate the mobile device of the user to couple to the WCD 110 (e.g., via the communication module 250) for data communication, such as downloading activity logs, changing configuration and preferences, training the WCD. The software application can also generate a user interface showing the results or readings from the health and fitness tracking performed by the WCD 110. FIG. 10 is an example screenshot illustrating such user interface 1000 displaying fitness monitoring readings in accordance with some embodiments.

[0185] Further, the WCD 110 can be used for gesture input, and the software application can facilitate the user to customize gesture input and control. FIG. 11 is an

Petitioner Samsung Ex-1004, 1254

example screenshot illustrating such user interface 1100 displaying sensor readings (e.g., for calibration purposes) in accordance with some embodiments. In one or more embodiments, the WCD 110 can also be used directly with other Bluetooth enabled devices such as electronic locks or keyless car entry. In other examples, the WCD 110 can also control other devices via a smartphone and other Wireless LAN enabled devices such as home automation systems.

[0186] FIG. 3C is a view 304 of two exterior windows of an alternative WCD (e.g., WCD 112 of FIG. 3C) with example components exposed in accordance with some embodiments. The components 330, 340, and 350 shown in FIG. 3C function similarly to those components described in FIG. 3A. However, some components (e.g., antenna 350) can be positioned to face a different exterior window than the exterior window the rest of the components face. This may increase the mechanical strength of the housing structure of the ring, and/or may reduce signal interference among the components.

[0187] FIG. 4 is an exploded view 400 showing an exemplary WCD 410 (e.g., WCD 110) illustrating a battery 480 and a flexible circuit 415 which are configured to fit inside a housing 412 of the WCD 410. It is recognized by the present disclosure that a human being's finger can come in various different sizes and so should the WCD 410. In order to reduce the cost of manufacturing different sizes of printed circuits, in some embodiments, the modules 210-270 (of FIG. 2) are formed on a flexible or rigid-flex printed circuit (FPC) board, an example 500 of which is shown as FPC 515 in FIG. 5. In particular, one or more embodiments provide that the FPC 515 and the battery 480 are not specific to a ring size, and that the same circuitry and/or battery can fit a multitude of sizes.

[0188] According to some embodiments, the WCD 410 provides a desirable form factor for a user to wear it for a prolonged period of time. The edges and the shape of the WCD 410 can be configured in a way that is comfortable and ergonomic; for example, the finished parts of the embodiments are to be free from burrs and sharp edges. The material which forms the housing portion of the WCD 410 can include medical grade metallic alloys that reduce the likelihood of allergic reactions. Examples of the housing material include stainless steel, tungsten carbide, titanium alloy, silver, platinum or gold.

Petitioner Samsung Ex-1004, 1255

[0189] In the examples shown in FIG. 4, the U-shape of the ring housing 412 allows for the flexible PCB 415 to be inserted into the edge of the WCD 410. The windows (e.g., windows 120, 130) on the walls of the WCD 410 can align with the operating circuitry to allow, for example, battery charging, Bluetooth connection, and user feedback LED/micro display on the outer wall, and biological feedback sensors (e.g., pulse oximetry, temperature sensor) on the inner wall. In one or more embodiments, the WCD 410 can be completely sealed using potting epoxy. The sealing epoxy can be transparent to allow light to pass through for the CPVs and sensors. In some embodiments, the WCD 410 can be potted with two different compounds. In these embodiments, the body of the WCD 410 can be filled with clear material, and the edge of the WCD 410 can be filled with an opaque material so that different colors can be incorporated (e.g., as a decorative element). It is noted that sealing the assembly using potting epoxy can also bring the additional benefit of making the WCD 410 completely or almost completely waterproof as well as increasing the structural rigidity of the WCD 410.

[0190] **I. Internal Housing/External Potting**

[0191] FIG. 12A is a perspective view and FIG. 12B is a side view of a WCD 1200 according to one or more aspects of the disclosure. The WCD 1200 can be in the shape of a ring and can be worn on any of the five fingers (including the thumb) of (typically) a human user. In this regard, the WCD 1200 can define an interior diameter d1 and exterior diameter d2. The interior diameter d1 can be defined as the distance between opposing points on the interior surface of the ring, with the interior surface being the portion of the WCD facing the finger of a user while the device is worn by the user. The interior surface of the WCD can generally define a finger space for receiving the finger of the user. The exterior diameter d2 can be defined as the diameter between opposing points on the exterior surface of the ring, with the exterior surface being the portion of the WCD opposed to the interior surface and facing away from the finger of the user.

[0192] The interior diameter d1 and exterior diameter d2 can be any size to accommodate any finger size. In one example, d2 is determined by d1 plus a thickness of any components and/or flexible circuit boards disposed within the WCD. Additionally, although depicted as being circular, the finger space of the WCD 1200 can be any shape, such as ovular, elliptical, or the like, to accommodate users with atypical

Petitioner Samsung Ex-1004, 1256

finger profiles. In these examples, the dimensions of the interior and/or exterior diameter may be measured according to other variables, such as length, width, major diameter, minor diameter, etc. By way of non-limiting example, the WCD interior diameter d1 (the diameter generally defining the ring size) can be in an approximate range of 12mm to 24mm so as to accommodate finger sizes ranging from a small child to a larger adult, and on any acceptable finger, including the thumb. The exterior diameter d2 can also be any reasonable size or shape, and can define an approximate range of between 18mm and 30mm. Likewise, the thickness between diameters d1 and d2 can vary widely, but can typically reside in an approximate range of 1.5mm to 3 mm. The width WR of the WCD along the direction of finger extension (finger longitudinal direction) is widely variable, and can be selected, in part to accommodate internal and external components. In a non-limiting example, the width WR is in a range of approximately 3mm to 8mm.

[0193] The WCD 1200 can include an overall housing 1210 that includes an internal housing 1212 and an external potting or encapsulant 1214. Together, the internal housing 1212 and external potting 1214 combine to form the overall form factor of the WCD 1200, in addition to providing a housing for one or more electronic components stored within the housing 1210 of the WCD 1200, as will be described in greater detail below.

[0194] The internal housing 1212 can be formed of any material, such as a nonconductive material, a conductive material, a ferrous material and/or a nonferrous metal, composite material (e.g. carbon-fiber and/or glass fiber composite) a dielectric material, or a combination of any of the above. In one example, the material of the inner housing 1212 is conductive and nonferrous, such as aluminum, titanium, or stainless steel. In other examples, the internal housing can be formed of a polymer, such as plastic. The external potting 1214 can be formed of any material, solid or gelatinous, that can provide resistance to shock and/or vibration and can prevent moisture and/or debris from entering the housing 1210 of the WCD 1200, such as silicone, epoxy, polyester resin or any other polymer.

[0195] In one example, the external potting 1214 can be transparent. In this regard, the transparent external potting can allow electromagnetic radiation, such as visible, IR, or UV light sources from inside the housing 1210 to pass through the external potting

Petitioner Samsung Ex-1004, 1257

1214 without the need of a window or discontinuity in the external potting 1214 and without changing the optical properties of the radiation. In the same vein, electromagnetic radiation sources, such as visible, IR, or UV light, external to the housing can pass through the external potting 1214 and can be detected by, sensed by, or fall incident upon internal components of the WCD 1200 without the need for a window or discontinuity in the housing and without changing the optical properties of the radiation. In another example, the external potting 1214 can be tinted. The tint can be cosmetic and can prevent the internal components of the WCD to be visible by the user. In this regard, depending on the tint, optical properties of light passing therethough may be slightly changed. For example, certain colors of the light can be filtered and can result in decreased power transmission. The above description regarding external potting 1214 can be applied to any of the pottings described below.

[0196] The internal housing 1212 can define a window 1216. In one example, the internal housing is formed of a material that completely or partially prevents light (or other electromagnetic radiation) from passing through the internal housing 1212. In this regard, the internal housing 1212 can define the window 1216 to allow for such radiation to pass through the housing 1212. As shown, the window 1216 can be generally elliptical-shaped, but can be any other suitable shape according to other examples, such as rectangular, circular, ovular, etc. Since the window 116 is defined by the internal housing 1212, the window 1216 can face the finger of the user while the user is wearing the WCD 1200, which can provide many advantageous features and implementations, as will be described in greater detail below.

[0197] FIG. 12C is a front view of the WCD and FIG. 12D is a cross section of the WCD 1200 along the line A-A of FIG. 12C. As shown, the internal housing 1212 can have a generally U-shaped internal surface 1212a to accommodate one or more internal components and can define a pair of flanges 1212b and 1212c. The external potting 1214 can extend between the flanges 1212b and 1212c of the internal housing to provide an internal space 1220 to accommodate one or more components. By virtue of the external potting 1214, the internal space 1220 defined by the internal surface 1212a and the external potting 1214 can be hermetically sealed, thereby preventing debris, dust, moisture, or any other unwanted fluids or materials from interacting with the internal components of the WCD 1200. Although not depicted, the internal components

Petitioner Samsung Ex-1004, 1258

can reside within the internal space 1220, and the external potting 1214 can be disposed immediately atop the components to provide the seal.

[0198] FIG. 12E is a perspective view of the internal housing 1212 without external potting 1214. As shown, the internal surface 1212a defines a generally U- shaped surface for receiving the components.

[0199] FIG. 12F is a perspective view of the internal housing 1212 with a portion of the external potting 1214 removed and showing one or more components 1230 and printed circuit board (PCB) 1240. The components and PCB can be constructed as flex circuits, thereby allowing the components 1230 and PCB 1240 to be geometrically configured within the ring shaped internal space 1220. The PCB 1240 can be any type of flexible material clear to those of skill, such as polyimide, PEEK, etc. Additionally, the PCB could be rigid-flex whereby panels of RF4 are connected together with a flexible substrate.

[0200] As shown, the PCB 1240 and the components 1230 can be disposed within the internal space 1220 generally defined by the internal surface 1220a and the flanges 1220b-c. The PCB 1240 can define one or more folding regions 1242 that allow the PCB 1240 to conform to the circumference and/or perimeter of the internal surface 1212a. The PCB 1240 can extend around at least a portion, or up to an entire circumference, of the internal surface 1212a. In one example, the size of the internal diameter d1 of the WCD can determine the portion of the internal surface 1212a around which the PCB 1240 extends. Illustratively, for a larger ring size and a larger internal diameter d1, the PCB 1240 can extend only a portion (an arc) of the overall circumference, while for smaller ring sizes a greater portion (arc) of the circumference can be employed to accommodate PCB 1240 and the internal components 1230. The adjacent portions of PCB can form an arc angle therebetween by virtue of the folding regions disposed therebetween, allowing for the PCB to be conform to the internal surface 1212a.

[0201] **II. External Housing/Internal Potting**

[0202] FIG. 13 is a cross section of a WCD 1300 according to another aspect of the disclosure and illustrative embodiments. In this example, the WCD 1300 includes a housing 1310 that includes an external housing 1312 and an internal potting or

Petitioner Samsung Ex-1004, 1259

encapsulant 1314. The external housing 1312 includes an internal surface 1312a that has a generally C-shaped cross section-but alternate cross section shapes, such shapes with an external notch or groove. The external housing includes flanges 1312b-c that extend toward each other, beyond portions of the internal surface 1312a, to define a partially enclosed internal space 1320. In an assembled state, the WCD 1300 can include a battery 1330, a PCB 1340, and components 1350, which can be at least partially or completely disposed within the partially enclosed internal space 1320. The internal potting 1314 can extend between the flanges 1312b-c and can seal the partially enclosed internal space 1320. The components can be encapsulated by the internal potting 1314. The PCB 1340 and components 1350 can extend along an inner circumference of the internal surface 1312a.

[0203] Illustratively, the external housing 1312 can be formed of the same materials as the internal housing 1212 described above, and the internal potting 1314 can be formed of the same materials as the external potting 1214 described above. As also described above, the internal potting 1314 can be transparent and the external housing 1312 can define one or more windows according to one or more aspects of the disclosure.

[0204] FIG. 14A is a cross section of a WCD according to another aspect of the disclosure and illustrative embodiment. In this example, the WCD 1400 includes a housing 1410,internal surface 1412a, an internal or external housing 1412, an internal or external potting 1414, an internal space 1420, a battery 1430, a flexible circuit 1440, and one or more components 1450. This example is similar to the examples described above with respect to FIGs. 12 and 13, except the addition of a stiffener element 1442 and the flanges 1412b-c extend further into the space 1420 toward one another such that the flanges 1412b-c overlap with the stiffener element 1442.

[0205] FIG. 14B is a perspective view of the PCB and stiffener element of FIG. 14A. As shown in FIG. 14B, the stiffener element 1442 extends beyond an overall width w of the PCB 1440 and extends wider than a distance between flanges 1412b-c. The stiffener element is disposed between folding regions 1444. The PCB 1440 can include one or more stiffener elements 1442 attached thereto, and the elements 1442 can be disposed periodically (in separated intervals) along a length l of the PCB 1440. As shown in FIG. 14C, the stiffener element 1442 can be disposed underneath the flexible

Petitioner Samsung Ex-1004, 1260

circuit 1440, e.g., on a face of the flexible circuit 1440 opposed to the face on which the components 1450 are disposed, and can be permanently or semi-permanently attached thereto. The stiffener element can be implemented in any of the configurations described, and in particular, with either the internal housing/external potting arrangement or the external housing/internal potting arrangement.

[0206] The stiffener element 1442 can be formed of any material, such as polyamide or thin FR4, depending on construction of the PCB 1440. In particular, the material of the stiffener can be chosen to be more or less flexible than the PCB 1440. In one example, the stiffener element 1442 can be a polyamide stiffener disposed on a back surface of a flexible PCB. In another example, the stiffener element 1442 can be FR4 and can be substantially flush with respect to the flanges 1412b-c. In this regard, the stiffener element can extend substantially the distance between flanges 1412b-c and may not deform upon insertion into the space 1420. The stiffener element can include surface features disposed on an edge thereof, with the edge facing one of the flanges 1412b-c. The surface features can include a sawtooth profile (e.g., intersecting straight lines at acute angles), or any other type of feature capable of providing an interference fit between flanges 1412b-c.

[0207] FIG. 14D shows a cross section of the WCD at a point in time during assembly/manufacture when the PCB 1440 is being inserted into the internal space 1420 and prior to the application of potting 1414. As shown, the stiffener 1442 contacts the flanges 1412b-c of the housing 1410 by virtue of the width w of the stiffener element 1442. Upon an application of force, the PCB 1440 and stiffener 1442 assembly can be inserted into the internal space 1420. In this regard, the stiffener element has a predetermined flexibility that allows for a certain amount of flexion, as shown in FIG. 14D. The flexion allows for the flexible circuit 1440 to be inserted within the internal space 1420 and can prevent the flexible circuit 1440 from being removed or from accidentally falling out once inserted. In this regard, the flexible circuit 1440 is held in place within the space 1420 by virtue of the width of the stiffener element 1442 and the distance between the flanges 1412b-c. Once inserted, the potting 1414 can be applied free of the concern of improper positioning of the flexible circuit 1440.

[0208] FIG. 14E is a cross section of the WCD of after a potting material 1414 has been applied subsequent to the WCD of FIG. 14D.

Petitioner Samsung Ex-1004, 1261

[0209] **III. Inner/outer bands**

[0210] FIG. 15A depicts a perspective view of a WCD 1500 according to another aspect of the disclosure. In this example, the WCD includes a housing 1510 that includes an internal housing 1512 and an external housing 1514. The internal housing 1512 can be similar to the internal housing described above with respect to internal housing 1212, and the external housing can be similar to the external housing described above with respect to external housing 1312. The internal housing 1512 can include one or more windows 1516 that can allow electromagnetic radiation (e.g. visible and near-visible light) to pass therethrough, allowing it to fall incident upon components disposed within the housing 1510 and allowing EM radiation sources (e.g. visible light, RF, IR, etc.) within the housing to exit the housing.

[0211] FIG.15B is an exploded view of the WCD 1500. As shown, the WCD can include internal housing and external housing 1512 and1514. The WCD can further include a PCB 1540 and components 1550. Once the housings 1512-1514 are assembled and the PCB 1540 and components 1550 are assembled within space defined between the housings 1512-414, potting layers 1502 and 1504 can be applied to seal the WCD at both sides thereof to ensure a secure seal.

[0212] **IV. Inner/outer bands with U shaped window**

[0213] FIG. 16A is an exploded view of a housing 1610 and a PCB of a WCD according to one or more aspects of the disclosure. The WCD 1600 comprises a housing 1610 with an integral inner wall and outer wall 1612 and 1614. The housing can be made of any material, such as any material described above with respect to the internal/external housing structures. In this example, the inner and outer walls 1612,1614 each define a window in the shape cutaway portions 1616. The cutaway portions are bounded on three sides by the walls 1612 and 1614 and unbounded at the other side thereof. The cutaway portions 1616 can be aligned with one another to ensure transmission of radiation into/out of the housing 1610. The space1620 between the inner and outer walls 1612,1614 can receive a PCB 1640, battery, components, etc.

[0214] FIG.16B is a cross section ofFIG.16A along line B-B. As shown, the inner and outer walls 1612,1614 are directly connected by a floor 1618. The space 1620 is defined by the space between the inner and outer walls 1612,1614 and the floor 1618.

Petitioner Samsung Ex-1004, 1262

[0215] FIG.16C is a perspective view of the WCD with potting material 1630. As described above, the PCB, battery, and components can be disposed within the space. Once disposed therein, a potting 1630 can be provided atop the components and within the cutaway portion 1616. The potting 1630 can be transparent to allow for transmission of light through the cutaway portions 1616.

[0216] **V. Charging By Concentrated Light Source**

[0217] According to one aspect of the disclosure, the WCD can be charged by an external concentrated light source, e.g., laser light, laser diode, etc. In this regard, the photovoltaic device described above can include a concentrated photovoltaic element (CPV) that is constructed and arranged to receive concentrated light from the concentrated light source, e.g., laser light from a laser diode, light from a light emitting diode (LED), etc., and converting the received concentrated light into an electric current. The photovoltaic device can also generate power from nonconcentrated light sources, such as office lighting and ambient sunlight. The electric current can be used to charge one or more batteries stored within the housing of the WCD.

[0218] FIG.17A depicts a cross section of a WCD employing charging by concentrated light source according to one or more aspects of the disclosure. In this example, the WCD 1700 can include a housing material 1710. The WCD can include a PCB 1720 and a concentrated photovoltaic cell 1730. The WCD can be positioned adjacent a base assembly or base station 1750. The base assembly 1750 can be connected to an external power source 1765 and can have internal circuitry 1760 to power one or more concentrated light sources 1770, e.g., one or more laser diodes and/or one or more LEDs, disposed within the base assembly 1750. In this example, the concentrated light source 1770 comprises one or more laser diodes.

[0219] The base assembly 1750 can define a first opening 1752 at one portion thereof to allow the concentrated light 1780 to exit the housing of the base assembly I 750. As shown in the diagram of FIG.17A, the concentrated light 1780 is generated by the concentrated light source 1770 and exits the housing of the base assembly 1750 via a first opening 1752. The concentrated light 1780 then enters into the WCD by a second opening 1712 in the housing of the WCD 1700 where it can fall upon the CPV 1730. Once the concentrated laser light falls upon the CPV 1730, the CPV 1730 can convert

Petitioner Samsung Ex-1004, 1263

the incident concentrated light into a current that can be used to directly power one or more components within the WCD and/or can be used to charge one or more rechargeable batteries onboard the WCD.

[0220] The concentrated light source 1770, as described above, can be any type of light source that is arranged to generate concentrated light, such as an LED or a laser diode. The concentrated light can be any type of concentrated and/or coherent electromagnetic radiation, such as laser light and/or LED light. The concentrated light can have any desired intensity or wavelength, according to the characteristics of the CPV 1730.

[0221] In one example, the source 1770 can be a 200 mW laser diode that produces red or green laser light. This can generate approximately 80mW (or typically less) of power in the WCD where the CPV 1730 includes a plurality of groups of photovoltaics configured in series or in parallel with one another. Each group of photovoltaics can include one or more CPV cells. In another example, the CPV can include a single group of photovoltaics.

[0222] The base assembly 1750 described above can include additional components that can interact with the WCD 1700. For example, the base assembly can include one or more antennas that can communicate according to one or more wireless protocols, such as 3G, 4G, WiFi, Bluetooth®, NFC, or the like, for direct or indirect wired or wireless communication with the WCD or mobile device. In addition to the charging methods above, the base assembly can employ inductive charging techniques.

[0223] FIG.17B depicts a cross section of a WCD employing charging by concentrated light source according to another aspect of the disclosure. In this example, the concentrated light source 1770 comprises an LED. Further, the base assembly comprises an optical element 1790 positioned adjacent to the concentrated light source I 770 for focusing the LED light onto the CPV inside the WCD. The optical element 1790 can be any type of optical element, such as a lens. The lens can be formed of any material, such as glass, plastic, etc., and can be any type of lens, such as concave, convex, piano-concave, piano-convex, etc. In this example, the optical element 1790 includes a piano-concave, with the concave portion facing the concentrated light source 1770. In the example where the source 1770 is an LED, the LED emits light in many

Petitioner Samsung Ex-1004, 1264

directions. The optical element 1790 can focus the emitted LED light to focus as much of the LED light as possible onto the CPV of the WCD. The optical element 1790 can be disposed at least partially or completely within the first opening 1752. In some implementations, the optical element may not be necessary due to LEDs with substantially focused light.

[0224] FIG.17C is a perspective view of a base assembly 1750 and WCD 1700 according to one or more aspects of the disclosure. As shown, the WCD 1700 is in the shape of a ring and the base assembly 1750 includes a post 1754 for receiving the ring. The post 1754 can be cylindrical and can be sized and shaped according to an internal diameter of the WCD in order for the WCD to be received on an external surface of the post. The first opening 1752 of the base assembly 1750 is formed on a portion of the post 1754 such that, when the WCD 1700 is stored on the post, the second opening 1712 can be aligned with the first opening 1752 to ensure alignment of the CPV and the concentrated light source. The base assembly can receive/transmit power and/or data via external input/output 1795, which can be a DC power input, a USB input connection or any other acceptable connection/form factor.

[0225] FIG.17D depicts a perspective view of internal components of the base assembly 1750 and WCD 1700 according to another aspect of the disclosure. In this figure, the respective housings of the base assembly and WCD have been omitted, thereby showing a plurality of concentrated light sources 1770, optical elements 1790, and a plurality of CPVs 1730 disposed on mounting substrates 1775 on a PCB. In this example, the WCD can include a plurality of CPVs and the base assembly can include a plurality of sources. This allows for a greater current to be generated during charging and for faster charging times of the WCD. The CPVs and concentrated light sources can correspondingly be disposed in a line, with a constant or variable pitch between respective elements. In this regard, the optical element can include corresponding concavities with the same pitch.

[0226] FIGs.17E-F depicts other CPV configurations according to one or more aspects of the disclosure. As shown in FIG.17E, the CPVs 1730 can be arranged in a lx4 array, while FIG.17F depicts the CPVs arranged in a 2x2 array. In addition to the examples shown in the above figures, the WCD can include any number of CPVs according to any number of geometric configurations.

Petitioner Samsung Ex-1004, 1265

[0227] FIG.17G is perspective view of a WCD and base assembly with a lx3 CPV arrangement. As shown, the WCD can include a lx3 array of CPVs and the base assembly can include a corresponding lx3 array of concentrated light sources. As indicated by the arrow, a user can then rotate the WCD on the base assembly in order to align the respective first and second openings, as well as the CPV and concentrated light sources.

[0228] FIG.18A depicts a cross section of a WCD 1800 employing charging by concentrated light source 1870 according to another aspect of the disclosure. In this example, the WCD includes an internal/external housing portion 1810 and an internal/external potting portion 1820, as described above. In this regard, the base assembly 1850 includes a first opening 1852, but is free of a second opening on the WCD. The concentrated light 1880 passes through the transparent potting portion and falls incident upon the CPV cell 1830. In this example, the source can be a laser diode.

[0229] FIG.18B depicts a cross section of a WCD employing charging by concentrated light source according to another of the disclosure. In this example, the concentrated light source 1870 includes one or more LEDs and the base includes one or more optical elements 1890 for focusing the concentrated light 1880. The LEDs may be of different wavelengths to provide power to two or more junctions in the triple junction CPV cell.

[0230] FIG.19A depicts a cross section of a WCD 1900 employing charging by concentrated light source 1970 according to another of the disclosure. In this example, the WCD and/or the base assembly 1950 can employ one or more magnetic and/or ferrous materials to ensure alignment between the concentrated light source and the CPV cell. Such alignment can improve charging efficiency of the WCD.

[0231] The base assembly includes a first opening 1952 and the WCD includes a second opening 1912 to allow for concentrated light to fall incident upon the CPV 1930. In this example, the second opening is formed on an external housing portion of the WCD. In this arrangement, the base assembly can charge the WCD from an exterior of the WCD, rather than an internal charging method as identified above.

[0232] The WCD can include a ferrous or other suitable (e.g. ferromagnetic) material 1920, such as steel, disposed within the housing 1910. In this example, the

Petitioner Samsung Ex-1004, 1266

ferrous material is disposed in a space defined between an internal housing and an external housing. The ferrous material can surround the CPV.

[0233] The base assembly can include corresponding magnets 1960 that can cause an attractive force between the WCD and the base assembly into an optimal configuration for charging. The magnets can be disposed within the base assembly and can surround the concentrated light source. The magnets 1960 can be formed of a rare earth material, such as neodymium or any other acceptable material that provides a requisite magnetic field strength.

[0234] FIG.19B depicts a cross section of a WCD 1900b employing charging by concentrated light source 1980b according to another of the disclosure. The CPV 1930b of the WCD1900 is charged from an interior portion, such as by a base assembly 1950b with a post 1954b. Similarly, the WCD can include a ferrous material 1920b disposed within the housing1910b and the base assembly1950b can include a magnet 1960b.

[0235] FIG.19C depicts a schematic diagram of magnets 1920c,1960c that can be used in a WCD and/or base assembly, including a CPV 1930d and concentrated light source 1930d, according to one or more aspects of the disclosure. As shown, the magnets and/or ferrous/ferromagnetic materials can be axially polarized, with each having a respective north pole and south pole. In this regard, the WCD can have axially polarized magnets 1920c with a south pole S facing toward the base assembly, and the base assembly can have axially polarized magnets 1960c with a north pole N facing toward the WCD. The attractive force between the north and south poles can ensure alignment of the CPV 1930c of the WCD and the source 1970c base.

[0236] FIG.19D depicts a schematic diagram of magnets that can be used in a WCD and/or base assembly according to one or more aspects of the disclosure. In this example, the base assembly includes axially polarized magnet 1960d, with a north pole N facing toward the WCD. The WCD can include ferrous steel 1920d, with an attractive force between the ferrous steel and the north pole of the base assembly magnet.

[0237] FIG.19E is a perspective view of a WCD and a base assembly according to one or more aspects of the disclosure. As shown, the WCD 1900e can be received by a post 1954e of a base assembly 1950e. The respective magnets I960e and/or ferrous materials 1920e are shown in phantom to illustrate their positioning with respect to the

Petitioner Samsung Ex-1004, 1267

WCD and base assembly devices and the CPV1930e as well as the concentrated light source 1970e.

[0238] FIG. 20A is a cross section of a WCD 2000 engaged with a base assembly 2050 according to one or more aspects of the disclosure. In this example, the magnets 2060 can surround the concentrated light source 2070, and the WCD can include a ferrous steel 2020, CPV 2022, and battery 2024 disposed within an internal/external potting 2014 of the WCD. The ferrous steel 2020 can be disposed on a face of the PCB 2040 and can be encapsulated by the internal/external potting 2014. The base assembly can include one or more optical elements 2090 for focusing the concentrated light 2080.

[0239] FIG. 20B is a perspective view of a PCB 2040b with a CPV 2030b and ferrous element 2020b configuration according to one or more aspects of the disclosure. In this example, the ferrous element 2020b comprises a steel ring that can surround a CPV 2030b and can be disposed on the PCB 2040b.

[0240] FIG.20C is a perspective view of a PCB 2040c with a CPV 2030c and ferrous element 2020c configuration according to one or more aspects of the disclosure. In this example, the ferrous element 2020c comprises a plurality of rectangular bars disposed on the PCB. In this way, the ferrous element 2020c can be coated to be reflowed onto the PCB.

[0241] FIG.20D is a perspective view of a magnet 2060d and a concentrated light source 2070d according to one or more aspects of the disclosure. As shown, the magnet 2060d can include a ring that can extend around a circumference of the concentrated light source 2070d. The magnetic ring can be attracted to the ferrous steel ring and/or the rectangular ferrous steel examples set forth in 20A-C above.

[0242] In some examples, the WCD can be adapted to uniquely identify the wearer of the WCD using, for example biometric features unique to the user.

[0243] FIG.21A is a schematic view of a WCD 2100 showing components used for identifying the wearer of the WCD. As shown, the WCD2100 can include one or more infrared illumination sources 2110 and an infrared CMOS imaging device 2120. The finger 2190 can extend through the finger space of the WCD and the IR source 2110 can illuminate a portion of the skin of the finger 2190. The IR CMOS imaging device 2120 can receive light that has been reflected from the skin surface and produce an image of

Petitioner Samsung Ex-1004, 1268

the skin of the finger 2190. As shown, the IR source2110 and the imaging device 2120 are positioned near the interior surface of the WCD, e.g., the surface facing the skin of the finger. The IR illumination can pass through a window provided on the interior housing or can pass through a transparent potting material.

[0244] During the imaging process, the WCD 2100 can be rotated about an axis passing through the center of the finger space and along the longitudinal direction of the finger. In this regard, the imager 2120 can capture a larger swath of the skin surface than if the WCD 2100 were held stationary with respect to the finger during the imaging process.

[0245] At the time of first use, or any time thereafter, the user can generate a reference capillary map in order to identify himself/herself as the authorized user of the WCD. As described above, the user can rotate the WCD around the finger to capture image data of an analyzed section of skin 2192 and on or more capillaries 2194 of the user currently wearing the WCD. The image data can correspond to an overall analyzed section of the skin 2196 of the wearer. The image data of the capillaries can be used to generate a reference capillary map of the wearer, which can be stored in the memory, such as flash memory or EEPROM, of the WCD.

[0246] When the same user puts the WCD on his or her finger after generation of the reference capillary map, the WCD can capture image data of the wearer's skin surface that can be compared to the reference capillary map stored in the memory. In this regard, the user need not rotate the device around the finger. Instead, the WCD can compare a subset of the gathered image data to a corresponding subset of reference capillary map. If there a match, within a predetermine error tolerance, the WCD can uniquely identify the wearer as an authorized user of the WCD and as the unique individual who generated the reference capillary map. Once authorized, the wearer can have access to certain functions, features, data, or other content that is not otherwise available without authorization. In another example, the identification can be a step in a transaction or other type of authorization, such as an electronic payment, bank transaction, etc. If the gathered data does not match the reference capillary map, then the user may be prevented from accessing certain features on the WCD.

Petitioner Samsung Ex-1004, 1269

[0247] Illustratively, the comparison process between sensed capillaries and some or all of the capillary map can be implemented using basic pattern recognition algorithms (processes) instantiated in the electronics of the WCD. Such processes can rely on edge detection and similar techniques that should be clear to those of skill in the art and can be sourced from various commercial vendors of biometric recognition software.

[0248] In another example, the illumination can include NIR illumination and can project radiation into the skin of the finger. The reflected NIR illumination can then be analyzed to determine one or more characteristics of the blood, such as blood alcohol levels, blood glucose levels, and blood oxygenation levels. In this regard, the WCD analyzes the reflected radiation to identify wavelengths that were absorbed from the projected radiation by the blood of the user. Techniques and processed used in conjunction with commercially available venous oximeters (for example) can be employed to undertake certain readings.

[0249] FIG. 22A is a perspective view of a user employing ECG monitoring according to one or more aspects of the disclosure. In this example, the user can wear the WCD2200 on a first finger 2210 of first hand 2220, and can touch a second finger 2230 of a second hand 2240 to an exterior surface of the WCD 2200. This can provide an electric pathway 2250 through the body, as shown in FIG. 22B, allowing for the transmission of electrical current between distant portions of the body.

[0250] FIG. 22C is a perspective view of a WCD that can employ ECG monitoring according to one aspect of the disclosure. In this example, the WCD 2200 includes an internal/external housing 2250 with a conductive pad2260. The conductive pad 2260 can be electrically isolated from the external/internal housing 2250 of the WCD, thereby providing distinct and isolated electrical contacts on the WCD. The internal/external housing 2250 can be in electrical communication with the first finger2210 of the first hand, while the conductive pad 2260 can be in electrical communication with the second finger 2230 of the second hand. In this regard, an electrical path 2250 is formed through the respective hands 2220, 2240 and through the rest of the user's body, particularly through the chest. In this regard, the WCD can take various electrical measurements of the user, such as ECG. The ECG measurement can include measurements of the various waveforms, such as P-U waveforms. The WCD can store

Petitioner Samsung Ex-1004, 1270

such ECG data in a memory and/or can communicate the data to a wirelessly connected mobile device. In another example, the WCD can employ electrically isolated internal and external housings, such as those described above. In this regard, the conductive pad may not be utilized, and the user can wear the WCD on a first finger and apply the second finger anywhere on the external housing.

[0251] The WCD can also serve as a monitor for those who are mobility impaired or who are prone to falls, such as disabled persons and/or retired persons. The accelerometer onboard the WCD detect a fall of the user via a sudden change in acceleration data. The WCD, in conjunction with a mobile device and/or one or more base stations positioned around the home of the user, can determine the position of the user within the house. For example, the mobile device can employ GPS capabilities, and either the mobile device or the base stations can use GPS in combination with WiFi signal strengths to determine the location of the user within the house. The WCD can then issue an alert, either directly or indirectly (via the mobile device or base station) to a third party that a fall has occurred. The alert can be a phone call, text message, e-mail, or any other type of communication. The third party can then take appropriate measures to aid the fallen user.

[0252] The WCD can also monitor heart rate and/or temperature, in addition to the other monitored characteristics described above. If any of the monitored characteristics is abnormal, e.g., measured parameters outside of a predetermined threshold range, an alert can be sent to a third party. In some examples, the third party can be a medical health professional, such as a doctor, nurse, caretaker, etc. It is noted that, for those embodiments which can function as a cardiac monitor (e.g., that measures electrocardiogram (EKG)), it can be necessary to establish a closed loop (e.g., for the electrical measurement of EKG) across the heart. As such, in some of those embodiments, a separate conductive pad or other skin-contacting structure/probe can be coupled to the WCD so that a user can pinch the pad with fingers on an opposite hand.

[0253] Since the WCD has the form factor of a ring, the WCD is designed to be worn over long periods of time by a user with little to no discomfort or interference. In this regard, the WCD can monitor the above-described, monitored characteristics over long periods of time (e.g. weeks, months, etc.), and determine trends in the data. For example, the WCD can measure heart rate over a long period of time and determine a

Petitioner Samsung Ex-1004, 1271

unique resting heart rate for a user. If the user's heart rate deviates from the resting heart rate, the WCD can be arranged to issue an alert to a third party. In one specific example, the WCD can use appropriate processes to analyze both the trends of monitored characteristics, as well as current accelerometer data. In this way, if a person's heart rate deviates from a resting heart rate, but the accelerometer indicates that the user is exercising and/or engaging in strenuous activity that provides an equivalent workout, then the WCD may not issue an alert in this circumstance.

[0254] FIG.23A is a perspective view of the hand of a user in various positions employing the navigational features of the WCD. As described above, the WCD can communicate with a mobile device though one or more wireless communication protocols. The mobile device can include a processor and a memory and can execute a map application/process that can provide tum-by-tum walking or driving directions to the user based on the user's GPS location. A portion of those directions can include information regarding heading, distance to travel at that heading, waypoints, and the direction of next tum. By way of the wireless communication, the mobile device can communicate one or more of pieces of information relating to directions, such as the heading. Once the heading is received the WCD, the WCD can give feedback to the user regarding the actual heading measured by the onboard magnetometer and the heading set forth in the direction information. In one example, the feedback can be haptic or physical feedback provided by one or more actuators, such as the actuators 670 described above.

[0255] FIG. 23A depicts a user's hand in various positions of navigation, each hand including a WCD worn thereon. In this example, the heading provided by the mobile device is the heading 2335, which represents the direction in front of the hand position2330. In this regard, if the user gestures, e.g., points a ring finger, in the direction of the correct heading, the WCD 2300 can give feedback to the user indicating the correct heading. The feedback can include, for example, an LED indicator 2310 showing a green visible light. In the example of hand position2320, the finger is gesturing in a direction to the left of the correct course 2325. In this way, the WCD 2300 can provide feedback to correct the heading of the user. Such feedback can include illumination of an LED indicator showing (e.g.) a red visible light. Similarly, hand 2340

Petitioner Samsung Ex-1004, 1272

is gesturing in direction 2345, which is to the right of the correct/appropriate direction. The WCD can provide (e.g.) a blue indicator informing the user to change heading.

[0256] FIG.23B is a flow chart 2300B depicting a method of providing feedback to a user according to one or more aspects of the disclosure. At block 231OB, a user can establish a communication link between a WCD and a mobile device. At block2320B, the user can generate or request a set of directions at the mobile device, including information/data regarding heading, distance to travel at that heading, and the direction of next tum. At block 2330B, the mobile device can transmit at least one of the information items/datum regarding heading, distance to travel at that heading, and the direction of next tum. At 2340B, the WCD can take a measurement of heading by measuring a heading associated with an explicit gesture by the user's finger donning the ring. Such gesture can include pointing in a proposed heading of travel. At block 2350B, the WCD can compare the measured or proposed heading to the correct heading provided by the mobile device. At 2360B, the WCD can provide feedback to the user based on the comparison at 2350B, e.g., if the user is gesturing in the correct direction, a green LED indicator may appear. In other examples, if the gesture is in a direction that does not correspond with the correct direction, a (e.g.) blue or red indicator can appear. In one specific example, indicators representing left and right course alterations can be different so a user can easily discern a correct direction of travel.

[0257] FIG. 24A is a schematic diagram of a system 2400 for controlling an environment of a user according to one or more aspects of the disclosure. As shown, the WCD can be connected, wired or wirelessly, to one or more appliances in the home of a user. The system 2400 can include a WCD 2410, a thermostat 2420, a wireless access point (e.g., WiFi router) 2430, and a mobile device 2440. The WCD can be wirelessly connected (e.g., link 2415) to both the thermostat and the mobile device by any type of wireless communication protocol, such as Bluetooth. The access point can be wirelessly connected to the thermostat and the mobile device by any type of wireless communication protocol, such as WiFi. It is noted that a wide range of commercially available appliances, thermostats, lighting controllers, home controllers, and the like, can interface with the WCD using WiFi or another conventional/proprietary communication protocol, as described further below.

Petitioner Samsung Ex-1004, 1273

[0258] The WCD 2410 can include one or more temperature sensors. In one example, the WCD can include at least one internal facing temperature sensor 2410a and an at least one outward facing temperature sensor 2410b, as shown at FIG. 24B. The inward facing temperature sensor 2410a can be near the skin of a user when the user is wearing the ring, and can therefore measure the skin temperature of the user. The outward facing temperature sensors 2410b can be disposed away from the finger of the user, and can therefore be arranged to measure an ambient temperature of the room in which the user currently resides with sufficient thermal isolation from the user's hand and his/her body heat. In particular, in order to ensure accurate ambient temperature measurements, the WCD can employ a combination of multiple light sensors 2410c and outward facing temperature sensors 2410b. In this regard, the temperature sensor 2410b associated with the light sensor 2410c that receives the most light can be the most accurate, as it is most likely that this sensor is furthest from the finger or palm of the user. In another example, the WCD can employ multiple outwardly facing temperature sensors 2410b and compare the temperature values of each to the inward facing sensor 2410a. The WCD can then select the most accurate temperature value from the outward facing sensors.

[0259] Based on the measured skin temperature and measured ambient temperature, the WCD can automatically adjust the thermostat 2420 to alter the ambient temperature of the room. In this regard, if a user's skin temperature is too high, the WCD can instruct the thermostat 2420 to lower the ambient temperature. Similarly, if the user's skin temperature is too cold, the WCD can instruct the thermostat 2420 to raise the temperature. The WCD 2410 can instruct the thermostat (and/or an HVAC controller) directly, e.g., via a direct wireless link 2415, or indirectly, e.g., via one or more of the mobile device 2440 and the access point 2430. The WCD can also use historic temperature data to develop trend temperature data.

[0260] In another example, the WCD can be part of a system 2400C for controlling home appliances. The system 2400C can include a WCD 2410C, one or more home appliances 2420C, and an access point 2430C. Such home appliances 2420C can include, for example, a television, lights, speakers, microwave, range, stove, oven, etc. Each of the home appliances can include an antenna that allows the respective home appliances to communicate wirelessly with one or more access points 2430C. In one

Petitioner Samsung Ex-1004, 1274

example, the appliances can include a ScenSor DWIO00 chip provided by DecaWave. In this way, the locations of the appliances in the room can be determined to an accuracy of approximately 10 cm. The location of the WCD 2410C can also be determined, using the above-referenced chip, or by using signal strengths of one or more base stations.

[0261] Having established the position of one or more home appliances and the user in a room, the user can make a gesture to control such home appliances 2420C. For example, the user can point at the TV (while wearing the WCD) in order to tum it on/off. Knowing the position of the user and the position of the TV, the direction of the gesture and the type of gesture can indicate what action to take on which device. The accelerometer and/or magnetometer on the WCD can be used to create a vector to the object to control, and a wireless packet can bet sent to a wireless access point to control the respective appliance.

[0262] FIG. 24D is a flow chart depicting a method 2400D of controlling home appliances according to one or more aspects of the disclosure. At block 241OD, the locations of one or more home appliances in a room and/or house can be ascertained/determined. As described above, the appliances can include a processor configured to identify location within a room. At block 2420D, the location of the WCD is determined. At block 2430D, the user can make a gesture toward a home appliance to exert control over the home appliance. Such gesture can include a snap, a point, etc. At block 2440D, the accelerometer and/or magnetometer on the WCD can be used to create a vector to the object to control. At block 2450D, a wireless packet can bet sent to a wireless access point to control the respective appliance. The access point can then issue the command to the respective appliance.

[0263] FIG.25 is a perspective view of the hand of a user employing a two-factor authentication technique according to one or more aspects of the disclosure.

[0264] As shown, the user 2500 is wearing a WCD 2510 and is approaching a locked door 2520 with an access node 2530 associated therewith. The access node 2530 can be a wireless access node of a conventional or custom arrangement, and can communicate wirelessly according to any type of wireless protocol, such as WiFi or Bluetooth. As the user approaches the door 2520, the WCD 2510 can initiate a

Petitioner Samsung Ex-1004, 1275

communication link, e.g., Bluetooth or WiFi, with the access node 2530. In this way, the WCD and the access node can engage in one or more handshaking or query procedures to verify the WCD. For example, the access node 2530 can detect a MAC address, IP address, or other alphanumeric identifier associated with the WCD and compare it to a list of authorized users. Such network-based communication processes should also be clear to those of skill.

[0265] Once the MAC address or other identifier is verified, the user can engage in a pre-defined gesture 2550 to complete the authentication procedure. The gesture 2550 can be any type of hand and/or finger motion that can be performed by the user. In this regard, the accelerometer or magnetometer can detect the gesture 2550 performed by the user and provide the gesture information to the access node. If the provided gesture information corresponds with an authorized gesture stored at or accessible by the access node, then the user may be granted authorization and the door can be unlocked. The authorized gesture can be a general authorized gesture for all users, or can be a specific gesture authorized only for the particular MAC address.

[0266] In addition to a door, the method above can be used to gain access to other features, such as unlocking a mobile phone, unlocking a car door, starting a car. The authentication technique above is advantageous in that it can eliminate extraneous authentication devices, such as key fobs for a car, a door, keypads for entry control, etc., and can provide a secure two-factor authentication technique to avoid unwanted access. More generally any type of keyless entry system (e.g. a keypad, card-reader, keyless lock, etc.) can be equipped with appropriate communication interfaces (RF, IR, etc.) to communicate with the WCD and operate based on a gesture and/or proximity of the user using the techniques described above. The WCD can also be employed generally in this manner to activate or deactivate a residential or commercial alarm system-substituting, for example, for a key fob used for this purpose.

[0267] FIG. 26A is a schematic view of a charging apparatus for charging the WCD according to one or more aspects of the disclosure. As shown, a mobile device 2610 can be received within a case 2620. The mobile device 2610 can be electrically connected to the case 2620 via a port 2610a on the mobile device 2610 and a connector 2620a on the case 2620. As shown in phantom, the case 2620 can include an integrated battery 2630

Petitioner Samsung Ex-1004, 1276

within the case that can charge the mobile device via the connector or can charge a WCD, as will be described in greater detail below.

[0268] The integrated battery can be connected to an antenna 2640 disposed on or within the case 2620 that can emit an RF signal, as shown in the block diagram in FIG. 26C. The RF signal can have a power of less than 500mW and a frequency of 13.56MHz. The RF signal can be emitted in all directions around the case such that it can be received by a WCD in proximity to the case.

[0269] FIG. 26B shows a WCD 2650 including an RF antenna 2660 and charging circuitry 2670. The RF antenna 2640 can be disposed within the housing 2680 and can receive the RF signal emitted by the case 2620 and convert it to a current that can be used to charge the WCD battery (not shown). This can advantageously allow the user to charge the WCD without removing the WCD from the finger. As shown in FIG. 26D, the charging can occur whenever the WCD is in close proximity to the case, such as when a user talking on the phone or merely handling the phone. In another implementation, the case can utilize inductive charging to charge the WCD. In this regard, the case can include an induction coil subjected to a predetermined current to produce a magnetic field. A corresponding induction coil within the housing of the WCD can be subjected to the magnetic field to produce a current that can charge the onboard battery in accordance with known electromagnetic principles.

[0270] FIG. 27A is a pictorial diagram and FIG. 27B is a block diagram of a WCD employing flash storage according to one or more aspects of the disclosure. As described above, the WCD 2700 can include a housing 2710, an antenna 2720, and an integrated circuit (IC) 2730 including a flash memory 2740. The IC and the flash memory can be disposed within the housing 2710. The flash memory 2740 can be powered by a battery 2750 and connected to the IC 2730, which can be implemented as a system-on-a-chip (SoC) IC 2760. The IC can include Bluetooth Low Energy (BLE) capability to allow for communication with another device. The flash memory can be used to store data, or can be used in any of the authentication techniques described above. The WCD can transmit data stored on the flash memory to another device 2780 via the BLE connection, or can receive data and store the data on the flash memory.

Petitioner Samsung Ex-1004, 1277

[0271] FIG. 28A is a schematic diagram of one or more WCDs performing proximity functions according to one or more aspects of the disclosure. The WCD can detect a strength of an RF signal received by its antenna, and calculate a distance to the source of the RF signal using a Received Signal Strength Indicator (RSSI). In one example, the RF signal can be from a mobile device, an access point, or another WCD. The use of RSSI can have many applications in proximity detection. For example, the WCD can be placed on a child and can be connected to mobile device held by a parent. If the WCD travels a predetermined distance from the mobile device, the WCD can issue an alert to the mobile device, thereby alerting the parent that the child has wandered too far. In another example, the parent can wear a first WCD and the child can wear a second WCD. The first WCD can alert the parent that a child has wandered too far.

[0272] A single user can wear a first WCD 2800 on a first finger on a first hand and a second WCD 2810 on a second finger on a second hand. In this regard, the user can measure the relative distance between the first and second fingers using an RSSI via a wireless link 2830 between the WCDs 2800, 2810, such as a BLE connection. This can be used to measure an approximate dimension of an object held in both hands or to estimate a mid-air measurement.

[0273] In some examples, a first user can wear a first WCD 2800 and a second user can wear a second WCD 2810. The RSSI can be collected over a period of time and the processor can analyze the data to develop trends or statistics. For example, the RSSI data can indicate that the first and second users have spent a certain amount of time together and can serve as a relationship monitor.

[0274] The WCD can also detect when the first user and second user are holding hands. FIG. 28B is a schematic diagram of one or more WCDs 2800, 2810 performing proximity functions according to one or more aspects of the disclosure. Similar to the ECG monitoring techniques described above, a circuit can be formed when the users hold hands 2840 (with the respective hands wearing the WCDs). The circuit can be used to transmit data and/or electrical impulses between the respective WCDs via the circuit. The WCDs can collect data regarding the length of time that the users are holding hands and, in combination with the amount of time spent together, monitor the relationship of the two users. In addition, the WCD can collect data regarding communication between

Petitioner Samsung Ex-1004, 1278

the users, e.g., e-mail, social media, etc. Based on all of the above factors, the WCD can develop a relationship score between respective WCD users, with a higher relationship score indicating more and more frequent interactions.

[0275] FIG.29A is a flow chart depicting a method of initiating gesture input according to one or more aspects of the disclosure. The WCD can be used to perform one or more commands, or to instruct another device, such as a mobile device, to perform one or more commands. Such commands can include, initiate sleep state of WCD, initiate sleep mode or default mode of WCD, powering off/on of the WCD, turning on/off an LED light of the WCD, powering on/off of a mobile device, placing a phone call on the mobile device, etc. The user can establish one or more custom gestures to initiate any of the commands above. For example, the user can select a command to be customized from a number of commands. Once selected, the user can perform a custom gesture to be associated with that command. In some examples, the user can perform the custom gesture multiple times to allow the WCD to better identify the gesture and to develop error tolerances for registering the gesture.

[0276] At block 2910, the user can perform a first gesture. In this example, the user can perform a finger snap. At block 2920, WCD can register the gesture, via the accelerometer and/or the magnetometer. At block 2930, the accelerometer can send an interrupt signal to the processor. At block 2940, the processor can wake from a sleep or default system state. At block 2950, the processor can monitor the accelerometer for a second gesture, at which point the user can perform a second gesture. If the second gesture matches a gesture in the gesture command database, then the WCD can perform the associated command. If not, the WCD can return to the sleep state.

[0277] FIG.29B is a chart 2900B showing an exemplary graph of acceleration vs. time as measured by the accelerometer of the WCD. As shown at peak2910B, the gesture can only be registered if it reaches a predetermined acceleration threshold. If the gesture performed at 2910 meets the threshold, it can proceed to block2930 where the interrupt procedure is performed.

[0278] FIG. 30 is a perspective view of a WCD 3000 employing an illustrative reset function and associated procedure/process. As shown, the WCD 3000 can be removed from the finger of the user in order to initiate a system reset of the WCD. In one

Petitioner Samsung Ex-1004, 1279

example, the system reset can be initiated by spinning about a rotation axis R at a predetermined speed. The predetermined speed can be any value, and in one example is a rotational velocity. Upon performing the reset procedure at the predetermined speed, operation of the WCD 3000 can be interrupted and the onboard components of the 3000 can power off, and revert to factory default settings. Additionally, a series of movements can initiate a rest, such as putting the ring on a table and turning it over several times.

[0279] FIG. 3lA is a perspective view of a WCD including an LED indicator according to one or more aspects of the disclosure. As shown, the WCD 3100 can include an internal/external housing 3112 and an internal/external potting 3114. The WCD can include an LED 3120 that can be visible through the internal/external potting 3114.

[0280] FIGs. 31B and 31C are cross sections along line C-C of a WCD employing an LED indicator according to one or more aspects of the disclosure. As described above, the WCD 3100 can have an internal and/or external potting 3114 that can be transparent. This allows light sources within the housing to pass through the potting without changing, or with minimal change to, the optical properties of the light. In this way, a light source 3120, such as an LED, can be disposed on the PCB 3140 and can be powered at least partially by battery 3130. The LED can be encapsulated by the potting 3112 and can project light through the potting 3112. As shown in FIG. 31B, the LED 3120 can include a vertical LED, while 31C depicts a right angle LED. The vertical LED can project light along direction L1, while the right angle LED can project light along direction L2. When light is projected along L2, the light can travel around a circumference of the finger of the user.. Note that, according to aspects of the disclosure, the potting can be generally adapted in whole or in part to condition, filter or modify the wavelengths and/or projection qualities of light by for example, embedding lensmatic components, applying light-diffusive additives, light attenuating filter materials, etc.

[0281] FIG. 32 is flow chart depicting a method 3200 of communicating with a near field communication (NFC) device according to one or more aspects of the disclosure.

Petitioner Samsung Ex-1004, 1280

[0282] In some examples, the WCD can enable or disable NFC or change the functionality of a NFC device. For example, the WCD can itself engage in NFC with another computing device, or the WCD can be connected via wireless link to a computing device that engages in NFC with a different computing device. In certain existing NFC devices, NFC will connect and begin transmitting data as soon as it is queried. In the present example, NFC is enabled or begin transmitting data exclusively upon performing of a pre-determined gesture. However, a variety of other transmission processes can be implemented-for example a periodic chirp or handshake request by the WCD for communication with appropriate devices.

[0283] At block 3210, a NFC capable device is provided. The device can be any type of device, such as a laptop, tablet, mobile device, or dedicated NFC device.

[0284] At block 3220, the WCD initiates a connection with the NFC device. The connection can be a direct connection via NFC, or an indirection connection via an intermediate device. At this point, no data has yet been transmitted between the WCD and the NFC device.

[0285] At block 3230, a user performs a predetermined gesture that is registered by the WCD. The gesture can be any type of gesture, such as a point, a snap, waving the hand, etc.

[0286] At block 3240, data transmission begins between the NFC device and the WCD.

[0287] In other examples, the user can perform another gesture to cease NFC communication. The gesture can be the same gesture as described above or a different gesture. Additionally, the user can remove the ring to disable the NFC. Upon donning the ring the user will be prompted by the application on the mobile device to re-authenticate by entering a PIN, whereby the proper PIN results in re-enabling the NFC functionality.

[0288] In yet another example, the WCD device employing NFC can be configured on the fly to map to different data sets stored thereon. For example, the WCD device employing NFC can employ data thereon to make purchases, e.g., account information, data to access a building, e.g., a key fob, and data thereon to board public transportation, e.g., smart card, metro card, etc. A user can perform a predetermined different gesture

Petitioner Samsung Ex-1004, 1281

for each of the above data sets to access the data. Once accessed, the WCD device employing NFC can initiate a link with another computing device to initiate a transaction, to open a door, or to board public transportation, etc.

[0289] **VI. Optical Element and Attachment Frame**

[0290] FIG. 33A depicts a perspective view of a WCD assembly 3300 according to one or more aspects of the disclosure, while FIGs. 33B-D depict exploded views of the WCD assembly and 33E depicts a cross sectional view of the WCD assembly along A-A. In this example, the WCD assembly 3300 includes a WCD 3310, an attachment frame 3320, and an optical element 3330. The WCD 3310 can be any of the WCD examples described above or below in the present application.

[0291] The attachment frame 3320 is releasably attached to the WCD3310. The optical element 3330 is itself releasably attachable to the attachment frame 3320. In this regard, the attachment frame 3320 provides an attachment interface between the WCD 3310 and the optical element 3330, thereby allowing the optical element 3330 to be at a fixed position in space with respect to the WCD 3310 or any portion thereof. The attachment frame3320 can be made of any material, such as a metal, polymer, etc. Any type of polymer can be used, such as thermosetting plastics, thermoplastics, PETE, polycarbonate, polyethylene, LDPE, or any other type of plastic.

[0292] The attachment frame can be sized and shaped to fit along the curved surface of the WCD. For example, the attachment frame can have a curved undersurface to allow a flush fit with the curved surface of the WCD. The attachment frame can have any shape, size, or radius of curvature depending on the size and shape of the WCD.

[0293] The attachment frame 3320 includes a first retaining a portion 3322 and a pair of second retaining portions 3324. The first retaining portion 3322 defines a conical recess 3322a configured to receive the optical element 3330, and provides a generally unoccluded pathway for light to pass through the optical element and onto the WCD. Although depicted as defining a conical or frustoconical shape, the recess 3322a can be any other shape depending on the shape of the optical element 3330. Each of the second retaining portions3324 includes a respective locking feature 3324a. The respective locking features3324 and a extend from the second it retaining portion3324 toward one another such that a distance between the respective locking features is greater than a

Petitioner Samsung Ex-1004, 1282

distance between the remaining portions of the second retaining portions. As shown in FIG. 33E, the locking features engage with an inward-facing surface 3350 of the WCD to ensure a secure fit. In one example, the inward-facing surface of the WCD may itself have one or more features 3360 to engage with the locking features of the second retaining portions. Such one or more WCD features can include projected surfaces, recesses, or any other type a feature to allow for engagement with the attachment frame.

[0294] The optical element 3330 can be made of any material capable of modifying, e.g., focusing, incident electromagnetic radiation, such as visible light, ultraviolet light, infrared light, or any other type of electromagnetic radiation. In some examples, the optical element 3330 can be constructed from a polymer, such as any of the polymers identified above. In another example, the optical element can be made of glass, quartz, diamond, zirconium, or any other material capable of focusing light. More generally, the optical element 3330 is formed with a general outward appearance simulative of a faceted jewel with an appropriate tint or coloration (including clear/white). The term "jewel" can also be used in the alternative to describe the optical element 3330 herein.

[0295] The WCD can include CPV cell 3312 that can be disposed directly underneath the attachment frame 3320 and optical element 3330 when assembled. In other examples, the CPV can be positioned within the housing and can receive electromagnetic radiation via a transparent potting material. In this regard, incident light striking the optical element 3330 can be focused on to the CPV cell to allow for charging of the internal battery of the WCD. The optical element 3330 provides an increased charging efficiency when compared to the CPV exclusively receiving ambient light, since the ambient light is collected/gathered from a wider field, and then focused onto the CPV by the optical element 3330. In one example, a focal length of the optical element 3330 is different than a distance between the optical element and the CPV. For example, the focal length can be greater than or less than the distance between the optical element and the CPV. This can be advantageous in various aspects of the disclosure so as to avoid the light from focusing at a focal point directly on the CPV, which could cause damage to the CPV itself by over-concentrating the light at that single point of the overall CPV surface.

[0296] FIGs.34A-B depict a WCD assembly 3400 according to one or more aspects of the disclosure. In this example, the attachment frame 3420 does not extend to an

Petitioner Samsung Ex-1004, 1283

inward-facing surface of the WCD 3410, but is instead form entirely on the outside-facing surface of the WCD. In some examples, the attachment frame 3420 can be semi-permanently or permanently affixed to the outward-facing surface of the WCD and can have a plurality of retaining portions (mounting prongs) 3422 that at least partially define a recess 3422a for receiving the optical element. As shown in FIG.34B, the optical element 3430 is releasably attached to the attachment frame 3420. This configuration can be particularly desirable, as it exhibits ornamental similarities to a traditional engagement ring while still having the increased functionality of the WCD. Note that while not shown, the mounting prongs can include small hook ends that springably retain the optical element 3430 when attached, but that can release the optical element based upon a prying motion. A customized grasping tool (not shown) can also be employed to remove (and attach) the optical element in this example.

[0297] **VII. Enclosure/Packaging**

[0298] FIG. 35A depicts an enclosure or case 3500 for storing a WCD according to one or more aspects of the disclosure. As shown, the enclosure3500 includes a lid 3510 and a base 3520. The lid 3510 and base 3520 can engage via a recessed portion 3522 formed in the base 3520 to provide a substantially sealed interior environment.

[0299] The lid 3510 can be cuboidal in external dimensions, or define any other type of geometric shape that allows sufficient internal volume to contain the WCD. For example a custom design shape (polyhedral, etc.) can be employed. In this example, the top portion3510 is substantially cuboidal as shown, including rounded edges rather than vertices. The lid can be substantially transparent to allow viewing of the WCD while enclosed therein, and can be made of any type of material, such as a polymer, glass, etc. The lid can also be mounted with pins on a hinge.

[0300] The base 3520 can be cuboidal, or any other type of geometric shape. In this example, the bottom portion is substantially cuboidal, including rounded edges rather than vertices as shown. The bottom portion can be made of any material and can be transparent or opaque.

[0301] The base 3520 can define a receptacle 3524 for receiving the WCD3505. The receptacle 3524 can be sized and shaped to receive the WCD 3505 and in this example is semicylindrical, e.g., a portion of a cylinder. The radius of the semicylinder

Petitioner Samsung Ex-1004, 1284

can be slightly larger than a radius of the WCD in order to accommodate the WCD securely. The receptacle can lined with a soft material to allow for a soft, safe material to receive the WCD, such as a silicone, thermoplastic, fabric, felt, or other material.

[0302] FIG.35B is a cross sectional view of the assembled enclosure3500 shown above along the line B-B. As shown, when assembled, the WCD 3505 fits securely within the receptacle 3524. The interior of the lid3510 can be sized and shaped to conform to the shape of the WCD such that the WCD is completely surrounded and enclosed by the lid 3510, while in other examples, the lid3510 can be sized and shaped to allow for airspace 3514 between the lid surface and the WCD.

[0303] FIG.35C is a cross section of the enclosure along line A-A. As shown, the lid 3510 can include an integral optical element 3512. The optical element3512 can be a lens or any other device to modify, e.g. focus, light that passes therethrough. In this example, the optical element 3512 can be disposed at a predetermined distance away from one or more CPV cells 3507 disposed on the WCD 3505. This distance *d* can be measured from the center of the optical element to the CPV cells 3507, and the optical element can itself have a focal length *f*. In one example, the distance *d* can be greater than the focal length *f*, such that the optical element focuses light at a point above the WCD in the enclosure. In this regard, the light will not focus directly on the CPV cells disposed at the surface of the WCD, thereby avoiding overheating or damage to the CPV cells. In other examples, the distance *d* can be less than the focal length, which can also prevent light from focusing at a surface of the WCD.

[0304] FIG. 36 depicts an enclosure 3600 including air vents 3650 according to one or more aspects of the disclosure. In this example, the enclosure 3600 includes a plurality of vent holes 3650. The vent holes can be arranged on one or more faces of the lid. The vent holes 3650 can prevent overheating within the enclosure during charging of the WCD by allowing for circulation of convective air current. During shipping, the vent holes3650 can be covered by an adhesive and/or adhering (peel-off) polymer sheet of conventional arrangement to prevent debris or moisture from entering the enclosure. The enclosure can include a lid 3610, base 3620, receptacle 3624, and optical element 3612 as in the examples set forth above.

[0305] **VIII. Sizing**

Petitioner Samsung Ex-1004, 1285

[0306] FIG. 37 depicts a method 3700 of sizing a finger according to one or more aspects of the disclosure. At block 3710, the hand of a user can be provided. The hand can be held still in mid-air or alternatively can be resting on a surface.

[0307] At block 3720, a first image is taken of the user's hand from a first perspective. The image can be taken by any type of imaging apparatus, such as a CCD or CMOS camera, a digital camera, a camera associated with a mobile phone, etc. The first image can be stored in a memory.

[0308] At block 3730, a second image is taken of the user's hand at a second perspective. In this regard, the second perspective is different from the first perspective so as to provide a distinct view in the second image of the user's hand. Block 3730 can be repeated any number of times. For example, a third image can be taken of the user's hand at a third perspective. In this regard, the third perspective is different from both the first and second perspectives so as to provide a distinct view in the third image of the user's hand, and so on.

[0309] At block 3740, a size of the user's finger can be derived from the plurality of images taken above. In some examples, as few as two images may be required, while in other scenarios, more than three images may be required, depending on a number of circumstances including image quality, selected perspectives, etc. The size can be derived from the plurality of images by any number of techniques, such as stitching the plurality of images together to generate a 3D typography of the fingers, then using photogrammetry algorithms to identify features on the fingers to determine the appropriate ring size. Furthermore, the touch screen of the smart phone can be used to measure the hardness of tissue by measuring the footprint/impression the fingers make while pressing a finger against the touch screen of a mobile phone.

[0310] FIG. 38 is a pictorial diagram showing a plurality of image perspectives of a user's hand 3802. As shown, perspectives 3810, 3820, and 3830, as well as the other perspectives, produce corresponding images (in a strip) 3812, 3822, and 3832. The images can be used to derive a size of the user's finger according to the methods described above.

Petitioner Samsung Ex-1004, 1286

[0311] FIG. 39 depicts a sizing tool for sizing the finger of a user. As shown, the tool 2900 can include a plurality of finger holes 3910-3950. The tool 3900 can be made of any material, such as plastic, metal, or cardboard.

[0312] FIG. 40 depicts a sizing tool for sizing the finger of a user according to an alternate example. As shown, the tool 4000 can include a plurality of finger holes 4010-4050. The tool 4000 can be made of any material, such as plastic, metal, or cardboard.

[0313] FIG. 41 depicts yet another alternate example of a sizing tool for sizing the finger of a user. As shown, the tool 4100 can include a plurality of finger holes 4110-4150. The tool 4100 can be made of any material, such as plastic, metal, or cardboard. The thickness of the card reflects the thickness of the ring to ensure proper fit. Additionally, the sizing tool is designed such that it can be easily mailed to the user with a standard mail service such as USPS.

[0314] Any of the tools 3900, 4000, or 4100 can be provided to a user prior to purchase of the ring in order to obtain accurate sizing information prior to purchase. The tools include holes, as shown above, that can come in a plurality of predetermined finger sizes to allow a user to match his or her finger size with the tool. The best match, e.g., closest size that ensures a comfortable fit, can be identified using the tools. Alternatively, the tools can be provided at retail locations to size the finger of the user on site prior to purchase. More generally, a variety of other sizing techniques, such as those employed by conventional jewelers can be employed according to further aspects of the disclosure.

[0315] In another embodiment, a packaging or enclosure of the WCD can include a sizing diagram or interface embodied therein to allow a user to size a finger during the purchase process.

[0316] FIG. 42 depicts a method 4200 of monitoring activity according to one or more aspects of the disclosure.

[0317] At block 4210, a user can don or place the WCD onto the finger to secure it in the wearing position.

[0318] At block 4220, a user can perform any number of daily activities, such as running on a treadmill, walking, exercising, typing, etc.

Petitioner Samsung Ex-1004, 1287

[0319] At block 4230, the WCD, contemporaneous with block 3220, can use one or more sensors to sense the activities of the user. For example, the sensors can detect location, speed, acceleration, orientation, heart rate, etc.

[0320] At block 4240, the WCD, or another computing device, can generate an entry in an activity log at the conclusion of a detected activity. If the activity detected by the sensors has a profile that has not yet been identified, the WCD can prompt the user to identify the activity. For example, the user can identify profiles such as "Run in Central Park," "Typing," "Run on Treadmill," etc. The WCD can associate the identity provided by the user with the activity profile identified by the sensors and store the identified activity in the WCD memory, or any other memory. Later, if the user performs the same activity and the WCD detects the activity profile as being similar to a saved activity, the WCD can identify the activity while the user is performing the activity and save the activity in the activity log. Each of the activities performed can be saved in the overall activity log and can be stored in a memory on the WCD, or other device, for later v1ewmg.

[0321] FIG.43 depicts a method 4300 of determining whether a user is wearing gloves according to one or more aspects of the disclosure. At block 4310, a user is provided while wearing the WCD, where such user may or may not be wearing gloves.

[0322] At block 4320, one or more light sensors on board the WCD can detect surrounding ambient light. Such light sensors could include, for example, a CPV or other light sensitive element.

[0323] At block 4330, one or more additional measurements maybe made. Such additional measurements can include, for example, an ambient temperature measurement and or a proximity measurement, e.g., detecting proximity of an object to the WCD via reflected electromagnetic radiation in the form of IR light.

[0324] At block 4340, a measured ambient temperature and ambient light measurements are compared to predetermined thresholds. If the ambient temperature measurement is above a certain predetermined temperature threshold and the ambient light measurement is below a certain threshold, it can be determined that the user is wearing a glove over the WCD.

Petitioner Samsung Ex-1004, 1288

[0325] At block 4350, a measured proximity and ambient light measurements are compared to respective predetermined thresholds. If the proximity measurement is below a certain distance threshold (e.g., determines an item is in close proximity to the WCD) and the ambient light measurement is below threshold, it can determined that the user is wearing a glove over the WCD. In any of the above examples, an intensity of LED indicators of the WCD can be adjusted according to a detected ambient light using an appropriate algorithm or process that compares the ambient light to a scale and adjusts a desired driving current/voltage for the LEDs according to a predetermined formula (e.g. a proportional adjustment using an adjustment coefficient) or scale (e.g. a lookup table). For example, where there is abundant ambient light (e.g., detected ambient light above a predetermined threshold), the intensity of the LED indicators can be increased. In the same way, where there is little ambient light (detected ambient light below a predetermined threshold), the intensity of the LED indicators can be decreased.

[0326] In one example, the WCD can detect whether it is removed and or installed on the finger of the user. In this regard, as mentioned above, the WCD can have inward-facing light sensors, CPV, or temperature sensors. When a user installs a ring on his finger the measure of ambient light may decrease or the temperature may increase. Such changes in ambient light and/or temperature can be detected by one or more sensors onboard the WCD and a determination can be made that the user has removed and or installed the ring on his finger.

[0327] FIG.44 depicts a method 4400 of securing data onboard the WCD according to one or more aspects of the disclosure. At block 4410, a user may don the WCD on the finger. At block 4420, a user may execute an application on a mobile device, or other computing device, that can be previously associated and authenticated with the WCD. At block 4430, the user can enter an authorization code into the application running on the mobile device, such as a PIN code. At block 4440 the mobile device may transmit the authorization code to the WCD by any means of communication, such as, wired, wireless, Bluetooth, NFC, etc. At block 4450, the user wearing the WCD can now be again authenticated and associated with the WCD and can be granted access to certain functions and/or data storage of the WCD. At block 4460 a user may remove the WCD. At block4470 the WCD can detect that it is removed such as bio detection (including e.g., biometric identification) techniques described above with respect to inward facing

Petitioner Samsung Ex-1004, 1289

sensor changes, temperature changes, or heart rate decreasing to zero. At block 4480, the authorization code previously stored on the WCD can be automatically deleted upon detection of removal to avoid unauthorized access to such information by a subsequent wearer or other querying party. Further or alternatively, additional information can be automatically deleted upon removal of the WCD, for example any data and or instructions stored on the onboard memory of the WCD such as personal information, banking information, confidential information, or other sensitive data.

[0328] **IX. Timepiece System**

[0329] FIG. 45A is a timepiece system 4500 according to one or more aspects of the disclosure. As shown, the timepiece system 4500 can include a conventional timepiece 4510 and a timepiece computing device (TCD) 4520. The TCD can be any shape, and in this example is in the shape of a cylinder. The radius can be significantly greater than a height of the TCD to provide the shape of a puck. The TCD can have one or more structural and/or functional components, and can be similar to the WCD described above with respect to hardware features, components, sensors, etc. Although depicted as cylindrical, the TCD can have any shape depending on the shape of the conventional timepiece. For example, where the timepiece has a rectangular or square face, the TCD can similarly have a rectangular or square profile.

[0330] A top surface 4520a of the TCD can include a pressure sensitive adhesive (PSA) layer 4522 to allow for adhesion of the TCD to the under surface of the timepiece 4510. The TCD 4520 can have a radius or circumference that does not exceed radius or circumference of the face of the conventional timepiece so as not to be seen when a user is wearing the timepiece system 4500. The TCD can enhance the conventional timepiece with many of the features described above with respect to the WCD such as, heart rate sensing, temperature sensing pedometer, activity sensing, gesture sensing and control, without having to alter the look of the conventional timepiece.

[0331] Fig 45B is a bottom view of the TCD. As shown, the TCD can include a battery 4540, any printed circuit board 4550 with one or more components attached thereto (not shown) such as motion sensors, power management circuitry, charging circuitry, etc. As with the WCD, the printed circuit board of the TCD can be overmolded 4560. The overmold can be transparent or substantially transparent to allow

Petitioner Samsung Ex-1004, 1290

electromagnetic radiation to pass through to be incident upon one or more components of the TCD.

[0332] As shown, the TCD can include a light pipe 4524 around the perimeter thereof. The light pipe 4524 can be substantially annular in shape and can be formed in part by the overmold of the TCD. The light pipe can be constructed from a conventional transparent or translucent moldable material (e.g. acrylic, polycarbonate, etc.), and can be arranged to focus ambient light onto a CPV disposed onboard the TCD for additional charging capability. The optical arrangement/geometry of the light pipe can be implemented using skill in the art to achieve the desired optical characteristics. In another example, excess heat generated by the TCD or excess body heat emitted from the skin of the user can be converted to electrical energy via a thermoelectric (TEG) module, such as a Peltier module, disposed onboard the TCD.

[0333] The TCD can also include any number of CPV cells, either on a top surface or bottom surface, to allow for charging. For example, a CPV cell can be placed on the underside of the TCD to allow for docking with a charging/docking station.

[0334] FIG.46 depicts a WCD 4600 with a pair of LED indicators 4610-4620 disposed at an inward-facing portion of the WCD. As shown, the WCD 4600 can include a pair of transparent regions 4640-3650 and an opaque region 4630. The LEDs 4610- 3620 can be positioned under the transparent regions 4640-3650 to allow light from the LEDs to exit the WCD. In one example, the LEDs 4610-3620 can create a subtle diffuse glow to the skin to provide a desirable visual effect to user. In another example, a user feedback LED can be placed at an inward facing surface and a second can be placed at an outward facing surface of the WCD. Depending on the circumstances, one of the LEDs may be disabled to save battery life. For example, LEDs that are facing away from a user e.g. facing down or away from user's line of sight, may be disabled. As described above, the WCD can determine its orientation based on onboard sensors, such as the magnetometer, accelerometer, GPS, etc.

[0335] FIG. 47A is a system for generating and managing alerts according to one or more aspects of the disclosure. As shown, the system can include a WCD 4710A, one or more networks 4720A, and one or more server computers 4730A according to one or more aspects of the disclosure. The WCD 4710A can communicate directly and/or

Petitioner Samsung Ex-1004, 1291

indirectly with the server 4730A via the network 4720A. In this regard, data generated and/or stored at the WCD 4710A can be transmitted to the server 4730A and vice versa. In one example, such data can include biometric data pertaining to a user wearing the WCD that is detected and stored by the WCD.

[0336] FIG. 47B depicts a block process diagram for generating and managing alerts according to one or more aspects of the disclosure and FIG. 47C is a flow chart depicting a method for generating and managing alerts according to one or more aspects of the disclosure.

[0337] At block 4710C, and as shown at process block 4710B, the user is authenticated with respect to the WCD. In this regard, a single user can be associated with a single WCD and can be associated with a predetermine identifier, such as an alphanumeric number. If the user is not authenticated or the authentication process is not conclusive, the WCD may invite the user to retry authentication at block 4715C until the user is successfully authenticated. In some examples, the WCD may timeout the authentication process, lock the WCD, or place the WCD in safe mode in the event of too many unsuccessful authentication attempts as a security measure.

[0338] The user can be authenticated according to any of the authentication methods described in the present application, such as via a unique capillary map, a unique ECG profile, etc.

[0339] If the user is authenticated, biometric data can be transmitted to the server at block 4720C. The captured biometric data 4720B can be transmitted to the server via network 4720A, 47222B

[0340] Once received at the server, the biometric data can be aggregated, sorted, categorized, or profiled at block 4730C and as shown at process block 4730B. In this regard, a profile (corresponding to the alphanumeric identifier) may be created at a database at the server that stores data for a particular user. The profile can store transmitted biometric data, as well as other data, such as user gender, height, weight, age, family history, disease information, location, etc.

[0341] In some examples, identifying information may be removed from the data and/or not transmitted to allow for anonymity and/or to comply with regulations regarding transmission of medical data. The transmitted biometric data can be

Petitioner Samsung Ex-1004, 1292

normalized in order to comply with predetermined data requirements in order to be added to the profile. In one example, a minimum amount of data may be required in order to be considered viable for association with the profile. The biometric data of a single profile can be aggregated, or in other examples multiple profiles can be aggregated simultaneously.

[0342] Aggregation of the user's biometric data into a single profile allows for the profile to be visualized or analyzed according to any number of methods. For example, a timeline can be created showing biometric data over a period of time. The data can also be synthesized or analyzed to calculate trend data, or other mathematical features.

[0343] Although only one WCD is depicted, it is contemplated that a plurality of WCDs can exist, with each WCD corresponding to a distinct user (and distinct alphanumeric identifier) and therefore resulting in a plurality of distinct profiles at the server. Accordingly, each of the distinct users/WCDs may be authenticated separately according to the methods described herein.

[0344] At block 4740C, once the transmitted data has been associated with the user profile, the updated profile can be correlated with one or more other profiles stored at the server as shown as process block 4740B. The profiles may be correlated according to any number of correlation standards, such as correlating users with similar traits such as age, gender, location, profession, or by any other data stored at the server. In some examples, one or more of the traits can be used to make such a correlation. The biometric data from the one or more users that are correlated with one another can be combined to form a group profile. The group profile can be the aggregation, average, range, or sum of individual profiles that form the group profile. For example, for a particular group profile, a range of resting heart can be generated by taking the maximum and minimum values of resting heart from the individual profiles. In other examples, an average (and standard deviation or standard deviation of the mean) can be generated for each trait, such as average resting heart rate, average active heart rate, average blood pressure, average blood sugar, average skin temperature, ECG profiles, as well as any other features capable of being detected by the WCD as described above.

[0345] At block 4750C, transmitted biometric data can be compared to the established values from the group profile. In this way, if a user's heart rate deviates by a

Petitioner Samsung Ex-1004, 1293

predetermined threshold (such as by predetermined magnitude or standard deviation), an alert can be generated at process block 4750B. The comparison process can occur at the server after transmission of the biometric data. In another example, the group profile data can be transmitted to the WCD for comparison at the WCD. This advantageously allows the comparison to be made where the WCD cannot establish a network link. The group profile can be updated on a continuous basis or a predetermined time interval or at each transmission of biometric data.

[0346] At block 4760C, the alert is transmitted to the WCD and displayed to the user at process block 4760B. The alert can indicate that the user's biometric data has deviated from the profile group and may advise the user to seek medical attention. In another example, the server can directly contact a medical health professional. In the example where block 4750C occurs at the WCD, transmission of alert information from the server may not be necessary.

[0347] The alert at the WCD can be any type of audio or visual indicator, such as an LED, haptic feedback, audible alarm, etc. The indicator may also invite the user to rest, make an appointment with a medical health professional, recommend a particular medication, or suggest certain physical activities that may health condition that caused the alert.

[0348] As shown in FIG. 47B, the authentication 4710B, aggregation 4730B, and correlation 4740B can occur at server 4730A, which can include a process, memory, and any other features of a general purpose computer. The authentication 471OB, aggregation 4730B, and correlation 4740B can access a database stored at the memory, where profiles, group profiles, and biometric data can be stored.

[0349] FIG. 48A is a method for variable sampling according to one or more aspects of the disclosure. As described above, the processor module of the WCD can determine (e.g., based on identified physical activities, routine pattern, and/or time) a frequency at which one or more sensors in the sensor modules should operate.

[0350] At block 4810A, one or more sensors of the WCD may take one or more measurements. For example, the WCD can detect temperature, heart rate, acceleration, as described above.

Petitioner Samsung Ex-1004, 1294

[0351] At block 4820A, the WCD can calculate an activity level of a user. For example, the WCD can compare to a number of stored activity profiles (as described above) stored by the user, or can compare the sensor measurements to sensor threshold values corresponding to different activities, such as sitting, running, sleeping etc. In one example, the WCD detect acceleration values over time to generate an activity level for a particular time period.

[0352] At block 4830A, the WCD may compare the identified activity level to a predetermine activity threshold value. In one example, the WCD may categorize the detected activity as either a high level activity or a low level activity. High level activities can include running, swimming, biking etc., while low level activities may include sitting, standing still, or sleeping.

[0353] At block 4840A, the WCD can set a first sample rate for high level activities and at block 4850A, the WCD can set a second sample rate for low level activities. The first sample rate can be a shorter time interval than the second sample rate, resulting in more data being detected and generated during a set amount of time while the user is active. This allows for increased power efficiency of the WCD while also providing the advantage of generating more data when a user is more active, thereby providing added biometric data for later analysis.

[0354] In another example, the sample rate can be scaled according to activity level. For example, the sample rate can be scaled to be directly proportional to heart rate. This results in a shorter time interval for sampling (more frequent data gather) for running than for walking.

[0355] As activity level changes, the method above can be repeated a plurality of times at certain intervals in order to quick or abrupt activity changes.

[0356] FIG. 48B and 48c are graphs depicting one or more aspects of the sample method of FIG. 48A. As shown in FIG. 48B, the WCD may determine a user is engaging in a high level activity by detecting acceleration values that are above a predetermined threshold value. In this regard, a shorter time interval (more frequent data gathering) can be set. As shown in FIG. 48C, the user is engaging in a low level activity since the acceleration values are below a predetermined threshold. A longer sample rate (less frequent data gathering) can be set in this instance.

Petitioner Samsung Ex-1004, 1295

[0357] FIG. 49 a diagrammatic representation of a machine in the example form of a computer system 4900 within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed. Specifically, FIG. 49 shows a diagrammatic representation of a machine in the example form of a computer system within which instructions (e.g., software or program code) for causing the machine to perform any one or more of the methodologies discussed herein may be executed. In alternative embodiments, the machine operates as a standalone device or may be connected (e.g., networked) to other machines. In a networked deployment, the machine may operate in the capacity of a server machine or a client machine in a server-client network environment, or as a peer machine in a peer-to-peer (or distributed) network environment.

[0358] The machine may be a server computer, a client computer, a personal computer (PC), a tablet PC, a set-top box (STB), a personal digital assistant (PDA), a cellular telephone, a smartphone, a web appliance, a network router, switch or bridge, or any machine capable of executing instructions (sequential or otherwise) that specify actions to be taken by that machine. Further, while only a single machine is illustrated, the term "machine" shall also be taken to include any collection of machines that individually or jointly execute instructions to perform any one or more of the methodologies discussed herein.

[0359] The example computer system includes a processor (e.g., a central processing unit (CPU), a graphics processing unit (GPU), a digital signal processor (DSP), one or more application specific integrated circuits (ASICs), one or more radio-frequency integrated circuits (RFICs), or any combination of these), a main memory, and a non-volatile memory, which are configured to communicate with each other via a bus. The computer system may further include graphics display unit (e.g., a plasma display panel (PDP), a liquid crystal display (LCD), a projector, or a cathode ray tube (CRT)). The computer system may also include alphanumeric input device (e.g., a keyboard), a cursor control device (e.g., a mouse, a trackball, a joystick, a motion sensor, a touch screen, or other pointing instrument), a storage unit, a signal generation device (e.g., a speaker), and a network interface device, which also are configured to communicate via the bus.

Petitioner Samsung Ex-1004, 1296

[0360] The storage unit includes a non-transitory machine-readable medium on which is stored instructions embodying any one or more of the methodologies or functions described herein. The instructions may also reside, completely or at least partially, within the main memory or within the processor (e.g., within a processor's cache memory) during execution thereof by the computer system, the main memory and the processor also constituting machine-readable media. The instructions may be transmitted or received over a network via the network interface device.

[0361] While machine-readable medium is shown in an example embodiment to be a single medium, the term "machine-readable medium" should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, or associated caches and servers) able to store instructions. The term "machine-readable medium" shall also be taken to include any medium that is capable of storing instructions for execution by the machine and that cause the machine to perform any one or more of the methodologies disclosed herein. The term "machine-readable medium" includes, but not be limited to, data repositories in the form of solid-state memories, optical media, magnetic media, or other non-transitory machine readable medium.

[0362] **X. Conclusion**

[0363] It should be clear that the WCD and TCD arrangements described according to various aspects of the disclosure provide a highly versatile and useful item of wearable electronics that is comfortable and convenient to wear, conveniently charged, and weatherproof for all-purpose and all-condition wearing. Various options for style and appearance can be implemented, as well as a variety of storage options. The functions and structure of the device lend themselves to both a ring version and a wrist-worn version. All versions are designed for long-life with minimal maintenance, and are adaptable to interoperate with a variety of networked devices including computers, smartphones, home controllers, security systems, and virtually any other device capable of communicating over a wireless link-including another WCD or TCD.

[0364] The foregoing has been a detailed description of illustrative embodiments of the invention. Various modifications and additions can be made without departing from the spirit and scope of this invention. Features of each of the various embodiments

Petitioner Samsung Ex-1004, 1297

described above may be combined with features of other described embodiments as appropriate in order to provide a multiplicity of feature combinations in associated new embodiments. Furthermore, while the foregoing describes a number of separate embodiments of the apparatus and method of the present invention, what has been described herein is merely illustrative of the application of the principles of the present invention. For example, as used herein various directional and orientational terms such as "vertical", "horizontal", "up", "down", "bottom", "top", "side", "front", "rear", "left", "right", and the like, are used only as relative conventions and not as absolute orientations with respect to a fixed coordinate system, such as the acting direction of gravity. Note also, as used herein the terms "process" and/or "processor" should be taken broadly to include a variety of electronic hardware and/or software based functions and components. Moreover, a depicted process or processor can be combined with other processes and/or processors or divided into various sub-processes or processors. Such sub-processes and/or sub-processors can be variously combined according to embodiments herein. Likewise, it is expressly contemplated that any function, process, application, and/or processor here herein can be implemented using electronic hardware, software consisting of a non-transitory computer-readable medium of program instructions, or a combination of hardware and software. Also, while a variety of visible and near-visible radiation sources are described as LEDs, it is expressly contemplated that other types of sources can be employed according to aspects of the disclosure-for example plasma discharge sources and bioluminescent sources, as well as sources that are based upon developing technologies. Electronic circuits and RF components can similarly be based on alternate and/or developing technologies. Accordingly, this description is meant to be taken only by way of example, and not to otherwise limit the scope of this invention.

Petitioner Samsung Ex-1004, 1298

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/323,385	**08/14/2023 05:57:48 PM ET**	**PM001.01.03.01.01.01.01.0**

Title of Invention

WEARABLE COMPUTING DEVICE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	7585	FILED BY	Carmen Simon
PATENT CENTER #	62613513	FILING DATE	05/24/2023
CUSTOMER #	179918	FIRST NAMED INVENTOR	Mr. Curt C. von Badinski
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Nathan Mutter

Documents

TOTAL DOCUMENTS: 3

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
PM001.01.03.01.01.01.01.01.02_ResponseIncompleteReply.pdf		138	-	633 KB
PM001.01.03.01.01.01.01.01.02_ResponseIncompleteReply-PEFR.pdf	(1-2)	2	Applicant Response to Pre-Exam Formalities Notice	89 KB
PM001.01.03.01.01.01.01.01.02_ResponseIncompleteReply-SPEC.pdf	(3-70)	68	Specification	345 KB
PM001.01.03.01.01.01.01.01.02_ResponseIncompleteReply-SPEC.pdf	(71-138)	68	Specification	329 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
PM001.01.03.01.01.01.01.01.02_ResponseIncompleteReply.pdf	C3668835CC2C7F67C58D5ADFFD7AB1B64D882446D98D9DFBA21EE94977F69CDA5BB358CB5C044526E4065511C382F74E75B8420BFA4BA52DB336158161EF2A84
PM001.01.03.01.01.01.01.01.02_ResponseIncompleteReply-PEFR.pdf	D6A4BE52EED3E4D60ACD8673C4A685067BCDC356721F3C29FA454D55911FE3E57304894CE1BA4B31FC73DEB3CE832140DB74990E7E26D31B0A54567825A6D54D
PM001.01.03.01.01.01.01.01.02_ResponseIncompleteReply-SPEC.pdf	9C7F95B95D9D47C037FBD673039BE6F0588B7973E80AFB31A9BE8F4F360E04AD6BE2AC1A90733239D94530DDF6CE9B9B4668AD5B6037FC2786AD4CB202A4EC05
PM001.01.03.01.01.01.01.01.02_ResponseIncompleteReply-SPEC.pdf	CC2DF82FE945585EF9A40355C116E0A044777133A74163FD7E2CAFC58072D248B563FDE04444E7453564F85C6FF0FE5A63D593553A79F819AB5724A187356DC2

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

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New International Application Filed with the USPTO as a Receiving Office

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
18/323,385	05/24/2023		832	PM001.01.03.01.01.01.01.0	18	1

CONFIRMATION NO. 7585

UPDATED FILING RECEIPT

179918
Holland & Hart LLP/Oura Health Oy
P.O. Box 11583
Salt Lake City, UT 84147

OC000000060598542

Date Mailed: 08/15/2023

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

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Inventor(s)

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Peter Twiss, Lakewood, CA;

Applicant(s)

Ouraring Inc., San Francisco, CA;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 18/179,272 03/06/2023
which is a CON of 17/519,201 11/04/2021 PAT 11,599,147
which is a CON of 17/013,348 09/04/2020 PAT 11,188,124
which is a CON of 16/224,686 12/18/2018 PAT 10,768,666
which is a DIV of 15/444,217 02/27/2017 PAT 10,156,867
which is a DIV of 14/556,062 11/28/2014 PAT 9,582,034
which claims benefit of 62/006,835 06/02/2014
and claims benefit of 61/910,201 11/29/2013

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Petitioner Samsung Ex-1004, 1301

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

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If Required, Foreign Filing License Granted: 06/13/2023

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 18/323,385**

Projected Publication Date: 11/23/2023

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

WEARABLE COMPUTING DEVICE

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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Petitioner Samsung Ex-1004, 1302

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Title 37, Code of Federal Regulations, 5.11 & 5.15

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 18/323,385

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	64		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	280		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	320		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	18 minus 20 =	* 0	x =	0	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*	x =	0			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			168			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	832		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)	OR	RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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Sale Accounting Date:08/17/2023

Sale Item Reference Number	Effective Date
18323385	05/24/2023

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I20238G835397807	2830	PROCESSING FEE, EXCEPT PROV. APPLS.	$56.00	Deposit Account

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/323,385	05/24/2023	Curt C. von Badinski	PM001.01.03.01.01.01.0	7585

179918 7590 08/21/2023

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CENTRAL, DOCKET

ART UNIT	PAPER NUMBER
OPAP	

NOTIFICATION DATE	DELIVERY MODE
08/21/2023	ELECTRONIC

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Petitioner Samsung Ex-1004, 1307

Decision Granting Request for Prioritized Examination (Track I)	**Application No.** 18/323,385	**Applicant(s)** von Badinski et al.	
	Examiner ANGELA E WALKER	**Art Unit** OPET	**AIA (FITF) Status** Yes

1. THE REQUEST FILED 24 May 2023 IS **GRANTED** .

The above-identified application has met the requirements for prioritized examination

A. ☑ for an original nonprovisional application (Track I).
B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination**. The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

A. filing a **petition for extension of time** to extend the time period for filing a reply;

B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims** , or a multiple dependent claim;

C. filing a **request for continued examination** ;

D. filing a notice of appeal;

E. filing a request for suspension of action;

F. mailing of a notice of allowance;

G. mailing of a final Office action;

H. completion of examination as defined in 37 CFR 41.102; or

I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to ANGELA WALKER at (571) 272-1058. In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.

/ANGELA E WALKER/ Paralegal Specialist, OPET	

Petitioner Samsung Ex-1004, 1308

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

179918 7590 11/15/2023

Holland & Hart LLP/Oura Health Oy
P.O. Box 11583
Salt Lake City, UT 84147

EXAMINER
HUNNINGS, TRAVIS R

ART UNIT	PAPER NUMBER
2689	

DATE MAILED: 11/15/2023

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/323,385	05/24/2023	Curt C. von Badinski	PM001.01.03.01.01.01.0	7585

TITLE OF INVENTION: WEARABLE COMPUTING DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0.00	$0.00	$480	02/15/2024

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

Petitioner Samsung Ex-1004, 1309

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

179918 7590 11/15/2023
Holland & Hart LLP/Oura Health Oy
P.O. Box 11583
Salt Lake City, UT 84147

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/323,385	05/24/2023	Curt C. von Badinski	PM001.01.03.01.01.01.0	7585

TITLE OF INVENTION: WEARABLE COMPUTING DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0.00	$0.00	$480	02/15/2024

EXAMINER	ART UNIT	CLASS-SUBCLASS
HUNNINGS, TRAVIS R	2689	340-539120

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1_____
2_____
3_____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via Patent Center or EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29
NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

Petitioner Samsung Ex-1004, 1310

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/323,385	05/24/2023	Curt C. von Badinski	PM001.01.03.01.01.01.0	7585

179918 7590 11/15/2023

Holland & Hart LLP/Oura Health Oy
P.O. Box 11583
Salt Lake City, UT 84147

EXAMINER	
HUNNINGS, TRAVIS R	

ART UNIT	PAPER NUMBER
2689	

DATE MAILED: 11/15/2023

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Petitioner Samsung Ex-1004, 1311

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	**Application No.** 18/323,385	**Applicant(s)** von Badinski et al.	
	Examiner TRAVIS R HUNNINGS	**Art Unit** 2689	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 5/24/23.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-18 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/TRAVIS R HUNNINGS/
Primary Examiner, Art Unit 2689

Petitioner Samsung Ex-1004, 1313

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Allowable Subject Matter

Claims 1-18 are allowed.

The following is an examiner's statement of reasons for allowance: the prior art does not disclose nor suggest a finger-worn ring device with internal and external housing components, an inner circumferential cavity with a battery positioned and shaped to fit inside the cavity and including a circuit board disposed within the interior and exterior component and extending through a portion of the cavity. The closest prior art to Vescovi (US 20150277559) discloses a similar computing device but fails to disclose the particularly claimed structure.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to TRAVIS R HUNNINGS whose telephone number is (571)272-3118. The examiner can normally be reached MTHF 830-430 (Office); W 8-4 (Home).

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Joseph Feild can be reached on 571-272-4090. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/TRAVIS R HUNNINGS/
Primary Examiner, Art Unit 2689

Notice of References Cited	Application/Control No. 18/323,385	Applicant(s)/Patent Under Reexamination von Badinski et al.	
	Examiner TRAVIS R HUNNINGS	Art Unit 2689	Page 1 of 3

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20150277559-A1	10-2015	Vescovi; Marcos Regis	G06F3/017	345/173
*	B	US-20140230019-A1	08-2014	Civelli; Jay Pierre	G06F21/35	726/4
*	C	US-20130106603-A1	05-2013	Weast; Aaron B.	G06F1/163	340/539.11
*	D	US-20130027341-A1	01-2013	Mastandrea; Nicholas J.	G06F3/038	345/173
*	E	US-20060055517-A1	03-2006	Ghabra; Riad	H01Q7/00	340/426.11
*	F	US-11360558-B2	06-2022	Wang; Paul X.	G06T19/006	1/1
*	G	US-11360587-B1	06-2022	Wang; Paul X.	G06F3/016	1/1
*	H	US-11324292-B2	05-2022	Min; Jin-hong	G06F1/16	1/1
*	I	US-11262795-B2	03-2022	Kuwabara; Hideaki	G06F3/044	1/1
*	J	US-10863802-B2	12-2020	McLear; John	G06K19/07749	1/1
*	K	US-10579099-B2	03-2020	Wang; Paul X.	G06F1/163	1/1
*	L	US-10082829-B2	09-2018	Kuwabara; Hideaki	G06F1/1654	1/1
*	M	US-10281953-B2	05-2019	von Badinski; Curt C.	A61B5/7264	1/1

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Petitioner Samsung Ex-1004, 1316

Notice of References Cited	Application/Control No. 18/323,385	Applicant(s)/Patent Under Reexamination von Badinski et al.	
	Examiner TRAVIS R HUNNINGS	Art Unit 2689	Page 2 of 3

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-10884455-B2	01-2021	von Badinski; Curt C.	A61B5/6806	1/1
*	B	US-9582034-B2	02-2017	von Badinski; Curt C.	A61B5/349	1/1
*	C	US-9958904-B2	05-2018	von Badinski; Curt C.	A61B5/6826	1/1
*	D	US-10126779-B2	11-2018	von Badinski; Curt C.	A61B5/1455	1/1
*	E	US-10139859-B2	11-2018	von Badinski; Curt C.	G06F1/163	1/1
*	F	US-10156867-B2	12-2018	von Badinski; Curt C.	G06F3/014	1/1
*	G	US-10331168-B2	06-2019	von Badinski; Curt C.	G08B5/36	1/1
*	H	US-10496131-B2	12-2019	von Badinski; Curt C.	G08C17/02	1/1
*	I	US-10768666-B2	09-2020	von Badinski; Curt C.	G08B5/36	1/1
*	J	US-10901460-B2	01-2021	von Badinski; Curt C.	A61B5/6826	1/1
*	K	US-11188124-B2	11-2021	von Badinski; Curt C.	A61B5/0205	1/1
*	L	US-11599147-B2	03-2023	von Badinski; Curt C.	A61B5/349	1/1
*	M	US-20230270384-A1	08-2023	Apoorv; Shankar	A61B5/02055	600/301

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Petitioner Samsung Ex-1004, 1317

Notice of References Cited	Application/Control No. 18/323,385	Applicant(s)/Patent Under Reexamination von Badinski et al.	
	Examiner TRAVIS R HUNNINGS	Art Unit 2689	Page 3 of 3

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20200085360-A1	03-2020	Yuan; Haiquan	A61B5/14552	1/1
*	B	US-20180310891-A1	11-2018	FINE; Ilya	A61B5/02241	1/1
	C					
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	L					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Petitioner Samsung Ex-1004, 1318

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/323,385	von Badinski et al.
	Examiner	Art Unit
	TRAVIS R HUNNINGS	2689

CPC - Searched*		
Symbol	**Date**	**Examiner**
G06F 1/163	11/03/2023	TRH

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
inventor search	11/03/2023	TRH
text search of G06F 1/163	11/03/2023	TRH
SEARCH history attached	11/03/2023	TRH

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
G06F	1/163	11/03/2023	TRH

/TRAVIS R HUNNINGS/ Primary Examiner, Art Unit 2689	

Petitioner Samsung Ex-1004, 1319

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/323,385	von Badinski et al.
	Examiner	**Art Unit**
	TRAVIS R HUNNINGS	2689

CPC						
Symbol					**Type**	**Version**
G06F	/	1	/	163	F	2013-01-01
A61B	/	5	/	681	I	2013-01-01
A61B	/	5	/	6826	I	2013-01-01
H02J	/	7	/	35	I	2013-01-01
A61B	/	5	/	332	I	2021-01-01
A61B	/	5	/	349	I	2021-01-01
G06V	/	40	/	10	I	2022-01-01
G06V	/	40	/	70	I	2022-01-01
G06V	/	10	/	751	I	2022-01-01
G01P	/	15	/	00	I	2013-01-01
G04G	/	21	/	02	I	2013-01-01
G06F	/	3	/	014	I	2013-01-01
G06F	/	3	/	017	I	2013-01-01
G08B	/	21	/	02	I	2013-01-01
G08C	/	17	/	02	I	2013-01-01
G06F	/	1	/	1635	I	2013-01-01
G06F	/	3	/	14	I	2013-01-01
G08B	/	5	/	36	I	2013-01-01
H02J	/	7	/	0044	I	2013-01-01
H02S	/	40	/	22	I	2014-12-01
G02B	/	19	/	0052	I	2013-01-01
H02S	/	99	/	00	I	2013-01-01
A61B	/	5	/	01	I	2013-01-01
A61B	/	5	/	02416	I	2013-01-01
A61B	/	5	/	14532	I	2013-01-01
A61B	/	5	/	1455	I	2013-01-01
G06F	/	21	/	32	I	2013-01-01
A61B	/	5	/	0205	I	2013-01-01
G04G	/	21	/	025	I	2013-01-01
A61B	/	2560	/	0214	A	2013-01-01
A61B	/	2560	/	0412	A	2013-01-01

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	18	
/TRAVIS R HUNNINGS/ Primary Examiner, Art Unit 2689	03 November 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20231103

Petitioner Samsung Ex-1004, 1320

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/323,385	von Badinski et al.
	Examiner	**Art Unit**
	TRAVIS R HUNNINGS	2689

CPC						
Symbol					**Type**	**Version**
A61B	/	2562	/	146	A	2013-01-01
A61B	/	2562	/	164	A	2013-01-01
A61B	/	2562	/	166	A	2013-01-01
Y02E	/	10	/	52	A	2013-01-01
G06V	/	40	/	15	A	2022-01-01
G02B	/	19	/	0042	A	2013-01-01
G08C	/	2201	/	30	A	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	18	
/TRAVIS R HUNNINGS/ Primary Examiner, Art Unit 2689	03 November 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20231103

Petitioner Samsung Ex-1004, 1321

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/323,385	von Badinski et al.
	Examiner	**Art Unit**
	TRAVIS R HUNNINGS	2689

INTERNATIONAL CLASSIFICATION				
CLAIMED				
G06F	/	1	/	16

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	18	
/TRAVIS R HUNNINGS/ Primary Examiner, Art Unit 2689	03 November 2023	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20231103

Petitioner Samsung Ex-1004, 1322

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/323,385	von Badinski et al.
	Examiner	**Art Unit**
	TRAVIS R HUNNINGS	2689

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		10												
	2		11												
	3		12												
	4		13												
	5		14												
	6		15												
	7		16												
	8		17												
	9		18												

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 18	
/TRAVIS R HUNNINGS/ Primary Examiner, Art Unit 2689 (Primary Examiner)	03 November 2023 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

U.S. Patent and Trademark Office — Part of Paper No.: 20231103

Petitioner Samsung Ex-1004, 1323

Bibliographic Data

Application No: 18/323,385

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /TRAVIS R HUNNINGS/ (Examiner's Signature) | (Initials)

Title: WEARABLE COMPUTING DEVICE

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
05/24/2023	340	2689	PM001.01.03.01.01.01.01.0
RULE			

APPLICANTS

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INVENTORS

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Mr. Michael J. Strasser, San Francisco, CA, UNITED STATES

Mr. Peter Twiss, Lakewood, CA, UNITED STATES

CONTINUING DATA

This application is a CON of 18179272 03/06/2023

18179272 is a CON of 17519201 11/04/2021 PAT 11599147

17519201 is a CON of 17013348 09/04/2020 PAT 11188124

17013348 is a CON of 16224686 12/18/2018 PAT 10768666

16224686 is a DIV of 15444217 02/27/2017 PAT 10156867

15444217 is a DIV of 14556062 11/28/2014 PAT 9582034

14556062 has PRO of 62006835 06/02/2014

14556062 has PRO of 61910201 11/29/2013

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

06/13/2023

**** SMALL ENTITY ****

STATE OR COUNTRY

UNITED STATES

ADDRESS

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P.O. Box 11583

Salt Lake City, UT 84147
UNITED STATES

FILING FEE RECEIVED

$2,512

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	16	(("8279107") or ("9373256") or ("9589465") or ("20010052860") or ("20090098903") or ("20110099126") or ("20130106621") or ("20150339924")).PN.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:07 PM
L2	1	L1 and lidar	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:08 PM
L3	6	("9704400").PN.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:08 PM
L4	2356	340/932.2.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:11 PM
L5	386	g08g1/142.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:11 PM
L6	2685	L4 L5	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:12 PM
L7	18	L6 and park$4 with lidar	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:12 PM
L8	23	("20030112154" | "20040032342" | "20040068433" | "5910782" | "6694259" | "6750786").PN. OR ("7312722").URPN.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/01/04 01:14 PM
L9	41	L7 L8	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/01/04 01:14 PM
L10	18	L9 and lidar	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2018/01/04 01:14 PM
L11	38	340/$.ccls. and park$4 with lidar	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:20 PM
L12	40	340/$.ccls. and (park$4 occupancy) with lidar	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:20 PM
L13	24	L12 not L10	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:20 PM
L14	28	340/$.ccls. and (park$4) near3 (space garage occupancy) same lidar	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:22 PM

Petitioner Samsung Ex-1004, 1326

L15	143	(park$4) near3 (space garage occupancy) same lidar	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:22 PM
L16	11	L14 not L12	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:22 PM
L17	79	lidar with occupancy	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/01/04 01:24 PM
L22	2409	340/932.2.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/08/16 12:01 PM
L23	463	g08g1/142.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/08/16 12:01 PM
L24	2811	L22 L23	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2018/08/16 12:01 PM
L33	2448	340/932.2.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2019/01/04 09:37 AM
L34	521	g08g1/142.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2019/01/04 09:37 AM
L35	2903	L33 L34	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2019/01/04 09:37 AM
L36	25	L35 and park$4 with lidar	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2019/01/04 09:37 AM
L37	4	("10096247").PN.	(US-PGPUB; USPAT; EPO; JPO; DERWENT)	OR	OFF	OFF	2019/01/04 09:37 AM
L38	2493	340/932.2.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2019/04/25 03:25 PM
L39	604	g08g1/142.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2019/04/25 03:25 PM
L44	2574	340/932.2.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2019/09/09 04:40 PM
L45	684	g08g1/142.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2019/09/09 04:40 PM
L46	3182	L44 L45	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2019/09/09 04:40 PM
L47	35	L46 and park$4 with lidar	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2019/09/09 04:40 PM
L52	9	(("10510250") or	(US-PGPUB; USPAT;	OR	OFF	OFF	2020/04/10

Petitioner Samsung Ex-1004, 1327

		("10373493") or ("10096247")).PN.	EPO; JPO; DERWENT)				10:18 AM
L53	2563	340/932.2.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2021/07/14 12:16 PM
L54	9150	(G08G1/142 G08G1/04 G08G1/143 G08G1/144 G08G1/146).cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2021/07/14 12:17 PM
L55	11311	L53 L54	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2021/07/14 12:17 PM
L56	1341	L55 and lidar	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2021/07/14 12:17 PM
L57	9	"10748424"	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2021/07/14 12:37 PM
L58	2	("20150277559").PN.	(US-PGPUB; USPAT; EPO; JPO; DERWENT)	OR	OFF	OFF	2021/07/15 01:25 PM
L59	2856	340/932.2.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/10/03 12:00 PM
L60	11808	(G08G1/142 G08G1/04 G08G1/143 G08G1/144 G08G1/146).cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2022/10/03 12:00 PM
L61	7797	59 60	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2022/10/03 12:00 PM
L62	5	("20150277559" "20130106603" "20140230019" "20060055517" "20130027341").pn.	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2022/10/03 02:57 PM
L63	301	("2015/0277559").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/03 03:10 PM
L64	213	63 AND ring	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2022/10/03 03:10 PM
L65	25	63 AND (epoxy potting)	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2022/10/03 03:11 PM
L66	9	("6701618" | "7526927" | "9612578" | "20090306485" | "20120218184" | "20150220109" | "20150277559" | "20150342308" | "20180343993").pn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2022/10/03 03:14 PM
L67	20	("11188124" "10768666" "10901460" "10139859" "10156867"	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2022/10/03 03:20 PM

Petitioner Samsung Ex-1004, 1328

		"9582034" "9958904" "10281953" "10496131" "10126779" "10331168" "10884455").pn.					
L68	1	("11599147").pn.	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/07/06 02:21 PM
L69	12749	(G08G1/142 G08G1/04 G08G1/143 G08G1/144 G08G1/146).cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/07/06 02:35 PM
L70	8422	59 60	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/07/06 02:35 PM
L71	8422	69 70	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/07/06 02:35 PM
L72	8422	69 70	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/07/06 02:36 PM
L73	2914	340/932.2.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/07/06 02:36 PM
L74	8422	69 73	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/07/06 02:36 PM
L75	12930	(G08G1/142 G08G1/04 G08G1/143 G08G1/144 G08G1/146).cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/09/05 01:26 PM
L76	2948	340/932.2.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/09/05 01:26 PM
L77	8547	75 76	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/09/05 01:26 PM
L78	6	77 AND (accelerat$4) WITH (gesture)	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/09/05 01:26 PM
L79	13081	(G08G1/142 G08G1/04 G08G1/143 G08G1/144 G08G1/146).cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/10/19 09:33 AM
L80	2972	340/932.2.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/10/19 09:33 AM
L81	8659	79 80	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/10/19 09:33 AM
L82	361429	(G06F1/163 H02S40/22 A61B5/349 A61B5/332 G06V40/10 G06V10/751 G06V40/70 A61B5/01 A61B5/0205 A61B5/02416 A61B5/14532 A61B5/1455 A61B5/681 A61B5/6826 G01P15/00 G02B19/0052 G04G21/02 G04G21/025 G06F1/1635	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/10/19 09:35 AM

Petitioner Samsung Ex-1004, 1329

		G06F3/014 G06F3/017 G06F3/14 G06F21/32 G08B5/36 G08B21/02 G08C17/02 H02J7/0044 H02J7/35 H02S99/00 G06V40/15 A61B2560/0214 A61B2560/0412 A61B2562/146 A61B2562/164 A61B2562/166 G02B19/0042 G08C2201/30 Y02E10/52).cpc.					
L83	2382	340/539.12.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/10/19 09:35 AM
L84	363145	83 82	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/10/19 09:35 AM
L85	14813	84 AND (ring jewelry band circlet loop) WITH (light led illuminat$4)	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/10/19 09:43 AM
L86	1926	84 AND (ring jewelry band circlet loop) WITH (light led illuminat$4) SAME (transparent translucent clear)	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/10/19 10:06 AM
L87	60	84 AND (ring jewelry band circlet loop) WITH (light led illuminat$4) WITH (finger thumb hand) SAME (transparent translucent clear)	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/10/19 10:06 AM
L88	362382	(G06F1/163 H02S40/22 A61B5/349 A61B5/332 G06V40/10 G06V10/751 G06V40/70 A61B5/01 A61B5/0205 A61B5/02416 A61B5/14532 A61B5/1455 A61B5/681 A61B5/6826 G01P15/00 G02B19/0052 G04G21/02 G04G21/025 G06F1/1635 G06F3/014 G06F3/017 G06F3/14 G06F21/32 G08B5/36 G08B21/02 G08C17/02 H02J7/0044 H02J7/35 H02S99/00 G06V40/15	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/10/26 04:17 PM

Petitioner Samsung Ex-1004, 1330

		A61B2560/0214 A61B2560/0412 A61B2562/146 A61B2562/164 A61B2562/166 G02B19/0042 G08C2201/30 Y02E10/52).cpc.					
L89	2380	340/539.12.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/10/26 04:17 PM
L90	212934	88 89	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/10/26 04:17 PM
L91	14849	90 AND (ring jewelry band circlet loop) WITH (light led illuminat$4)	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/10/26 04:17 PM
L92	60	90 AND (ring jewelry band circlet loop) WITH (light led illuminat$4) WITH (finger thumb hand) SAME (transparent translucent clear)	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/10/26 04:17 PM
L93	2380	340/539.12.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/11/03 04:31 PM
L94	213300	88 89	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/11/03 04:31 PM
L95	213300	93 94	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/11/03 04:31 PM
L96	60	95 AND (ring jewelry band circlet loop) WITH (light led illuminat$4) WITH (finger thumb hand) SAME (transparent translucent clear)	(US-PGPUB; USPAT; USOCR; EPO; JPO)	OR	ON	ON	2023/11/03 04:31 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N18	844	340/932.2.ccls.	(USPAT)	OR	ON	ON	2018/05/11 02:28 PM
N19	84	g08g1/142.cpc.	(USPAT)	OR	ON	ON	2018/05/11 02:28 PM
N20	921	N18 N19	(USPAT)	OR	ON	ON	2018/05/11 02:28 PM
N21	10	N20 and park$4 with lidar	(USPAT)	OR	ON	ON	2018/05/11 02:28 PM
N25	844	340/932.2.ccls.	(USPAT)	OR	ON	ON	2018/08/16 12:01 PM
N26	95	g08g1/142.cpc.	(USPAT)	OR	ON	ON	2018/08/16

Petitioner Samsung Ex-1004, 1331

							12:01 PM
N27	932	N25 N26	(USPAT)	OR	ON	ON	2018/08/16 12:01 PM
N28	10	N27 and (park$4) near3 (space garage occupancy) same lidar	(USPAT)	OR	ON	ON	2018/08/16 12:01 PM
N29	844	340/932.2.ccls.	(USPAT)	OR	ON	ON	2018/08/23 09:17 AM
N30	95	g08g1/142.cpc.	(USPAT)	OR	ON	ON	2018/08/23 09:17 AM
N31	932	N29 N30	(USPAT)	OR	ON	ON	2018/08/23 09:17 AM
N32	10	N31 and (park$4) near3 (space garage occupancy) same lidar	(USPAT)	OR	ON	ON	2018/08/23 09:17 AM
N40	844	340/932.2.ccls.	(USPAT)	OR	ON	ON	2019/04/25 03:25 PM
N41	113	g08g1/142.cpc.	(USPAT)	OR	ON	ON	2019/04/25 03:26 PM
N42	949	N40 N41	(USPAT)	OR	ON	ON	2019/04/25 03:26 PM
N43	11	N42 and (park$4) near3 (space garage occupancy) same lidar	(USPAT)	OR	ON	ON	2019/04/25 03:26 PM
N48	843	340/932.2.ccls.	(USPAT)	OR	ON	ON	2019/09/11 04:46 PM
N49	119	g08g1/142.cpc.	(USPAT)	OR	ON	ON	2019/09/11 04:46 PM
N50	954	N48 N49	(USPAT)	OR	ON	ON	2019/09/11 04:46 PM
N51	13	N50 and (park$4) near3 (space garage occupancy) same lidar	(USPAT)	OR	ON	ON	2019/09/11 04:47 PM
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N60	193	g08g1/142.cpc.	(USPAT)	OR	ON	ON	2021/07/15 01:03 PM
N61	1029	N59 N60	(USPAT)	OR	ON	ON	2021/07/15 01:03 PM
N62	22	N61 and (park$4) near3 (space garage occupancy) same lidar	(USPAT)	OR	ON	ON	2021/07/15 01:03 PM
N63	18937	(G08G1/142 G08G1/04 G08G1/143 G08G1/144 G08G1/146 g06f1/163).cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N64	844	340/932.2.ccls.	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N65	844	340/932.2.ccls.	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N66	260	g08g1/142.cpc.	(USPAT)	OR	ON	ON	2023/01/11

Petitioner Samsung Ex-1004, 1332

							04:15 PM
N67	1096	N18 N19	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N68	28	N20 and park$4 with lidar	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N69	844	340/932.2.ccls.	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N70	260	g08g1/142.cpc.	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N71	1096	N25 N26	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N72	28	N27 and (park$4) near3 (space garage occupancy) same lidar	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N73	844	340/932.2.ccls.	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N74	260	g08g1/142.cpc.	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N75	1096	N29 N30	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N76	28	N31 and (park$4) near3 (space garage occupancy) same lidar	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N77	844	340/932.2.ccls.	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N78	260	g08g1/142.cpc.	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N79	1096	N40 N41	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N80	28	N42 and (park$4) near3 (space garage occupancy) same lidar	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N81	844	340/932.2.ccls.	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N82	260	g08g1/142.cpc.	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N83	1096	N48 N49	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N84	28	N50 and (park$4) near3 (space garage occupancy) same lidar	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N85	844	340/932.2.ccls.	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N86	260	g08g1/142.cpc.	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N87	1096	N59 N60	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N88	28	N61 and (park$4) near3 (space garage occupancy) same lidar	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM

Petitioner Samsung Ex-1004, 1333

N89	18937	(G08G1/142 G08G1/04 G08G1/143 G08G1/144 G08G1/146 g06f1/163).cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N90	844	340/932.2.ccls.	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N91	20181	N63 N64	(US-PGPUB; USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N92	87	n91 AND (park$4) near3 (space garage occupancy) SAME lidar	(USPAT)	OR	ON	ON	2023/01/11 04:15 PM
N93	20449	(G08G1/142 G08G1/04 G08G1/143 G08G1/144 G08G1/146 g06f1/163).cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2023/09/05 01:25 PM
N94	882	340/932.2.ccls.	(USPAT)	OR	ON	ON	2023/09/05 01:25 PM
N95	21727	N93 n94	(US-PGPUB; USPAT)	OR	ON	ON	2023/09/05 01:25 PM
N96	110	n95 AND (park$4) near3 (space garage occupancy) SAME lidar	(USPAT)	OR	ON	ON	2023/09/05 01:25 PM
N97	882	340/932.2.ccls.	(USPAT)	OR	ON	ON	2023/09/05 01:26 PM
N98	197441	(G06F1/163 H02S40/22 A61B5/349 A61B5/332 G06V40/10 G06V10/751 G06V40/70 A61B5/01 A61B5/0205 A61B5/02416 A61B5/14532 A61B5/1455 A61B5/681 A61B5/6826 G01P15/00 G02B19/0052 G04G21/02 G04G21/025 G06F1/1635 G06F3/014 G06F3/017 G06F3/14 G06F21/32 G08B5/36 G08B21/02 G08C17/02 H02J7/0044 H02J7/35 H02S99/00 G06V40/15 A61B2560/0214 A61B2560/0412 A61B2562/146 A61B2562/164 A61B2562/166 G02B19/0042 G08C2201/30 Y02E10/52).cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2023/10/19 02:50 PM
N99	1373	340/539.12.ccls.	(US-PGPUB; USPAT)	OR	ON	ON	2023/10/19 02:50 PM

Petitioner Samsung Ex-1004, 1334

N100	198422	N98 N99	(US-PGPUB; USPAT)	OR	ON	ON	2023/10/19 02:53 PM
N101	59	n100 AND (ring jewelry band circlet loop) WITH (light led illuminat$4) WITH (finger thumb hand) SAME (transparent translucent clear)	(US-PGPUB; USPAT)	OR	ON	ON	2023/10/19 02:53 PM
N102	1371	340/539.12.ccls.	(US-PGPUB; USPAT)	OR	ON	ON	2023/10/26 04:18 PM
N103	197818	(G06F1/163 H02S40/22 A61B5/349 A61B5/332 G06V40/10 G06V10/751 G06V40/70 A61B5/01 A61B5/0205 A61B5/02416 A61B5/14532 A61B5/1455 A61B5/681 A61B5/6826 G01P15/00 G02B19/0052 G04G21/02 G04G21/025 G06F1/1635 G06F3/014 G06F3/017 G06F3/14 G06F21/32 G08B5/36 G08B21/02 G08C17/02 H02J7/0044 H02J7/35 H02S99/00 G06V40/15 A61B2560/0214 A61B2560/0412 A61B2562/146 A61B2562/164 A61B2562/166 G02B19/0042 G08C2201/30 Y02E10/52).cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2023/10/26 04:18 PM
N104	198798	N102 N103	(US-PGPUB; USPAT)	OR	ON	ON	2023/10/26 04:18 PM
N105	9	N104 AND (park$4) near3 (space garage occupancy) SAME lidar	(USPAT)	OR	ON	ON	2023/10/26 04:18 PM
N106	1371	340/539.12.ccls.	(US-PGPUB; USPAT)	OR	ON	ON	2023/11/03 04:31 PM
N107	198184	(G06F1/163 H02S40/22 A61B5/349 A61B5/332 G06V40/10 G06V10/751 G06V40/70 A61B5/01 A61B5/0205 A61B5/02416 A61B5/14532 A61B5/1455 A61B5/681	(US-PGPUB; USPAT)	OR	ON	ON	2023/11/03 04:31 PM

Petitioner Samsung Ex-1004, 1335

		A61B5/6826 G01P15/00 G02B19/0052 G04G21/02 G04G21/025 G06F1/1635 G06F3/014 G06F3/017 G06F3/14 G06F21/32 G08B5/36 G08B21/02 G08C17/02 H02J7/0044 H02J7/35 H02S99/00 G06V40/15 A61B2560/0214 A61B2560/0412 A61B2562/146 A61B2562/164 A61B2562/166 G02B19/0042 G08C2201/30 Y02E10/52).cpc.					
N108	199164	N106 N107	(US-PGPUB; USPAT)	OR	ON	ON	2023/11/03 04:31 PM
N109	9	N108 AND (park$4) near3 (space garage occupancy) SAME lidar	(USPAT)	OR	ON	ON	2023/11/03 04:31 PM

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Sheet 1 of 8

Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

U. S. PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Document Number Number-Kind Code[2] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
	001	1589547	1926-06-22	Novack	
	002	2048878	1936-07-28	Moldenhauer	
	003	3022648	1962-02-27	Thaler	
	004	3653051	1972-03-28	WU	
	005	3684125	1972-08-15	Laurizio	
	006	4407295	1983-08-04	Steuer et al.	
	007	4541207	1985-09-17	Antonson	
	008	5191891	1993-03-09	Righter	
	009	5382778	1995-01-17	Takahira et al.	
	010	5490523	1996-02-13	Isaacson et al.	
	011	5832296	1998-11-03	Wang et al.	
	012	5964701	1999-10-12	Asada et al.	
	013	6101843	2000-08-15	Nagano	
	014	6255800	2001-07-03	Bork	
	015	6277079	2001-08-21	Avicola et al.	
	016	6495283	2002-12-17	Yoon et al.	
	017	6502906	2003-01-07	Chen	
	018	6546749	2003-04-15	Canty	
	019	6608562	2003-08-19	Kimura et al.	
	020	7161484	2007-01-09	Tsoukalis	
	021	7375494	2008-05-20	Daniel et al.	
	022	7374540	2008-05-20	Schnall	
	023	7427979	2008-09-23	Park et al.	
	024	7444001	2008-10-28	Roberts et al.	
	025	7517222	2009-04-14	Rohrbach et al.	
	026	7526927	2009-05-05	Pinto	

Examiner Signature	/TRAVIS R HUNNINGS/	Date Considered	10/26/2023

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Sheet 2 of 8

Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

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	027	7555327	2009-06-30	Matlock	
	028	7637746	2009-12-29	Lindberg et al.	
	029	7733224	2010-06-08	Tran	
	030	8157161	2012-04-17	Yach	
	031	8157731	2012-04-17	Teller et al.	
	032	8270914	2012-09-18	Pascolini et al.	
	033	8346327	2013-01-01	Campbell et al.	
	034	8373656	2013-02-12	Hou et al.	
	035	8421748	2013-04-16	Tanaka	
	036	8457654	2013-06-04	Roskind	
	037	8515506	2013-08-20	Ridder et al.	
	038	8554297	2013-10-08	Moon et al.	
	039	8570372	2013-10-29	Russell	
	040	8583167	2013-11-12	Chun	
	041	8599572	2013-12-03	Neudecker et al.	
	042	8626249	2014-01-07	Ungari et al.	
	043	8638190	2014-01-28	Want et al.	
	044	8888720	2014-11-18	Hudson	
	045	8954135	2015-02-10	Yuen et al.	
	046	9076589	2015-07-07	Wright et al.	
	047	9110505	2015-08-18	Mastandrea Jr	
	048	9113793	2015-08-25	Terumoto et al.	
	049	9148717	2015-09-29	Shaffer	
	050	9197270	2015-11-24	Ying et al.	
	051	9203463	2015-12-01	Asrani et al.	
	052	9311825	2016-04-12	Lusted et al.	

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Sheet 3 of 8

Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

U. S. PATENT DOCUMENTS

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	053	9313609	2016-04-12	Prencipe	
	054	9335790	2016-05-10	Stoller	
	055	9345404	2016-05-24	Proud	
	056	9414125	2016-08-09	Ferren et al.	
	057	9734477	2017-08-15	Weast et al.	
	058	9788789	2018-10-17	Bailey	
	059	10085689	2018-10-02	Giuffrida et al.	
	060	10219709	2019-03-05	Basu	
	061	10729388	2020-08-04	Reihman et al.	
	062	20020156352	2002-10-24	Eggers	
	063	20030142065	2003-07-31	Pahlavan	
	064	20050038348	2005-02-17	Avicola et al.	
	065	20050189906	2005-09-01	SUN HUEI-HSIN	
	066	20060046709	2006-03-02	Krumm et al.	
	067	20060142968	2006-06-29	Han et al.	
	068	20060202618	2006-09-14	Ishii et al.	
	069	20070100218	2007-05-03	Sweitzer et al.	
	070	20070100666	2007-05-03	STIVORIC JOHN M	
	071	20070123756	2007-05-31	Kitajima et al.	
	072	20080045806	2008-02-21	Keppler	
	073	20080048036	2008-02-28	Matsumoto et al.	
	074	2008266118	2008-10-30	Pierson et al.	
	075	20090306485	2009-12-10	Bell	
	076	20100100004	2010-04-22	van Someren	
	077	20100156624	2010-06-24	Hounsell	
	078	2010168531	2010-07-01	Shaltis et al.	

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Sheet 4 of 8

Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

U. S. PATENT DOCUMENTS

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	079	2010298677	2010-11-25	Lu et al.	
	080	20110038511	2011-02-17	Takiguchi	
	081	20110057901	2011-03-10	Raty et al.	
	082	20110070480	2011-03-24	Hahn et al.	
	083	20110070480	2011-03-24	Griffin et al.	
	084	20110312311	2011-12-22	Abifaker et al.	
	085	20120016793	2012-01-19	Peters et al.	
	086	20120130203	2012-05-24	Stergiou et al.	
	087	20120218184	2012-08-30	Wissmar	
	088	20120220835	2012-08-30	Chung	
	089	20120254809	2012-10-04	Yang et al.	
	090	20120293107	2012-11-22	Ajagbe; Adebowale	
	091	20120317024	2012-12-13	Rahman et al.	
	092	20130027341	2013-01-31	Masandrea	
	093	20130044215	2013-02-21	Rothkopf et al.	
	094	20130069583	2013-03-21	Lemelman et al.	
	095	20130088186	2013-04-11	Hsieth	
	096	20130106603	2013-05-02	WEAST AARON B	
	097	20130108907	2013-05-02	Bhardwaj et al.	
	098	20130131519	2013-05-23	LEBOEUF STEVEN FRANCIS	
	099	20130144176	2013-06-06	Lec	
	100	20130217326	2013-06-22	Symons	
	101	20130167221	2013-06-27	VUKOSZAVL YEV et al.	
	102	20130191789	2013-07-25	Calman et al.	
	103	20130226486	2013-08-29	Henderson et al.	
	104	20130261771	2013-10-03	Ten Kate	

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Sheet 5 of 8

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Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

U. S. PATENT DOCUMENTS

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	105	20130271069	2013-10-17	Partovi	
	106	20130163326	2013-10-31	Hunter et al.	
	107	20130332286	2013-12-12	Medelius et al.	
	108	20140065956	2014-03-08	Yang et al.	
	109	20140102136	2014-04-17	Warren	
	110	20150037616	2015-02-05	Wyatt et al.	
	111	20150177559	2015-10-01	Vescovi et al.	
	112	20150303722	2015-10-22	Li	
	113	20150349556	2015-12-03	Mercando et al.	
	114	20150380961	2015-12-31	Tseng et al.	
	115	20150327809	2015-11-19	Tateda et al.	
	116	2015342468	2015-12-03	Semler et al.	
	117	20160013602	2016-01-14	Strisower et al.	
	118	2017006414	2017-01-05	Tomassini	

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]-Number[4]-Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
	119	CN-103109462-A	2013-05-15	Masntandrea et al.		☐
	120	CN-103441306-A	2013-12-11	Huizhou Techne Group Co Ltd.		
	121	CN-204440426-U	2015-07-01	Huizhou 8 MM Technology Co., Ltd.		
	122	CN-204732935-U	2015-10-28	Shi Xiong		

Examiner Signature	/TRAVIS R HUNNINGS/	Date Considered	10/26/2023

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.R.H/

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 6 of 8

Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

FOREIGN PATENT DOCUMENTS

Examiner Initials*	Cite No.[1]	Foreign Patent Document Country Code[3]–Number[4]–Kind Code[5] (if known)	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages Or Relevant Figures Appear	T[6]
	123	DE-202006000119-U1	2006-04-05	TaiDoc Technology Corp.		
	124	EP-2660680-A1	2013-11-06	Alcatel Lucent		
	125	FR-2767384-B3	1997-08-14	Chen Mei Yen		
	126	JP-2003275192	2003-09-30	Citizen Watch Co Ltd		
	127	KR-200417885-Y1	2006-03-13	KIM KYUNG		
	128	KR-20100091592-A	2010-08-19	Kim Ki-jung		
	129	WO-2009079461-A	2009-06-25	NELLCOR PURITAN BENNETT LLC		
	130	WO-2004078028-A2	2004-09-16	Avicola et al.		
	131	WO-2006060949-A1	2006-06-15	We-All Patent Agent Co., LTD		
	132	WO-2009124076-A1	2009-10-08	NELLCOR PURITAN BENNETT LLC		
	133	WO-2011053235-A1	2011-05-05	Wissmar et al.		
	134	WO-2012024889-A1	2012-03-01	Wang		
	135	WO-2013104629-A1	2013-07-18	Kaptalia Monitoring		
	136	WO-2013093638-A2	2013-06-27	MASHINERY PTY LTD		
	137	WO-2013163326-A1	2013-10-31	QUALCOMM Incorporated		

Examiner Signature	/TRAVIS R HUNNINGS/	Date Considered	10/26/2023

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. [1] Applicant's unique citation designation number (optional). [2] See Kinds Codes of USPTO Patent Documents at www.uspto.gov or MPEP 901.04. [3] Enter Office that issued the document, by the two-letter code (WIPO Standard ST.3). [4] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [5] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [6] Applicant is to place a check mark here if English language Translation is attached.

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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 7 of 8

Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

NON-PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.[1]	Include name of the author(in CAPITAL LETTERS),title of the article(when appropriate), title of the item (book,magazine,journal,serial,symposium,catalog,etc.),date,page(s),volume-issue number(s),publisher, city and/or country where published.	T[2]
	138	SAMEDAYFLASH, "SET OF 10 2GB/4GB/8GB/16GB WOODEN BAMBOO FLASH DRIVE – BULK PACK O USB 2.0 WOOD BAMBOO STICK DESIGN – WOOD USB FLASH DRIVE", www.etsy.com/listing/248051205/set-of-10-2gb4gb8gb16gb-wooden-bamboo?ref+m", 6/2/2016, Publisher: Etsy, Published in: US	
	139	Medical Mood Ring – Anonymous- Technology Review; Apr. 2004; 107, 3; ProQuest Pg. 18	

Examiner Signature	/TRAVIS R HUNNINGS/	Date Considered	10/26/2023

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant's unique citation designation number (optional). 2 Applicant is to place a check mark here if English language Translation is attached.

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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 8 of 8

Complete if Known	
Application Number	18/323,385
Filing Date	May 24, 2023
First Named Inventor	von Badinski; CURT C.
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	PM001.01.03.01.01.01.01.02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Nathan J. Mutter/	Date (YYYY-MM-DD)	2023-07-21
Name/Print	Nathan J. Mutter	Registration Number	70,107

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.R.H/

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
18/323,385	05/24/2023	Curt C. von Badinski	PM001.01.03.01.01.01.01.0

CONFIRMATION NO. 7585

179918
Holland & Hart LLP/Oura Health Oy
P.O. Box 11583
Salt Lake City, UT 84147

PUBLICATION NOTICE

OC000000064956360

Date Mailed: 11/24/2023

Title:WEARABLE COMPUTING DEVICE

Publication No.US-2023-0376071-A1
Publication Date:11/23/2023

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

Petitioner Samsung Ex-1004, 1345

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/323,385	11/29/2023 05:10:45 PM Z ET	PM001.01.03.01.01.01.01.0

Title of Invention

WEARABLE COMPUTING DEVICE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	7585	FILED BY	Jamie LaFleur
PATENT CENTER #	63422048	AUTHORIZED BY	Nathan Mutter
CUSTOMER #	179918	FILING DATE	05/24/2023
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Mr. Curt C. von Badinski

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
DA / 082623	E2023ASH11248880	Jamie LaFleur

PRE-AUTHORIZED ACCOUNT

082623

PRE-AUTHORIZED CATEGORY

37 CFR 1.16 (National application filing, search, and examination fees); 37 CFR 1.17 (Patent application and reexamination processing fees); 37 CFR 1.19 (Document supply fees); 37 CFR 1.20 (Post Issuance fees); 37 CFR 1.21 (Miscellaneous fees and charges)

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1501	UTILITY ISSUE FEE	1200.00	1	1200.00
			TOTAL AMOUNT:	$1,200.00

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement

Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

179918 7590 11/15/2023
Holland & Hart LLP/Oura Health Oy
P.O. Box 11583
Salt Lake City, UT 84147

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

Jamie LaFleur	(Typed or printed name)
/Jamie LaFleur/	(Signature)
November 29, 2023	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/323,385	05/24/2023	Curt C. von Badinski	PM001.01.03.01.01.01.0	7585

TITLE OF INVENTION: WEARABLE COMPUTING DEVICE

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$480	$0.00	$0.00	$480	02/15/2024

EXAMINER	ART UNIT	CLASS-SUBCLASS
HUNNINGS, TRAVIS R	2689	340-539120

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Holland & Hart LLP
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Ouraring, Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): San Francisco, CA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via Patent Center or EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 08-2623

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

☐ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

☒ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Nathan J. Mutter/ Date November 29, 2023

Typed or printed name Nathan J. Mutter Registration No. 70,107

PTOL-85 Part B (08-18) Approved for use through 01/31/2020 OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Petitioner Samsung Ex-1004, 1348

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/323,385	**11/29/2023 05:10:45 PM Z ET**	**PM001.01.03.01.01.01.01.0**

Title of Invention

WEARABLE COMPUTING DEVICE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	7585	FILED BY	Jamie LaFleur
PATENT CENTER #	63422048	FILING DATE	05/24/2023
CUSTOMER #	179918	FIRST NAMED INVENTOR	Mr. Curt C. von Badinski
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Nathan Mutter

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
18323385IssueFee.pdf	1	Issue Fee Payment (PTO-85B)	990 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
18323385IssueFee.pdf	E4497105B0759BAD08F4EA542264B53323B16510C5A1C5B442CE3EF59BBFF17957296D8F9BC19D0244124E958FA012DEB95D939BC028ABC8422DA3CBA6685778

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as

described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/323,385	01/09/2024	11868178	PM001.01.03.01.01.01.01.0	7585

179918 7590 12/20/2023

Holland & Hart LLP/Oura Health Oy
P.O. Box 11583
Salt Lake City, UT 84147

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (https://patentcenter.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

Petitioner Samsung Ex-1004, 1351

INVENTOR(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional inventors):

Mr.Curt C. von Badinski, Valencia, CA;
Mr.Michael J. Strasser, San Francisco, CA;
Mr.Peter Twiss, Lakewood, CA;

APPLICANT(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional applicants):

Ouraring Inc., San Francisco, CA;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

Petitioner Samsung Ex-1004, 1352

UNITED STATES PATENT AND TRADEMARK OFFICE

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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/323,385	05/24/2023	Curt C. von Badinski	PM001.01.03.01.01.01.0	7585

179918 7590 01/09/2024

Holland & Hart LLP/Oura Health Oy
P.O. Box 11583
Salt Lake City, UT 84147

EXAMINER	
HUNNINGS, TRAVIS R	

ART UNIT	PAPER NUMBER
2689	

NOTIFICATION DATE	DELIVERY MODE
01/09/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

oura.pair.acct.1@maxval.com
patentdocket@hollandhart.com
patentdocketing@ouraring.com

Petitioner Samsung Ex-1004, 1353

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	ISSUE DATE	PATENT NO.
18/323,385	09-Jan-2024	11868178

Holland & Hart LLP/Oura Health Oy
P.O. Box 11583
Salt Lake City, UT 84147

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at https://patentcenter.uspto.gov

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit https://www.uspto.gov/electronicgrants

Petitioner Samsung Ex-1004, 1354

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www.uspto.gov

ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/323,385	01/09/2024 03:54:02 PM Z ET	PM001.01.03.01.01.01.01.0

Title of Invention

WEARABLE COMPUTING DEVICE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	11868178
CONFIRMATION #	7585	FILED BY	Jamie LaFleur
PATENT CENTER #	63891281	AUTHORIZED BY	Anthony Ferris
CUSTOMER #	179918	FILING DATE	05/24/2023
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Mr. Curt C. von Badinski

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
DA / 082623	E202419F54229489	Jamie LaFleur

PRE-AUTHORIZED ACCOUNT

082623

PRE-AUTHORIZED CATEGORY

37 CFR 1.16 (National application filing, search, and examination fees); 37 CFR 1.17 (Patent application and reexamination processing fees); 37 CFR 1.19 (Document supply fees); 37 CFR 1.20 (Post Issuance fees); 37 CFR 1.21 (Miscellaneous fees and charges)

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1811	CERTIFICATE OF CORRECTION	160.00	1	160.00
			TOTAL AMOUNT:	$160.00

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: von Badinski et al. Application No.: 18/323,385 Filed: May 24, 2023 For: WEARABLE COMPUTING DEVICE Docket No.: PM001.01.03.01.01.01.01.02 (112434.0517) Customer No.: 179918	Confirmation No.: 7585 Examiner: Travis R. Hunnings Art Unit: 2689 **REQUEST FOR CERTIFICATE OF CORRECTION OF APPLICANT'S MISTAKE (37 CFR 1.323)** **CERTIFICATE OF TRANSMISSION** I hereby certify that this correspondence is being filed via EFS-Web with the United States Patent and Trademark Office on January 9, 2024. By: / Jamie LaFleur / Jamie LaFleur

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

The assignee of the above-identified patent hereby requests that a Certificate of Correction be issued by the Office to correct the errors that are attributable to the applicant and identified on the enclosed Form PTO/SB/44.

The errors in the patent that are attributable to the applicant are of a clerical or typographical nature, or of minor character, occurred in good faith, and are not believed to constitute new matter or require examination.

The fee set forth in 37 CFR §1.20(a) is submitted herewith. Please deduct any additional fees from, or credit any overpayment to, the above-noted Deposit Account.

Respectfully Submitted,

/ A. Mitchell Ferris /
A. Mitchell Ferris
Reg. No. 77,060

HOLLAND & HART LLP
P.O. Box 11583
Salt Lake City, Utah 84147
Tel: 208-342-5000
Fax: 208-343-8869

PTO/SB/44 (09-07)
Approved for use through 03/31/2023. OMB 0651-0033
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 11,868,178

APPLICATION NO.: 18/323,385

ISSUE DATE : January 9, 2024

INVENTOR(S) : von Badinski et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the claims:

Claim 17, column 46, lines 48-50 should read:

"and the internal housing component define the cavity configured to at least partially surround the battery"

MAILING ADDRESS OF SENDER (Please do not use Customer Number below):

Holland & Hart LLP
P.O. Box 11583
Salt Lake City, UT

This collection of information is required by 37 CFR 1.322, 1.323, and 1.324. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1.0 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Attention Certificate of Corrections Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary, and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/323,385	**01/09/2024 03:54:02 PM Z ET**	**PM001.01.03.01.01.01.01.0**

Title of Invention

WEARABLE COMPUTING DEVICE

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	11868178
CONFIRMATION #	7585	FILED BY	Jamie LaFleur
PATENT CENTER #	63891281	FILING DATE	05/24/2023
CUSTOMER #	179918	FIRST NAMED INVENTOR	Mr. Curt C. von Badinski
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Anthony Ferris

Documents

TOTAL DOCUMENTS: 2

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
18323385_RequestForCoC.pdf		3	-	234 KB
18323385_RequestForCoC-TRAN.LET.pdf	(1-1)	1	Transmittal Letter	70 KB
18323385_RequestForCoC-COCIN.pdf	(2-3)	2	Request for Certificate of Correction	158 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)

18323385_RequestForCoC.pdf	4DDC58A568F30C5494B95D122E1BC854577E83906BA7BACE6 AAB35620CCA215377CF35B7F2D5BA3A0D48785B8F8CBA2E5 43A26914FB83CE6EAC5CD6AD29397AA
18323385_RequestForCoC-TRAN.LET.pdf	F5A1E1584B8C91ED1A9470F0EF462004332AB367ACD0B861E 442D49F39A68A69CF5E549CE8A3CC0ED487DBE25721323747 DA17C70B255AD6FA27BCE2C458BF6C
18323385_RequestForCoC-COCIN.pdf	8C79A197F1F7A19821B9C16BBDA0A4F265C98FCCBEE6016F0 F7CDCC95CD868B917F06C58FB13207AE61D6D325340C07F7E B26924D63A7E2F062E4F81E5B3FF2A

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UNITED STATES
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

ACKNOWLEDGEMENT OF LOSS OF ENTITLEMENT TO ENTITY STATUS DISCOUNT

APPLICATION #	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET #	REQUEST ID
18/323,385	05/24/2023	Curt C. von Badinski	PM001.01.03.01.01.01.01.0	183008

The entity status change request below filed through Patent Center on 03/15/2024 has been accepted.

Certifications

APPLICANT CHANGING TO REGULAR UNDISCOUNTED FEE STATUS

Signature

I certify, in accordance with 37 CFR 1.4(d)(4), that I am one of the signatories making the entity status change.

Signature	Name	Registration #
/Nathan J. Mutter/	Nathan Mutter	70107

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 11,868,178 B2
APPLICATION NO. : 18/323385
DATED : January 9, 2024
INVENTOR(S) : von Badinski et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

Claim 17, Column 46, Lines 48-50 should read:
"and the internal housing component define the cavity configured to at least partially surround the battery"

Signed and Sealed this
Twenty-first Day of May, 2024

Katherine Kelly Vidal

Katherine Kelly Vidal
Director of the United States Patent and Trademark Office

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/323,385	05/24/2023	Curt C. von Badinski	PM001.01.03.01.01.01.01.0	7585

179918 7590 05/21/2024
Holland & Hart LLP/Oura Health Oy
P.O. Box 11583
Salt Lake City, UT 84147

EXAMINER	
HUNNINGS, TRAVIS R	

ART UNIT	PAPER NUMBER
2689	

NOTIFICATION DATE	DELIVERY MODE
05/21/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

oura.pair.acct.1@maxval.com
patentdocket@hollandhart.com
patentdocketing@ouraring.com

Petitioner Samsung Ex-1004, 1364

APPLICATION NO.	ISSUE DATE	PATENT NO.
18/323,385	21-May-2024	11868178

Holland & Hart LLP/Oura Health Oy
P.O. Box 11583
Salt Lake City, UT 84147

ELECTRONIC CERTIFICATE OF CORRECTION NOTIFICATION

Your electronic certificate of correction is now available, and can be accessed via Patent Center at https://patentcenter.uspto.gov.

The electronic certificate of correction is the official certificate of correction under 35 U.S.C. 254 or 255. For more information, please visit https://www.uspto.gov/electronicgrants.

Petitioner Samsung Ex-1004, 1365

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

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APPLICATION NO. : 18/323385
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Director of the United States Patent and Trademark Office