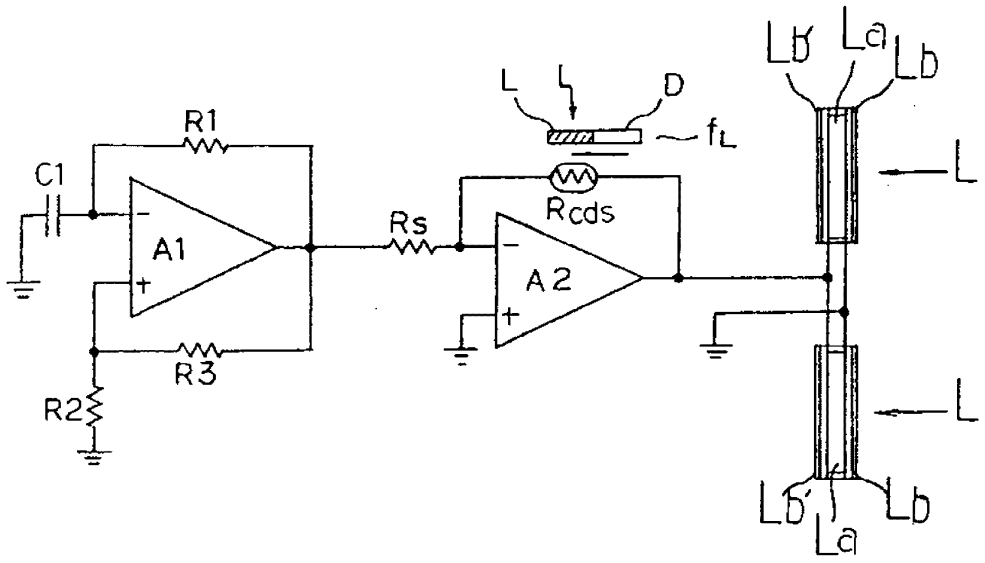
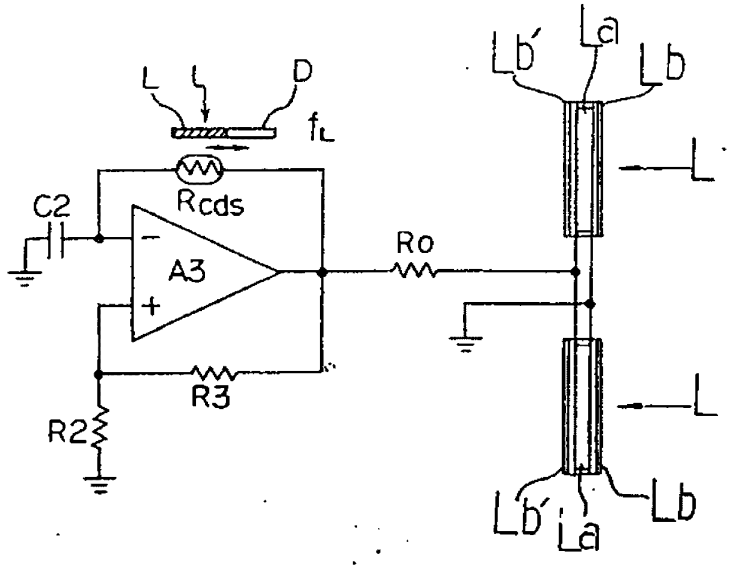
第15図



第16図

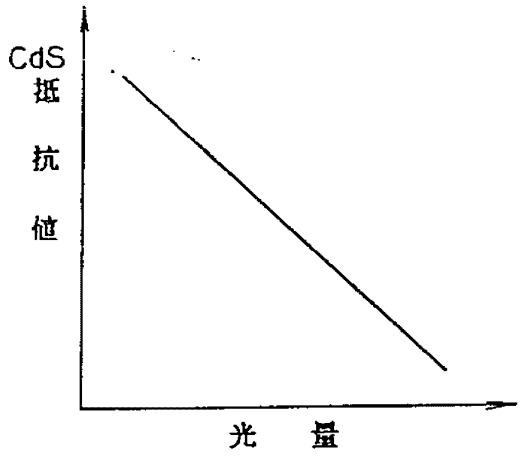


代理人
弁理士 畠 山 [illegible]

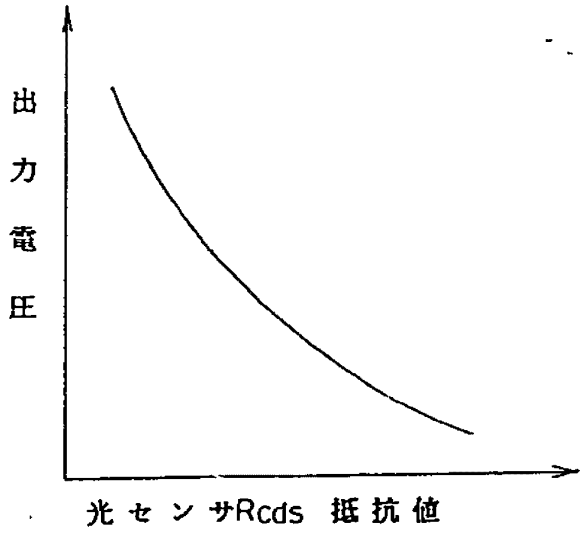
222

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1383_PRIOR_ART_000432



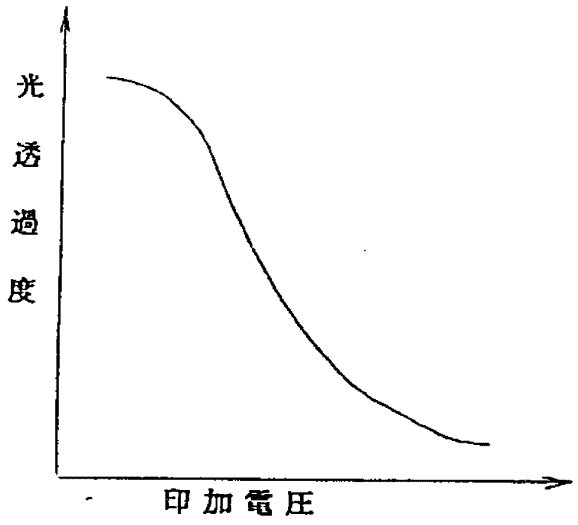
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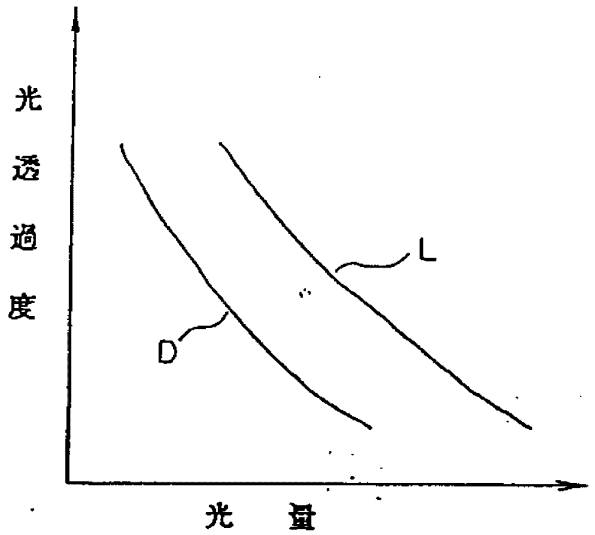
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代理人
223 弁理士 畠 山 隆

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JP6301_PRIOR_ART_000433

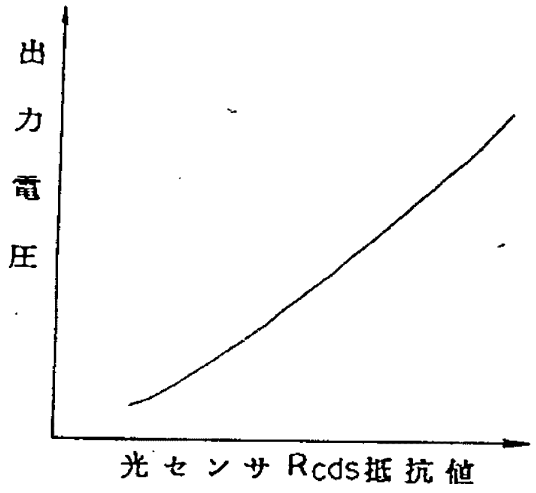


第19図

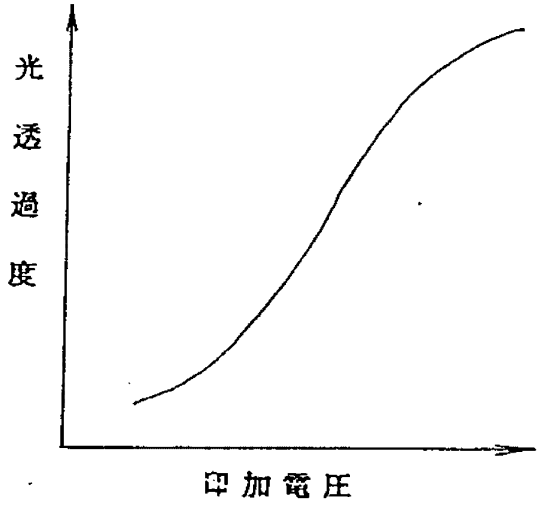


第20図

代理人
弁理士 畠 山



第21図

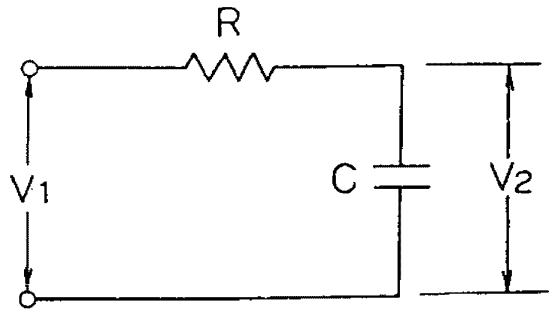


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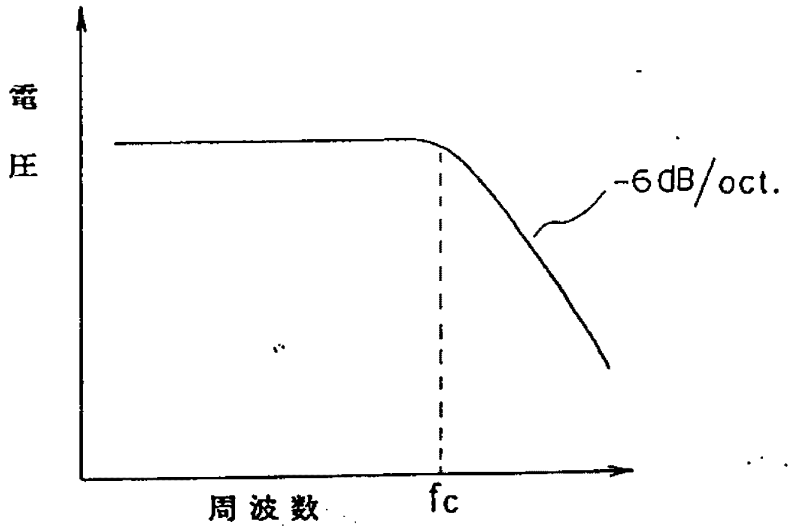
実開63-153

代理人
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1383_PRIOR_ART_000435



第23図



第24図

実開63-15321

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1383_PRIOR_ART_000436

MACHINE TRANSLATION

Name of the device Structure of glasses or helmets, etc. with dimming lenses

priority claim
July 4, 1986 Japan (JP) Jissho 61-103330
October 4, 1986 Japan (JP) Jitsugyo 61-152899

Scope of Utility Model Registration Claims
(1) In helmets or sunglasses, etc. for motorcycles that have an electrode substrate and use an element in the lens section or visor section that causes the color or light transmittance to change by the application of an external voltage, all electronic circuits, including the control circuit of the element, a light sensor that detects external light, a power battery and a power switch, are contained in the body of the glasses or The structure of glasses or helmets, etc. with light-dimming lenses, characterized in that all electronic circuits such as control circuits of elements, light sensors to detect external light, power batteries and power switches are housed in the body of the helmet, etc.
(2) The structure of eyeglasses or helmets, etc. with light-dimming lenses as described in paragraph 1 of the utility model registration claims, characterized in that the electronic circuit is equipped with a light sensitivity switching mechanism that switches or varies the element that causes the color or light transmittance to change upon application of an external voltage to a specific light intensity range or any light intensity range.
(3) The structure of eyeglasses or helmets, etc. with a light-tuning lens as described in paragraphs 1 and 2 of the Utility Model Registration claims, characterized in that the element that causes the color or light transmittance to change upon application of an external voltage is a guest-host type liquid crystal cell.
(4) The structure of eyeglasses or helmets, etc. with a light-tuning lens as described in paragraphs 1 and 2 of the Utility Model Registration claims, characterized in that the element that causes the color or light transmittance to change by the application of an external voltage is a twisted nematic liquid crystal cell.
(5) The structure of eyeglasses or helmets, etc. with light-dimming lenses as described in paragraphs 1 to 4 of the Utility Model Registration Claims, characterized in that the light sensitivity switching mechanism comprises an automatic control mechanism by a microcomputer.
(6) A structure for eyeglasses or helmets, etc. with a light control lens as described in paragraphs 1 to 4 of the Utility Model Registration claims, characterized in that the light sensitivity switching mechanism switches or varies the signal amplification level to adjust the liquid crystal element to a specific light intensity range or any light intensity range.
(7) A structure for eyeglasses or helmets, etc. with light-dimming lenses as described in paragraphs 1 to 4 of the utility model registration claims, characterized in that the light sensitivity switching mechanism switches or varies the output impedance to adjust the liquid crystal element or EC cell to a specific light intensity range or any light intensity range.
(8) The light sensitivity switching mechanism is characterized by a structure in which a filter with a different light transmittance is placed in the light input window of the light sensor, and the filter is switched or varied to adjust the liquid crystal element or EC cell to a specific light intensity range or any light intensity range, as described in paragraphs 1 to 4 of the utility model registration claims. Structure of eyeglasses or helmets, etc. with lenses.
(9) The structure of glasses or helmets, etc. with a light-dimming lens as described in paragraphs 1 to 8 of the Utility Model Registration claims, characterized in that the liquid crystal element is housed between two synthetic resin transparent plates having a columnar or spherical radius of curvature.

(10) In addition to said light-dimming lens, a part of the helmet or glasses is equipped with an obstacle warning device that detects a distance from a forward obstacle by a distance sensor and sounds a buzzer installed in said helmet or glasses via a detection distance switching mechanism that switches or changes the distance to a specific distance or less or to any detection distance. The structure of eyeglasses or helmets, etc. with light-dimming lenses as described in paragraphs 1 to 8 of the scope of claims for utility model registration, characterized in that
(11) The structure of eyeglasses or helmets, etc. with dimming lenses as described in paragraph 10 of the Utility Model Registration claims, characterized in that the distance sensor is an infrared distance sensor.
(12) The structure of eyeglasses or helmets, etc. with dimming lenses as described in paragraph 10 of the Utility Model Registration claims, characterized in that the distance sensor is an ultrasonic distance sensor.
(13) A structure for eyeglasses or helmets, etc. with a dimming lens as described in paragraphs 1 to 12 of the Utility Model Registration claims, characterized in that the electronic circuit is configured on a flexible blintz board.
(14) The structure of eyeglasses, etc. with dimming lenses as described in paragraphs 1 to 8 of the Utility Model Registration Claims, characterized in that the electronic circuit excluding the power supply battery is located in the bridge portion of the eyeglass frame.
(15) The structure of eyeglasses, etc. with light-dimming lenses as described in paragraphs 1 to 8 of the Utility Model Registration Claims, characterized in that the power supply battery for the electronic circuit is located in the wisdom portion of the eyeglass frame.

Brief Description of Drawings
Figure 1 shows a diagram of a helmet with a dimming lens, Figure 2 shows a cross-sectional view of the II-II line in Figure 1, Figure 3 shows the structure and control structure of a liquid crystal cell, Figure 4 shows a cross-sectional view of the IV-IV line in Figure 1, and Figure 5 and Figure 6 show block diagrams of an obstacle warning mechanism respectively Figures 7, 8, 9, 10, 11, 16, and 17 show the circuit diagram of a basic example of the control circuit of this idea, and the circuit diagram of the light sensitivity switching mechanism, respectively. The 17th figure shows an example of light intensity vs. resistance characteristics of a CdS cell, the 18th figure shows an example of resistance vs. output voltage characteristics of a CdS cell when an optical sensor is used as input resistance, the 19th figure shows an example of applied voltage vs. light transmittance characteristics when a twisted nematic liquid crystal cell is placed between orthogonal niches, and the 20th figure shows an example of external light intensity vs. light transmittance characteristics when a twisted nematic liquid crystal cell is placed between orthogonal niches. -Figure 21 shows an example of resistance value vs. output voltage characteristics of a CdS cell when an optical sensor is used as a feedback resistor; Figure 22 shows an example of applied voltage vs. optical transmittance characteristics when a twisted nematic liquid crystal cell is placed between parallel niches; Figure 23 shows the equivalent circuit of an output resistor and a liquid crystal Figure 24 is a graph showing an example of frequency-voltage characteristics of a low-pass circuit.

1...Helmet body, 2...Visor, 4, 5...Transparent synthetic resin plate, 14...Light sensor, 16, 65...Light sensitivity changeover switch, 20...Obstacle detection mechanism, 21. Obstacle detection mechanism, 21...Detection distance setting pick, 22...Light emitter, 23...Light receiver, 61...Glasses body, 62...Glasses frame, 64...Light sensor, L...lens.

Correction Dec. 19, 1961
The name of the device is amended as follows
Name of the device Structure of glasses or helmets, etc. with dimming lenses

The scope of claims and brief description of the drawings are amended as follows

Scope of Utility Model Registration Claims
(1) In helmets or sunglasses, etc. for motorcycles that have an electrode substrate and use an element that changes color or light transmittance by the application of an external voltage or a liquid crystal lens that changes its refractive index by changing the orientation state of liquid crystal molecules as a lens part or visor part, a control circuit for the element, an optical sensor that detects external light, The structure of glasses or helmets, etc. with light-dimming lenses, characterized in that all electronic circuits, such as power supply batteries and power switches, are housed in the body of the glasses or helmets, etc.
(2) A structure for eyeglasses or helmets, etc. with light-dimming lenses as described in paragraph 1 of the claims for utility model registration, characterized in that the electronic circuit is equipped with a light sensitivity switching mechanism that switches or varies the element that causes the color or light transmittance to change upon application of an external voltage to a specific light intensity range or any light intensity range.
(3) The structure of eyeglasses or helmets, etc. with a light-tuning lens as described in paragraphs 1 and 2 of the Utility Model Registration claims, characterized in that the element that causes the color or light transmittance to change upon application of an external voltage is a guest-host type liquid crystal cell.
(4) The structure of eyeglasses or helmets, etc. with a light-tuning lens as described in paragraphs 1 and 2 of the Utility Model Registration claims, characterized in that the element that causes the color or light transmittance to change by the application of an external voltage is a twisted nematic liquid crystal cell.
(5) The structure of eyeglasses or helmets, etc. with light-dimming lenses as described in paragraphs 1 to 4 of the Utility Model Registration Claims, characterized in that the light sensitivity switching mechanism comprises an automatic control mechanism by a microcomputer.
(6) A structure for eyeglasses or helmets, etc. with a light control lens as described in paragraphs 1 to 4 of the Utility Model Registration claims, characterized in that the light sensitivity switching mechanism switches or varies the signal amplification level to adjust the liquid crystal element to a specific light intensity range or any light intensity range.
(7) A structure for eyeglasses or helmets, etc. with light-dimming lenses as described in paragraphs 1 to 4 of the Utility Model Registration claims, characterized in that the light sensitivity switching mechanism switches or varies the output impedance to adjust the liquid crystal element to a specific light intensity range or any light intensity range.
(8) Glasses with a light control lens as described in paragraphs 1 to 4 of the Utility Model Registration Claims, characterized in that the light sensitivity switching mechanism comprises a structure in which a filter with a different light transmission level is placed in the light input window of the light sensor, and the filter is switched or varied to adjust the liquid crystal element to a specific light intensity range or any light intensity range. or structure of a helmet, etc. as described in paragraphs 1 to 4 of the utility model registration claims.
(9) The structure of glasses or helmets, etc. with a light-dimming lens as described in paragraphs 1 to 8 of the Utility Model Registration claims, characterized in that the liquid crystal element is housed between two synthetic resin transparent plates having a columnar or spherical radius of curvature.

(10) In addition to said light-dimming lens, a part of the helmet or glasses is equipped with an obstacle warning device that detects a distance from a forward obstacle by a distance sensor and sounds a buzzer installed in said helmet or glasses via a detection distance switching mechanism that switches or changes the distance to a specific distance or less or to any detection distance. The structure of eyeglasses or helmets, etc. with light-dimming lenses as described in paragraphs 1 to 8 of the scope of claims for utility model registration, characterized in that
(11) The structure of eyeglasses or helmets, etc. with dimming lenses as described in paragraph 10 of the Utility Model Registration claims, characterized in that the distance sensor is an infrared distance sensor.
(12) The structure of eyeglasses or helmets, etc. with dimming lenses as described in paragraph 10 of the Utility Model Registration claims, characterized in that the distance sensor is an ultrasonic distance sensor.
(13) A structure for eyeglasses or helmets, etc. with a dimming lens as described in paragraphs 1 to 12 of the Utility Model Registration claims, characterized in that the electronic circuit is configured on a flexible blintz board.
(14) The structure of eyeglasses, etc. with dimming lenses as described in paragraphs 1 to 8 of the Utility Model Registration Claims, characterized in that the electronic circuit excluding the power supply battery is located in the bridge portion of the eyeglass frame.
(l5) The structure of eyeglasses, etc. with dimming lenses as claimed in paragraphs 1 to 8 of the Utility Model Registration, characterized in that the power supply battery for the electronic circuit is located in the wisdom portion of the eyeglass frame.

Brief Description of Drawings
Figure 1 shows a diagram of a helmet with a dimming lens, Figure 2 shows a cross-sectional view of the II-II line in Figure 1, Figure 3 shows the structure and control structure of the liquid crystal cell, Figure 4 shows a cross-sectional view of the IV-IV line in Figure 1, Figure 5 and Figure 6 show examples of the obstacle warning mechanism, respectively. Fig. 4 shows the IV-IV cross section of Fig. 1; Fig. 5 and 6 show an example of the obstacle warning mechanism; Fig. 7 is a diagram of the sunglasses showing another example of this idea; Fig. 8 is an enlarged view of the electronic circuit housing; Fig. 9 is an enlarged view of the power battery housing; Fig. 10 is a circuit diagram showing a basic example of the control circuit of this idea; Fig. 11 to 16 show an example of the light sensitivity switching mechanism, respectively; Fig. 17 and 18 are circuit diagrams showing an example of the light sensitivity switching mechanism. The 17th figure is a graph showing an example of light intensity vs. resistance characteristics of a CdS cell, the 18th figure is a graph showing an example of resistance vs. output voltage characteristics of a CdS cell when an optical sensor is used as input resistance, the 19th figure is a graph showing an example of applied voltage vs. light transmission characteristics when a twisted nematic liquid crystal cell is placed between orthogonal niches Figure 20 shows an example of external light level - light transmittance characteristics; Figure 21 shows an example of resistance value - output voltage characteristics of a CdS cell when an optical sensor is used as a feedback resistor; and Figure 22 shows an example of applied voltage - light transmittance characteristics when a twisted nematic liquid crystal cell is placed between parallel niches, Figure 23 is an equivalent circuit of output resistance and liquid crystal cell, and Figure 24 is a graph showing an example of frequency-voltage characteristics of a low-pass circuit.

1...Helmet body, 2...Visor, 4, 5...Transparent synthetic resin plate, 1 4...Light sensor, 16, 65...Light sensitivity switching switch, 20...Obstacle detection mechanism, 21. Obstacle detection mechanism, 21...Detection distance setting knob, 22...Light emitter, 23...Light

receiver, 61...Eyeglass body, 62...Eyeglass frame, 64...Light sensor, L...Lens, 63...Light sensor, 64...Light sensor, 63...Light sensor, 64...Light sensor, 63...Light sensor, 64...Light sensor, 63...Light sensor sensor, L...lens.

specification

1. Name of the device

Structure of glasses or helmets, etc. with light-dimming lenses

2. Scope of claims for utility model registration

(1) In helmets or sunglasses, etc. for motorcycles that have an electrode substrate and use an element in the lens section or visor section that causes the color or light transmittance to change by the application of an external voltage, all electronic circuits, including the control circuit of the element, a light sensor that detects external light, a power battery and a power switch, are contained in the body of the glasses or The structure of glasses or helmets, etc. with light-dimming lenses, characterized in that all electronic circuits such as control circuits of elements, light sensors to detect external light, power batteries and power switches are housed in the body of the helmet, etc.

(2) The structure of eyeglasses or helmets, etc. with light-dimming lenses as described in paragraph 1 of the utility model registration claims, characterized in that the electronic circuit is equipped with a light sensitivity switching mechanism that switches or varies the element that causes the color or light transmittance to change upon application of an external voltage to a specific light intensity range or any light intensity range.

(3) The structure of eyeglasses or helmets, etc. with a light-tuning lens as described in paragraphs 1 and 2 of the Utility Model Registration claims, characterized in that the element that causes the color or light transmittance to change upon application of an external voltage is a guest-host type liquid crystal cell.

(4) The structure of eyeglasses or helmets, etc. with a light-tuning lens as described in paragraphs 1 and 2 of the Utility Model Registration claims, characterized in that the element that causes the color or light transmittance to change by the application of an external voltage is a twisted nematic liquid crystal cell.

(5) The structure of eyeglasses or helmets, etc. with light-dimming lenses as described in paragraphs 1 to 4 of the Utility Model Registration Claims, characterized in that the light sensitivity switching mechanism comprises an automatic control mechanism by a microcomputer.

(6) A structure for eyeglasses or helmets, etc. with a light control lens as described in paragraphs 1 to 4 of the Utility Model Registration claims, characterized in that the light sensitivity switching mechanism switches or varies the signal amplification level to adjust the liquid crystal element to a specific light intensity range or any light intensity range.

(7) A structure for eyeglasses or helmets, etc. with light-dimming lenses as described in paragraphs 1 to 4 of the utility model registration claims, characterized in that the light sensitivity switching mechanism switches or varies the output impedance to adjust the liquid crystal element or EC cell to a specific light intensity range or any light intensity range.

(8) The light sensitivity switching mechanism is characterized by a structure in which a filter with a different light transmittance is placed in the light input window of the light sensor, and the filter is switched or varied to adjust the liquid crystal element or EC cell to a specific light intensity range or any light intensity range, as described in paragraphs 1 to 4 of the utility model registration claims. Structure of eyeglasses or helmets, etc. with lenses.

(9) The structure of glasses or helmets, etc. with a light-dimming lens as described in paragraphs 1 to 8 of the Utility Model Registration claims, characterized in that the liquid crystal element is housed between two synthetic resin transparent plates having a columnar or spherical radius of curvature.

(10) In addition to said light-dimming lens, a part of the helmet or glasses is equipped with an obstacle warning device that detects a distance from a forward obstacle by a distance sensor and sounds a buzzer installed in said helmet or glasses via a detection distance switching mechanism that switches or changes the distance to a specific distance or less or to any

detection distance. The structure of eyeglasses or helmets, etc. with light-dimming lenses as described in paragraphs 1 to 8 of the scope of claims for utility model registration, characterized in that
(11) The structure of eyeglasses or helmets, etc. with dimming lenses as described in paragraph 10 of the Utility Model Registration claims, characterized in that the distance sensor is an infrared distance sensor.
(12) The structure of eyeglasses or helmets, etc. with dimming lenses as described in paragraph 10 of the Utility Model Registration claims, characterized in that the distance sensor is an ultrasonic distance sensor.
(13) A structure for eyeglasses or helmets, etc. with a dimming lens as described in paragraphs 1 to 12 of the Utility Model Registration claims, characterized in that the electronic circuit is configured on a flexible blintz board.
(14) The structure of eyeglasses, etc. with dimming lenses as described in paragraphs 1 to 8 of the Utility Model Registration Claims, characterized in that the electronic circuit excluding the power supply battery is located in the bridge portion of the eyeglass frame.
(15) The structure of eyeglasses, etc. with light-dimming lenses as described in paragraphs 1 to 8 of the Utility Model Registration Claims, characterized in that the power supply battery for the electronic circuit is located in the wisdom portion of the eyeglass frame.

3. Detailed description of the idea
(Industrial Applications)
This invention relates to the construction of a helmet for motorcycles, light motorcycles, passenger cars, light airplanes, and various other types of vehicles, and to the construction of glasses or helmets with light-controlling lenses for improving sunglasses, etc. worn during general riding.

(Conventional technology)
Various types of head protection helmets are in use in accordance with the mandatory wearing of helmets when riding motorcycles, and many of them are equipped with a wind visor that doubles as a sun visor in the opening to secure a field of vision. However, helmets with sun visors have the disadvantage that visibility varies depending on the intensity of sunlight, and especially when driving on roads with many tunnel entrances and exits, visibility suddenly drops when entering a tunnel, resulting in a blind state.

The same is true for sunglasses used in general, and it was necessary to change glasses depending on the intensity of outside light.

(Problem to be solved by the device)
Therefore, when wearing the above helmet, on roads with frequent tunnel entries and exits, the driver had to stop and change the sun visor each time when entering or exiting a tunnel, and it was impossible to use the helmet when using the highway because it was not possible to stop on the road.

In particular, in the case of eyeglasses such as sunglasses, the electronic circuit for electrically controlling the liquid crystal and EC material used in the lens section must be equipped in a limited location on the eyeglass frame, which has been extremely difficult to arrange and has not been embodied in practice.

The purpose of this invention is to provide a structure for glasses or helmets with light-controlling lenses that automatically adjusts or switches the translucent lenses of sun visors or

sunglasses installed on helmets according to the external illumination level, and also to provide a structure for glasses or helmets with light-controlling lenses that detect obstacles in front and issue warning signals to warn the wearer of obstacles in front. The purpose is to provide a structure for glasses or helmets with light-dimming lenses with an added function of detecting obstacles in front and issuing a warning signal. In addition, it is intended to provide a technology to place the electronic circuit for electrically controlling the liquid crystal and EC material used in the lens section in a limited location on the eyeglass frame.

(Means to solve the problem)
The structure of the proposed helmet or helmet, etc., with a light-dimming lens is a helmet or sunglasses, etc., for motorcycles, in which an element having an electrode substrate and in which the color or light transmittance is changed by the application of an external voltage is used in the lens part or visor part, wherein the control circuit of the element, light sensor to detect external light, power supply battery and a power switch are housed in the body of the glasses or helmet, etc.

The above electronic circuit is equipped with a light sensitivity switching mechanism that switches or varies the element, which changes color or light transmittance by the application of an external voltage, to a specific light intensity range or to an arbitrary light intensity range, and is used in response to the intensity of ambient light.

The liquid crystal element that causes the color or light transmittance to change upon application of the above external voltage can be composed of a guest host liquid crystal cell or a twisted nematic liquid crystal cell.

The light sensitivity switching mechanism can be an automatic control structure that automatically controls the external voltage applied to the liquid crystal element by a microcomputer, and the light sensitivity switching mechanism can be configured to switch or vary the output impedance, or to place a filter with different light transmittance in the light input window of the optical sensor and switch or vary the filter. The light sensitivity switching mechanism can be configured to switch or vary the output impedance, or to place a filter with a different light transmittance in the light input window of the light sensor and adjust the liquid crystal element or EC cell to a specific light intensity range or an arbitrary light intensity range.

Furthermore, the aforementioned liquid crystal element or EC cell is housed between two synthetic resin transparent plates with a columnar or spherical radius of curvature to eliminate external pressure directly applied to the lens.

The structure of glasses or helmets, etc., with light-dimming lenses is such that, in addition to the above-mentioned light-dimming lenses, a part of the helmet or glasses, etc., is equipped with an obstacle warning device that detects the distance from a forward obstacle by a distance sensor and switches or varies the detection distance to a specific distance or less or any detection distance through a detection distance switching mechanism, which is installed on the helmet or glasses, etc. The pusher can be used as a bell. In the case of glasses, a vibrating body that directly stimulates the wearer's skin can be provided instead of a pusher.

The above distance sensor can be composed of an infrared distance sensor or an ultrasonic distance sensor.

In addition, the structure of glasses or helmets, etc. with light-dimming lenses of the present invention can achieve the purpose by configuring the electronic circuit with a flexi ble printed circuit board and placing the electronic circuit excluding the power supply battery in the bridge part of the eyeglass frame and the power supply battery in the wisdom part of the eyeglass frame. The power supply battery is located in the bridge of the eyeglass frame.

(Action)
The structure of glasses or helmets, etc., with light-dimming lenses in the above configuration can obtain appropriate transmitted light presentation in places where there are differences in the intensity of external light, such as daytime and nighttime use, use inside or outside a tunnel, etc., by means of a light-dimming action that changes light transmission by switching the voltage applied to the liquid crystal cell of the light-dimming visor or lens by the light sensitivity switching mechanism. This allows the user to change the light transmittance without the need to replace the polarizers or lenses.

In addition, the above flat liquid cell is housed in the gap between two transparent synthetic resin plates with a cylindrical or spherical curved surface, which protects the liquid cell from external shocks and ensures sufficient strength against shocks.

Furthermore, the obstacle detection mechanism detects obstacles in front of the helmet with a distance sensor and sounds a buzzer when the distance is less than a preset or adjusted distance, thus acting as a distance warning device.

In addition, the control circuitry can be downsized without changing the appearance of conventional eyeglasses, so the design of eyeglasses can be implemented without compromising the design.

(Example)
The following is an example of the structure of glasses or helmets, etc. with light-dimming lenses of the present invention, which will be described in accordance with the drawings. Figures 1 to 6 show an example of a helmet for motorcycles, and Figures 1 to 3 show its appearance.

The sign 1 is the helmet body which covers the user's head and consists of a visor 2 for securing a field of vision in the front. As shown in the second figure, the visor 2 consists of lenses L, L consisting of flat liquid crystal cells La, La via a liquid crystal cell storage frame 6 between two synthetic resin transparent plates 4, 5 such as plastic resin having a cylindrical or spherical radius of curvature separated by a spacer 3, wherein the liquid crystal cells La are of the In the case of a twisted nematic type, a polarizing film 8 is attached to the back surface of a synthetic resin transparent plate 4. As shown in Figure 4, the liquid crystal cell La consists of glass plates 10 and 10 with transparent electrode films 9 formed on their inner surfaces through insulating spacers 11 and filled with liquid crystal 12 in the minute gaps between the transparent electrode films 9 and 9, respectively, as shown in Guest-host type A, and twisted-nematic type B. The liquid crystal cell La is composed of a helmets. The liquid crystal cell La is driven by a power supply unit 13 such as a battery equipped in the helmet body 1, and an output voltage is applied to both transparent electrode films 9 and 9 from a control means 15 that adjusts the output voltage by inputting a signal from an optical sensor 14 such as a CdS element fixed to the front face of the helmet body 1. The light sensitivity can be switched by the light sensitivity switching switch 16 installed in the main body 1, and the control circuit described below controls the applied voltage to the lense s L and L.

The obstacle detection mechanism 20 is composed of a control circuit including a light emitter 22 made of LED and a light receiver 23 made of PSD fixed on the forehead of the helmet body 1, as shown in the block diagram in Figure 5. . The control drive circuit inputs the output of the bias circuit 24 of the light-receiving element 23, which receives light through the light-receiving lens 24, and the output of the differential amplifier 27, which is driven by the difference in output from the two pulse crawling conversion amplifiers 25 and 26, to a sample and hold circuit 28, and the output of the sample and hold circuit 28 and the detection distance setting knob The output of the sample and hold circuit 28 is compared with the output of the variable resistor 29, the setting of which is changed by the detection distance setting knob 21, by the comparator 30 in the latter stage, and the comparative output drives the buzzer 32 installed inside the helmet body 1 via the buzzer drive circuit 31. The above sample-and-hold circuit 28 is synchronized with the timing generator 33, and the LED drive circuit 34 energizes the above light projector 22, which consists of LEDs, to emit infrared rays toward obstacles located in front of the helmet through the light projection lens 35, and the reflected light of the infrared rays is input to the light receiving element 23. The reflected light of the infrared ray is input to light receiving element 23.

Figure 6 shows a block diagram of the obstacle detection mechanism 20 using an ultrasonic sensor, which consists of a wave transmitter sensor 41 and a receiver sensor 42 fixed to the forehead of the helmet body 1, replacing the light emitter 22 and receiver 23 of the previous example. Sign 43 is the sensitivity adjustment volume of the receiver sensor 42, 44 is the receiver signal shaping circuit, 45 is the distance pulse generation circuit, 46 is the distance coefficient circuit, and the buzzer 50 is driven by comparison with the timing generator 49 via the buzzer drive circuit 47. The timing generator 49 sends a drive signal to the distance pulse generation circuit 52 and the wave sensor drive circuit 48 according to the input value from the distance setting switch 51, which is composed of a digital switch circuit, and the wave sensor drive circuit 48 oscillates a high frequency for distance measurement at a predetermined frequency from the wave sensor 41. The structure is designed to oscillate a high-frequency wave for distance measurement at a predetermined frequency from the wave transmitter sensor 41 by the wave transmitter sensor drive circuit 48.

Figures 7 through 9 show the implementation of this idea in sunglasses.

The main body 61 of the glasses consists of the eyeglass frame 62, the lenses L, L, and the light sensor window 64 and light sensitivity switching switch 65 formed on the eyeglass frame 62. The electronic circuit and power supply battery, which will be described later, are built into a part of the eyeglass frame 62. The lenses L, L use liquid crystal cells, each of which electrically controls the amount of transmitted light.

As shown in Figure 8, the above electronic circuit is configured in the bridge section of the eyeglass frame 62, and is the control electronic circuit described below with CdS cell 67, analog IC 68, power switch 69, chip capacitor 70, and chip resistor 71 mounted on flexible print substrate 66.

The above control electronic circuits can be mounted using conventional techniques such as chip mounter machines and reflow solder machines, which allow for compact microfabrication and high-density mounting that can be accommodated in the bridge section of the above eyeglass frame 62.

Furthermore, because the 66 flexible printed circuit board is a film-like substrate, it is capable of forming electric circuits that follow its shape even in uneven or deformed locations.

The connection between the control electronic circuit and the liquid crystal cell of the lens L, L is made at the connection indicated by the sign 72 via conductive adhesive or the like. The power supply wiring section 73 extending from the flexible printed circuit board 66 is wired from the bridge section of the eyeglass frame 62 to the wisdom section, leading to the electrode section of the power supply battery 74 shown in the 9th figure.

The control circuits for the voltage applied to the lenses L, L of the helmet's light modulating visor for motorcycles shown in the first example above and the sunglasses shown in the second example are described below in Figs. 10 through 16.

The control circuit in Figure 10 shows a basic example of this idea.

This circuit shows an example in which an operational amplifier is used as the analog IC68, and the analog IC68, capacitor C3, CdS cell 67, resistors R3 and R4 constitute a multivibrator circuit. Therefore, in this circuit, the oscillation frequency of the multivibrator is increased when the light level is high, and is decreased when the light level is low. The signal thus obtained is applied to the liquid crystal cell La of lens L, L via resistor R5.

However, since the liquid crystal cell La forms a capacitive load C in terms of electrical characteristics, R5 and CL constitute a low-pass filter as shown in the equivalent circuit in Figure 23. Therefore, the voltage V2 between the two ends of the liquid crystal cell La becomes low at high frequencies, and conversely becomes high at low frequencies. In other words, when the amount of light is high, the voltage applied to the liquid crystal cell La is low and the light transmittance of the lens L is suppressed, and when the amount of light is low, the voltage applied to the liquid crystal cell La is high and the light transmittance of the lens L is increased, thus demonstrating the light-shielding effect of sunglasses in response to external light.

Next, the control circuit equipped with the light sensitivity switching mechanism is described. The power supply connections are omitted from the circuit diagrams in Figures 11 through 16. The connection of the power supply is made as needed depending on the elements used, and the circuit diagrams are examples of the minimum necessary.

Figures 11 and 12 show the circuit diagram of an example in which the optical sensitivity is switched by switching the amplification level. The oscillation frequency of the multivibrator circuit is determined by C1 and R1, and the oscillation frequency f can be obtained by the following equation (a).

$$f = \frac{1}{2 \cdot C1 \cdot R1} \quad (Hz) \quad \cdots (1)$$

The Al used in this multivibrator circuit can be an operational amplifier IC, comparator IC, or a circuit combining discrete components.

In Figure 11, the signal obtained in the multivibrator circuit described above is supplied to amplifier A2 via optical sensor Rcds. The amplifier A2 has a combination of feedback resistors Rfl and Rfd, and a switch 16(65) to switch between them.

Since the amplification G of amplifier A2 is obtained by the following equation (mouth), it is possible to change the amplification G by switching the switch 16 (65).

$$\text{増幅度 } G = -\frac{Rfl \text{ または } Rfd}{Rcds} \quad \cdots (口)$$

The signal amplified by amplifier A2 is supplied to lenses L and L. The lenses L, L consist of a liquid crystal cell La sandwiched between polarizing plates Lb and Lb'. A twisted nematic liquid crystal cell is used for the liquid crystal cell La, and the polarizing plates Lb and Lb' are placed in an orthogonal niche with their polarization axes orthogonal to each other. When the twisted nematic liquid crystal cell is placed between the orthogonal-nicole polarizing plates, as shown in Figure 19, the optical transmittance decreases when a high-voltage signal is applied, while the optical transmittance increases when a low-voltage signal is applied.

In this example, a CdS cell is used for the light sensor Rcds, and the characteristics of the CdS cell with respect to light are shown in Figure 17, where the resistance value is low when the light level is high and high when the light level is low.

Therefore, as can be seen in equation (mouth), when the light sensor Rcds receives light, the resistance value becomes small, the amplification of amplifier A2 increases, a high voltage signal is applied to lenses L and L, and the light transmittance of lenses L and L decreases. When the amount of light received by the light sensor Rcds is low, the resistance value increases, the amplification of amplifier A2 decreases, a low voltage signal is applied to lenses L and L, and the light transmittance of lenses L and L increases. The circuit that operates in this way has two feedback resistors, Rfl and Rfd, and by switching these resistors, the light sensitivity can be switched.

The relationship between the resistance values of Rfl and Rfd is Rfl<Rfd, and the Rfl side is used during the day when external light intensity is high, and the Rfd side is used at night (or when external light intensity is low). In other words, when the light level is high, the light sensor Rcds operates in the low resistance range, so the resistance value of the feedback resistor Rfl should be set to a low resistance value that matches the change in Rcds. The characteristics of the output voltage of A2 will be as shown in Figure 18. Therefore, the light intensity and lens light transmittance characteristics will be as shown in the 20th figure. In the 20th figure, the characteristic curve of D shows an example of the characteristics when Rfd is connected, and the characteristic curve of L shows an example of the characteristics when Rfl is connected.

In this example, two feedback resistors are used, but more than two may be used depending on the application. In this case, the number of contacts of the changeover switch 16(65) should be the same number of steps as the number of feedback resistors. The 16(65) can be toggle switches, rotary switches, slide switches, or the like, as long as they are capable of switching the circuit.

When the light sensitivity is variable without steps, a variable resistor can be used as a feedback resistor instead of Rfl and Rfd. In this case, the switching switch 16(65) becomes unnecessary, and the light intensity can be set to any desired range.

Figure 9 shows a circuit diagram of an example in which an optical sensor Rcds is used as the feedback resistor of amplifier A2, and the output voltage of amplifier A2 with respect to the light level can be changed to change the light sensitivity by switching the input resistors Rs1 and Rsd.

This example shows a case in which polarizing plates Lb and Lb' with parallel-nickel polarization axes are used for lenses L and L, and a liquid crystal cell La (twisted nematic liquid crystal cell) is placed between them. In this example, in addition to the twisted nematic liquid crystal, a liquid crystal cell using a guest host liquid crystal, which is a mixture of a liquid crystal with positive dielectric anisotropy and a dye that absorbs light in the long axis direction of the dye molecules, may be used for the lenses L, L. In the case of a liquid crystal cell using guest host liquid crystal, polarizing plates Lb and Lb' may not be used at all, or either one of the polarizing plates Lb and Lb' may be used.

The applied voltage and light transmittance characteristics of lenses L and L are shown in Figure 22. When Rsd and Rsl are used as input resistors as in this example, the amplification G of amplifier A2 can be obtained by the following equation (c), and the characteristics of light sensor Rcds with respect to light intensity are as shown in Figure 17, and the characteristics of light sensor Rcds and output voltage of amplifier A2 are shown in Figure 21.

$$\text{増幅度 } G = -\frac{Rcds}{Rsd} \quad \text{又は} \quad G = -\frac{Rcds}{Rsl} \quad \cdots (ハ)$$

Therefore, by switching the input resistors Rsd and Rsl with switch 16(65), the output voltage of amplifier A2 with respect to the light intensity can be changed to change the light sensitivity. The light intensity and lens light transmittance characteristics at this time are shown in Figure 20. In Figure 20, the characteristic curve in D shows an example when Rsd is connected to the input resistor, and the characteristic curve in L shows an example when Rsl is connected.

In this example, two input resistors are used, but more than two may be used depending on the application. In this case, the number of contacts of the changeover switch 16(65) should be the same as the number of input resistors. In this case, the number of contacts of the changeover switch 16(65) should be the same number of steps as the number of input resistors.

When the light sensitivity is to be varied steplessly instead of stepwise, a variable resistor can be used as an input resistor instead of Rsl and Rsd. In this case, the changeover switch 16(65) becomes unnecessary, and the light sensitivity can be set to any light intensity range.

Figure 13 shows a circuit diagram of an example of switching optical sensitivity by changing the output impedance. A3, C2, R2, R3, and Rcds constitute a multivibrator circuit. The oscillation frequency f of this multivibrator circuit can be obtained by the following equation (d).

$$f = \frac{1}{2 \cdot C2 \cdot Rcds} \quad (Hz) \quad \cdots (ニ)$$

Therefore, since the resistance value of the optical sensor Rcds varies with the amount of light as shown in Figure 17, the oscillation frequency f varies with the change in the resistance value of the optical sensor Rcds.

Since the liquid crystal cell exhibits capacitive electrical characteristics, a low-pass circuit can be configured by connecting Rol or Rod in the circuit configuration shown in the 13th figure. Therefore, if the capacitance value of the liquid crystal cell is C, the equivalent circuit is as shown in the 23rd figure, and the voltage V2 applied to the liquid crystal cell can be obtained by the following formula (e). In the 23rd figure, V1 is the output voltage of the multivibrator circuit, V2 is the voltage applied to the liquid crystal cell, R represents Rol or Rod, and C represents the combined capacitance value of the liquid crystal cells of lenses L and L.

$$V2 = \frac{V1}{1 + j\omega CR} \quad \cdots (ホ)$$

ただし、$\omega = 2\pi f$

As shown in equation (e), V2 becomes a low voltage when the frequency is high and a high voltage when the frequency is low, and its frequency characteristic will show a characteristic of 1 6 dB/octave when the cutoff frequency fC or higher as shown in Figure 24. The cutoff frequency fC can be obtained by the following equation (He).

$$fc = \frac{1}{2\pi CR} \quad (Hz) \quad \cdots (ヘ)$$

Therefore, by changing R in equation (he) to Rol or Rod, the cutoff frequency fC can be changed, and the sensitivity to light intensity can be switched.

For the lenses L and L shown in this example, a twisted nematic liquid crystal cell with polarizers Lb and Lb' in parallel niche or a liquid crystal cell with guest host liquid crystal using either polarizers Lb and Lb' or no polarizer at all can be used. In this case, the light intensity and lens transmittance characteristics are as shown in Figure 20. In Figure 20, the characteristic curve in D shows an example when Rod is connected, and the characteristic curve in L shows an example when Rol is connected.

In this example, two output impedances, Rol and Rod, are used, but more than two may be used depending on the application. In this case, the number of contacts of the changeover switch 16(65) should be the number of steps appropriate for the number of output impedances. The changeover switch 16(65) can be a toggle switch, rotary switch, slide switch, or the like, as long as it is capable of switching the circuit.

When the light sensitivity is to be varied steplessly instead of stepwise, a variable resistor can be used as the output impedance instead of Rod and Rol. In this case, the changeover switch 16(65) is not needed, and the light sensitivity can be set to any light intensity range.

Figures 14 through 16 show the circuit diagram of an example in which a filter with different light transmittance is placed in the light receiving window of the light sensor, and the light sensitivity is switched by switching the filter. The filter fl has a side L with low light transmittance and a side D with high light transmittance, which is switched. That is, when the external light level is high, the filter is set to the L side, and the external light level is reduced by this filter and is applied to the light sensor Rcds. Also . When the external light level is low, it is set to the D side. If the difference in light transmittance between the L and D sides of the filter is set to the difference in light intensity between day and night, for example, the filter can be set to the L side, which reduces light intensity during the day, and to the D side, which does not reduce light intensity during the night, to provide the same light control effect for both day and night with a difference in light intensity.

Two or more filters with different light transmittance in Figures 14 through 16 may be used, in which case the light sensitivity can be set as many times as the number of filters. If filters with continuously varying light transmittance are used, the light sensitivity can be set steplessly instead of step by step. Furthermore, the shape of the fill evening f1 can be a rectangular plate or a disk, and the light sensitivity can be switched (or made variable) by sliding or rotating them.

For the lenses L, L in the example shown in Figure 14, a twisted nematic liquid crystal cell La sandwiched between polarizing plates Lb, Lb' with their polarization axes in parallel niche, or a liquid crystal cell La using a guest host liquid crystal mixed with a liquid crystal with positive dielectric anisotropy and a dye that absorbs light in the long axis direction of dye molecules, etc. can be used. In the case of liquid crystal cells using guest host liquid crystals, polarizing plates Lb and Lb' may not be used at all, or either one of the polarizing plates Lb and Lb' may be used.

In the above examples, the case in which nematic liquid crystal cells are used for the lenses L and L is described, but liquid crystal cells using cholesteric liquid crystal, smetic liquid crystal, ferroelectric liquid crystal, etc. may also be used for the lenses L and L.

(Effects of the device)
As described above, the structure of glasses or helmets, etc., with a light-transmitting lens of this invention can obtain the appropriate maximum transmitted light in places where there is a difference in the intensity of external light, such as use during the daytime and nighttime or use inside or outside a tunnel, by changing the degree of light transmission, so not only is it unnecessary to replace a visor or glasses, it is also possible to adjust the light transmission level of the lens to the desired level. In addition, the obstacle detection mechanism detect s obstacles in front of the helmet with a distance sensor and sounds a buzzer when the distance is less than a preset or adjusted distance, thus acting as a distance warning device.

In addition, since the above flat liquid crystal cell is housed in the gap between two synthetic resin transparent plates having a cylindrical or spherical curved surface, the lens can be protected from external impact force and a helmet with sufficient strength against impact can be constructed. In particular, when the helmet is used for eyeglasses, it can be implemented with almost no change in appearance from conventional eyeglasses, so the design of the eyeglasses can be implemented without losing any of its design.

4. brief description of the drawing

Figure 1 shows a diagram of a helmet with a dimming lens, Figure 2 shows a cross-sectional view of the II-II line in Figure 1, Figure 3 shows the structure and control structure of the liquid crystal cell, Figure 4 shows a cross-sectional view of the IV-IV line in Figure 1, Figure 5 and Figure 6 show examples of the obstacle warning mechanism, respectively. Fig. 4 shows the IV-IV cross section of Fig. 1; Fig. 5 and 6 show an example of the obstacle warning mechanism; Fig. 7 is a diagram of the sunglasses showing another example of this idea; Fig. 8 is an enlarged view of the electronic circuit housing; Fig. 9 is an enlarged view of the power battery housing; Fig. 10 is a circuit diagram showing a basic example of the control circuit of this idea; Fig. 11 to 16 show an example of the light sensitivity switching mechanism, respectively; Fig. 17 and 18 are circuit diagrams showing an example of the light sensitivity switching mechanism. The 17th figure is a graph showing an example of light intensity vs. resistance characteristics of a CdS cell, the 18th figure is a graph showing an example of resistance vs. output voltage characteristics of a CdS cell when an optical sensor is used as input resistance, the 19th figure is a graph showing an example of applied voltage vs. light transmission characteristics when a twisted nematic liquid crystal cell is placed between orthogonal niches Figure 20 shows an example of external light level - light transmittance characteristics; Figure 21 shows an example of resistance value - output voltage characteristics of a CdS cell when an optical sensor is used as a feedback resistor; and Figure 22 shows an example of applied voltage - light transmittance characteristics when a twisted nematic liquid crystal cell is placed between parallel niches, Figure 23 is an equivalent circuit of output resistance and liquid crystal cell, and Figure 24 is a graph showing an example of frequency-voltage characteristics of a low-pass circuit.

1...Helmet body, 2...Visor, 4, 5...Transparent synthetic resin plate, 1 4...Light sensor, 16, 65...Light sensitivity switching switch, 20...Obstacle detection mechanism, 21. Obstacle detection mechanism, 21...Detection distance setting knob, 22...Light emitter, 23...Light receiver, 61...Eyeglass body, 62...Eyeglass frame, 64...Light sensor, L...Lens, 63...Light sensor, 64...Light sensor, 63...Light sensor, 64...Light sensor, 63...Light sensor, 64...Light sensor, 63...Light sensor sensor, L...lens.

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Title of Invention

HEAD-WORN DEVICE WITH CONNECTION REGION

Application Information

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CUSTOMER #	34071	FIRST NAMED INVENTOR	Thomas A. Howell
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Peter Tong

Documents

TOTAL DOCUMENTS: 34

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New International Application Filed with the USPTO as a Receiving Office

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(54) Title: DEVICE AND METHOD FOR ULTRAVIOLET RADIATION MONITORING

(57) Abstract: An ultraviolet radiation monitor is disclosed. The monitor includes an aluminum gallium nitride-based detector, such as a Schottky junction fabricated with aluminum gallium nitride and a Schottky layer containing palladium, and a processor. The composition of the detector is tailored so that the detector is responsive substantially only to radiation of certain wavelengths, such as UV-B. The processor is adapted to receive user input of the user's skin type and ultraviolet-blocking power of any sunscreen the user is wearing. The processor is also adapted to read the signal generated by the detector and calculate the intensity of the ultraviolet radiation received by the detector. The processor is further adapted to calculate the maximum length ultraviolet exposure time for the user, based on the radiation intensity, skin type and sunscreen information.

DEVICE AND METHOD FOR ULTRAVIOLET RADIATION MONITORING

This application is being filed as a PCT International Patent application in the name of APA Optics, Inc., a U.S. national corporation (applicant for all countries except the U.S.), and in the names of Minseub Shin, a citizen of the Republic of Korea (South Korea), and Anil K. Jain, a U.S. citizen (applicants for the U.S. only), on 27 April 2001, designating all countries.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

The invention relates generally to monitoring ultraviolet radiation and more specifically to monitoring UV radiation using aluminum gallium nitride detectors.

2. DESCRIPTION OF THE RELATED ART

Ultraviolet radiation (UV) detectors are useful in a variety of applications. For example, UV radiometers are used to detect UV radiation from the sun to assist users engaged in outdoor activities in setting time limits for exposure to the sunlight. In manufacturing processes where epoxy is used, UV radiometers are often used to monitor the UV radiation intensity from UV lamps to determine the proper length of time for curing epoxy. UV detectors are also useful in flame sensing and missile guidance systems.

In certain applications, it is advantageous or necessary to use UV detectors that have spectral selectivity, *i.e.*, sensor that are sensitive only to radiation of certain wavelength but not of others. In flame sensing, for example, it is often desirable to employ visible-blind UV detectors, *i.e.*, those sensitive to UV but not to radiation of longer wavelengths. This is because in some applications, flames are to be detected against hot backgrounds such as infrared emissions from hot bricks in a furnace. By detecting only UV emissions, which are present in the flames but not in the hot backgrounds, one can distinguish flames from the backgrounds.

For sunburn prevention, it is also desirable to selectively measure UV radiation of wavelengths of 320 nanometers (nm) or shorter. Most of the sun's UV radiation of wavelengths shorter than 290 nm (often called "UV-C") does not reach

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the earth's surface due to the absorption by the earth's ozone layer. Of the remainder, UV radiation of wavelengths between 290 nm and 320 nm ("UV-B") is known to be particularly harmful to humans. Thus, it is desirable to accurately monitor UV-B instead of radiation of a broad spectrum.

For sunburn prevention applications, it is also desirable to have a convenient way to set accurate dosage limits and alert the user when the limits are reached.

Conventional devices and methods have not adequately addressed these and other needs.

SUMMARY OF THE INVENTION

According to the invention, an ultraviolet radiation monitor includes (a) an aluminum gallium nitride detector configured to produce an intensity signal indicative of the intensity of the ultraviolet radiation received by the detector; (b) signal generator configured to produce a skin type signal indicative of a level of tolerance by a person's skin to ultraviolet radiation; (c) a signal generator configured to produce a blocking power signal indicative of the blocking power of a sunscreen applied to the skin of the person; and (d) a processor operatively connected to, and receiving signals from, the detector, and the signal generators signal generator to receive the intensity signal, skin type signal and blocking power signal. The processor is configured to generate, in response to the skin type signal and blocking power signal, a dose limit signal indicative of a limit of the cumulative ultraviolet radiation the person is to receive and, in response to the intensity signal, a cumulative dosage signal indicative of the cumulative ultraviolet radiation the person has received over a time period. The processor is also configured to produce a signal, such as an alarm or visual display, perceptible to the user when the cumulative ultraviolet radiation indicated by the dosage signal is at least the limit indicated by the dose limit signal.

The signal generators can include user interfaces to receive user inputs indicative of the level of tolerance by a person's skin to ultraviolet radiation and indicative of the blocking power of the sunscreen applied to the skin of the person.

The ultraviolet radiation monitor can include a housing accommodating the

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signal generators, processor and user interfaces, with the housing being in the form of a wrist watch.

The detector used in the ultraviolet radiation monitor can have a spectral response in which the magnitude of response changes by at least an order of 1,000 between 300 nm and 330 nm. The spectral response can substantially match the erythemal response spectrum. The detector can be a Schottky-barrier junction detector. It can further be a junction in which one electrode is made substantially of $Al_xGa_{1-x}N$, with x not less than about 25% and not more than about 30%, or not less than about 27% and not more than about 29%.

The processor in the ultraviolet radiation monitor can be configured to generally continuously receive from the detector intensity signals over the time period and produce a dosage signal indicative of the time integral over the time period of the ultraviolet radiation intensity. The processor can also be configured to receive from the detector an intensity signal and produce a dosage signal indicative of product of the intensity and the length of the time period.

The ultraviolet radiation monitor can include a substantially flat display surface configured to show a variety of signals produced by the various components of the monitor, and the detector can have a directional variation in the response in which there is a direction in which the radiation flux causes the maximum response by the detector. This direction can be at a non-zero angle, for example 40°, from the orientation of the display surface.

A method for aiding a person to prevent over exposure to ultraviolet radiation according to the invention includes (a) measuring the intensity of the ultraviolet radiation using a ultraviolet radiation detector at least partially fabricated from aluminum gallium nitride; (b) ascertaining the level of tolerance by the person's skin to ultraviolet radiation; (c) ascertaining the blocking power of any sunscreen applied to the skin of the person; (d) deriving from the tolerance level and blocking power a limit of the cumulative ultraviolet radiation the person is to receive; (e) calculating, based at least partially on the measured ultraviolet radiation intensity, the cumulative ultraviolet radiation the person has received over a time period; and (f) alerting the use, for example by alarm or a visual display, when the

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cumulative ultraviolet radiation is at least the limit of the cumulative ultraviolet radiation the person is to receive.

The method can also include selecting, without using spectral filters, the spectral response of the detector such that the magnitude of response of the detector to ultraviolet radiation changes by at least an order of 800, or between 800 and 1200, or about 1000, between 300 nm and 330 nm. The selection can be accomplished by setting the composition of the aluminum gallium nitride used in the detector, for example, by constructing the detector with a Schottky-barrier junction detector in which one electrode is made substantially of $Al_xGa_{1-x}N$, wherein x is not less than about 25% and not more than about 30%, or not less than about 27% and not more than about 29%.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects and advantages of the invention will become apparent upon reading the following detailed description and upon reference to the drawings in which:

Figure 1 shows the erythemal response spectrum of human skin;

Figure 2 shows the spectral response of a UV detector constructed with aluminum gallium nitride of an approximate composition of $Al_{0.26}Ga_{0.74}N$;

Figure 3 shows a watch-type UV radiation monitor as an illustrative embodiment of the invention;

Figure 4 shows a cross-sectional view of the UV radiation monitor shown in Fig. 3;

Figure 5 shows a schematic diagram of the electrical circuit for a UV radiation monitor in one illustrative embodiment of the invention;

Figure 6 shows a more detailed diagram of the micro control unit;

Figure 7 shows the main steps in an illustrative process in accordance with one aspect of the invention; and

Figures 8A-8C shows the structure of a UV radiation detector in accordance with one aspect of the invention.

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While the invention is susceptible to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and are herein described in detail. It should be understood, however, that the description herein of specific embodiments is not intended to limit the invention to the particular forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

The UV-monitoring device and method of the invention are particularly useful for monitoring the UV radiation most harmful to human skin. They provide sensitive and accurate UV measurements by using aluminum gallium nitride detectors with tailored composition and UV dosage limit warning signals based on calculations that take into account user skin type and UV-blocking power of any sunscreen the user is using.

On average, how long a person may be safely exposed to UV radiation is determined by a number of factors. First, the safe exposure time, *i.e.*, the amount of time a person can stay in the solar UV radiation without skin damage, is inversely proportional to the intensity of the UV radiation, often expressed as "UV-index" ("UVI") for solar UV. Second, the tolerance of UV radiation by an individual is related to that individual's skin type, which may be quantified as a numeric "skin factor" ("SF"), devised by the American Dermatological Association. Other factors being equal, the higher the SF of a person, the longer the person can be exposed to UV radiation. Specifically, if a person's SF is incremented by one, the safe exposure time of the person is lengthened by a factor of about 1.22. Third, a sunscreen typically enables a person to be safely exposed to UV radiation longer. The "Sun Protection Factor" ("SPF") of a sunscreen denotes the factor by which the sun exposure time may be lengthened. For example, a sunscreen with an SPF of 15 enables the person wearing the sunscreen to stay out in the sun 15 times the length of time that person can be subjected to the same UV condition without the protection of the sunscreen.

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In measuring UV radiation intensity for sunburn protection, it is important to measure the portions of UV radiation that is harmful to humans. In general, human skin is much more sensitive to UV-B than to UV-A. As shown in Figure 1, known as the "erythemal response spectrum", the human skin sensitivity to erythema (redness or burning due to UV exposure) typically undergoes a increase of several decades when the wavelength is decreased from about 330 nm to 300 nm. Thus, to accurately measure harmful UV radiation, it is preferable to have a detector that has a spectral response that closely matches the erythemal response spectrum, at least in the range of about 290 nm to about 350 nm.

Although specific spectral responses of monitors may be achieved by a combination of UV detectors and filters, it is often costly to use the number of filters needed. In addition, the efficiency of the monitor is compromised because of the energy losses in the filters. Photomultipliers may be used for some of these applications but unfortunately are bulky, difficult to integrate with control electronics and, in general, require high operating voltages.

The use of detectors made of aluminum gallium nitride addresses these problems. Aluminum gallium nitride, $Al_xGa_{1-x}N$, where x ranges from 0 to 1, is a compound semiconductor that is ideally suited for devices in the ultraviolet parts of the spectrum. Aluminum gallium nitride has a direct band gap which is tunable from 3.4 electron volts (or 365 nm) at x=0 to 6.2 electron volts (or 200 nm) at x=1, by adjusting the composition, *i.e.*, the value of x. This makes the material ideally suited for intrinsic ultraviolet sensors with high responsivities for wavelengths shorter than 365 nanometers and essentially no photosensitivity for longer wavelengths. For example, Schottky-barrier detectors fabricated from aluminum gallium nitride (including the end-members AlN and GaN) for visible-blind UV detection have been disclosed in the U.S. Patent No. 6,104,074, which is commonly assigned with the present application and is incorporated herein by reference. The spectral response (Figure 2), for example, of a detector fabricated with the approximate composition $Al_{0.26}Ga_{0.74}N$ and in photovoltaic mode exhibits a cut-off at about 290 nm, which is the $Al_{0.26}Ga_{0.74}N$ band edge, with the responsivity falling off by orders of magnitude for longer wavelengths.

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The spectral response of the aluminum gallium nitride detector can be designed to closely match the erythemal response spectrum, *i.e.*, to have an onset of the drop in responsivity at about 290 to 300 nm and a drop of responsivity of at least 800, for example between 800 and 1,200 or about 1,000, between 300 nm and 330 nm. For example, with an approximate composition $Al_{0.26}Ga_{0.74}N$, the detector has responsivity that decreases by a factor of about 1000, between wavelengths of 300 nm and 330 nm. The spectral response of the detector is otherwise also similar to the erythemal response spectrum at least between about 290 nm and 350 nm wavelengths.

As shown in Fig. 3, the UV radiation monitor **300** includes a housing **302**, which can be of any suitable housing, including a wrist-watch-type housing having a watchband **304** for attaching the monitor **300** to a person.

The monitor **300** also includes a UV radiation detector **308** adapted to be exposed to UV radiation through the housing **302**. The detector **308** is of a photo-electrical type that has an intrinsic (*i.e.*, without the aid of filters) spectral response limited to UV radiation. For example, the detector **308** can be a junction device having aluminum gallium nitride on one side of the junction. More specifically, the detector **308** can include a Schottky-barrier junction detector such as those disclosed in the U.S. patent application S/N 09/206,328, as incorporated herein above. In particular, the composition of aluminum gallium nitride can be chosen, such that the detector **308** is sensitive substantially only to UV-B radiation. Experiments have shown that detectors with a composition with x of about 25-30% have such characteristics. For example, a composition of x of about 27-29% results in a detector that is has a spectral response cutoff, *i.e.*, the point where the responsivity drops to10 % of peak responsivity, at about 320 nm.

The detector **308** can further be of a type that has a spectral response approximately matching the spectral sensitivity of the human skin, *i.e.*, the erythemal response spectrum. That is, the percentage decrease in the detector response to radiation as a function of radiation frequency around the cutoff wavelength is approximately the same as the percentage decrease in erythemal response spetrum. For example, a composition with x of about 27% to about 29%

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results in a detector that is has a spectral response that drops off by a factor of about 1000 between wavelengths of 300 nm and 330 nm.

An example of this type of device is shown in Fig. 8A. The detector **308** includes a detector housing **802**, which contains a Schottky-barrier junction **804** that is sensitive substantially only to radiation with wavelengths of 320 nm or shorter, as described above. The junction **804** is covered with a layer of a UV-transparent epoxy **806**, the spectral response of which is such that the combination of the epoxy with the junction **804** results in a spectral response that approximately matches the spectral sensitivity of the human skin. An example is the Epo-Tek 301-2 epoxy, available from Epoxy Technology, Inc., Boston Massachusetts. This epoxy is 98-99% transparent at wavelengths from 310 nm to 2.5 μm and 90% transparent at 300 nm but rapidly becomes opaque at wavelengths shorter than 290 nm. Thus the combination of the junction **804** and epoxy layer **808** is sensitive substantially only to radiation with wavelengths between 290 and 320 nm, *i.e.*, UV-B, and the spectral response approximately matches the spectral sensitivity of human skin. Figures 8B and 8C illustrates the detector **308** in further details.

Aluminum gallium nitride UV detectors can be made by a variety of known techniques, including those disclosed in the U.S. Patent No. 6,104,074 for Schottky-barrier detectors, as mentioned above, and U.S. Patent No. 5,278,435, which is also incorporated herein by reference.

As shown in Fig. 4, the detector **408** (308 in Fig. 3) can be covered by a protective cover **410** (310 in Fig. 3). The protective cover **410** can be of any UV-transparent material, including a visible-blocking, UV-transparent color filter such as those commercially available from Corning, Inc., Corning, New York. Although aluminum gallium nitride based detectors exhibit excellent rejection ratio of the visible range (better than 1000:1), a color filter can further improve that performance.

The housing **302** accommodates a number of pushbuttons, including the START+ button **312**, HOLD- button **314**, MODE button **316** and SET button **318**. These buttons, when pushed, operate their respective switches **312** (See Fig. 3) in the

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electronic circuit **300** contained in the housing **302**. Some of the functions of the switches **312** will be described later below.

The housing **302** also contains a display **306**, which includes a UVI display area **324**, a date display area **326** and a time display area **328**. The display can be of any suitable type, including LCD. The UVI display area has an upper portion **322** and a lower portion **324**. The lower portion **324** is adapted to display UVI in numerical form, (whereas the upper portion **322** is adapted to display UVI in graphic form, such as a "sun dot", having ten bars, with the number of bars lit (or darkened) representing the UVI value up to 10. The bars of the "sun dot" may also be randomly lit and not represent the UVI, or may be a series of preprogrammed patterns. This way, the "sun dot" is used to make the watch display more interesting to the user and other observers. The time display area **328** is adapted to display the time. The date display area **326** is adapted to display the date and day of week, but also other parameters depending on the mode selected by the MODE or START+ buttons, as described in more detail below.

Referring again to Fig. 4, the detector **408** is positioned to face a direction that is at an angle relative to the surface of the display **406**. The detector may have a direction in which the responsivity of the detector is the greatest. This is typically the case, for example, where signal-generating layer in a junction detector is generally planar and the detector does not employ other means, such as a diffuser, to eliminate directional dependency. In that case, the direction of the maximum responsivity is generally the direction perpendicular to the signal-generating layer, or the junction. In the illustrative embodiment shown in Fig. 4, the detector **408** defines a direction of maximum responsivity generally perpendicular to the face of the detector **408**, and the surface of the display **406** has a general orientation that is generally perpendicular to the surface. Preferably the angle is between about 30 to 50 degrees, and more preferably about 40 degrees so that when a person in an upright posture facing the sun and wearing the monitor on his/her wrist attempts to read and adjust the settings on the monitor, the detector **408** is most likely to point approximately directly at the sun. This will most likely result in a reading of substantially the maximum UV intensity.

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Electronically, as shown in Fig. 5, the UV monitor includes a processor **500**, which includes an amplifier **504** for receiving the current signal from the UV detector **502** (the physical embodiment of which is the detector **308** in Figs. 3 and 4) and converting the current signal to a voltage signal of a predetermined range, *e.g.*, 0-3 volts. The processor **500** also includes a micro controller unit ("MCU") **506**, which handles all or most of the signal processing, including analog-to-digital ("A/D") conversion, detector calibration, time calculation, display drive and other signal processing. The amplifier **504** is operatively connected to the MCU **506** and supplies voltage signal to the MCU. The processor **500** further includes a nonvolatile memory **508**, such as an EEPROM, for storing the calibration parameters for the detector **502**. If the relation between the detector signal amplitude and UV radiation intensity is linear, two numbers (offset and linear coefficient) can be stored in the memory **508** and read by the MCU **506**. The processor further includes switches **512**, which can be activated by the pushbuttons **312-318** to send signals to the MCU **506** to accomplish setting the various parameters of the UV monitor. The MCU **506** is operably connected to the display **510** for output.

The MCU **506** can be of any suitable micro-processor. Many off-the-shelf microprocessors can be used. In the embodiment illustrated in Fig. 4, the MCU **506** includes a CPU **602**, the processing codes are stored in the ROM **604**, connected to the CPU **602**. Other parts of the MCU **606** are operably connected to the CPU **602** via the I/O port and interrupt control **606**: the serial I/O port **608**, which is operably connected to the nonvolatile memory **508**; the LCD driver **610**, which is operably connected to the display **310**; watch timer **612**, which supplies timing signals to the various watch functions and UV exposure time countdown; A/D converter **612**, which is connected to the amplifier **504** for converting the voltage signal to a digital signal; and the I/O ports **614a-d** for receiving signals generated by the switches **512**, respectively.

In operation, upon receiving UV radiation, the detector **508** generates a current signal corresponding to the intensity of the radiation. The signal is converted to a voltage signal by the amplifier **504**. The MCU **506** reads the voltage signal and

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calculates the UVI value from the magnitude of the signal and calibration parameters read from the nonvolatile memory **508**. The UVI value is displayed in the UVI display area **320** as described above. In the above example of graphical representation of UVI using a "sun dot" having ten rays, the "sun dot" can be programmed to flash when UVI exceeds 10, indicating a dangerously high level of UV radiation.

To set the safe exposure time, as outlined in Fig. 7, the user first initializes (**700**) the UV monitor by pressing the START+ button **312**. In response, the MCU **506** sets the percentage time remaining to 100% and prompts for the user to enter the SF and SPF by incrementally changing the displayed values using the START+ (**312**) or HOLD- (**314**) buttons (**710**). After each value is set, the user pushes the SET button **318**. Once both SF and SPF are set, the MCU **506** takes a reading of the signal from the detector **502** (**720**). From the signal, from which and the calibration parameters stored in the nonvolatile memory **508** the UVI can be calculated, and the SF and SPF values, the MCU **506** calculates the corresponding safe exposure time ("SE") and multiplies it by the percentage time remaining (100% at the beginning) (**730**). For example, the SE can be calculated as a function of UVI, SF and SPF approximately by the equation:

$$SE(UVI, SF, SPF) = SE(UVI_0, SF_0, SPF_0) \times \frac{UVI_0}{UVI} \times e^{(SF-SF_0)\times \ln 1.22} \times \frac{SPF}{SPF_0},$$

where $SE(UVI_0, SF_0, SPF_0)$ is the safe exposure time for a person of skin factor of SF_0, wearing a sunscreen of SPF_0, and exposed to UV radiation of UVI_0. Any $SE(UVI_0, SF_0, SPF_0)$ can be chosen as the starting value from which other SE can be calculated. For example, one can choose SE(3, 5, 6), which is approximately one hour. Any other suitable ways to ascertain SE can also be used. For example, SE values corresponding to various combinations of SF, SPF and UVI can be pre-stored in memory and selected from based on the particular combination of SF, SPF and UVI.

The MCU **506** then lets a certain amount of time, for example 0.5 seconds, elapse (**740**) and calculates the percentage time remaining (**750**). Next the MCU **506** checks if the percentage time remaining is zero or less (**760**). If it is not, the MCU **506** then checks if the HOLD function, to be discussed in more detail below, is

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acitvated (**770**). If it is not, the process repeats itself beginning at step **720**, *i.e.*, a new UVI measurement is made and new SE calculated; if the HOLD function is activated, the process repeats itself beginning at step **740**, *i.e.*, more time is let pass without taking a new UVI reading.

Whenever the percentage time remaining has reached zero or negative, the MCU **506** triggers an alarm, alerting the user that the maximum safe UV exposure time has expired (**780**).

The HOLD function lets the user decide whether the UVI is to be assumed to be constant until the further instruction. When the user is not engaged in rigorous activities, as in the case of sunbathing, the monitor is like to be relatively steady and measure the UVI that the user is actually exposed to. In contrast, if the user is engaged in rigorous activities such as tennis playing, the position of the monitor is like to change frequently. There is then a possibility that the UV exposure measured by the monitor is substantially different from that actually experienced by most parts of the user's body if the monitor continues to update its UVI reading. To avoid this situation or to ensure a conservative setting, the user has the option to activated the HOLD function, indicating that the UVI reading is to be held constant.

The HOLD function can be activated by pressing the HOLD- button **314** for longer than a predetermined time period, for example five seconds. When the HOLD function is activated, the value of the assumed UVI is displayed in digital form in the lower portion **324** of the UVI display area **320**, while the actual UVI is optionally displayed graphically in the upper portion **322**.

The user can use the MODE button **316** to display the values of SF, SPF, and UVI and use the other pushbuttons **312, 314** and **318** to change any of the values.

Other processes are also possible. For example, instead of decreasing percentage time remaining from the SE, in an equivalent process, the maximum allowable UV dosage is set by the MCU **506** according to skin factor, UV dosage rate is measured as UVI reduced by a factor of SPF, and the dosage rate is integrated until the maximum allowable dosage is reached.

Other features can be added to further enhance the utility of the UV monitor. For example, the UV monitor can also be constructed to have a "Storage" mode, in

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which the power consumption rate by the monitor is significantly reduced. The MCU **506** can be programmed such that upon a predetermined sequence of pressing some or all of the buttons **312, 314, 316** and **318**, a selected group of energy consuming components are turned off. For example, the display driver **610** and detector amplifier **504** can be powered off in this mode. The MCU **506** itself carries out no operation other than checking its own status and that of the I/O ports **614a-d** every half a second or any other acceptable periodicity. If none of the buttons **312, 314, 316** and **318** has been pressed, the monitor will remain in the storage mode. If, however, any of the buttons **312, 314, 316** and **318** has been pressed, the MCU **506** sends instructions to power up all components and set the monitor in the normal operational mode.

The particular embodiments disclosed above are illustrative only, as the invention can be modified and practiced in different but equivalent manners apparent to those skilled in the art having the benefit of the teachings herein. Furthermore, no limitations are intended to the details of construction or design herein shown, other than as described in the claims below. It is therefore evident that the particular embodiments disclosed above can be altered or modified and all such variations are considered within the scope and spirit of the invention. Accordingly, the protection sought herein is as set forth in the claims below.

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This specification describes aspects of prior art UV detectors and monitoring UV radiation. However, neither such aspects of prior art UV detectors and monitoring UV radiation nor the description contained herein of such aspects of prior art UV radiation detectors and monitoring UV radiation is to be taken as forming part of the common general knowledge solely by virtue of the inclusion herein of the reference to and description of such aspects of prior art UV radiation detectors and monitoring UV radiation.

Throughout the specification, unless the context requires otherwise, the word "comprise" or variations such as "comprises" or "comprising", will be understood to imply the inclusion of a stated integer or group of integers but not the exclusion of any other integer or group of integers.

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COMS ID No: SBMI-04266132 Received by IP Australia: Time (H:m) 17:42 Date (Y-M-d) 2006-07-25

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CLAIMS

What is claimed is:

1. An ultraviolet radiation monitor, comprising:

(a) an ultraviolet radiation detector at least partially fabricated from aluminum gallium nitride and configured to produce an intensity signal indicative of the intensity of the ultraviolet radiation received by the detector;

(b) a first signal generator configured to produce a skin type signal indicative of a level of tolerance by a person's skin to ultraviolet radiation;

(c) a second signal generator configured to produce a blocking power signal indicative of the blocking power of a sunscreen applied to the skin of the person; and

(d) a processor operatively connected to the detector, the first signal generator and the second signal generator to receive the intensity signal, skin type signal and blocking power signal,

wherein the processor is configured to generate, in response to the skin type signal and blocking power signal, a dose limit signal indicative of a limit of the cumulative ultraviolet radiation the person is to receive and, in response to the intensity signal, a cumulative dosage signal indicative of the cumulative ultraviolet radiation the person has received over a time period,

wherein the processor is further configured to produce a signal perceptible to the user when the cumulative ultraviolet radiation indicated by the dosage signal is at least the limit indicated by the dose limit signal.

2. The ultraviolet radiation monitor of claim 1, wherein the first signal generator includes a first user interface configured to receive a user input indicative of the level of tolerance by a person's skin to ultraviolet radiation, and wherein the second signal generator includes a second user interface configured to receive a user input indicative of the blocking power of the sunscreen applied to the skin of the person.

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3. The ultraviolet radiation monitor of claim 2, further comprising a housing accommodating the signal generators, processor and user interfaces, wherein the housing is in the form of a wrist watch.

4. The ultraviolet radiation monitor of claim 1, wherein the magnitude of response of the detector to ultraviolet radiation changes by at least an order of 800 between 300 nm and 330 nm.

5. The ultraviolet radiation monitor of claim 4, wherein the detector has a spectral response that substantially matches the erythemal response spectrum.

6. The ultraviolet radiation monitor of claim 2, wherein the processor is configured to receive from the detector an intensity signal and to produce a dosage signal indicative of product of the intensity and the length of the time period.

7. The ultraviolet radiation monitor of claim 1, wherein the monitor further includes a substantially flat display surface configured to show a visual signal indicative of at least one of the intensity signal, skin-type signal, blocking power signal, dose limit signal and cumulative dosage signal, wherein the detector defines a direction in which the radiation flux causes the maximum response by the detector, wherein the direction is at an angle from the orientation of the display surface.

8. The ultraviolet radiation monitor of claim 1, wherein the detector is a Schottky-barrier junction detector.

9. The ultraviolet radiation monitor of claim 1, wherein the detector comprises a Schottky-barrier junction in which one electrode is made substantially of $Al_xGa_{1-x}N$, wherein x is not less than about 26% and not more than about 29%.

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10. A method for aiding a person to prevent over exposure to ultraviolet radiation, the method comprising:

(a) measuring the intensity of the ultraviolet radiation using an ultraviolet radiation detector at least partially fabricated from aluminum gallium nitride;

(b) ascertaining the level of tolerance by the person's skin to ultraviolet radiation;

(c) ascertaining the blocking power of any sunscreen applied to the skin of the person;

(d) deriving from the results of steps (b) and (c) a limit of the cumulative ultraviolet radiation the person is to receive;

(e) calculating, based at least partially on the ultraviolet radiation intensity measured in step (a), the cumulative ultraviolet radiation the person has received over a time period; and

(f) alerting the user when the cumulative ultraviolet radiation is at least the limit of the cumulative ultraviolet radiation the person is to receive.

11. The method of claim 10, further comprising (g) selecting, with out using spectral filters, the spectral response of the detector such that the magnitude of response of the detector to ultraviolet radiation changes by at least an order of 800 between 300 nm and 330 nm.

12. The method of claim 11, wherein (g) comprises setting the composition of the aluminum gallium nitride used in the detector, constructing the detector with a Schottky-barrier junction detector in which one electrode is made substantially of $Al_xGa_{1-x}N$, wherein x is not less than about 26% and not more than about 29%.

13. The method of claim 10, further comprising the steps of:

(h) setting a percentage time value as remaining for the person to stay exposed to the ultraviolet radiation without skin damage;

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(i) deriving from the results of steps (a), (b) and (c) a total amount of time, SE, the person can stay exposed to ultraviolet radiation without skin damage according to the formula

$$SE(UVI, SF, SPF) = SE(UVI_0, SF_0, SPF_0) \times \frac{UVI_0}{UVI} \times e^{(SF-SF_0)\times \ln 1.22} \times \frac{SPF}{SPF_0}$$

where UVI is the radiation intensity, SF is the level of tolerance, quantified and skin type, by the person's skin to ultraviolet radiation, SPF is the blocking power, quantified as sun protection factor, of the sunscreen applied to the skin of the person, $SE(UVI_0, SF_0, SPF_0)$ is a predetermined constant equal to the amount of time a person of skin factor of SF_0 and wearing a sunscreen of SPF_0 can stay exposed to ultraviolet radiation of intensity UVI_0 without skin damage;

(j) calculating the time remaining for the person to stay exposed to the ultraviolet radiation without skin damage as the result of step (i) multiplied by the percentage time value;

(k) waiting for a predetermined time interval;

(l) reducing the percentage time value by the ratio between the length of the predetermined time interval and the result of step (j);

(m) repeating steps (a) and (i) through (l) until the percentage time value is not more than a predetermined value; and

(n) alerting the user after step (m).

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14. An ultraviolet radiation monitor substantially as hereinbefore described.

15. An ultraviolet radiation monitor substantially as hereinbefore described with reference to Figures 2 to 6 and 8A to 8C of the accompanying drawings.

16. A method for aiding a person to prevent overexposure to ultraviolet radiation substantially as hereinbefore described.

17. A method for aiding a person to prevent overexposure to ultraviolet radiation substantially as hereinbefore described with reference to Figure 7 of the accompanying drawings.

Dated this Twenty Fifth day of July 2006.

APA Enterprises, Inc.
Applicant

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Perth, Western Australia
Patent Attorneys for the Applicant

1383_PRIOR_ART_000593
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FIG. 1

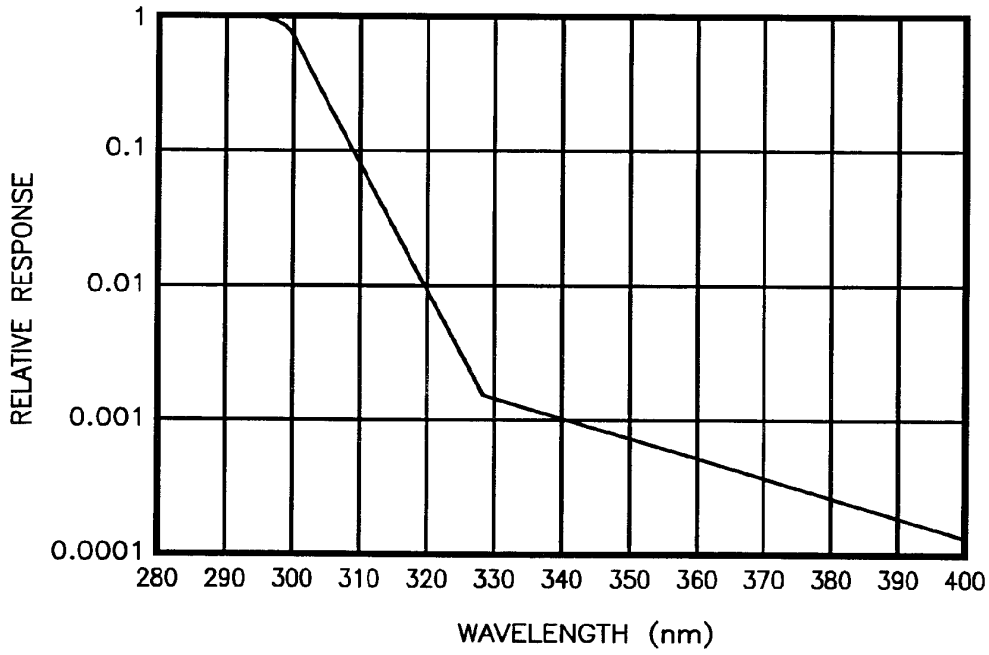

1
0.1
0.01
0.001
0.0001
RELATIVE RESPONSE
280 290 300 310 320 330 340 350 360 370 380 390 400
WAVELENGTH (nm)

FIG. 2

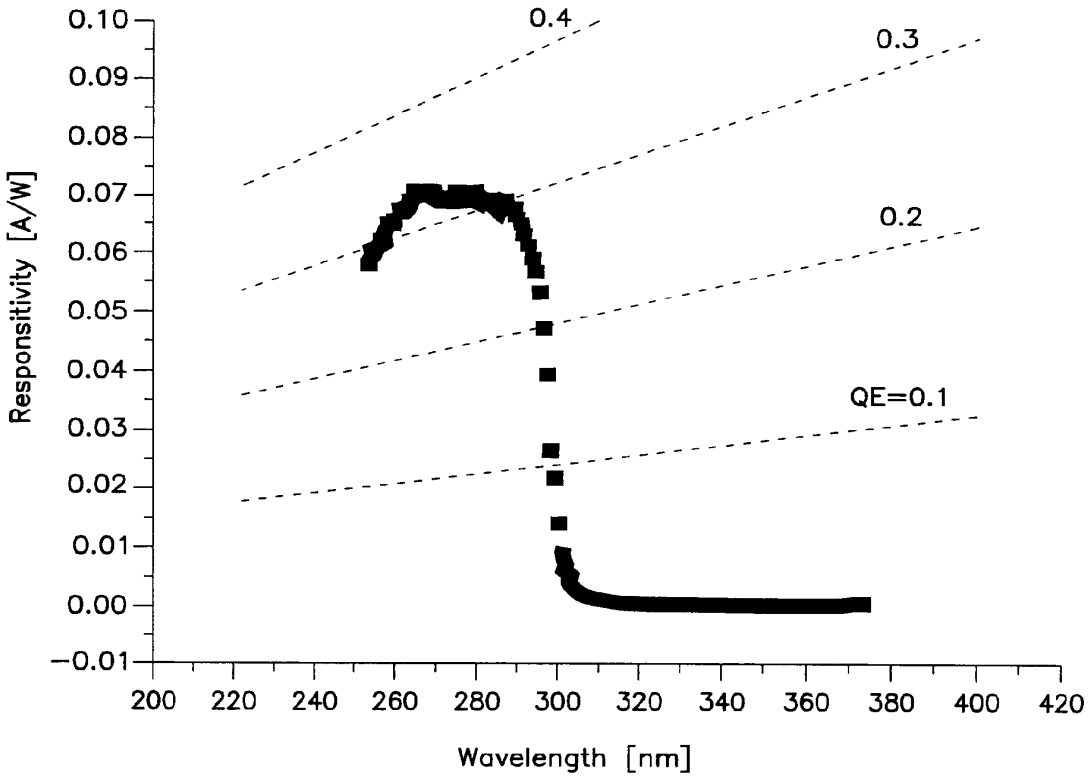

0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
−0.01
Responsitivity [A/W]
200
220
240
260
280
300
320
340
360
380
400
420
Wavelength [nm]
0.4
0.3
0.2
QE=0.1

FIG. 3

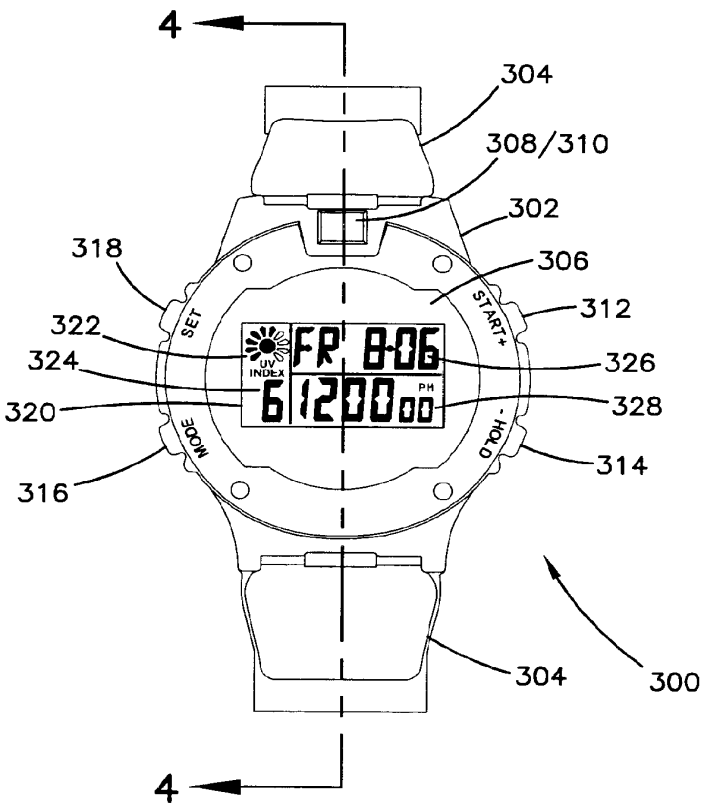

4
304
308/310
302
318
306
312
322
324
326
320
328
316
314
304
300
4
SET
START+
MODE
HOLD-
UV INDEX
FR 8-06
6 12 00
PM

FIG. 4

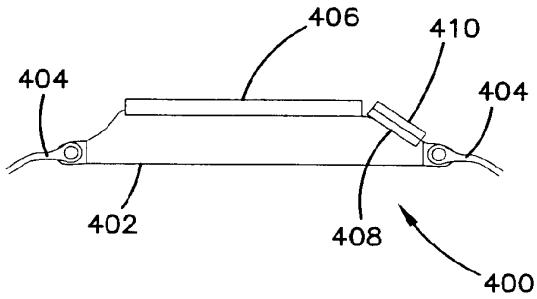

406
410
404
404
402
408
400

FIG. 5

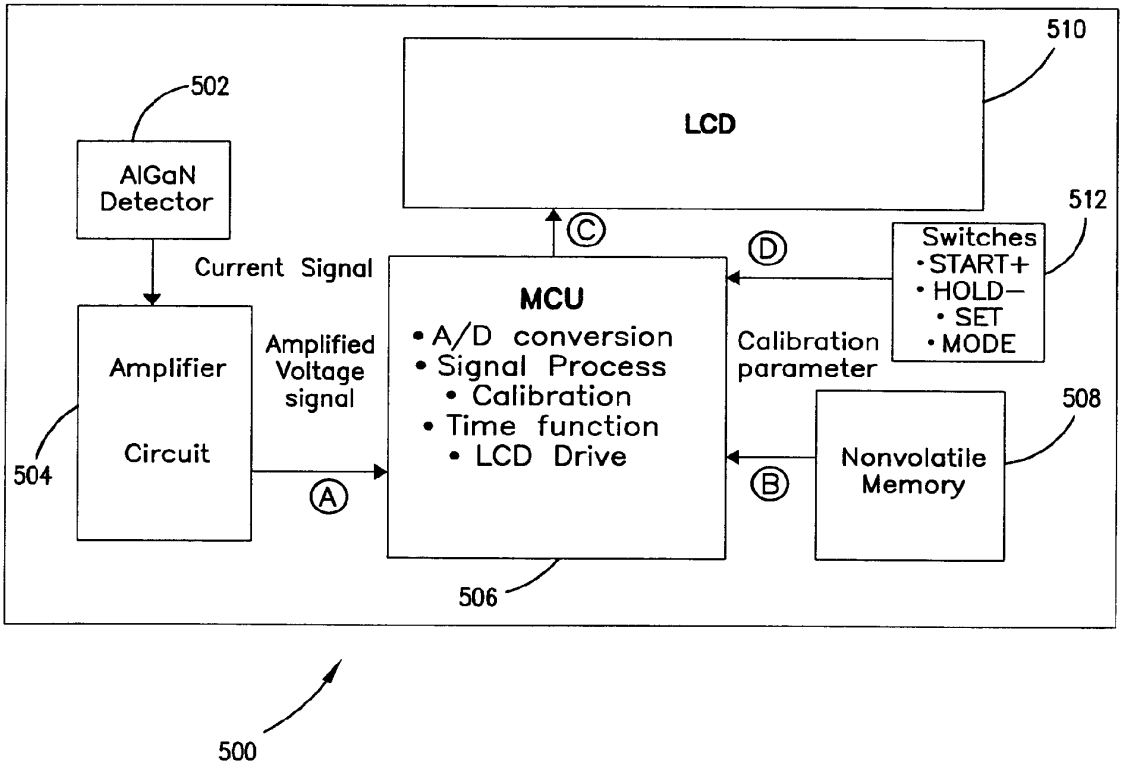

510
LCD
502
AlGaN Detector
512
Switches
• START+
• HOLD−
• SET
• MODE
Current Signal
MCU
• A/D conversion
• Signal Process
• Calibration
• Time function
• LCD Drive
Amplified Voltage signal
Amplifier Circuit
504
Calibration parameter
508
Nonvolatile Memory
A
B
C
D
506
500

FIG. 6

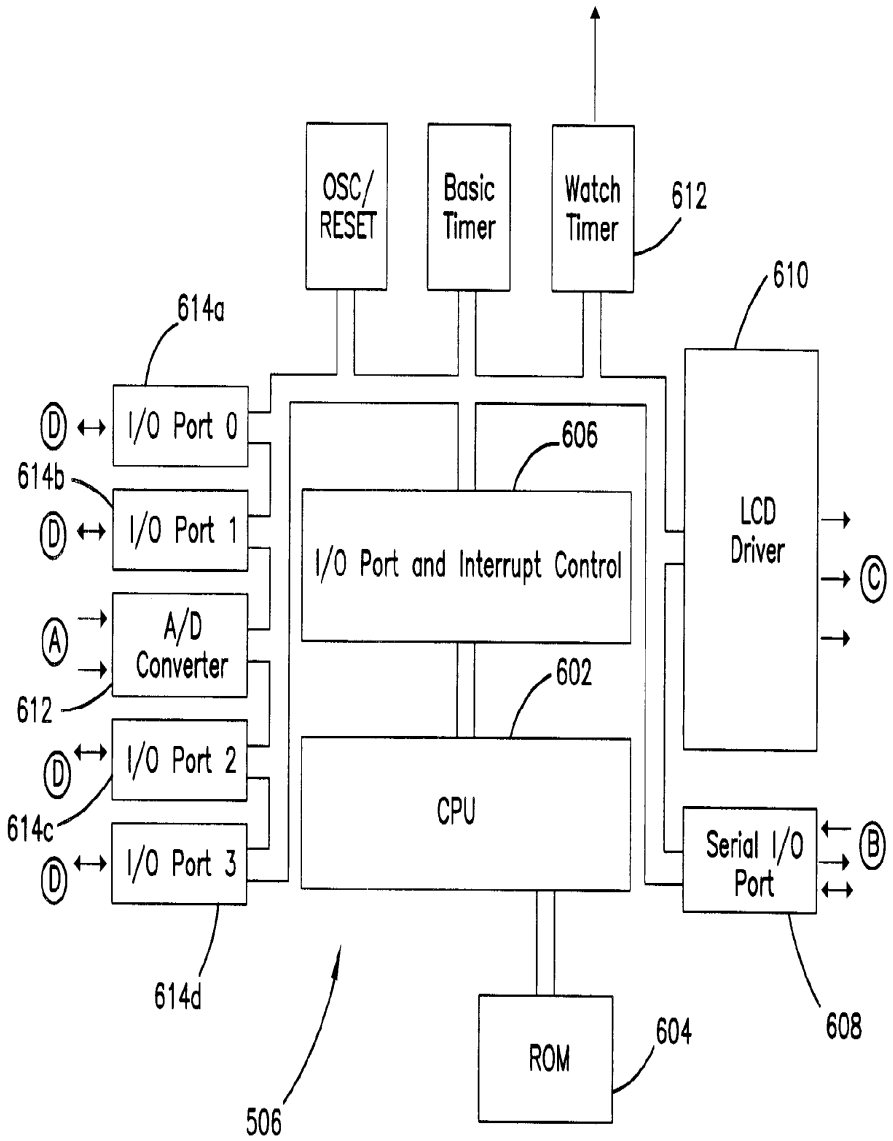

OSC/
RESET
Basic
Timer
Watch
Timer
612
610
614a
I/O Port 0
606
614b
I/O Port 1
I/O Port and Interrupt Control
LCD
Driver
A/D
Converter
602
612
I/O Port 2
CPU
614c
I/O Port 3
Serial I/O
Port
614d
608
506
ROM
604

FIG. 7

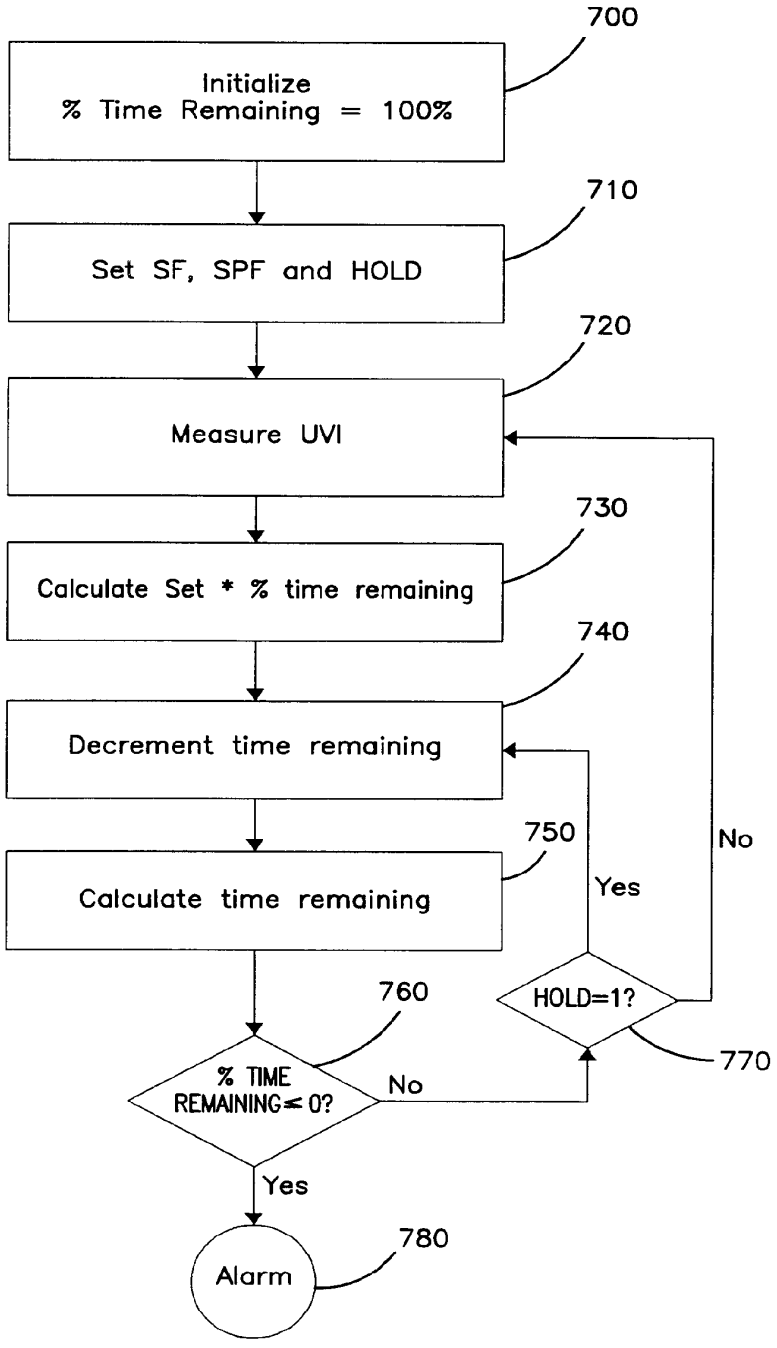

700
Initialize
% Time Remaining = 100%
710
Set SF, SPF and HOLD
720
Measure UVI
730
Calculate Set * % time remaining
740
Decrement time remaining
750
Calculate time remaining
760
% TIME REMAINING≤ 0?
No
Yes
HOLD=1?
No
Yes
770
780
Alarm

FIG. 8A

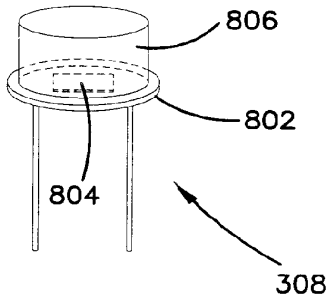


FIG. 8B

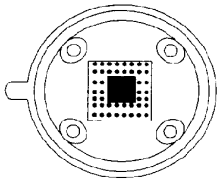
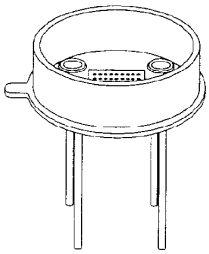


FIG. 8C



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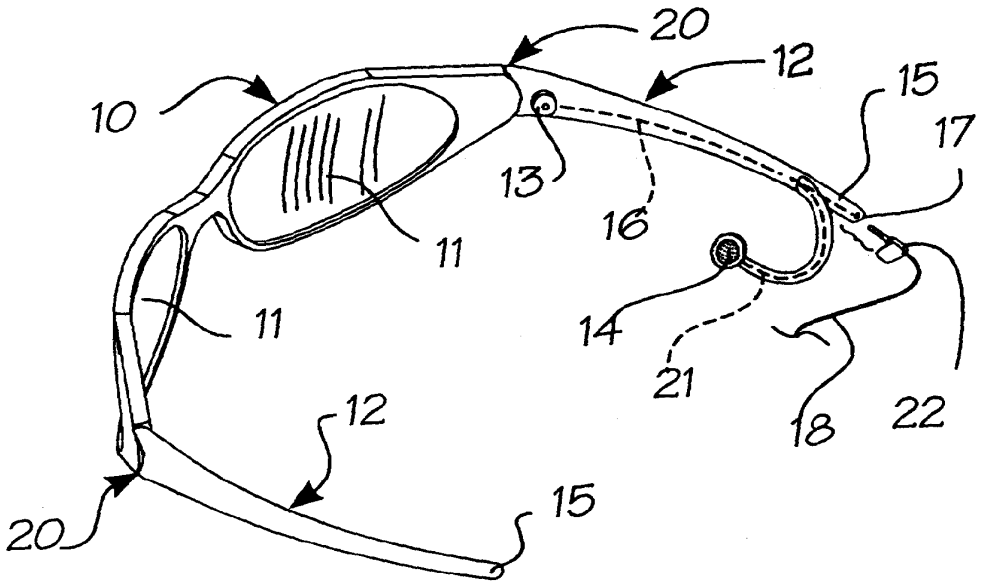
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[Continued on next page]

(54) Title: EYEGLASSES SUITABLE FOR TRANSMITTING AND RECEIVING CELLULAR TELEPHONE CALLS



(57) Abstract: Eyeglasses comprising a microphone (13) in the front part, at least one earpiece (14) adjacent to one end of a corresponding temple (12), connection wires inside the structure, and a connector for a cable for connection to a cellular telephone. (Fig. 1)

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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.

EYEGLASSES SUITABLE FOR TRANSMITTING AND RECEIVING CELLULAR TELEPHONE CALLS

Technical Field

The present invention relates to a pair of eyeglasses suitable for transmitting and receiving cellular telephone calls.

Disclosure of the invention

The aim of the present invention is to provide eyeglasses that in addition to the normal optical and/or sunlight protection function are capable of constituting a means for transmitting and receiving cellular telephone calls.

Within this aim, an object of the invention is to provide eyeglasses that can be worn just as easily and comfortably as conventional ones.

Another object is to provide eyeglasses that can be used with any kind of cellular telephone.

Another object is to provide eyeglasses whose devices for transmitting and receiving cellular telephone calls are integrated, so as to avoid varying their ergonomic performance.

Another object is to provide eyeglasses whose structure allows industrial-scale manufacture at competitive costs.

This aim and these and other objects that will become better apparent hereinafter are achieved by eyeglasses, comprising a frontpiece which supports lenses, to the ends of which temples are articulated, characterized in that they comprise a microphone in the front part, at least one earpiece adjacent to one end of a corresponding temple, connection wires inside at least one temple, and a connector for a cable for connection to a cellular telephone.

Brief description of the drawings

Further characteristics and advantages of the invention will become better apparent from the following detailed description of an embodiment thereof, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a rear perspective view of eyeglasses according to the invention;

Figures 2 to 4 are enlarged-scale views of details of the eyeglasses of Figure 1;

Figure 5 is a view of a detail of a further embodiment of the invention.

Ways of carrying out the Invention

With reference to the figures, a pair of eyeglasses according to the invention is constituted, in a conventional manner, by a frontpiece 10, which supports the lenses 11 (of a type suitable to correct defects or of a type that provides protection against sunlight), to the ends of which temples 12 are articulated.

According to the invention, the eyeglasses comprise a microphone 13 located in the internal front part that is not in view, at least one earpiece 14 adjacent to an end 15 of a corresponding temple 12, connection wires 16 arranged inside the structure, and a connector 17 for a cable 18 for connection to a cellular telephone 19.

More particularly, the microphone 13 can be integrated in the front part of the corresponding temple 12 (Figures 1 to 4) or integrated in the frontpiece 10 (reference numeral 113 in Figure 5), in which case at the corresponding hinge 20 it is necessary to provide electrical contacts, not shown in the figure, for continuity.

The earpiece 14 can be arranged at the end of an extension 21 made of plastically deformable material, which diverges from the end 15 of the corresponding temple 12.

This is done to allow the user to perform personalized orientation and positioning of the earpiece 14.

The material of the extension 21 can be plastically deformable metal or a plastic material such a rubber co-molded on the temple 12 and containing a plastically deformable metallic core.

As an alternative, it is possible to use a plastically deformable plastic

material.

The passage of the connecting wires 16 is of course provided inside the extension 21.

Such wires, like the wires for the microphone 13, are in fact embedded in the plastic material, in the case of eyeglasses having a plastic frame, or are located inside hollow regions of the structure, in the case of eyeglasses having a metal structure.

As regards the connector 17, it is of the female type and is embedded in the end 15 and can be of the commonly commercially available type that is complementary to the male connectors 22 normally used in cellular telephone connections.

In practice, it has observed that the intended aim and objects of the present invention have been achieved.

The eyeglasses in fact are entirely similar in appearance to normal sight-correction eyeglasses or sunglasses and can be used normally for this purpose, with the additional possibility, for example when in a car, on a motorcycle, on a bicycle or in other cases, to connect the microphone 13 and the earpiece 14 by means of the cable 18 to a cellular telephone 19 and therefore to transmit and receive calls.

The earpiece 14 can of course also be integrated directly in the end 15.

In practice, the materials employed, so long as they are compatible with the contingent use, as well as the dimensions, may be any according to requirements.

The disclosures in Italian Utility Model Application No. PD2001U000034 from which this application claims priority are incorporated herein by reference.

CLAIMS

1. Eyeglasses, comprising a frontpiece which supports lenses, to the ends of which temples are articulated, characterized in that they comprise a microphone in the front part, at least one earpiece adjacent to one end of a corresponding temple, connection wires inside at least one temple, and a connector for a cable for connection to a cellular telephone.

2. The eyeglasses according to claim 1, characterized in that said microphone is located in the inner part thereof, which is not in view.

3. The eyeglasses according to claim 1, characterized in that said microphone is integrated in said front part of a temple.

4. The eyeglasses according to claim 1, characterized in that said microphone is integrated in the frontpiece.

5. The eyeglasses according to claim 1, characterized in that said at least one earpiece is arranged at the end of an extension made of plastically deformable material that diverges from said end of said temple.

6. The eyeglasses according to claim 5, characterized in that the material of said tab is plastically deformable metal or elastically deformable plastic material with a plastically deformable metallic core, or plastically deformable plastic material.

7. The eyeglasses according to claim 1, characterized in that said connection wires are embedded in the plastic material in the case of eyeglasses having a frame made of plastics.

8. The eyeglasses according to claim 1, characterized in that said connecting wires are located inside hollow regions of the structure in the case of metal eyeglasses.

9. The eyeglasses according to claim 1, characterized in that said connector is a female connector, which is embedded in the corresponding end and is complementary to the connectors used in cellular telephone connections.

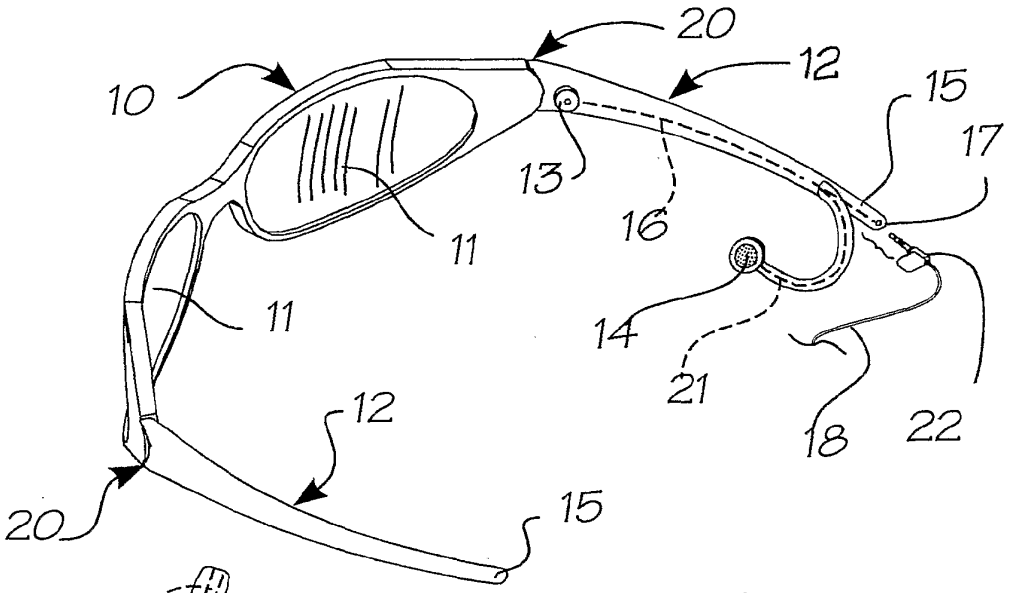


Fig. 1

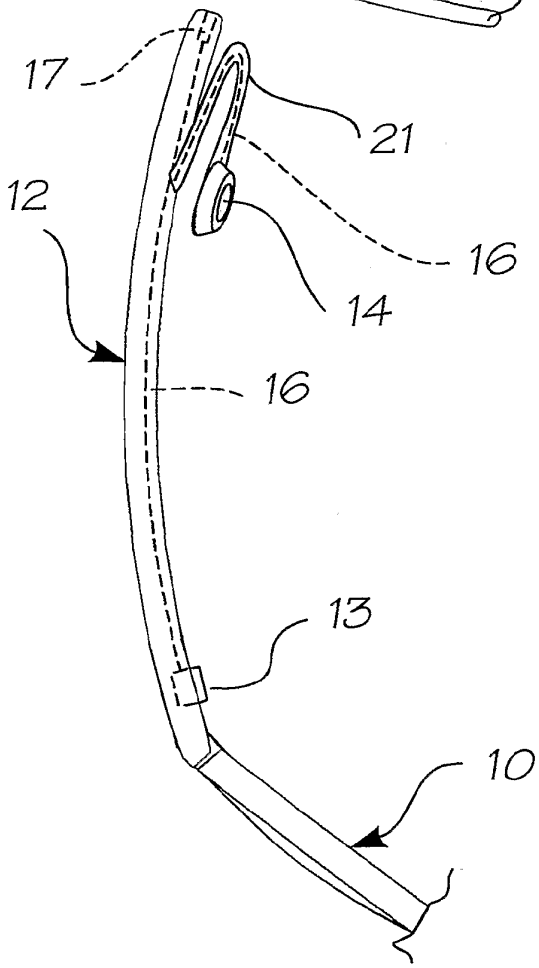


Fig. 2

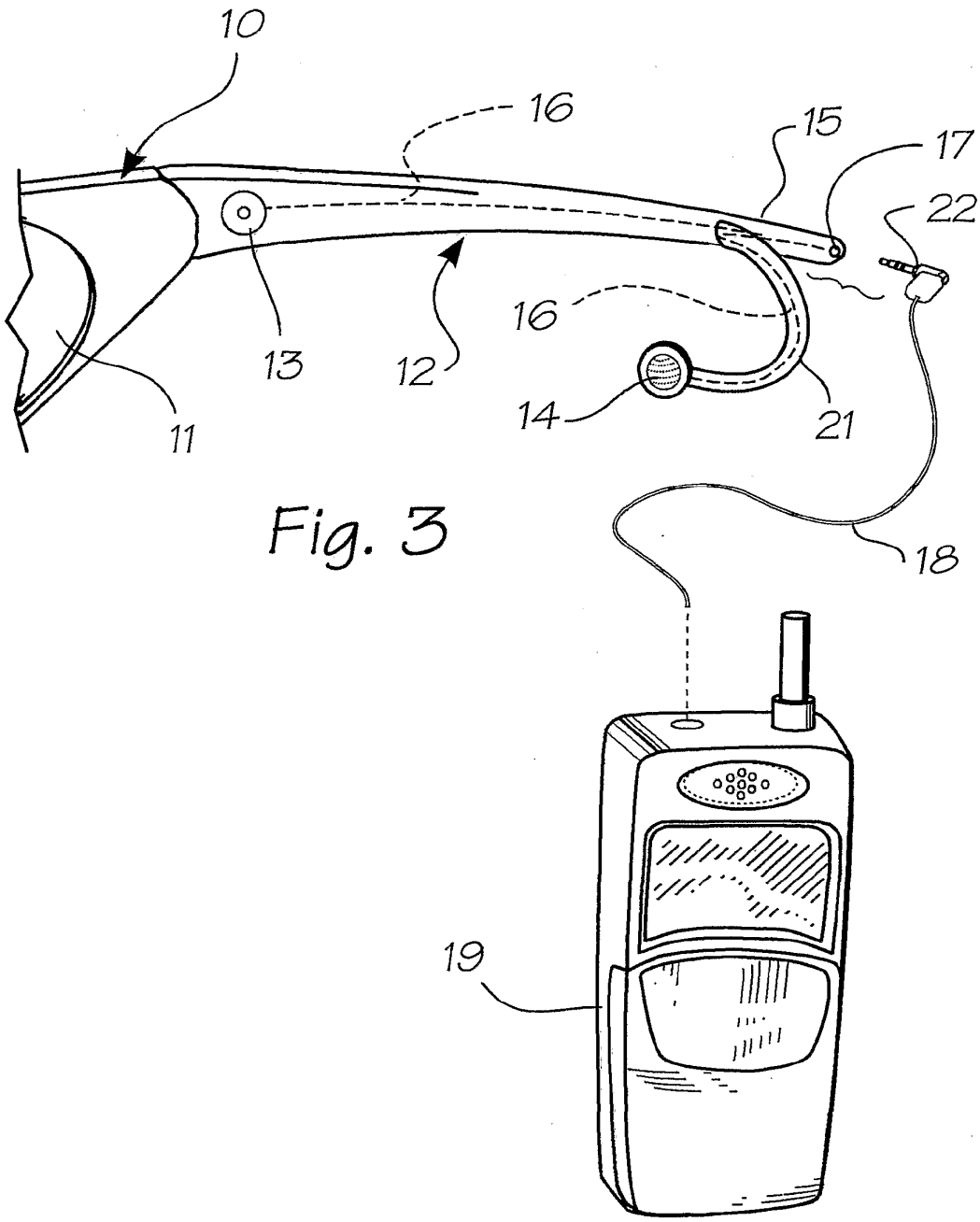


Fig. 3

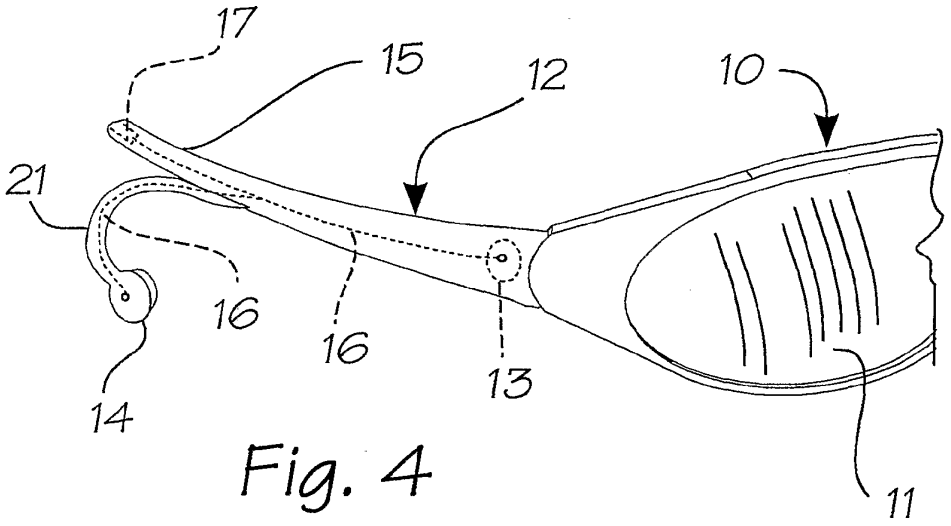


Fig. 4

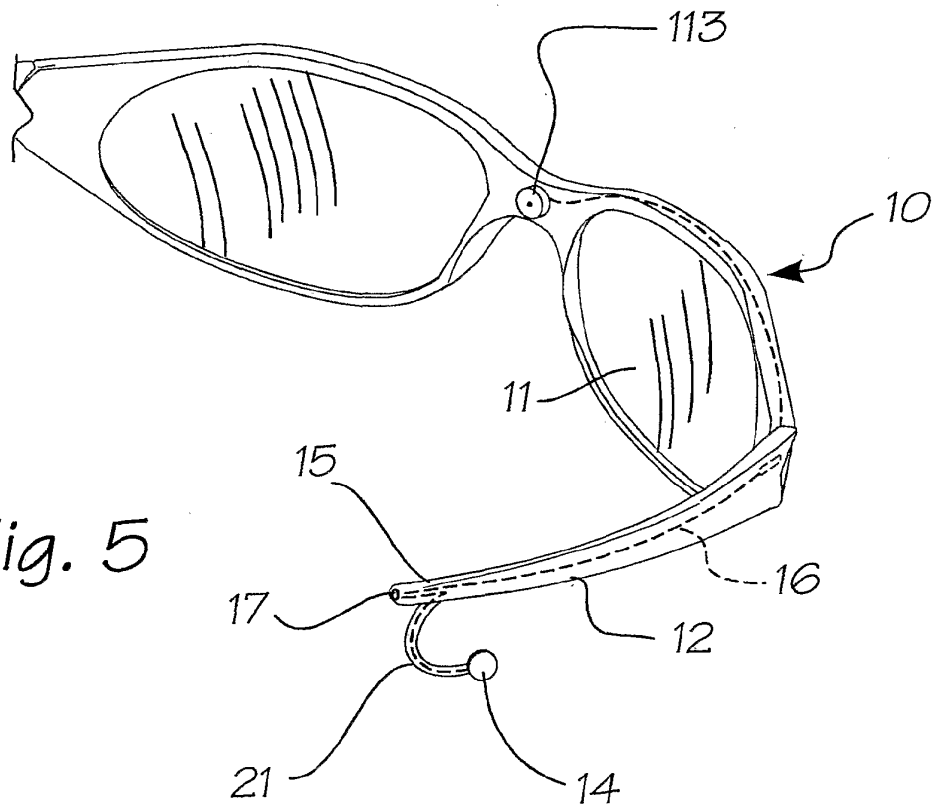


Fig. 5

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 02/04309

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G02C11/06

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 7 G02C

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, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	WO 90 10361 A (ULLMAN JOHAN) 7 September 1990 (1990-09-07) page 3, line 35 -page 9, line 14 ---	1-8
X	WO 99 23524 A (MICROOPTICAL CORP) 14 May 1999 (1999-05-14) page 17, line 5 -page 18, line 13 ---	1-4
A	US 6 176 576 B1 (BRIGHT AARON L ET AL) 23 January 2001 (2001-01-23) column 16, line 61 -column 18, line 2 --- -/--	1-9

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

[X] Patent family members are listed in 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 document 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
4 September 2002	11/09/2002

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 02/04309

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 02/04309

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(51) Cl.Int./Int.Cl. *G02B 27/01* (2006.01), *A61B 3/113* (2006.01), *G01C 23/00* (2006.01)

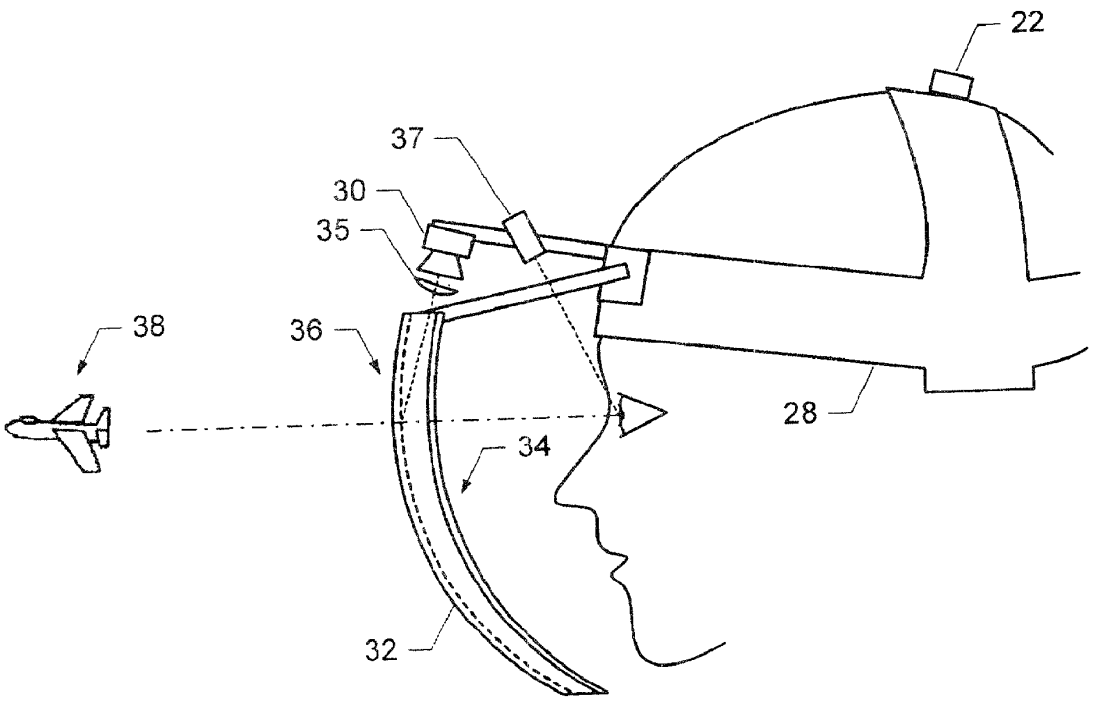
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(54) Titre : SYSTEME DE SUIVI DU REGARD, ENSEMBLE DE SUIVI DU REGARD ET METHODE D'ETALONNAGE ASSOCIEE

(54) Title: GAZE TRACKING SYSTEM, EYE-TRACKING ASSEMBLY AND AN ASSOCIATED METHOD OF CALIBRATION



(57) Abrégé/Abstract:
A system for tracking a gaze of an operator includes a head-mounted eye tracking assembly, a head-mounted head tracking assembly and a processing element. The head-mounted eye tracking assembly comprises a visor having an arcuate shape

(57) Abrégé(suite)/Abstract(continued):
including a concave surface and an opposed convex surface. The visor is capable of being disposed such that at least a portion of the visor is located outside a field of view of the operator. The head-mounted head tracking sensor is capable of repeatedly determining a position of the head to thereby track movement of the head. In this regard, each position of the head is associated with a position of the at least one eye. Thus, the processing element can repeatedly determine the gaze of the operator, based upon each position of the head and the associated position of the eyes, thereby tracking the gaze of the operator.

1383_PROPR_ART_060101

GAZE TRACKING SYSTEM, EYE-TRACKING ASSEMBLY AND AN ASSOCIATED METHOD OF CALIBRATION

ABSTRACT OF THE DISCLOSURE

A system for tracking a gaze of an operator includes a head-mounted eye tracking assembly, a head-mounted head tracking assembly and a processing element. The head-mounted eye tracking assembly comprises a visor having an arcuate shape including a concave surface and an opposed convex surface. The visor is capable of being disposed such that at least a portion of the visor is located outside a field of view of the operator. The head-mounted head tracking sensor is capable of repeatedly determining a position of the head to thereby track movement of the head. In this regard, each position of the head is associated with a position of the at least one eye. Thus, the processing element can repeatedly determine the gaze of the operator, based upon each position of the head and the associated position of the eyes, thereby tracking the gaze of the operator.

GAZE TRACKING SYSTEM, EYE-TRACKING ASSEMBLY AND AN ASSOCIATED METHOD OF CALIBRATION

FIELD OF THE INVENTION

The present invention relates generally to head/eye tracking systems for visual display systems and, more particularly, to head/eye tracking systems including an eye tracking device having a curved visor.

BACKGROUND OF THE INVENTION

Visual display systems, such as flight simulation systems, are commonly employed to train military and commercial pilots. Conventional visual display systems include one or more screens onto which a video image is projected by one or more projectors containing image sources, such as cathode ray tubes (CRTs). The operator of the visual display system is also generally provided with a control panel and, in some instances, a joystick for providing input to the visual display system in response to the displayed video image. In this regard, the control panel and joystick are often designed to duplicate the controls and displays found in an aircraft. Thus, the operator can simulate the flight of an aircraft, for example, and can respond to the environment as depicted by the visual display.

In order to provide a relatively large display for the operator, the video image produced by the projector of a conventional flight simulation system is generally expanded and displayed upon a screen having a much larger surface area than the surface of the image source. For example, each optical line pair of a conventional projector generally defines a projection angle of 7 to 12 arcminutes. Thus, while a relatively large image is displayed for the operator, the resolution of the image is somewhat diminished by the expansion of the video image.

To improve the effective resolution of the projected video image, systems and methods have been developed to inset a high resolution video image into the displayed video image or background image. The high resolution inset image is generally relatively small and is, for example, positioned at an area of interest, such as the portion of the screen that the operator is currently viewing. The high resolution inset image generally has a small relative size, taking advantage of the human visual system's limited ability to see clear images outside a small area surrounding the line

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of sight. The small region surrounding the line of sight corresponds to the foveal region of the human eye and, therefore, the corresponding ability to see high detail in the region surrounding the line of sight is typically referred to as foveal vision. This high resolution inset image, which is positioned to generally follow the operator's line of sight, is typically referred to as the Area of Interest (AOI) display. The line of sight including the foveal vision of the operator is generally defined by (1) the direction the operator's head faces, and (2) the direction the operator's eyes face relative to the position of the operator's head.

An area of interest **8** is typically determined by a head/eye tracking device, as shown in FIG. 1. As shown, to track the operator's head position, the head/eye tracking device **10** includes a head tracker sensor **12** mounted above the operator's head by means of a headband **14**, helmet, or other securing device worn on the operator's head so that the position of the head/eye tracking device is held fixed in position and orientation relative to the operator's head. To track the position of the operator's eyes, the head/eye tracking device includes a video camera **16** mounted above and forward of the operator's head by means of the headband or other head-mounted securing device. The image capture device tracks the position of the operator's eyes by imaging the pupils of the operator's eyes through a partially reflective/partially transmissive flat mirror **18**, which is mounted in front of the operator's eyes. By imaging the operator's pupils through the mirror, the image capture device can be mounted in a position out of the operator's visual field of view. In operation, before the head/eye tracking device **10** can track position of the operator's head and eyes, the head/eye tracking device must be calibrated with the screen upon which the video image produced by the projector is displayed. According to one conventional method of calibrating the head/eye tracking device, a plurality of calibration points are displayed upon the screen, such as nine calibration points displayed in a 3x3 matrix. Then, to calibrate the head tracker sensor **12** of the head/eye tracking device, the operator moves his head and, thus, the head tracker sensor such that one of the calibration points is in line with a fixed reference point attached to the head/eye tracker. A data point is then recorded based upon the position of the head tracker sensor. The operator then repeats the process for each of the calibration points displayed upon the screen, with a data point recorded at each calibration point. Once a data point has been recorded for all calibration points, a head tracking calibration function is calculated based upon the recorded data points.

1003_PRIOR_ART_000104

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Either before or after calibrating the head tracker sensor, the image capture device of the head/eye tracker must be calibrated with the screen so that the head/eye tracking device can accurately track the position of the operator's eyes relative to the head tracker sensor. To calibrate the image capture device, the calibration points are again displayed upon the screen. The operator then orients his head and, thus the head tracker sensor, in a fixed position, preferably such that the operator's line of sight intersects a center point of the screen. Holding his head in the fixed position, the operator moves his eyes such that the operator's line of sight intersects one of the calibration points. A data point is then recorded for the calibration point based upon an image of the operator's pupils taken by the image capture device. In this regard, the data point can include information such as pupil position in both the X and Y directions, as well as corneal reflection in both the X and Y directions. Also as before, the operator repeats the process of moving his eyes to each calibration point and recording a data point for each calibration point, all while holding his head in the fixed position. And after the data points have been recorded for all of the calibration points, an eye tracking calibration function is calculated based upon the recorded data points, e.g., (eye pitch, eye yaw) = f(input data from tracker).

After calculating the calibration functions, the head/eye tracking device tracks the position of the operator's head based upon the position of the operator's head as determined by the head tracker sensor, and based upon the head tracking calibration function. Similarly, the head/eye tracking device tracks the position of the operator's eyes as determined by the image capture device, and based upon the eye tracking calibration function. And based upon the position of the operator's head and pupils at any given time, the area of interest is selected relative to the screen and thereafter displayed, such as in line with the operator's line of sight. The high resolution inset image can then be projected within the area of interest to thereby be within the operator's foveal vision.

Whereas conventional head/eye tracking devices are adequate in tracking the head and eye position of the operator, such conventional tracking devices have drawbacks. The partially reflective/partially transmissive flat mirror **18**, which is mounted in front of the operator's eyes, is visually distracting for the operator. In this regard, the mirror is an unnatural obstruction in the operator's visual field of view, limiting the operator's feeling of visual immersion in a virtual reality application, such as that found in flight simulation systems.

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In addition to the structural drawback of the partially reflective/partially transmissive flat mirror **18**, the method by which conventional head/eye tracking devices are calibrated also has drawbacks. As stated before, either the operator's eyes or head must remain in a fixed position for a period of time during various stages of calibrating the head/eye tracking device. In this regard, the calibration method is prone to errors caused by inadvertent movement of either the operator's eyes or head during a time in which the eyes or head must remain in a fixed position for complete accuracy. Due to the time period the operator is required to keep either his eyes or head in the fixed position, the operator can have a tendency to fatigue, which can cause the operator's eyes or head to inadvertently move.

SUMMARY OF THE INVENTION

In accordance with one aspect of the invention there is provided a head-mounted eye tracking assembly for tracking movement of at least one eye of an operator. The eye tracking assembly includes a visor having an arcuate shape including a concave surface and an opposed convex surface, wherein the visor is capable of being disposed such that the at least one eye is located proximate the concave surface, wherein the visor is at least partially reflective such that the visor is capable of reflecting an image of the at least one eye, and wherein the visor is capable of being disposed such that at least a portion of the visor is located outside a field of view of the operator. The eye tracking assembly further includes an image capture device disposed proximate the concave surface of the visor, wherein the image capture device is capable of tracking movement of the at least one eye based upon the image of the at least one eye reflected by the visor.

The concave surface of the visor may include a reflective coating.

The head-mounted eye tracking assembly may further include an illuminator capable of illuminating the at least one eye.

The illuminator may be capable of illuminating the at least one eye with infrared light.

The head-mounted eye tracking assembly may further include a lens disposed in an optical path of the image capture device, wherein an effective focus of the image capture device is based upon an optical power of the visor and an optical power of the lens.

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The image capture device may be located outside the field of view of the operator.

In accordance with another aspect of the invention, there is provided a system for tracking a gaze of an operator. The gaze tracking system includes a head-mounted eye tracking assembly. The head-mounted eye tracking assembly further includes a visor having an arcuate shape including a concave surface and an opposed convex surface, wherein the visor is capable of being disposed such that at least one eye is located proximate the concave side, wherein the visor is at least partially reflective such that the visor is capable of reflecting an image of the at least one eye, wherein the visor is capable of being disposed such that at least a portion of the visor is located outside a field of view of the operator, and wherein the head-mounted eye tracking assembly is capable of repeatedly determining a position of the at least one eye based upon the image of the at least one eye reflected by the visor to thereby track movement of the at least one eye. The head-mounted eye tracking assembly further includes a head-mounted head tracking sensor capable of repeatedly determining a position of the head to thereby track movement of the head, wherein each position of the head is associated with a position of the at least one eye. The head-mounted eye tracking assembly further includes a processing element capable of repeatedly determining the gaze of the operator to thereby track the gaze of the operator, wherein the processing element repeatedly determines the gaze of the operator based upon each position of the head and the associated position of the at least one eye.

The concave surface of the visor of the head-mounted eye tracking assembly may include a reflective coating.

The head-mounted eye tracking assembly may further include an illuminator capable of illuminating the at least one eye.

The illuminator may be capable of illuminating the at least one eye with infrared light.

The head-mounted eye tracking assembly may further include an image capture device disposed proximate the concave surface of the visor, and wherein the image capture device is capable of tracking movement of the at least one eye based upon the image of the at least one eye reflected by the visor.

1383_PRIOR_ART_000197

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The head-mounted eye tracking assembly may further include a lens disposed in an optical path of the image capture device, wherein an effective focus of the image capture device is based upon an optical power of the visor and an optical power of the lens.

The image capture device may be located outside the field of view of the operator.

In accordance with another aspect of the invention, there is provided a visual display system. The visual display system includes a background image projector having a predetermined field of view, the background image projector generating a background image having a predetermined size and resolution that at least partially fills the field of view. The visual display system further includes at least one inset image projector for generating an area of interest (AOI) image having a smaller size and a higher resolution than the background image, the inset image projector having a predetermined field of view that is capable of being movably disposed at least partially within the field of view of the background image projector. The visual display system further includes a gaze tracking system capable of directing the movement of the field of view of the inset image projector based upon the direction in which an operator is looking. The gaze tracking system includes a head-mounted eye tracking assembly. The head-mounted eye tracking assembly includes a visor having an arcuate shape including a concave surface and an opposed convex surface, wherein the visor is capable of being disposed such that at least one eye is located proximate the concave surface, wherein the visor is at least partially reflective such that the visor is capable of reflecting an image of the at least one eye, and wherein the visor is capable of being disposed such that at least a portion of the visor is located outside a field of view of an operator. The head-mounted eye tracking assembly further includes an image capture device disposed proximate the concave surface of the visor, wherein the image capture device is capable of tracking movement of the at least one eye based upon the image of the at least one eye reflected by the visor.

The gaze tracking system may further include a head-mounted head tracking sensor capable of repeatedly determining a position of the head to thereby track movement of the head, wherein each position of the head is associated with a position of the at least one eye. The gaze tracking system may further include a processing element capable of repeatedly determining a gaze of the operator to thereby track the gaze of the operator, wherein the processing element repeatedly determines the gaze

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of the operator based upon each position of the head and the associated position of the at least one eye.

The concave surface of the visor of the head-mounted eye tracking assembly may include a reflective coating.

The head-mounted eye tracking assembly may further include an illuminator capable of illuminating the at least one eye.

The head-mounted eye tracking assembly may further include a lens disposed in an optical path of the image capture device, wherein an effective focus of the image capture device is based upon an optical power of the visor and an optical power of the lens.

In accordance with another aspect of the invention, there is provided a head-mounted eye tracking assembly for tracking movement of at least one eye of an operator. The eye tracking assembly includes a visor having an arcuate shape including a concave surface and an opposed convex surface, wherein the visor is capable of being disposed such that the at least one eye is located proximate the concave surface, wherein the visor is at least partially reflective such that the visor is capable of reflecting an image of the at least one eye, and wherein the visor is capable of being disposed such that at least a portion of the visor is located outside a field of view of the operator. The eye tracking assembly further includes an image capture device disposed proximate the concave surface of the visor, wherein the image capture device is capable of tracking movement of the at least one eye based upon the image of the at least one eye reflected by the visor. The eye tracking assembly further includes a lens disposed in an optical path of the image capture device wherein an effective focus of the image capture device is based upon an optical power of the visor and an optical power of the lens.

The concave surface of the visor may include a reflective coating.

The head-mounted eye tracking assembly may further include an illuminator capable of illuminating the at least one eye.

The illuminator may be capable of illuminating the at least one eye with infrared light.

The image capture device may be located outside the field of view of the operator.

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The visor may be capable of reflecting an image of a pupil of at least one eye, and wherein the image capture device is capable of tracking movement of the at least one eye based upon the image of the pupil of the at least one eye.

In accordance with another aspect of the invention, there is provided a system for tracking a gaze of an operator. The gaze tracking system includes a head-mounted eye tracking assembly. The head-mounted tracking assembly includes a visor having an arcuate shape including a concave surface and opposed an convex surface, wherein the visor is capable of being disposed such that the at least one eye is located proximate the concave side, wherein the visor is at least partially reflective such that the visor is capable of reflecting an image of the at least one eye, wherein the visor is capable of being disposed such that at least a portion of the visor is located outside a field of view of the operator, and wherein the head-mounted eye tracking assembly is capable of repeatedly determining a position of the at least one eye based upon the image of the at least one eye reflected by the visor to thereby track movement of the at least one eye. The head-mounted tracking assembly further includes an image capture device disposed proximate the concave surface of the visor, wherein the image capture device is capable of tracking movement of the at least one eye based upon the image of the at least one eye reflected by the visor. The head-mounted tracking assembly further includes a lens disposed in an optical path of the image capture device, wherein an effective focus of the image capture device is based upon an optical power of the visor and an optical power of the lens. The gaze tracking system further includes a head-mounted head tracking sensor capable of repeatedly determining a position of the head to thereby track movement of the head, wherein each position of the head associated with a position of the at least one eye. The gaze tracking system further includes a processing element capable of repeatedly determining the gaze of the operator to thereby track the gaze of the operator, wherein the processing element repeatedly determines the gaze of the operator based upon each position of the head and the associated position of the at least one eye. The concave surface of the visor of the head-mounted eye tracking assembly may include a reflective coating.

The head-mounted eye tracking assembly may further include an illuminator capable of illuminating the at least one eye.

The illuminator may be capable of illuminating the at least one eye with infrared light.

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The image capture device may be located outside the field of view of the operator.

The visor may be capable of reflecting an image of a pupil of at least one eye, and wherein the head-mounted eye tracking assembly is capable of repeatedly determining a position of the at least one eye based upon the image of the pupil of the at least one eye.

In accordance with another aspect of the invention, there is provided a visual display system. The visual display system includes a background image projector having a predetermined field of view, the background image projector generating a background image having a predetermined size an resolution that at least partially fills the field of view. The visual display system further includes at least one inset image projector for generating an area of interest (AOI) image having a smaller size and a higher resolution than the background image, the inset image projector having a predetermined field of view that is capable of being movably disposed at least partially within the field of view of the background image projector. The visual display system further includes a gaze tracking system capable of directing the movement of the field of view of the inset image projector based upon the direction in which an operator is looking. The gaze tracking system includes a head-mounted eye tracking assembly. The head-mounted eye tracking assembly includes a visor having an arcuate shape including a concave surface and an opposed convex surface, wherein the visor is capable of being disposed such that the at least one eye is located proximate the concave surface, wherein the visor is at least partially reflective such that the visor is capable of reflecting an image of the at east one eye, and wherein the visor is capable of being disposed such that at least a portion of the visor is located outside a field of view of the operator. The head-mounted eye tracking assembly further includes an image capture device disposed proximate the concave surface of the visor, wherein the image capture device is capable of tracking movement of the at least one eye based upon the image of the at least one eye reflected by the visor. The head-mounted eye tracking assembly further includes a lens disposed in an optical path of the image capture device, wherein an effective focus of the image capture device is based upon an optical power of the visor and an optical power of the lens.

The gaze tracking system may further include a head-mounted head tracking sensor capable of repeatedly determining a position of the head to thereby track movement of the head, wherein each position of the head is associated with a position

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of the at least one eye. The gaze tracking system may further include a processing element capable of repeatedly determining the gaze of the operator to thereby track the gaze of the operator, wherein the processing element repeatedly determines the gaze of the operator based upon each position of the head and the associated position of the at least one eye.

The concave surface of the visor of the head-mounted eye tracking assembly may include a reflective coating.

The head-mounted eye tracking assembly may further include an illuminator capable of illuminating the at least one eye.

The head-mounted eye tracking assembly may further include a lens disposed in an optical path of the image capture device, wherein an effective focus of the image capture device is based upon an optical power of the visor and an optical power of the lens.

The visor may be capable of reflecting an image of a pupil of at least one eye, and wherein the image capture device is capable of tracking movement of the at least one eye based upon the image of the pupil of the at least one eye.

The inset image projector may have a predetermined field of view that is capable of being movably disposed based upon electronic raster deflection.

BRIEF DESCRIPTION OF THE DRAWINGS

Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

FIG. 1 is a schematic illustration of portions of a conventional gaze tracking system;

FIG. 2 is a schematic illustration of portions of a gaze tracking system according to one embodiment of the present invention;

FIG. 3 is a block diagram of a gaze tracking system according to one embodiment of the present invention;

FIGS. 4A and 4B are schematic illustrations illustrating various movements in a method for calibrating the gaze tracking system according to one embodiment of the present invention;

FIG. 5 is a flow chart illustrating various steps in a method of calibrating a gaze tracking system according to one embodiment of the present invention; and

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FIG. 6 is a perspective view illustrating a visual display system incorporating the gaze tracking system of one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout.

Referring to FIGS. 2 and 3, a gaze tracking system **20** according to one embodiment of the present invention is shown. The system includes a head-mounted head tracking sensor **22**, a head-mounted eye tracking assembly **24**, and a processing element **26**. The head tracking sensor and eye tracking assembly are mounted to an operator's head by means of a headband **28**, helmet or other head-mounted securing device. The head tracking sensor is mounted to the operator's head out of the field of vision of the operator so as to not impede the operator's vision. The head tracking sensor is capable of repeatedly determining a position of the operator's head to thereby track the movement of the head. In this regard, the head tracking sensor can comprise any of a number of known sensors capable of determining the position of the operator's head. For example, the head tracker sensor can comprise an InsideTrak™ model head tracking sensor or a FasTrak™ model head tracking sensor, both manufactured by Polhemus Incorporated of Colchester, VT. Alternatively, the head tracker sensor can comprise any of a number of other head tracking sensors that operate based on magnetic, acoustic, optical or other technologies, as such are known to those skilled in the art.

The eye tracking assembly comprises an image capture device **30** and a visor **32**. The visor is secured to the headband **28** such that, when the headband is mounted to the operator's head, the visor is disposed in front of the operator's head. The visor is preferably at least partially reflective for light of a predetermined wavelength or range of wavelengths. For example, the visor may be made from a partially reflective material, such as Lexan® brand polycarbonate (manufactured by the General Electric Company of Pittsfield, MA) coated with a reflective film, so that the operator's field

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of view can extend through the visor while an image of the operator's eyes, or more particularly the operator's pupils, reflects off of the visor into the optical path of the image capture device. Advantageously, the visor is designed to provide an environment for the operator that is typically found in many applications employing the system, such as flight simulation applications. In this regard, the visor is designed to not present any visually obstructive edges with the operator's field of view. Thus, the visor has an arcuate or curved shape including a concave surface **34** and an opposed convex surface **36**, one of which may support an at least partially reflective coating. The visor is secured to the headband such that, when the headband is

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mounted to the operator's head, the concave surface is disposed proximate the operator's eyes. Further, the visor is secured to the headband such that, when the headband is mounted to the operator's head, at least a portion of the visor is located outside the operator's field of view.

Like the head tracking sensor **22**, the image capture device **30** is mounted outside the field of view of the operator so as to not impede the operator's vision. In this regard, the image capture device is preferably mounted on a front portion of the headband **28** such that the image capture device is located at a position peripheral to the operator's head out of the operator's field of view. The image capture device is capable of repeatedly determining a position of the operator's eyes by imaging the pupil of one or both of the operator's eyes. Because the image capture device is mounted on the headband outside the field of view of the operator, the image capture device images the operator's pupils by imaging a reflection of the pupils from the visor of the eye tracking assembly. Thus, the image capture device can comprise any of a number of devices capable of repeatedly determining the position of the operator's eyes to thereby track the movement of the operator's eyes. According to one embodiment, for example, the image capture device comprises a camera, such as is included within ETL-500 model eye tracking system manufactured by ISCAN, Inc. of Burlington, MA.

Advantageously, the image capture device **30** can comprise a camera, such as is used in a conventional head/eye tracking device including a partially reflective/partially transmissive flat mirror **18**, as shown in FIG. 1. But it will be appreciated that the visor **32** of the present invention will typically have a different optical power than the flat mirror of the conventional head/eye tracking device. In this regard, lenses have a characteristic power that is typically measured in diopters and equals the inverse of the focal length of the lens in meters, as such is known to those skilled in the art. It will also be appreciated that, in using a camera such as is used in a conventional head/eye tracking device, the effective focus of the camera will differ from the desired effective focus due to the difference in optical power between the visor and the conventional flat mirror. Thus, in embodiments where the image capture device comprises a camera such as is used in a conventional head/eye tracking device, the system preferably compensates for the change effective focus due to the difference in optical power so as to bring the effective focus to a desired value, or the

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value of the effective focus of the camera as used in the conventional head/eye tracking device.

The system **20** can compensate for the optical power of the visor **32** in any of a number of different manners. For example, the aperture of the camera lens can be reduced to thereby increase the depth-of-field of the camera. And by increasing the depth-of-field of the camera, the system can compensate for the change in effective focus of the camera. Additionally or alternatively, the system can include a lens **35** disposed in the optical path of the camera to compensate for the optical power of the visor. In this regard, if the aperture of the camera lens is not reduced, the lens can be selected such that the optical power of the lens plus the optical power of the visor equals the optical power of a flat mirror as would be included in a conventional head/eye tracking device including the camera.

As previously stated, the image capture device **30** images the operator's pupils by receiving light reflected off of the pupils and thereafter off of the visor **32** into the optical path of the image capture device. To facilitate tracking the eyes, the system **20** can include an illuminator **37** capable of illuminating the eyes such that more light reflects off of the eyes and, thus, the visor. However, to avoid visual distractions, the illuminator is preferably an infrared illuminator, such as an infrared light emitting diode, capable of illuminating infrared light to the eyes. The infrared light, thus, reflects off of the front and rear surfaces of the corneas and the lenses of the eyes, and thereafter reflects off of the visor into the optical path of the camera. It will be appreciated that such images are commonly referred to as Purkinje images by those skilled in the art. It will also be appreciated that as the light in this embodiment comprises infrared light, the image capture device of this embodiment is preferably infrared sensitive, such as an infrared sensitive camera. Additionally, the predetermined wavelength or range of wavelengths that the visor is capable of reflecting advantageously includes infrared light in this embodiment.

To track the gaze of the operator based upon a position of the operator's eyes and head, the system **20** also includes a processing element **26**. The processing element can comprise any of a number of different devices, such as a personal computer or other high level processor. As shown in FIG. 3, and as already stated, the eye-tracking assembly is capable of determining a position of the operator's eyes. Similarly, the head tracking sensor **22** is capable of determining a position of the operator's head. The processing element **26**, in turn, is capable of receiving the

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position of the operator's eyes from the eye-tracking assembly and the position of the operator's head from the head tracking sensor. Based upon the position of the operator's eyes and operator's head, the processing element can determine the operator's gaze. Repeatedly receiving the position of the operator's eyes and head, the processing element can therefore track the operator's gaze, as will be appreciated by those skilled in the art. And based upon the gaze of the operator the processing element can define an area of interest **38** (shown in FIG. 2) relative to an external device, such as a display.

Before the system can track the gaze of the operator, the system **20** is preferably calibrated to the external device, such as a display. As previously indicated, the difficulty in calibrating conventional eye trackers is that any head movement during calibration will cause an error in the calibration. Thus, embodiments of the present invention provide a method of calibrating a gaze tracking system, such as the gaze tracking system described above, using data from the head tracking sensor **22**. By using data from the head tracking sensor, then, the calibration can compensate for any head movement, and the true gaze angle can be determined more accurately.

Advantageously, embodiments of the method of the present invention also uses movement of the head tracking sensor during calibration to collect eye data. In this regard, conventional eye tracker calibration methods commonly calibrate the eye tracker based upon a set of calibration points that typically numbers less than ten. Conventional calibration methods, then, are typically limited to a small number of data points (i.e., input parameters) by which to approximate a calibration function for the eye tracker. As such, the more data points that are recorded, and the more distributed the data points, the better the final calibration of the eye tracker. Whereas any of a number of different techniques can be employed to collect data points, embodiments of the present invention provide are capable of collecting a large number of data points during calibration, as described below.

Referring now to FIGS. 4A, 4B and 5, the method of calibrating the gaze tracking system begins with initializing calibration of the gaze tracking system, as shown in block **40** of FIG. 5. Initialization can be accomplished according to any of a number of different manners but, according to one embodiment, calibration of the system is initialized by initiating a calibration routine within the processing element **26**. Once calibration of the system has been initialized, the processing element can

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drive a display to present a first reference point **42**, or target, within the operator's field of view, as shown in FIGS. 4A, 4B and block **44** of FIG. 5.

Once the target **42** has been presented to the operator, the operator aligns the operator's line of sight **46** with the displayed target, as shown in block **48** of FIG. 5. The operator then begins the calibration process, such as by actuating the processing element **26** to begin calibration of the system. In this regard, when the operator actuates the processing element, the processing element drives the eye tracking assembly to measure the position of the operator's eyes, which measurement the processing element will then associate with the target, as shown in block **50**. At the same time, the processing element drives the head tracking sensor **22** to measure the angle of the operator's head as well as translations of the position of the operator's head, as shown in block **52**. The measured angle and translations are then set by the processing element to be a second reference position.

After the position of the operator's eyes and head have been measured by the gaze tracking system **20**, while keeping the operator's line of sight **46** aligned with the target **42**, the operator moves the operator's head and, thus, the head tracking sensor **22**, to a position offset from the second reference position, as shown in FIGS. 4A and 4B, and block **54** of FIG. 5. In keeping the operator's line of sight aligned with the target while the operator moves the operator's head, the operator's eyes generally move opposite of the head to maintain alignment of the line of sight with the target. Once at the offset position, then, the gaze tracking system measures the position of the eyes and an angle offset of the line of sight of the eyes relative to the first reference point, as shown in block **56**. Similarly, the gaze tracking system measures the position of the head tracking sensor or, more particularly, the angle of the operator's head and translations of the position of the operator's head relative to the second reference position, as shown in block **58**. Next, the processing element **26** records the positions, such as in a memory location. Also, the processing element can determine the direction of the operator's eyes relative to the operator's head from the measurements, and record the direction along with the measurements.

After the processing element **26** has recorded the measurements and the direction of the operator's eyes, the operator then moves the operator's head to another offset position, again keeping the line of sight **46** aligned with the target **42**. The gaze tracking system again measures the position of the eyes and head tracking sensor **22**, and records the measurements along with the direction of the operator's

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eyes. The process continues for N (e.g., 300) movements of the operator's head such that the processing records N data points consisting of the recorded measurements and directions of the operator's eyes relative to the operator's head, as shown in blocks **60** and **62** of FIG. 5. Advantageously, the operator can move the operator's head to different offset positions, and the processing element can correspondingly record measurements, at a high rate, such as 60 times a second. As such, large amounts of data can be collected in a short amount of time. For example, recording measurements at a rate of 60 times a second, the processing element can record 300 measurements in five seconds. In comparison, it would require roughly ten second to collect data from a nine point grid of calibration points using conventional methods.

Allowing the operator to move the operator's head freely while aligning the line of sight **46** with the target **42** allows a large amount of data to be collected in a short amount of time. But such a method typically gives very little control over what data is collected. For example, since the operator can move his head in any way the operator chooses, the recorded data can become concentrated in a small area, such as around the target. For most calibration functions, the more distributed the data, the better the resulting calibration. Thus, to allow for more control over the data that is collected, the processing element **26** can be capable of moving the target to one or more different positions. And after moving the target to each position ,the operator again aligns the line of sight and moves the head tracking sensor **22** to different offset positions, with the processing element collecting data at each position. Whereas the processing element can move the target to any one of a number of different points, the processing element preferably moves the target to areas on a reference plane (e.g., display screen) for which the processing element has fewer recorded measurements.

With the data points, then, the processing element **26** determines a calibration function to thereby calibrate the gaze tracking system **20**. The processing element can determine the calibration function according to any one of a number of different methods. For example, the processing element can determine the calibration function according to an interpolation method using an interpolation function, such as akima interpolation, b-spline interpolation, bi-cubic interpolation, linear interpolation quadratic interpolation, or the like. In such functions, the set of data points are used as reference points and intermediate points, between the data points, are determined, or interpolated, based on the surrounding data points.

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According to one advantageous embodiment, the processing element determines the calibration function utilizing an artificial neural network, as illustrated in block **64** of FIG. 5. As is known to those skilled in the art, artificial neural networks are modeled upon the human brain's interconnected system of neurons. Based upon this premise, the artificial neural network allows the processing element to imitate the brain's ability to sort out patterns and learn from trial and error, discerning and extracting the relationships that underlie the input data. The network learns when the input data (with known results) is presented to processing element. Factors associated with the known results are then adjusted to bring the calibration output closer to the known result (e.g., position relative to the target).

In addition to the above identified methods of determining the calibration function, the processing element can use known physical properties of the optics of the eye tracking assembly **24** of the gaze tracking system **20**, and/or the physical properties of the operator's eyes (e.g., curvature of the eyes), to determine the calibration function. In this regard, the above methods of determining the calibration function allow for any unknown distortion to be present in the input data. For example, due to the curvature of the visor **32**, the image capture device **30** may receive and/or record an image of the pupils of the operator's eyes that has some degree of radial distortion. Embodiments of the calibration method of the present invention can at least partially compensate for the distortion by estimating the calibration function for the data. However, using the known physical properties of the optics, the processing element can further compensate for any optical distortion. For example, the processing element can further compensate for optical distortion by computing the light path through the system and mapping out any irregularities according to any of a number of known techniques.

Referring now to FIG. 6, a visual display system **70**, such as a flight simulation system, that would benefit from the gaze tracking system of the present invention is illustrated. The visual display system generally includes a plurality of display screens **72**. For example, the visual display system can include an out-the-window flight simulation system such as the Visual Integrated Display System manufactured by The Boeing Company, the assignee of the present application. As also illustrated in FIG. 6, the image displayed on the display screens **72** includes a background image having a predetermined size and resolution. The background image is generally generated by a background image projector. The background

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image projector can, and preferably does, include a plurality of background image projectors, at least one of which is associated with each display screen. For full color background images, the background image projectors are generally RGB projector.

In order to display a relatively large background image for the operator, the individual pixels are projected, and thereby expanded, for display on the associated display screen **72**. For example, each pair of video lines typically defines a projection angle of 7 to 12 arcminutes. Therefore, the resulting background image displayed on the display screens has a relatively low resolution. As illustrated in FIG. 6, an inset image **74** can also be displayed on the display screen and is generally generated by an inset image projector. As shown, the inset image can include other aircraft in an area of interest (AOI) **76** of the operator. Each inset image (i.e., AOI image) preferably has a smaller size and a higher resolution than the background image in order to provide the operator with additional detail in this particular AOI. The AOI is defined by the gaze of the operator and, as such, the visual display system includes a gaze tracking system, such as a gaze tracking system **20** in accordance with the present invention (shown in FIGS. 2 – 4), to track the gaze of the operator. For more information on such a display system, see U.S. Patent No. 5,487,665 or U.S. Patent No. 5,746,599.

Therefore, the present invention provides an improved eye-tracking assembly, gaze tracking system and method of calibration. In this regard, by including a visor, at least a portion of which is capable of being located outside the field of view of the operator, the operator can utilize the eye-tracking assembly without distractions associated with conventional eye-tracking assemblies. As such, the visor of the eye-tracking assembly can provide a more native environment to an operator, particularly in instances in which the operator would typically wear a visor that encompasses the operator's field of view. Also, the present invention provides an improved method of calibrating a gaze tracking system. The method of calibration includes movement of the head tracking sensor with the operator's eyes aligned in a particular direction, as opposed to fixing the head in position and aligning the operator's line of sight with several reference points. As such, the method provides a more accurate technique for calibrating the gaze tracking system. Further, the method can utilize an artificial neural network to calibrate the system based upon input data from an eye-tracking

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assembly and head tracking sensor, which allows the neural network to adaptively learn from previous movements.

Many modifications and other embodiments of the invention will come to mind to one skilled in the art to which this invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

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THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A head-mounted eye tracking assembly for tracking movement of at least one eye of an operator, said eye tracking assembly comprising:

a visor having an arcuate shape including a concave surface and an opposed convex surface, wherein said visor is capable of being disposed such that the at least one eye is located proximate the concave surface, wherein said visor is at least partially reflective such that said visor is capable of reflecting an image of the at least one eye, and wherein said visor is capable of being disposed such that at least a portion of said visor is located outside a field of view of the operator; and

an image capture device disposed proximate the concave surface of said visor, wherein said image capture device is capable of tracking movement of the at least one eye based upon the image of the at least one eye reflected by said visor.

2. A head-mounted eye tracking assembly according to Claim **1**, wherein the concave surface of said visor includes a reflective coating.

3. A head-mounted eye tracking assembly according to Claims **1** or **2**, further comprising an illuminator capable of illuminating the at least one eye.

4. A head-mounted eye tracking assembly according to Claim **3**, wherein said illuminator is capable of illuminating the at least one eye with infrared light.

5. A head-mounted eye tracking assembly according to any one of Claims **1** to **4** further comprising a lens disposed in an optical path of said image capture device, wherein an effective focus of said image capture device is based upon an optical power of said visor and an optical power of said lens.

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6. A head-mounted eye tracking assembly according to any one of Claims **1** to **5**, wherein said image capture device is located outside the field of view of the operator.

7. A system for tracking a gaze of an operator, said gaze tracking system comprising:

a head-mounted eye tracking assembly comprising:

a visor having an arcuate shape including a concave surface and an opposed convex surface, wherein said visor is capable of being disposed such that at least one eye is located proximate the concave side, wherein said visor is at least partially reflective such that said visor is capable of reflecting an image of the at least one eye, wherein said visor is capable of being disposed such that at least a portion of said visor is located outside a field of view of the operator, and wherein the head-mounted eye tracking assembly is capable of repeatedly determining a position of the at least one eye based upon the image of the at least one eye reflected by said visor to thereby track movement of the at least one eye;

a head-mounted head tracking sensor capable of repeatedly determining a position of the head to thereby track movement of the head, wherein each position of the head is associated with a position of the at least one eye; and

a processing element capable of repeatedly determining the gaze of the operator to thereby track the gaze of the operator, wherein said processing element repeatedly determines the gaze of the operator based upon each position of the head and the associated position of the at least one eye.

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8. A system according to Claim **7**, wherein the concave surface of the visor of said head-mounted eye tracking assembly includes a reflective coating.

9. A system according to Claims **7** or **8**, wherein said head-mounted eye tracking assembly further comprises an illuminator capable of illuminating the at least one eye.

10. A system according to Claim **9**, wherein the illuminator is capable of illuminating the at least one eye with infrared light.

11. A system according to any one of Claims **7** to **10**, wherein said head-mounted eye tracking assembly further comprises an image capture device disposed proximate the concave surface of said visor, and wherein the image capture device is capable of tracking movement of the at least one eye based upon the image of the at least one eye reflected by said visor.

12. A system according to Claim **11**, wherein said head-mounted eye tracking assembly further comprises a lens disposed in an optical path of the image capture device, wherein an effective focus of the image capture device is based upon an optical power of the visor and an optical power of the lens.

13. A system according to Claims **11** or **12**, wherein the image capture device is located outside the field of view of the operator.

14. A visual display system comprising:

a background image projector having a predetermined field of view, said background image projector generating a background image having a predetermined size and resolution that at least partially fills the field of view;

at least one inset image projector for generating an area of interest (AOI) image having a smaller size and a higher resolution than the

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background image, said inset image projector having a predetermined field of view that is capable of being movably disposed at least partially within the field of view of said background image projector; and

a gaze tracking system capable of directing the movement of the field of view of said inset image projector based upon the direction in which an operator is looking, said gaze tracking system comprising a head-mounted eye tracking assembly comprising:

a visor having an arcuate shape including a concave surface and an opposed convex surface, wherein said visor is capable of being disposed such that at least one eye is located proximate the concave surface, wherein said visor is at least partially reflective such that said visor is capable of reflecting an image of the at least one eye, and wherein said visor is capable of being disposed such that at least a portion of said visor is located outside a field of view of an operator; and

an image capture device disposed proximate the concave surface of said visor, wherein said image capture device is capable of tracking movement of the at least one eye based upon the image of the at least one eye reflected by said visor.

15. A visual display system according to Claim **14**, wherein said gaze tracking system further comprises:

a head-mounted head tracking sensor capable of repeatedly determining a position of the head to thereby track movement of the head, wherein each position of the head is associated with a position of the at least one eye; and

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a processing element capable of repeatedly determining a gaze of the operator to thereby track the gaze of the operator, wherein said processing element repeatedly determines the gaze of the operator based upon each position of the head and the associated position of the at least one eye.

16. A visual display system according to Claims **14** or **15**, wherein the concave surface of the visor of said head-mounted eye tracking assembly includes a reflective coating.

17. A visual display system according to any one of Claims **14** to **16**, wherein said head-mounted eye tracking assembly further comprises an illuminator capable of illuminating the at least one eye.

18. A visual display system according to any one of Claims **14** to **17**, wherein said head-mounted eye tracking assembly further comprises a lens disposed in an optical path of said image capture device, wherein an effective focus of said image capture device is based upon an optical power of said visor and an optical power of said lens.

19. A head-mounted eye tracking assembly for tracking movement of at least one eye of an operator, said eye tracking assembly comprising:

a visor having an arcuate shape including a concave surface and an opposed convex surface, wherein said visor is capable of being disposed such that the at least one eye is located proximate the concave surface, wherein said visor is at least partially reflective such that said visor is capable of reflecting an image of the at least one eye, and wherein said visor is capable of being disposed such that at least a portion of said visor is located outside a field of view of the operator;

an image capture device disposed proximate the concave surface of said visor, wherein said image capture device is capable of tracking

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movement of the at least one eye based upon the image of the at least one eye reflected by said visor; and

a lens disposed in an optical path of said image capture device wherein an effective focus of said image capture device is based upon an optical power of said visor and an optical power of said lens.

20. A head-mounted eye tracking assembly according to claim **19**, wherein the concave surface of said visor includes a reflective coating.

21. A head-mounted eye tracking assembly according to claim **19**, further comprising an illuminator capable of illuminating the at least one eye.

22. A head-mounted eye tracking assembly according to claim **21**, wherein said illuminator is capable of illuminating the at least one eye with infrared light.

23. A head-mounted eye tracking assembly according to claim **19**, wherein said image capture device is located outside the field of view of the operator.

24. A head-mounted eye tracking assembly according to claim **19**, wherein said visor is capable of reflecting an image of a pupil of at least one eye, and wherein said image capture device is capable of tracking movement of the at least one eye based upon the image of the pupil of the at least one eye.

25. A system for tracking a gaze of an operator, said gaze tracking system comprising:

a head-mounted eye tracking assembly comprising:

a visor having an arcuate shape including a concave surface and opposed an convex surface, wherein said visor is capable of being disposed such that the at least one eye is located proximate the concave side, wherein said visor is at least

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partially reflective such that said visor is capable of reflecting an image of the at least one eye, wherein said visor is capable of being disposed such that at least a portion of said visor is located outside a field of view of the operator, and wherein the head-mounted eye tracking assembly is capable of repeatedly determining a position of the at least one eye based upon the image of the at least one eye reflected by said visor to thereby track movement of the at least one eye;

an image capture device disposed proximate the concave surface of said visor, wherein the image capture device is capable of tracking movement of the at least one eye based upon the image of the at least one eye reflected by said visor; and

a lens disposed in an optical path of the image capture device, wherein an effective focus of the image capture device is based upon an optical power of the visor and an optical power of the lens;

a head-mounted head tracking sensor capable of repeatedly determining a position of the head to thereby track movement of the head, wherein each position of the head associated with a position of the at least one eye; and

a processing element capable of repeatedly determining the gaze of the operator to thereby track the gaze of the operator, wherein said processing element repeatedly determines the gaze of the operator based upon each position of the head and the associated position of the at least one eye.

26. A system according to claim **25**, wherein the concave surface of the visor of said head-mounted eye tracking assembly includes a reflective coating.

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27. A system according to claim **25**, wherein said head-mounted eye tracking assembly further comprises an illuminator capable of illuminating the at least one eye.

28. A system according to claim **27**, wherein the illuminator is capable of illuminating the at least one eye with infrared light.

29. A system according to claim **25**, wherein the image capture device located outside the field of view of the operator.

30. A system according to claim **25**, wherein said visor is capable of reflecting an image of a pupil of at least one eye, and wherein the head-mounted eye tracking assembly is capable of repeatedly determining a position of the at least one eye based upon the image of the pupil of the at least one eye.

31. A visual display system comprising:

a background image projector having a predetermined field of view, said background image projector generating a background image having a predetermined size an resolution that at least partially fills the field of view;

at least one inset image projector for generating an area of interest (AOI) image having a smaller size and a higher resolution than the background image, said inset image projector having a predetermined field of view that is capable of being movably disposed at least partially within the field of view of said background image projector; and

a gaze tracking system capable of directing the movement of the field of view of said inset image projector based upon the direction in which an operator is looking, said gaze tracking system comprising a head-mounted eye tracking assembly comprising:

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a visor having an arcuate shape including a concave surface and an opposed convex surface, wherein said visor is capable of being disposed such that the at least one eye is located proximate the concave surface, wherein said visor is at least partially reflective such that said visor is capable of reflecting an image of the at east one eye, and wherein said visor is capable of being disposed such that at least a portion of said visor is located outside a field of view of the operator;

an image capture device disposed proximate the concave surface of said visor, wherein said image capture device is capable of tracking movement of the at least one eye based upon the image of the at least one eye reflected by said visor;

a lens disposed in an optical path of said image capture device, wherein an effective focus of said image capture device is based upon an optical power of said visor and an optical power of said lens.

32. A visual display system according to claim **31**, wherein said gaze tracking system further comprises:

a head-mounted head tracking sensor capable of repeatedly determining a position of the head to thereby track movement of the head, wherein each position of the head is associated with a position of the at least one eye; and

a processing element capable of repeatedly determining the gaze of the operator to thereby track the gaze of the operator, wherein said processing element repeatedly determines the gaze of the operator based upon each position of the head and the associated position of the at least one eye.

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33. A visual display system according to claim **31**, where the concave surface of the visor of said head-mounted eye tracking assembly includes a reflective coating.

34. A visual display system according to claim **31**, wherein said head-mounted eye tracking assembly further comprises an illuminator capable of illuminating the at least one eye.

35. A visual display system according to claim **31**, wherein said head-mounted eye tracking assembly further comprises a lens disposed in an optical path of said image capture device, wherein an effective focus of said image capture device is based upon an optical power of said visor and an optical power of said lens.

36. A visual display system according to claim **31**, wherein said visor is capable of reflecting an image of a pupil of at least one eye, and wherein said image capture device is capable of tracking movement of the at least one eye based upon the image of the pupil of the at least one eye.

37. A visual display system according to claim **31**, wherein said inset image projector has a predetermined field of view that is capable of being movably disposed based upon electronic raster deflection.

1393_PRIOR_ART_000212

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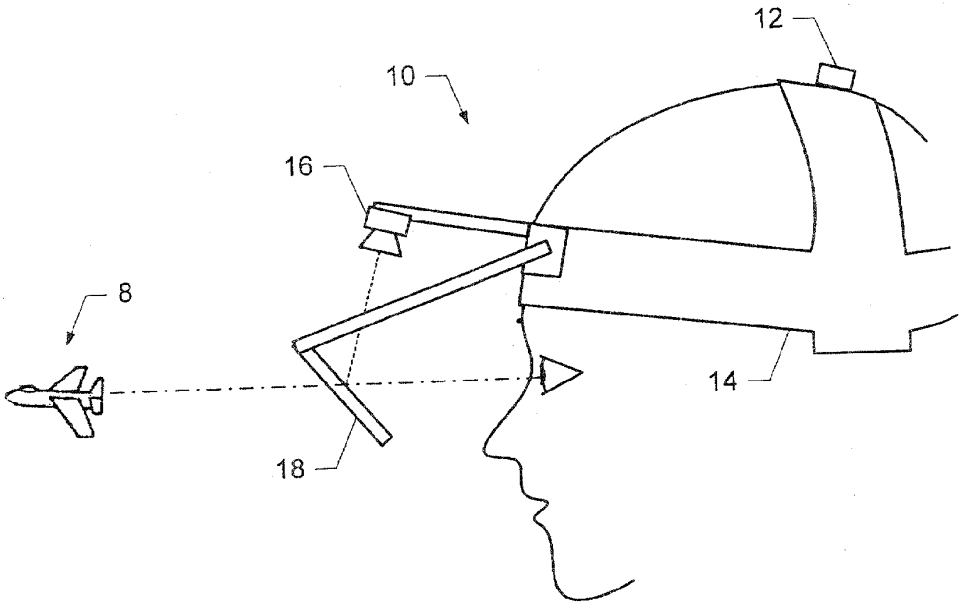


FIG. 1.
(PRIOR ART)

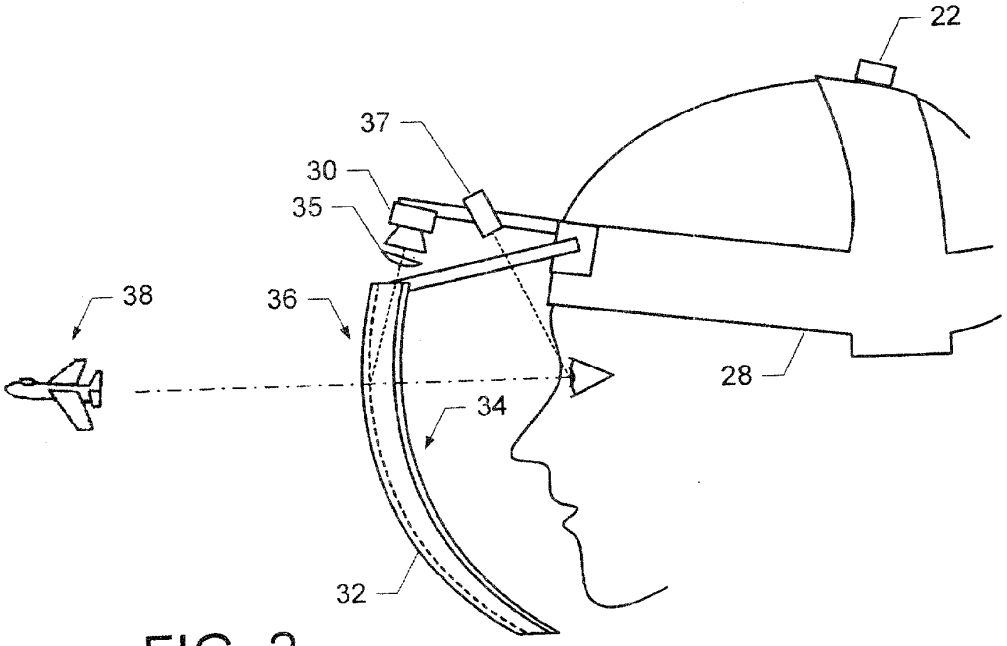


FIG. 2.

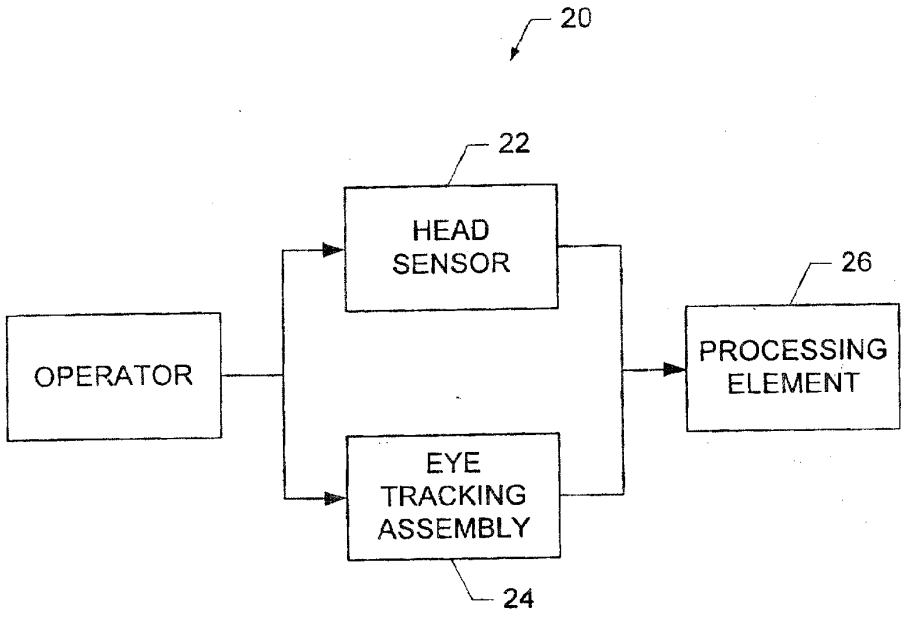

20
22
HEAD SENSOR
26
OPERATOR
PROCESSING ELEMENT
EYE TRACKING ASSEMBLY
24

FIG. 3.

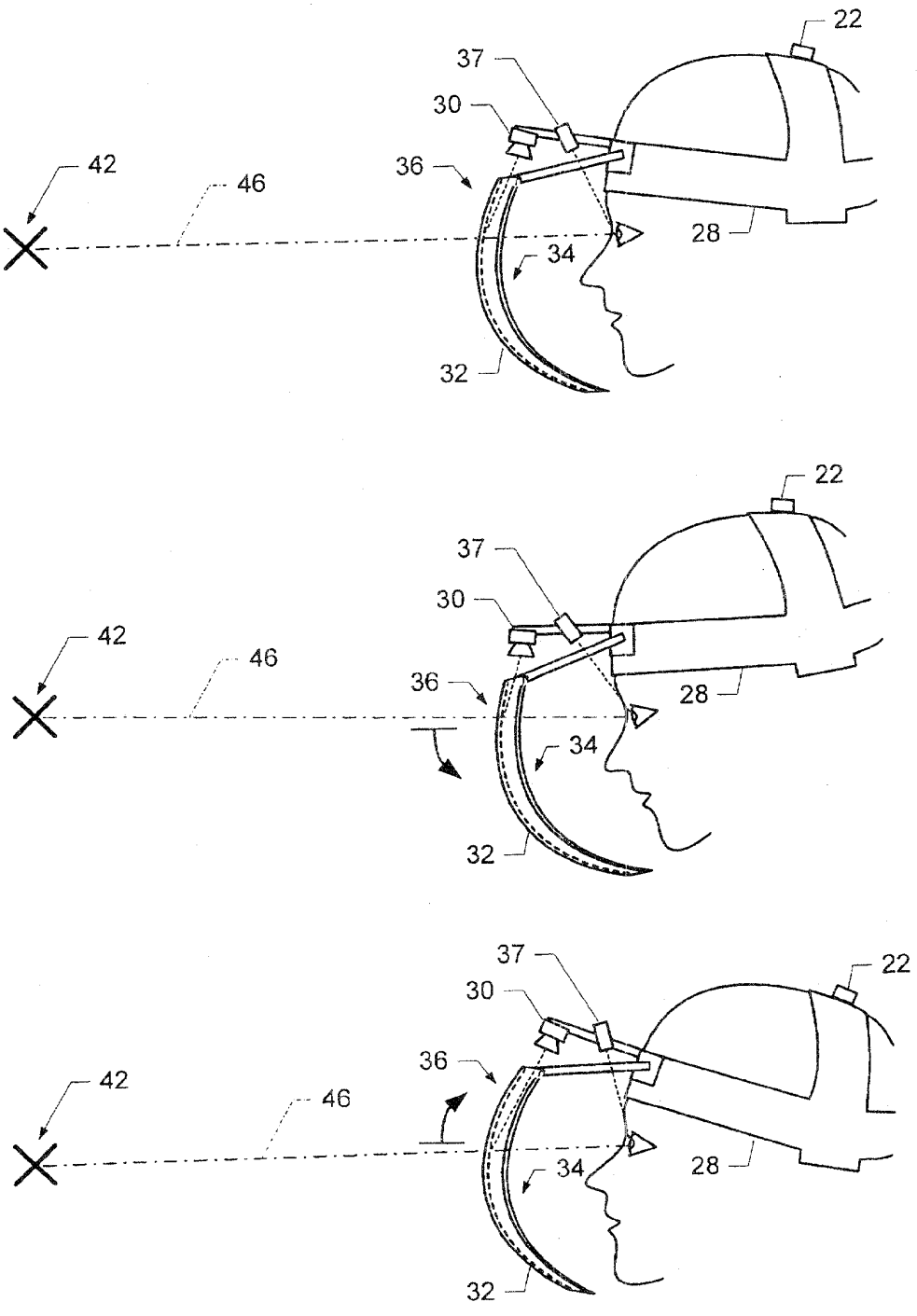

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FIG. 4A.

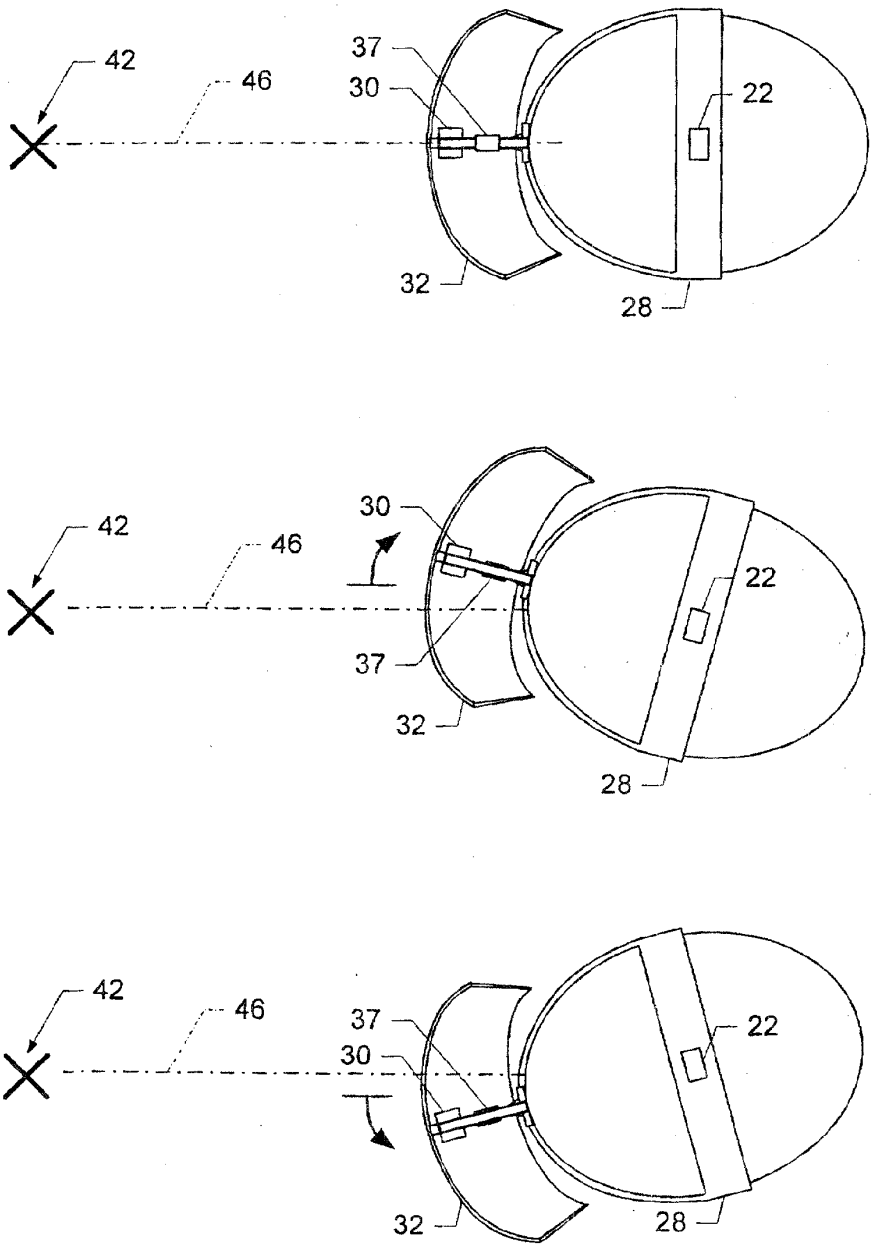


FIG. 4B.

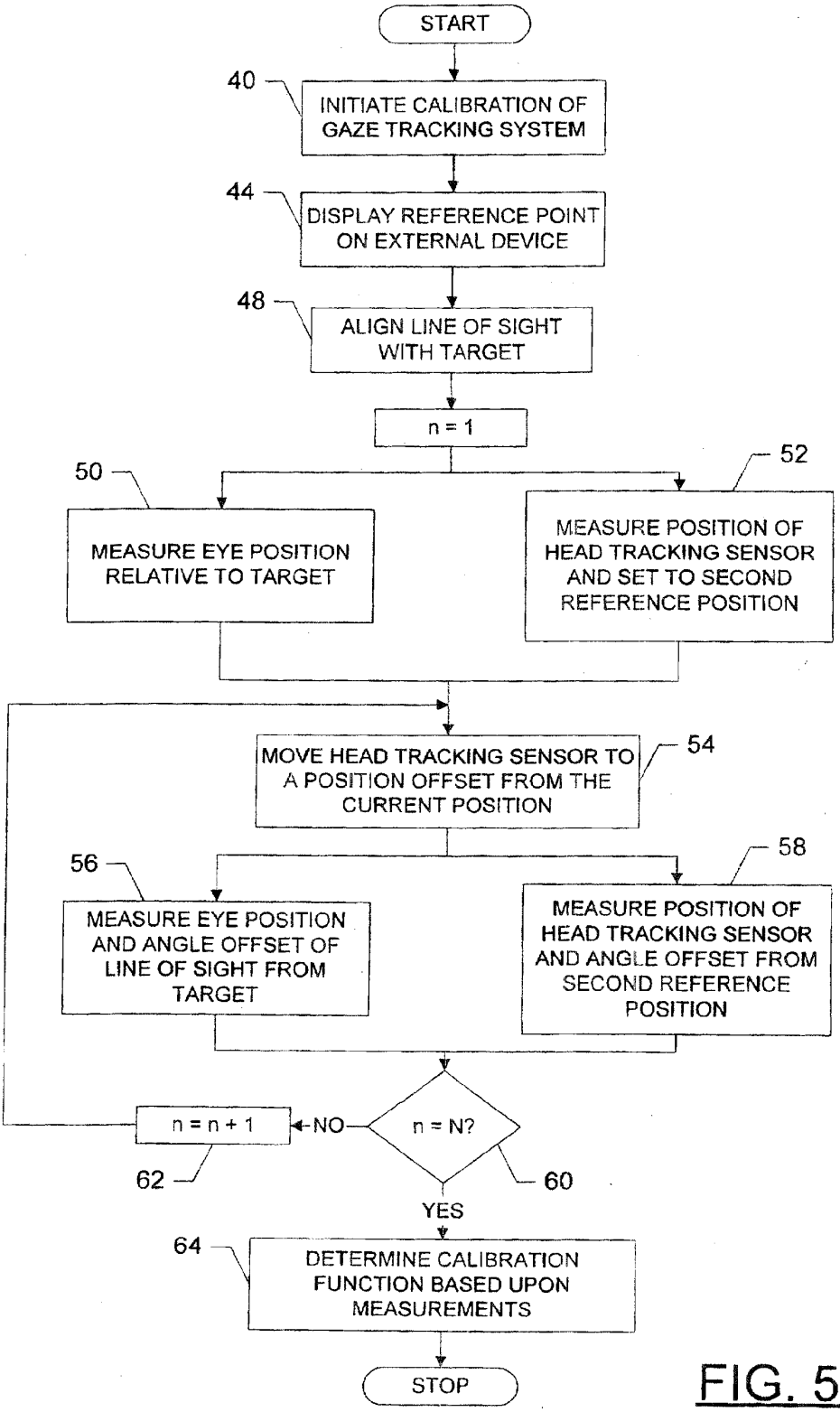

START
40
INITIATE CALIBRATION OF GAZE TRACKING SYSTEM
44
DISPLAY REFERENCE POINT ON EXTERNAL DEVICE
48
ALIGN LINE OF SIGHT WITH TARGET
n = 1
50
MEASURE EYE POSITION RELATIVE TO TARGET
52
MEASURE POSITION OF HEAD TRACKING SENSOR AND SET TO SECOND REFERENCE POSITION
MOVE HEAD TRACKING SENSOR TO A POSITION OFFSET FROM THE CURRENT POSITION
54
56
MEASURE EYE POSITION AND ANGLE OFFSET OF LINE OF SIGHT FROM TARGET
58
MEASURE POSITION OF HEAD TRACKING SENSOR AND ANGLE OFFSET FROM SECOND REFERENCE POSITION
n = N?
NO
n = n + 1
62
60
YES
64
DETERMINE CALIBRATION FUNCTION BASED UPON MEASUREMENTS
STOP

FIG. 5.

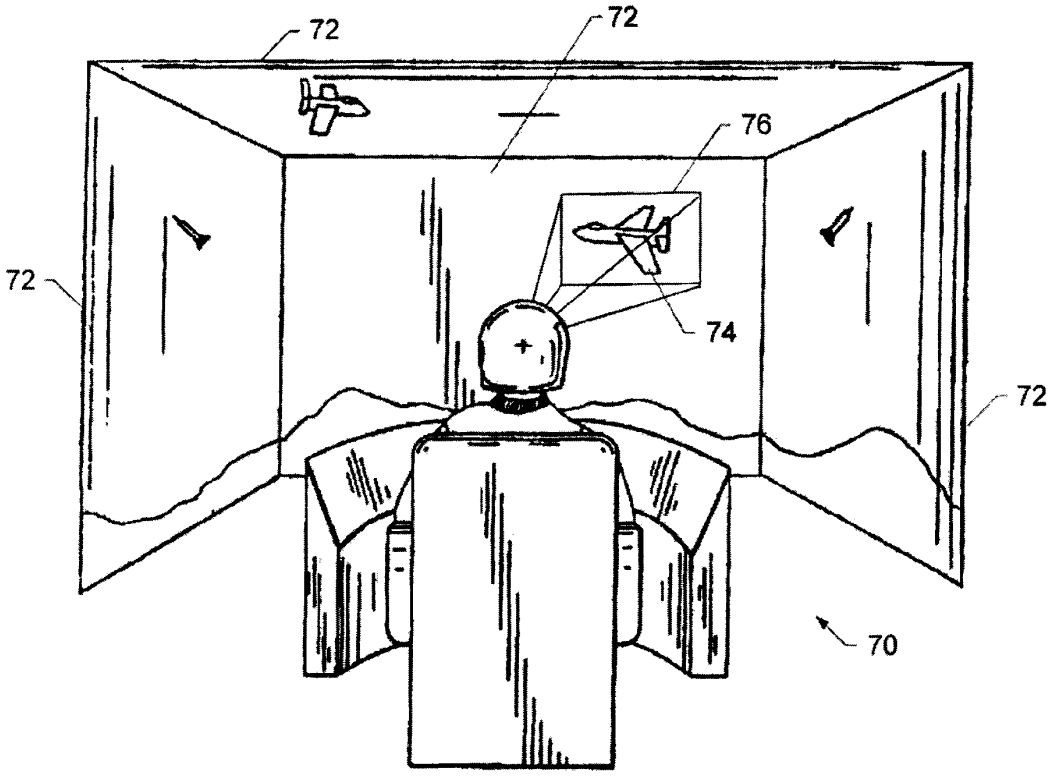
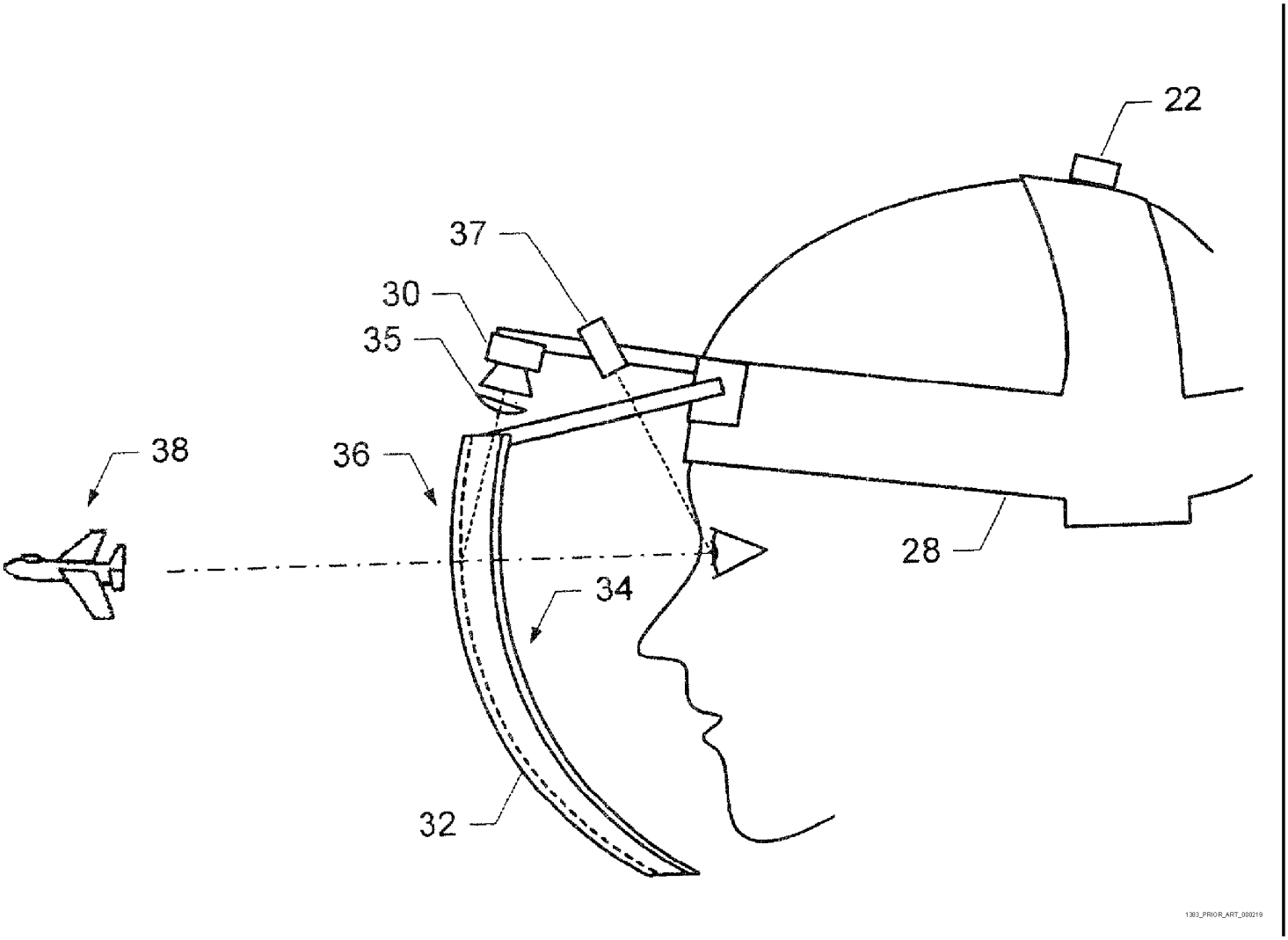


FIG. 6.


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1383_PRIOR_ART_000219

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(54) PORTABLE HEMOGLOBINOMETER

TRAGBARES HÄMOGLOBINMETER

HEMOGLOBINOMETRE PORTABLE PAR UN UTILISATEUR, MESURANT L'ETAT METABOLIQUE D'UN SUJET

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US-A- 4 223 680
US-A- 4 259 963
US-A- 4 380 240
US-A- 4 774 679

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EP 0 441 791 B1

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Description

The present invention relates to wearable apparatus for noninvasive determinations of the metabolic condition of a specific target region of tissue. More specifically, we describe embodiments of user-wearable system for monitoring the oxygen concentration in the tissue of a subject undergoing aerobic stress, such as an exercising person.

The increasing popularity of all forms of exercise over the last several decades has also lead to an increased interest in the measurement of individual athletic performance. However, at the present time, athletes are limited to obtaining heartbeat and blood pressure data while they are exercising. Although of some use, these data do not reflect peripheral circulatory capacity or the oxygenation state of specific muscle tissue.

In order to measure oxygen delivery to the capillary bed of the muscles, an athlete must be tethered to electrocardiogram apparatus and have blood samples drawn while running on a treadmill. These are essentially operating room apparatus and procedures, which do not simulate the actual conditions of exercise. The measurement of aerobic efficiency by analyzing the oxygenation state of a particular muscle while exercising is important to a variety of persons. For example, as a casual jogger strives to become a marathon runner, the efficiency at which they use oxygen can severely impact performance; data reflecting the utilization of oxygen can provide information which allows an athlete to change pacing strategies or otherwise adjust their activity to produce better results. Other athletes, such as swimmers, cyclists and rowers would also find this information useful for evaluating performance. However, the use of blood oxygenation data is not limited to competitive athletes; even geriatrics who undergo mild aerobic exercise to maintain and improve their health can benefit from data concerning the changes in blood oxygenation brought about by exercise or other activity. Other animals, such as racehorses, can also benefit form this type of performance data. By measuring the oxygen delivery to the muscles, both the quality of training and the natural ability to exercise may be evaluated.

In addition to monitoring and maximizing athletic performance, information pertaining to the delivery of oxygen to the limbs and the brain is important in military and space applications where changes in gravity and other stresses may result in fatigue, and ultimately, blackouts.

Although apparatus are available which measure the oxygenation content of blood using data collected from a fingertip or ear lobe, these devices do not actually measure the oxygenation state of nearby muscle groups or the brain. To monitor athletic performance, or the condition of exerted muscles, data collection must be performed at the site of interest. For example, runners will wish to know the condition of the muscles in their legs, and further wish to be provided with this information curing a race, not in a laboratory. Therefore, for an apparatus measuring the metabolic condition of an athlete to be truly useful, a rugged, lightweight, user-wearable system must be provided.

EP-A-0 102 816 discloses a pulse oximeter in which two LED'S sequentially pulse light of two different wavelengths (one infra-red, one red) through human tissue. The light is modulated by the pulsatile component of the arterial blood in the tissue (as blood flows in, more light is absorbed by the tissue) and a photosensor measures the transmitted light. By its construction it does not target relatively deep tissue.

In summary, the prior art provides a portable apparatus comprising:

(a) detector means for detecting scattered electromagnetic radiation, said detector means producing a signal proportional to a condition of living tissue, said detector means being removably attached against the exterior surface of said tissue, said detector means including;

(i) lamp means for producing electromagnetic radiation directed against said tissue;
(ii) sensor means for detecting a scattered portion of said radiation which has migrated through said tissue, said sensor being located adjacent to said lamp means on said exterior surface;
(iii) substantially opaque barrier means disposed between said lamp means and said sensor means for substantially reducing the transmission of near-surface transmitted radiation from said lamp means to said sensor means; and
(iv) means for pulsing said lamp means in a plurality of pulses having a known duration;

(b) power pack means for delivering current electrically connected to said detector means for producing a signal; and
(c) signal processing means for receiving said signal generated by said detector means and for processing said signal to produce information indicative of said condition and display means for displaying said information.

One method by which the oxygen level in a muscle may be measured is by tissue spectrometry. For example, red and near-red light, having wavelengths between about 600-800 nanometres (nm), will harmlessly penetrate body tissues. As the light penetrates the tissue, it migrates and is absorbed by deoxygenated haemoglobin in small blood vessels. Normally, tissue receives oxygen from haemoglobin contained in red blood cells, which circulate in the major blood vessels and eventually into the capillary bed, supplying muscle tissues with oxygen. Aerobic activity can cause the level of oxygen use to raise, causing a commensurate rise in the level of

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deoxyhaemoglobin in individuals. Near-red light is absorbed by tissue that is not receiving as much oxygen as the surrounding tissue due to increased levels of deoxyhaemoglobin in less trained individuals. Thus, by determining the amount of incident radiation absorbed, the oxygenation state of a specific area of tissue and the training level of an individual can be determined.

The present invention is characterized

(A) in that both said detector means and said power pack means are wearable by said subject during activity,
(B) in that said lamp means and sensor means are mounted on a flexible, water-proof, body-conformable array capable of simultaneously maintaining said lamp and sensor means adjacent the skin of the subject during such activity, said lamp means and said sensor means being located in an arrangement which establishes at least two substantially symmetric photon lateral-scatter paths through a target region lying beneath said surface, said arrangement including a centrally located sensor means with respect to at least two laterally spaced-apart lamp means adapted to target deep lying tissue regions of a body part,
(C) in that said barrier means is mounted on said flexible array, said barrier means being disposed on said flexible array between said lamp means and said sensor means in such manner that, while substantially blocking superficial photons migrating in the skin from entering said detector means, said barrier means allows photon migration through both of the respective photon lateral-scatter paths from the lamp means to the sensor means,
(D) in that said pulsing means is adapted to pulse said lamp means at a selected rate, and
(E) in that said signal processing means is adapted to process the received signal to produce information indicative of the metabolic condition of said target region.

The present invention thus provides a novel, wearable system for determining the metabolic condition of an aerobically stressed portion of the muscle tissue of an exercising person. The system comprises a lightweight rugged detector, worn against the skin surface of the subject, adjacent the muscle being monitored. The system of the present invention thus minimizes any performance impairment. The system further comprises a wearable power pack and a display means for displaying information indicative of the aerobic metabolic condition of the region being monitored. In a preferred embodiment intended for use while running or engaged in similar athletic activities, the display is a worn on the wrist and displays information from a leg-mounted detector. In another embodiment, intended to provide information to coaches, a telemetry system is employed to transmit a signal carrying the data from the detector to a remote location, for processing and display

The detector suitably employs electromagnetic radiation of red or near-red light and preferably employs a continuous wave spectrophotometer having at least two sources of electromagnetic radiation with wavelengths between about 760 nanometers and about 800 nanometers directed into the tissue of the subject. The detector is efficiently coupled to the body tissue and utilizes the principle of photon migration to detect the portion of the transmitted radiation arriving at an adjacent skin region.

The present invention also provides a method of monitoring a metabolic condition within a target region of the tissue of a subject comprising the steps of:

(a) providing an apparatus as aforesaid;
(b) activating said detector means when flashing at least two sources of said lamp means to direct electromagnetic radiation into said target region;
(c) sensing the scattered portion of the electromagnetic radiation which has migrated through the target region;
(d) determining the metabolic condition in the target region; and
(e) displaying information indicative of the metabolic condition in said target region of said subject responsive to said signal produced by said detector means.

By this means, the percentage of deoxyhemoglobin in the blood of the subject may be determined, and a signal representative of this percentage is converted into a graphic representation. The display may preferably be a digital display, a bar graph or a series of deoxyhemoglobin levels, placed on a time scale.

In embodiments of our apparatus we can obtain a rapid determination of the oxygenation state of tissue, such as muscle tissue, located beneath the surface of the skin of a subject, such as an athlete, without requiring the subject to be tethered or physically connected to laboratory or operating room monitoring equipment.

The apparatus may be attached to a user to determine the oxygenation state of a portion of the user's body and to provide that information in a readily understandable form.

Certain embodiments of our apparatus provide information pertaining to the oxygenation state of tissue directly to a user wearing the apparatus of the present invention.

Certain embodiments of our apparatus transmit information pertaining to the oxygenation state of tissue to a remote observer.

In the drawings:

Figure 1 is a depiction of a preferred configuration of an embodiment of apparatus according to the present invention.
Figure 2 is a partially diagrammatic, partially schematic representation of a preferred embodiment of detector.

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Figure 3 illustrates another preferred configuration of an embodiment of apparatus according to the present invention.

Figure 4 is a partially diagrammatic, partial schematic representation of an alternate preferred embodiment of detector.

A preferred embodiment of our apparatus is illustrated in Figure 2. In this embodiment an electro-optical pickoff detector unit 10 is worn on the leg of the exercising subject 50. It is preferred that the weight of the detector be kept to a minimum so that hindrance to a competing athlete is negligible. In a preferred embodiment, the detector will be housed in a flexible array constructed from a suitable non-irritating, lightweight material.

Power is provided to the detector unit 10 from a replaceable battery pack 30. The replaceable power pack 30 is preferably designed to be of minimal dimensions and weight. Most preferably, the battery pack 30 would be designed to last only for the duration of the activity, e.g., several minutes of sprinting, several hours for a marathon runner, etc. In competitive sports applications, the life of the battery pack is preferably based upon the interval between substitutions or other interruptions between periods of competition.

The embodiment illustrated in Figure 1 further comprises an arm indicator 40, which is preferably worn on the arm in the manner of a wristwatch. The arm indicator 40 displays the percentage of deoxyhemoglobin (%Hb) as a measure of the subject's metabolic state. As seen in Figure 1A, such a display may comprise a simple readout of this information, such as a bar graph. Alternatively, the information displayed may be placed on a time scale, to graphically illustrate the change in %Hb concentration over the course of the activity, as illustrated by Figure 1B. In a most preferred embodiment, the graphic displays illustrated by Figures 1A and 1B are comprised of liquid crystal displays (LCD's), although other electrical or electronic display means may also be used. The amplitude interval of this embodiment is preferably divided into 6-10 levels, each covering a portion of the designated %Hb scale.

It will be appreciated that the range of the %Hb scale may be adjusted depending upon the range expected to occur during the activity. Since the precision of the apparatus is limited by that of the indicator, the range which is displayed is an important variable parameter. In the most accurate embodiment, with the endpoints of the %Hb scale set at 20% and 40%, the apparatus would have an accuracy of about 6%, which is about the limit of precision which can be obtained from a moving limb. One of ordinary skill will realize that the gain of the apparatus is preset, depending upon the intensity of the intensity of the activity expected. In a most preferred embodiment, a button placed on the arm indicator 40 allows the gain to be set.

Referring now to Figure 2, there is illustrated a partially schematic, partially diagrammatic representation of a preferred embodiment of a circuit which comprises the optical pickoff component of a DC tissue spectrophotometer detector 10 contemplated for use in our system. The detector 10 is shown for illustrative purposes mounted against a skin surface 25 of a subject. In a typical configuration, the detector is mounted against either large, homogeneous muscles, such as the gastrocnemius or the quadriceps or against the forehead of an adult. Two lamps 12,14 and two detectors 16,18 are contained in a flexible waterproof array. Also contained in the array is an opaque specular barrier, which is a concentric ring of material 11 between the lamps 12,14 and the detectors 16,18 which acts as a barrier zone to light of a specified wavelength. Most preferably, the material which comprises the barrier zone will not only be opaque to light within a specified region, but will further act as an absorber thereof.

Thus, superficial light rays from the skin are, in effect, blocked by the opaque barrier 11 from entering the detectors 16,18. This blocking action by the barrier 11 of these superficial rays enables the system to determine the oxygenation state of hemoglobin within the muscle rather than at the skin surface. The rays that migrate deep within the tissue are received by the detectors 16,18. The light rays that migrate superficially "escape" through the skin surface and will be absorbed by the opaque barrier 11. When, for example, a 760 nm impulse is applied, the deoxygenated hemoglobin (Hb) within the muscle is detected and when an 800 nm signal is applied, the oxygenated and deoxygenated hemoglobin (HbO_2 and Hb) within the tissue region are detected. The system is able to ignore the oxygenation state at the skin surface and determine that within the tissue.

The lamps 12,14 may be, for example, 1/2 W flashlight bulbs that are periodically illuminated in the NR region. The lamps are provided with cutoff filters 13,15 so that only energy of a specified wavelength illuminates the tissue. The silicon diode detectors 16,18 are sensitive to 760 $\pm$ 20 nm and 800 $\pm$ 20 nm wavelengths respectively.

In a preferred embodiment, the lamps 12,14 are light emitting diode (LED) sources, which emit light having a wavelength of about 760 nanometers and about 800 nanometers respectively. In either embodiment, the lamps are flashed or pulsed at a predetermined repetition rate. The repetition rate of sampling, i.e., the rate at which the lamps are flashed determines the rate at which data may be collected. Thus, for a long distance runner, the lamps are flashed slowly; the output is commensurately changed for a sprinter, the lamps flashed rapidly to produce sufficient data to evaluate an exercise having a duration on the order of seconds. The selection of LEDs as sources of electromagnetic radiation provides a further advantage, since these sources produce a signal-to-noise ratio (S/N) approximately one order of magnitude greater than previously disclosed optical coupling systems using optical light fiber sources.

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Referring now to Figure 4, an alternate embodiment of circuit for use with the system is illustrated. In this case a single detector 17 responding to separate light flashes collects and transmits signals to an amplifier 24, which has bipolar outputs that are connected intermittently to an integrator 27 by a switch 26A. Another switch 26 adjusts the relative duration of the two light pulses to equalize the two signals. One of ordinary skill will understand that those portions of Figure 2 and Figure 4 having the same reference numerals perform substantially similar functions. Many details of the particular circuits need not be set forth with particularity as they are well known or will be obvious to those of ordinary skill.

Referring to Figure 2, it can be seen that the detectors 16,18 are also protected by a transmitting filter 19 to minimize the effect of background light. The filter 19 may be comprised of a separate member, a coating or integrated into the housing of the circuit. The DC output of each of the detectors 16,18 is time-shared into its respective differential amplifier 20,22. The amplifiers are connected in opposite polarity, one non-inverting, the other inverting. The dwell time of the switch 23 connecting the amplifiers 20,22 is adjusted to equalize the response of the two signals by appropriate circuitry 28. The signal from the integrator is coupled to a recorder (not illustrated). As shown in Figure 4, the signal from the 800 nm lamp 12 may be simultaneously employed to vary the gain of the amplifier 24 so as to correct the signals for changes of blood volume and to produce the ratio of the two signals, and thus maintaining constant sensitivity for difference detection. One of ordinary skill will appreciate that a similar gain compensation circuit can be incorporated into the circuitry of the 800 nm detector amplifier 22, shown in Figure 2. Whether incorporated into the circuits of Figure 2 or Figure 4, the 800 nm signal is also coupled to a second recorder channel to collect data reflecting total absorbtion or blood volume.

Another configuration is illustrated in Figure 3. In this embodiment, a radio-linked telemetry system comprised of a transmitter 60 attached to the subject and a receiver 62, allows the remote monitoring of the subject. A supervisor, coach, or clinician is thereby enabled to monitor the performance of the subject. The display is remote. One of ordinary skill will appreciate that the displays utilized may be similar to those illustrated in Figures 1A and 1B, or may be more complex, displaying data using various scales, time overlays, colors, etc. In a most preferred embodiment the telemetry signal would be carried on the 220-400 MHz band, using a transmitter in the 100 MW range.

The configuration illustrated by Figure 3 allows us to monitor athletes in competition or workers and military/space personnel located in remote locations. For example, the apparatus may be used in training to determine the duration of peak performance and the appropriate times for the substitution of fresh players or other adjustments. This configuration would also be preferred for monitoring the metabolic condition of an animal such as a racehorse, racing dog, or any animal whose metabolic condition is being studied for clinical or other purposes.

In any of the embodiments, it is preferred that the data be integrated over at least about ten seconds to smooth out irregularities which normally occur in the concentration of deoxyhaemoglobin during exercise. However, it will be understood that the period integration can be varied, depending upon the duration of the activity being monitored.

Although manual balancing of the apparatus is required, in a preferred embodiment, the balancing is accomplished by depressing a button, which will normalize the output of the two wavelengths.

One of ordinary skill in the art will appreciate that the present invention is not limited to the particular embodiments described in detail. Modifications to the circuitry disclosed, and other aspects of the spectrophotometer configurations disclosed, as well as other modifications to the physical arrangement of the specifically described and illustrated apparatus are feasible.

Claims

1. Portable apparatus for determining a condition of tissue of a subject (50), said tissue having an exterior surface (25), said apparatus comprising:

   (a) detector means (10) adapted operatively to detect scattered electromagnetic radiation, said detector means being adapted to be removably attached against said exterior surface, and said detector means mounting:

   (i) lamp means (12,14) for operatively producing electromagnetic radiation directed against said tissue;
   (ii) sensor means (16,18,17) for operatively detecting a scattered portion of said radiation which has migrated through said tissue, said sensor (16,18,17) being arranged for location adjacent to said lamp means on said exterior surface; and
   (iii) substantially opaque barrier means (11) disposed between said lamp means and said sensor means for substantially reducing the transmission of near-surface transmitted radiation from said lamp means to said sensor means;

   and being provided with means for operatively pulsing said lamp means in a plurality of pulses having a known duration;
   (b) power pack means (30) electrically connected to said detector means and adapted for delivering current thereto; and
   (c) signal processing means adapted operatively to receive a signal generated by said

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detector means and to process said signal to produce information indicative of the said condition, and display means (40) for displaying said information;

said apparatus being characterized

(A) in that both said detector means and said power pack means are wearable by said subject during activity,

(B) in that said lamp means and sensor means are mounted on a flexible, waterproof, body-conformable array capable of simultaneously maintaining said lamp and sensor means adjacent the skin of the subject during such activity, said lamp means and said sensor means being located in an arrangement which establishes at least two substantially symmetric photon lateral-scatter paths through a target region lying beneath said surface, said arrangement including a centrally located sensor means with respect to at least two laterally spaced-apart lamp means adapted to target deep lying tissue regions of a body part,

(C) in that said barrier means is mounted on said flexible array, said barrier means being disposed on said flexible array between said lamp means and said sensor means in such manner that, while substantially blocking superficial photons migrating in the skin from entering said detector means, said barrier means allows photon migration through both of the respective photon lateral-scatter paths from the lamp means to the sensor means,

(D) in that said pulsing means is adapted to pulse said lamp means at a selected rate, and

(E) in that said signal processing means is adapted to process the received signal to produce information indicative of the metabolic condition of said target region.

2. Apparatus according to Claim 1, further characterized in that said display means (40) is electrically connected to said detector means (10) and wearable by said subject (50).

3. Apparatus according to Claim 2, further characterized in that said display means is removably mountable within the view of said subject.

4. Apparatus according to Claim 1, further characterized in that said display means further comprises telemetry means (60,62) for operatively transmitting a signal from said detector means to the display means.

5. Apparatus according to Claim 4, further characterized in that said telemetry means comprises:

(a) transmitter means (60) attachable to said subject (50); and

(b) receiver means (62) associated with said display means (40) and located remotely from said subject.

6. Apparatus according to any preceding claim, further characterized in that the display means (40) is a liquid crystal display.

7. Apparatus according to any preceding claim, further characterized in that said lamp means (12,14) provides electromagnetic radiation in the form of red or near-red light and is preferably comprised of at least two sources of electromagnetic radiation having a wavelength generally in the range of 760 nanometres to 800 nanometres.

8. Apparatus according to any preceding claim, further characterized in that said pulsing means is adjustable to vary the duration of the produced pulses.

9. Apparatus according to any preceding claim, further characterized in that said lamp means includes a flashlight bulb or a light emitting diode.

10. Apparatus according to any preceding claim, further characterized in that said flexible array is adapted for mounting said detector means against the head or leg of said subject, the target region being a region within the head or leg of the said subject.

11. Apparatus according to any preceding claim, further characterized in that said array is adapted to be worn by an athlete, by a person working, by active military personnel, by space personnel, or by an animal.

12. A method of monitoring a metabolic condition within a target region of the tissue of a subject comprising the steps of:

(a) providing an apparatus according to Claim 1;

(b) activating said detector means when flashing at least two sources of said lamp means to direct electromagnetic radiation into said target region;

(c) sensing the scattered portion of the electromagnetic radiation which has migrated through the target region;

(d) determining the metabolic condition in the target region; and

(e) displaying information indicative of the met-

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abolic condition in said target region of said subject responsive to said signal produced by said detector means.

13. A method according to Claim 12, further comprising the step of transmitting said information indicative of the metabolic condition in said target region to a remote located by telemetry.

14. A method according to Claim 12, further comprising the step of adjusting said pulsing means to flash said lamp means at a rate dependant on the activity of said subject.

Patentansprüche

1. Tragbare Vorrichtung zur Bestimmung eines Zustands des Gewebes eines Subjekts (50), wobei das Gewebe eine Außenoberfläche (25) besitzt und die Vorrichtung folgendes aufweist:

(a) Detektormittel (10) geeignet zum betriebsmäßigen Detektieren gestreuter elektromagnetischer Strahlung, wobei die Detektormittel entfernbar an der erwähnten Außenoberfläche anbringbar sind, und die Detektormittel folgendes tragen:

(i) Lampenmittel (12, 14) zur betriebsmäßigen Erzeugung elektromagnetischer, gegen das Gewebe gerichteter Strahlung;
(ii) Abfühlmittel (16, 18, 17) zum betriebsmäßigen Detektieren eines gestreuten Teils der Strahlung der durch das Gewebe gelaufen ist, wobei der Sensor (16, 18, 17) zur Anordnung benachbart zu den Lampenmittel auf der Außenoberfläche angeordnet ist; und
(iii) im wesentlichen undurchsichtige Barrierenmittel (11) angeordnet zwischen den Lampenmitteln und den Sensormitteln zum substantiellen Reduzieren der Übertragung der nahe der Oberfläche übertragenen Strahlung von den Lampenmitteln zu den Sensormitteln;

und wobei die Detektormittel mit Mitteln versehen sind zum betriebsmäßigen Pulsen der Lampenmittel mit einer Vielzahl von Pulsen mit bekannter Dauer;
(b) Leistungspackmittel (30) elektrisch verbunden mit den Detektormitteln und geeignet zur Lieferung von Strom an diese; und
(c) Signalverarbeitungsmittel geeignet zum betriebsmäßigen Empfang eines durch die Detektormittel erzeugten Signals und zur Verarbeitung des Signals zur Erzeugung von Information, die den erwähnten Zustand anzeigt und Anzeigemittel (40) zum Anzeigen der Information;
wobei die Vorrichtung dadurch gekennzeichnet ist,

(a) daß sowohl die Detektormittel als auch die Leistungspackmittel durch das Subjekt während Aktivität tragbar sind,
(b) daß die Lampenmittel und die Sensormittel auf einer flexiblen, wasserdichten, für den Körper bequemen Anordnung angebracht sind, die in der Lage ist, gleichzeitig die Lampe und die Sensormittel benachbart zur Haut des Subjektes während dieser Aktivität zu halten, wobei die Lampenmittel und die Sensormittel in einer Anordnung angeordnet sind, die mindestens zwei im wesentlichen symmetrische Photonen-Seiten-Streupfade durch eine Zielregion unterhalb der Oberfläche vorsieht, wobei die Anordnung zentrale oder mittig angeordnete Sensormittel aufweist, und zwar bezüglich mindestens zwei seitlich voneinander mit Abstand angeordneten Lampenmitteln, geeignet zum Zielen auf tiefliegende Gewebegebiete oder Regionen eines Körperteils,
(c) daß die Barrierenmittel auf der erwähnten flexiblen Anordnung angebracht sind und auf dieser zwischen den Lampenmitteln und den Sensormitteln derart angeordnet sind, daß, während sie oberflächliche Photonen, die in der Haut wandern, vom Eintritt in die Detektormittel blockieren, die Barrierenmittel die Photonenwanderung durch die beiden entsprechenden Photonen-Seiten-Streupfade von den Lampenmitteln zu den Sensormitteln gestatten,
(d) daß die Pulsmittel geeignet sind, die Lampenmittel mit einer ausgewählten Rate zu pulsieren, und
(e) daß die Signalverarbeitunsmittel geeignet sind, um das empfangene Signal zu verarbeiten, um Information zu erzeugen, die eine Anzeige für den metabolischen Zustand oder die metabolische Bedingung der Target- oder Zielzone angibt.

2. Vorrichtung nach Anspruch 1, ferner gekennzeichnet dadurch, daß die erwähnten Anzeigemittel (40) elektrisch mit den Detektormitteln (10) verbunden sind und durch das Subjekt (50) tragbar sind.

3. Vorrichtung nach Anspruch 2, ferner dadurch gekennzeichnet, daß die Anzeigemittel entfernbar innerhalb des Gesichtsfeldes des Subjektes angeordnet sind.

4. Vorrichtung nach Anspruch 1, ferner dadurch

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gekennzeichnet, daß die Anzeigemittel Telemetriemittel (60, 62) aufweisen zum betriebsmäßigen Übertragen eines Signals von den Detektormitteln zu den Anzeigemitteln.

5. Vorrichtung nach Anspruch 4, ferner dadurch gekennzeichnet, daß die Telemetriemittel folgendes aufweisen:

(a) Transmitter- oder Sendemittel (60) anbringbar an dem Subjekt (50); und
(b) Empfängermittel (62) assoziiert mit den Anzeigemitteln (40) und angeordnet entfernt vom Subjekt.

6. Vorrichtung nach einem der vorhergehenden Ansprüche, ferner dadurch gekennzeichnet, daß die Anzeigemittel (40) eine Flüssigkeitskristallanzeige sind.

7. Vorrichtung nach einem vorhergehenden Anspruch, ferner dadurch gekennzeichnet, daß die Lampenmittel (12, 14) elektromagnetische Strahlung in der Form roten oder nahe roten Lichtes vorsehen, und zwar vorzugsweise mindestens zwei Quellen elektromagnetischer Strahlung aufweisen mit einer Wellenlänge im allgemeinen Bereich von 760 Nanometer bis 800 Nanometer.

8. Vorrichtung nach einem vorhergehenden Anspruch, ferner dadurch gekennzeichnet, daß die Pulsmittel einstellbar sind, um die Dauer der erzeugten Impulse zu verändern.

9. Vorrichtung nach einem vorhergehenden Anspruch, ferner dadurch gekennzeichnet, daß die Lampenmittel eine Blitzlichtbirne oder eine lichtemittierende Diode aufweisen.

10. Vorrichtung nach einem vorhergehenden Anspruch, ferner dadurch gekennzeichnet, daß die flexible Anordnung geeignet ist, um die Detektormittel am Kopf oder am Bein des Subjekts anzuordnen, wobei die Target- oder Zielzone eine Region oder Gebiet innerhalb des Kopfes oder des Beins des Subjektes ist.

11. Vorrichtung nach einem vorhergehenden Anspruch, ferner dadurch gekennzeichnet, daß die Anordnung geeignet ist, um von einem Athleten, einer arbeitenden Person oder aktiven Militärpersonal, im Weltraum tätigem Personal oder einem Tier getragen wird.

12. Verfahren zur Überwachung eines metabolischen Zustandes innerhalb einer Zielregion des Gewebes eines Subjekts, wobei die folgenden Schritte vorgesehen sind:

(a) Vorsehen einer Vorrichtung gemäß Anspruch 1;
(b) Aktivieren der Detektormittel, wenn mindestens zwei Quellen der Lampenmittel blitzen, um die elektromagnetische Strahlung in die Zielregion zu richten;
(c) Abfühlen des gestreuten Teils der elektromagnetischen Strahlung, die durch die Zielregion gelaufen ist;
(d) Bestimmung des metabolischen Zustands der Zielregion; und
(e) Anzeigen der Information, die den metabolischen Zustand der Zielregion des Subjekts angibt, und zwar ansprechend auf das durch die Detektormittel erzeugte Signal.

13. Verfahren nach Anspruch 12, wobei ferner der Schritt des Übertragens der Information, die eine Anzeige für den metabolischen Zustand der Targetregion bildet, zu einer entfernten Stelle durch Telemetrie vorgesehen ist.

14. Verfahren nach Anspruch 12, wobei ferner der Schritt des Einstellens der Impuls- oder Pulsmittel vorgesehen ist, um die Lampenmittel blitzlichtartig zu betätigen, und zwar mit einer von der Aktivität des Subjekts abhängigen Rate.

Revendications

1. Dispositif portable pour déterminer la condition d'un tissu d'un sujet (50), ce tissu ayant une surface externe (25), ce dispositif comprenant :

(a) un moyen (10) adapté pour détecter un rayonnement électromagnétique diffus, ce moyen étant conçu pour pouvoir être fixé de manière non définitive sur cette surface externe et comportant :

(i) des lampes (12) et (14) pour produire un rayonnement électromagnétique dirigé sur ce tissu;
(ii) des capteurs (16), (18) et (17) pour détecter une partie diffuse de ce rayonnement ayant migré à travers ce tissu, ces capteurs étant disposés de manière à se trouver à des emplacements voisins de ces lampes sur cette surface externe; et
(iii) une barrière sensiblement opaque (11) placée entre ces lampes et ces capteurs pour réduire de manière substantielle la transmission de rayonnement émis au voisinage de la surface de ces lampes vers les capteurs;

et étant équipé d'un moyen destiné à activer les lampes par une pluralité d'impulsions de durée connue;

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(b) un groupe d'alimentation électrique (30) connecté électriquement à ce détecteur et adapté pour lui délivrer un courant ; et

(c) un moyen de traitement de signal adapté pour recevoir un signal généré par ce détecteur et le traiter de manière à produire une information indiquant ladite condition, ainsi qu'un moyen (40) pour afficher cette information;

ce dispositif étant caractérisé en ce que :

(A) les détecteurs et le groupe d'alimentation électrique sont tous les deux portables par le sujet en activité,

(B) les lampes et les capteurs sont montés sur un support souple, imperméable, se conformant au corps, capable de maintenir simultanément ces lampes et capteurs à proximité de la peau du sujet pendant cette activité, ces lampes et capteurs étant placés selon une disposition établissant au moins deux trajets sensiblement symétriques de diffusion latérale de photons à travers une zone cible se trouvant sous ladite surface, cette disposition comportant un capteur centré par rapport à au moins deux lampes espacées latéralement adaptées pour viser les zones de tissu situé en profondeur d'une partie du corps,

(C) la barrière est montée sur ce support souple entre les lampes et les capteurs de telle manière que, tout en empêchant sensiblement les photons superficiels migrant dans la peau d'entrer dans les détecteurs, elle permette la migration des photons par les deux trajets respectifs de diffusion latérale des lampes vers les capteurs,

(D) le moyen générateur d'impulsions est adapté pour fournir une impulsion à la lampe à une fréquence donnée, et

(E) le moyen de traitement de signal est adapté pour traiter le signal reçu de manière à produire une information indiquant la condition métabolique de cette zone cible.

2. Dispositif selon la revendication 1, caractérisé en outre en ce que le moyen d'affichage (40) est connecté électriquement au détecteur (10) et portable par le sujet (50).

3. Dispositif selon la revendication 2, caractérisé en outre en ce que le moyen d'affichage est monté de manière non définitive dans le champ de vision du sujet.

4. Dispositif selon la revendication 1, caractérisé en ce que le moyen d'affichage comprend en outre des moyens de télémétrie (60) et (62) pour transmettre un signal provenant de ces détecteurs au moyen d'affichage.

5. Dispositif selon la revendication 4, caractérisé en outre en ce que le moyen de télémétrie comprend :

(a) un moyen émetteur (60) susceptible d'être fixé au sujet (50); et

(b) un moyen récepteur (62) associé au dispositif d'affichage (40) et placé à distance de ce sujet.

6. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en outre en ce que le moyen d'affichage (40) est à cristaux liquides.

7. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en outre en ce que les lampes (12) et (14) fournissent un rayonnement électromagnétique sous forme de lumière rouge ou proche du rouge et comprennent de préférence deux sources de rayonnement ayant une longueur d'onde généralement de l'ordre de 760 à 800 nanomètres.

8. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en outre en ce que le moyen générateur d'impulsions est réglable de manière à pouvoir faire varier la durée des impulsions produites.

9. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en ce que les lampes comprennent une ampoule de lampe torche ou une diode électroluminescente.

10. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en outre en ce que le support souple est adapté pour permettre de placer les détecteurs sur la tête ou la jambe du sujet, la zone cible étant située dans la tête ou la jambe.

11. Dispositif selon l'une quelconque des revendications précédentes, caractérisé en outre en ce que ce support est adapté pour être porté par un athlète, par une personne travaillant, par le personnel militaire actif, le personnel de l'espace ou par un animal.

12. Procédé de surveillance de la condition métabolique dans une zone cible du tissu d'un sujet comprenant les étapes consistant à :

(a) mettre en place un appareil selon la revendication 1;

(b) activer les détecteurs quand on allume au moins deux sources desdites lampes de manière a dirigé un rayonnement électromagnétique sur cette zone cible;

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(c) capter la partie diffuse du rayonnement électromagnétique ayant migré à travers la zone cible;

(d) déterminer la condition métabolique dans cette zone; et

(e) afficher l'information indiquant cette condition dans cette zone cible du sujet sensible au signal produit par ces détecteurs.

13. Procédé selon la revendication 12, comprenant en outre l'étape consistant à transmettre par télémétrie cette information indiquant la condition métabolique dans cette région cible à distance.

14. Procédé selon la revendication 12, comprenant en outre l'étape consistant à régler le moyen générateur d'impulsions pour activer ladite lampe à une fréquence dépendant de l'activité du sujet.

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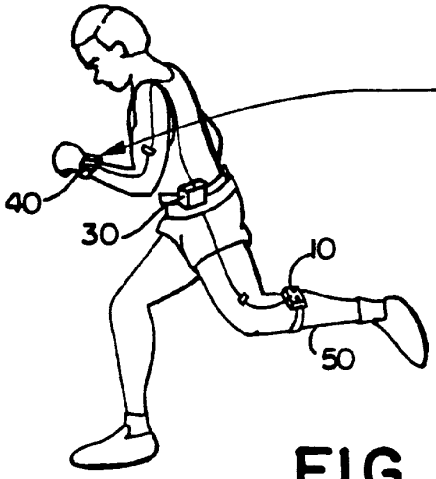


FIG. 1

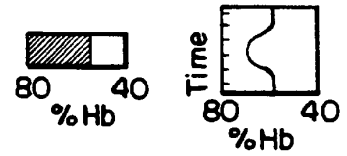


FIG. 1A FIG. 1B

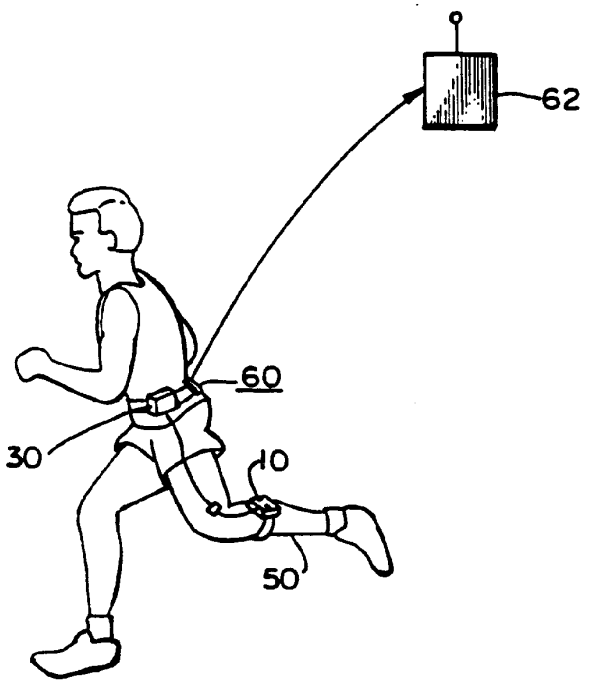


FIG. 3

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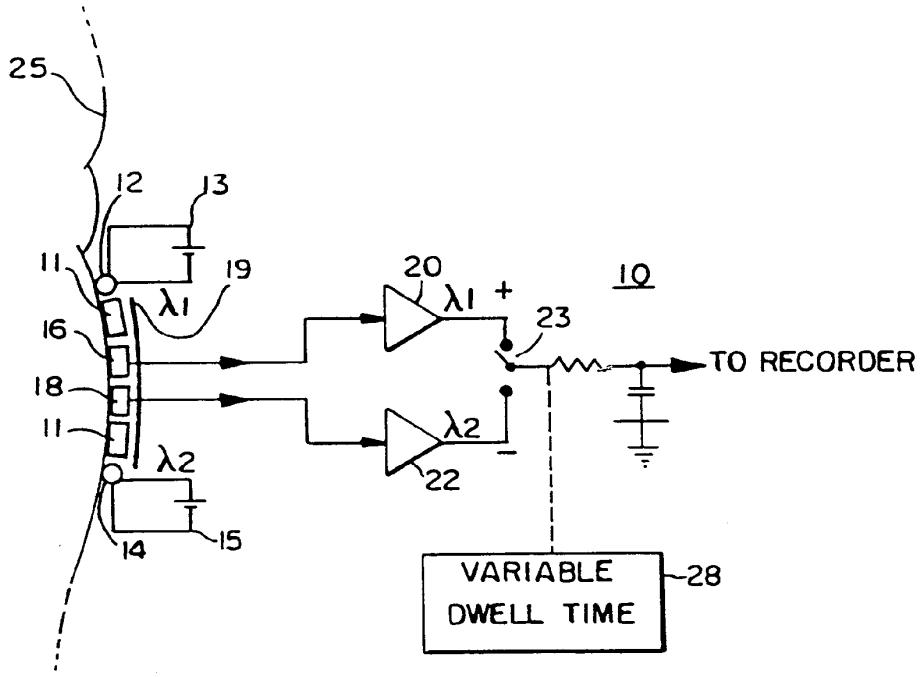


FIG. 2

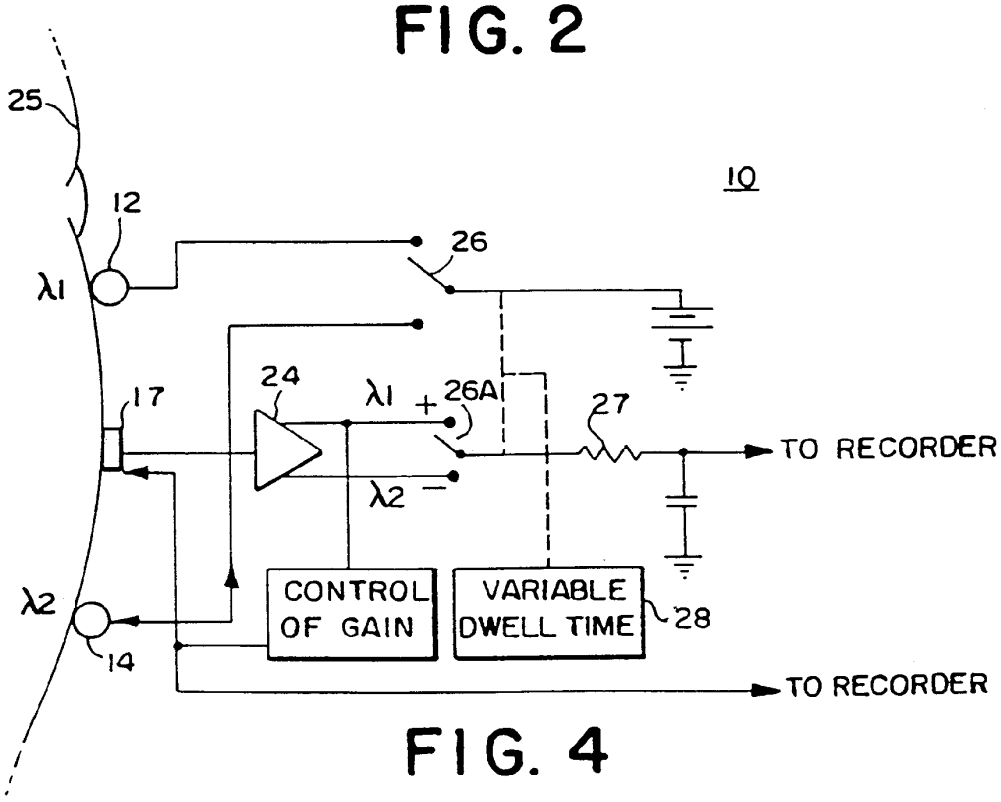


FIG. 4

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(54)【発明の名称】移動無線デバイスと通信するための組み込まれた音響通信システムを有する眼鏡フレーム、及び対応する方法

(57)【特許請求の範囲】

【請求項１】

音響通信のためのシステムであって、

１つ又は複数の音声信号をキャプチャするための複数の方向依存のマイクロホンを含む眼鏡フレームと、

１つ又は複数の外部電子デバイスにキャプチャされた該１つ又は複数の音声信号を含むデータを伝送するように構成される送信機と、

該複数の方向依存のマイクロホンのうちの少なくとも１つの第２の方向依存のマイクロホンによってキャプチャされた該１つ又は複数の音声信号に基づき、該複数の方向依存のマイクロホンのうちの少なくとも１つの第１の方向依存のマイクロホンの方向依存性を調整するための制御モジュールとを備え、

該第２の方向依存のマイクロホンは、身体的振動音響信号をキャプチャするために該眼鏡フレームの耳係合部分に配置された、音響通信のためのシステム。

【請求項２】

請求項１に記載の音響通信のためのシステムにおいて、

該第２の方向依存のマイクロホンは、接触マイクロホンである音響通信のためのシステム。

【請求項３】

請求項１に記載の音響通信のためのシステムにおいて、

該第１の方向依存のマイクロホンによってキャプチャされた該１つ又は複数の音声信号

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は、第３の方向依存のマイクロホンによってキャプチャされた該１つ又は複数の音声信号に基づき該制御モジュールによって濾波されることが可能である音響通信のためのシステム。

【請求項４】

請求項１に記載の音響通信のためのシステムにおいて、

第３の方向依存のマイクロホンによってキャプチャされた１つ又は複数の音声信号を使用して制御可能な増幅器を備えた音響通信のためのシステム。

【請求項５】

請求項１に記載の音響通信のためのシステムにおいて、

少なくとも１つの方向依存のマイクロホンは、マイクロホン・アレイである音響通信のためのシステム。

【請求項６】

請求項５に記載の音響通信のためのシステムにおいて、

少なくとも１つのマイクロホン・アレイは、ＭＥＭＳ技術で実施される音響通信のためのシステム。

【請求項７】

請求項１に記載の音響通信のためのシステムにおいて、

該１つ又は複数の外部デバイスは、移動無線デバイスを含む音響通信のためのシステム。

【請求項８】

請求項１に記載の音響通信のためのシステムにおいて、

該眼鏡フレームは、網膜走査表示のための手段を含む音響通信のためのシステム。

【請求項９】

請求項８に記載の音響通信のためのシステムにおいて、

該眼鏡フレームは、視線方向をキャプチャするように構成された方向モジュールを含む音響通信のためのシステム。

【請求項１０】

請求項１に記載の音響通信のためのシステムにおいて、

少なくとも１つの方向依存のマイクロホンを使用して口頭のコマンドをキャプチャするように構成された音声認識モジュールを含む音響通信のためのシステム。

【請求項１１】

請求項１に記載の音響通信のためのシステムにおいて、

Ｂｌｕｅｔｏｏｔｈインタフェース、ＺｉｇＢｅｅインタフェース、ＧＳＭインタフェース、及びＵＭＴＳインタフェースのうちの少なくとも１つを含む音響通信のためのシステム。

【請求項１２】

請求項１に記載の音響通信のためのシステムにおいて、

眼鏡フレームが、電力を供給するように構成された光電池を含む音響通信のためのシステム。

【請求項１３】

請求項１に記載の音響通信のためのシステムにおいて、

該制御モジュールは、該第１の方向依存のマイクロホン及び該複数の方向依存のマイクロホンのうちの少なくとも１つの第２の方向依存のマイクロホンによってキャプチャされた該１つ又は複数の音声信号に基づき、少なくとも１つの該第１の方向依存のマイクロホンの位置を調整する音響通信のためのシステム。

【請求項１４】

音響通信のための方法であって、

１つ又は複数の音声信号を複数の方向依存のマイクロホンによってキャプチャするステップと、

キャプチャされた該１つ又は複数の音声信号を含むデータを、１つ又は複数の外部デバ

イスに伝送するステップと、
該複数の方向依存のマイクロホンのうちの少なくとも１つの第２の方向依存のマイクロホンによってキャプチャされた該１つ又は複数の音声信号に基づき、制御モジュールを使用して、該複数の方向依存のマイクロホンのうちの少なくとも１つの第１の方向依存のマイクロホンの方向依存性を調整するステップとを含み、
該第２の方向依存のマイクロホンは身体的振動音響信号をキャプチャすることができる位置に配置される、音響通信のための方法。
【請求項１５】
請求項１４に記載の音響通信のための方法において、
該第２の方向依存のマイクロホンは、接触マイクロホンである音響通信のための方法。
【請求項１６】
請求項１４に記載の音響通信のための方法において、
該第１の方向依存のマイクロホンによってキャプチャされた該１つ又は複数の音声信号を、第３の方向依存のマイクロホンによってキャプチャされた該１つ又は複数の音声信号に基づいて濾波するステップを含む音響通信のための方法。
【請求項１７】
請求項１４に記載の音響通信のための方法において、
第３の方向依存のマイクロホンによってキャプチャされた該１つ又は複数の音声信号を使用して増幅器を制御するステップを含む音響通信のための方法。
【請求項１８】
請求項１４に記載の音響通信のための方法において、
該少なくとも１つの方向依存のマイクロホンは、マイクロホン・アレイである音響通信のための方法。
【請求項１９】
請求項１８に記載の音響通信のための方法において、
該少なくとも１つのマイクロホン・アレイは、ＭＥＭＳ技術によって実装される音響通信のための方法。
【請求項２０】
請求項１４に記載の音響通信のための方法において、
該キャプチャされた１つ又は複数の音声信号を、移動無線デバイスに伝送するステップを含む音響通信のための方法。
【請求項２１】
請求項１４に記載の音響通信のための方法において、
網膜走査ディスプレイを使用して網膜上にイメージ・データを投射するステップを含む音響通信のための方法。
【請求項２２】
請求項２１に記載の音響通信のための方法において、
ユーザの視線方向を、モジュールを使用してキャプチャするステップを含む音響通信のための方法。
【請求項２３】
請求項１４に記載の音響通信のための方法において、
口頭のコマンドを、音声認識モジュールを使用してキャプチャするステップを含む音響通信のための方法。
【請求項２４】
請求項１４に記載の音響通信のための方法において、
該１つ又は複数のキャプチャされた信号を、Ｂｌｕｅｔｏｏｔｈインタフェース、ＺｉｇＢｅｅインタフェース、ＧＳＭインタフェース、及びＵＭＴＳインタフェースのうちの少なくとも１つを介して該１つ又は複数の外部デバイスに伝送するステップを含む音響通信のための方法。
【請求項２５】

請求項１４に記載の音響通信のための方法において、
光電池を介して電源を提供するステップを含む音響通信のための方法。
【請求項２６】
音響通信のためのシステムにおいて、
１つ又は複数の音声信号をキャプチャするための複数の記録手段を含む眼鏡フレームと、
１つ又は複数の外部電子デバイスにキャプチャされた該１つ又は複数の音声信号を含むデータを伝送するための通信手段と、
該複数の記録手段のうちの少なくとも１つの第２の記録手段によってキャプチャされた該１つ又は複数の音声信号に基づき、該複数の記録手段のうちの少なくとも１つの第１の記録手段の方向依存性を調整するための制御手段と、
身体的振動音響信号をキャプチャするために該第２の記録手段を保持する耳係合手段とを備える音響通信のためのシステム。
【請求項２７】
音響通信のためのシステムであって、
１つ又は複数の音声信号をキャプチャするための複数の方向依存のマイクロホンと、
１つ又は複数の外部電子デバイスにキャプチャされた該１つ又は複数のキャプチャされた音声信号を含むデータを伝送するように構成された送信機と、
該複数の方向依存のマイクロホンのうちの少なくとも１つの第２の方向依存のマイクロホンによってキャプチャされた該１つ又は複数の音声信号に基づき、該複数の方向依存のマイクロホンのうちの少なくとも１つの第１の方向依存のマイクロホンの方向依存性を調整するための制御モジュールとを備え、
該第２の方向依存のマイクロホンは身体的振動音響信号をキャプチャすることができる位置に配置される、音響通信のためのシステム。
【請求項２８】
請求項２７に記載の音響通信のためのシステムにおいて、
該第２の方向依存のマイクロホンは、接触マイクロホンである音響通信のためのシステム。
【請求項２９】
請求項２７に記載の音響通信のためのシステムにおいて、
該第１の方向依存のマイクロホンによってキャプチャされた該１つ又は複数の音声信号は、第３の方向依存のマイクロホンによってキャプチャされた該１つ又は複数の音声信号に基づき該制御モジュールによって濾波されることが可能である音響通信のためのシステム。
【請求項３０】
請求項２７に記載の音響通信のためのシステムにおいて、
第３の方向依存のマイクロホンによってキャプチャされた１つ又は複数の音声信号を使用して制御可能な増幅器を備えた音響通信のためのシステム。
【請求項３１】
請求項２７に記載の音響通信のためのシステムにおいて、
少なくとも１つの方向依存のマイクロホンは、マイクロホン・アレイである音響通信のためのシステム。
【請求項３２】
請求項３１に記載の音響通信のためのシステムにおいて、
少なくとも１つのマイクロホン・アレイは、ＭＥＭＳ技術で実施される音響通信のためのシステム。
【請求項３３】
請求項２７に記載の音響通信のためのシステムにおいて、
該１つ又は複数の外部デバイスは、移動無線デバイスを含む音響通信のためのシステム。

【請求項３４】
請求項２７に記載の音響通信のためのシステムにおいて、
少なくとも１つの方向依存のマイクロホンを使用して複数の口頭のコマンドをキャプチャするように構成された音声認識モジュールを含む音響通信のためのシステム。
【請求項３５】
請求項２７に記載の音響通信のためのシステムにおいて、
Ｂｌｕｅｔｏｏｔｈインタフェース、ＺｉｇＢｅｅインタフェース、ＧＳＭインタフェース、及びＵＭＴＳインタフェースのうちの少なくとも１つを含む音響通信のためのシステム。
【発明の詳細な説明】
【技術分野】
【０００１】
本発明は、眼鏡フレームが、ユーザの音声信号をキャプチャするための少なくとも１つの方向依存のマイクロホン、ならびに外部電子デバイスに信号送信するための通信手段を含む、音響通信のための方法及びシステムに関する。詳細には、本発明は、少なくとも１つのマイクロホンの方向依存性が、動的な形でユーザ固有に調整可能である通信システムに関する。
【背景技術】
【０００２】
移動通信端末装置は、今日、ますます重要な役割を果たしている。より新型の移動通信端末装置は、近頃は、単純な音声通信又はデータ通信に応えるだけでなく、複雑なマルチメディア・デバイスにますます変容しており、そのデバイスを使用して、オーディオ・ブロードキャスト又はビデオ・ブロードキャストが受信されることが可能である、例えば、ゲームが行われることが可能である、又はインターネットもしくは移動無線ネットワークなどのネットワーク内で、情報にアクセスが行われることが可能である。それらの複雑な移動通信端末装置の制御、特に、利用可能なデータ及び／又はデータ・セット、あるいは動作モードの選択、ならびにデータの入力及び／又はコマンドの入力には、しばしば、キーボード、スタイラス、トラックボール、タッチスクリーン、その他などの、高価で、扱いにくい補助デバイスの使用が関わることになり、しばしば、そのようなデバイスの使用を必然的に伴うことになる。これに関連して、それぞれの事例において、移動通信デバイスを自分の手に持つことも不可欠であり、最新の通信端末装置のハンズフリーの便利な使用が、極度に制限される。
【０００３】
音声認識に基づく問題解決法が、技術の現状において既に知られている。音声認識又は自動音声認識は、口頭の言語を認識する、又は口頭の言語を文字列に変換すること、及び処理することをそれぞれ行うコンピュータなどの、マシンを可能にする方法の研究及び開発を扱う。その一方で、音声認識は、例えば、例として、時刻表問い合わせなどの、自動ダイアログ・システムにも技術的応用を見出している。自動音声認識は、限られたボキャブラリだけが使用されている場所ではどこでも実施されている。しかし、自動化された音声認識では、音響受信の品質が、決定的な役割を果たし、したがって、受信品質が可能な限り向上させられて、認識の大幅により高い精度が実現されることが可能であるようになることが不可欠である。
【０００４】
刊行物、国際公開第０３／０６２９０６号及び国際公開第０２／０８６５９９号が、例えば、マイクロホン及び小型スピーカが眼鏡フレーム上に配置されたデバイスを説明している。次いで、眼鏡フレームは、ケーブル接続を介して外部電子デバイスに接続される。しかし、この提案されるデバイスの抱える問題は、ユーザ固有のサウンド及びオーディオの記録のために許容できる雑音除去を実現すること、特に、ユーザの口頭のコマンドを、近辺に位置する他の人々の音声と区別することの困難である。
【０００５】

刊行物、欧州特許第０　２１９　０２６　Ｂ１号において説明されているのが、補聴器をどのように眼鏡フレームに組み込むことができるかである。眼鏡フレーム上のいくつかのマイクロホンの、特定の空間的分布を介して、聴覚障害者が、音響イベントと関連して空間的向きを得ることができるようにするはずである、方向効果及び位置特定効果が実現されることが可能である。すべての音響コンポーネント及び電子コンポーネントが、眼鏡に収容される。外部電子デバイスに対する送信接続及び／又は受信接続は、提供されない。

【０００６】

米国特許出願公開第２００２／０１９７９６１　Ａ１号において開示されているのが、マイクロホン、小型スピーカ、電源供給装置（アキュムレータ）、及び移動無線デバイス、又は他の外部電子デバイスに信号を送信するための送信機又は相当する受信機が実装された、眼鏡フレームである。代替として、前記コンポーネントは、眼鏡フレームに取り付けられ、再び取り外されることが可能な、又は帽子、もしくは頭部に着用されることが可能な類似の物品上の、クリップの中に収容されることも可能である。また、マイクロホンは、調整可能なアーム上に取り付けられることも可能である。大きい、一定でないスタティック・ノイズを有する環境における前述した構成の使用では、それでもやはり、所望される信号が、十分なレベルでマイクロホンに印加されることは保証されない。

国際出願ＷＯ２００４／０１６０３７号が、音声の分かりやすさを向上させるための方法、及び対応するデバイスを説明している。この出願には、マイクロホン・アレイと、スピーカと、信号処理デバイスとを含む眼鏡フレームが関わる。この信号処理デバイスは、マイクロホン・アレイの信号を受け取り、干渉する背景信号の量を減らし、このように処理された信号をスピーカ又は外部電子デバイスに伝送する。また、眼鏡フレームは、マイクロホンの方向を調節して、より良好な信号品質が実現されることが可能であるようにすることができるマイクロホン・コントロールも含む。様々な方法及びアルゴリズム、特に、いわゆるＡＮＣ（アクティブ雑音制御）技術が、信号処理のために使用されることが可能である。それでも、説明されているビーム形式方法は、周囲雑音及び周囲干渉をすべての状況において効率的な形で除去するのに適していない。

【先行技術文献】

【特許文献】

【０００７】

【特許文献１】国際公開第０３／０６２９０６号

【特許文献２】国際公開第０２／０８６５９９号

【特許文献３】欧州特許第０　２１９　０２６　Ｂ１号

【特許文献４】米国特許出願公開第２００２／０１９７９６１　Ａ１号

【特許文献５】国際出願ＷＯ２００４／０１６０３７号

【発明の概要】

【発明が解決しようとする課題】

【０００８】

本発明の目的は、技術の現状の前述した諸問題を有さない音響通信のための新たなシステム、及び新たな方法を提案することである。特に、システムは、移動無線デバイスの便利な、ハンズフリーの使用を可能にするとともに、雑音のある環境においてＩＶＲシステム（対話型音声応答）に関連して、口頭のコマンドの信頼できる便利な入力、及び対話型音声制御を可能にしなければならない。

【課題を解決するための手段】

【０００９】

以上の諸目的は、特に、独立請求項の要素を介して、本発明に従って実現される。それに加えて、さらに有利な諸実施形態が、従属請求項及び本明細書からもたらされる。

特に、以上の諸目的は、眼鏡フレームが、ユーザの音声信号をキャプチャするための少なくとも１つの方向依存のマイクロホンと、外部電子デバイスに信号を送信するための通信手段とを含み、少なくとも１つのマイクロホンの方向依存性は、制御モジュールによっ

て動的な形でユーザ固有に調整可能であり、制御モジュールは、少なくとも１つの第２の方向依存のマイクロホンによってキャプチャされた音声信号に基づき、少なくとも１つの第１の方向依存のマイクロホンの方向依存性の、適応的なユーザ固有の調整を行うための手段を含むという点で、本発明を介して実現される。この実施形態変種の利点は、とりわけ、効果的な雑音除去であり、そのため、各個人ユーザに関して、キャプチャされる音声信号の大幅により高い品質が可能であることである。これは、特に、ユーザの口頭のコマンドの認識のために、必要な前提条件である可能性がある。さらなる利点は、口頭の命令のハンズフリーの入力、ならびに入力デバイスが、眼鏡フレームに組み込まれるために、ほとんど目立たないことである。

【００１０】

さらに、この実施形態変種は、とりわけ、方向依存のマイクロホンの方向依存性の調整が、他のマイクロホンによってキャプチャされる信号の関数として実行されることが可能であるという利点を有する。そのため、さらに良好なユーザ固有の適合が実現されることが可能であり、高いレベルの干渉雑音を有する環境において、本発明によるシステム及び方法の応用に関して、より高い音声品質、及びより良好な前提条件がもたらされる。

【００１１】

さらなる実施形態変種において、少なくとも１つの第２の方向依存のマイクロホンは、接触マイクロホンである。この実施形態変種は、とりわけ、話すユーザによって送られる音声信号が、空気中における伝播後だけでなく、ユーザの身体における伝播後にもキャプチャされることが可能であるという利点を有する。これにより、対応する取り扱い及び処理の後、雑音の除去のさらなる改良が、実現されることが可能である。詳細には、接触マイクロホンを使用して、ユーザが、ちょうど今、話しているか否かが、非常に容易に判定されることが可能であり、近辺で話しているさらなるユーザとの可能な混乱が、実質的に解消されることが可能である。さらに、接触マイクロホンによってキャプチャされる信号は、他の方向依存のマイクロホンの方向依存性の、適応的なユーザ固有の調整を行うための制御モジュールによって使用されるのに、非常によく適している。

【００１２】

さらに別の実施形態変種では、第１の方向依存のマイクロホンによってキャプチャされる信号は、第３のマイクロホンによってキャプチャされる信号を使用して濾波される。この実施形態変種は、とりわけ、別のマイクロホンによってキャプチャされる周囲雑音が、第１の方向依存のマイクロホンによってキャプチャされる信号の濾波及び信号品質向上のために使用されることが可能であるという利点を有する。そのため、方向依存のマイクロホンの肯定的な諸特徴が、濾波を介する雑音除去の肯定的な諸特徴と最適な形で組み合わせられて、さらに良好な音声品質がもたらされる。

【００１３】

さらなる実施形態変種では、少なくとも１つの方向依存のマイクロホンは、マイクロホン・アレイとして実施される。少なくとも１つのマイクロホン・アレイは、有利には、例えば、ＭＥＭＳ技術で実施されることが可能である。その結果、この実施形態変種は、とりわけ、特別に効果的で、強力な方向効果が実現されることが可能であるという利点を有する。また、マイクロホン・グループの使用を介して、音波の多くの空間的特徴も利用されることが可能であり、それらの特徴は、単一のマイクロホンでは、利用されることが可能でない。この実施形態変種のさらなる利点は、はるかに低い製造費用、及び高い一体化の割合であり、これにより、特に小さく、コンパクトな構成が、実現されることが可能である。

【００１４】

別の実施形態変種では、外部デバイスは、移動無線デバイスを含む。その結果、移動無線デバイスは、例えば、眼鏡フレームに組み込まれることも、自己完結型のデバイスとして存在することも可能である。この実施形態変種は、とりわけ、本発明によるシステム、及び本発明による方法が、移動無線ネットワークを介する音声通信のために使用されることが可能であるという利点を有する。このため、その眼鏡の着用者は、眼鏡フレームを介

して、移動無線ネットワークに接続された１つ又は複数のサーバと通信すること、又は音響命令を入力することもできる。したがって、眼鏡の着用者は、補足のハンズフリー・デバイスを全く使用する必要がなく、そのため、大幅により低い費用で、より便利に通信することができる。

【００１５】

別の実施形態変種では、眼鏡フレームは、網膜走査ディスプレイのための手段を含む。網膜走査ディスプレイは、光線が、目の網膜上に直接に投射されるディスプレイ・デバイスである。光線の対応する光変調、及び迅速な分解を介して、ピクチャ全体が示されることが可能である。眼鏡フレームは、視線方向をキャプチャするためのさらなる手段を含むことが可能である。その結果、この実施形態変種は、とりわけ、ユーザが、外部出力デバイスに依存することなしに、情報を直接に見ること、及び情報を直接に聞くことを可能にする、複雑なシステムが構成されることが可能であるという利点を有する。同時に、視線キャプチャにより、データ入力のさらなる可能性が、システムに組み込まれることが可能である。

【００１６】

さらなる実施形態変種では、システムは、少なくとも１つの方向依存のマイクロホンを使用して口頭のコマンドをキャプチャするための音声認識モジュールを含む。この実施形態変種は、データが、口頭のコマンドを使用して、ユーザによって単純な形で制御され、かつ／又は選択されることが可能であるという利点を有する。さらなる利点は、すべてのデバイスが、同一のフレーム内で一体化されるため、より低い電力消費である。

【００１７】

さらなる実施形態変種では、通信システムは、Ｂｌｕｅｔｏｏｔｈ（登録商標）インタフェース及び／又はＺｉｇＢｅｅ（登録商標）インタフェース及び／又はＧＳＭ（登録商標）インタフェース及び／又はＵＭＴＳインタフェース及び／又はＷＬＡＮインタフェースを含む。以上のインタフェースは、例えば、通信端末装置、及び／又は眼鏡フレームの通信手段の中に組み込まれることが可能である。これは、とりわけ、現在の業界標準に、通信システムを使用してアクセスが行われることが可能であるという利点を有する。

【００１８】

ここで、本発明によるシステムに加えて、本発明は、音響通信のための方法にも関することを述べておかなければならない。

本発明の実施形態変種を、実施例に関連して以下に説明する。諸実施形態の実施例は、以下の添付された図によって示される。

【図面の簡単な説明】

【００１９】

【図１】本発明による音響通信のためのシステム及び方法を概略で示すブロック図である。

【図２】図１による本発明のシステム及び方法を実行するために使用されることが可能な眼鏡フレームの側面図である。

【図３】音響通信のための本発明によるシステム及び方法の別の実施形態を概略で示すブロック図である。

【図４】図１による音響通信のための本発明のシステムの構造を概略で示すブロック図である。

【図５】図３による音響通信のための本発明のシステムの別の実施形態の構造を概略で示すブロック図である。

【図６】本発明によるシステム及び方法を実施するために使用されることが可能な、着用されている眼鏡フレームのおおよその通常の位置が示されている、人間の頭蓋の骨を示す分解図である。

【発明を実施するための最良の形態】

【００２０】

図１で、符号１０は、眼鏡フレームを指し、例えば、近視の、又は遠視の個人によって

着用される、矯正レンズを有する眼鏡フレーム、又は日よけレンズを有するサングラスのためのフレームを指す。眼鏡フレーム１０は、ユーザ２０の口から出る音波２１がキャプチャされることが可能な位置において、少なくとも１つの方向依存の音響センサ１６を含む。センサ１６の方向依存性を介して、伝播の直線上の、ユーザ２０の口から出る音波２２が、特によくキャプチャされることが可能である。方向依存の音響センサ１６は、例えば、単純なマイクロホンであることが可能であるが、マイクロホンのグループとして、つまり、いわゆるマイクロホン・アレイとして実施されることも可能である。マイクロホン・アレイの使用を介して、音場の空間的特徴が、利用されることが可能であり、キャプチャされる信号の品質、又は、それぞれ、分かりやすさが、その結果、相当に向上させられることが可能である。複数のそのようなマイクロホン又はマイクロホン・アレイ１６が、同様に、眼鏡フレーム１０上に、例えば、眼鏡フレーム１０の両側上に対称的に実装されることも可能である。

【００２１】

やはり、図１又は図２に示されるとおり、眼鏡フレーム１０は、１つ又は複数の方向依存の音響センサ１５をさらに含むことが可能である。さらなる方向依存の音響センサ１５が、その方向依存の音響センサ１５によって、ユーザの身体的振動音響信号が、よくキャプチャされることが可能な位置に実装される。身体的振動音響信号は、音波が、ユーザの喉頭において、話す際に生じさせられ、その音波が、次いで、ユーザの身体によって伝播させられるという点で生じる。身体的振動音響信号を受信し、キャプチャするために特に好適な位置は、図６に示されるとおり、人間の頭蓋６０の両側部上に位置する側頭骨６６である。眼鏡フレーム１０のアームが、普通、側頭骨に接して着用され、そのことが、キャプチャされる身体的振動音波の、より高い品質に寄与することが可能である。方向依存の音響センサ１５は、同様に、単純なマイクロホンとして実施されることも、又はマイクロホンのグループとして、つまり、いわゆるマイクロホン・アレイとして実施されることも可能である。

【００２２】

図１及び図２で、符号１３は、１つ又は複数のさらなる方向依存の音響センサ１３を指す。１つ又は複数のさらなる方向依存の音響センサ１３は、ユーザの環境から来る周囲サウンドが、特によくキャプチャされることが可能な、眼鏡フレーム１０上の位置に実装される。方向依存の音響センサ１３は、同様に、単純なマイクロホンとして実施されることも、又はキャプチャされる信号のより良好な品質のために、マイクロホン・アレイとして実施されることも可能であり、周囲サウンドに対して揃えられた複数の方向依存のマイクロホン又は方向依存のマイクロホン・アレイ１３も、眼鏡フレーム１０上に実装されることが可能である。

【００２３】

マイクロホン、又は、それぞれ、マイクロホン・アレイ１３、１５、１６は、特に、いわゆるＭＥＭＳ技術（ＭｉｃｒｏＥｌｅｃｔｒｏＭｅｃｈａｎｉｃａｌ　Ｓｙｓｔｅｍｓ）で実施されることが可能である。ＭＥＭＳによって理解されるのは、ある論理と、少なくとも一部の可動部品とを有する極小チップである。したがって、ＭＥＭＳは、通例、データを収集することができるとともに、それらのデータからもたらされるタスクを実行することもできる、機械的部品を有するプロセッサである。このため、さらに良好なサウンド品質を、同時に小さい全体的サイズで実現することができる、ＭＥＭＳ技術の使用を介して製造されることが可能な、非常に小さいマイクロホン又はマイクロホン・アレイであり、それらのマイクロホン又はマイクロホン・アレイが、眼鏡フレーム１０内に実装するのに、特によく適するようになる。

【００２４】

図１で、符号１１は、制御モジュールを指す。制御モジュールは、方向依存の音響センサ１３、１５、１６から信号を獲得し、評価することができる。また、制御モジュール１１は、方向依存の音響センサ１３、１５、１６と通信して、センサ１３、１５、１６を制御することもできる。特に、ＭＥＭＳ技術の使用を介して、方向依存の音響センサ１３、

１５、１６は、特に単純な形で、あまり労力をかけずに制御されることが可能である。その結果、方向依存の音響センサ１３、１５、１６の位置、感度、及び／又は方向依存性に影響が与えられることが可能である。例えば、ある方向依存の音響センサ１３、１５、１６によってキャプチャされた音声信号に基づき、制御モジュール１１は、別の方向依存の音響センサ１３、１５、１６を制御することができる。信号処理、信号増幅、及びその他の信号取り扱いに必要とされるすべてのコンポーネントが、例えば、増幅器４６、４８、５１、調整要素４３、制御回路４４、５４、又は遅延要素４７が、眼鏡フレーム１０内に、特に、制御モジュール１１内に収容されることが可能である。

【００２５】

本発明による問題解決法の実施形態変種では、例えば、身体的振動音波が、話しているユーザの喉頭内で生じさせられ、身体によって伝播させられる。また、それらの身体的振動音波、又は、それぞれ、音声信号は、頭蓋骨及び側頭骨にも伝播させられ、頭蓋骨及び側頭骨において、音声信号は、方向依存の音響センサ１５によってキャプチャされる。キャプチャされた音声信号は、制御モジュール１１によって解釈され、評価されて、方向依存の音響センサ１６が、その評価に基づき、ユーザ固有に調整される。特に、制御モジュール１１は、ＭＥＭＳ技術で実施された方向依存の音響センサ１６の位置を変更して、それらのセンサ１６が、ユーザの顔つきをよりよく考慮に入れるようにすることができる。制御モジュール１１は、同様に、方向依存の音響センサ１６の感度をユーザ固有の形で変更して、それらのセンサ１６が、側頭骨上に身体的振動音波が当たっている間に、ユーザ２０の口から出る音声信号に特に高い感度で反応するようにすることもできる。

【００２６】

本発明による問題解決法の別の実施形態変種では、話しているユーザからの身体的振動音波が、方向依存の音響センサ１３によってキャプチャされるだけでなく、環境から来る周囲サウンドもキャプチャされる。第１の方向依存の音響センサ１５によってキャプチャされた身体的振動音波と、第２の方向依存の音響センサ１３によってキャプチャされた周囲雑音信号とが、制御モジュール１１によって解釈され、評価されて、方向依存の音響センサ１６が、その評価に基づき、ユーザ固有に調整される。特に、一定のままである周囲サウンドでは、方向依存の音響センサ１６の方向依存性の適応的な、つまり動的なユーザ固有調整が、必要になることが生じる可能性がある。すなわち、ユーザは、内々の性質を有し、近辺に位置する人々によって気付かれるべきでない話題を切り出したために、突然、より穏やかに話す可能性がある。このため、適応型のユーザ固有の調整によって理解されるのは、マイクロホンの方向依存性が、例えば、ＭＥＭＳマイクロホンを使用して、最適な値に動的な形で適合させられる動的調整である。

【００２７】

特に、眼鏡フレーム１０は、物理的ネットワーク・インタフェース１２も備え、インタフェース１２を使用して、口頭の情報及び／又はデータの形態の情報が、通信チャネル１７を介して、眼鏡フレーム１０と移動通信端末装置３０の間で交換されることが可能である。ネットワーク・インタフェース１２は、複数の異なるネットワーク標準、例えば、Ｂｌｕｅｔｏｏｔｈ又はＺｉｇＢｅｅという名前で知られているローカル無線ネットワーク標準だけでなく、ＧＳＭ（Ｇｌｏｂａｌ Ｓｙｓｔｅｍ ｆｏｒ Ｍｏｂｉｌｅ Ｃｏｍｍｕｎｉｃａｔｉｏｎ）、ＧＰＲＳ（Ｇｅｎｅｒａｌｉｚｅｄ Ｐａｃｋｅｔ Ｒａｄｉｏ Ｓｅｒｖｉｃｅ）、ＵＭＴＳ（Ｕｎｉｖｅｒｓａｌ Ｍｏｂｉｌｅ Ｔｅｌｅｃｏｍｍｕｎｉｃａｔｉｏｎｓ Ｓｙｓｔｅｍ）、ＷＬＡＮ（無線ローカル・エリア・ネットワーク）８０２．１１、赤外線通信技術、又は他の任意の非接触通信技術もサポートすることができる。しかし、原則として、ネットワーク・インタフェース１２は、任意の接触インタフェースであること、例えば、ＵＳＢインタフェース又はＦｉｒｅｗｉｒｅ（登録商標）インタフェース、あるいはイーサネット（登録商標）、トークンリング、又は他の任意の有線ＬＡＮ（ローカル・エリア・ネットワーク）に対するインタフェースであることも可能である。インタフェースは、もちろん、例えば、イーサネット又はトークンリングなどのネットワーク・プロトコルを直接に使用するので、パケット交換インタフェースだ

けでなく、例えば、ＰＰＰ（ポイントツーポイント・プロトコル）、ＳＬＩＰ（シリアル・ライン・インターネット・プロトコル）又はＧＰＲＳ（Ｇｅｎｅｒａｌｉｚｅｄ　Ｐａｃｋｅｔ　Ｒａｄｉｏ　Ｓｅｒｖｉｃｅ）などのプロトコルによって使用されることが可能な、回線交換インタフェース、すなわち、例えば、ＭＡＣアドレス又はＤＬＣアドレスなどのネットワーク・アドレスを全く有さないインタフェースも「含む」ことが可能である。原則として、本発明によるシステム及び／又は方法は、本発明による諸特徴が存在する限り、特定のネットワーク標準に限定されず、代わりに、１つ又は複数の所望されるネットワークで実現されることが可能であり、特に、異なる通信技術の間でトランスペアレントに切り替えられる、又はルーティングされる音声伝送及び／又はデータ伝送によっても実現されることが可能であることが、強調されなければならない。それに加えて、さらなる要求されるコンポーネント、例えば、スピーカ及び電源供給装置が、眼鏡フレーム１０内に収容されることも可能である。

【００２８】

図１の符号３０は、移動通信端末装置、又は任意の所望される、いわゆる顧客宅内機器（ＣＰＥ）を指す。移動通信端末装置３０は、任意の移動無線ネットワークの任意の移動無線デバイスであることが可能であり、移動無線デバイスは、例えば、ＧＳＭ移動無線ネットワークのＧＳＭデバイス、又はＵＭＴＳネットワークのＵＭＴＳデバイス、又はサテライト・ネットワークのサテライト・デバイスであることが可能である。しかし、移動通信端末装置３０は、原則として、標準のパーソナル・コンピュータ（ＰＣ）、ポータブルＰＣ、固定ネット電話機、移動無線デバイスのための充電デバイス、プレイステーション、あるいは電子的にネットワーク化されたコンポーネントを有する他の任意のデバイスであることも可能である。移動通信端末装置３０は、例えば、データ要素を入力するための入力ユニット３２を含む。移動通信端末装置３０は、例えば、数字キー及びコントロール・キーから成る、移動無線電話機のタイプに応じた、標準のキーボード、又は類似の入力デバイスを有することが可能であり、数字キーは、例えば、文字の入力に切り替えられることが可能である。例えば、遠隔通信における料金の登録のケースにおいて、許可及び認証の目的で、移動通信端末装置３０は、通例、取り外し可能な識別モジュール、例えば、ＳＩＭ（加入者ＩＤモジュール）カード３４を含み、カード３４は、この図では、端末装置３０の下に示され、動作の際、移動通信端末装置内部の接触子と接触する。移動通信端末装置３０は、データ要素を表示するためのディスプレイ・デバイス３１をさらに含むことが可能である。アンテナ３５が、遠隔通信ネットワークを介するデータの伝送のために、知られている形で役割を果たし、ネットワークは、通例、移動無線ネットワーク、例えば、ＧＳＭ（Ｇｌｏｂａｌ　Ｓｙｓｔｅｍ　ｆｏｒ　Ｍｏｂｉｌｅ　Ｃｏｍｍｕｎｉｃａｔｉｏｎ）ネットワーク、ＵＭＴＳ（Ｕｎｉｖｅｒｓａｌ　Ｍｏｂｉｌｅ　Ｔｅｌｅｃｏｍｍｕｎｉｃａｔｉｏｎ　Ｓｙｓｔｅｍ）ネットワーク、又はＷＬＡＮ（無線ローカル・エリア・ネットワーク）ネットワークである。移動通信端末装置３０に実装されているのが、非接触インタフェース３３であり、例えば、そのインタフェース３３を介して、眼鏡フレーム１０の非接触インタフェース１２からのデータ及びコマンドが、送受信されることが可能である。

【００２９】

本発明によるシステム、及び本発明による方法の実施形態変種の構造が、図４に示されている。第１の方向依存の音響センサ１６によって受信されるのが、とりわけ、ユーザ２２の口の領域からの音声信号であるのに対して、第２の方向依存の音響センサ１３は、とりわけ、近辺から来る周囲サウンドに向けられる。第３の方向依存の音響センサ１５が、とりわけ、ユーザの身体的振動サウンドからの音声信号をキャプチャすることができるようにセットアップされ、位置付けられる。第１の方向依存の音響センサ１６、及び第２の方向依存の音響センサ１３によってキャプチャされる音声信号は、信号調整モジュール４３及び制御回路４４によって、差動増幅器４６の出力において最小周囲雑音に調整される。第３の方向依存の音響センサ１５によってキャプチャされる音声信号は、「身体的振動サウンドがない」ケースにおいて、第１の方向依存の音響センサ１６によってキャプチャ

される音声信号の増幅が、あまりにも増幅され過ぎないように、増幅器コントローラ４８によって使用される。しかし、「身体的振動サウンドが存在する」ケースでは、増幅器は、第１の方向依存の音響センサ１６によってキャプチャされた音声信号が、第２の方向依存の音響センサ１３によってキャプチャされた音声信号に対して増幅されるように設定される。実行時間に起因して歪みが全く生じないように、信号遅延モジュール４７が、備えられることが可能である。

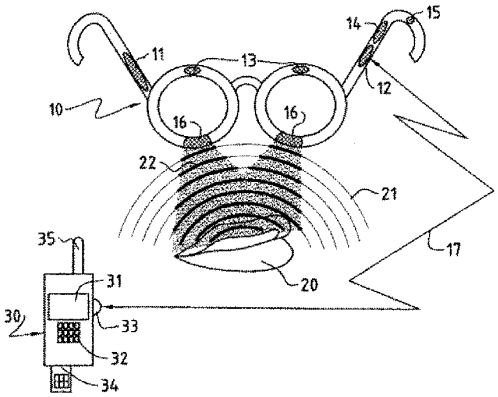
【００３０】

図３に示されているのが、本発明によるシステム、及び本発明による方法の別の実施形態変種である。符号１０は、この場合も、１つ又は複数の方向依存の音響センサ１５を含む眼鏡フレームに関し、センサ１５は、ユーザの身体的振動音響信号が、その方向依存の音響センサ１５によってよくキャプチャされることが可能な位置に実装される。方向依存の音響センサ１５は、同様に、単純なマイクロホンとして、又はマイクロホンのグループ、つまり、いわゆるマイクロホン・アレイとして、かつ／又はＭＥＭＳ技術で実施されることが可能である。少なくとも１つの方向依存の音響センサ１５、５０によってキャプチャされた音声信号は、制御モジュール１１に伝送される。図５に示されるとおり、方向依存の音響センサ１５によってキャプチャされた音声信号は、制御モジュール１１内の増幅器５１によって増幅され、信号処理モジュール５２によって、レベル及び周波数に関して処理され、その後、基準－制御回路５４によって処理されて、キャプチャされたマイクロホン信号が、特性において、通常のマイクロホンによってキャプチャされる音声信号に対応するようにされる。次いで、音声信号は、移動通信端末装置３０のオーディオ・パス５３に追加される。基準－制御回路５４に関する基準が、各ユーザに関して、移動通信端末装置３０の中に、例えば、デバイスのマイクロホンによって記録される。信号処理モジュール５２、ならびに基準－制御回路５４はともに、眼鏡フレーム１０内にも、移動通信端末装置内にも配置されることが可能である。

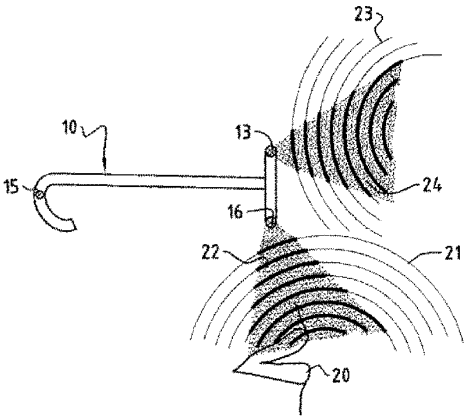
【００３１】

電子システムに給電するための、電源供給装置１４に対するエネルギー源は、特に、光電池（図示せず）を介して実施されることが可能であり、この光電池は、眼鏡レンズ上に真空蒸着させられる。さらに、エネルギー源は、眼鏡フレーム１０に組み込まれた、又はフレーム１０に接続された一般的なバッテリを使用して実施されることも可能である。

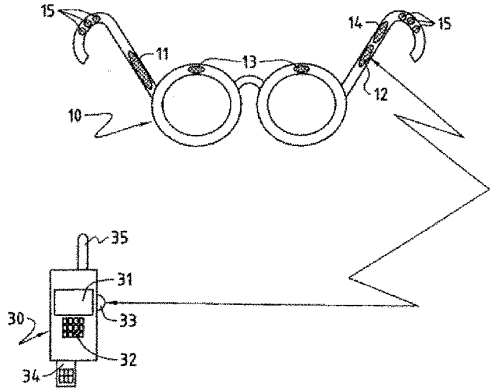
【図１】



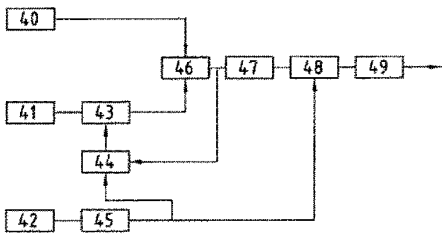
【図２】



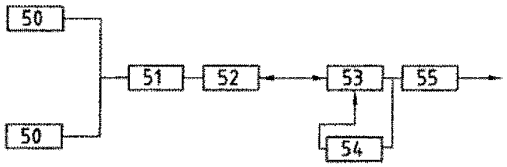
【図３】



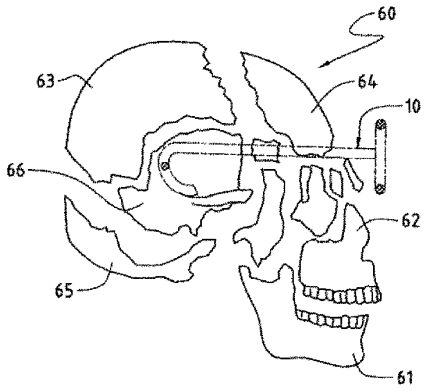
【図４】



【図５】



【図６】



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特開２０００－１６５９８３（ＪＰ，Ａ）
特開平１－１９５４９９（ＪＰ，Ａ）

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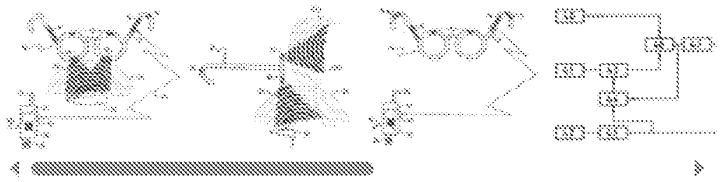
Patents JP6275987B2

Eyeglass frame with integrated acoustic communication system for communicating with a mobile wireless device and corresponding method

Abstract

A system and method for acoustical communication, in which an eyeglass frame includes at least one directionally dependent microphone for capturing voice signals of a user and a communication device for signal transmission to external electronic devices, so that the directional dependence of the at least one microphone is user-specifically adjustable in an adaptive way. The directionally dependent microphones can be implemented as microphone arrays and/or in MEMS technology, and contact microphones can be used.

Images (6)



Classifications

- H04M1/725 Cordless telephones

View 10 more classifications

JP6275987B2

Japan

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Other languages: Japanese

Inventor: リッター, ルドルフ, クリスター, エリック

Current Assignee : Swisscom AG

Worldwide applications

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2025-03-29 Anticipated expiration

Info: Patent citations (26), Cited by (30), Legal events, Similar documents, Priority and Related Applications

External links: Espacenet, Global Dossier, Discuss

Claims (35)

Hide Dependent
translated from Japanese

A system for acoustic communication,
A spectacle frame including a plurality of direction-dependent microphones for capturing one or more audio signals;
A transmitter configured to transmit data including the one or more audio signals captured by one or more external electronic devices;
Based on even without least one said 1 captured by one second directionally dependent microphone or audio signals of the plurality of direction-dependent microphones of the plurality of direction-dependent microphones least one A control module for adjusting the direction dependency of the first direction dependent microphone;
The system for acoustic communication, wherein the second direction-dependent microphone is disposed at an ear engaging portion of the spectacle frame to capture a body vibration acoustic signal.
The system for acoustic communication according to claim 1,
The system for acoustic communication, wherein the second direction-dependent microphone is a contact microphone.
The system for acoustic communication according to claim 1,
The one or more audio signals captured by the first direction-dependent microphone are filtered by the control module based on the one or more audio signals captured by a third direction-dependent microphone. A system for acoustic communication that is possible.
The system for acoustic communication according to claim 1,
A system for acoustic communication comprising an amplifier controllable using one or more audio signals captured by a third direction dependent microphone.
The system for acoustic communication according to claim 1,
The system for acoustic communication, wherein the at least one direction dependent microphone is a microphone array.
The system for acoustic communication according to claim 5 ,
At least one microphone array is a system for acoustic communication implemented in MEMS technology.
The system for acoustic communication according to claim 1,
The system for acoustic communication, wherein the one or more external devices include a mobile wireless device.
The system for acoustic communication according to claim 1,
The eyeglass frame is a system for acoustic communication including means for retinal scanning display.
The system for acoustic communication according to claim 8 ,
The system for acoustic communication, wherein the eyeglass frame includes a direction module configured to capture a gaze direction.
The system for acoustic communication according to claim 1,
A system for acoustic communication including a speech recognition module configured to capture verbal commands using at least one direction-dependent microphone.
The system for acoustic communication according to claim 1,
A system for acoustic communication including at least one of a Bluetooth interface, a ZigBee interface, a GSM interface, and a UMTS interface.
The system for acoustic communication according to claim 1,

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A system for acoustic communication wherein a spectacle frame includes a photovoltaic cell configured to provide power.
The system for acoustic communication according to claim 1,
The control module is based on the one or more audio signals captured by the first direction-dependent microphone and at least one second direction-dependent microphone of the plurality of direction-dependent microphones, and at least A system for acoustic communication that adjusts the position of one of the first direction-dependent microphones.
A method for acoustic communication comprising:
Capturing one or more audio signals with a plurality of direction-dependent microphones;
Transmitting the captured data including the one or more audio signals to one or more external devices;
Based on even without least one said 1 captured by one second directionally dependent microphone or audio signals of the plurality of direction-dependent microphones, using a control module, the plurality of direction-dependent Adjusting the direction dependency of a first direction dependent microphone of at least one of the microphones;
A method for acoustic communication, wherein the second direction-dependent microphone is located at a location where a physical vibration acoustic signal can be captured.
The method for acoustic communication according to claim 14 .
The method for acoustic communication, wherein the second direction-dependent microphone is a contact microphone.
The method for acoustic communication according to claim 14 ,
Acoustics including filtering the one or more audio signals captured by the first direction-dependent microphone based on the one or more audio signals captured by a third direction-dependent microphone Method for communication.
The method for acoustic communication according to claim 14 ,
A method for acoustic communication comprising controlling an amplifier using the one or more audio signals captured by a third direction dependent microphone.
The method for acoustic communication according to claim 14 ,
The method for acoustic communication, wherein the at least one direction-dependent microphone is a microphone array.
The method for acoustic communication according to claim 18 ,
The method for acoustic communication, wherein the at least one microphone array is implemented by MEMS technology.
The method for acoustic communication according to claim 14 ,
A method for acoustic communication comprising transmitting the captured one or more audio signals to a mobile wireless device.
The method for acoustic communication according to claim 14 ,
A method for acoustic communication comprising projecting image data onto a retina using a retinal scanning display.
The method for acoustic communication according to claim 21 .
A method for acoustic communication comprising capturing a user's gaze direction using a module.
The method for acoustic communication according to claim 14 ,
A method for acoustic communication comprising the step of capturing verbal commands using a speech recognition module.
The method for acoustic communication according to claim 14 ,
Transmitting the one or more captured signals to the one or more external devices via at least one of a Bluetooth interface, a ZigBee interface, a GSM interface, and a UMTS interface; Way for
The method for acoustic communication according to claim 14 ,
A method for acoustic communication comprising providing a power source via a photovoltaic cell.
In a system for acoustic communication,
A spectacle frame including a plurality of recording means for capturing one or more audio signals;
Communication means for transmitting data comprising the one or more audio signals captured by one or more external electronic devices;
Based on even without least one said 1 captured by one of the second recording means or a plurality of audio signals of the plurality of recording means, the at least one first recording means of the plurality of recording means Control means for adjusting the direction dependence;
A system for acoustic communication comprising ear engagement means for holding the second recording means for capturing a body vibration acoustic signal.
A system for acoustic communication,
A plurality of direction-dependent microphones for capturing one or more audio signals;
A transmitter configured to transmit data including the one or more captured audio signals captured by one or more external electronic devices;
Based on even without least one said 1 captured by one second directionally dependent microphone or audio signals of the plurality of direction-dependent microphones of the plurality of direction-dependent microphones least one A control module for adjusting the direction dependency of the first direction dependent microphone;
A system for acoustic communication, wherein the second direction-dependent microphone is located at a location where a physical vibration acoustic signal can be captured.
28. The system for acoustic communication according to claim 27 .
The system for acoustic communication, wherein the second direction-dependent microphone is a contact microphone.
28. The system for acoustic communication according to claim 27 .
The one or more audio signals captured by the first direction-dependent microphone are filtered by the control module based on the one or more audio signals captured by a third direction-dependent microphone. A system for acoustic communication that is possible.
28. The system for acoustic communication according to claim 27 .
A system for acoustic communication comprising an amplifier controllable using one or more audio signals captured by a third direction dependent microphone.
28. The system for acoustic communication according to claim 27 .
The system for acoustic communication, wherein the at least one direction dependent microphone is a microphone array.
The system for acoustic communication according to claim 31 ,
At least one microphone array is a system for acoustic communication implemented in MEMS technology.
28. The system for acoustic communication according to claim 27 .
The system for acoustic communication, wherein the one or more external devices include a mobile wireless device.
28. The system for acoustic communication according to claim 27 .
A system for acoustic communication including a speech recognition module configured to capture a plurality of verbal commands using at least one direction-dependent microphone.
28. The system for acoustic communication according to claim 27 .
A system for acoustic communication including at least one of a Bluetooth interface, a ZigBee interface, a GSM interface, and a UMTS interface.

Description

translated from Japanese

The present invention relates to a method and system for acoustic communication, in which a spectacle frame includes at least one direction-dependent microphone for capturing a user's audio signal and communication means for transmitting a signal to an external electronic device. In particular, the present invention relates to a communication system in which the direction dependence of at least one microphone can be adjusted in a dynamic manner, in a user-specific manner.

Mobile communication terminal equipment plays an increasingly important role today. Newer mobile communication terminals are not only responding to simple voice or data communications, but are increasingly transforming into complex multimedia devices that can be used for audio broadcast or A video broadcast can be received,

for example, a game can be played, or information can be accessed in a network such as the Internet or a mobile wireless network. The control of these complex mobile communication terminals, in particular the selection of available data and / or data sets, or operating modes, and the entry of data and / or commands, are often keyboards, styluses, tracks This involves the use of expensive and cumbersome auxiliary devices such as balls, touch screens, etc., and often entails the use of such devices. In this connection, in each case, it is also essential to have a mobile communication device in his hand, which limits the hand-free and convenient use of the latest communication terminal devices.

Problem solving methods based on speech recognition are already known in the state of the art. Speech recognition or automatic speech recognition deals with research and development of methods that enable machines, such as computers that recognize verbal languages or convert verbal languages into strings and process them respectively. . On the other hand, voice recognition has also found technical application in automatic dialog systems such as, for example, timetable queries. Automatic speech recognition is performed everywhere where only a limited vocabulary is used. However, in automated speech recognition, the quality of acoustic reception plays a decisive role, and therefore the reception quality can be improved as much as possible to achieve a much higher accuracy of recognition. It is essential that

Publications WO 03/062906 and WO 02/086599 describe, for example, devices in which a microphone and a small speaker are arranged on a spectacle frame. The spectacle frame is then connected to the external electronic device via a cable connection. However, the problem with this proposed device is that it achieves acceptable noise removal for user-specific sound and audio recording, in particular, the user's verbal command, the voice of other people in the vicinity. Difficult to distinguish

As described in the publication EP 0 219 026 B1, it is how a hearing aid can be incorporated into a spectacle frame. Directional effects and localization, which should allow deaf people to gain spatial orientation in relation to acoustic events, through a specific spatial distribution of several microphones on the spectacle frame An effect can be realized. All acoustic and electronic components are housed in eyeglasses. Send connections and / or receive connections to external electronic devices are not provided.

US 2002/0197961 A1 discloses a microphone, a small speaker, a power supply (accumulator), and a transmitter for transmitting signals to a mobile radio device or other external electronic device Or it is a spectacles frame in which a corresponding receiver is mounted. Alternatively, the component may be housed in a clip on a similar article that can be attached to the spectacle frame and removed again, or worn on a hat or head. Is possible. The microphone can also be mounted on an adjustable arm. The use of the above-described arrangement in an environment with large, non-constant static noise still does not guarantee that the desired signal is applied to the microphone at a sufficient level.
International application WO 2004/016037 describes a method and corresponding device for improving the comprehension of speech. This application involves a spectacle frame including a microphone array, a speaker, and a signal processing device. The signal processing device receives the microphone array signal, reduces the amount of interfering background signals, and transmits the processed signal to a speaker or external electronic device. The eyeglass frame also includes a microphone control that can adjust the direction of the microphone so that better signal quality can be achieved. Various methods and algorithms, in particular so-called ANC (active noise control) techniques, can be used for signal processing. Nevertheless, the beamform method described is not suitable for removing ambient noise and interference in an efficient manner in all situations.

International Publication No. 03/062906 International Publication No. 02/086599 European Patent 0 219 026 B1 US Patent Application Publication No. 2002/0197961 A1 International application WO2004 / 016037

The object of the present invention is to propose a new system and a new method for acoustic communication that do not have the above-mentioned problems of the state of the art. In particular, the system allows for convenient, hands-free use of mobile radio devices and provides reliable and convenient input of verbal commands in connection with IVR systems (interactive voice response) in noisy environments, And interactive voice control must be enabled.

The above objects are achieved according to the invention in particular through the elements of the independent claims. In addition, further advantageous embodiments result from the dependent claims and the present description.
In particular, the above objects are such that the spectacle frame includes at least one direction-dependent microphone for capturing a user's audio signal and a communication means for transmitting the signal to an external electronic device, the at least one microphone. The direction dependence of the can be adjusted in a user-specific manner in a dynamic manner by the control module, which is based on the audio signal captured by the at least one second direction-dependent microphone. This is achieved through the present invention in that it includes means for performing an adaptive user-specific adjustment of the direction dependence of the direction-dependent microphone. The advantage of this embodiment variant is inter alia effective denoising, so that for each individual user a much higher quality of the captured audio signal is possible. This may be a necessary prerequisite, especially for recognition of the user's verbal commands. A further advantage is that hands-free input of verbal instructions, as well as the input device is almost inconspicuous because it is incorporated into the spectacle frame.

Furthermore, this embodiment variant has the advantage, inter alia, that the direction-dependent adjustment of direction-dependent microphones can be performed as a function of the signals captured by other microphones. Therefore, better user specific adaptations can be realized, higher voice quality and better preconditions for application of the system and method according to the invention in an environment with a high level of interference noise is brought about

In a further embodiment variant, the at least one second direction-dependent microphone is a contact microphone. This embodiment variant has the advantage, inter alia, that the audio signal sent by the speaking user can be captured not only after propagation in the air but also after propagation in the user's body. Thereby, further improvements in noise removal can be realized after corresponding handling and processing. In particular, using a contact microphone, it can be very easily determined whether the user is speaking right now, and there is possible confusion with additional users speaking in the vicinity. Can be substantially eliminated. Furthermore, the signal captured by the contact microphone is very well suited for use by the control module to make an adaptive user-specific adjustment of the direction dependence of other direction dependent microphones.

In yet another embodiment variant, the signal captured by the first direction-dependent microphone is filtered using the signal captured by the third microphone. This embodiment variant has the advantage that, inter alia, ambient noise captured by another microphone can be used for filtering and signal quality enhancement of the signal captured by the first direction-dependent microphone. Have Thus, the positive features of direction-dependent microphones are optimally combined with the positive features of noise removal via filtering, resulting in better voice quality.

In a further embodiment variant, the at least one direction-dependent microphone is implemented as a microphone array. The at least one microphone array can advantageously be implemented, for example, in MEMS technology. As a result, this embodiment variant has the advantage that, inter alia, a particularly effective and powerful directional effect can be realized. Also, through the use of microphone groups, many spatial features of sound waves can be exploited, and those features cannot be exploited with a single microphone. A further advantage of this embodiment variant is a much lower manufacturing cost and a high integration rate, whereby a particularly small and compact configuration can be realized.

In another embodiment variant, the external device comprises a mobile wireless device. As a result, the mobile wireless device can be incorporated into a spectacle frame, for example, or can exist as a self-contained device. This embodiment variant has, inter alia, the advantage that the system according to the invention and the method according to the invention can be used for voice communication over mobile radio networks. For this reason, the wearer of the glasses can communicate with

one or more servers connected to the mobile radio network or input an acoustic command via the glasses frame. Thus, the wearer of glasses does not need to use any supplementary hands-free device and can therefore communicate more conveniently at a significantly lower cost.

In another embodiment variant, the spectacle frame includes means for a retinal scanning display. A retinal scanning display is a display device in which light rays are projected directly onto the retina of the eye. Through corresponding light modulation of the rays and rapid decomposition, the entire picture can be shown. The spectacle frame may include additional means for capturing the gaze direction. As a result, this embodiment variant constitutes, among other things, a complex system that allows users to directly view and listen to information without relying on external output devices. Has the advantage that it is possible. At the same time, with line-of-sight capture, further possibilities of data input can be incorporated into the system.

In a further embodiment variant, the system includes a speech recognition module for capturing verbal commands using at least one direction-dependent microphone. This embodiment variant has the advantage that the data can be controlled and / or selected in a simple manner by the user using verbal commands. A further advantage is lower power consumption since all devices are integrated in the same frame.

In a further embodiment variant, the communication system comprises a Bluetooth (R) interface and / or a ZigBee (R) interface and / or a GSM (R) interface and / or a UMTS interface and / or a WLAN interface. The above interface can be incorporated into, for example, a communication terminal device and / or a communication unit of a spectacle frame. This has the advantage, among other things, that current industry standards can be accessed using a communication system.

It has to be mentioned here that, in addition to the system according to the invention, the invention also relates to a method for acoustic communication. Embodiment variants of the invention are described below in connection with the examples. Examples of embodiments are illustrated by the accompanying figures below.

1 is a block diagram schematically illustrating a system and method for acoustic communication according to the present invention. 2 is a side view of a spectacle frame that can be used to carry out the system and method of the present invention according to FIG. FIG. 6 is a block diagram schematically illustrating another embodiment of a system and method according to the present invention for acoustic communication. FIG. 2 is a block diagram schematically showing the structure of the system of the present invention for acoustic communication according to FIG. 1 Fig. 4 is a block diagram schematically showing the structure of another embodiment of the system of the present invention for acoustic communication according to Fig. 3; FIG. 2 is an exploded view of a human skull bone showing the approximate normal position of a worn spectacle frame that can be used to implement the system and method according to the present invention.

In FIG. 1, reference numeral 10 refers to a spectacle frame, for example a spectacle frame with a corrective lens or a frame for sunglasses with a sunshade lens, worn by a myopic or hyperopic individual. The spectacle frame 10 includes at least one direction-dependent acoustic sensor 16 at a position where sound waves 21 emanating from the mouth of the user 20 can be captured. Through the direction dependence of the sensor 16, the sound wave 22 emanating from the mouth of the user 20 on the straight line of propagation can be captured particularly well. The direction-dependent acoustic sensor 16 can be, for example, a simple microphone, but can also be implemented as a group of microphones, ie a so-called microphone array. Through the use of a microphone array, the spatial characteristics of the sound field can be exploited, and the quality of the captured signal or, respectively, the intelligibility is consequently improved considerably. It is possible. A plurality of such microphones or microphone arrays 16 can likewise be mounted symmetrically on the spectacle frame 10, for example on both sides of the spectacle frame 10.

Again, as shown in FIG. 1 or 2, the spectacle frame 10 may further include one or more direction-dependent acoustic sensors 15. A further direction-dependent acoustic sensor 15 is implemented by the direction-dependent acoustic sensor 15 at a location where the user's physical vibrational acoustic signal can be well captured. The physical vibration acoustic signal is generated in that sound waves are generated in the user's larynx as they speak and that sound waves are then propagated by the user's body. A particularly suitable location for receiving and capturing physical vibroacoustic signals is the temporal bone 66 located on both sides of the human skull 60, as shown in FIG. The arm of the spectacle frame 10 is usually worn against the temporal bone, which can contribute to the higher quality of the captured physical vibration sound waves. The direction-dependent acoustic sensor 15 can likewise be implemented as a simple microphone or as a group of microphones, ie as a so-called microphone array.

1 and 2, reference numeral 13 refers to one or more additional direction-dependent acoustic sensors 13. One or more further direction-dependent acoustic sensors 13 are implemented at a position on the spectacle frame 10 where ambient sounds coming from the user's environment can be particularly well captured. The direction-dependent acoustic sensor 13 can likewise be implemented as a simple microphone, or as a microphone array, for better quality of the signal being captured, A plurality of direction-dependent microphones or direction-dependent microphone arrays 13 aligned with respect to can also be mounted on the spectacle frame 10.

The microphones or the microphone arrays 13, 15, 16, respectively, can be implemented in particular with so-called MEMS technology (MicroElectroMechanical Systems). Understood by MEMS is a microchip with some logic and at least some moving parts. Thus, a MEMS is typically a processor with mechanical parts that can collect data and also perform the tasks that result from that data. This is a very small microphone or microphone array that can be manufactured through the use of MEMS technology, which can achieve better sound quality at the same time with a small overall size. A microphone or microphone array will be particularly well suited for mounting in the spectacle frame 10.

In FIG. 1, reference numeral 11 indicates a control module. The control module can acquire and evaluate signals from direction-dependent acoustic sensors 13, 15, 16. The control module 11 can also communicate with the direction-dependent acoustic sensors 13, 15, 16 to control the sensors 13, 15, 16. In particular, through the use of MEMS technology, the direction-dependent acoustic sensors 13, 15, 16 can be controlled in a particularly simple manner and with little effort. As a result, the position, sensitivity, and / or direction dependency of the direction-dependent acoustic sensors 13, 15, 16 can be influenced. For example, based on the audio signal captured by one direction-dependent acoustic sensor 13, 15, 16, the control module 11 can control another direction-dependent acoustic sensor 13, 15, 16. All components required for signal processing, signal amplification, and other signal handling are, for example, amplifiers 46, 48, 51, adjustment elements 43, control circuits 44, 54, or delay elements 47 in the spectacle frame 10, in particular, it can be accommodated in the control module 11.

In an embodiment variant of the problem-solving according to the invention, for example, physical vibration sound waves are generated in the larynx of the talking user and propagated by the body. In addition, the physical vibration sound wave or the audio signal is propagated to the skull and the temporal bone, and the audio signal is captured by the direction-dependent acoustic sensor 15 in the skull and the temporal bone. The captured audio signal is interpreted and evaluated by the control module 11, and the direction-dependent acoustic sensor 16 is tailored to the user based on the evaluation. In particular, the control module 11 can change the position of the direction-dependent acoustic sensors 16 implemented with MEMS technology so that the sensors 16 better take into account the user's facial appearance. The control module 11 similarly changes the sensitivity of the direction-dependent acoustic sensors 16 in a user-specific manner so that while the sensors 16 are experiencing physical vibrational sound waves on the temporal bone, it is also possible to react with a particularly high sensitivity to an audio signal coming out of the mouth.

In another embodiment variant of the problem-solving according to the invention, not only the physical vibration sound waves from the speaking user are captured by the direction-dependent acoustic sensor 13, but also ambient sounds coming from the environment. The body vibration sound wave captured by the first direction-dependent acoustic sensor 15 and the ambient noise signal captured by the second direction-dependent acoustic sensor 13 are interpreted and evaluated by the control module 11 to determine the direction. The dependent acoustic sensor 16 is tailored to the user based on the evaluation. In particular, ambient sounds that remain constant may require an adaptive or dynamic user-specific adjustment of the direction dependence of the direction-dependent acoustic sensor 16. That is, the user may suddenly speak more gently because he or she has cut out a topic that has a secret nature and should not be noticed by nearby people. Thus, what is understood by

adaptive user-specific adjustment is a dynamic adjustment in which the direction dependence of the microphone is dynamically adapted to an optimal value, for example using a MEMS microphone. .

In particular, the spectacle frame 10 also comprises a physical network interface 12 using which the verbal information and / or information in the form of data can be communicated with the spectacle frame 10 and the mobile communication terminal via the communication channel 17. It can be exchanged between devices 30. The network interface 12 is not only a local wireless network standard known by the name of Bluetooth or ZigBee, but also GSM (Global System for Mobile Communication), GPRS (Generalized Packet Radio Service), UTS. (Universal Mobile Telecommunication Systems), WLAN (Wireless Local Area Network) 802.11, infrared communication technology, or any other contactless communication technology can also be supported. However, in principle, the network interface 12 may be any contact interface, for example, USB interface or Firewire (R) interface or an Ethernet (registered trademark), Token Ring, or any other wired LAN, (local. It can also be an interface to an area network. The interface, of course, directly uses a network protocol such as, for example, Ethernet or Token Ring, so that not only packet switched interfaces, but also PPP (Point to Point Protocol), SLIP (Serial Line internet Protocol, for example)) Or a circuit-switched interface that can be used by a protocol such as GPRS (Generalized Packet Radio Service), ie, an interface that has no network address such as a MAC address or a DLC address, for example. Is possible. In principle, the system and / or method according to the present invention is not limited to a particular network standard, as long as the features according to the present invention exist, but instead may be implemented in one or more desired networks. It has to be emphasized that it is possible, and in particular can also be realized by voice transmission and / or data transmission switched transparently or routed between different communication technologies. In addition, further required components such as speakers and power supply devices can be accommodated in the spectacle frame 10.

Reference numeral 30 in FIG. 1 refers to a mobile communication terminal device or any desired so-called customer premises equipment (CPE). The mobile communication terminal 30 can be any mobile radio device of any mobile radio network, for example a GSM device of a GSM mobile radio network, or a UMTS device of a UMTS network, or a satellite. It can be a network satellite device. However, the mobile communication terminal 30 in principle has a standard personal computer (PC), portable PC, fixed net telephone, charging device for mobile wireless devices, PlayStation, or electronic networked components. It can be any other device. The mobile communication terminal device 30 includes, for example, an input unit 32 for inputting data elements. The mobile communication terminal 30 can have a standard keyboard or similar input device, for example consisting of numeric keys and control keys, depending on the type of mobile radiotelephone. It is possible to switch to character input. For example, in the case of fee registration in telecommunications, for the purposes of authorization and authentication, the mobile communication terminal device 30 typically includes a removable identification module, for example a SIM (Subscriber ID Module) card 34, is shown under the terminal device 30 in this figure, and contacts the contact inside the mobile communication terminal device during operation. The mobile communication terminal device 30 may further include a display device 31 for displaying data elements. An antenna 35 plays a role in a known manner for the transmission of data over a telecommunications network, which is typically a mobile radio network, for example a GSM (Global System for Mobile Communication) network, a UMTS (Universal). It is a Mobile Telecommunication System (WLAN) network or a WLAN (Wireless Local Area Network) network. Mounted on the mobile communication terminal device 30 is a non-contact interface 33. For example, data and commands from the non-contact interface 12 of the spectacle frame 10 can be transmitted and received via the interface 33. It is.

The structure of an embodiment variant of the system according to the invention and the method according to the invention is shown in FIG. What is received by the first direction-dependent acoustic sensor 16 is, inter alia, an audio signal from the mouth area of the user 22, whereas the second direction-dependent acoustic sensor 13 is notably from the vicinity. Directed to the incoming ambient sound. A third direction-dependent acoustic sensor 15 is set up and positioned so that, inter alia, an audio signal from the user's physical vibration sound can be captured. The audio signals captured by the first direction-dependent acoustic sensor 16 and the second direction-dependent acoustic sensor 13 are adjusted to the minimum ambient noise at the output of the differential amplifier 46 by the signal conditioning module 43 and the control circuit 44. Is done. The audio signal captured by the third direction-dependent acoustic sensor 15 is too amplified in the case of "no physical vibration sound" when the audio signal captured by the first direction-dependent acoustic sensor 16 is amplified. It is used by the amplifier controller 48 so that it is not overdoed. However, in the "physical vibration sound is present" case, the amplifier causes the audio signal captured by the first direction-dependent acoustic sensor 16 to be converted into an audio signal captured by the second direction-dependent acoustic sensor 13. Set to be amplified. A signal delay module 47 can be provided so that no distortion occurs due to the execution time.

Shown in FIG. 3 is another embodiment variant of the system according to the invention and the method according to the invention. Reference numeral 10 again relates to a spectacle frame that includes one or more direction-dependent acoustic sensors 15, where the user's physical vibrational acoustic signal is well captured by the direction-dependent acoustic sensor 15. Can be implemented at a possible position. The direction-dependent acoustic sensor 15 can likewise be implemented as a simple microphone or as a group of microphones, ie a so-called microphone array, and / or in MEMS technology. The audio signal captured by the at least one direction-dependent acoustic sensor 15, 50 is transmitted to the control module 11. As shown in FIG. 5, the audio signal captured by the direction-dependent acoustic sensor 15 is amplified by an amplifier 51 in the control module 11 and processed in terms of level and frequency by a signal processing module 52, after which reference-control is performed. Processed by the circuit 54, the captured microphone signal is made to correspond in character to the audio signal captured by the normal microphone. Next, the audio signal is added to the audio path 53 of the mobile communication terminal device 30. The criteria for the reference-control circuit 54 are recorded in the mobile communication terminal 30 for each user, for example by means of a device microphone. Both the signal processing module 52 and the reference-control circuit 54 can be arranged in the spectacle frame 10 or in the mobile communication terminal device.

The energy source for the power supply 14 for powering the electronic system can in particular be implemented via a photovoltaic cell (not shown), which is vacuum deposited on the spectacle lens. Furthermore, the energy source can be implemented using a general battery built into or connected to the spectacle frame 10.

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Priority And Related Applications

Parent Applications (1)

Application	Priority date	Filing date	Relation	Title
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Applications Claiming Priority (2)

Application	Filing date	Title
EP04101327	2004-03-31	
EP04101327.7	2004-03-31	

Legal Events

Date	Code	Title	Description
2014-07-10	A977	Report on retrieval	**Free format text**: JAPANESE INTERMEDIATE CODE: A971007 **Effective date**: 20140709
2014-07-16	A131	Notification of reasons for refusal	**Free format text**: JAPANESE INTERMEDIATE CODE: A131 **Effective date**: 20140715
2014-10-16	A601	Written request for extension of time	**Free format text**: JAPANESE INTERMEDIATE CODE: A601 **Effective date**: 20141015
2014-10-21	A602	Written permission of extension of time	**Free format text**: JAPANESE INTERMEDIATE CODE: A602 **Effective date**: 20141020
2015-01-15	A521	Request for written amendment filed	**Free format text**: JAPANESE INTERMEDIATE CODE: A523 **Effective date**: 20150115
2015-04-15	A131	Notification of reasons for refusal	**Free format text**: JAPANESE INTERMEDIATE CODE: A131 **Effective date**: 20150414
2015-07-14	A601	Written request for extension of time	**Free format text**: JAPANESE INTERMEDIATE CODE: A601 **Effective date**: 20150714
2015-08-14	A601	Written request for extension of time	**Free format text**: JAPANESE INTERMEDIATE CODE: A601 **Effective date**: 20150814
2015-08-31	A521	Request for written amendment filed	**Free format text**: JAPANESE INTERMEDIATE CODE: A523 **Effective date**: 20150831
2016-02-03	A02	Decision of refusal	**Free format text**: JAPANESE INTERMEDIATE CODE: A02 **Effective date**: 20160202
2017-07-27	A601	Written request for extension of time	**Free format text**: JAPANESE INTERMEDIATE CODE: A601 **Effective date**: 20170727
2017-10-26	A521	Request for written amendment filed	**Free format text**: JAPANESE INTERMEDIATE CODE: A523 **Effective date**: 20171026
2018-01-16	A61	First payment of annual fees (during grant procedure)	**Free format text**: JAPANESE INTERMEDIATE CODE: A61 **Effective date**: 20180111

2018-01-19	R150	Certificate of patent or registration of utility model	**Ref document number**: 6275987 **Country of ref document**: JP **Free format text**: JAPANESE INTERMEDIATE CODE: R150
2021-01-14	R250	Receipt of annual fees	**Free format text**: JAPANESE INTERMEDIATE CODE: R250
2022-01-13	R250	Receipt of annual fees	**Free format text**: JAPANESE INTERMEDIATE CODE: R250
2023-01-12	R250	Receipt of annual fees	**Free format text**: JAPANESE INTERMEDIATE CODE: R250
2024-01-12	R250	Receipt of annual fees	**Free format text**: JAPANESE INTERMEDIATE CODE: R250

Concepts

machine-extracted

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Name	Image	Sections	Count	Query match
communication		title,claims,abstract,description	94	0.000
method		title,claims,abstract,description	44	0.000
dependent effect		claims,abstract,description	95	0.000
engineering process		claims,abstract,description	13	0.000
sound signal		claims,description	44	0.000
vocal effect		claims,description	12	0.000
retinal effect		claims,description	4	0.000
filtration		claims,description	3	0.000
retina		claims,description	2	0.000
adaptive effect		abstract,description	5	0.000
array		abstract,description	4	0.000
signal transmission		abstract	1	0.000

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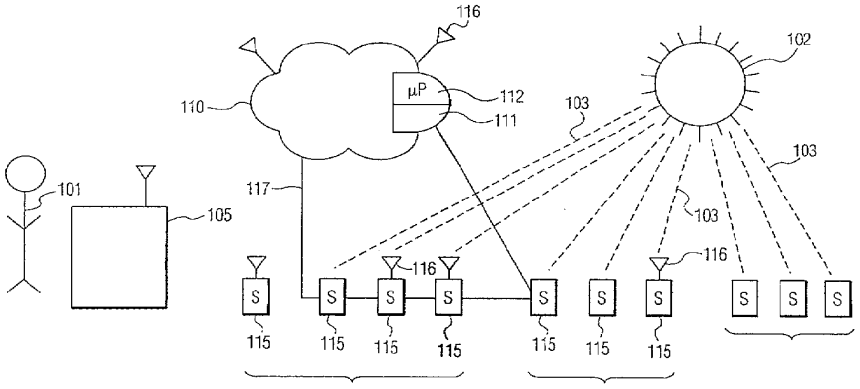
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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations 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,*

[Continued on next page]

(54) Title: UV RADIATION DETECTION AND WARNING APPARATUS AND METHOD



(57) Abstract: An ultraviolet radiation indicator system includes a wireless telephone adapted communication with a wireless communication network having a positioning system, such as an enhanced emergency services function. A plurality of radiation sensors that sense ultraviolet radiation are arranged in predetermined areas. The radiation sensors are adapted for communication with the wireless communication network. The wireless communication network provides at least an ultraviolet radiation index (UV index) based on readings from the sensors located closest to the wireless telephone, with the UV index being transmitted to the wireless telephone. In the event the wireless telephone is far enough away from the closest sensors to cross a threshold, then the user is sent general information from the Weather Bureau for a particular geographic designation, such as a zip code, city, portion of city, etc. The ultraviolet radiation indicator can provide the UV index to the wireless telephone upon a user request received from the wireless telephone, or the user may subscribe to the surface. Alternatively, the user may receive unsolicited updates for a period of time subsequent to the first request, or when conditions change significantly.

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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, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

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UV RADIATION DETECTION AND WARNING APPARATUS AND METHOD

The present invention relates to detection and warning systems. More particularly, the present invention relates to a UV radiation detection system.

Health professionals, as well as the general public, are becoming increasingly aware of the harmful effects that an extended exposure to sunlight has on human skin. The ozone layer, which acts as a filter to reduce the amount of ultraviolet light present in sunlight that makes it to the Earth's surface, is thinning (there is even an opening at the North Pole). By most standards of measure, the amount of harmful rays present in sunlight continues to grow, increasing the risk of skin cancer, and otherwise generally aging the skin and causing spotting and wrinkles. Excessive exposure to ultraviolet light is now linked to an increased probability of eye damage, particularly cataracts, which is why eye glasses coated with a UV blocking material has become very popular. UVB radiation is a specific band of ultraviolet light that is considered particularly harmful to humans.

As result of all the warnings both by doctors and the media, people now tend to spend less time in the sun even during their holiday. When they do spend time outdoors it is common for people to use a sunscreen with an SPF (Sun Protection Factor) which usually gives an indication of how strong is the protection.

However, the majority of people are still unsure of what is the difference in protection between a 30 SPF lotion and a 60 SPF lotion (it is not a linear scale), and whether or not the lotion is "water proof" or at least water resistant, and how often it should be re-applied depending on the duration the person is swimming, perspiring from physical activity (or just from the heat), etc.

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In addition, there are additional conditions, such as environmental conditions, time of day, sunlight intensity, wind, etc., all of which can affect how much sunscreen should be put on and how often it should be reapplied.

There are some portable devices that do not actually measure the UV but rather calculate how long one should stay in the sun based on the ambient condition information input to the device. For example, U.S. Patent 5,365,068 discloses a device that calculates certain information that is associated with sunburn and damaging skin. This portable device requests the user to identify how long they plan to stay in the sun, what is the user's skin type, and based on entries regarding the ambient conditions (i.e. sunny, cloudy, etc.) the device recommends an optimal level of SPF (sun protection factor) that should be used, the amount that should be applied, etc. These types of devices do not consider other factors such the quantity of UV light peaks from the hours of 11 A.M. to 2 P.M., and that during a period from approximately the beginning of spring to the summer, the UV levels are approximately two to three times greater than in December, when the UV is at a minimum.

There are also simple methods and devices that exist for actually measuring UV radiation, for example, in the form of UV cards, but generally they are not very accurate. In addition, these cards also represent another additional item that people have to remember to take with them when they go out. More expensive devices provide more accurate measurements but these devices tend to be larger in size than the cards, making it all the more unlikely for people to carry them around. In addition, UVB light is felt to be the most damaging to humans of all the light in the UV spectrum, so the monitoring device should be able to discriminate between UVA and UVB, for example, in order to get the most accurate indication possible. Thus, an individual measurement device needs to have certain capabilities that increase its

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costs to the point where the typical sunbather is either cannot or will pay for such a measuring device.

It is known that cellphones have become everyday objects and one can assume that as objects most likely to be found on people at any place and occasion (similar to a wallet). In addition, cellphone networks by definition (due to their working principle) and most recently by upgrades applied for enhanced emergency services, can be used to determine the geographic location of a cellphone in the network. Thus, in case of emergency such as illness, a person can be located by the cellphone network in a fashion similar to determine a location using GPS but with much less accuracy.

The present invention exploits the geographic location feature of cell phones by providing a UV radiation report that can be individualized to the location of a particular cellphone, or area.

In a first aspect of the invention, the network provider can receive conditions regarding UV radiation from a local weather forecast station and transmit the appropriate UV report to the user's cellphone. This could be an alphanumeric call or page, or it could include audio that announces the UV level. The report could be sent to a person's cellphone periodically or upon an activation request by the user.

Thus a user can find out quickly and accurately the UV index for their particular area. This information can be provided, for example, by a weather forecasting service that monitors area of particular interest regarding sunburn, such as public beaches, or by broadcasting to the user the UV index for a particular zip code, predetermined zone, cell area, etc.

In another aspect of the present invention, a system involves a subscriber service, cell service, or government entity setting up UV detection devices. These devices would then relay the information to a central cite, which in turn, when

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requested, could provide individuals with localized UV index information on their cellphone that is far more accurate than the weather forecast from the night before or the morning of that particular day.

In yet another aspect of the invention, the user is informed about a level of UVB information, which is thought to be particularly harmful to human skin and eyes. Along with the UV information, recommend SPF levels for suntan lotion, and recommended maximum exposure time in the sun can be provided. Also, if the user, for example, doesn't have suntan lotion with an SPF of 45, the system can broadcast how long exposure is recommended if one has suntan lotion with an SPF of 30. For example, the communication network can transmit to the wireless telephone a recommended maximum duration time for exposure to ultraviolet radiation based on the UV index determined in the vicinity of the wireless telephone, wherein the maximum duration time includes a first time period based on no SPF lotion has been applied and a second time based on application of the proper SPF.

According to another aspect of the invention, a user may enter an SPF rating of an available SPF lotion and the communication network corresponds with a third time period based on the rating of the available SPF lotion.

Fig. 1 is an illustration of a UV indication system according to a first aspect of the invention.

Figs. 2A and 2B illustrate a method according to the present invention.

It is to be understood by persons of ordinary skill in the art that the following descriptions are provided for purposes of illustration and not for limitation. An artisan understands that there are many variations that lie within the spirit of the invention and the scope of the appended claims. Unnecessary detail of known functions and operations may be omitted from the current description so as not to obscure the present invention.

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Fig. 1 is an illustration of a first aspect of the present invention. A user 101 having a cellphone 105 (not drawn to scale) is in an outdoor area that is closest to Area A (Areas B and C are also shown). The sun 102, along with daylight, also transmits ultraviolet light. Each area has a plurality of sensors 115 that are specifically designed for sensing ultraviolet light. For example, U.S. Patent 5,387,798 to Funakoshi et al., which is hereby incorporated by reference as background material, discloses a UVA –UVB discriminating sensor. While it is preferable that a sensor discriminate between UVA and UVB because UVA exposure causes human skin to darken, whereas UVB is the far more harmful UV light that is associated with freckles, blisters, skin cancer, and cataracts, a simple UV sensor could also be used, particularly if costs need to be controlled.

The sensors 115 communicate with network 110, which has or communicates with a positioning system 111 and a microprocessor 112 for analyzing sensor data, either via fiber optic link or copper link 117, or via wireless communication through antenna 116. The sensors, for example, can change color when exposed to different amounts of ultraviolet light. This change can be sensed by a photosensor and converted into distinguishable levels of current to be fed back as wireless or optical, electrical signals to the network 110, which then can analyze the levels, find the UV index, and make appropriate recommendations with regard to recommended exposure times to the sun and/or amount of SPF that needs to be worn.

The sensors, in this particular aspect of the invention, are envisioned to be arranged along, for example, the boardwalk of public beach, at different areas of public playgrounds, at outdoor arenas and stadiums, volley ball courts, ballfields, i.e. anywhere that is deemed to be a popularly frequented area that normally includes activity that is conducive to one getting exposure to the sun.

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The three areas (A-C) are chosen merely for illustrative purposes, and a person of ordinary skill in the art should not infer any limitation with regard to the number and type of sensors, and/or the number and type of sensors. Each of these three areas are at a slightly different angle to the sun, and as a result, may not have the same levels of UV light. In addition, it is possible that there are objects, such as trees, hills tall buildings, etc., that interfere with receipt of direct sunlight at a given point. Thus, according to an aspect of the invention, the plurality of sensors closest to the cellphone is used to determine the UV index, as this is in all likelihood the most closely associated level that is experienced by the user.

The user 102 receives an indication of, for example, the UV index on his/her wireless telephone 105. While the term telephone has been selected for the description, for purposes of the scope of the invention, and scope of the appended claims, it is to be understood that in this particular instance a wireless telephone is merely a generic term, and the device may comprise a PDA, such as a Palm Pilot, a handheld or notebook computer with or without a telephone function, a pager, which may be an audio pager, visual pager (alpha-numeric) or any combination. What is necessary is either at least one of an audio or a visual display.

The user 102, in a first aspect of the invention, can dial a certain number and receive the readings directly on his/her cellphone. This number queues the network into providing the UV readings. In other aspects of the invention, the user may subscribe to a service and automatically receive the transmissions when they are within range of the network. Finally, it is also envisioned that the cellphone within range could receive a broadcast of the levels detected by the nearest sensor or sensors. With an actual wireless telephone, for example, this data could be transmitted via the SMS (short message service) of a cellphone. The information could be transmitted in, for purposes of illustration and not for limitation, CDMA, TDMA, GSM, QDMA.

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It is also envisioned that the network is a wireless LAN operating under a protocol, for example, such as 802.11. Both the sensors and the telephone (or other applicable communicator) are devices associated with a particular WLAN, and the telephone receives communication from the network based on a predetermined number of sensors 115 that are within a certain number of feet, such as a radius, or within a certain signal strength of the telephone (for example, based on a pilot signal strength determined by a Base Station Controller (BSC) that communicates with the WLAN.

Wireless telephones 105 now have a preferable feature in that many now have enhanced emergency services for calls to police, fire, etc (911) so that appropriate personnel can determine where the caller is located. Often, in a wooded area or after a crash in the dark, people may either be unfamiliar with the area or disoriented with regard to their location. This feature, which can be turned on as well to locate missing persons, can also be used to determine a location of the telephone, and thus, its owner 101. Then, a reading based on the sensors 115 closest to the telephone, in this case, the sensors in AREA A, but not Area B or Area C, are used to calculate UV index, etc.

The user may receive data such as the UV index and SPF data only after specifically requesting it, or he/she may receive additional updates by programming, or when it has been determined that there is a serious change in the UV index. The users cellphone could beep, ring, etc. and the new data can be displayed on the face of the phone. Alternatively, once a maximum or recommended time has passed, the network may signal the telephone with an indication that additional exposure to the sun is not recommended. It is also clear how another aspect of the invention can be to notify a person or persons when they have received an adequate amount of sunlight sufficient to synthesize quantities of vitamin D in the average human that are

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acceptable. Vitamin D plays an important role in bone development, and there have been several well-documented studies showing a possible link between lack of exposure to the sun during winter months over an extended period and an increased risk of contracting multiple sclerosis. Throughout the world, people from different continents are at increased risk when their winter time sun exposure is low. There are also disorders, such as SAD, in which the medical profession is prescribing a certain amount of exposure to light as a remedy. The presently claimed invention would be ideal for any of these purposes as it would provide the user with accurate information and not require one to carry around a monitor, sensor, etc. The cellphone would be all that is required on the user's part.

Figs. 2A and 2B illustrate a method according to the present invention.

At step 210 a network for a wireless telephone is provided. The network should have a positioning capability, such as Enhanced Emergency Services and/or GPS, or any other positioning system may suffice. The Enhanced Emergency Services offer the advantage that they are already part of a cellphone network, so protocol to develop GPS or some other positioning system is not required.

At step 220 a plurality of sensors are arranged in a plurality of areas. As discussed above, this could be high-traffic areas for outdoor exposure, such as beaches, parks, public pools, playgrounds, outdoor arenas, etc. The sensors can be, for example, arranged along the boardwalk of a beach, on the roof tops of local beachfront hotels, etc. The sensors could also be arranged in the ground, and in such cases should be located somewhat to the side of normal pedestrian traffic. The ground sensors may also incur a problem in that someone could step on them, place objects on them and/or otherwise stand between the sensors and the sunlight and cause the sensors to give incorrect readings. For this reason, placement on street lamps, posts, etc. is preferred. False readings are also another reason why it is preferred to use a

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plurality of sensors in each area, so that the network can either average or discard the highest and lowest readings.

At step 230 the sensors from each area report the sensed data back to the network for processing. These sensors can be connected wirelessly to the network, or they may connect via optical fiber, or even copper wire. In any event, the sensors' output needs to be sent to the network (i.e. a controller) that in all likelihood will process the data. However, it is possible that the processing occur locally, but this would increase costs of the system.

At step 240 the network calculates for each area at least one of the UV index, and/or a recommended exposure time. Based on the UV index, this data can be cross-referenced with a table that indicates the recommended SPF lotion to be used for each value of the index, and the maximum time before burning typically occurs. The table may also contain equivalents to the SPF, so that, while, for example, SPF 30 lotion might be recommended, if someone has SPF 15 the network will reduce the time of the recommended exposure. It should be noted that in some instances a sliding scale of SPF versus time might not be favored by dermatologists, but in reality most people tend to have either only one type of lotion, or have one very strong one, such as 30, and a lower number, such as 15, for use after several days of exposure.

At step 250, upon a request from a wireless telephone, the network will determine the location of the wireless telephone and a distance of sensors that are closest to the wireless telephone. This request could be activated by the user pushing a function key on their cellphone, or dialing a certain number dedicated to using this feature. Alternatively, a user may put the cellphone into a sun-monitor mode which automatically provides the information and updates every predetermined time period, or when the information has changed by a certain threshold amount.

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At step 260, there is a decision as to whether the distance of the sensors closest to the wireless phone is greater than a predetermined threshold? If the answer is yes, then the readings might not be applicable, or could indicate less UV exposure than what is actually present at the user location due to the difference in positions. At such a point, or where there are no sensors installed, the UV indication may be based on weather bureau forecasts for the closest city, part of the city, town, zip code, or other geographic designation. It is also possible to place sensors beside the cellphone towers, and use the closest cell area. Thus, step 265A would be applicable. In this case, it might be advised to let the user know the indication is a general UV indication.

However, if the distance to the sensors closest to the wireless telephone is not less than the predetermined threshold, then the network can transmit the data based on the sensor readings deemed closest. In this regard, it should be understood that the processing of the sensor data may only occur when a user requests information, so as not to waste processor time churning away at calculations for all the different areas when there aren't any users requesting the information. Alternatively, the UV index data (and SPF data, etc.) can be stored in a table that is updated every predetermined interval of time.

Various modifications can be made by a person of ordinary skill in the art to the present invention that does not depart from the spirit of the invention or the scope of appended claims. For example, while only three or four sensors per area are shown, depending on the cost, there could be fewer, or literally hundreds of sensors. The number of areas, the size of the areas can all be varied to suit user need. As previously discussed, the term wireless telephone and cellphone can be used interchangeably, and it should be understood that reference to cellphone or wireless telephone in the specification and the appended claims includes but is not limited to

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PDAs, pagers, notebook computers with wireless transmission capability, virtually any device that is used to communicate voice and/or visual data. The sound system and/ or the visual display is used to communicate the UV index information. For example, it can be displayed on the cellphone screen, computer screen, PDA screen, Pager screen, or listened to by the speaker on the telephone, computer, pager (if applicable), PDA, digital communicator, etc.

What is claimed is:

1. An ultraviolet radiation indicator system comprising:

a wireless telephone (105) adapted for communication with a wireless communication network (110) having a positioning system (111);

a plurality of radiation sensors (115) that sense ultraviolet radiation being arranged in predetermined areas, wherein the radiation sensors (115) are adapted for communication with the wireless communication network (110);

wherein said wireless communication network (110) provides at least an ultraviolet radiation index (UV index) based on readings from the sensors located closest to the wireless telephone, said UV index being transmitted to the wireless telephone (105).

2. The ultraviolet radiation indicator system according to claim 1, wherein said wireless communication network (110) provides said UV index to the wireless telephone (105) upon a user request received from the wireless telephone (105).

3. The ultraviolet radiation indicator system according to claim 2, wherein the wireless telephone (105) includes a predetermined setting requesting updated UV index reports of a predetermined number over a predetermined period of time.

4. The ultraviolet radiation indicator system according to claim 3, wherein the communication network (110) automatically transmits a warning to the wireless telephone (105) when the UV index exceeds a certain predetermined threshold.

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5. The ultraviolet radiation indicator system according to claim 3, wherein a user additionally requests the communication network (110) to begin timing a period of exposure to ultraviolet light, said communication network transmitting a signal to the wireless telephone (105) indicating when a maximum recommended exposure time to ultraviolet light has reached a predetermined threshold.

6. The ultraviolet radiation indicator system according to claim 1, wherein said wireless communication network (110) transmits to the wireless telephone (105) a recommended sun protection factor (SPF) for sunburn/suntan lotion to be applied in the vicinity of the wireless telephone (105).

7. The ultraviolet radiation indicator system according to claim 6, wherein said wireless communication network (110) transmits to the wireless telephone (105) a recommended maximum duration time for exposure to ultraviolet radiation based on the UV index determined in the vicinity of the wireless telephone (105), said maximum duration time includes a first time period based on no SPF lotion has been applied and a second time based on application of the proper SPF.

8. The ultraviolet radiation indicator system according to claim 7, wherein a user enters a rating of an available SPF lotion and the communication network (110) corresponds with a third time period based on the rating of the available SPF lotion.

9. The ultraviolet radiation indicator system according to claim 1, wherein the positioning system (111) comprises a Global Positioning System that is used to determine a location of the wireless telephone (105) so as to provide information based on radiation sensors that are a shortest distance from the wireless telephone.

10. The ultraviolet radiation indicator system according to claim 1, wherein the positioning system (111) comprises said means for determining a location of the wireless telephone (105) according to a strongest received signal strength of a base station controller out of one or more base controllers that can communicate with the wireless telephone (105).

11. The ultraviolet radiation indicator system according to claim 10, wherein the signal strength received by the positioning system (111) comprises a pilot signal from the wireless telephone (105).

12. The ultraviolet radiation indicator system according to claim 11, wherein the wireless telephone (105) is adapted to receive a wake-up/power up message from a power reduction mode and/or a power up mode message via the pilot signal if an emergency message regarding exposure to ultraviolet light requires transmission to the wireless telephone.

13. An ultraviolet radiation indicator system comprising:

a wireless telephone (105) adapted for receiving information regarding at least one of an ultraviolet radiation (UV) index that indicates a level of ultraviolet light sensed, and a sunlight

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protection factor (SPF) number that indicates a recommended SPF suntan/sunburn lotion for use outdoors;

a plurality of sensors (115) that sense ultraviolet radiation, the sensors being arranged in a plurality of predetermined locations where knowledge of at least one of the (UV) index and the (SPF) number is desired;

a microprocessor (112) that receives information from the plurality of sensors (115) in at least one predetermined location and determines at least a (UV) index; and

a transmitter (116) in communication with the microprocessor for transmitting said at least one of the (UV) index and the (SPF) number to the wireless telephone (105).

14. The ultraviolet radiation indicator system according to claim 13, wherein said at least one of the (UV) index and the (SPF) factor is transmitted using a SMS (short message service) frequency of the wireless telephone (105).

15. The ultraviolet radiation indicator system according to claim 13, wherein said at least one of the (UV) index and the (SPF) factor is transmitted to the wireless telephone (105) using one of CDMA, TDMA, and GSM.

16. The ultraviolet radiation indicator system according to claim 15, wherein the plurality of sensors (115) and the microprocessor (112) communicate via an IEEE 802.11 wireless protocol.

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17. The ultraviolet radiation indicator system according to claim 13, wherein the plurality of sensors (115) and the microprocessor (112) are linked via one of optical fiber (117) and copper wire.

18. The ultraviolet radiation indicator system according to claim 13, wherein the plurality of sensors (115) monitor (UV)B ultraviolet radiation.

19. An ultraviolet radiation indicator comprising:

a wireless telephone (105) adapted for receiving information regarding at least one of: (1) an ultraviolet radiation (UV) index that indicates a level of ultraviolet light sensed, (2) a sunlight protection factor (SPF) number that indicates a recommended SPF suntan/sunburn lotion for use outdoors, and (3) a recommended exposure time in the sunlight;

wherein said wireless telephone (105) includes an enhanced emergency services function identifying its physical location to permit receipt of information associated with said at least one of the (UV) index, the recommended SPF suntan/sunburn lotion, and the recommended exposure time in the sunlight for a particular physical location closest to the wireless telephone (105).

20. A method for providing ultraviolet radiation indication, comprising the steps of:

(a) providing a communication network for communication with a wireless telephone having a positioning system (210);

(b) arranging in predetermined areas a plurality of radiation sensors that sense ultraviolet radiation, wherein the radiation sensors are adapted for communication with the communication network (220);

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(c) sensing a level of ultraviolet radiation and providing a result to the communication network (230);

(d) said communication network calculating at least one of an ultraviolet radiation index (UV index), a recommended sunlight protection factor (SPF) lotion used to protect skin from sunburn, or a recommended exposure time to the ultraviolet radiation (240);

wherein said communication network provides the information recited in step (c) to a wireless telephone based on readings from the sensors selected from the plurality of sensors that are located closest to the wireless telephone, said information being provided to the wireless telephone subsequent to a user keying a predetermined code or requesting a UV indication level by activating a function key (250).

21. The method according to claim 20, wherein step (d) includes comparing a distance of the closest plurality of sensors to the wireless telephone located with a predetermined maximum threshold distance, and if that distance is greater than the predetermined maximum threshold, providing the information regarding UV index and SPF by one of zip code, geographical area, city, section of city (260, 265A, 265B).

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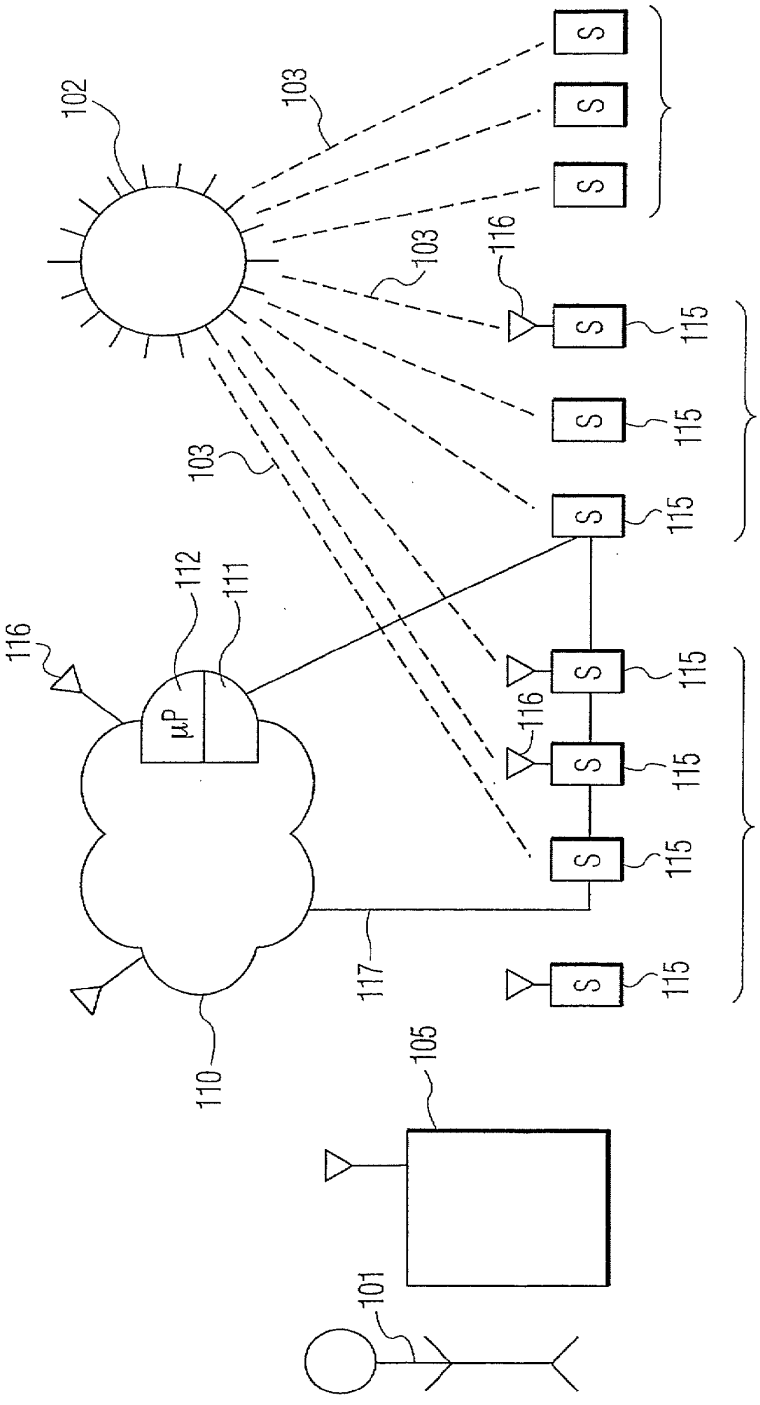

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FIG. 1

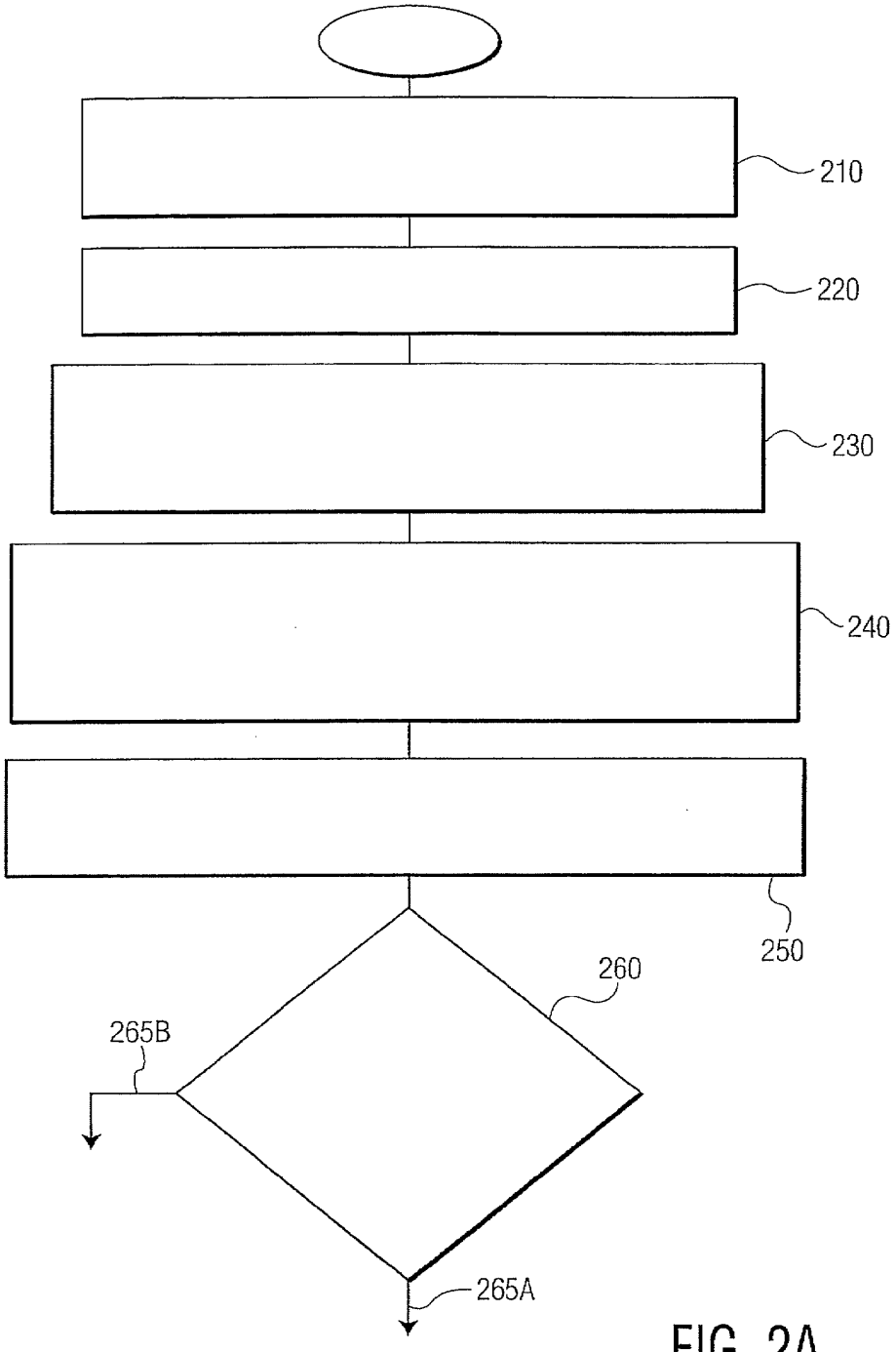


FIG. 2A

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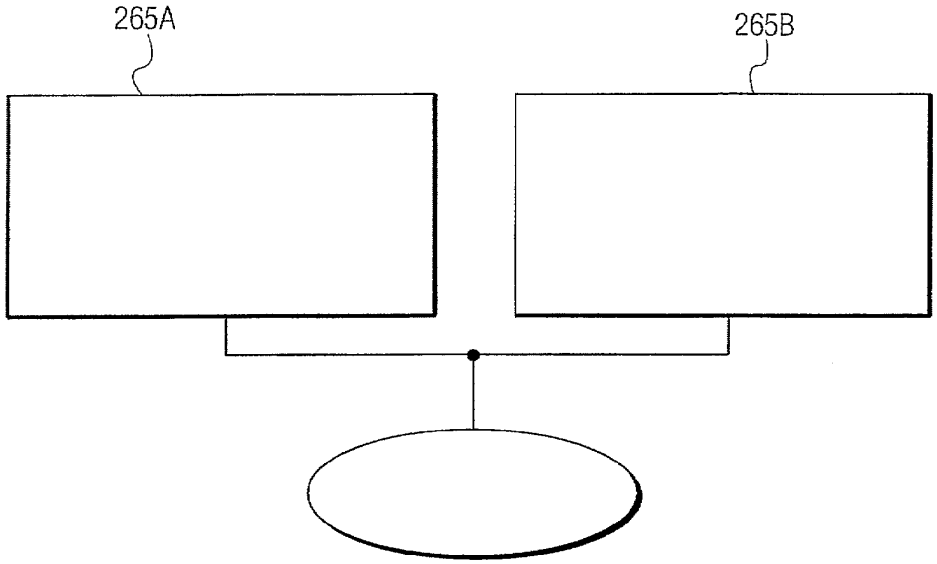


FIG. 2B

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INTERNATIONAL SEARCH REPORT

International Application No
/IB2004/051997

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G01J1/42 H04M11/00 G08B29/12

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 7 G01J H04M G08B

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, PAJ, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	PATENT ABSTRACTS OF JAPAN & JP 2002 358590 A (NIPPON TELEGR & TELEPH CORP), 13 December 2002 (2002-12-13) abstract	1-21
A	WO 03/031921 A (FLYBY S R L ; SIMEONE EMILIO (IT)) 17 April 2003 (2003-04-17) claims 1,9,10	1-21
A	WO 02/35193 A (BEN NER ZOHAR ; PHYTECH LTD (IL); TON YURI (IL)) 2 May 2002 (2002-05-02) claims 1,2,5,6,8,17	1-21

☐ Further documents are listed in the continuation of box C

☒ Patent family members are listed in 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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"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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Date of the actual completion of the international search	Date of mailing of the international search report
17 January 2005	25/01/2005

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, Tx 31 651 epo nl, Fax (+31-70) 340-3016	Rasmusson, R

Form PCT/ISA/210 (second sheet) (January 2004)

BNSDOCID: <WO 2005036110A1 I >

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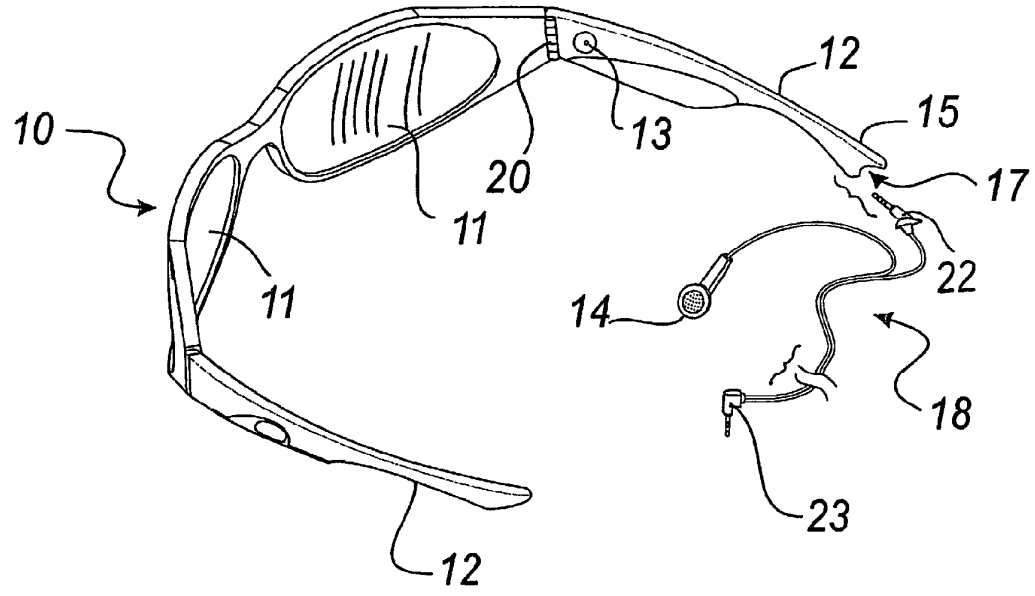
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT,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

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Published:
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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.

(54) Title: EYEGLASSES PRESET FOR CONNECTION TO CELLULAR TELEPHONES FOR TRANSMITTING AND RECEIVING CALLS



(57) Abstract: Eyeglasses comprising a microphone (13) in the front part, electronic noise-reduction components (27, 28), connection cables (16) located inside the structure, and a connector (17) for a cable (18) for connection to a cellular telephone.

WO 03/062906 A1

EYEGLASSES PRESET FOR CONNECTION TO CELLULAR TELEPHONES FOR TRANSMITTING AND RECEIVING CALLS

Technical Field

The present invention relates to a pair of eyeglasses preset for connection to cellular telephones for transmitting and receiving calls.

Background Art

Over the last few decades, as telephony has developed, telephone connections have become increasingly frequent; however, while fixed telephones require interrupting any activity in order to make and/or receive calls, the arrival of the cellular telephone has given a new meaning to the concept of telephony, allowing telephone connections even in particular situations that are not strictly linked to the work or private environment and without the need to have a telephone connected to the telephone line by means of wires and placed in a specific room.

It is in fact possible to communicate substantially in any enclosed or open location covered by the telephone network and without necessarily having to interrupt activity or work.

However, the use of a cellular telephone, which entails the use of one's hands to hold and handle the device, reply and/or dial the number, as well as the use of one's sight to perform certain functions, distracts the user's attention and concentration from the activity he is performing, such as for example driving a vehicle, maneuvering a machine, performing sports activities, et cetera, possibly producing dangerous situations.

Disclosure of the Invention

The aim of the present invention is to provide eyeglasses which, in addition to the normal optical and/or sunlight-barrier function, are capable of constituting a means for transmitting and receiving cellular telephone calls, so that the user can receive and make calls without taking his attention off the activity he is performing.

Within this aim, a consequent object of the invention is to provide

eyeglasses that reduce the risk of emission of electromagnetic waves, which are believed to be dangerous for human organs such as the brain.

Another object is to provide eyeglasses that can be worn as easily and comfortably as conventional eyeglasses.

A further object is to provide eyeglasses that can be used with any kind of cellular telephone.

Another object is to provide eyeglasses in which the devices for transmitting and receiving cellular telephone calls are integrated so as to not alter their ergonomic features.

A still further object is to provide eyeglasses whose structure allows industrial-scale production at competitive costs.

This aim and these and other objects that will become better apparent hereinafter are achieved by eyeglasses, characterized in that they comprise a microphone in a front part thereof, electronic noise-reduction components, connection cables located inside the structure, and a connector for a cable for connection to a cellular telephone.

Brief description of the Drawings

Further characteristics and advantages of the invention will become better apparent from the following detailed description of an embodiment thereof, illustrated by way of non-limitative example in the accompanying drawings, wherein:

Figure 1 is a rear perspective view of eyeglasses according to the invention;

Figure 2 is an enlarged-scale perspective view of a detail of the eyeglasses of Figure 1;

Figure 3 is a perspective view of the eyeglasses of Figure 1 with a corresponding telephone;

Figure 4 is a circuit diagram of the components located inside the frame of the eyeglasses;

Figure 5 is a detail view of a universal three-contact connector for a

connecting cable that is used;

Figure 6 is a detail view of a four-contact connector for a connecting cable that is used.

Ways of carrying out the Invention

With reference to the figures, a pair of eyeglasses according to the invention is, as usual, constituted by a front 10, which supports lenses 11 (of the sight-correcting type or of the sunlight-barrier type), to the ends of which temples 12 are articulated.

According to the invention, the eyeglasses comprise a microphone 13, preferably an ultraflat high-sensitivity one, which is located in the inner front part that is not in sight, for example of one of the temples 12. Electronic noise-reduction components, described hereinafter in greater detail, are also located inside the frame, as well as connecting cables 16. A connector 17 for a cable 18 for connection to a cellular telephone 19 is also provided.

The microphone 13 can also be integrated in the front 10, in which case electrical contacts for continuity must be provided at a corresponding hinge 20.

As regards the connector 17, it is of the female type and is embedded in a terminal 15, and can be of the commonly commercially available type that is complementary to a male connector 22 normally used in cellular telephone connections and located at the end of the connecting cable 18.

The connecting cable also comprises a branch, at the end of which an in-ear headset 14 is arranged.

The other end of the cable 18 is provided with another male connector 23, which can be inserted in a corresponding female connector 24 of the telephone 19.

The connector 23 can be either of the universal three-contact type (Figure 5), or of the four-contact type (Figure 6, designated by the reference numeral 23a).

The connector 17 is conveniently of the three-contact type in order to

interface with all telephone connection kits.

The connecting cables 16 (preferably of the shielded coaxial type in order to eliminate any interference) are embedded in the plastics material in the case of eyeglasses with a frame made of plastics, or are located inside hollow regions of the structure in the case of eyeglasses having a metal structure.

As regards the electronic noise reduction components, with particular reference to the previously cited Figure 4, an SMD passive noise reduction component is arranged in parallel to the microphone 13; such component is constituted by a capacitor 27 with a resistor 28 in series, also of the SMD type, in order to eliminate all transmission noise caused by electrostatic discharges.

A button 29 is further integrated in the temple 12, adjacent to the microphone 13, and is connected in parallel to the microphone 13 and in series to an interface resistor 30, which allows to recognize the clearance signal given by the button 29.

The button 29, which avoids the need to pull out the telephone whenever it is used, has at least one of the following functions:

-- manual answer (call acceptance);

-- end of call;

-- voice call start.

In a board 31 on which the electronic components are located, the surface arranged opposite the components is shielded with conducting material in order to avoid external noise.

In practice it has been found that the intended aim and objects of the present invention have been achieved.

The eyeglasses in fact appear to be entirely similar to normal corrective eyeglasses or sunglasses and can be used normally for this purpose, with the additional possibility, for example when driving, motorcycling, cycling or in other situations, to connect the microphone, by means of a cable, to a

cellular telephone and to a corresponding in-ear headset and therefore to be able to transmit and receive calls.

Moreover, with the automatic answer function it is not necessary to hold the telephone in one's hand, and by means of the button 29 it is possible to make calls locally without taking one's sight off the action, avoiding dangerous situations that can occur when driving a car.

In practice, the materials used, so long as they are compatible with the contingent use, as well as the dimensions, may be any according to requirements.

The disclosures in Italian Utility Model Application No. PD2002U000007 from which this application claims priority are incorporated herein by reference.

CLAIMS

1. Eyeglasses, characterized in that they comprise a microphone (13) in a front part thereof, electronic noise-reduction components (27, 28), connection cables (16) located inside the structure, and a connector (17) for a cable (18) for connection to a cellular telephone (19).

2. The eyeglasses according to claim 1, characterized in that said microphone (13) is located in the internal part thereof that is not visible.

3. The eyeglasses according to claim 1, characterized in that said microphone (13) is integrated in the front part of a temple (12).

4. The eyeglasses according to claim 1, characterized in that said microphone (13) is integrated in the front (10).

5. The eyeglasses according to claim 1, characterized in that said connecting cables (16) are embedded in the plastics material in the case of eyeglasses having a plastics frame.

6. The eyeglasses according to claim 1, characterized in that said connecting cables (16) are located inside hollow regions of the structure in the case of metal eyeglasses.

7. The eyeglasses according to claim 1, characterized in that said connector (17) is a female connector embedded in the corresponding terminal (15), said female connector (17) being complementary to the connectors used in cellular telephony connections.

8. The eyeglasses according to claim 1, characterized in that said electronic noise reduction components comprise an SMD passive noise reduction component, which is connected in parallel to said microphone and is constituted by a capacitor (27) and, in series with said capacitor, a resistor (28), also of the SMD type.

9. The eyeglasses according to claim 1, characterized in that said connecting cables (16) are of the shielded coaxial type.

10. The eyeglasses according to claim 1, characterized in that for noise reduction there is a shielding, made of conducting material, of the base on

which the electronic components are located, said shielding being provided on the opposite surface with respect to said components.

11. The eyeglasses according to claim 1, characterized in that a button (29) is integrated in the frame and is connected in parallel to said microphone (13).

12. The eyeglasses according to claim 11, characterized in that said button (29) is arranged in series to an interfacing resistor (30), which allows to recognize the clearance signal given thereby.

13. The eyeglasses according to claims 11 and 12, characterized in that said button (29) has at least one of the following functions:

-- manual answer (call acceptance);

-- end of call;

-- voice call start.

14. A connecting cable (18) for eyeglasses, characterized in that it comprises, at its ends, respective connectors (22, 23, 23a), one of said connectors being complementary to a connector (17) of the eyeglasses and one of said connectors being complementary to a connector of a telephone, said cable (18) having a branch with an in-ear headset (14).

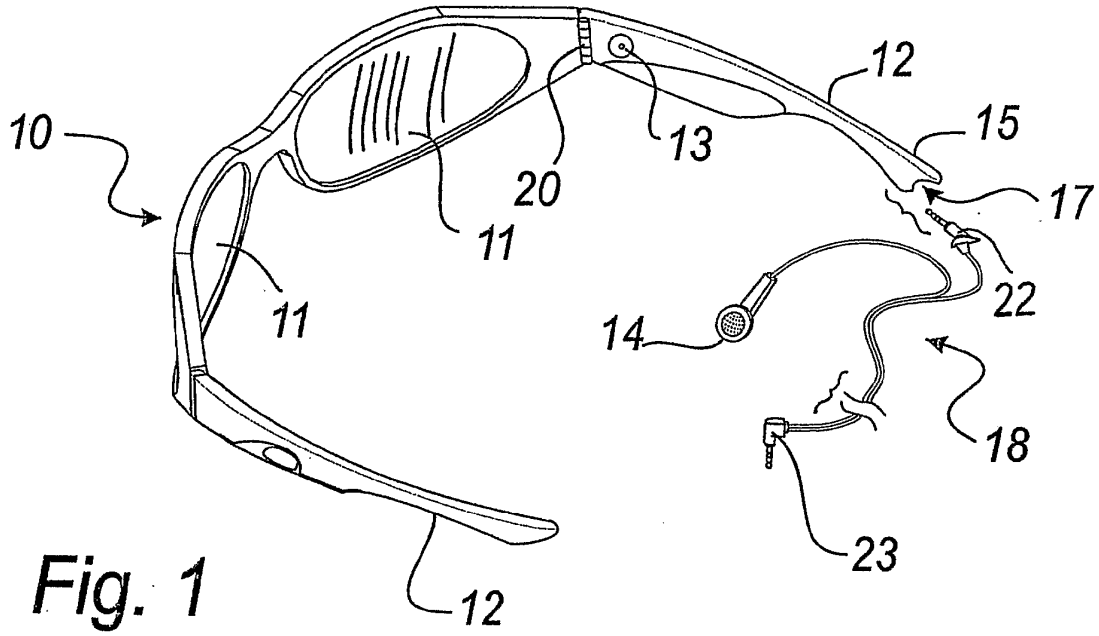


Fig. 1

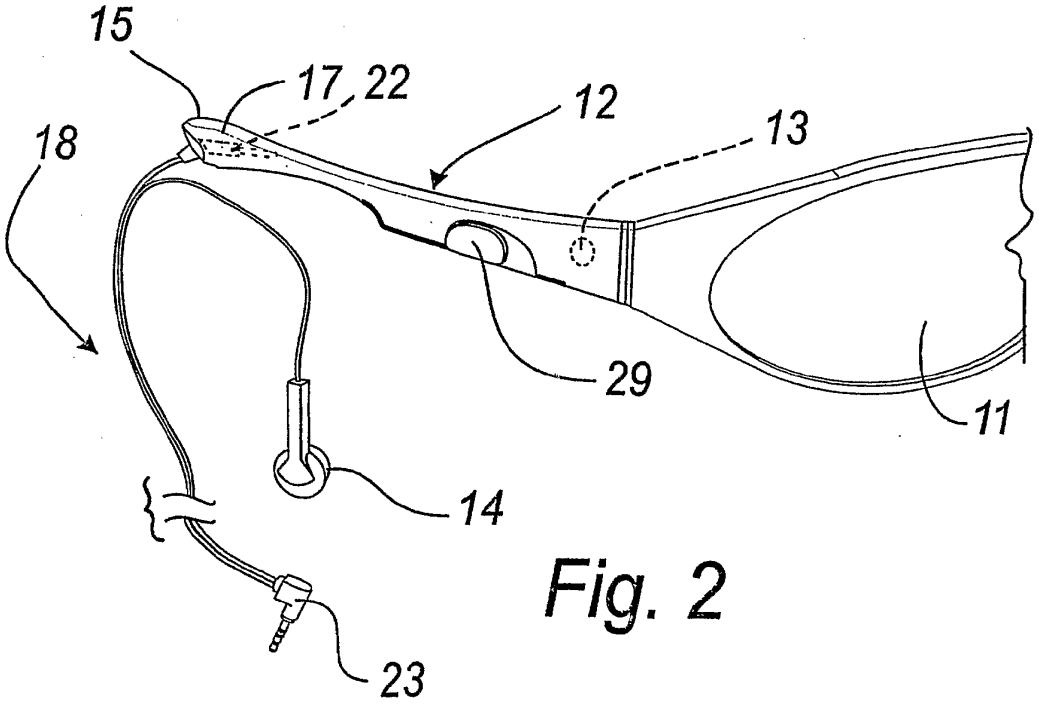


Fig. 2

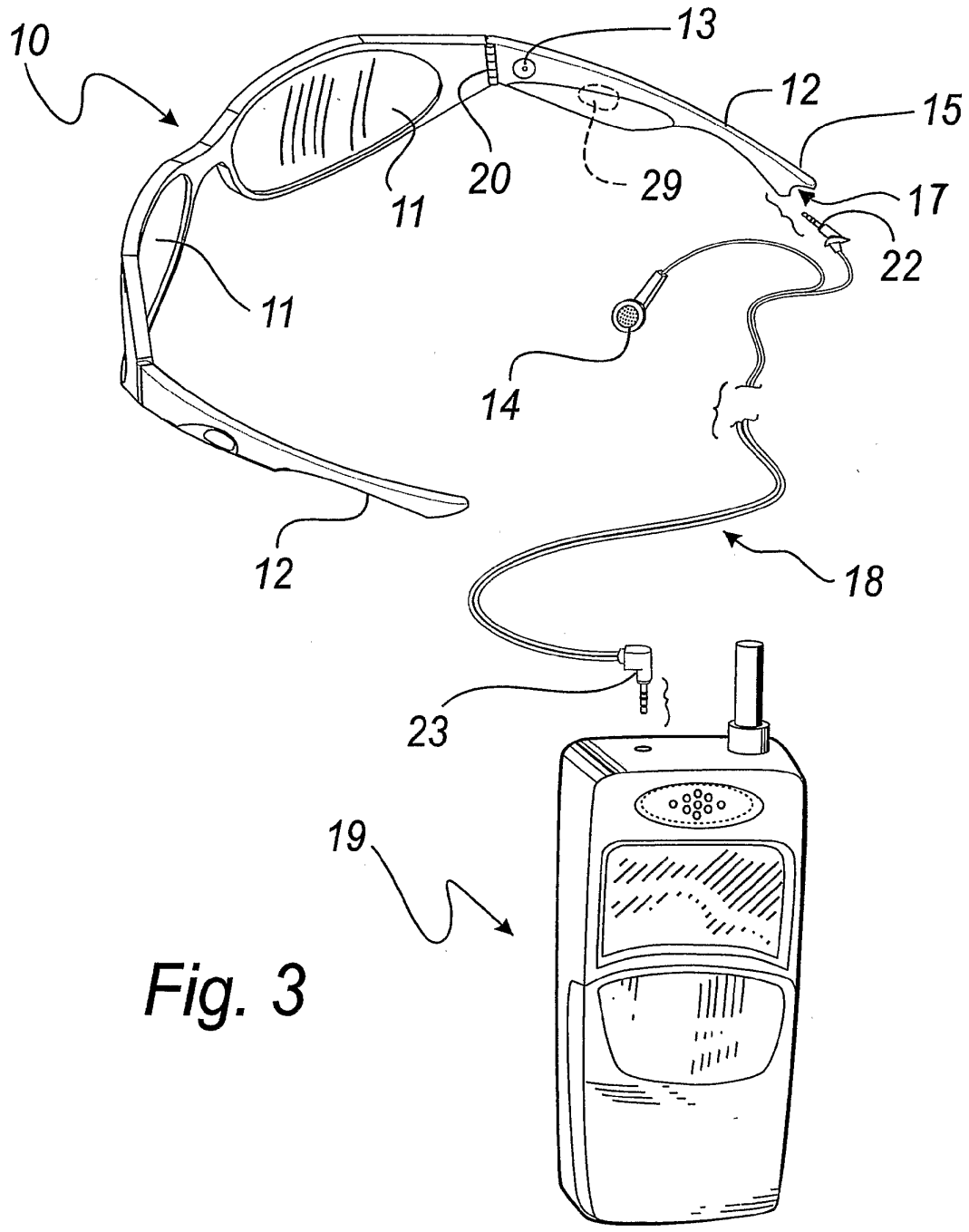


Fig. 3

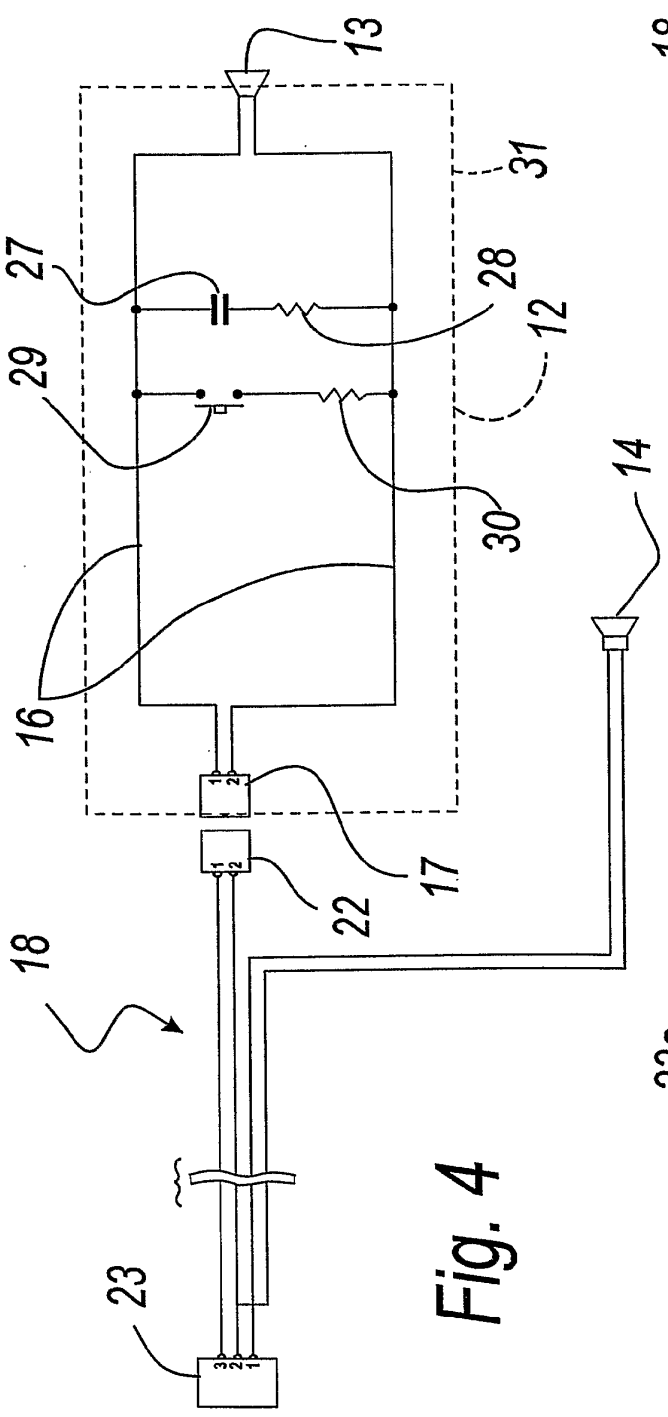


Fig. 4

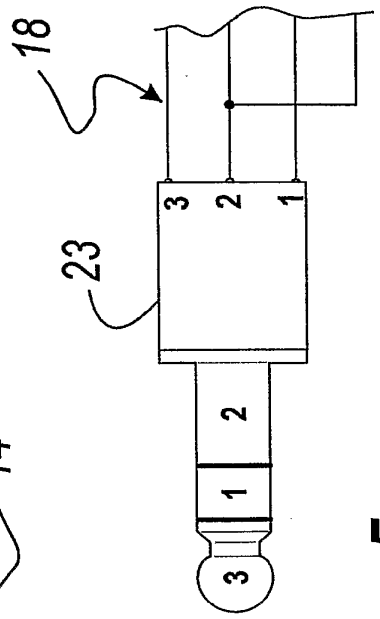


Fig. 5

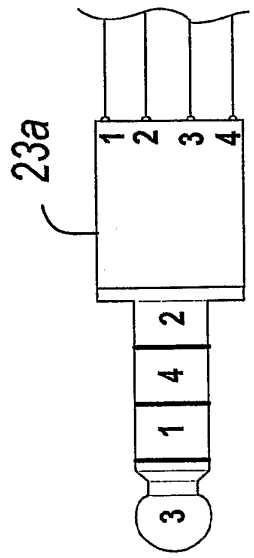


Fig. 6

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/00368

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G02C11/06

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 7 G02C

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, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	WO 90 10361 A (ULLMAN JOHAN) 7 September 1990 (1990-09-07) page 3, line 35 -page 11, line 17	1-14

-/--

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

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Date of the actual completion of the international search	Date of mailing of the international search report
9 April 2003	16/04/2003

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, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	CALLEWAERT, H

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Apple Inc. EX1002 Page 841

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

International Application No
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(12) DEMANDE DE BREVET CANADIEN
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(30) Priorité/Priority: 2001/06/26 (CA2351660) CA

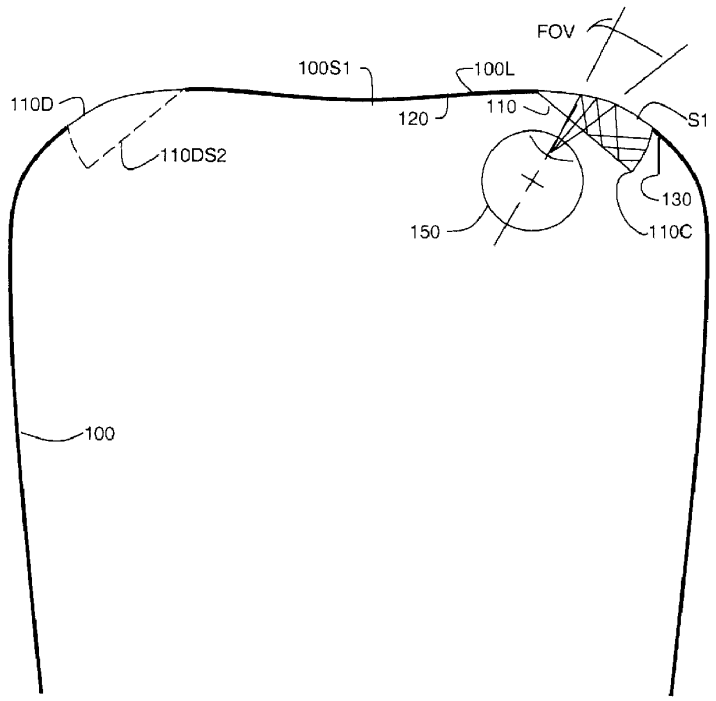
(51) Cl.Int.^{7}/Int.Cl.^{7} G02B 27/01, G06F 3/14, G02C 9/00

(71) Demandeur/Applicant:
MANN, STEVE, CA

(72) Inventeur/Inventor:
MANN, STEVE, CA

(54) Titre : LUNETTES DE SOLEIL INTELLIGENTES OU AFFICHEUR D'INFORMATIONS INFORMATISEES INTEGRE DANS DES LUNETTES D'APPARENCE ORDINAIRE, EVENTUELLEMENT AVEC LICENCE

(54) Title: SMART SUNGLASSES OR COMPUTER INFORMATION DISPLAY BUILT INTO EYEWEAR HAVING ORDINARY APPEARANCE, POSSIBLY WITH SIGHT LICENSE



(57) Abrégé/Abstract:
A wearable viewfinder or display apparatus for being incorporated into eyeglasses having an ordinary appearance is described. The wearable viewfinder or display provides eve safety by eliminating sharp objects and by matching eye contour with a low curvature or flat inward surface, but at the same time allows for a natural curvature outwardly, so that the outward facing surface of the eyeglass lens has a natural curvature, and therefore a natural (normal-looking to persons other than the wearer) appearance.

INTELLECTUAL PROPERTY
DISTRICT OFFICE
TORONTO
NOV 13 2001
TORONTO
BUREAU DE DISTRICT
PROPRIÉTÉ INTELLECTUELLE

ABSTRACT: SMART SUNGLASSES OR COMPUTER INFORMATION DISPLAY BUILT INTO EYEWEAR HAVING ORDINARY APPEARANCE, POSSIBLY WITH SIGHT LICENSE

A wearable viewfinder or display apparatus for being incorporated into eyeglasses having an ordinary appearance is described. The wearable viewfinder or display provides eye safety by eliminating sharp objects and by matching eye contour with a low curvature or flat inward surface, but at the same time allows for a natural curvature outwardly, so that the outward facing surface of the eyeglass lens has a natural curvature, and therefore a natural (normal-looking to persons other than the wearer) appearance.

1383_PROS_ART_002271

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INTELLECTUAL PROPERTY
DISTRICT OFFICE
TORONTO
NOV 13 2001
TORONTO
BUREAU DE DISTRICT
PROPRIÉTÉ INTELLECTUELLE

Patent Application

of

Steve Mann

for

SMART SUNGLASSES OR COMPUTER INFORMATION DISPLAY BUILT INTO EYEWEAR HAVING ORDINARY APPEARANCE, POSSIBLY WITH SIGHT LICENSE

of which the following is a specification:

FIELD OF THE INVENTION

The present invention pertains generally to a wearable apparatus that provides the wearer with an electronic display device, graticule, reticule, or crosshairs, similar to or suitable for a camera viewfinder screen, or for a wearable computer information display, or the like, while at the same time appearing to others as ordinary eyeglasses.

BACKGROUND OF THE INVENTION

Visual wearable computers of the 1970s and early 1980s (up to and including 1981, being the "seventies" of wearable computing) once tended to have an unusual appearance, primarily because of the display device over at least one eye of the user. This era was characterized by headworn devices, e.g. helmets, and headsets, such as devices having an appearance of headphones, with apparatus attached thereto.

Throughout the early 1980s a change from head mounted displays to eyeglass mounted displays took place as described in a wearable computing textbook recently published by John Wiley and Sons, entitled "Intelligent Image Processing", ISBN: 0-471-40637-6, 384 pages, published November 2, 2001.

Throughout the 1990s, the apparatus evolved into what appears as if it were ordinary looking eyeglasses. Various version of the "nineties" embodiment place components inside the eyeglasses.

1001_PRIOR_ART_00172

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Thus we wearable computing for Intelligent Image Processing (Personal Imaging) follows, in terms of physical appearance, three distinct eras:

- the seventies: headworn, helmets, headsets, headphones, etc.;
- the eighties: smart sunglasses, eyewear with components that persons other than the wearer can see:
- the nineties: eyewear having an ordinary appearance to others, preferably such that the apparatus is not detected by others.

Within the context of the "nineties" generation systems, it is desired that there be no sharp edges, and that preferably therefore, the inside surface have little or negative curvature (e.g. be not excessively convex, and in fact, ideally it would be approximately flat or concave toward the eye) and that the outside surface match approximately the curvature of the eyeglasses on the outside.

Accordingly, a wedge-shaped optical element mounted within or inside eyeglasses provides a view toward safety and ordinary appearance.

Preferably this wedge-shaped optical element is mounted in the lower portion of the field of view of at least one eye of the wearer of the eyeglasses, e.g. it is preferably mounted below the optical axis of straight-ahead vision. Preferably this wedge-shaped optical element is mounted so that the wedge points upward, so that the fatter end points downward toward a display element concealed within the lower portion of the eyeglass frames, or within a lower portion of an eyeglass lens. In this way, the apparatus will have the appearance of ordinary bifocal eyeglasses or ordinary reading glasses.

Preferably, either both eyes have a display, or if only one eye has a display, the other lens of the eyeglasses has a dummy element, to match the physical appearance of the functioning element. Thus both eyeglass lenses preferably have roughly identical appearance, so that the eyeglasses overall have a normal appearance.

SUMMARY OF THE INVENTION

1383_PRIOR_ART_000273

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It is possible with this invention to provide a wearable viewfinder that may be used without a camera of any kind, so that the wearer can simply imagine what it is like to be shooting, and can hone his or her compositional skills by having a reticle, graticule, crosshairs, or the like, in front of his or her vision at all times while wearing an embodiment of the invention.

It is possible with this invention to provide a wearable eyeglass based device allowing the wearer to view data, such as from the screen of a wearable computer (wearcomp) system but where the device appears to others to be simply a pair of ordinary eyeglasses.

When used with a camera, the invention can provide a viewfinder in which a very natural first-person perspective documentary results. A computational system, either built into the wearable camera, or worn on the body elsewhere and connected to the camera system, may be used to enhance images. This may be of value to the visually impaired. The computer may also perform other tasks such as object recognition. Because the device is worn constantly, it may also function as a photographic/videographic memory aid, e.g. to help in way-finding through the recall and display of previously captured imagery. For example, the wearable camera system may recognize the face of someone within the camera's field of view and superimpose the name of the person it recognized into the viewfinder. This is presented to the wearer in the form of a virtual name tag.

An important aspect of the invention, when combined with a camera, is the capability of the apparatus to mediate (augment, and to a limited extent diminish, or otherwise alter) the visual perception of reality.

It is possible with this invention to provide the user with a means of determining the composition of the picture from a display device that is located such that only the user can see the display device, and so that the user can ascertain the composition of a picture or take a picture or video and transmit image(s) to one or more remote locations, possibly as a personal safety device for use without the knowledge

1383_PRIOR_ART_000274

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of perpetrators, criminals, or terrorists in the immediate environment.

It is possible with this invention to provide the user with a means of determining the composition of the picture from a display device that is located such that only the user can see the display device, as well as an optional additional display device that the user can show to others if and when the user desires to do so.

It is possible with this invention to provide a means for a user to experience additional information overlaid on top of his or her visual field of view such that the information is relevant to the imagery being viewed.

It is possible with this invention to provide a means and apparatus for a user to capture a plurality of images of the same scene or objects, in a natural process of simply looking around, and then have these images combined together into a single image of increased spatial extent, spatial resolution, dynamic range, or tonal fidelity.

□

When used as a viewfinder the invention is simply a means of determining the extent of coverage of the camera in a natural manner, and may comprise either of:

- A reticle, graticule, rectangle, or other marking that appears to float within a portion of the field of view.

- A display device that shows a video image, or some other dynamic information perhaps related to the video image coming from a camera.

Other uses include a computer screen or other information that might include organizer, calendar, clock, airline information, etc..

One aspect of the invention allows a photographer or videographer to wear the apparatus continuously and therefore always end up with the ability to produce a picture from something that was seen a couple of minutes ago. This may be useful to everyone in the sense that we may not want to miss a great photo opportunity, and often great photo opportunities only become known to us after we have had time to think about something we previously saw.

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Such an apparatus might also be of use in personal safety, as a sousveillance (undersight) system to balance excessive surveillance (oversight). Although there are a growing number of video surveillance cameras installed in the environment allegedly for "public safety", there have been recent questions as to the true benefit of such centralized surveillance infrastructures, especially when the surveillance is not balanced with a reasonable degree of sousveillance. Most notably there have been several examples in which such centralized infrastructure has been abused by the owners of it (as in roundups, detainment, and execution of peaceful demonstrators). Moreover, "public safety" systems may fail to protect individuals against crimes committed by the organizations that installed the systems. The apparatus of this invention allows the storage and retrieval of images by transmitting and recording images at one or more remote locations. Images may be transmitted and recorded in different countries, so that they would be difficult to destroy, in the event that the perpetrator of a crime might wish to do so through the political machinery of a single country, state, or organization.

The apparatus of the invention allows information to be displayed to the wearer in a natural manner, without giving an unusual appearance to others (such as a potential assailant or human rights violator), and therefore can be used as a sousveillance system, or simply as a personal organizer.

□

According to one aspect of the invention, there is provided a display system in eyeglasses, wherein a wedge shaped display optic has a convex outer surface matching an approximate curvature and positioning of the lens of typical eyeglasses.

According to another aspect of the invention, there is provided a wearable camera concealed in the eyeglasses, in which the above mentioned crosshairs are used to aim the camera.

According to another aspect of the invention, there is provided eyeglasses in which a viewscreen in the eyeglasses provides an electronic viewfinder connected to the

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output of the camera also concealed in the eyeglass frames. Preferably this viewfinder allows the wearer to examine not just composition, but also exposure, contrast, and details of the image, as well as meta information such as that determined by an object recognition program that might, for example, recognize faces of people in the picture and remind the wearer who it is that the wearer wanted to photograph, or remind the wearer of people in the picture who are not satisfied with their picture portraits, or who need to be re photographed in better lighting or the like, or the wearable face recognizer might recognize people and construct a family tree in the viewfinder so for example, a wedding photographer could orient himself for best shot of the group by understanding and arranging individuals in a meaningful order.

According to another aspect of the invention there is provided an information display having the appearance of ordinary eyeglasses.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of examples which in no way are meant to limit the scope of the invention, but, rather, these examples will serve to illustrate the invention with reference to the accompanying drawings, in which:

FIG. **1** illustrates the principle and components of typical eyeglass display of the invention.

FIG. **2** illustrates an outwardly displaying embodiment of the invention in which the optical elements form part of the outer surface of the eyeglasses.

FIG. **3** illustrates a downwardly displaying embodiment of the invention having the appearance of ordinary bifocal eyeglasses.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

While the invention shall now be described with reference to the preferred embodiments shown in the drawings, it should be understood that the intention is not

1001_PRIOR_ART_00177

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to limit the invention only to the particular embodiments shown but rather to cover all alterations, modifications and equivalent arrangements possible within the scope of appended claims.

In all aspects of the present invention, references to "camera" mean any device or collection of devices capable of simultaneously determining a quantity of light arriving from a plurality of directions and or at a plurality of locations, or determining some other attribute of light arriving from a plurality of directions and or at a plurality of locations. Similarly references to "viewscreen" shall not be limited to just miniaturized television monitors or computer monitors, but shall also include computer data display means, as well as fixed display means, where such fixed display means include crosshairs, graticules, reticles, brackets, etc., and other video display devices, still picture display devices, ASCII text display devices, terminals, and systems that directly scan light onto the retina of the eye to form the perception of an image.

References to "processor", or "computer" shall include sequential instruction, parallel instruction, and special purpose architectures such as digital signal processing hardware, Field Programmable Gate Arrays (FPGAs), programmable logic devices, as well as analog signal processing devices.

When it is said that object "A" is "borne" by object "B", this shall include the possibilities that A is attached to B, that A is part of B, that A is built into B, or that A is B.

FIG. 1 is a diagram depicting a pair of eyeglasses, having temple side pieces of frame 100 with frames that support eyeglass lenses 100L. The term "lens" is used in the wide sense to include lenses having infinite focal length, as found, for example, in decorative or fashionable non-corrective eyewear, or in sunglasses where lenses 100L provide light control (attenuation, polarization, etc.).

An eye axis EA of an eye 150 of the wearer is defined as an axis when looking straight ahead. A viewing axis VA of eye 150 is defined when looking off-axis. The direction of off-axis looking for the viewing axis is a direction of looking such that

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the eye is looking at the center of an image of a display element 130 as magnified, focused, or the like, by optics 110. Satisfactory optics are the optics manufactured by Canon, as described in U.S. Pat. No. 6,292,301, or other similar wedge-shaped optics with display element opposite an apex of the wedge.

Viewing Axis VA may be in any of various directions. In a preferred embodiment of the invention, for a right eye system, VA is to the right or downwards of eye axis EA, and for a left eye system, VA is to the left or downwards of eye axis EA. Without loss of generality, Fig. 1 depicts a right eye outward system, where it is understood that either or both eyes may be accommodated with display capability in either an inward or downward (or even upward or inward) embodiment without departing from the spirit of the invention.

Optics 110 has an outer surface S1, and an inner (eyeward) surface S2. If optics 110 has a corner 110C on an eyeward side, the corner is preferably rounded so that it is not a sharp surface. Alternatively, a shroud 110S forms an eye protection surface, so the entire inward surface S2 matches shroud 110S to form a continuously smooth surface. Shroud 110S also forms a light-tight seal along with eyeglass frames 100.

Optics 110 also has an apex 110A. In the outward embodiment an apex 110A points inward. In the outward right-eye embodiment, the wearer may see the image display as being straight ahead, such that EA and VA are approximately collinear, but preferably the image display is off to the side. In the preferred outward right-eye embodiment, the wearer looks to the right to see along a viewing axis VA.

The shape of optics 110 is such that the inward surface S2, (along with a shroud 110S, if present) forms a smooth safe inward surface for the eyeglasses. Opposite the apex 110A is a magnifying surface, S3. A display element 130 defines a display axis DA. The outward end of display axis DA is angled in an outward direction away from eye 150, wheras the inward end of display axis DA is angled inward toward eye 150.

A portion 120 of eyeglass lenses 100L will typically allow some see-around capability, so that the wearer of the glasses can see around the display optic 110. In

1383_PRGR_ART_00179

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a preferred embodiment of the eyeglasses, the portion 120 allows the wearer to see straight ahead. In a preferred embodiment of the invention, the optics 110 begins to block the wearer's view from roughly straight ahead, to an outward portion of straight ahead. In some preferred embodiments, when the wearer looks outward to see the display, the wearer can see above and below the optics 110, so that the wearer has full stereo vision in a good portion of the field of view around the display.

Wiring 140W is concealed inside ordinary looking eyeglass safety straps to connect to a pocked sized computer, or the like. Alternatively the computer may be built into the eyeglass frames. Other devices in the eyeglasses such as a microphone, speakers, indicator lights, cameras, etc., allow the eyeglasses to function as a telephone, videophone, pocket organizer, personal safety device, or the like. For example, in some, but not necessarily all embodiments of the invention, one or more cameras 160L, 160C, and 160R may be present. Preferably a right camera 160R and a center camera 160C (preferably concealed in the nosebridge of the glasses) provide outputs to a processor for interpolation of viewpoint, to achieve an effective viewpoint of eye 150. Preferably the dimensional stability of the eyeglass frames is such that the epipolar geometry across cameras 160C and 160R is sufficiently fixed, that it can be determined in one calibration step. Thus two images, a center image from camera 160C and a right image from camera 160R can be processed jointly by way of a coordinate transformation that causes epipolar lines to be parallel along one axis. Then the interpolation between these two cameras is a simple matter. Preferably the outputs of the two cameras are somewhat identical so that interpolation errors at worst provide an image no worse than just incorrectly selecting viewpoint 160C or 160R not exactly at eye 150.

In other embodiments, a near infrared camera and a source of infrared illumination in the eyeglasses provide some kind of night vision capability. Alternatively, an infrared bolometer or other kind of thermal imaging system in the eyeglass frames may provide passive IR vision system with no light source required.

1383_PROS_APP_002350

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An infrared camera may also be incorporated into the system by making surface S1 into a hot mirror and allowing light to be reflected from subject matter onto the hot mirror. Another embodiment has one or both lenses 100L being hot mirrors for reflection of infrared light back to an IR camera.

A detachable module may be placed on the glasses when using them as an IR vision system, so that they function ordinarily as only a display, and then become a thermal vision system when the detachable portion is used.

In another embodiment, the eyeglasses may display images from other body worn imaging systems, such as a neckworn infrared bolometer, concealed in neck wear. In this case, the relative orientation of eyeglasses and neckwear may be determined by inertial guidance systems upon each of these two items, so that their relative orientation is known. Other sensors that determine relative orientation and position feed this information to a processor to compute and overlay 3D scene information and annotation.

Thus a computer mediated reality environment is possible, wherin the apparatus does not have an unusual appearance. In this way personal safety environments can be created in which large corporate or government organizations may not necessarily be safe harbours for terrorists. With the possibility that an ordinary person might capture good quality images of terrorist or state-sponsored terrorist activity, there is a risk, for these engaging in and supporting such activity of being discovered.

Such an apparatus may also include a sight license feature. A sight license is a license to see. A sight license may be downloaded over the network to enable the eyeglasses to operate. For example, a retinal or iris scanner in the eyeglasses may license the eyeglasses to provide sight to the wearer, but not to others who might steal the eyeglasses.

A communication between the apparatus and room lighting, heating, ventilation, and the like, of an intelligent building may provide a situation in which lights in the room turn off automatically when a person without a seeing license enters the room.

1383_PROS_APP_00281

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The intelligent building can know if persons have a seeing license, and also it can know how many people are in a room. If the number of persons in a room exceeds the number of licenses detected, the lights can go off automatically. Some persons with sight licenses may have the eyeglasses of the invention such that the eyeglasses automatically start operating when the room lights turn off.

Those with sight licenses who are wearing the eyeglasses can assist others with sight licenses who do not have eyeglasses. These licensed persons can be assisted into an adjoining room, or other location, leaving only the unlicensed persons in the dark.

Windows in the building can be equipped with kerr cells, electrochromic materials, or other light control materials so that any natural light can be turned off to make rooms dark when desired. Thus in the presence of trouble, terrorism, crime, or suspicion, a sight license enforcement signal can be sent so that only those with sight licenses can see properly. Fogging agents can also be sent through the ductwork to reduce vision further, in the event that unlicensed individuals might carry unauthorized seeing aids such as pocket illuminators, flashlights cigarette lighters, or other contraband.

A seeing license downloaded into eyeglasses of the invention with infrared bolometer or thermal camera will allow licensed persons to continue seeing through darkness, fog, and other sight license circumvention prevention measures.

Additionally, certain markings, indicia, etc., in buildings and other places may be provided to those with a sight license. Licensed looking at certain materials is thus possible. Such infrastructure can be used to keep terrorists (or those suspected of possible terrorism) in the dark. Moreover, since those with sight licenses can be processed more easily, and since there becomes a benefit to becoming among those being certain not to be terrorists, there is an incentive to enroll in a group of non-terrorists. Unregistered aliens become categorized among those suspected of terrorism, communism, witchcraft, plague, disease, or whatever else is the preferred category for which to stigmatize a non-docile portion of the population.

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Other licenses may be incorporated. For example, all clocks in the environment may be equipped with special license servers, so that if there are unlicensed persons in view of a clock, the clock does not properly display time. Therefore undesirables can be kept from knowing the time of day. Moreover, a clock built into the eyeglasses can operate when a license is detected. Thus license-wear can be used to allow licensed individuals to have information, while ensuring that undesirables are kept in the dark.

Moreover, by replacing public services such as large clock towers, with licensed public services like time transmitters that can be received by licensed individuals, it can be made harder for unlicensed (unprocessed) persons to carry out their day-to-day lives.

A license can be coupled to other activity, such as vaccination, so that unvaccinated persons get fewer and fewer services, to the extent that their lives are made more difficult. This will provide an incentive to get with the program, and enroll for a vaccinID (TM) vaccine chip implant combined with identification and tracking device. VaccinID (TM) ensures that those receiving a vaccine dispensing identifying implant can be tracked for further softwear upgrades to their vaccine identification device.

Those not yet implanted or processed will be suspected of witchcraft, terrorism, or whatever else is unfashionable at the time.

Thus the information display of the invention can be used in a license network, such as a sight license, information license, reading license, walking license, license to sit (as described in http://wearcam.org/seatsale/index.htm) or the like.

FIG. 2 depicts an embodiment of the invention in which an outer surface such as S1 of optics 110 is actually part of, or blended into the outer surface 100S1 of the eyeglasses or eyeglass lens 100L. The optics 110 may be actually part of the eyeglass lens 100L, or may be bonded to the eyeglass lens 100L, preferably with index-matching adhesive, so that there is no apparent discontinuity. In some embodiments, lens 100L may be tinted in areas around optics 110, so that these surrounding areas of the lens

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100L match the appearance of optics 110. Especially if optics 110 has a mirrored or partially silvered or partially reflective outer surface S1, then it is desired to tint the lens 100L to match this mirrored or partially silvered, or partially reflective outer surface S1.

Preferably cameras, if present, are all angled toward the same field of view FOV as provided by the display apparatus. Thus in this example, one or more cameras (such as cameras 160L, 160C, and 160R) would all be pointed toward the right, so that they would have the same field of view FOV as an eye 150 sees on the display apparatus of the invention.

A dummy optic 110D preferably matches the appearance of the main optic 110. The dummy optic may also have only the surface structure, so that there is a less severe distortion in which case inner surface 110DS2 of the dummy optic may be absent or less inclined with respect to the outer surface. The optics 110 (and possibly 110D) may be progressive, like progressive multifocal eyeglasses, so that the optics blend into the eyeglass structure, and are not particularly visible to others. Others can see the wearer's eyes when looking at the wearer straight on, whereas the distortion in the seeing of the wearer's eyes would only be seen from one side (or the other).

FIG. 3 is a diagram depicting an embodiment of the invention in a pair of bifocal eyeglasses, and will serve to define the terminology pertaining to various parts of the bifocal eyeglasses. Eyeglasses are normally held upon the head of the wearer by way of temple side pieces 310. These temple side pieces 310 support, by way of a hinge held on with rivets 320, a frame 330. Within frame 330 are two lenses 340. Lenses 340 contain inset lenses 350 which might ordinarily have different prescriptions than lenses 340 in which they are set. Thus, within the context of the invention, optics 110 may be concealed by way of inset lenses 350, either as part of inset lenses 350, or in place of inset lenses 350.

There is typically a cut line 360 between lens 340 and lens 350. This cut line forms the apex 110A of optics 110. Alternatively, a more progressive kind of eyeglass lens

1003_PROOF_ART_000264

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can be made in which optics 110 are continuously embedded into the eyeglass lenses 340.

In ordinary usage of bifocal eyeglasses, lens 340 would provide a prescription for distant objects while inset lens 350 would provide a prescription for nearby objects. Lens 350 would be commonly used for reading. Accordingly, lens 340 would, in some cases, have infinite focal length (zero power) and simply serve as a support for lens 350, which would typically be a lens of positive focal length (e.g. a magnifying glass).

Therefore, in the context of the present invention, lens 350 being part of the information display, results in a natural user-interface in which the wearer simply looks downward to read material from the computer screen. This user-interface is intuitive and easy to learn, because many people are already familiar with bifocal eyeglasses in the context of reading paper based media, or the like, so using the same arrangement to read a computer screen is quickly learned.

In some cases, lens 340 may be non existent, as in typical reading glasses, in which lens 350 is mounted directly to frame 330, and the wearer looks over frame 330 to see distant objects and would look through lens 350 to see nearby objects such as the pages of a book. Thus an embodiment of the invention may be one in which there is no lens 340, and wherein lens 350 is optics 110. Thus optics 110 is mounted directly to the eyeglass frames, with the apex 110A of optics 110 mounted at the top, so that the wearer looks over the apex 110A to see the real world. The wearer looks downward to see the computer generated world.

In the bifocals embodiment, apex 110A corresponds to cut line 360. However, in many modern multifocal eyeglasses, there is no visible cut line 360, and instead there is a gradual ("progressive") transition from the prescription of lens 340 to that of lens 350. Such multifocal lenses are known as *progressive*. The purpose of such gradual transition is to accommodate a variety of distances, in situations where the wearer normally has an inability to focus over any appreciable range of distances, as well as for improved appearance. Since the need for multifocal lenses shows a deficiency

1383_PROOF_ART_00285

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on the part of the user, there has been a trend toward hiding this deficiency, just as there has been a trend toward contact lenses and laser eye treatments to eliminate the need for eyewear altogether. However, amid the desire among some to hide the fact that they need bifocals or even just ordinary glasses, there are others who like to wear eyeglasses. Even some people who do not need eyeglasses often wear so-called pseudo-intellectual glasses, which are glasses in which lens 340 has infinite focal length. Moreover, bifocal eyeglasses and reading glasses are often associated with intellectuals, and thus there is a portion of society that would readily wear glasses having the general appearance of those depicted in FIG. **3**, even if they did not require a prescription of any kind.

The eyeglass lenses 340 may also contain markings 370 made directly on the glass. Such markings, for example, may be the manufacturer's name or an abbreviation (such as the letters "GA" engraved on the left lens of Giorgio Armani (trade-mark) glasses). For illustration in this disclosure, the markings "L" and "R" denote left and right lenses, as labeled from the perspective of the wearer. Such markings may also be useful to conceal other optical elements.

Rivets 320 may also be used to conceal cameras. Alternatively, camera lens openings can be made to have the appearance of rivets 320. One or more cameras such as one in the nosebridge, and one at one or both sides of the eyeglass frames, can be angled down to match the field of view of the downward embodiment of the invention. Additionally, a processor can be used to interpolate viewpoints to get the eye viewpoint. Alternatively, a computer system, informed by a computer vision system from the cameras, can be used to synthesize a computer generated world as rendered from the viewpoint of an eye of the wearer.

From the foregoing description, it will thus be evident that the present invention provides a design for a wearable display or camera viewfinder. As various changes can be made in the above embodiments and operating methods without departing from the spirit or scope of the invention, it is intended that all matter contained in

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the above description or shown in the accompanying drawings should be interpreted as illustrative and not in a limiting sense.

Variations or modifications to the design and construction of this invention, within the scope of the invention, may occur to those skilled in the art upon reviewing the disclosure herein. Such variations or modifications, if within the spirit of this invention, are intended to be encompassed within the scope of any claims to patent protection issuing upon this invention.

1383_PRIOR_ART_002307

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WHAT I CLAIM IS:

1. A display system for use as a viewfinder or for viewing a static pattern or variable information for use within eyeglasses having an appearance of ordinary eyeglasses when including the display, said display comprising:

   - a display element;
   - a wedge-shaped optical element having an outer convex side for facing away from an eye of a wearer of said display system, and an inward side for facing toward an eye of a wearer, said inward side being one of:
     - concave;
     - approximately flat;
     - less convex than said outer convex side,

     said wedge-shaped optical element having an apex edge opposite a display-facing surface, said display facing surface facing said display,

   said outer convex side having approximately equal curvature to a surface of an outward facing surface of said eyeglasses.

2. A display system for use as a viewfinder or for viewing a static pattern or variable information for use in eyeglasses having an appearance of ordinary eyeglasses when said eyeglasses include the display, said display comprising:

   - a display element;
   - a wedge-shaped optical element having an outer convex side for facing away from an eye of a wearer of said display system, an inward side for facing toward an eye of a wearer, said inward side being one of:
     - concave;
     - approximately flat;
     - less convex than said outer convex side,

1383_PRGR_ART_002200

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and an edgeward facing side for facing said display element, said wedge-shaped optical element having an approximately triangular cross section, said outer convex side forming a long side of said approximately triangular cross section, said inward side forming another long side of said approximately triangular cross section, said edgeward facing side forming a short side of said approximately triangular cross section, an apex edge forming a point of said approximately triangular cross section, said point between said two long sides,

said outer convex side having approximately equal curvature to a surface of an outward facing surface of said eyeglasses.

3. A display system comprising display eyeglasses for use as a viewfinder or for viewing a static pattern or variable information, said eyeglasses comprising:

   - a display element;
   - a wedge-shaped optical element having an outer convex side for facing away from an eye of a wearer of said display eyeglasses, and an inward side for facing toward an eye of a wearer of said eyeglasses, said inward side being one of:
     - concave;
     - approximately flat;
     - less convex than said outer convex side,

     said wedge-shaped optical element having an apex edge opposite a display-facing surface, said display facing surface facing said display.

   said outer convex side having approximately equal curvature to a surface of a portion of a lens of said eyeglasses.

4. The display system of any of claims claim 1 to claim 3 said display system having an outward facing Viewing Axis.

1383_PROS_APP_002259

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5. The display system of any of claims claim 1 to claim 3 said display system having a downward facing Viewing Axis.

6. The display system of any of claims claim 1 to claim 3 said apex edge running up and down approximately in front of an eye of a wearer of said display system, when said display system is in use.

7. The display system of any of claims claim 1 to claim 3 said apex edge running left to right below an eye of a wearer of said display system, when said display system is in use.

8. The display system of any of claims claim 1 to claim 3 said apex edge running left to right along a line at a position close to the position in which a cut line of typical bifocal eyeglasses would run.

9. The display system of any of claims claim 1 to claim 3, further including a safety shroud running from an inward corner edge of said optical element, said inward corner edge on an edge of said inward facing surface opposite said apex edge.

10. The display system of any of claims claim 1 to claim 3 said outer surface of said optical element forming at least part of at least one lens of said eyeglasses.

11. The display system of any of claims claim 1 to claim 3 said outer surface of said optical element bonded to at least one lens of said eyeglasses, said bonding such that said optical element is concealed within a continuous surface of said eyeglass lens.

12. A display system of any of claims claim 1 to claim 3 further including a Sight License server.

13. A display system of any of claims claim 1 to claim 3 further including a camera borne by said eyeglasses.

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14. A display system of any of claims claim 1 to claim 3 further including a bolometer borne by said eyeglasses.

15. A display system of any of claims claim 1 to claim 3 where a lens of said eyeglasses has a mirrored finish.

16. A display system of any of claims claim 1 to claim 3 where a lens of said eyeglasses has a dark tint to conceal said optical element.

17. A display system of any of claims claim 1 to claim 3 where a lens of said eyeglasses has a dark or reflective tint around where said optical element is installed, such that a transmissivity loss of said optical element is matched to the surrounding view around said optical element.

1383_PRIOR_ART_00291

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INTELLECTUAL PROPERTY
DISTRICT OFFICE
TORONTO
NOV 13 2001
TORONTO
BUREAU DE DISTRICT
PROPRIÉTÉ INTELLECTUELLE

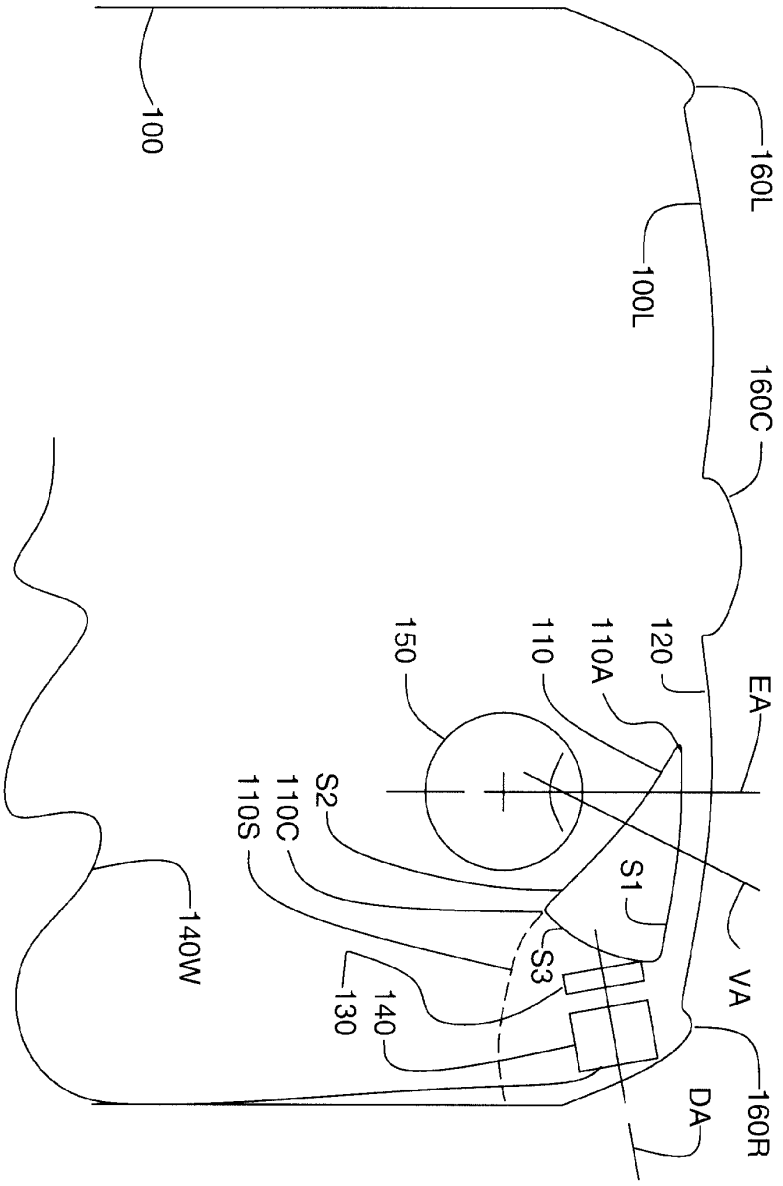


FIG. 1

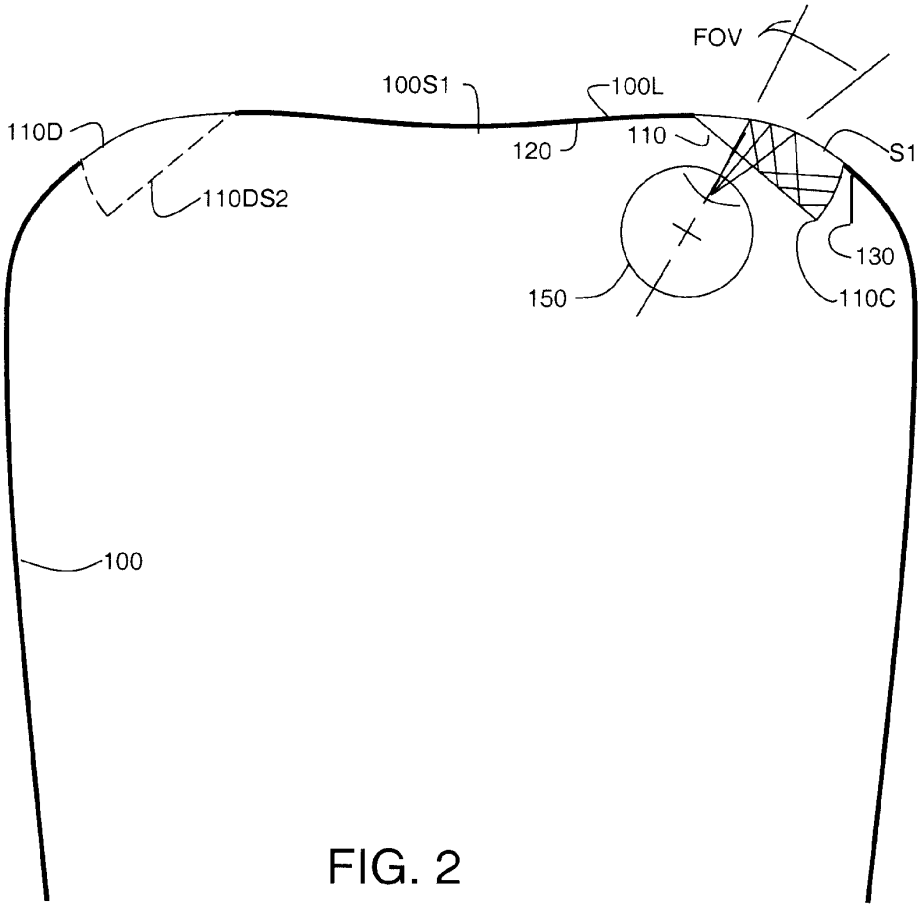


FIG. 2

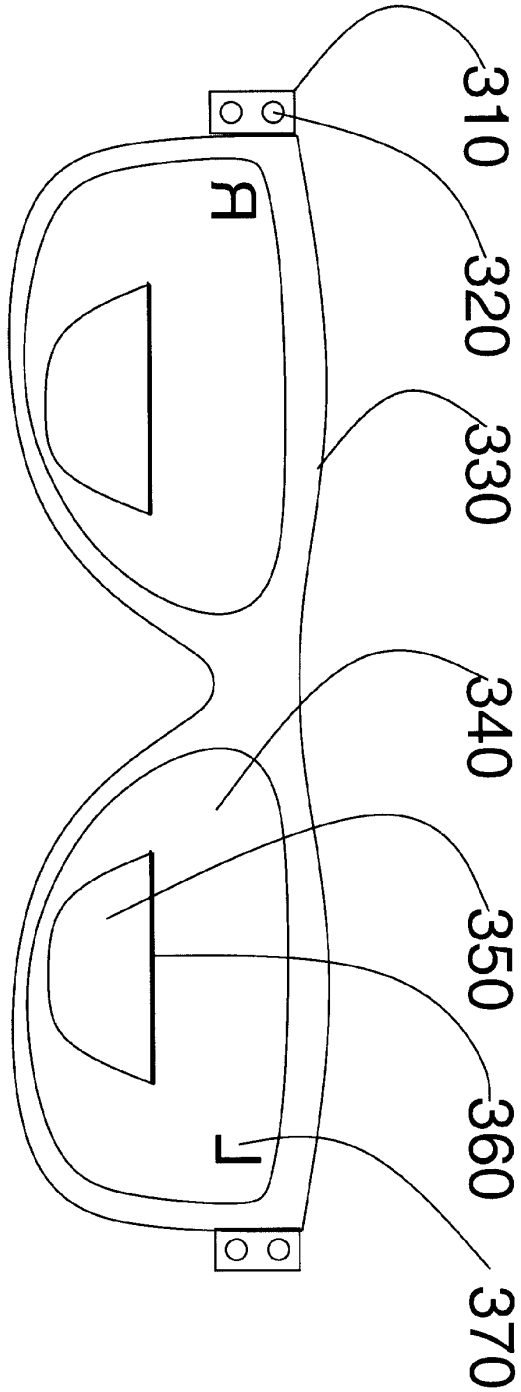
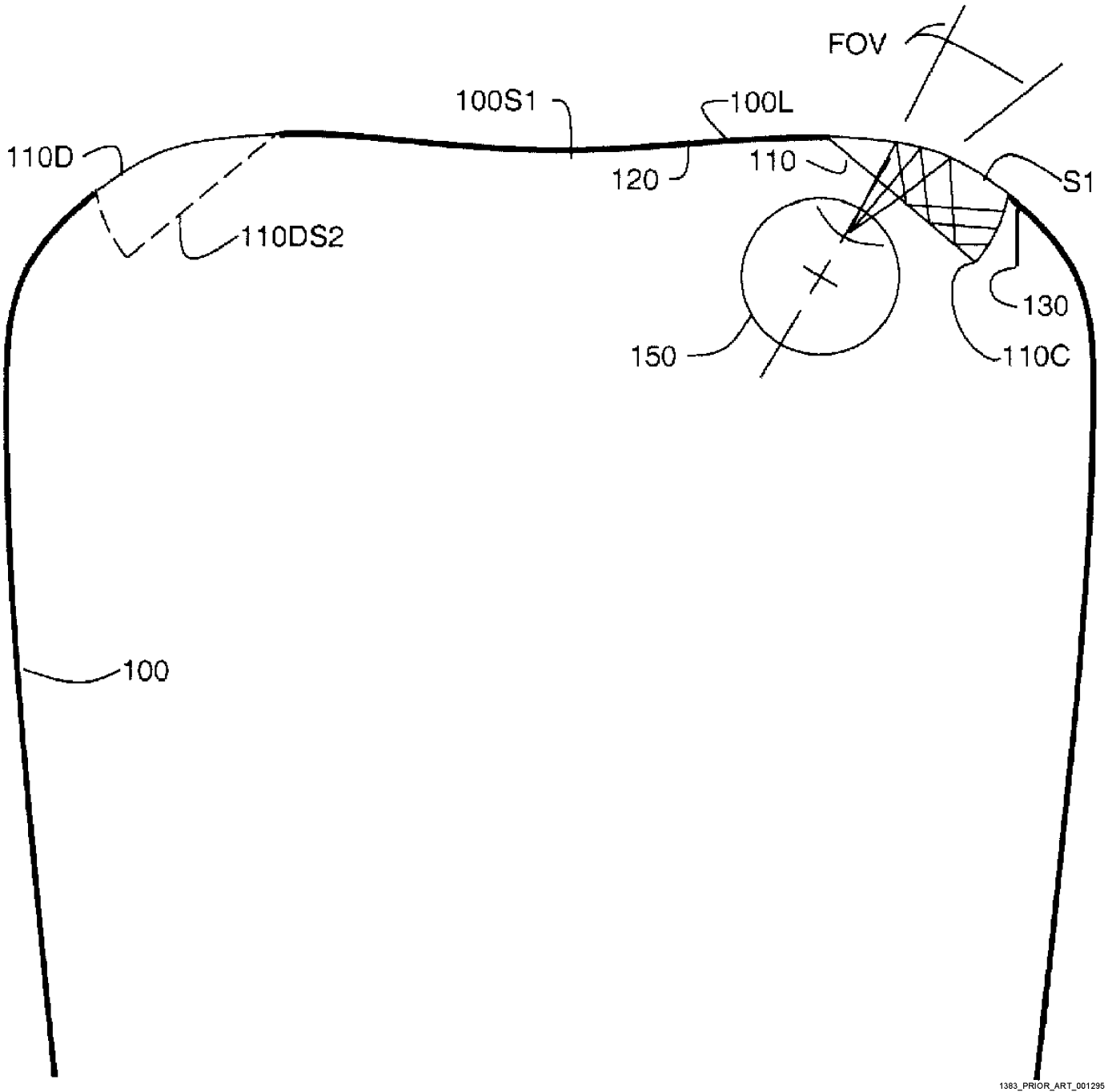


FIG. 3


FOV
100S1
100L
110D
120
110
S1
110DS2
130
150
110C
100
1383_PRIOR_ART_001295

OPIC
OFFICE DE LA PROPRIÉTÉ INTELLECTUELLE DU CANADA

CIPO
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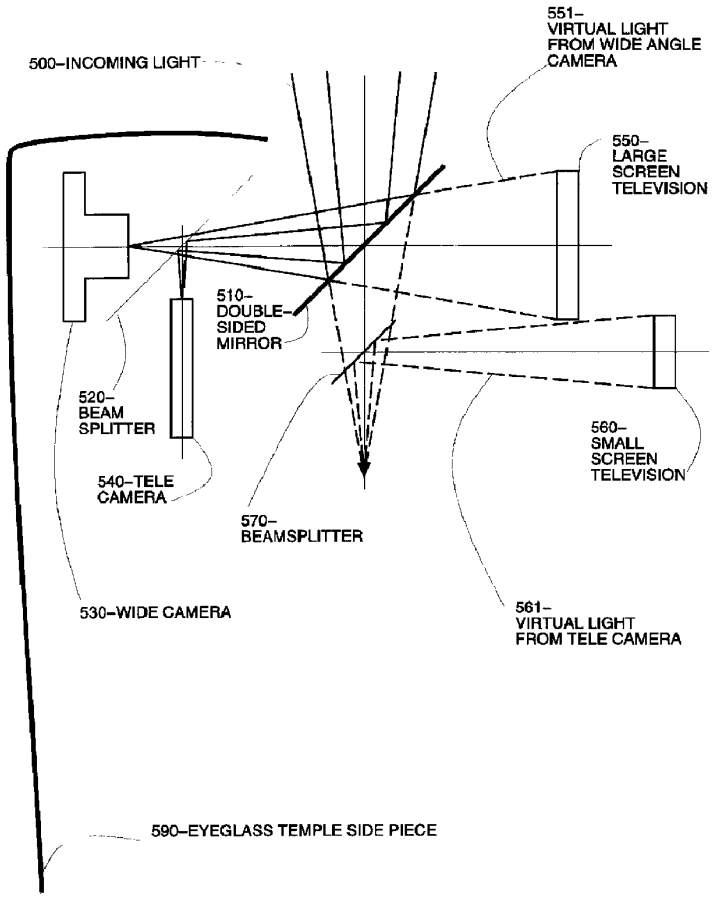
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(54) **SYSTEME DE CAMERA PORTABLE AVEC VISEUR**
(54) **WEARABLE CAMERA SYSTEM WITH VIEWFINDER MEANS**



FOVEATED WEARABLE CAMERA WITH FOVEATED VIEWFINDER MEANS

(57) A novel means and apparatus for a new kind of photography and videography is described. In particular, a wearable camera with viewfinder means is introduced. The system, in effect, absorbs and quantifies rays of light that are processed on a small wearable computer system and re-constituted to emerge to reconstruct the virtual image of objects at nearly the same position in space, or at a coordinate transformed position, as viewed by the wearer of the apparatus. The wearer of the apparatus becomes, after adaptation, an entity that seeks, without conscious thought or effort, an optimal point of vantage and camera orientation. Because of the wearer's ability to constantly see the world through the invention, which may also function as an image enhancement device, the apparatus behaves as a true extension of the wearer's mind and body, giving rise to a new genre of documentary video.

ABSTRACT: WEARABLE CAMERA SYSTEM WITH VIEWFINDER MEANS

A novel means and apparatus for a new kind of photography and videography is described. In particular, a wearable camera with viewfinder means is introduced. The system, in effect, absorbs and quantifies rays of light that are processed on a small wearable computer system and re-constituted to emerge to reconstruct the virtual image of objects at nearly the same position in space, or at a coordinate transformed position, as viewed by the wearer of the apparatus. The wearer of the apparatus becomes, after adaptation, an entity that seeks, without conscious thought or effort, an optimal point of vantage and camera orientation. Because of the wearer's ability to constantly see the world through the invention, which may also function as an image enhancement device, the apparatus behaves as a true extension of the wearer's mind and body, giving rise to a new genre of documentary video.

Patent Application

of

Steve Mann

for

WEARABLE CAMERA SYSTEM WITH VIEWFINDER MEANS

of which the following is a specification:

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FIELD OF THE INVENTION

The present invention pertains generally to a new photographic or video means and apparatus comprising a body-worn portable electronic camera system with wearable viewfinder means.

BACKGROUND OF THE INVENTION

In photography (and in movie and video production), it is desirable to capture events in a natural manner with minimal intervention and disturbance. Current state–of–the–art photographic or video apparatus, even in its most simple "point and click" form, creates a visual disturbance to others and attracts considerable attention on account of the gesture of bringing the camera up to the eye. Even if the size of the camera could be reduced to the point of being negligible (e.g. no bigger than the eyecup of a typical camera viewfinder, for example), the very gesture of bringing a device up to the eye is unnatural and attracts considerable attention, especially in establishments such as gambling casinos or department stores where photography is often prohibited. Although there exist a variety of covert cameras such a camera concealed beneath the jewel of a necktie clip, cameras concealed in baseball caps, and cameras concealed in eyeglasses, these cameras tend to produce inferior images, not just because of the technical limitations imposed by their small size, but, more importantly because they lack a means of viewing the image. Because of the lack of

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viewfinder means, investigative video and photojournalism made with such cameras suffers from poor composition.

Accordingly, what is proposed is a wearable camera and viewfinder means for capturing video of exceptionally high compositional and artistic calibre. In addition to the fact that covert versions of the apparatus can be used to create investigative documentary videos having very good composition, for everyday usage, the device need not necessarily be covert, and may, in fact, be a fashionable device that serves as both a visible crime deterrent, as well as a tool for documentary videomakers and photojournalists.

Moreover, the fact that the apparatus can be worn comfortably for many hours suggests a new genre of documentary video characterized by long-term psychophysical adaptation to the device. The result is a very natural first-person perspective genre of documentary, whose artistic style is very much as if a recording could be made from a video tap of the optic nerve of the eye itself.

Although one could imagine mounting a video camera with viewfinder onto a helmet, the apparatus would be cumbersome owing to the imbalance and high moment of inertia due to having weight out far from the center of rotation of the neck. The protrusion of the camera would also present a problem, making tha apparatus cumbersome. Moreover, the resulting mismatch between viewfinder image and the real world would create an unnatural mapping. Indeed, anyone who has walked around holding a small camcorder up to his or her eye for several hours a day will obtain an understanding of the ill psychophysical effects that result. Eventually, such adverse effects as nausea, and flashbacks, may persist even after the camera is removed. There is also the question as to whether or not such a so-called Mediated Reality might, over a long period of time, cause brain damage, such as damage to the visual cortex, in the sense that learning (including the learning of new spatial mappings) permanently alters the brain.

Accordingly, the invention proposes an embodiment with viewfinder means such

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that the image may be presented in a natural manner suitable for long-term usage patterns.

There are several reasons why it might be desired to wear the camera over a sustained period of time:

1. There is the notion of a personal visual diary of sorts.

2. There is the idea of being always ready. By constantly recording into a circular buffer, a retroactive record function, such as a button that instructs the device to "begin recording from five minutes ago" may be useful in personal safety (crime reduction) as well as in ordinary everyday usage, such as capturing a baby's first steps on video. With the prior art in photography and video, we spend so much time preparing the camera and searching for film, batteries, etc., or at the very least, just getting the camera out of its carrying case, that we often miss important moments like a baby's first steps, or a spontaneous facial expression during the opening of a gift.

3. There is the fact that the proposed invention, after worn for a long period of time, begins to behave as a true extension of the wearer's mind and body. As a result, the composition of video shot with the device is often impeccable without even the need for conscious thought or effort on the part of the user. Moreover, a very natural first-person perspective genre of video results. For example, while wearing an embodiment of the proposed invention, it is possible to look through the viewfinder of a telescope or microscope and record this experience, including the approach toward the eyepiece. This experience is recorded, from the perspective of the participant in the experience. The act of making the recording is also done without appreciable conscious thought or effort.

4. A computional system, either built into the wearable camera, or worn on the body elsewhere and connected to the camera system, may be used to enhance images. This may be of value to the visually impaired. The computer may

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also perform other tasks such as object recognition. Because the device is worn constantly, it may also function as a memory aid, e.g. to help in way–finding through the recall and display of previously captured imagery.

BACKGROUND OF THE INVENTION WITH RESPECT TO PRIOR ART: It appears that apart from large view cameras upon which the image is observed on a ground glass, that most viewfinders present an erect image. See, for example, U.S. Pat. No.5095326 entitled "Keppler–type erect image viewfinder and erecting prism". In contrast to this fact, it is well–known that one can become accustomed, through long–term psychophysical adaptation (as reported by George M. Stratton, in *Psychology Review*, in 1896 and 1897) to eyeglasses that present an upside–down image. After wearing upside–down glasses constantly, for eight days (keeping himself blindfolded when removing the glasses for bathing or sleeping) Stratton found that he could see normally through the glasses. More recent experiments, as conducted by and reported by Mann, in an MIT technical report *Mediated Reality*, medialab vismod TR260, (1994), (the report is available in http://wearcam.org/mediated-reality/index.html) suggest that slight transformations such as rotation by a few degrees or small image displacements give rise to a reversed aftereffect that is more rapidly assimilated by the wearer, and that such effects can often have a more detrimental effect on performing other tasks through the camera as well as detrimental flashbacks upon removal of the camera. These findings suggest that merely mounting a conventional camera such as a small 35mm rangefinder camera or a small video camcorder to a helmet, so that one can look through the viewfinder and use it it hands–free while performing other tasks, will result in poor performance at doing those tasks while looking through the camera viewfinder.

Moreover, these findings suggest that doing tasks while looking through the viewfinder of a conventional camera, over a long period of time, may give rise to detrimental flashback effects that may persist even after the camera is removed. This is especially true when the tasks involve a great deal of hand–eye coordination, such as when

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one might, for example, wish to photograph, film, or make video recordings of the experience of eating or playing volleyball or the like, by doing the task while concentrating primarily on the eye that is looking through the camera viewfinder. Indeed, since cameras of the prior art were never intended to be used this way, to record events from a first-person-perspective while looking through the viewfinder, it is not surprising that performance is poor in this usage.

Part of the reason for poor performance associated with simply attaching a conventional camera to a helmet is the induced parallax and the failure to provide an orthoscopic view. Even viewfinders which correct for parallax, as described in U.S. Pat. No.5692227 in which a rangefinder is coupled to a parallax error compensating mechanism, only correct for parallax between the viewfinder and the camera lens that is taking the picture, but do not correct for parallax between the viewfinder and the image that would be observed with the naked eye while not looking through the camera.

The invention may provide a viewfinder means that is suitable for long-term usage, such as when one may be wearing the camera for 16 hours per day, looking through it all the while. Accordingly, since traditional viewfinders are only viewed through on a shorter term basis, there will be some important differences between the proposed wearable camera system and traditional cameras. For example, when the proposed wearable camera system comprises a zoom lens for the camera, it will be necessary that the viewfinder also comprises a zoom lens, so that when zooming into a scene, the image in the viewfinder will subtend a lesser visual angle (appear to get smaller) to negate the usual effect in which zooming in produces increased magnification. In this manner the proposed wearable camera system will provide the wearer with absolutely no magnifcation regardless of the zoom adjustment.

Some viewfinders are equipped with a zoom capability, as, for example, is described in U.S. Pat. No.5323264, so that their field of coverage varies with the varying of a zoom lens. The reader will need to be careful not to confuse zoom viewfinders

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of the prior art with the zoom viewfinder of the proposed invention in which viewing takes place through an electronic viewfinder where the decrease in visual angle subtended by the image of the viewfinder screen is coupled to the increase in focal length of the camera within the proposed invention. This coupling negates any increase in magnification that would otherwise result from zooming in on the scene. At first this may seem counter-intuitive, in the sense that we normally expect zooming in to produce magnification. This expectation is owing to the cameras of the prior art. However, after using the proposed invention for an extended period of time, one quickly grows accustomed to the unique characteristics of its viewfinder, and the much more seamless integration of the viewfinder with everyday life. This seamlessness is such that after time, the wearer will begin to operate the proposed wearable camera invention without appreciable conscious thought or effort.

An important aspect of the proposed invention is the capability of the apparatus to mediate (augment, diminish, or otherwise alter) the visual perception of reality. Traditional camera viewfinders often include the ability to overlay virtual objects, such as camera shutter speed, or the like, on top of reality, as described in U.S. Pat. No.5664244 which describes a viewfinder with additional information display capability.

The proposed camera viewfinder is related to the displays that are used in the field of Virtual Reality (VR) in the sense that both are wearable. However, an important difference is that the proposed invention allows the wearer to continue to see the real world, while VR displays block out the ability to see the real world.

Displays for helmet mounted aircraft weapons aiming applications have been developed, as described in U.S. Pat. No.3697154, U.S. Pat. No.3833300, U.S. Pat. No.4081209, U.S. Pat. No.4220400. Such displays do not directly incorporate a camera. Although they could be used to display the output image from an electronic camera (hand-held or perhaps mounted to the same helmet), the above-mentioned problems will still exist. U.S. Pat. No.4806011 describes an eyeglass-based display of

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a clock or the like. While the clock could, in principle, be replaced with a small television, and a camera could be attached to the glasses and the output of the television connected to it, the above–mentioned problems would still exist.

Open–air viewfinders are often used on extremely low cost cameras, as well as on some professional cameras for use at night when the light levels would be too low to tolerate any optical loss in the viewfinder. Examples of open–air viewfinders used on professional cameras, in addition to regular viewfinders, include those used on the Grafflex press cameras of the 1940s (which had three different kinds of viewfinding means), as well as those used on some twin–lens reflex cameras. While such viewfinders could be used in the context of the proposed invention, and would have the advantage of not inducing the problems such as flashback effects described above, they also fail to provide an electronically mediated reality. It is an object of the invention to allow visual reality to be mediated in order to make certain that exposure is correct as well as to keep the wearer of the apparatus in the feedback loop of the photo compositional process by constantly providing the wearer with a video stream. Moreover, it is desired that the apparatus will allow the wearer to experience a computationally mediated visual reality, and for that experience to be shared through wireless communications networks so that the wearer may receive additional visual information, as well as be aware of modifications to visual reality that might arise, for example, as part of a communications process in a shared virtual environment. For such compositional and interactional capabilities, a simple air–based viewfinder is inadequate.

Wearable display devices have been described, such as in U.S. Pat. No.5546099, U.S. Pat. No.5708449, U.S. Pat. No.5331333, U.S. Pat. No.4636866, and may be used as a starting point for implementing the proposed invention, through the addition of the appropriate light sensing apparatus. U.S. Pat. No.5640221 also proposes an eye–tracking device which may be used in the context of the proposed invention.

A means of using a plurality of pictures of the same scene or object, in which

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the pictures were taken using a camera with automatic exposure control, automatic gain control, or the like has been proposed in *"PENCIGRAPHY" WITH AGC: JOINT PARAMETER ESTIMATION IN BOTH DOMAIN AND RANGE OF FUNCTIONS IN SAME ORBIT OF THE PROJECTIVE-WYCKOFF GROUP*, published by S. Mann, in M.I.T. medialab vismod tech report TR384, December, 1994, and later published also in Proceedings of the IEEE International Conference on Image Processing (ICIP-96), Lausanne, Switzerland, September 16–19, 1996, pages 193–196. The report is also available on a world wide web site: http://wearcam.org/icip96/index.html as a hypertext document. This report relates to the proposed invention in the formulation of a means for camera self-calibration in which the unknown nonlinear response function of the camera is determined up to a single unknown scalar constant. Therefore, once the camera is so understood, it may be used, within the context of the method, as a light measuring instrument. As each pixel of the camera then becomes a light measuring instrument, successive pictures in a video sequence become multiple estimates of the same quantity once the multiple images are registered and appropriately interpolated. The measurement from a plurality of such estimates gives rise to knowledge about the scene sufficient to render pictures of increased dynamic range and tonal fidelity, as well as increased spatial resolution and extent. In this way a miniature video camera as may be concealed inside a pair of eyeglasses may be used to generate images of very high quality, sufficient for fine–arts work or other uses where good image quality is needed.

DESCRIPTION OF THE INVENTION

The proposed invention facilitates a new form of visual art, in which the artist may capture, with relatively little effort, a visual experience as viewed from his or her own perspective. With some practice, it is possible to develop a very steady body posture and mode of movement that best produces video of the genre pertaining to this invention. Because the apparatus may be lightweight and close to the head, there is not the protrusion associated with carrying a hand–held camera. Also because

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components of the proposed invention may be mounted very close to the head, in a manner that balances the weight distribution as well as minimizes the moment of inertia about the rotational axis of the neck. the head can be turned quickly while wearing the apparatus. This allows one to record the experiences of ordinary day-to-day activities from a first-person perspective. Moreover, because both hands are free, much better balance and posture is possible while using the apparatus. Anyone skilled in the arts of body movement control as is learned in the martial arts such as karate, as well as in dance, most notably ballet, will have little difficulty capturing exceptionally high quality video using the proposed invention.

With the prior art, the best video or movie camera operators tend to be very large people who have trained for many years in the art of smooth control of the cumbersome video or motion picture film cameras used. In addition to requiring a very large person to optimally operate such cameras, various stabilization devices are often used, which make the apparatus even more cumbersome. The proposed wearable camera invention may be optimally operated by people of any size. Even young children can become quite proficient in the use of the proposed invention.

A typical embodiment of the invention comprises one or two spatial light modulators or other display means built into a pair of eyeglasses together with one or more sensor arrays. Typically one or more CCD (charge coupled device) image sensor arrays and appropriate optical elements comprise the camera portion of the invention. Typically a beamsplitter or a mirror silvered on both sides is used to combine the image of the viewfinder with the apparent position of the camera. The viewfinder is simply a means of determining the extent of coverage of the camera in a natural manner, and may comprise either of:

- A reticle, graticule, rectangle, or other marking that appears to float within a portion of the field of view.
- A display device that shows a video image, or some other dynamic information perhaps related to the video image coming from the camera.

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SUMMARY OF THE INVENTION: OBJECTS AND ADVANTAGES

It is an object of this invention to provide a method of positioning a camera in which both hands are left free.

It is a further object of this invention to provide a means of exposing a film or acquiring a picture electronically where the spatial extent (field of view) of the image may be ascertained without having to hold any device up to the eye.

This invention may provide such a method of exposing a film or acquiring a picture electronically where the tonal characteristics of the picture may be ascertained without having to hold any device up to the eye.

This invention may provide such a method of exposing a film or acquiring a picture electronically where no apparent difference in body movement or gesture between when a picture is being taken and when no picture is being taken is detectable by others.

This invention may provide the user with a means of determining the composition of the picture from a display device that is located such that only the user can see the display device, and so that the user can ascertain the composition of a picture or take a picture or video and transmit image(s) to one or more remote locations without the knowledge of others in the immediate environment.

This invention may provide the user with a means of determining the composition of the picture from a display device that is located such that only the user can see the display device, as well as a secondary additional display device that the user can show to others if and when the user desires to do so.

This invention may provide the user with a means of determining the composition of the picture from a display device that is located such that both the user as well as others can see it.

This invention may provide a wearable camera viewfinder means in which video is displayed on a viewfinder in such a way that all rays of light from the viewfinder that enter the eye appear to emenate from essentially the same direction as they would

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have had the apparatus not been worn.

This invention may provide a means for a user to experience additional information overlaid on top of his or her visual field of view such that the information is relevant to the imagery being viewed.

This invention may provide a means and apparatus for a user to capture a plurality of images of the same scene or objects, in a natural process of simply looking around, and then have these images combined together into a single image of increased spatial extent, spatial resolution, dynamic range, or tonal fidelity.

This invention may provide a viewfinder means in which the viewfinder has a focusing mechanism that is coupled to a focusing mechanism of a camera system, so that when the camera is focused on a particular object the viewfinder also presents that object in a manner such that when the apparatus moves relative to the user's eye, that the object appears to neither move with or against the movement of the eye, so that the rays of light entering the eye are approximately the same in direction as if the apparatus were not present.

This invention may provide a viewfinder means in which the viewfinder has a focusing mechanism that is coupled to a focusing mechanism of a camera system, so that when the camera is focused on a particular object the viewfinder also presents that object in the same focal depth plane as the object would appear to the user with the apparatus removed.

This invention may provide a viewfinder means in which the viewfinder has a focusing mechanism that is controlled by an automatic focusing mechanism of a camera system.

This invention may provide a stereo viewfinder means in which the viewfinder has focusing and vergence control mechanisms that are controlled by an automatic focusing mechanism of a camera system.

This invention may provide a viewfinder means in which the viewfinder has a focusing mechanism that is controlled by an automatic focusing mechanism of a cam-

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era system, and in which the apparatus comprises an eye-tracking mechanism that causes the focus of the camera to be based on where the user is looking, and therefore the focus of the viewfinder mechanism to be also focused in such a manner that the convergence of light rays from whatever object happens to be within the foveal region of the eye's view also produces rays of light that have the same focal distance as they would have had with the apparatus removed from the user.

This invention may provide a wearable camera with viewfinder means for collaboration between the user of the apparatus and one or more other persons at remote locations through the manipulation of virtual objects such as cursors, or computer graphics renderings displayed upon the camera viewfinder.

This invention may allow multiple users of the invention, whether at remote locations or side-by-side, or in the same room within each other's field of view, to intract with one another through the collaborative capabilities of the apparatus.

This invention may allow multiple users of the invention, at remote locations, to collaborate in such a way that a virtual environment is shared in which camera-based head-tracking of each user results in acquisition of video and subsequent generation of virtual information being made available to the other(s).

This invention may allow multiple users of the invention, at the same location, to collaborate in such a way that multiple camera viewpoints may be shared among the users so that they can advise each other on matters such as composition, or so that one or more viewers at remote locations can advise one or more of the users on matters such as composition or camera angle.

This invention may allow multiple users of the invention, at different locations, to collaborate on a project or endeavour that may not pertain to photography or videography directly, but a project or endeavour nevertheless that is enhanced by the ability for each person to experience the viewpoint of another.

This invention may allow one or more remote participants at conventional desktop computers or the like to interact with one or more users of the invention, at one or

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more other locations, to collaborate on a project or endeavour that may not pertain to photography or videography directly, but a project or endeavour nevertheless that is enhanced by the ability for one or more users of the invention to either provide or obtain advice from or to another individual at a remote location.

SUMMARY OF THE INVENTION: Informal review of what the new invention does

One aspect of the invention allows a photographer or videographer to wear the apparatus continuously and therefore always end up with the ability to produce a picture from something that was seen a couple of minutes ago. This may be useful to everyone in the sense that we may not want to miss a great photo opportunity, and often great photo opportunities only become known to us after we have had time to think about something we previously saw.

Such an apparatus might also be of use in personal safety. Although there are a growing number of video surveillance cameras installed in the environment allegedly for "public safety", there have been recent questions as to the true benefit of such centralized surveillance infrastructures. Most notably there have been several examples in which such centralized infrastructure has been abused by the owners of it (as in roundups and detainment of peaceful demonstrators). Moreover, "public safety" systems may fail to protect individuals against crimes committed by the organizations that installed the systems. Accordingly, embodiments of the invention often implement the storage and retrieval of images by transmitting and recording images at one or more remote locations. In one embodiment of the invention, images were transmitted and recorded in different countries, so that they would be difficult to destroy, in the event that the perpretrator of a crime might wish to do so.

The invention allows images to be captured in a natural manner, without giving an unusual appearance to others (such as a potential assailant).

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Moreover, as an artistic tool of personal expression, the apparatus allows the user to record, from a first–person–perspective, experiences that have been difficult to so record in the past. For example, a user might be able to record the experience of looking through binoculars while riding horseback, or the experience of waterskiing, rope climbing, or the like. Such experiences captured from a first–person perspective provide a new genre of video by way of a wearable camera system with viewfinder means that goes beyond current state–of–the–art point of view sports videos (such as created by cameras mounted in sports helmets which have no viewfinder means).

A typical embodiment of the invention comprises a wearable viewfinder system which is fitted with a motorized focusing mechanism. A camera also fitted with a motorized focusing mechanism is positioned upon one side of a mirror that is silvered on both sides, so that the viewfinder can be positioned on the other side and provide a view that is focused to whatever the camera is focused on. Such an apparatus allows the user to record a portion of his or her eye's visual field of view. With the correct design, the device will tend to cause the wearer to want to place the recording zone over top of whatever is most interesting in the scene. This tendency arises from the enhancement of the imagery in this zone. In much the same way that people tend to look at a TV set in a darkened room, regardless of what is playing (even if the TV is tuned to a blank station and just playing "snow"), there is a tendency when wearing the invention to look at the recording/display/viewfinder zone. Therefore, there is a tendency to try to put the recording zone on top that which is of most interest. Therefore using the apparatus, after time, does not require conscious thought or effort. In was once said that television is more real than real life, and in much the same way, the wearer of the apparatus becomes a cybernetic organism (cyborg) in a true synergy of human and camera. This is particularly true with a low vision system in which one can actually see better through the viewfinder than in real life (e.g. at night when an image intensifier provides enhanced vision). In this case, the tendency of the wearer to want to become an organism that seeks best picture is very

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pronounced.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will now be described in more detail, by way of examples which in no way are meant to limit the scope of the invention, but, rather, these examples will serve to illustrate the invention with reference to the accompanying drawings, in which:

FIG. **1** is a diagram of a simple embodiment of the invention in which there are two cameras, a wide–angle camera concealed in the nose bridge of a pair of sunglasses, a tele–camera concealed in the top part of the frame of the sunglasses, and combined by way of a beamsplitter with the wide–camera, as well as a viewfinder means concealed in the left temple side–piece of the glasses with optics concealed in or behind the glass of the left lens.

FIG. **2** is a diagram of the wearable camera system with an improvement in which the viewfinder is constructed so that when other people look at the wearer of the apparatus they can see both of the wearer's eyes in such a way that they do not notice any unusual magnification of the wearer's left eye which might otherwise look unusual or become a problem in making normal eye contact with the wearer.

FIG. **3** illustrates the principle of a camera viewfinder which replaces a portion of the visual field of view with the view from a camera, yet allows the wearer to see through the apparatus without experiencing any psychophysical adaptation or coordinate transformation.

FIG. **4** illustrates a version of the apparatus similar to that in FIG. **1**, except where a portion of the visual field of view is only partially replaced, owing to the use of polarizers to prevent video feedback, as well as a beamsplitter rather than a double–sided mirror.

FIG. **5** shows an embodiment of the invention in which there are two televisions of different sizes which are each superimposed upon exactly the field of view that corresponds to each of two cameras, one being wide–angle and the other being tele.

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FIG. 6 shows an embodiment of the wearable camera invention in which the viewfinder contains considerable magnification, yet allows other people to see both of the wearer's eyes except for a slight amount of blocked vision which may be concealed by making the glasses look like bifocal glasses.

While the invention shall now be described with reference to the preferred embodiments shown in the drawings, it should be understood that the intention is not to limit the invention only to the particular embodiments shown but rather to cover all alterations, modifications and equivalent arrangements possible within the scope of appended claims.

In all aspects of the present invention, references to "camera" mean any device or collection of devices capable of simultaneously determining a quantity of light arriving from a plurality of directions and or at a plurality of locations, or determining some other attribute of light arriving from a plurality of directions and or at a plurality of locations. Similarly references to "television" shall not be limited to just television monitors or traditional televisions used for the display of video from a camera near or distant, but shall also include computer data display means, computer data monitors, other video display devices, still picture display devices, ASCII text display devices, terminals, and the like.

With respect to both the cameras and televisions, as broadly defined above, the term "zoom" shall be used in a broad sense to mean any lens of variable focal length, any apparatus of adjustable magnification, or any digital, computational, or electronic means of achieving a change in apparent magnification. Thus, for example, a zoom viewfinder or zoom television shall be taken to include the ability to display a picture upon a computer monitor in various sizes through a process of image interpolation as may be implemented on a body–worn computer system.

DETAILED DESCRIPTION OF THE INVENTION WITH REFERENCE TO DRAWINGS

Fig 1 shows an early embodiment of the wearable camera invention built into eye-

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glass frames 100, typically containing two eyeglass lenses 105. A wide–angle camera 110 is typically concealed within the nose bridge of the eyeglass frames 100. In what follows, the wide–angle camera 110 will be simply referred to as the "wide–camera". In this embodiment of the wearable camera invention, a second camera, 120, is also concealed in the eyeglass frames 100. This second camera is one which has been fitted with a lens of longer focal length, and will be referred to as a "tele–camera" in what follows. The wide–camera 110 faces forward looking through a beamsplitter 130 so that the tele–camera 120 may have exactly the same field of view as the wide–camera 110. The beamsplitter 130 is typically mounted at a 45 degree angle, and the optical axes of the two cameras are typically at 90 degree angles to each other. The optical axes of the two cameras should intersect and thus share a common viewpoint. Typically eyeglasses with black frames are selected, and a CCD sensor array for wide–camera 110 is concealed in a cavity which is also used as a nose bridge support, so that the eyeglasses have a normal appearance. The wide–camera is typically fitted with a lens having a diameter of approximately 1/32 inch (less than one millimeter) — small enough that it cannot be easily seen by someone at close conversational distance to the person wearing the eyeglasses. The tele–camera 120 is typically concealed in the upper portion of the eyeglass frames. In some prototypes, an Elmo QN42H camera was used owing to its long and very slender (7mm diameter) construction. In actual manufacture, a custom–made tele–camera could be built directly into the eyeglass frames. Since the tele–camera 120 is typically built into the top of the eyeglass frames, the wide–camera 110 should also be mounted near the top of the frames. In most prototypes of the invention, a complete camera system providing NTSC video was not installed directly in the eyeglasses. Instead, wires 125 from the camera sensor arrays were concealed inside the eyeglass frames and run inside a hollow eyeglass safety strap such as the safety strap that is sold under the trade name "Croakies". Wires 125 are run down to a belt pack or to a body–worn computer, recording, transmitting device, or the like. In some embodiments, a minimal amount

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of circuitry was concealed in the eyeglass frames so that the wires 125 could be driven with a buffered signal in order to reduce signal loss. In or behind one or both of the eyeglass lenses 105, there is typically an optical system 150 for the camera viewfinder. This optical system provides a magnified view of a miniature television screen 160 in which the viewing area is typically less than one inch (or less than 25 millimeters) on the diagonal. For example, in one recent embodiment, the viewfinder comprised a 1/4 inch (approx. 6mm) television screen comprising an LCD spatial light modulator with a field–sequenced LED backlight. In some embodiments of the invention, the television screen was driven by a coaxial cable carrying a video signal similar to an NTSC RS–170 signal. In this case the coaxial cable and additional wires to power it are concealed inside the eyeglass safety–strap and run down to a belt pack or other body–worn equipment by connection 190.

In some embodiments television 160 contains a television tuner so that a single coaxial cable may provide both signal and power. In other embodiments the majority of the electronic components needed to construct the video signal are worn on the body, and the eyeglasses contain only a minimal amount of circuits, perhaps only a spatial light modulator, LCD flat panel, or the like, with termination resistors and backlight. In this case, there are a greater number of wires 170. In some embodiments of the invention the television screen 160 is a VGA computer display, or another form of computer monitor display, connected to a computer system worn on the body of the wearer of the eyeglasses. In typical operation of the invention, light enters the eyeglasses and is absorbed and quantified by one or more cameras. By virtue of the connection 190, information about the light entering the eyeglasses is available to a body–worn computer system. The computer system may calculate the actual quantity of light, up to a single unknown scalar constant, arriving at the glasses from each of a plurality of directions corresponding to the location of each pixel of the camera with respect to the camera's center of projection. This calculation may be done using the *PENCIGRAPHY* method described above. In some embodiments of the invention a

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second tele–camera 120 provides a more dense array of such photoquanta estimates. This increase in density toward the center of the visual field of view matches the characteristics of the human visual system in which there is a central foveal region of increased visual acuity. Video from one or both cameras is possibly processed by the body–worn computer and recorded or transmitted to one or more remote locations by body–worn video transmission means or body–worn Internet connection, such as a standard WA4DSY 56 kbps RF link with a KISS 56 eprom running TCP/IP over an AX25 connection to the serial port of the body–worn computer. The possibly processed video signal is sent back up into the eyeglasses through connection 190 and appears on viewfinder screen 160, viewed through optical elements 150. If desired, the wide–angle camera may be used for motion tracking to serve the role of a head–tracker by determining the location of the head using optical flow methods, and the foveal camera may then be used as a high–resolution index into that image. Thus even though television screen 160 may only have 240 lines of resolution, a virtual television screen of extremely high resolution may be implemented by virtue of the head–tracker, so that the wearer may view very high resolution pictures through what appears to be a small window that pans back and forth across the picture by the head–movements of the wearer. This act of panning the head back–and forth also may cause a high–resolution picture to be acquired through appropriate processing of a plurality of low–resolution pictures captured on tele–camera 120. This action mimicks the function of the human eye, where saccades are replaced with head movements to sweep out the scene using the camera's light–measurement ability as is typical of *PENCIGRAPHIC* imaging.

A major shortcoming of the apparatus depicted in Fig 1 is that the optical elements 150 block the eye(s) of the wearer. The wearer may be able to adapt to this condition, or at least compensate for it through the display of video from the wearable camera to create an illusion of transparency, in the same way that a hand–held camcorder creates an illusion of transparency when it is on and running even though it would

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function as a vision-blocking eye patch when turned off. However, the fact that the eye of the wearer is blocked means that others cannot make eye-contact with the wearer. In social situations this creates an unnatural form of interaction. Although the lenses of the glasses may be made sufficiently dark that the viewfinder optics are concealed, it is preferable that the viewfinder optics may be concealed in eyeglasses that allow others to see both of the wearer's eyes. Accordingly, a viewfinder system is depicted in Fig 2 in which an optical path 200 brings light from a viewfinder screen 210, through a first relay mirror 220, along a cavity inside the left temple-side piece of the glasses formed by an opaque side shield 230, or simply by hollowing out a temple side-shield. Light travels to a second relay mirror 240 and is combined with light from the outside environment as seen through diverging lens 250. The light from the outside and from the viewfinder is combined by way of beamsplitter 260. The rest of the eyeglass lenses 261 are typically tinted slightly to match the beamsplitter 260 so that other people looking at the wearer's eyes do not see a dark patch where the beamsplitter is. Converging lens 270 magnifies the image from the viewfinder screen 210, while canceling the effect of the diverging lens 250. The result is that others can look into the wearer's eyes and see both eyes at normal magnification, while at the same time, the wearer can see the camera viewfinder at increased magnification.

The embodiments of the wearable camera depicted in Fig 1 and Fig 2 give rise to a small displacement between the actual location of the camera, and the location of the virtual image of the viewfinder. Therefore, when performing tasks at close range, such as looking into a microscope while wearing the glasses, there is a discrepancy that must be learned. Initially when wearing the glasses, the tendency is to put the microscope up to the eye, rather than the camera. As a result, the apparatus fails to record exactly the wearer's experience. It is desired that the apparatus will record exactly the wearer's experience. Thus if the wearer looks into a microscope, the glasses should record that experience for others to observe vicariously through the wearer's eye. Although the wearer can learn the difference between the camera position and

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the eye position, it is preferable that this not be required, for otherwise, as previously described, long–term usage may lead to undesirable flashback effects. Accordingly, Fig 3 illustrates a system whereby rays of light spanning a visual angle from ray 310 to ray 320 enter the apparatus and are intercepted by a two–sided mirror 315, typically mounted at a 45 degree angle with respect to the optical axis of a camera 330. These rays of light enter camera 330. The video output of the camera 330 is displayed upon television screen 340 possibly after having been processed on a body–worn computer system or the like. A reflection of television screen 340 is seen in the other side of mirror 315, so that the television image of ray 310 appears as virtual ray 360 and the television image of ray 320 appears as ray 370. Since the camera 330 records an image image that is backwards, a backwards image is displayed on the television screen 340. Since the television 340 is observed in a mirror, the image is reversed again so that the view seen at eye location 390 is not backwards. In this way a portion of the wearer's visual field of view is replaced by the exact same subject matter, in perfect spatial register with the real world. The image could, in principle also be registered in tonal range, using the *PENCIGRAPHY* framework for estimating the unknown nonlinear response of the camera, and also estimating the response of the display, and compensating for both. So far focus has been ignored, and infinite depth–of–field has been assumed. In practice, a viewfinder with a focus adjustment is used, and the focus adjustment is driven by a servo mechanism controlled by an autofocus camera. Thus camera 330 automatically focuses on the subject matter of interest, and controls the focus of viewfinder 330 so that the apparent distance to the object is the same while looking through the apparatus as with the apparatus removed.

It is desirable that embodiments of the wearable camera invention comprising manual focus cameras have the focus of the camera linked to the focus of the viewfinder so that both may be adjusted together with a single knob. Moreover, a camera with zoom lens may be used together with a viewfinder having zoom lens. The zoom mechanisms are linked in such a way that the viewfinder image magnification is reduced as

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the camera magnification is increased. Through this appropriate linkage, any increase in magnification by the camera is negated exactly by decreasing the apparent size of the viewfinder image.

The calibration of the autofocus zoom camera and the zoom viewfinder may be done by temporarily removing the mirror 315 and adjusting the focus and zoom of the viewfinder to maximize video feedback. This must be done for each zoom setting, so that the zoom of the viewfinder will properly track the zoom of the camera. By using video feedback as a calibration tool, a computer system may monitor the video output of the camera while adjusting the viewfinder and generating a lookup table for the viewfinder settings corresponding to each camera setting. In this way, calibration may be automated during manufacture of the wearable camera system. Some similar embodiments of the wearable camera invention use two cameras and two viewfinders. In some embodiments, the vergence of the viewfinders is linked to the focus mechanism of the viewfinders and the focus setting of cameras, so that there is a single automatic or manual focus adjustment for viewfinder vergence, camera vergence, viewfinder focus, and camera focus.

The apparatus of Fig 3 does not permit others to make full eye–contact with the wearer. Accordingly, Fig 4 depicts a similar apparatus in which only a portion of the rays of the leftmost ray of light 410 is deflected by beamsplitter 415. A visual angle subtended by light ray 410 to light ray 420 is deflected by way of beamsplitter 415 into camera 430. Output from this camera is displayed on television 470, possibly after processing on a body–worn computer or processing at one or more remote sites, or a combination of local and remote image processing or the like. A partial reflection of television 440 is visible to the eye of the wearer by way of beamsplitter 415. The leftmost ray of light 460 of the partial television 440 is aligned with the direct view of the leftmost ray of light 410 from the original scene. Thus the wearer sees a superposition of whatever real object is located in front of ray 410 and the television picture of the same real object at the same location. The rightmost ray of light

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420 is similarly visible through the beamsplitter 415 in register with the rightmost virtual ray reflected off the beamsplitter 415. In order to prevent video feedback, in which light from the television screen would shine into the camera, a polarizer 480 is positioned in front of the camera. The polarization axis of the polarizer is aligned at right angles to the polarization axis of the polarizer inside the television, assuming the television already has a built-in polarizer as is typical of small battery powered LCD televisions, LCD camcorder viewfinders, and LCD computer monitors. If the television does not have a built in polarizer, a polarizer is added in front of the television. Thus video feedback is prevented by virtue of the two crossed polarizers in the path between the television 440 and the camera 430. If the television displays the exact same rays of light that come from the real world, the view at eye location 490 is essentially the same as it might otherwise be. However, in order that the viewfinder provide a distinct view of the world, it may be desirable that the virtual light from the television be made different in color or the like from the real light from the scene. For example, simply using a black and white television, or a black and red television, or the like, or placing a colored filter over the television, will give rise to a unique appearance of the region of the wearer's visual field of view by virtue of a difference in color between the television image and the real world upon which it is exactly superimposed. Even with such chromatic mediation of the television view of the world, it may still be difficult for the wearer to discern whether or not video is correctly exposed. Accordingly, a pseudocolor image may be displayed, or unique patterns may be used to indicate areas of over exposure or under exposure.

Television 440 may also be fitted with a focusing lens so that it may be focused to the same apparent depth as the real objects in front of the apparatus. A single manual focus adjustment may be used for both camera 430 and television 440 to adjust them both together. Alternatively, an autofocus camera 430 may control the focus of television 440. Similarly, if a varifocal or zoom camera is used, a varifocal lens in front of television 440 should be used, and should be linked to the camera

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lens, so that a single knob may be used to adjust the zoom setting for both.

The apparatus of Fig 4 may be calibrated by temporarily removing the polarizer, and then adjusting the focal length of the lens in front of television 440 to maximize video feedback for each zoom setting of camera 430. This process may be automated if desired, for example, using video feedback to generate a lookup table used in the calibration of a servo mechanism controlling the zoom and focus of television 440.

The entire apparatus is typically concealed in eyeglass frames in which the beamsplitter is either embedded in one or both glass lenses of the eyeglasses, or behind one or both lenses. In the case in which a monocular version of the apparatus is being used, the apparatus is built into one lens, and a dummy version of the beamsplitter portion of apparatus may be positioned in the other lens for visual symmetry. These beamsplitters may be integrated into the lenses in such a manner to have the appearance of ordinary the lenses in ordinary bifocal eyeglasses. Moreover, magnification may be unobtrusively introduced by virtue of the bifocal characteristics of such eyeglasses. Typically the entire eyeglass lens is tinted to match the density of the beamsplitter portion of the lens, so there is no visual discontinuity introduced by the beamsplitter.

Fig 5 depicts a foveated embodiment of the invention in which incoming light 500 is intercepted from the direct visual path through the eyeglasses and directed instead, by double–sided mirror 510 to beamsplitter 520. A portion of this light passes through beamsplitter 520 and is absorbed and quantified by wide–camera 530. A portion of this incoming light is also reflected by beamsplitter 520 and directed to tele–camera 540. The image from the wide–camera 530 is displayed on a large screen television 550, typically of size 0.7 inches (approx. 18mm) on the diagonal, forming a wide–field–of–view image of virtual light 551 from the wide–camera. The image from the tele–camera 540 is displayed on a small screen television 560, typically of screen size 1/4 inch (approx. 6mm) on the diagonal, forming a virtual image of the tele–camera as virtual light 561. A smaller television screen is used to display the image from

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the tele–camera in order to negate the increased magnification that the tele–camera would otherwise provide. In this manner, there is no magnification, and both images appear as if the rays of light were passing through the apparatus, so that the virtual light rays align with the real light rays were they not intercepted by the double–sided mirror 510. Television 550 is viewed as a reflection in mirror 510, while television 560 is viewed as a reflection in beamsplitter 570. Note also that the distance between the two televisions 550 and 560 should equal the distance between double–sided mirror 510 and beamsplitter 570 as measured in a direction perpendicular to the optical axes of the cameras. In this way, the apparent distance to both televisions will be the same, so that the wearer experiences a view of the two televisions superimposed upon one–another in the same depth plane. Alternatively, the televisions may be equipped with lenses to adjust their magnifications so that the television displaying the image from the tele camera 540 subtends a smaller visual angle than the television displaying the image from wide camera 530, and so that these visual angles match the visual angles of the incoming rays of light 500. In this way, two television screens of equal size may be used, which simplifies manufacture of the apparatus. Typically, the entire apparatus is built within the frames 590 of a pair of eyeglasses, where cameras 530 and 540, as well as televisions 550 and 560 are concealed within the frames 590 of the glasses, while double–sided mirror 510 and beamsplitter 570 are mounted in, behind, or in front of the lens of the eyeglasses. In some embodiments, mirror 510 is mounted to the front of the eyeglass lens, while beamsplitter 570 is mounted behind the lens. In other embodiments, one or both of mirror 510 and beamsplitter 570 are actually embedded in the glass of the eyeglass lens.

Fig 6 depicts an alternate embodiment of the wearable camera invention depicted in Fig 4 in which both the camera and television are concealed within the left temple side–piece of the eyeglass frames. A first beamsplitter 610 intercepts a portion of the incoming light and directs it to a second beamsplitter 620 where some of the incoming light is directed to camera 630 and some is wasted illuminating the television screen

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640. However, the screen 640, when presented with a video signal from camera 630 (possibly after being processed by a body–worn computer, or remotely by way of wireless communications, or the like) directs light back through beamsplitter 620, where some is wasted but is absorbed by the eyeglass frame to ensure concealment of the apparatus, and some is directed to beamsplitter 610. Some of this light is directed away from the glasses and would be visible by others, and some is directed to the curved mirror 650 where it is magnified and directed back toward beamsplitter 610. The portion that is reflected off of beamsplitter 610 is viewed by the wearer, while the portion that continues back toward beamsplitter 620 must be blocked by a polarizer 660 to prevent video feedback. Implicit in the use of polarizer 660 is the notion that the television produces a polarized output. This is true of LCD televisions which comprise a liquid crystal display between crossed polaroids. If the television is of a type that does not already produce a polarized output, an additional polarizer should be inserted in front of television 640. Finally, if it is desired that the apparatus be unobtrusive, an additional polarizer or polarizing beamsplitter should be used so that the television 640 is not visible to others by way of its reflection in beamsplitter 610. Alternatively, in certain situations it may actually be desirable to make the display visible to others. For example when the system is used for conducting interviews, it might be desirable that the person being interviewed see himself or herself upon the screen. This may be facilitated by exposing beamsplitter 620 to view, or allowing the reflection of the television to be seen in beamsplitter 610. Alternatively, another television may be mounted to the glasses, facing outwards. Therefore, just as the wearer of the proposed invention may see the image captured by the camera, along with additional information such as text of a teleprompter, the interviewee(s) may also be presented with an image of themselves so that they appear to be looking into an electronic mirror, or may be teleprompted by this outward–facing display, or both. In some embodiments of the invention, the use of two separate screens was useful for facilitation of an interview, in which the same image was presented to both

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the inward–facing television and the outward–facing television, but the images were mixed with different text. In this way the wearer was teleprompted with one stream of text, while the interviewee was prompted with a different stream of text.

BENEFITS OF THE INVENTION

The wearable camera invention allows the wearer to experience the camera over a long period of time. For example, after wearing the apparatus 16 hours per day for several weeks, it begins to function as a true extension of the mind and body. In this way, photographic composition is much more optimal, because the act of taking pictures or shooting video no longer requires conscious thought or effort. Moreover, the intentionality of the picture–taking process is not evident to others, because picture–taking is not preceeded by a gesture such as holding a viewfinder object up to the eye. The wearable viewfinder is an important element of the wearable camera invention allowing the wearer to experience everyday life through a screen, and therefore be always ready to capture anything that might happen, or even anything that might have happened previously by virtue of the retroactive record capability of the invention. Moreover, additional information beyond just exposure and shutter speed may be displayed in the camera viewfinder. For example, the camera allows the wearer to augment, diminish, or otherwise alter his or her perception of visual reality. This mediated–reality experience may be shared. The wearer may allow others to alter his or her perception of reality. In this way the invention is useful as a new communications medium, in the context of collaborative photography, collaborative videography, and telepresence. Moreover, the invention may perform other useful tasks such as functioning as a personal safety device and crime deterrent by virtue of its ability to maintain a video diary transmitted and recorded at multiple remote locations. As a tool for photojournalists and reporters, the invention has clear advantages over other competing technologies.

OTHER EMBODIMENTS

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From the foregoing description, it will thus be evident that the present invention provides a design for a wearable camera with a viewfinder. As various changes can be made in the above embodiments and operating methods without departing from the spirit or scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings should be interpreted as illustrative and not in a limiting sense.

Variations or modifications to the design and construction of this invention, within the scope of the invention, may occur to those skilled in the art upon reviewing the disclosure herein. Such variations or modifications, if within the spirit of this invention, are intended to be encompassed within the scope of any claims to patent protection issuing upon this invention.

EMBODIMENTS FEATURING BODY-WORN COMPUTER

A typical embodiment of the invention may be based on a wearable computer system and may include a body-worn electronic display means capable of display of a picture, video, or graphic information, where the display means is affixed to the body in such a manner as to leave both of the wearer's hands free, and where the display means is capable of the display of information from the body worn computer system, and where the computer system is capable of receiving input from a body-worn electronic camera.

This embodiment need not necessarily be eyeglass-based, as shown in the drawings, but may, for example, take the form of other headwear such as a helmet. For example, a separate camera and camera viewfinder are mounted to a helmet, and the camera is connected to a body-worn computer system in such a way that the computer system may capture images from the camera, and where the viewfinder comprises a computer monitor connected to the computer system.

Some of the preferred embodiments comprise a wearable computer based personal imaging system where some of the rays of light that would enter the eye in the absence

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of the system are diverted to the camera by the system and displayed in such a manner that each ray of light from the display device enters the eye in such a way that it is essentially collinear to the corresponding ray of light that initially entered the system (e.g. each ray of processed light can emerge collinearly with the corresponding rays of incoming light that gave rise to it).

This personal imaging system may operate by rays of light being diverted by a mirror which is reflective on both sides, one side being used to divert rays of light to one or more cameras, and the other side of the mirror being used to view a video image from the camera, possibly after the video image has been processed or altered by a body worn computer system or by virtue of a wireless communications means. In other words, the wearer can allow other people (wirelessly linked) to alter his or her visual perception of reality.

The personal imaging system may also direct only a portion of each ray of light that would otherwise enter the eye in the absence of the system, so that the portion of light is diverted to the camera and displayed in such a manner that the portion of each ray of light from the display device enters the eye in such a way that when the signal from the camera is displayed upon the display device, the rays of light entering the eye each correspond to subject matter that is essentially equivalent to that which would have been observed in the absence of the personal imaging system.

In this personal imaging system, the camera and the screen of may be concealed within the frame of eyeglasses, and means of diverting rays of light toward the camera may be concealed within one or both lenses of the eyeglasses.

With the partial reality mediator personal imaging system, a portion of each ray of light that enters the eye may be diverted to the camera and displayed in such a manner that this portion of each ray of light from the display device enters the eye in such a way that when the signal from the camera is displayed upon the display device, the rays of light entering the eye each correspond to subject matter that is in approximate spatial alignment with the undiverted portion of each of said rays of

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light, when the wearable computer just copies input (camera) to output (display).

Of course it is not necessary to maintain the above collinearity criterion, and there are in fact some lesser preferred embodiments of the invention that don't maintain this spatial alignment between the display, especially when it does not completely block the wearer's vision. In this case, it is preferable that the video image from the camera appears upside-down, rotated 90 degrees, or is otherwise presented in the display means in a manner that makes it sufficiently distinct from the portion of the wearer's field of view that is not mediated by the display means.

In many embodiments of the wearable computer personal imaging system, the display means is a see-through display in the sense that it blocks essentially none of the wearer's visual field of view, and where a continuously updated image from the camera may be presented upon the display in a sufficiently different color than it would otherwise appear in the absence of the personal imaging system, so that the continuously updated image remains distinctly visible from the unmediated portion of the visual field of view.

In some of the personal imaging system embodiments, especially those with see through displays, an indication of over exposure or under exposure is given as an overlay on the subject matter that is over or under exposed. Thus, for example, where the display means is a see-through display in the sense that it blocks essentially none of the wearer's visual field of view, a continuously updated image from the camera is presented upon the display means in a sufficient manner as to indicate clearly areas of over exposure or areas of underexposure as uniquely textured or colored patches superimposed on the scene.

The above exposure indicator may take the form of graphic information, e.g. graphics superimposed on reality. Thus a continuously updated image from said camera is presented upon the display means together with additional graphic information pertaining to image exposure or pixel value statistics calculated from the camera, by way of the wearable computer system.

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In some eyeglass embodiments of the invention, optical elements are embedded within a lens of the eyeglasses in such a way as to provide a magnified view of said display means, and where the optical elements are arranged and located to give the eyeglasses the appearance of ordinary bifocal eyeglasses. For aesthetic symmetry and improved covertness, a mirrored (left-right reversed) replica of the optical elements is installed in the other lens of the eyeglasses even if this mirrored replica is non-functional. Thus a stereo or two-eye system would have two sets of optics, but so would a monocular system, where the second set of optics is a dummy set of optics not actually used other than for the aesthetic benefit (visual symmetry) of others who look at the wearer of the apparatus.

Some embodiments work just like the old gun sights and weapons sights commonly used during the war years, where the beamsplitter (diverter) is installed backwards and a concave mirror is used so that the user sees a double reflection magnified by the concave mirror. In this case the display optics includes a beamsplitter mounted at an approximate 45 degree angle with respect to the optical axis of the wearer's eye looking through it, and a curved mirror with optical axis perpendicular to the that of the wearer's eye is mounted to provide a magnified image of the display means.

This means and apparatus may be embedded within the lenses of eyeglasses, to direct light from the display means into one or both eyes of the wearer of the eyeglasses.

Using the miniaturized weapon-sight principle embedded in eyeglasses, the beamsplitter unfortunately is not entirely covert. Therefore, it is preferable that the eyeglasses be lightly tinted. Preferably the eyeglass lens is tinted everywhere other than where the beamsplitter is located, so that the eyeglass lens matches exactly the degree of transmissivity of the portion where the beamsplitter is embedded in. That makes the apparatus almost completely covert.

This tinting can preferably be implemented by a metallization, so that the beamsplitter itself is just part of the same metallization (the same thin metal coating

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deposited on the eyeglass lens). Therefore the beamsplitter is implemented through a partial metalization within the eyeglass lenses, extending sufficiently that most of the rays of light passing through each of the lenses must also pass through the partial metalization, and where the partial metalization is located at varying depth from the front surface of each of the eyeglass lenses, so that the partial metalization curves around to form a beamsplitter that directs light from one or more of the display means into one or both eyes of the wearer.

In extreme cases, e.g. where a nice wide field of view is needed, it is hard to conceal the discontinuity of the beamsplitter portion. In some embodiments of the invention, rather than trying to conceal the beamsplitter, the partial metalization of the entire eyeglass lens is done in such a way that there will be a discontinuity in the partial metalization such that the partial metalization gives the eyeglass lenses the appearance of ordinary bifocal lenses commonly used in eyeglasses.

Embodiments of the invention using the weapons sight principle for the display will typically have a beamsplitter and concave mirror positioned such that light from the subject matter being photographed or observed through the eyeglasses may pass through the beamsplitter once to reach the wearer's eye, while light being observed from the display means must pass through the beamsplitter, be reflected off the concave mirror, and then be reflected off the beamsplitter to reach the wearer's eye.

Again, these items, beamsplitter and concave mirror are preferably embedded within the lens of the eyeglasses.

Even with this embodiment, it is preferable that the eyeglass lens is tinted everywhere except where said beamsplitter is located so that the entire eyeglass lens is of the same transmissivity.

Typically the display means comprises a computer monitor and the wearable computer system is capable of acquiring a digital representation of pictures from the camera at a rate of more than one picture per second, and displaying these pictures upon the display means, so that a viewfinder effect results.

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These wearable computer peripherals (computer monitor and camera) are preferably mounted in eyeglasses for the preferred embodiment, but may be mounted on other headwear for other useful embodiments.

In many eyeglass based embodiments, a television screen or spatial light modulator, or other active image display surface of the computer monitor and the camera are mounted in the frames of eyeglasses, and means of providing magnification and re-direction of light rays to view the monitor is embedded within the glass of one or both lenses of said eyeglasses.

There will often be a means of providing magnification and re-direction of light rays to view the monitor, where the magnification and re-direction means is embedded within the lens material of one or both lenses of the eyeglasses, below the main optical axis of the eye in its normal position, so that the means of providing magnification and re-direction of light rays to view said monitor is embedded in a position within said eyeglass lenses that is typical of bifocal eyeglass lenses. Thus the preferred embodiment will have the appearance of ordinary bifocal eyeglasses, to people other than the wearer (e.g. the wearer will be the only one who need know that the eyeglasses are different from ordinary bifocal eyeglasses).

In many embodiments the wearable computer system is connected wirelessly to a remote base–station by way of radio communications, so that images from the camera can be processed or altered on the remote base–station.

EMBODIMENTS FEATURING WEARABLE DISPLAYS

Some embodiments of the invention may feature multiple video display devices. This may facilitate monitoring more than one camera. One or more electronic cameras and one or more video display devices are fixed together in a wearable device such that one or more of the video display devices is visible to one or both eyes and is capable of displaying a picture or video signal from one or more of the cameras.

Some embodiments have displays that are responsive to an input from a camera, while others have displays that are not responsive to an input from a camera. In the

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former case, rays of light that would enter the eye in the absence of the apparatus are diverted to one or more cameras, and displayed in such a manner that rays of light from the one or more of said display devices enter the eye in such a way that when the signal from one or more of said cameras is connected to one or more of said displays,

In the former case, rays of light entering the eye each correspond to subject matter that is essentially equivalent to that which would have been observed in the absence of said apparatus.

In a preferred embodiment (preferred for its simplicity of design and manufacture), rays of light are diverted by a mirror which is reflective on both sides, one side being used to divert rays of light to one or more cameras, and the other side of the mirror being used to view a video image of the output from said camera, possibly after the video image has been processed or altered by a body worn computer system or by virtue of a wireless communications means.

This same apparatus with one or more cameras and one or more display means may also be mounted in eyeglasses.

Again, the means of providing magnification and re-direction of light rays to view said monitor may be embedded within the glass of one or both lenses of said eyeglasses, below the main optical axis of the eye in its normal position, so that the means of providing magnification and re-direction of light rays to view the monitor is embedded in a position within the eyeglass lenses that is typical of bifocal eyeglass lenses.

One or more of said cameras and one or more of said display devices may be affixed in eyeglasses.

In some embodiments, light may be split, by way of a beamsplitter, to two cameras of differing fields of view.

Similarly, in some embodiments of the invention, there may be two (or more) display devices, one displaying output from each of two cameras.

EMBODIMENTS FEATURING FIELD OF VIEW INDICATORS

1003_PRIOR_ART_000183

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Some embodiments of the invention have a display that is in now way responsive to any input from the camera. Other embodiments of the invention have a display that is responsive to an input from the camera part of the time, and some have a display that is only partially responsive to the camera (perhaps only part of the time). In one embodiment, a body-worn electronic camera is affixed to the body of a wearer in such a manner as to leave both of the wearer's hands free, and where, also affixed to the wearer is a means of displaying a static pattern of a rectangle, graticule, or other indication of the field of view of the camera.

This embodiment may of course be mounted within eyeglasses.

In some eyeglass based embodiments, a camera mounted in eyeglasses is mounted within eyeglasses that also include means of displaying a static pattern of a rectangle, graticule, or other indication of the field of view of the camera, where the means comprises reflective and refractive elements embedded within the lens material of one or both lenses of the eyeglasses. Again, the static pattern is, in many embodiments of the invention, not responsive to any input from the camera.

In a preferred embodiment, the optics for generating the static pattern of a rectangle, graticule, or other indication of the field of view of the camera comprise reflective and refractive elements embedded within the lower portion of the glass of both lenses of said eyeglasses.

1393_PRIOR_ART_001184

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CLAIMS

The embodiments of the invention in which I claim an exclusive property or privilege are defined as follows:

1. A personal imaging system for personal image capture and processing, comprising:

   - a wearable computer;
   - a camera for supplying a picture signal to said wearable computer, said camera for being borne by headwear;
   - a viewfinder for being borne by said headwear, said viewfinder for providing at least a visible image boundary, said visible image boundary in focus to a wearer of said headwear.

2. A personal imaging system for personal image capture and processing, comprising:

   - a wearable computer;
   - a camera for supplying a picture signal to said wearable computer, said camera for being borne by headwear;
   - a viewfinder for being borne by said headwear, said viewfinder for providing a visible image boundary, said visible image boundary for appearing in focus to a wearer of said headwear, rays of light from said visible image boundary being collinear with rays of light defining a field of view of said camera.

3. A personal imaging system for personal image capture and processing, comprising:

   - a camera, said camera for being borne by headwear;

- an image processing computer for processing an output of said camera;
- a viewfinder for being borne by said headwear, said viewfinder for providing a visible image boundary, said visible image boundary for appearing in focus to a wearer of said headwear, at least some rays of light from said visible image boundary being collinear with at least some rays of light defining a field of view of said camera.

4. A personal imaging system for personal image capture and processing, comprising:

- a camera, said camera for being borne by headwear;
- a wearable picture processing computer for processing an output of said camera;
- a viewfinder for being borne by said headwear, said viewfinder for providing a visible image boundary, said visible image boundary for appearing in focus to a wearer of said headwear,

the center of the field of view of said viewfinder, as viewed by a wearer of said personal imaging system, being collinear with an incoming ray of light to which the center of a picture from said camera is most responsive, when said personal imaging system is in use by said wearer.

5. A personal imaging system for personal image capture and processing, comprising:

- a camera, said camera for being borne by headwear;
- a wearable picture processing computer for processing an output of said camera;
- a viewfinder for being borne by said headwear, said viewfinder for providing a rectangular visible image boundary, said visible image boundary for appearing in focus to a wearer of said headwear,

rays of light from the corners of said visible image boundary as viewed by a wearer of said personal imaging system, being collinear with incoming ray of light to which the corners of a picture from said camera are most responsive, when said personal imaging system is in use by said wearer.

6. A personal imaging system for personal image capture and processing, comprising:

   - a camera, said camera for being borne by headwear;
   - a wearable picture processing computer for processing an output of said camera;
   - a viewfinder for being borne by said headwear, said viewfinder for providing a visible image boundary, said visible image boundary for appearing in focus to a wearer of said headwear.

   the field of view of said camera being equal to the field of view of said visible image boundary as viewed by a wearer of said personal imaging system.

7. A wearable personal imaging system for picture capture and processing, comprising:

   - a camera;
   - optics, at least a portion of said optics for being borne by headwear, said optics for directing rays of light into said camera, the effective center of projection of said camera when operating together with said optics, being located approximately at the center of a lens of an eye of a wearer of said personal imaging system, when said wearer is looking in an approximate forward direction;
   - a wearable picture processing computer for processing an output of said camera;

- a viewfinder for being borne by said headwear, said viewfinder for providing a visible image boundary, said visible image boundary for appearing in focus to said wearer,

the center of the field of view of said camera together with said optics, being approximately collinear with the center of the field of view of said visible image boundary as viewed by said wearer.

8. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, or, 7, including a diverter for diverting at least a portion of some rays of eyeward bound light into said camera.

9. The personal imaging system of Claim 8, where said diverter has one mirrorred surface.

10. The personal imaging system of Claim 8, where said diverter is located diagonally with respect to said camera's optical axis, and an optical axis defined by an eye of a wearer of said personal imaging system, when said wearer is looking straight ahead.

11. The personal imaging system of Claim 8, where said diverter is a two-sided mirror.

12. The personal imaging system of Claim 8, where said diverter is a beamsplitter.

13. The personal imaging system of Claim 12 further including at least one polarizer in the optical path between said camera and said viewfinder.

14. The personal imaging system of Claim 12 further including at least one polarizer in the optical path between said camera and said diverter.

15. The personal imaging system of Claim 8, where the effective center of projection of said camera is the same distance from the effective optical center, facing said

camera, of said diverter as the effective center of projection of an eye of a wearer of said personal imaging system is from the effective optical center, facing said eye, of said diverter.

16. The personal imaging system of Claim 8, where said diverter has at least one flat side.

17. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, said viewfinder including a camera aiming aid, said camera aiming aid including one of:

- a reticle;
- a graticule;
- a rectangle;
- a marking.

18. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, said viewfinder responsive to said computer, but said viewfinder not responsive to said camera, said viewfinder including a camera aiming aid, said camera aiming aid comprising visible information displayed on said viewfinder from said computer.

19. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, where said camera is a wide camera, said personal imaging system further including a narrow camera.

20. The personal imaging system of Claim 19, where said narrow camera and said wide camera share a common effective center of projection.

21. The personal imaging system of Claim 20 where said common effective center of projection co-incides with the center of projection of an eye of a wearer of said personal imaging system.

22. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, where the center of projection of said camera co-incides with the center of projection of an eye of a wearer of said personal imaging system.

23. The personal imaging system of Claim 19, 20, or 21, where said viewfinder is a wide viewfinder, said personal imaging system further including a narrow viewfinder.

24. The personal imaging system of Claim 23, respective rays of light from said wide viewfinder being collinear with rays of light to which said wide camera is responsive, and respective rays of light from said narrow viewfinder being collinear with rays of light to which said narrow camera is responsive.

25. The personal imaging system of Claim 23, or 24, where said narrow viewfinder is an electronic viewfinder, said narrow viewfinder for being responsive to an input from said camera.

26. The personal imaging system of Claim 25, where said wide viewfinder is not responsive to an input from either of said cameras.

27. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, further including a camera based headtracker.

28. The personal imaging system of Claim 23, or 24, further including a camera based headtracker.

29. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, further including an eyetracker.

30. The personal imaging system of Claim 23, or 24, further including an eyetracker.

31. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, 27, or 29, further including means for overlaying additional information

on said viewfinder, said additional information responsive to an input from said camera.

32. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, said camera responsive to rays of light collinear with lines extending outward from an eye of a wearer of said personal imaging system.

33. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, or, 7, further including means for directing at least some rays of light from said viewfinder, such that said rays of light are collinear with at least some light rays to which said camera is responsive.

34. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, or, 7, further including means for directing all rays of light from said viewfinder, such that said rays of light are collinear with all light rays to which said camera is responsive.

35. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, said viewfinder being in focus to an eye of a wearer of said personal imaging system regardless of a focus of a lens of said eye.

36. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, focus of said viewfinder being responsive to an output of said computer.

37. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, focus of said viewfinder being responsive to focus of said camera.

38. A personal always ready picture capture device, including the personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, together with means for retroactive recording of at least one picture, said means for retroactive recording including a circular buffer.

39. A visual memory prosthetic, including the personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, said visual memory prosthetic

including an object recognizer.

40. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, further including means for directing a user of said personal imaging system to position subject matter of greatest relevance within the field of view of said camera, said means comprising the processing of images from said camera, and display of results of said processing on said viewfinder.

41. The personal imaging system of Claim 40, for inducing a hypnotic semi-trance state in said user, similar to that induced by viewing a television in a darkened room, such that said user will tend to rotate his or her head until subject matter said user wishes to see is within the field of view of said camera.

42. The personal imaging system of Claim 40, where said processing includes the addition of noise to said images.

43. The personal imaging system of Claim 40, where said processing includes enhancement of said images.

44. The personal imaging system of Claim 40, where said camera is a night vision camera, and said processing is the processing normally done in the course of displaying imagery from a night vision camera.

45. A night vision system using the personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, further including means for directing a user of said personal imaging system to position subject matter of greatest relevance within the field of view of said camera, said means comprising means for brightening subject matter within the field of view from said camera, by way of display of results of processing of images from said camera on said viewfinder, said brightening for enabling said user to see more clearly objects in said field of view.

46. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, where said headwear comprises eyeglasses, and where said camera is concealed within the nose bridge of said eyeglasses.

47. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, where said headwear includes eyeglasses, and where said camera is concealed within the upper portion of the frames of said eyeglasses.

48. The personal imaging system of Claim 19, 20, or 21, said wide camera being concealed within the nose bridge of eyeglasses, and where said narrow camera is concealed within the upper portion of the frames of said eyeglasses.

49. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, a connection between said computer and said camera being made by way of wires concealed inside an eyeglass safety strap.

50. A quantigraphic personal imaging system, including the personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, where said computer calculates the actual quantity of light, up to a single unknown scalar constant, arriving at said camera from each of a plurality of directions.

51. The personal imaging system of Claim 19, 20, or 21, including headtracker, said headtracker comprising processing an output of said wide camera by way of said computer.

52. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, including a virtual television screen of high resolution, and means for indexing a view into said virtual television screen, said means comprising headtracker for tracking head movements of a wearer of said personal imaging system, said means for tracking head movements including the processing of a plurality of pictures from said camera by way of said computer.

53. A non eye-blocking personal imaging system, for allowing other people to make eye contact and see both eyes of a wearer of said non eye-blocking personal imaging system, said non eye-blocking personal imaging system comprising the personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, together with a magnifier for viewing said viewfinder, and a demagnifier for cancelling distortion of an eye of a wearer of said personal imaging system.

54. The system of Claim 53, where said demagnifier is a diverging lens.

55. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, or, 7, where said headwear is eyeglasses, said personal imaging system including a beamsplitter borne by a lens of said eyeglasses, said lens of said eyeglasses being tinted slightly to match said beamsplitter, for concealment of said beamsplitter.

56. The personal imaging system of Claim 8, where said headwear is eyeglasses, said diverter comprising a beamsplitter borne by a lens of said eyeglasses, said lens of said eyeglasses being tinted slightly to match said beamsplitter, for concealment of said beamsplitter.

57. A method of electronic newsgathering using the personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, and comprising the steps of:

- wearing said personal imaging system for some time period before, as well as during a newsworthy event;
- viewing objects through said viewfinder for some time before as well as during a newsworthy event;
- capturing images into said computer.

58. The method of electronic newsgathering of Claim 57, where said step of capturing images into said computer includes a step of capturing at least some of said

images into a circular buffer, and where said method of electronic newsgathering further includes a step of stopping the capturing of said at least some of said images into said circular buffer, after said newsworthy event.

59. A reality mediator for altering the visual perception of reality, said reality mediator including the personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, said reality mediator further including means for processing images captured from said camera and means for displaying results of processing said images on said viewfinder.

60. The reality mediator of Claim 59, where said means for processing said images comprises a program running on said computer.

61. The reality mediator of Claim 59, further including a picture signal transmitter means and a picture signal receiver means, where said means for processing said images comprises transmission of said picture signal to at least one remote location for processing at said remote location, followed by reception of said picture signal by way of said picture signal receiver.

62. The reality mediator of Claim 59, where said means for processing said images includes the steps of capturing said images by way of said computer, followed by transmission of at least some of said images to at least one remote location, followed by at least some processing of said at least some of said images at said at least one remote location, followed by reception of results of said at least some processing.

63. The reality mediator of Claim 59, or 60, where said computer is connected by a wireless communications link to a computer network comprised of said computer and at least one other computer.

64. A collaborative reality mediator system for a community of photographic cybernetic users, said collaborative reality mediator comprising at least two personal

imaging systems as described in Claim 59, 60, 61, or 62.

65. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, further including means for combining multiple pictures of the same subject matter into a single image of increased resolution.

66. A collaborative reality mediator, for a community of photographic cybernetic users, said collaborative reality mediator comprising at least two personal imaging systems as described in Claim 65.

67. A reality augmenter, including the personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, where said viewfinder is an electronic viewfinder, said reality augmenter further including means for overlaying information on top of information displayed from said camera on said viewfinder.

68. A method of videography, including the reality augmenter of Claim 67, said method of videography including the steps of:

- outfitting at least one user with said reality augmenter, together with remote data communications means for remotely communicating with said computer;
- using said means of overlaying information to remotely advise said at least one user with regard to matters of videographic composition or content.

69. The method of videography of Claim 68, wherein a plurality of users are each outfitted with said reality augmenter, and where said data communications means includes means for any of said users to remotely advise any other of said users.

70. A system for collaboration including at least two personal imaging systems of Claim 52, one of said personal imaging systems for a first user, and another of said personal imaging systems for a second user, said means for indexing a

view into said virtual television screen being for said first user to index a view into a virtual television screen of said second user, and further including means for said second user to index a view into a virtual television screen of said first user.

71. A system for shared lookpainting, including the system for collaboration of Claim 70, further including means for combining multiple pictures of the same subject matter into a single image of increased resolution.

72. A method of manufacturing the apparatus of Claim 8, or Claim 56, said method comprising the steps of:

- prior to installing said diverter;
- aligning said camera with respect to said viewfinder, while monitoring an output of said camera, said alignment responsive to said output of said camera, said alignment for maximizing the degree to which said rays of light from said visible image boundary enter said camera closest to said boundary of a field of view of said camera;
- installing said diverter after completing said aligning said camera with respect to said viewfinder.

73. A method of manufacturing an embodiment of the apparatus of Claim 8, or Claim 56, in which said viewfinder is an electronic viewfinder, said method comprising the steps of:

- prior to installing said diverter;
- presenting a feedback test signal to said viewfinder;
- aligning said camera with respect to said viewfinder, while monitoring an output of said camera, said alignment responsive to said output of said camera, said alignment for maximizing the degree to which said output of said camera matches at least one aspect of said feedback test signal;

- installing said diverter after completing said aligning said camera with respect to said viewfinder.

74. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, said viewfinder responsive to an input from said computer.

75. The personal imaging system of Claim 74 for use by a wearer of said personal imaging system, light from said viewfinder being virtual light, said personal imaging system further including means for providing said virtual light with a unique appearance in a region of said wearer's field of view that corresponds to a region to which said camera is responsive to light.

76. The personal imaging system of Claim 75, where said means is by the elimination of colour information from said virtual light.

77. The personal imaging system of Claim 75, where said means is a colour filter for altering the colour of said virtual light.

78. The personal imaging system of Claim 75, where said means includes display of images from said computer in pseudocolour on said viewfinder.

79. The personal imaging system of Claim 75, where said means includes display of unique patterns on said viewfinder, said unique patterns also indicating areas of over exposure.

80. The personal imaging system of Claim 75, where said means includes display of unique patterns on said viewfinder, said unique patterns also indicating areas of under exposure.

81. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, for use by a wearer of said personal imaging system, further including means for making said display visible to other people standing in front of said wearer.

82. The personal imaging system of Claim 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 11, 12, 13, 14, or 15, for use by a wearer of said personal imaging system, further including a second display visible to other people standing in front of said wearer.

83. A wearable personal imaging system for picture capture and processing, comprising:

- an image sensor;
- optics, at least a portion of said optics for being borne by headwear, said optics for directing rays of light into said sensor, the effective center of projection of said sensor together with said optics, being located approximately at the center of a lens of an eye of a wearer of said personal imaging system, when said wearer is looking in an approximate forward direction;
- a wearable picture processing computer for processing an output of said sensor;
- a viewfinder for being borne by said headwear, said viewfinder for providing a visible image boundary, said visible image boundary for appearing in focus to said wearer,

the center of the field of view of said sensor when operating together with said optics, being approximately collinear with the center of the field of view of said visible image boundary as viewed by said wearer.

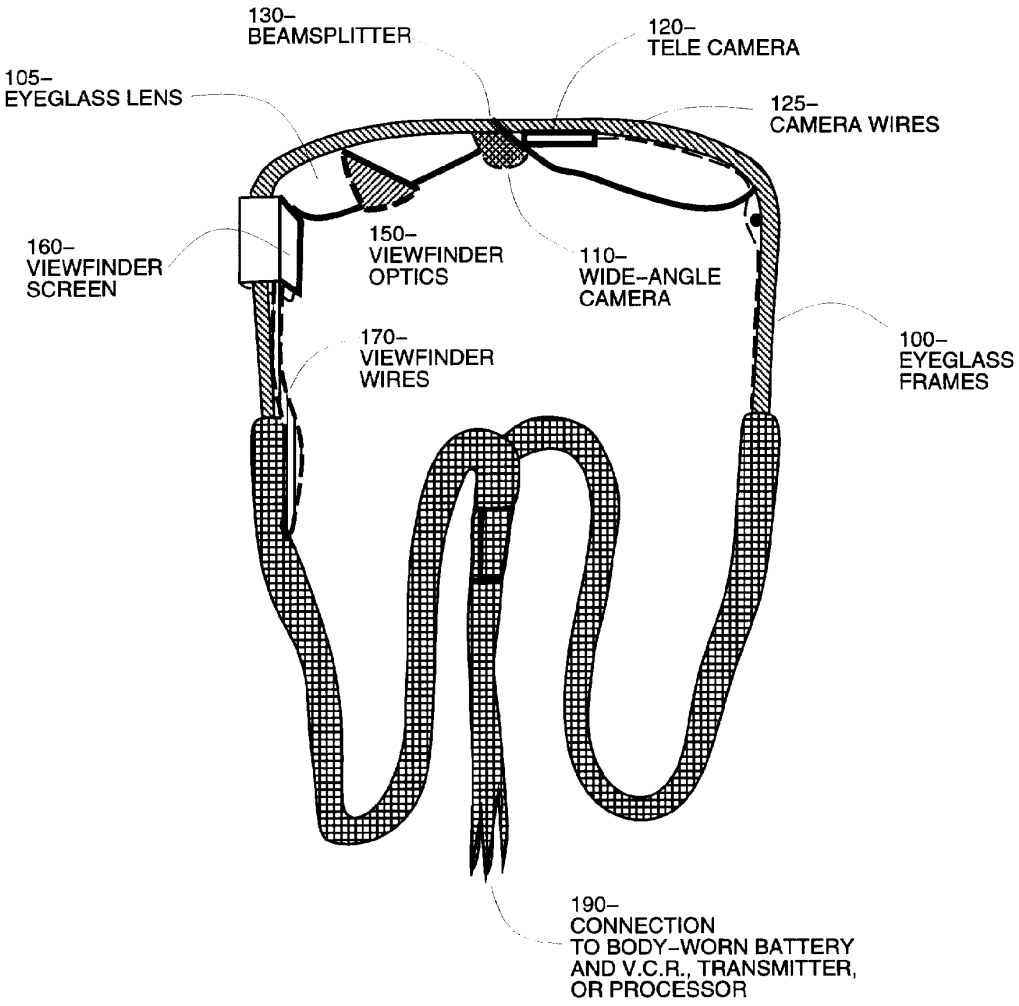


FIG. 1 – WEARABLE FOVEATED CAMERA SYSTEM WITH VIEWFINDER MEANS

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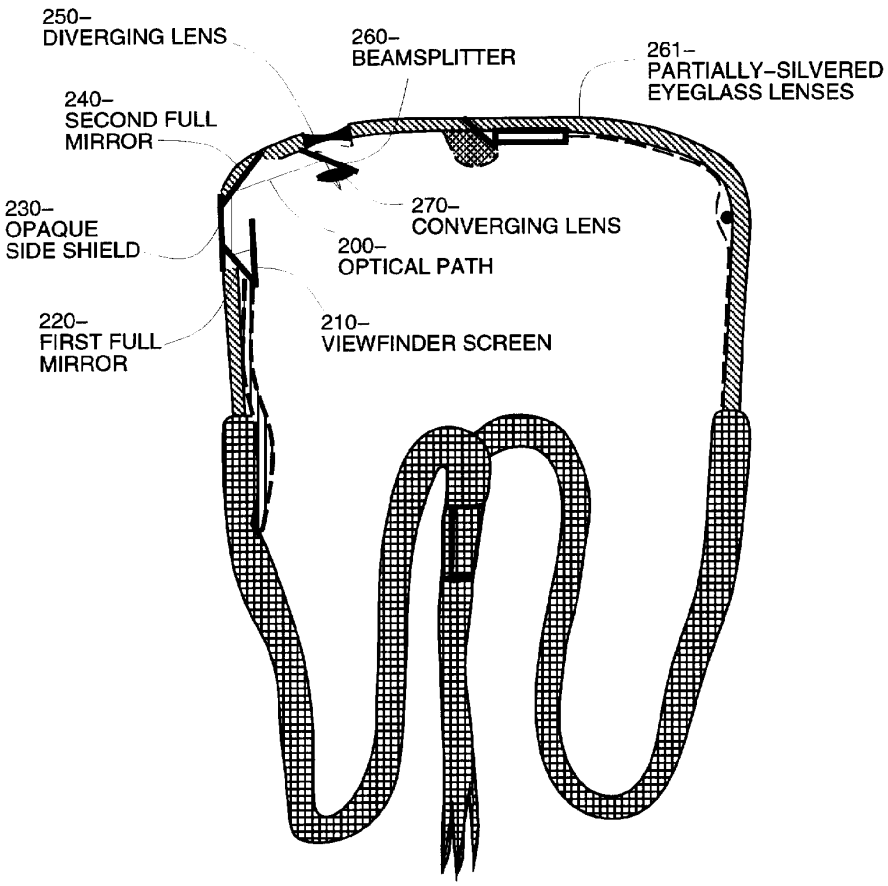


FIG. 2 – WEARABLE FOVEATED CAMERA SYSTEM WITH VIEWFINDER MEANS IN WHICH BOTH EYES ARE VISIBLE TO OTHERS

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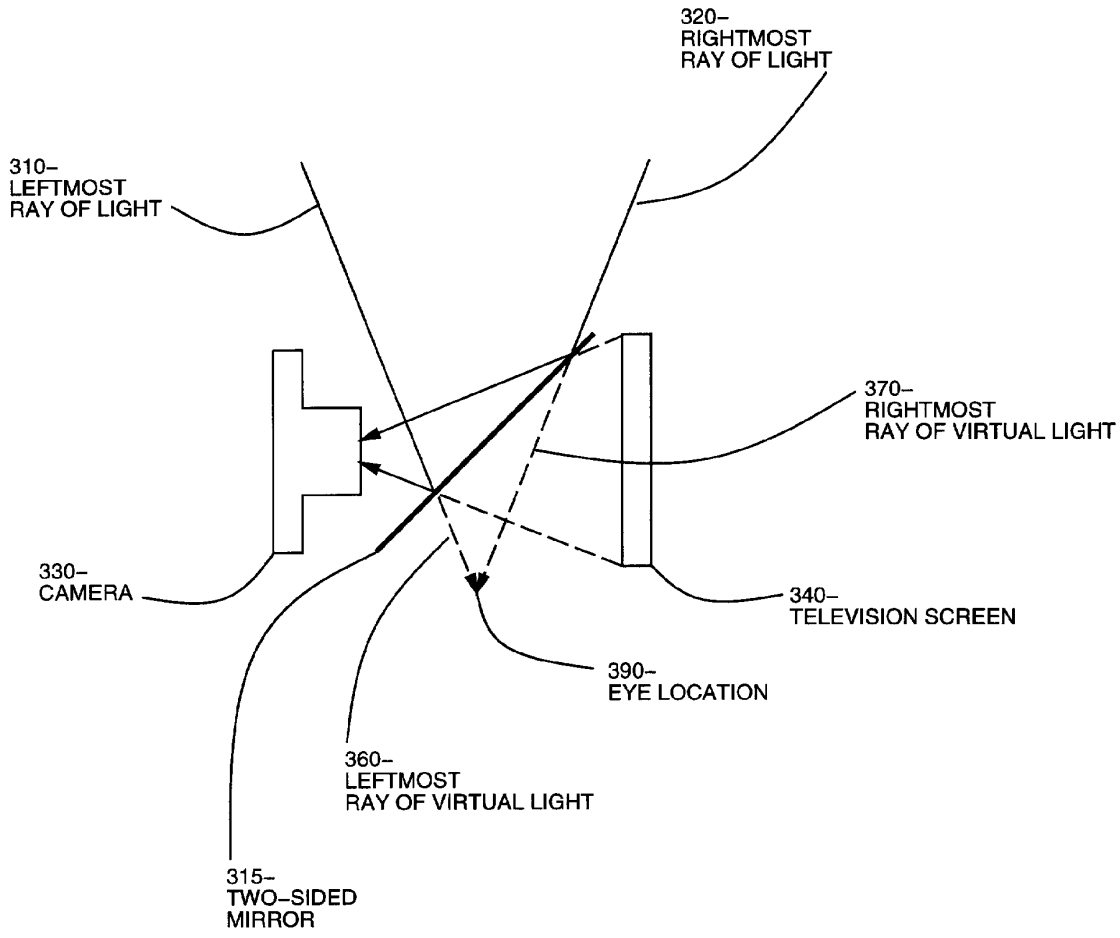


FIG. 3 – VIRTUAL LIGHT

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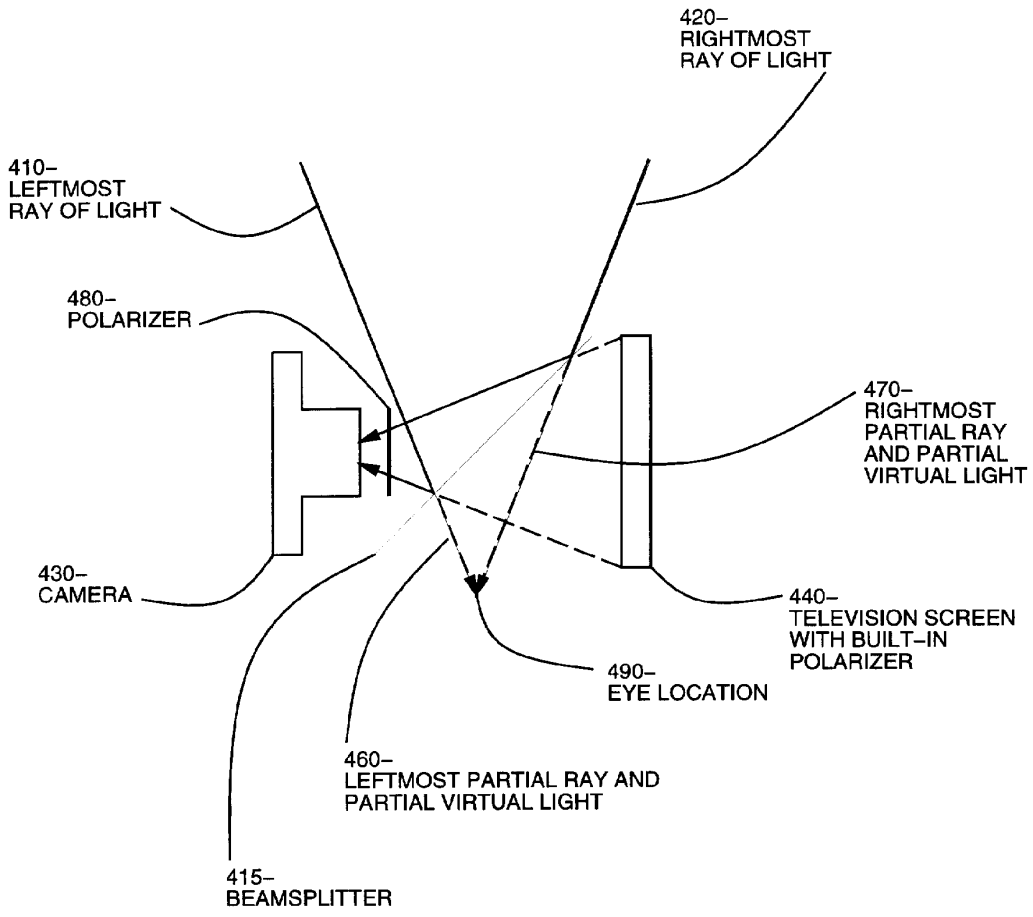


FIG. 4 – PARTIAL VIRTUAL LIGHT WITH VIDEO FEEDBACK PREVENTION MEANS

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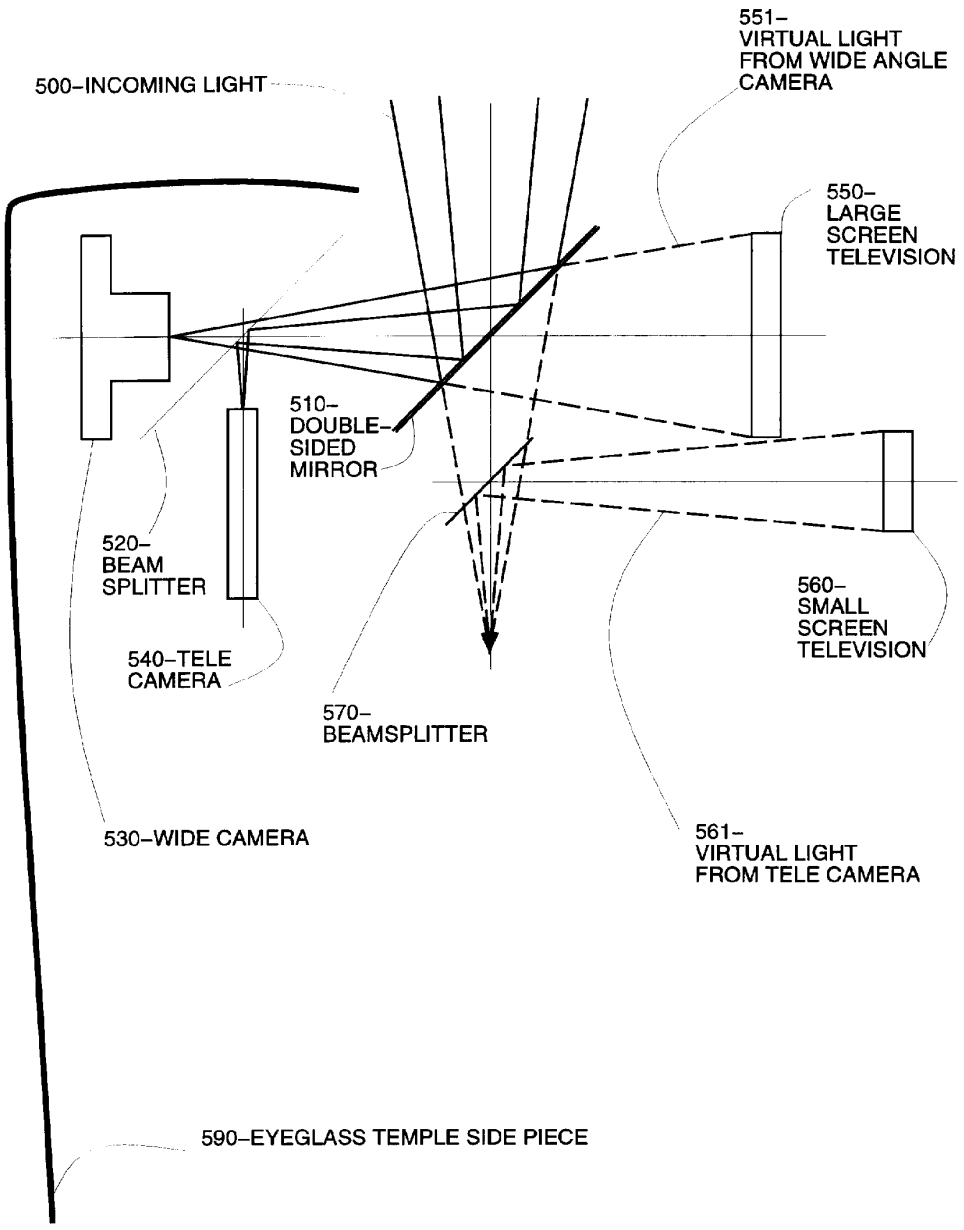


FIG. 5 – FOVEATED WEARABLE CAMERA WITH FOVEATED VIEWFINDER MEANS

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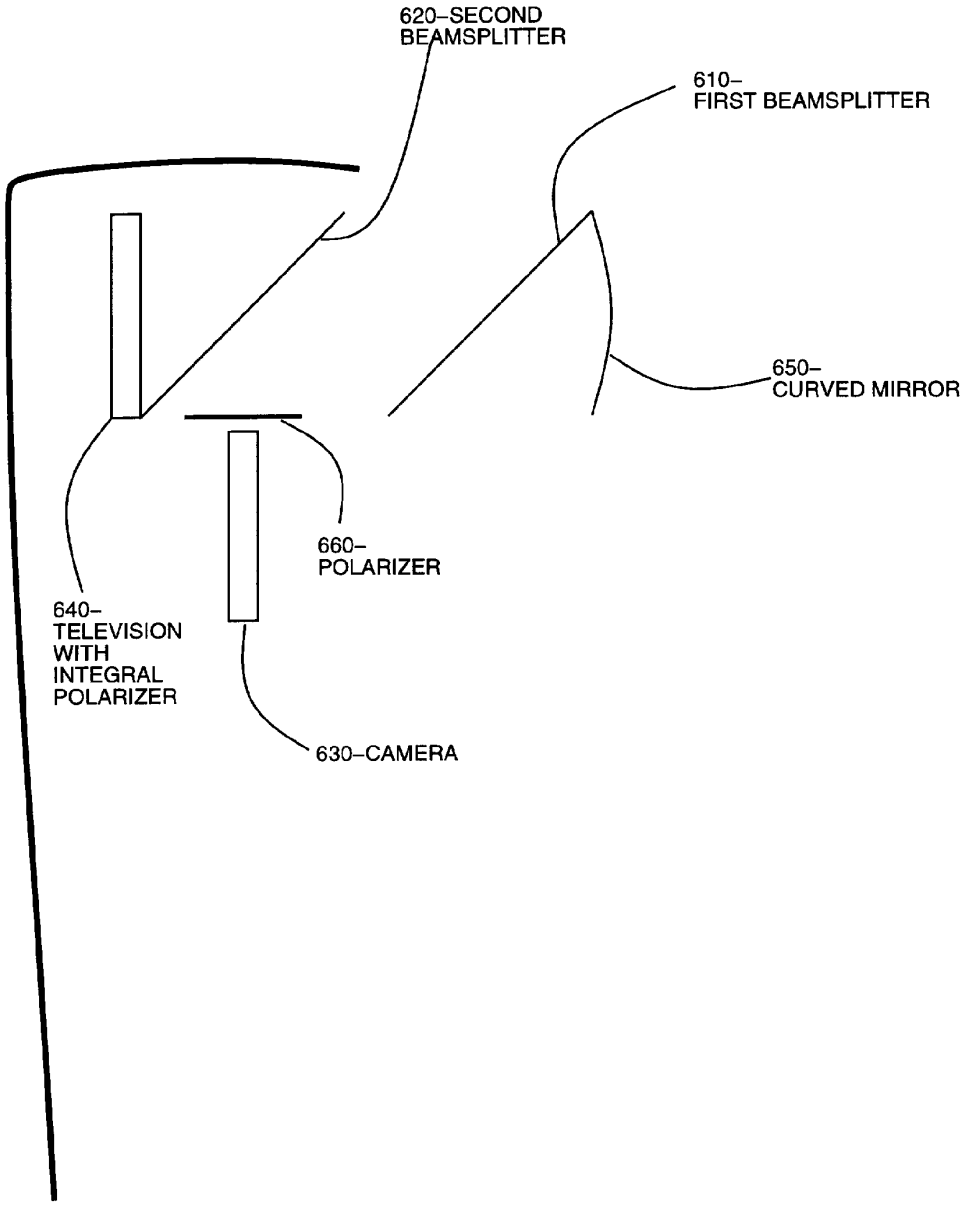
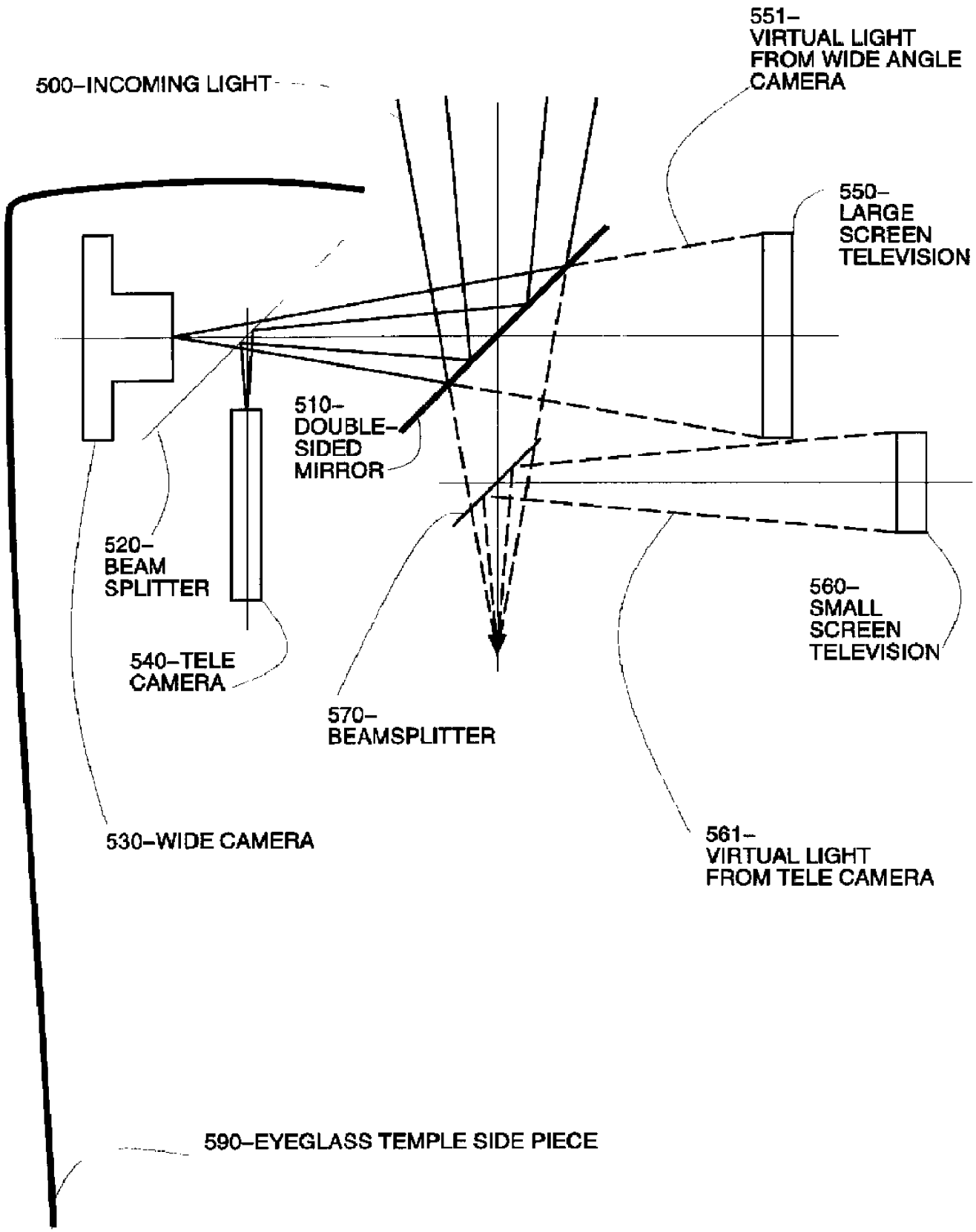


FIG.6 – WEARABLE CAMERA SYSTEM WITH VIEWFINDER ALLOWING OTHERS TO SEE BOTH OF WEARER'S EYES

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FOVEATED WEARABLE CAMERA WITH FOVEATED VIEWFINDER MEANS

1383_PRIOR_ART_001206

⑲日本国特許庁（JP）　⑪実用新案出願公開

⑫公開実用新案公報（U）　平2－102521

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G 02 C 11/00		7029－2H	
G 08 B 21/00	A	7605－5C	

審査請求　未請求　請求項の数 1　（全2頁）

⑤4考案の名称　音声警報装置付き眼鏡

⑵1実　願　平1－10109
⑵2出　願　平1(1989)1月30日

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⑦4代 理 人　弁理士　樋口　豊治　外1名

⑤7実用新案登録請求の範囲

一対のレンズおよび上記レンズを保持しつつ顔面に係止されるフレームを備えた眼鏡において、

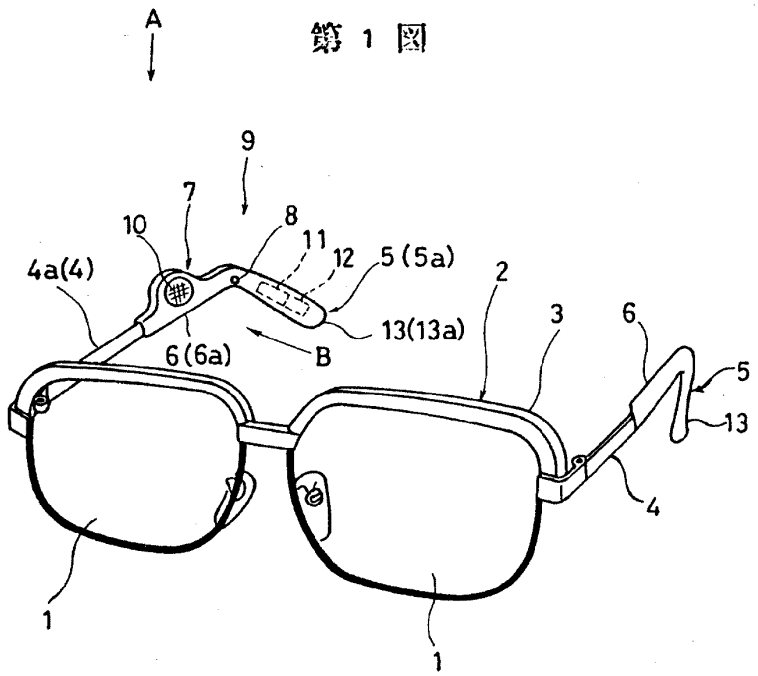
上記フレームに、スピーカ、制御回路および超小型電池等からなる音声発生装置を設ける一方、上記フレームの内側部に、眼鏡を外した時に外光を感知して上記音声発生装置に始動信号を出力する光センサーを設けたことを特徴とする、音声警報装置付き眼鏡。

図面の簡単な説明

第1図は本願考案にかかる眼鏡の実施例の全体斜視図、第2図は第1図に示す眼鏡を装着した場合の側面図、第3図は第1図における矢印A方向から見た場合のつる部の拡大図、第4図は第1図における矢印B方向から見た場合のつる部の拡大図である。

1……レンズ、2……フレーム、7……音声発生装置、8……光センサー、10……スピーカ、11……制御回路、12……超小型電池。

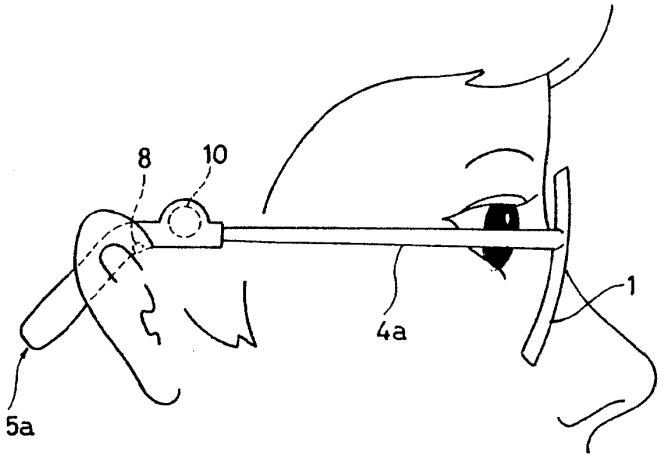
第1図



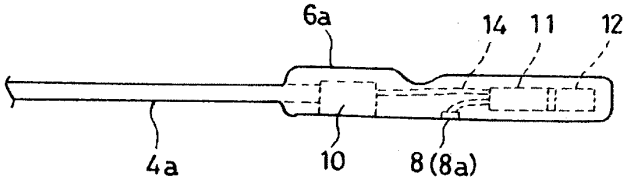
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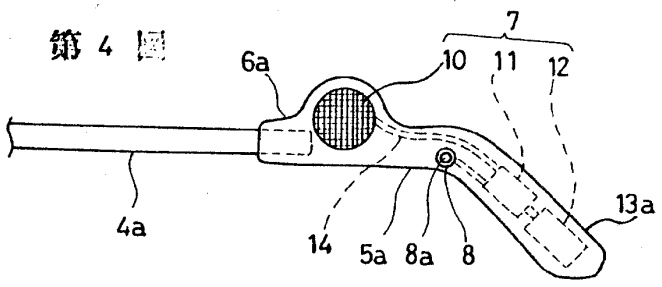
第 2 図



第 3 図



第 4 図



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⑲日本国特許庁（JP）　⑪実用新案出願公開

⑫公開実用新案公報（U）　平2－102521

⑤Int.Cl.⁵	識別記号	庁内整理番号	㊸公開　平成2年(1990)8月15日
G 02 C 11/00		7029－2H	
G 08 B 21/00	A	7605－5C	

審査請求　未請求　請求項の数 1　（全　頁）

㊹考案の名称　音声警報装置付き眼鏡

㉑実　願　平1－10109
㉒出　願　平1(1989)1月30日

㉒考案者　岡本　隆博　大阪府大阪市天王寺区玉造元町2－32－1303
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明　細　書

1．考案の名称

音声警報装置付き眼鏡

2．実用新案登録請求の範囲

(1)　一対のレンズおよび上記レンズを保持しつつ顔面に係止されるフレームを備えた眼鏡において、

上記フレームに、スピーカ、制御回路および超小型電池等からなる音声発生装置を設ける一方、上記フレームの内側部に、眼鏡を外した時に外光を感知して上記音声発生装置に始動信号を出力する光センサーを設けたことを特徴とする、音声警報装置付き眼鏡。

3．考案の詳細な説明

【産業上の利用分野】

本願考案は、音声警報装置付き眼鏡に関し、詳しくは、眼鏡を外したときに、上記眼鏡の置き忘れ等を防止する音声警報を発生する音声警報装置付き眼鏡に関する。

【従来の技術および考案が解決しようとする課題】

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眼鏡には、近視用眼鏡、遠視用眼鏡、乱視用眼鏡等種々のものがあるが、多くの人々は、日常生活において眼鏡を身体の一部のようにして使用している場合が多い。

しかし、眼鏡は本来、視覚の弱点を補うために利用されるものであり、とくに、近視等の度数が低い場合には、小さな文字を読む場合以外の日常生活では眼鏡を必要とせず、かえって、眼鏡が目障りとなることもある。

このため、眼鏡を利用している人は、必要に応じて無意識のうちに上記眼鏡を着脱していることが多い。

ところが、外した眼鏡をいったん手から離すと、眼鏡の存在を忘れてしまい、その場所に眼鏡を置き忘れることが非常に多い。とくに、外した眼鏡は、通常一方の手で保持することが多いため、眼鏡を外した状態で手を用いる作業をする必要が生じた場合等に置き忘れやすくなる。

上記問題を解決するために、フレームの左右つる部の先端に細い鎖を連結してループ状にするこ

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とにより、眼鏡を外したときには、眼鏡が上記鎖によって、使用者の首に係止されるようにしたものが用いられている。しかし、上記鎖付きの眼鏡は、眼鏡を使用している時に上記鎖が目障りとなり、また、上記鎖が長いため邪魔になって眼鏡の使用者の行動が制限される場合があり、さらに、デザイン上の問題も発生するため、一部の人によって利用されているに過ぎない。

また、就寝するときには眼鏡を外すが、外した眼鏡を眼鏡ケース等の所定場所へ収納しないまま枕元へ放置して、就寝時あるいは起床時に気が付かないで破損させてしまったり、起床時に眼鏡の置き場所を忘れてしまうことがよくある。

本願考案は、上述の事情のもとで考え出されたものであって、上記の問題を解決し、眼鏡を外した場合に音声警報を発生させることにより、置き忘れを防止するとともに、所定場所に収納するための注意を喚起することのできる眼鏡を提供することをその課題とする。

【課題を解決するための手段】

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本願考案では、上述の課題を解決するために、次の技術的手段を講じている。

すなわち、本願考案は、一対のレンズおよび上記レンズを保持しつつ顔面に係止されるフレームを備えた眼鏡において、上記フレームに、スピーカ、制御回路および超小型電池等からなる音声発生装置を設ける一方、上記フレームの内側部に、眼鏡を外した時に外光を感知して上記音声発生装置に始動信号を出力する光センサーを設けたことを特徴とする。

【考案の作用および効果】

本願考案は、眼鏡のフレームに、スピーカ、制御回路および超小型電池からなる音声発生装置を設ける一方、上記フレームの内側に、上記音声発生装置に始動信号を出力する光センサーを設けたものである。

上記光センサーは眼鏡のフレームの内側に設けられるため、眼鏡を装着している時には、上記センサーの受光部が顔面あるいは側頭部によって外光から遮蔽され、始動信号を出力しない。しかし、

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眼鏡を外すと、上記センサーに外光が入射し、上記音声発生回路に始動信号を出力して、スピーカから音声警報を発生させる。眼鏡の使用者は、この音声警報によって、注意を喚起されるとともに眼鏡を外したことを認識させられ、眼鏡を置き忘れることを防止することができる。

また、上記センサーは、所定の眼鏡ケース等に眼鏡を収納すると、上記センサーの受光部が眼鏡ケースによって外光から遮蔽されるために、始動信号を音声発生装置に出力することはなく、警告信号を停止させることができる。このため、眼鏡の使用者に、眼鏡を外したときに、所定の眼鏡ケースに収納する注意を喚起することにより、眼鏡を不用意に放置して傷つけたり破損したりすることを防止することができることはもちろん、眼鏡を使用しないときに、眼鏡を眼鏡ケースに収納するという習慣付けを行うこともできる。

一方、本願考案にかかる音声発生装置は、スピーカ、制御回路および超小型電池等からなり、上記光センサーから出力された始動信号によって、

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眼鏡使用者の注意を喚起することのできる警告音声を発生することができるように構成される。上記制御回路によって、単一の音声からなる警告音声はもちろんのこと、電子音によるメロディーを発生させることも可能であり、眼鏡の使用者に不快感を与えることなく注意を喚起することが可能となる。

また、近年の電子技術の発達によって、上記音声発生装置として非常に小さなものが開発され、眼鏡のフレームに組み込み、あるいは装着することに対しての技術的問題はほとんどない。さらに、フレームの一部あるいは全体を太陽電池の受光部として利用することにより、さらに使い勝手のよい警報装置付き眼鏡を提供することもできる。

【実施例の説明】

以下、本願の実施例を第1図ないし第4図に基づいて具体的に説明する。

第1図は本願考案に係る実施例の全体斜視図である。図に示すように、近視等の通常の視力矯正用に用いられる眼鏡は、一対のレンズ1，1と、

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上記レンズ１，１を両眼に対向させて保持するためのフレーム２とから大略構成される。上記フレーム２は、上記レンズ１，１をその前部３に保持する一方、上記前部３の両側に、使用者の両耳に係止されることにより、眼鏡を顔面に装着するための一対のつる部４，４が折り畳み可能に枢着される。また、本実施例においては、メタル製のつる部４，４が採用されるとともに、その先端部には樹脂等で形成され、眼鏡使用者の側頭部と耳の上部との間に当接係止されるいわゆる先セル部５，５が設けられている。上記先セル部５，５は、先端が下方に屈曲した略へ字状をしており、基部６，６において上記つる部４，４の先端部に接合されている。

本実施例においては、音声発生装置７と光センサー８とからなる音声警報装置９は、上記一方のつる部４ａの先端に接合される先セル部５ａに設けられている。

音声発生装置７は、第３図および第４図に示すように、スピーカ１０、制御回路１１および超小

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型電池１２から構成され、上記スピーカ１１は、上記先セル部５ａの基部６ａを上方に膨出させることにより、音声発生面を内方に向けて埋設される一方、上記制御回路１１および超小型電池１２は先セル部５ａの先端の屈曲部１３に装置全体を埋め込むようにして設けられている。

また、光センサー８は、上記先セル部５ａの屈曲点近傍内側に受光部８ａを眼鏡の内方に向けて埋設されている。これにより、上記眼鏡を装着したときには、第２図に示すように、上記光センサー８の受光部８ａが使用者の側頭部に確実に当接して遮蔽され、外光が上記受光部８ａに入射することを防止することができる。そして、上記樹脂製先セル部５ａの内部において上記スピーカ１０、制御回路１１、超小型電池１２および光センサー８がリード線１４によって接続され、音声警報装置９が構成されている。

上記光センサー８は、その受光部８ａに外光が入射すると、抵抗が減少しあるいは微小電流を発生すること等により、上記制御回路１１に始動信

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号を発生させる。一方、上記制御回路１１は上記光センサー８によって出力された始動信号によって作動し、所定時間音声警報を上記スピーカ１０から発生させる。また、超小型電池１２は上記制御回路１１およびスピーカ１０を駆動させるためのものであり、簡単に交換できあるいは充電することができるものが好ましい。

上記構成の警報装置付き眼鏡は、眼鏡が使用者の顔面に装着されている時には、第２図に示すように、上記センサー８の受光部８ａが顔面あるいは側頭部によって外光から遮蔽され、始動信号を出力しない。しかし、眼鏡を外すと、上記光センサー８の受光部８ａに外光が入射し、上記音声発生装置７に始動信号を出力して、スピーカ１０から音声警報を発生させる。眼鏡の使用者は、この音声警報によって、注意を喚起されるとともに眼鏡を外したことを認識させられ、眼鏡を置き忘れることを防止することができる。

また、上記センサー８は、所定の眼鏡ケース等に眼鏡を収納すると、上記センサー８の受光部８

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aが眼鏡ケース等によって外光から遮蔽されるため、始動信号を音声発生装置に出力することはなく、警告信号を停止させることができる。このため、眼鏡の使用者に、眼鏡を外したときに、所定の眼鏡ケースに収納する注意を喚起することにより、眼鏡を不用意に放置して傷つけたり破損したりすることを防止することができることはもちろん、眼鏡を使用しないときに、眼鏡を眼鏡ケースに収納するという習慣付けを行うこともできる。

さらに、本実施例の音声発生装置7は、上記光センサー8から出力された始動信号によって、眼鏡使用者の注意を喚起することのできる警告音声を発生することができるように構成されるのであるが、上記制御回路11によって、単一の音声からなる警告音声はもちろんのこと、上記制御回路11内に音声記憶回路を設けることにより電子音によるメロディーを発生させることも可能であり、眼鏡の使用者に不快感を与えることなく注意を喚起することが可能となる。

上述のように、本願考案によって、眼鏡を外し

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たときに音声警報を発生させることにより、置き忘れを防止するとともに、所定場所に収納するための注意を喚起することのできる眼鏡を提供することができる。

本願考案の範囲は上述の実施例に限定されることはない。実施例においては、つる部4の先端に接合される先セル部5に本願考案にかかる音声警報装置9を設けたが、フレーム2の他の部分に設けることも可能である。また、実施例は通常の視力矯正用眼鏡に本願考案を適用した例であるが、サングラスあるいは防塵眼鏡等に本願考案を適用することもできる。さらに、フレーム2の一部あるいは全体を太陽電池の受光部として利用することも可能である。

4．図面の簡単な説明

第1図は本願考案にかかる眼鏡の実施例の全体斜視図、第2図は第1図に示す眼鏡を装着した場合の側面図、第3図は第1図における矢印A方向から見た場合のつる部の拡大図、第4図は第1図における矢印B方向から見た場合のつる部の拡大

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図である。

1…レンズ、2…フレーム、7…音声発生装置、8…光センサー、10…スピーカ、11…制御回路、12…超小型電池。

出願人　みえーる株式会社

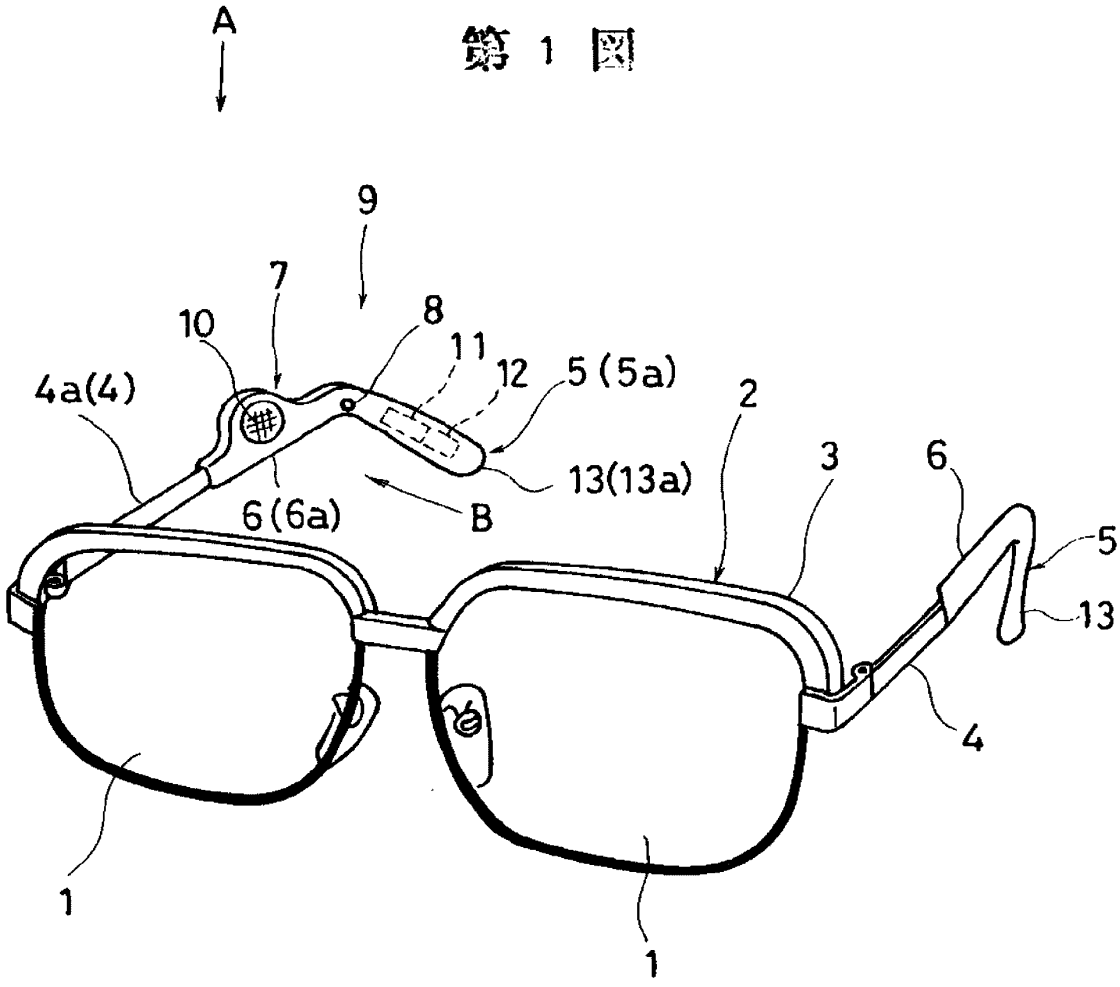
代理人　弁理士　樋口　豊治

同　　弁理士　吉田　　稔

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第 1 図



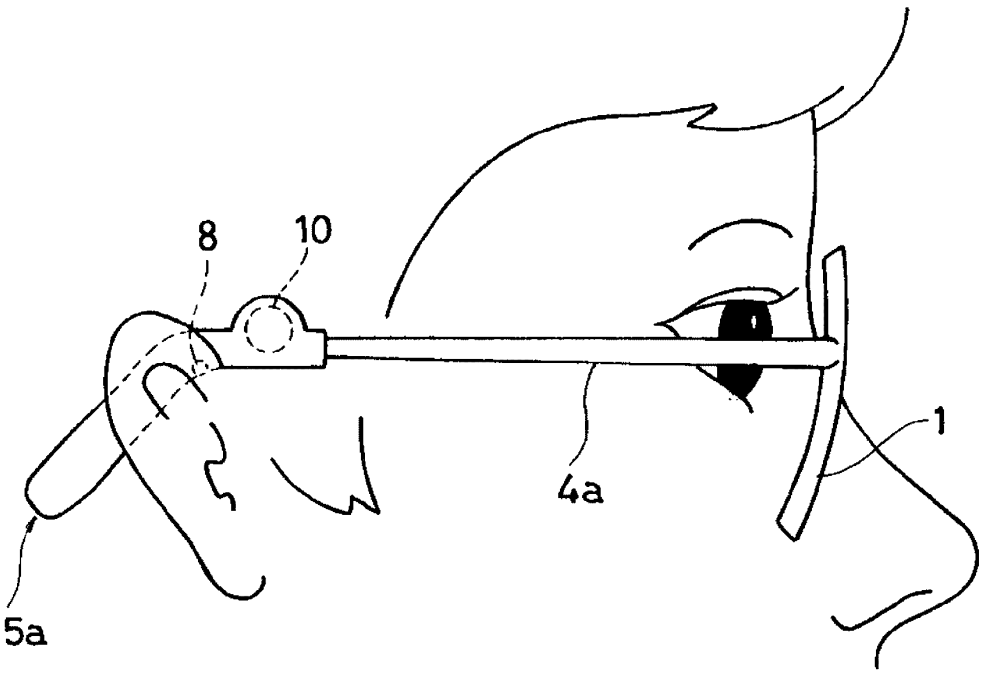
実開2-102521

代理人 弁理士 頓口博治 外1

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第 2 図



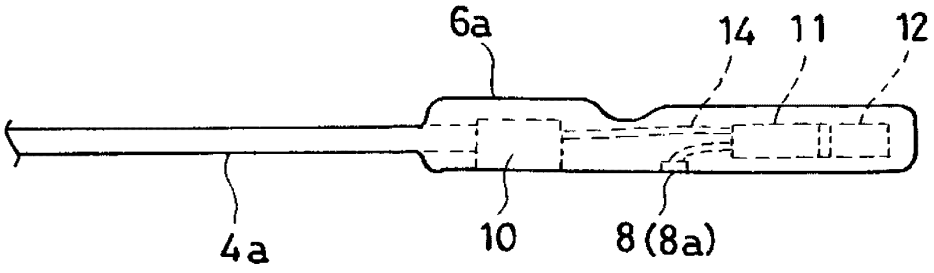
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実開2-102521

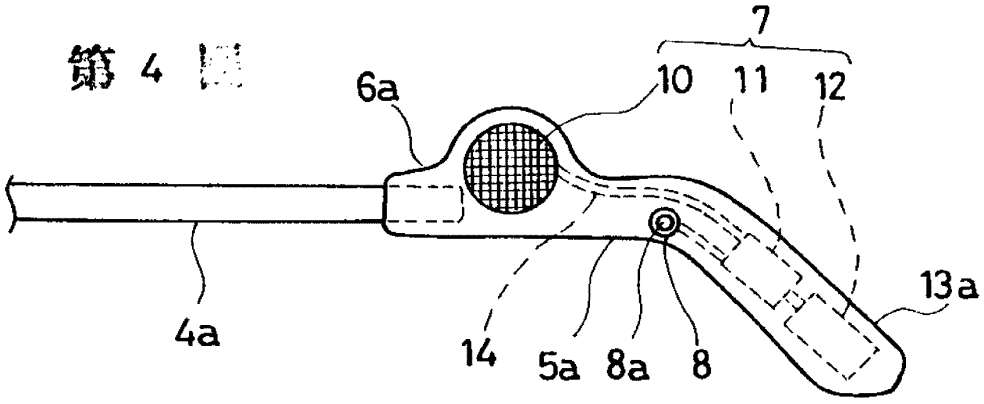
代理人 弁理士 [illegible]

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第 3 図



第 4 図



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実開2-10252

代理人 弁理士 [illegible]

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MACHINE TRANSLATION

Scope of Utility Model Registration Claims

Glasses equipped with a pair of lenses and a frame that holds the lenses and is fastened to the face, and the frame is equipped with an audio generator consisting of a speaker, a control circuit, and a micro battery, etc., while a light sensor is provided on the inside of the frame that detects outside light and outputs a start signal to the audio generator when the glasses are removed. On the other hand, the inside of the frame is equipped with a light sensor that detects ambient light and outputs a start signal to the sound generator when the glasses are removed.

Brief Description of Drawings

The first figure is an overall view of an example of the eyeglasses of this application, the second figure is a side view of the eyeglasses shown in the first figure when worn, the third figure is an enlarged view of the vine when viewed from the direction of arrow A in the first figure, and the fourth figure is an enlarged view of the vine when viewed from the direction of arrow B in the first figure.

1..... lens, 2..... frame, 7..... sound generator, 8..... light sensor, 10..... speaker, 11..... control circuitry, 12..... micro batteries.

specifications
1. name of the device
Glasses with voice alarm system

2. scope of claims for utility model registration
(l) Glasses with a pair of lenses and a frame that holds the lenses and is fastened to the face, wherein the frame is equipped with an audio generator consisting of a speaker, a control circuit, and an ultra-compact battery, and wherein the inside of the frame is equipped with a light sensor that detects exterior light when the glasses are removed and outputs a start signal to the audio generator. On the other hand, the glasses with an audio alarm device are characterized in that an optical sensor is provided on the inside of the above frame that detects ambient light and outputs a start signal to the above audio generator when the glasses are removed.

3. detailed description of the idea

[Industrial Applications]
This invention relates to eyeglasses with an audio alarm device, and in detail, to eyeglasses with an audio alarm device that generates an audio alarm when the eyeglasses are removed to prevent misplacing, etc., the eyeglasses.

[Problem to be solved by the conventional techniques and devices].
There are various types of eyeglasses, including glasses for nearsightedness, farsightedness, and astigmatism, but most people use eyeglasses as if they were a part of their body in daily life.

However, eyeglasses are originally used to compensate for weaknesses in vision, and especially in cases of nearsightedness or low power, eyeglasses are not needed in daily life except for reading small letters, and in fact, eyeglasses can be an eyesore.

For this reason, people who use eyeglasses often unconsciously put on and take off the above glasses as needed.

However, once the glasses are removed from the hand, it is very common for the wearer to forget that the glasses are there and to leave them where they are. In particular, since the removed eyeglasses are usually held in one hand, it is easy to misplace the eyeglasses when it is necessary to use one's hand to perform a task while the eyeglasses are removed.

In order to solve the above problem, thin chains are connected to the tips of the left and right vines of the frames to form a loop so that the glasses are fastened around the user's neck by the above chains when the glasses are removed. However, glasses with the above chain are only used by some people because the above chain becomes an eyesore when the glasses are being used, the above chain is long and sometimes gets in the way and restricts the activities of the user of the glasses, and it also causes a design problem.

In addition, people take off their eyeglasses when they go to bed, but often leave them by their bedside without storing them in their eyeglass case or other designated place, damaging them without being noticed when they go to bed or wake up, or forgetting where to put them when they wake up.

This invention was conceived under the circumstances described above, and its task is to solve the above problem and provide a pair of eyeglasses that can prevent misplacing and alert the user to store them in a designated place by generating an audible alarm when the eyeglasses are removed.

[Issue.]

In order to solve the above-mentioned problems, the following technical measures are taken in this application.

The invention is characterized in that the glasses are equipped with a pair of lenses and a frame that holds the lenses and is fastened to the face, and that the frame is provided with an audio generator consisting of a speaker, a control circuit, and a micro battery, while the inside of the frame is provided with a light sensor that detects outside light when the glasses are removed and outputs a start signal to the above audio generator. On the other hand, a light sensor is provided on the inside of the above frame that detects ambient light and outputs a start signal to the above sound generating device when the glasses are removed.

[The river of ideas and effects].
In this application, a sound generator consisting of a speaker, a control circuit, and a micro battery is installed in the frame of eyeglasses, and an optical sensor that outputs a start signal to the above sound generator is installed inside the above frame. Since the above light sensor is installed inside the frame of the glasses, when the glasses are worn, the light receiving part of the above sensor is shielded from the outside light by the face or the side of the head, and does not output a start signal. However, when the glasses are removed, external light enters the above sensor, which outputs a start signal to the above audio generator circuit and

generates an audio alarm from the speaker. The user of the glasses is alerted by this audible alarm and reminded that he/she has removed the glasses, thereby preventing the user from forgetting to put them back on.

The above sensor does not output a start signal to the sound generator and the warning signal can be stopped because the light receiving part of the above sensor is shielded from outside light by the eyeglass case when the eyeglasses are stored in the prescribed eyeglass case or the like. Therefore, by alerting the user of eyeglasses to store the eyeglasses in the specified eyeglass case when they are removed, it is possible to prevent the user from damaging or damaging the eyeglasses by leaving them unattended, as well as to make it a habit to store the eyeglasses in the eyeglass jrce when they are not in use. It is also possible to make it a habit to store eyeglasses in the eyeglass case when not in use.

On the other hand, the sound generating device of the present application is composed of a speaker, a control circuit, and a micro battery, etc., and is capable of generating a warning sound that can alert the spectacle wearer by means of a start signal output from the optical sensor mentioned above. The above control circuit can generate not only a warning sound consisting of a single voice, but also an electronic melody to alert the spectacle wearer without causing discomfort.

In addition, recent developments in electronic technology have led to the development of very small sound-generating devices mentioned above, which pose few technical problems for incorporating or attaching them to the frames of eyeglasses. Furthermore, by using part or the entire frame as a light receiving part of a solar cell, it is possible to provide glasses with an alarm device that is even easier to use.

［Example Description.］
The following is a concrete explanation of the example of this application based on Figures l through 4.

The first figure is an overall view of an example of the present application. As shown in the figure, eyeglasses used for normal vision correction, such as myopia, are roughly composed of a pair of lenses 1,1 and a frame 2 for holding the above lenses 1,l facing both eyes. The above frame 2 holds the above lenses 1,1 in its front 3, while a pair of vines 4,4 are foldably pivoted on both sides of the front 3 for attaching the glasses to the face by being engaged to the user's two ears. In this example, metal vines 4,4 are employed, and the tips of the metal vines 4,4 are provided with so-called "tip cell portions 5,5" made of resin or the like, which are tangentially moored between the side of the head and the upper part of the ear of the spectacle wearer. The tip cell portion 5, 5 has an abbreviated H-shape with the tip bent downward, and is joined to the tips of the above-mentioned vines 4, 4 at the base 6, 6.

In this example, an audio alarm device 9 consisting of an audio generator 7 and an optical sensor 8 is installed in the tip cell section 5a, which is joined to the tip of one of the above-mentioned vines 4a.

As shown in Figures 3 and 4, the sound generating device 1 consists of a speaker 10, a control circuit 11, and an ultra-small battery 12. The above speaker l1 is buried with the sound generating surface facing inward by expanding the base 6a of the above tip cell part 5a upward, while the above control circuit 11 and ultra-small battery 12 are installed in a bent

portion 13 at the tip of the tip cell portion 5a, so that the entire device is embedded in the bent portion 13.

The light sensor 8 is buried in the inner side near the bending point of the above-mentioned tip cell portion 5a, with the light-receiving portion 8a facing inward of the eyeglasses. As a result, when the above glasses are worn, the light-receiving portion 8a of the above light sensor 8 securely contacts the user's temporal head and shields it, preventing outside light from entering the above light-receiving portion 8a, as shown in the second figure. The above speaker 10, control circuit 1l, micro battery 12, and light sensor 8 are connected by lead wires 14 inside the above plastic tip cell portion 5a to form the voice alarm device 9.

When external light enters the light receiving part 8a, the above light sensor 8 generates a start signal to the above control circuit 11 by decreasing resistance or generating a small current, etc. On the other hand, the above control circuit 11 is activated by the start signal output by the above light sensor 8 and generates an audible alarm from the above beeper 10 at a predetermined time. On the other hand, the above control circuit 11 is activated by the start signal output by the above light sensor 8 and generates an audible alarm from the above beeper 10 at a predetermined time. The micro battery l2 is used to drive the above control circuit 11 and speaker 10, and should be easily replaceable or rechargeable.

As shown in Figure 2, when the glasses are worn on the face of the user, the light receiving part 8a of the sensor 8 is shielded from outside light by the face or the side of the head, and does not output a start signal. However, when the glasses are removed, the light receiving part 8a of the above optical sensor 8 is illuminated by outside light and outputs a start signal to the above sound generator 7 to generate an audio alarm from the l0 speaker. The user of the glasses is alerted by this audio alarm and made aware that he/she has removed the glasses, thereby preventing the user from forgetting to put the glasses on.

When the eyeglasses are stored in the prescribed eyeglass case, etc., the sensor 8 above does not output the start signal to the sound generator and the warning signal can be stopped because the light receiving part 8a of the sensor 8 above is shielded from the outside light by the eyeglass case, etc. Therefore, by reminding eyeglass users to store their eyeglasses in the specified eyeglass case when they remove them, it is possible to prevent them from damaging or damaging their eyeglasses by leaving them unattended and also to make it a habit to store their eyeglasses in the eyeglass case when they are not using them. It is also possible to make it a habit to store eyeglasses in the eyeglass case when they are not in use.

Furthermore, the sound generator 7 in this example is configured to generate a warning sound that can alert the spectacle wearer by means of the start signal output from the optical sensor 8 above, and the control circuit 11 above can generate a warning sound consisting of a single sound or even an electronic sound melody by setting up a sound storage field in the control circuit 11 above. The control circuit 11 can generate not only a warning sound consisting of a single sound, but also an electronic sound melody by setting up a sound storage circuit in the control circuit 11, which can alert the spectacle wearer without causing discomfort.

As described above, the present invention can provide eyeglasses that can prevent misplacing and alert the user to store the eyeglasses in a designated place by generating an audible alarm when the eyeglasses are removed.

The scope of this application is not limited to the above examples. In the example, the voice alarm device 9 of the present application is installed in the tip cell portion 5 joined to the tip of the vine portion 4, but it can also be installed in other portions of the frame 2. The example shows the application of the present invention to ordinary eyeglasses for vision correction, but the invention can also be applied to sunglasses or dust-proof eyeglasses. Furthermore, it is also possible to use part or the entire frame 2 as the light-receiving part of a solar cell.

4. brief description of the drawing

The first figure is an overall view of an example of the eyeglasses of this application, the second figure is a side view of the eyeglasses shown in the first figure when worn, the third figure is an enlarged view of the vine when viewed from the direction of arrow A in the first figure, and the fourth figure is an enlarged view of the vine when viewed from the direction of arrow B in the first figure.

1..... lens, 2..... frame, 7..... sound generator , 8..... light sensor, 10..... speaker, 11..... control circuitry, 12..... micro batteries.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: HOWELL et al.	Attorney Docket No.: IPVCP006X1C10D1C1
Application No.: 18/519,802	Examiner: HAMID, AMMAR T.
Filed: November 27, 2023	Group: 2695
Title: HEAD-WORN DEVICE WITH CONNECTION REGION	

AMENDMENT B

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

Dear Sir:

In response to the Notice of Allowance dated March 4, 2024, please amend the above-identified patent application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments are on page 9 of this paper.

Amendments to the Claims:
The listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently amended) A wireless wearable device, with at least a portion of the wireless wearable device configured to be worn in at least one ear of a user, to at least help the user hear audio outputs produced by the device, the wireless wearable device comprising:

a speaker at least partially in the wireless wearable device;

an electrical connector at least partially in the wireless wearable device,

wherein the electrical connector includes at least two conductive areas, each area on a surface of the wireless wearable device, and

wherein the at least two conductive areas are configured to removably couple to corresponding conductive contacts of a counterpart connector external to and separate from the wireless wearable device, at least via spring-force, to at least enable each of the at least two conductive areas to be electrically connected to its corresponding conductive contact;

a rechargeable battery at least partially in the wireless wearable device, with the battery configured to be charged via at least the electrical connector; and

a microphone at least partially in the wireless wearable device.

2. (Original) A wireless wearable device as recited in claim 1 comprising another microphone at least partially in the wireless wearable device configured to capture at least sound in vicinity of the wireless wearable device.

3. (Previously presented) A wireless wearable device as recited in claim 2 comprising electronic circuitry at least partially in the wireless wearable device configured to cancel at least a portion of the sound captured by the another microphone to produce the audio outputs.

4. (Previously presented) A wireless wearable device as recited in claim 2, wherein at least the microphone and the another microphone are configured to receive audio inputs, with at least some sound in the audio inputs configured to be cancelled based on using at least the microphone and the another microphone.

5. (Original) A wireless wearable device as recited in claim 2, wherein the microphone is configured to be positioned closer to mouth of the user than the another microphone, when the wireless wearable device is worn by the user.

6. (Previously presented) A wireless wearable device as recited in claim 2 comprising a storage medium at least partially in the wireless wearable device configured to store at least computer program codes for facilitating voice recognition to recognize at least a word received at least by the microphone for an operation of the wireless wearable device.

7. (Original) A wireless wearable device as recited in claim 2 comprising wireless communication circuitry at least partially in the wireless wearable device configured for coupling to at least a Bluetooth network.

8. (Previously presented) A wireless wearable device as recited in claim 2 comprising:

a touch-sensitive input surface on a portion of the wireless wearable device; and

a storage medium at least partially in the wireless wearable device configured to store at least computer program codes for facilitating an operation of the wireless wearable device based on identifying a sliding user-input action across at least a portion of the touch-sensitive input surface.

9. (Original) A wireless wearable device as recited in claim 2 comprising a controller at least partially in the wireless wearable device configured to determine whether the wireless wearable device is being worn based on outputs from a sensor at least partially in the wireless wearable device.

10. (Original) A wireless wearable device as recited in claim 2 comprising a motion sensor at least partially in the wireless wearable device.

11. (Previously presented) A wireless wearable device as recited in claim 2 comprising a touch-sensitive input surface on the wireless wearable device, wherein the touch-sensitive input surface is configured to facilitate generating at least an electrical signal for an operation of the wireless wearable device based on receiving at least a touch input.

12. (Original) A wireless wearable device as recited in claim 2 comprising an area configured for attachment via magnetic force.

13. (Original) A wireless wearable device as recited in claim 12 comprising a magnet in the area.

14. (Previously presented) A wireless wearable device as recited in claim 12 comprising a storage medium at least partially in the wireless wearable device configured to store at least computer program codes for facilitating voice recognition to recognize at least a word received at least by the microphone for an operation of the wireless wearable device.

15. (Previously presented) A wireless wearable device as recited in claim 14 comprising wireless communication circuitry at least partially in the wireless wearable device configured for coupling to at least a wireless network.

16. (Previously presented) A wireless wearable device as recited in claim 15 comprising a pressure sensor at least partially in the wireless wearable device.

17. (Previously presented) A wireless wearable device as recited in claim 15 comprising a controller at least partially in the wireless wearable device configured to determine whether the wireless wearable device is being worn based on outputs from a sensor at least partially in the wireless wearable device.

18. (Original) A wireless wearable device as recited in claim 17 comprising a motion sensor at least partially in the wireless wearable device.

19. (Previously presented) A wireless wearable device as recited in claim 18 comprising a touch-sensitive input surface on the wireless wearable device, wherein the touch-sensitive input surface is configured to facilitate generating at least an electrical signal for an operation of the wireless wearable device based on receiving at least a touch input.

20. (Currently amended) A wireless wearable device to at least help a user hear audio outputs produced by the device, with at least a portion of the wireless wearable device configured to be worn in an ear of the user, and the wireless wearable device comprising:

a speaker at least partially in the wireless wearable device;

an electrical connector at least partially in the wireless wearable device,

wherein the electrical connector includes at least two conductive areas, each area on a surface of the wireless wearable device, and

wherein the at least two conductive areas are configured to removably couple to corresponding conductive contacts of a counterpart connector external to and separate from the wireless wearable device, at least via spring-force, to at least enable each of the at least two conductive areas to be electrically connected to its corresponding conductive contact;

a rechargeable battery at least partially in the wireless wearable device, with the battery configured to be charged via at least the electrical connector;

a microphone at least partially in the wireless wearable device;

another microphone at least partially in the wireless wearable device configured to capture at least sound in vicinity of the wireless wearable device, wherein the microphone is configured to be positioned closer to mouth of the user than the another microphone, when the wireless wearable device is worn by the user;

a storage medium at least partially in the wireless wearable device configured to store at least computer program codes for facilitating voice recognition to recognize at least a word received at least by the microphone for an operation of the wireless wearable device;

wireless communication circuitry at least partially in the wireless wearable device; and

an area configured for attachment via magnetic force.

21. (Previously presented) A wireless wearable device as recited in claim 20 comprising:

a touch-sensitive input surface on a portion of the wireless wearable device; and

electronic circuitry configured to identify a sliding user-input action across at least a portion of the touch-sensitive input surface.

22. (Currently amended) A wireless wearable device to at least help a user hear audio outputs produced by the device, with at least a portion of the wireless wearable device to be worn in an ear of the user, and the wireless wearable device comprising:

a speaker at least partially in the wireless wearable device;

an electrical connector at least partially in the wireless wearable device,

wherein the electrical connector includes at least two conductive areas, each area on a surface of the wireless wearable device, and

wherein the at least two conductive areas are configured to removably couple to corresponding conductive contacts of a counterpart connector external to and separate from the wireless wearable device, at least via spring-force, to at least enable each of the at least two conductive areas to be electrically connected to its corresponding conductive contact;

a rechargeable battery at least partially in the wireless wearable device, with the battery configured to be charged via at least the electrical connector;

a microphone at least partially in the wireless wearable device;

another microphone at least partially in the wireless wearable device configured to capture at least sound in vicinity of the wireless wearable device, wherein the microphone is configured to be positioned closer to mouth of the user than the another microphone, when the wireless wearable device is worn by the user;

wireless communication circuitry at least partially in the wireless wearable device;

a touch-sensitive input surface on the wireless wearable device, wherein the touch-sensitive input surface is configured to facilitate generating at least an electrical signal for an operation of the wireless wearable device based on receiving at least a touch input; and

an area configured for attachment via magnetic force.

23. (Previously presented) A wireless wearable device as recited in claim 22 comprising:

a pressure sensor at least partially in the wireless wearable device; and

a controller at least partially in the wireless wearable device configured to determine whether the wireless wearable device is being worn based on outputs from a sensor at least partially in the wireless wearable device.

24. (New) A wireless wearable device to at least help a user hear audio outputs produced by the device, with at least a portion of the wireless wearable device to be worn in an ear of the user, the wireless wearable device comprising:

an electrical connector at least partially in the wireless wearable device,

wherein the electrical connector includes at least two conductive areas, each area on a surface of the wireless wearable device, and

wherein the at least two conductive areas are configured to removably couple to corresponding conductive contacts of a counterpart connector of an apparatus external to and separate from the wireless wearable device, at least via spring-force, to at least enable each of the at

least two conductive areas to be electrically connected to its corresponding conductive contact;

a rechargeable battery in the wireless wearable device, with the battery configured to be charged via at least the electrical connector;

a speaker at least partially in the wireless wearable device, with the battery configured to provide power to the speaker;

a first microphone, at least partially in the wireless wearable device, configured to capture at least sound in vicinity of the wireless wearable device, with the battery configured to provide power to the first microphone; and

a second microphone, at least partially in the wireless wearable device,

wherein the battery is configured to provide power to the second microphone, and

wherein the second microphone is configured to be positioned closer to mouth of the user than the first microphone, when the wireless wearable device is worn by the user.

25. (New) A wireless wearable device as recited in claim 24 comprising an area configured for attachment via magnetic force.

REMARKS

Applicants previously presented claims 1-23 for examination. The Examiner has allowed the claims, which Applicants acknowledge with gratitude. By this amendment, Applicants have amended claims 1, 20, and 22; and have added claims 24 and 25. Accordingly, claims 1-25 are pending. Reconsideration of the application and an early Notice of Allowance are earnestly solicited.

Reconsideration of the application and an early Notice of Allowance are earnestly solicited. If there are any issues remaining which the Examiner believes could be resolved through either a Supplemental Response or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned representative at the telephone number listed below.

Respectfully submitted,

/Peter P. Tong/

Peter P. Tong
Reg. No. 35,757

(650) 903-9200, x102

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: HOWELL et al.

Application No.: 18/519,802

Filed: January 25, 2024

Title: HEAD-WORN DEVICE WITH CONNECTION REGION

Attorney Docket No.: IPVCP006X1C10D1C1

Examiner: HAMID, AMMAR T.

Group: 2695

AMENDMENT B TRANSMITTAL

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

Sir:

Transmitted herewith is an Amendment in the above-identified application.

The fee has been calculated as shown below.

	Claims After Amendment		Highest Previously Paid For	Present Extra	Small Entity Rate Fee	Undiscounted Rate Fee
Total Claims	25	MINUS	23	02	x 40 =	x 100 = 200
Independent Claims	4	MINUS	3	01	x 192 =	x 480 = 480
Multiple Dependent Claim Present and Fee Not Previously Paid					$	$
				Total	$0.00	$680.00

☐ Applicant(s) hereby petition for a _____- month extension(s) of time to respond to the aforementioned Office Action.

☒ Applicant(s) believe that no (additional) Extension of Time is required; however, if it is determined that such an extension is required, Applicant(s) hereby petition that such an extension be granted and authorize the Commissioner to charge the required fees for an Extension of Time under 37 CFR 1.136 to Deposit Account No. 50-3874 (Order No. IPVCP006X1C10D1C1).

☒ Any fees due are being paid electronically herewith.

☒ Please charge any additional fees required to facilitate filing the enclosed response, to Deposit Account No. 50-3874 (Order No. IPVCP006X1C10D1C1).

Respectfully submitted,

/Peter P. Tong/

Peter P. Tong
Reg. No. 35,757

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/519,802	04/01/2024 11:59:10 AM Z ET	IPVCP006X1C10D1C1

Title of Invention

HEAD-WORN DEVICE WITH CONNECTION REGION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	3510	FILED BY	Angela Nijim
PATENT CENTER #	64887680	AUTHORIZED BY	Peter Tong
CUSTOMER #	34071	FILING DATE	11/27/2023
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Thomas A. Howell

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 9649	E202441C00528833	Angela Nijim

PRE-AUTHORIZED ACCOUNT	PRE-AUTHORIZED CATEGORY
503874	37 CFR 1.21 (Miscellaneous fees and charges)

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1801	REQUEST FOR CONTINUED EXAMINATION (RCE) - 1ST REQUEST (SEE 37 CFR 1.114)	1360.00	1	1360.00
1202	EACH CLAIM IN EXCESS OF 20	100.00	2	200.00
1201	EACH INDEPENDENT CLAIM IN EXCESS OF THREE	480.00	1	480.00
			TOTAL AMOUNT:	$2,040.00

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: HOWELL et al. Attorney Docket No.: IPVCP006X1C10D1C1

Application No.: 18/519,802 Examiner: HAMID, AMMAR T.

Filed: November 27, 2023 Group: 2695

Title: HEAD-WORN DEVICE WITH CONNECTION REGION

CERTIFICATE OF ELECTRONIC FILING

I hereby certify that this correspondence is being transmitted electronically to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on April 1, 2024.

Signed: /Angela D. Nijim/ Printed Name: Angela D. Nijim

AMENDMENT B

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

Dear Sir:

In response to the Notice of Allowance dated March 4, 2024, please amend the above-identified patent application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments are on page 9 of this paper.

Amendments to the Claims:
The listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently amended) A wireless wearable device, with at least a portion of the wireless wearable device configured to be worn in at least one ear of a user, to at least help the user hear audio outputs produced by the device, the wireless wearable device comprising:

a speaker at least partially in the wireless wearable device;

an electrical connector at least partially in the wireless wearable device,

wherein the electrical connector includes at least two conductive areas, each area on a surface of the wireless wearable device, and

wherein the at least two conductive areas are configured to removably couple to corresponding conductive contacts of a counterpart connector external to and separate from the wireless wearable device, at least via spring-force, to at least enable each of the at least two conductive areas to be electrically connected to its corresponding conductive contact;

a rechargeable battery at least partially in the wireless wearable device, with the battery configured to be charged via at least the electrical connector; and

a microphone at least partially in the wireless wearable device.

2. (Original) A wireless wearable device as recited in claim 1 comprising another microphone at least partially in the wireless wearable device configured to capture at least sound in vicinity of the wireless wearable device.

3. (Previously presented) A wireless wearable device as recited in claim 2 comprising electronic circuitry at least partially in the wireless wearable device configured to cancel at least a portion of the sound captured by the another microphone to produce the audio outputs.

4. (Previously presented) A wireless wearable device as recited in claim 2, wherein at least the microphone and the another microphone are configured to receive audio inputs, with at least some sound in the audio inputs configured to be cancelled based on using at least the microphone and the another microphone.

5. (Original) A wireless wearable device as recited in claim 2, wherein the microphone is configured to be positioned closer to mouth of the user than the another microphone, when the wireless wearable device is worn by the user.

6. (Previously presented) A wireless wearable device as recited in claim 2 comprising a storage medium at least partially in the wireless wearable device configured to store at least computer program codes for facilitating voice recognition to recognize at least a word received at least by the microphone for an operation of the wireless wearable device.

7. (Original) A wireless wearable device as recited in claim 2 comprising wireless communication circuitry at least partially in the wireless wearable device configured for coupling to at least a Bluetooth network.

8. (Previously presented) A wireless wearable device as recited in claim 2 comprising:

a touch-sensitive input surface on a portion of the wireless wearable device; and

a storage medium at least partially in the wireless wearable device configured to store at least computer program codes for facilitating an operation of the wireless wearable device based on identifying a sliding user-input action across at least a portion of the touch-sensitive input surface.

9. (Original) A wireless wearable device as recited in claim 2 comprising a controller at least partially in the wireless wearable device configured to determine whether the wireless wearable device is being worn based on outputs from a sensor at least partially in the wireless wearable device.

10. (Original) A wireless wearable device as recited in claim 2 comprising a motion sensor at least partially in the wireless wearable device.

11. (Previously presented) A wireless wearable device as recited in claim 2 comprising a touch-sensitive input surface on the wireless wearable device, wherein the touch-sensitive input surface is configured to facilitate generating at least an electrical signal for an operation of the wireless wearable device based on receiving at least a touch input.

12. (Original) A wireless wearable device as recited in claim 2 comprising an area configured for attachment via magnetic force.

13. (Original) A wireless wearable device as recited in claim 12 comprising a magnet in the area.

14. (Previously presented) A wireless wearable device as recited in claim 12 comprising a storage medium at least partially in the wireless wearable device configured to store at least computer program codes for facilitating voice recognition to recognize at least a word received at least by the microphone for an operation of the wireless wearable device.

15. (Previously presented) A wireless wearable device as recited in claim 14 comprising wireless communication circuitry at least partially in the wireless wearable device configured for coupling to at least a wireless network.

16. (Previously presented) A wireless wearable device as recited in claim 15 comprising a pressure sensor at least partially in the wireless wearable device.

17. (Previously presented) A wireless wearable device as recited in claim 15 comprising a controller at least partially in the wireless wearable device configured to determine whether the wireless wearable device is being worn based on outputs from a sensor at least partially in the wireless wearable device.

18. (Original) A wireless wearable device as recited in claim 17 comprising a motion sensor at least partially in the wireless wearable device.

19. (Previously presented) A wireless wearable device as recited in claim 18 comprising a touch-sensitive input surface on the wireless wearable device, wherein the touch-sensitive input surface is configured to facilitate generating at least an electrical signal for an operation of the wireless wearable device based on receiving at least a touch input.

20. (Currently amended) A wireless wearable device to at least help a user hear audio outputs produced by the device, with at least a portion of the wireless wearable device configured to be worn in an ear of the user, and the wireless wearable device comprising:

a speaker at least partially in the wireless wearable device;

an electrical connector at least partially in the wireless wearable device,

wherein the electrical connector includes at least two conductive areas, each area on a surface of the wireless wearable device, and

wherein the at least two conductive areas are configured to removably couple to corresponding conductive contacts of a counterpart connector external to and separate from the wireless wearable device, at least via spring-force, to at least enable each of the at least two conductive areas to be electrically connected to its corresponding conductive contact;

a rechargeable battery at least partially in the wireless wearable device, with the battery configured to be charged via at least the electrical connector;

a microphone at least partially in the wireless wearable device;

another microphone at least partially in the wireless wearable device configured to capture at least sound in vicinity of the wireless wearable device, wherein the microphone is configured to be positioned closer to mouth of the user than the another microphone, when the wireless wearable device is worn by the user;

a storage medium at least partially in the wireless wearable device configured to store at least computer program codes for facilitating voice recognition to recognize at least a word received at least by the microphone for an operation of the wireless wearable device;

wireless communication circuitry at least partially in the wireless wearable device; and

an area configured for attachment via magnetic force.

21. (Previously presented) A wireless wearable device as recited in claim 20 comprising:

a touch-sensitive input surface on a portion of the wireless wearable device; and

electronic circuitry configured to identify a sliding user-input action across at least a portion of the touch-sensitive input surface.

22. (Currently amended) A wireless wearable device to at least help a user hear audio outputs produced by the device, with at least a portion of the wireless wearable device to be worn in an ear of the user, and the wireless wearable device comprising:

a speaker at least partially in the wireless wearable device;

an electrical connector at least partially in the wireless wearable device,

wherein the electrical connector includes at least two conductive areas, each area on a surface of the wireless wearable device, and

wherein the at least two conductive areas are configured to removably couple to corresponding conductive contacts of a counterpart connector external to and separate from the wireless wearable device, at least via spring-force, to at least enable each of the at least two conductive areas to be electrically connected to its corresponding conductive contact;

a rechargeable battery at least partially in the wireless wearable device, with the battery configured to be charged via at least the electrical connector;

a microphone at least partially in the wireless wearable device;

another microphone at least partially in the wireless wearable device configured to capture at least sound in vicinity of the wireless wearable device, wherein the microphone is configured to be positioned closer to mouth of the user than the another microphone, when the wireless wearable device is worn by the user;

wireless communication circuitry at least partially in the wireless wearable device;

a touch-sensitive input surface on the wireless wearable device, wherein the touch-sensitive input surface is configured to facilitate generating at least an electrical signal for an operation of the wireless wearable device based on receiving at least a touch input; and

an area configured for attachment via magnetic force.

23. (Previously presented) A wireless wearable device as recited in claim 22 comprising:

a pressure sensor at least partially in the wireless wearable device; and

a controller at least partially in the wireless wearable device configured to determine whether the wireless wearable device is being worn based on outputs from a sensor at least partially in the wireless wearable device.

24. (New) A wireless wearable device to at least help a user hear audio outputs produced by the device, with at least a portion of the wireless wearable device to be worn in an ear of the user, the wireless wearable device comprising:

an electrical connector at least partially in the wireless wearable device,

wherein the electrical connector includes at least two conductive areas, each area on a surface of the wireless wearable device, and

wherein the at least two conductive areas are configured to removably couple to corresponding conductive contacts of a counterpart connector of an apparatus external to and separate from the wireless wearable device, at least via spring-force, to at least enable each of the at

least two conductive areas to be electrically connected to its corresponding conductive contact;

a rechargeable battery in the wireless wearable device, with the battery configured to be charged via at least the electrical connector;

a speaker at least partially in the wireless wearable device, with the battery configured to provide power to the speaker;

a first microphone, at least partially in the wireless wearable device, configured to capture at least sound in vicinity of the wireless wearable device, with the battery configured to provide power to the first microphone; and

a second microphone, at least partially in the wireless wearable device,

wherein the battery is configured to provide power to the second microphone, and

wherein the second microphone is configured to be positioned closer to mouth of the user than the first microphone, when the wireless wearable device is worn by the user.

25. (New) A wireless wearable device as recited in claim 24 comprising an area configured for attachment via magnetic force.

REMARKS

Applicants previously presented claims 1-23 for examination. The Examiner has allowed the claims, which Applicants acknowledge with gratitude. By this amendment, Applicants have amended claims 1, 20, and 22; and have added claims 24 and 25. Accordingly, claims 1-25 are pending. Reconsideration of the application and an early Notice of Allowance are earnestly solicited.

Reconsideration of the application and an early Notice of Allowance are earnestly solicited. If there are any issues remaining which the Examiner believes could be resolved through either a Supplemental Response or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned representative at the telephone number listed below.

Respectfully submitted,

/Peter P. Tong/

Peter P. Tong
Reg. No. 35,757

(650) 903-9200, x102

Notice of References Cited	Application/Control No. 18/519,802	Applicant(s)/Patent Under Reexamination Howell et al.	
	Examiner AMMAR T HAMID	Art Unit 2695	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Name	CPC Classification	US Classification
*	A	US-6769767-B2	2004-08-03	Swab; Gregory	H04W56/0015	351/158
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	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 YYYY-MM-DD format are publication dates. Classifications may be US or foreign.

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/519,802	Howell et al.
	Examiner	**Art Unit**
	AMMAR T HAMID	2695

CPC							
Symbol						**Type**	**Version**
G06F	/	3	/	01		F	2013-01-01
G02C	/	11	/	10		I	2013-01-01
G02C	/	5	/	001		I	2013-01-01
G02C	/	5	/	143		I	2013-01-01
G02C	/	5	/	14		I	2013-01-01
G10L	/	15	/	22		I	2013-01-01
G06F	/	1	/	163		I	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 25	
/AMMAR T HAMID/ Primary Examiner, Art Unit 2695 (Primary Examiner)	03 April 2024 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

U.S. Patent and Trademark Office — Part of Paper No.: 20240403A

Apple Inc. EX1002 Page 975

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/519,802	Howell et al.
	Examiner	**Art Unit**
	AMMAR T HAMID	2695

INTERNATIONAL CLASSIFICATION					
CLAIMED					
H04R	/	3	/	00	
	/		/		

NON-CLAIMED				
H03G	/	3	/	00

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
381	110

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					
381	104					

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 25	
/AMMAR T HAMID/ Primary Examiner, Art Unit 2695 (Primary Examiner)	03 April 2024 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

U.S. Patent and Trademark Office — Part of Paper No.: 20240403A

Apple Inc. EX1002 Page 976

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/519,802	Howell et al.
	Examiner	**Art Unit**
	AMMAR T HAMID	2695

☑ 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
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	2		11		20										
	3		12		21										
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	5		14		23										
	6		15		24										
	7		16		25										
	8		17												
	9		18												

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 25	
/AMMAR T HAMID/ Primary Examiner, Art Unit 2695 (Primary Examiner)	03 April 2024 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

U.S. Patent and Trademark Office Part of Paper No.: 20240403A

Apple Inc. EX1002 Page 977

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/519,802	Howell et al.
	Examiner	Art Unit
	AMMAR T HAMID	2695

CPC - Searched*		
Symbol	**Date**	**Examiner**
G06F3/01	01/23/2024	AH
G02C5/001	01/23/2024	AH
G02C5/14	01/23/2024	AH
G02C5/14	01/23/2024	AH
G02C11/10	01/23/2024	AH
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G10L15/22	01/23/2024	AH
G06F3/01	02/27/2024	AH
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G10L15/22	04/03/2024	AH

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

/AMMAR T HAMID/ Primary Examiner, Art Unit 2695	/AMMAR T HAMID/ Primary Examiner, Art Unit 2695

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
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	Examiner	Art Unit
	AMMAR T HAMID	2695

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
381	111	01/23/2024	AH
351	111	01/23/2024	AH
381	104,110	02/27/2024	AH
381	104,110	04/03/2024	AH

* 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**
Consulted with examiner Xu Mei for class subclass search	01/23/2024	AH
Text search using PE2E	01/23/2024	AH
Inventor and applicant search using PE2E	01/23/2024	AH
Concept search using IP.com	01/23/2024	AH
Consulted with examiner Xu Mei for class subclass search	02/27/2024	AH
Text search using PE2E	02/27/2024	AH
Inventor and applicant search using PE2E	02/27/2024	AH
Concept search using IP.com	02/27/2024	AH
Consulted with examiner Xu Mei for class subclass search	04/03/2024	AH
Text search using PE2E	04/03/2024	AH
Inventor and applicant search using PE2E	04/03/2024	AH
Concept search using IP.com	04/03/2024	AH

/AMMAR T HAMID/ Primary Examiner, Art Unit 2695	/AMMAR T HAMID/ Primary Examiner, Art Unit 2695

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/519,802	Howell et al.
	Examiner	Art Unit
	AMMAR T HAMID	2695

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
G06F3/01		02/27/2024	Ah
G02C5/001		02/27/2024	Ah
G02C5/14		02/27/2024	Ah
G02C11/10		02/27/2024	AH
G10L15/22		02/27/2024	AH
381	104,110	02/27/2024	AH
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G02C5/14		04/03/2024	AH
G02C11/10		04/03/2024	AH
G10L15/22		04/03/2024	AH
381	104,110	04/03/2024	AH

/AMMAR T HAMID/ Primary Examiner, Art Unit 2695	/AMMAR T HAMID/ Primary Examiner, Art Unit 2695

Bibliographic Data

Application No: 18/519,802

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /AMMAR T HAMID/ (Examiner's Signature) | (Initials)

Title: HEAD-WORN DEVICE WITH CONNECTION REGION

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
11/27/2023	351	2695	IPVCP006X1C10D1C1
RULE			

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CONTINUING DATA

This application is a CON of 18224793 07/21/2023 PAT 11829518

18224793 is a DIV of 18129660 03/31/2023 PAT 11803069

18129660 is a CON of 16424018 05/28/2019 PAT 11630331

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11183256 has PRO of 60592045 07/28/2004 *

(*) Data provided by applicant is not consistent with PTO record

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

12/07/2023

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FILING FEE RECEIVED

$1,820

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
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L63	5968	G02C11/10.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/02/27 10:21 AM
L64	24513	G06F1/163.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/02/27 10:21 AM
L65	45744	G10L15/22.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/02/27 10:21 AM
L66	822	351/111.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/02/27 10:21 AM
L67	2296	381/104.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/02/27 10:22 AM
L68	695	381/110.ccls.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/02/27 10:22 AM
L69	31	((("INGENIOSPEC") near3 ("LLC"))).AS,AANM.	(USPAT)	OR	ON	ON	2024/04/03 02:36 PM
L70	20336	((("HOWELL") near3 ("Thomas")) OR (("CHAO") near3 ("David")) OR (("THOMAS") near3 ("C")) OR (("TONG") near3 ("Peter"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/04/03 02:36 PM
L71	10005	G06F3/01.cpc.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/04/03 02:37 PM
L72	606	G02C5/001.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:37 PM
L73	477	G02C5/14.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:38 PM
L74	831	G02C5/143.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:38 PM
L75	3596	G02C11/10.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:38 PM
L76	15189	G06F1/163.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:39 PM
L77	25015	G10L15/22.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:39 PM
L78	415	351/111.ccls.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:39 PM
L79	1183	381/104.ccls.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:40 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default	Plurals	British	Time Stamp

				Operator		Equivalents	
N1	4611	G06F3/01.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:37 PM
N2	606	G02C5/001.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:37 PM
N3	477	G02C5/14.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:38 PM
N4	831	G02C5/143.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:38 PM
N5	3596	G02C11/10.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:38 PM
N6	15189	G06F1/163.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:39 PM
N7	25015	G10L15/22.cpc.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:39 PM
N8	1183	381/104.ccls.	(US-PGPUB; USPAT)	OR	ON	ON	2024/04/03 02:40 PM

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Report Run Date: 2024-04-03 UTC
Searches: 1
Markers: 0

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Search #	Timestamp	Results	Page
1	2024-04-03 18:51 UTC	~12,168,199	3