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I, Chan Wook Doh, of Transperfect Translations, Inc., performed the attached English translation of the original Korean document, **Korean Patent Application No. 10-2018-0038206**. I have a M.A. in Applied Linguistics, was a former assistant professor of the Korean language and have strong technical background with college degrees in engineering as well and have been engaged as a professional Korean to English and English to Korean patent translator since 2016. I hereby certify that, to the best of my knowledge and ability, the attached English translation accurately reflects the content, meaning, and style of the original Korean document identified above and constitutes a true, accurate, and complete translation of that document.

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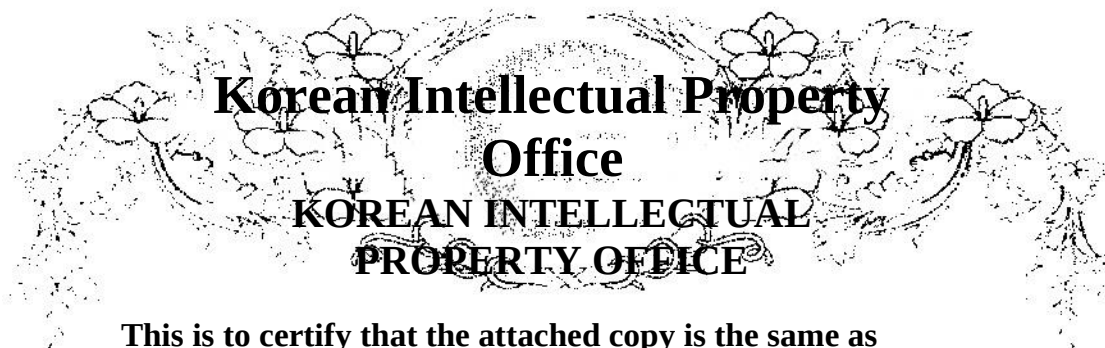
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【Bibliography】

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【Title of the Invention in Korean】 프레넬 렌즈를 이용한 광학 센서를 포함하는 전자 장치
【Title of the Invention in English】 ELECTRONIC DEVICE INCLUDING AN OPTICAL SENSOR USING A FRESNEL LENS
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【Application Language】 Korean

【Purpose】 We hereby submit this patent application to the Commissioner of the Korean
Intellectual Property Office as above.

Agent Bae, Kim & Lee IP

(Signature or Stamp)

【Fee】

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【Priority Claim Fee】 0 Case 0 Won

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【Description of the Invention】

【Title of the Invention】

프레넬 렌즈를 이용한 광학 센서를 포함하는 전자 장치 (ELECTRONIC DEVICE INCLUDING AN OPTICAL SENSOR USING A FRESNEL LENS)

【Technical Field】

【0001】 Various exemplary embodiments of this document relate to an electronic device including an optical sensor using a Fresnel lens.

【Background Art of the Invention】

【0002】 Electronic devices, such as smartphones and tablet PCs, may perform various functions of calling, Internet browsing, and health care. The electronic devices may run applications to provide various information to a user. In addition, the electronic devices are equipped with a variety of sensors to collect ambient information or information related to the user (e.g. biometrics information). The electronic devices may use the collected information to reflect in the running of the applications. Recently, an electronic device equipped with an optical sensor for collecting biometric information (e.g., fingerprint information, heart rate information, and iris information) of the user has been released.

【Summary of the Invention】

【Problems to Be Solved by the Invention】

【0003】 If an electronic device according to the prior art is equipped with an optical sensor for collecting the user's biometric information, it contains a partition disposed

between a light emitter and a light receiver. The partition may prevent light generated at the light emitter from being reflected to an external object and flowing into the light receiver. When the partition is disposed, there is a problem that a mounting space of the optical sensor is increased.

【0004】 In addition, if a light emitter generates photons that have no direction, the photons to be output may be dispersed without directionality, resulting in reduced amounts of photons to flow into a light receiver. As a result, there is a problem that the recognition efficiency of the sensor is lowered.

【Means to Solve the Problems】

【0005】 An electronic device according to various exemplary embodiments of the present invention includes a housing comprising a sensor plane, a light emitter generating the light radiated to the outside through the sensor plane, a light receiver collecting reflected light from an external object, a first Fresnel lens disposed between the light receiver and the sensor plane. A first surface of the first Fresnel lens may totally reflect the reflected light flowing in a direction perpendicular to the sensor plane and a second surface thereof may refract the totally reflected light to cause the light to flow into the light receiver.

【Effect of the Invention】

【0006】 An electronic device according to various exemplary embodiments of the present invention is equipped with an optical sensor using a Fresnel lens, so that a partition may not be disposed between a light emitter and a light receiver and that the transmission

efficiency of photons may be increased.

【0007】 An electronic device according to various exemplary embodiments of the present invention is equipped with a Fresnel lens on a light receiver, so that it may totally reflect and refract incident light to increase the transmission efficiency of photons. This allows object recognition performance to be improved.

【0008】 An electronic device according to various exemplary embodiments of the present invention is equipped with a Fresnel lens on a light emitter, so that the light generated from a light emitter may totally reflect and refract incident light to increase the transmission efficiency of photons.

【0009】 An electronic device according to various exemplary embodiments of the present invention includes a notch structure in a peripheral area of a Fresnel lens to prevent crosstalk.

【Simple Description of the Drawings】

【0010】 FIGS. 1A and 1B illustrate electronic devices according to various exemplary embodiments.

FIGS. 2A to 2C are cross-sectional views of an optical sensor including a Fresnel lens according to various exemplary embodiments.

FIG. 3 illustrates the progression of light in a toothed lens of a Fresnel lens according to various exemplary embodiments.

FIG. 4 shows the transmittance of a lens according to the convergent angle θ of a

Fresnel lens for receiving light according to various exemplary embodiments.

FIG. 5 illustrates the structure of a notch formed in a Fresnel lens according to various exemplary embodiments.

FIG. 6 is an exemplary view of inserting a reinforcement into a notch according to various exemplary embodiments.

FIG. 7 illustrates a configuration form of an optical sensor having one light emitter and a plurality of light receivers according to various exemplary embodiments.

FIG. 8 shows a form including a Fresnel lens in a light emitter and a light receiver, respectively, according to various exemplary embodiments.

FIG. 9 illustrates an optical sensor including one light emitter and one light receiver according to various exemplary embodiments.

FIG. 10 shows an optical sensor having a Fresnel lens for emitting light for each of a plurality of light emitters according to various exemplary embodiments.

FIG. 11 is an exemplary view in which a Fresnel lens is disposed toward a sensor plane according to various exemplary embodiments.

FIG. 12 is a block diagram of an electronic device in a network environment according to various exemplary embodiments.

【Detailed Description of the Exemplary Embodiments】

【0011】 Hereinafter, various exemplary embodiments of this document are described with reference to the attached drawings. However, this document is not intended

to limit the technology described herein to specific exemplary embodiments and should be understood to include various modifications to, equivalents of, and/or alternatives to exemplary embodiments of this document. With respect to the description of the drawings, similar reference symbols may be used for similar components.

【0012】 In this document, expressions such as "have," "may have," "include (comprise)," or "may include (comprise)" refer to the presence of applicable features (e.g., components such as numerals, functions, operations, or parts) and do not exclude the presence of additional features.

【0013】 In this document, expressions such as "A or B," "at least one of A or/and B," or "one or more of A or/and B" may include all possible combinations of items listed together. For example, "A or B," "at least one of A and B," or "at least one of A or B" may refer to all cases including (1) at least one A, (2) at least one B, or (3) both at least one A and at least one B.

【0014】 As used herein, expressions such as "a first," "a second," "first," or "second" may modify various components, regardless of their order and/or importance, and are used to distinguish one component from another, but do not limit those components. For example, a first user device and a second user device may represent different user devices, regardless of their order or importance. For example, a first component may be named a second component without departing from the scope of the rights described herein, and similarly a second component may also be renamed a first component.

【0015】 It should be understood that when a component (e.g., a first component)

is referred to as being “(operationally or communicatively) coupled with/to or connected to” a different component (e.g., a second component), the component may be directly coupled with/to the different component or connected through another component (e.g., a third component). On the other hand, when a specific component (e.g., a first component) is referred to as being “directly coupled” or “directly connected” to a different component (e.g., a second component), it may be understood that no other component (e.g., a third component) exists between the specific component and the different component.

【0016】 “Configured to” (or set up to)” as used in this document may be used interchangeably, depending on the situation, for example, with “suitable for,” “having the capacity to,” “designed to,” “adapted to,” “made to,” or “capable of.” The term "configured (or set up)" may not necessarily mean only "specially designed to" in hardware. Instead, in some circumstances, the expression "a device configured to" may mean that the device is "capable of –" with other devices or parts. For example, the phrase "a processor configured (or set up) to perform A, B, and C" may refer to a dedicated processor (e.g., an embedded processor) for performing that operation, or a generic-purpose processor (e.g., a CPU or application processor) capable of performing those operations by executing one or more software programs stored on a memory device.

【0017】 The terms used herein are used to describe a particular exemplary embodiment alone and may not be intended to limit the scope of other exemplary embodiments. A singular expression may include the plural, unless the context clearly indicates otherwise. The terms used herein, including technical or scientific terms, may have

the same meaning as commonly understood by those of ordinary skill in the art described herein. Among the terms used in this document, those defined in general dictionaries may be interpreted as having a meaning which is the same as or similar to one in the context of the relevant art, and unless expressly defined herein, are not to be interpreted in an ideal or excessively formal sense. In some cases, even the terms defined herein cannot be interpreted to exclude exemplary embodiments of this document.

【0018】 A wearable device according to various exemplary embodiments of this document may include at least one of the following types: an accessory type [e.g., a watch, a ring, a bracelet, an anklet, a necklace, eyeglasses, contact lenses, or a head-mounted-device (HMD)]; a fabric- or garment-integrated type (e.g., an electronic garment); a body-attached type (e.g., a skin pad (skin pad) or a tattoo; or a bio-transplantable type (e.g., an implantable circuit).

【0019】 Hereinafter, a wearable device according to various exemplary embodiments will be described with reference to the accompanying drawings. In this document, the term user may refer to a person using a wearable device or a device using a wearable device (e.g., an artificial intelligence electronic device).

【0020】 FIGS. 1A and 1B illustrate electronic devices according to various exemplary embodiments.

【0021】 FIGs. 1A and 1B illustrate exemplary cases where electronic devices 101 and 102 are smartphones or smart watches, but are not limited thereto. For example, an electronic device 101 may be a tablet PC or a laptop PC. For another example, an electronic

device 102 may be a wearable device (e.g., a smart band, a smart necklace, or smart glasses).

【0022】 Referring to FIG. 1A, an electronic device 101 may include a display 110 and a housing (or main body) 120.

【0023】 A display 110 may output the content of text or an image. For example, the display 110 may indicate a user interface associated with a healthcare application when the application is executed. In addition, the display 110 may display the user's heart rate information, or blood pressure information.

【0024】 A housing (or main body) 120 may fix a display 110 and protect various configurations therein. The housing 120 may include an optical sensor 130, a processor 140, a memory 145, and a communication circuit required for driving an electronic device 101.

【0025】 According to various exemplary embodiments, an optical sensor 130 may include a light emitter and a light receiver. The light emitter may output light to the outside. The light receiver may receive the light reflected from an external object and convert it to an electrical signal. The light receiver may provide the collected signal to a processor 140. According to one exemplary embodiment, the optical sensor 130 may be mounted on a rear surface 125 of an electronic device 101. For example, if a user puts his/her finger on the optical sensor 130, light may be emitted to the user's finger, so that biometric information may be collected by the reflected light.

【0026】 According to various exemplary embodiments, an optical sensor 130 may include a Fresnel lens that supports total reflection of light incident perpendicularly to a sensor plane (or a sensor window, a cover member) in the light emitter or the light receiver.

For example, if a Fresnel lens is disposed in the light emitter, the light emitted to the outside may be in the form of collimated light. For another example, if a Fresnel lens is disposed in the light receiver, light concentration may be increased. Further information about the optical sensor 130 including the Fresnel lens supporting total reflection may be provided through FIGS. 2A to 11.

【0027】 A processor 140 may perform various data processing and operations to drive an electronic device 101. For example, the processor 140 may execute an application and display an associated execution screen on a display 110.

【0028】 According to various exemplary embodiments, a processor 140 may receive information collected through an optical sensor 130. The processor 140 may analyze the collected information and provide the user with various information. For example, the processor 140 may execute a health care app to display the user's heart rate information, or blood pressure information, measured through the optical sensor 130. The processor 140 may provide exercise information or dietary information, based on the user's biometric information.

【0029】 A memory 145 may store various data generated in the process of driving an electronic device 101. For example, the memory 145 may store biometric information of the user collected via an optical sensor 130.

【0030】 Referring to FIG. 1B, an electronic device 102 may be a wearable device including a display 160, a housing (or main body) 170, and a strap 171.

【0031】 A display 160 may output the content of text or an image. For example, the display 160 may indicate a user interface associated with a health care application when the application is executed. In addition, the display 160 may display the user's heart rate information or blood pressure information.

【0032】 A housing (or main body) 170 may fix a display 160 and protect various configurations therein. The housing 170 may include an optical sensor 180, a processor 190, a memory 195, and a communication circuit required for driving an electronic device 102. The housing 170 may include a structure connected to a strap 171.

【0033】 The operation of an optical sensor 180, a processor 190, and a memory 195 may be the same as or similar to that of the optical sensor 130, the processor 140, and the memory 145 in FIG. 1A.

【0034】 According to one exemplary embodiment, an optical sensor 180 may be mounted on a rear surface 175 of an electronic device 102. For example, if a user wears an electronic device 102 on the wrist, the optical sensor 180 may emit light to the user's wrist, so that biometric information may be collected by the reflected light.

【0035】 A strap (or fixer, fastener) 171 may fix an electronic device 102 to a part 105 (e.g., wrist) of the user's body. The strap 171 may include a first portion and a second portion having a fastening structure corresponding to each other. The strap 171 may be connected to a housing 170.

【0036】 FIGS. 2A to 2C are cross-sectional views of an optical sensor including

a Fresnel lens according to various exemplary embodiments. FIGS. 2A to 2C are illustrative and are not limited thereto.

【0037】 Referring to FIG. 2A, an optical sensor 201 (e.g., the optical sensor 130 of FIG. 1A or the optical sensor 180 of FIG. 1B) may include a light emitter 210, a light receiver 220, and a Fresnel lens 250 for receiving light. The light emitter 210 may generate infrared light. In one exemplary embodiment, the light emitter 210 may output collimated light. The light generated by the light emitter 210 may be radiated to the outside through a sensor plane 130a.

【0038】 A light receiver 220 may collect light flowing from the outside and convert it into an electrical signal. In one exemplary embodiment, the light receiver 220 may collect the light (hereinafter, “reflected light”) that is generated from a light emitter 210 and reflected to an external object (e.g., the user’s body) and convert it to an electrical signal. The light receiver 220 may transmit the collected signal to a processor 140 or 190 inside an electronic device 101 or 102.

【0039】 In one exemplary embodiment, a light emitter 210 and a light receiver 220 may be disposed on the same plane. In another exemplary embodiment, the light emitter 210 and the light receiver 220 may be disposed on different planes. For example, the light emitter 210 may protrude more than the light receiver 220 in a direction toward a sensor plane 130a.

【0040】 A Fresnel lens 250 for receiving light may be disposed at the top of a light receiver 220 (i.e., between a sensor plane 130a and the light receiver 220). The Fresnel

lens 250 for receiving light may totally reflect and refract the light reflected from an external object (e.g., the user's body) and direct it to the light receiver 220. The Fresnel lens 250 for receiving light may prevent light passing through the sensor plane 130a from being scattered to a peripheral area inside an electronic device, thereby increasing light transmittance efficiency and object recognition efficiency. The Fresnel lens for receiving light 250 may absorb photons in a wider area than the light receiver 220 to deliver them to the light receiver 220. This allows a relatively wide range of photons to be collected in a small area of the light receiver 220. The Fresnel lens for receiving light 250 may be implemented with the following materials: poly methyl methacrylate (PMMA), acryl, or glass material.

【0041】 According to various exemplary embodiments, a Fresnel lens for receiving light 250 may include a central lens 251 and a toothed lens 252. The central lens 251 may be disposed in a central area of the Fresnel lens for receiving light 250. The central lens 251 may have a similar shape to a typical convex lens. In one exemplary embodiment, a center point of the central lens 251 and a center point of a light receiver 220 may be disposed on a normal perpendicular to a sensor plane 130a.

【0042】 A toothed lens 252 may be disposed around a central lens 251. The toothed lens 252 may be in the shape of an arc surrounding the central lens 251. The toothed lens 252 may have a larger arc as it moves away further from the central lens 251. The toothed lenses 252 may be disposed in a plurality of numbers and may have a symmetric shape based on a center point of the central lens 252. In one exemplary embodiment, the toothed lens 252 may be in the shape of protruding towards a light receiver 220.

【0043】 According to various exemplary embodiments, a toothed lens 252 may direct reflected light incident perpendicularly to a sensor plane 130a to a light receiver 220 through total reflection and refraction. Further information regarding total reflection and refraction of the reflected light in the toothed lens 252 may be provided via FIG. 3.

【0044】 According to various exemplary embodiments, a Fresnel lens for receiving light 250 may include a notch 255. The notch 255 may have a groove shape formed on a surface where the Fresnel lens 250 for receiving light faces a light receiver 220. The notch 255 may prevent the light output from a light emitter 210 from directly flowing into the light receiver 220 without being reflected to an external object (i.e., cross-talk). Additional information regarding the notch 255 may be provided through FIG. 5.

【0045】 According to various exemplary embodiments, an extension 258 of a Fresnel lens 250 for receiving light may be disposed between a light emitter 210 and a sensor plane 130a. The extension 258 may be integrally formed with the Fresnel lens 250 for receiving light. The Fresnel lens 250 may transmit the light generated from the light emitter 210.

【0046】 Referring to FIG. 2B, an optical sensor 202 (e.g., the optical sensor 130 of FIG. 1A or the optical sensor 180 of FIG. 1B) may include a light emitter 210, a light receiver 220, and a Fresnel lens 260 for emitting light.

【0047】 A Fresnel lens 260 for emitting light may be disposed at the top of a light emitter 210 (i.e., between a sensor plane 130a and the light emitter 210). The Fresnel lens 260 for emitting light may refract and totally reflect the light generated from the light emitter

210 to cause the light to be incident perpendicularly to the sensor plane 130a.

【0048】 A typical Fresnel lens may redirect the light being output up to 45 degrees. On the other hand, a Fresnel lens 260 for emitting light that supports total reflection may redirect the light being output up to 90 degrees. This allows collimated light (parallel light) to be incident perpendicularly to a sensor plane 130a. When the collimated light (parallel light) is output, it may be easy to measure scattering by an object which is subject to measurement. If the transmission of light is changed to a straight direction, absorption and scattering by ingredients in the human body may be more easily measured at a light receiver 220. In addition, when the Fresnel lens 260 for emitting light is applied to the light emitter of a distance sensor [e.g., a time of flight (ToF)], it may be used to measure the distance from the object, thereby improving a camera's photographing performance.

【0049】 A Fresnel lens 260 for emitting light may include a central lens 261 and a toothed lens 262. The central lens 261 may be disposed in a central area of the Fresnel lens 260 for emitting light. The central lens 261 may have a similar shape to a typical convex lens. In one exemplary embodiment, a center point of the central lens 261 and a center point of a light emitter 210 may be disposed on a normal perpendicular to a sensor plane 130a.

【0050】 A toothed lens 262 may be disposed in the shape of an arc surrounding the periphery of a central lens 261. The toothed lens 262 may have a larger arc as it moves away further from the central lens 261. The toothed lenses 262 may be disposed in a plurality of numbers and may have a symmetric shape based on a center point of the central lens 261. In one exemplary embodiment, the toothed lens 262 may be in the shape of protruding

toward a light emitter 210.

【0051】 According to various exemplary embodiments, a toothed lens 262 may convert the light generated at a light emitter 210 into light perpendicular to a sensor plane 130a through refraction and total reflection. In one toothed lens 262, the light output may be refracted on a first surface (inner surface) and totally reflected on a second surface (outer surface) to be converted into light perpendicular to the sensor plane 130a.

【0052】 According to various exemplary embodiments, a Fresnel lens 260 for emitting light may include a notch 265. The notch 265 may have a groove shape formed on a surface where the Fresnel lens 260 for emitting light faces a light emitter 210. The notch 265 may prevent the light output from a light emitter 210 from directly flowing into a light receiver 220 without being reflected to an external object (i.e., cross-talk). Additional information regarding the notch 265 may be provided through FIG. 5.

【0053】 According to various exemplary embodiments, an extension 268 of a Fresnel lens 260 for emitting light may be disposed between a light receiver 220 and a sensor plane 130a. The extension 268 may be integrally formed with the Fresnel lens 260 for emitting light. The Fresnel lens 260 may transmit the reflected light flowing from the outside.

【0054】 In one exemplary embodiment, a light emitter 210 and a light receiver 220 may be disposed on different planes. The light receiver 210 may be further protruded in a direction toward a sensor plane 130a. For example, a separate support member 221 may be disposed at the bottom of the light receiver 210 (in the opposite direction of the sensor plane 130a). If the light receiver 210 protrudes further in a direction toward the sensor plane

130a, the light transmittance efficiency may be increased.

【0055】 Referring to FIG. 2C, an optical sensor 203 (e.g., the optical sensor 130 of FIG. 1A or the optical sensor 180 of FIG. 1B) may include a light emitter 210, a light receiver 220, and a plurality of Fresnel lenses 270 (a Fresnel lens 250 for receiving light and a Fresnel lens 260 for emitting light).

【0056】 FIG. 2C illustrates an exemplary case in which a Fresnel lens for receiving light 250 and a Fresnel lens 260 for emitting light are integrally formed, but is not limited thereto. For example, the Fresnel lens 250 for receiving light and the Fresnel lens 260 for emitting light may be formed and disposed separately from each other.

【0057】 The function or operation of a light emitter 210, a light receiver 220, a Fresnel lens 250 for receiving light, and a Fresnel lens 260 for emitting light may be the same as or similar to the function or operation of the corresponding configuration of FIGS. 2A or 2B.

【0058】 When a Fresnel lens 260 for emitting light and a Fresnel lens 250 for receiving light are applied to a light emitter 210 and a light receiver 220, respectively, the signal-to-noise ratio may be higher than that of the optical sensor 201 or the optical sensor 202 of FIGS. 2A or 2B.

【0059】 According to various exemplary embodiments, a Fresnel lens 260 for emitting light and a Fresnel lens 250 for receiving light may protrude in the same direction. For example, they both may face a side opposite to a sensor plane 130a.

【0060】 FIGS. 2A to 2C illustrate an exemplary case in which a sensor plane 130a

and Fresnel lenses 250 and 260 are separated, but are not limited thereto. For example, the sensor plane 130a and the Fresnel lenses 250 and 260 may contact each other.

【0061】 FIG. 3 shows the progression of light in a toothed lens of a Fresnel lens according to various exemplary embodiments. FIG. 3 illustrates an exemplary case where reflected light is incident on a light receiver, but may also be applied when light is generated from a light emitter. The path of movement of light in the light emitter and the Fresnel lens for emitting light may be in the opposite direction to FIG. 3.

【0062】 Referring to FIG. 3, a Fresnel lens 250 for receiving light may be disposed at the top of a light receiver 220 (i.e., between a sensor plane 130a and the light receiver 220). The Fresnel lens 250 for receiving light may totally reflect and refract the reflected light L1 from an external object (e.g., the user's body) and direct it to the light receiver 220. In one exemplary embodiment, a center point 0 of the Fresnel lens 250 for receiving light and a center point of the light receiver 220 may be disposed on a normal 130a1 perpendicular to the sensor plane 130a.

【0063】 The Fresnel lens 250 for receiving light may include one or more toothed lenses 252. It may include an inner surface 252a relatively close to the center point 0 of the Fresnel lens 250 for receiving light and an outer surface 252b relatively far from the center point 0.

【0064】 According to one exemplary embodiment, the inner surface 252a may form a first angle with a sensor plane 130a. The outer surface 252b may form a second angle with the sensor plane 130a. The first angle may be greater than the second angle.

【0065】 According to various exemplary embodiments, incident light L1 (incidence angle i_1) which is incident perpendicularly to a sensor plane 130a may be totally reflected on an outer surface 252b. For example, when a Fresnel lens for receiving light 250 made of polymethyl methacrylate (PMMA) is used, the refractive index of a toothed lens 252 may be about 1.49. Since the refractive index in air is 1, total reflection may occur at the outer surface 252b if the incidence angle i_1 of incident light L1 perpendicular to the sensor plane 130a is greater than about 42 degrees.

【0066】 According to various exemplary embodiments, the disposition angle, length, or curvature of an outer surface 252b may be determined, reflecting the properties of material (e.g., a refractive index, the distance R_n between the toothed lens 252 and the center point O) of a Fresnel lens for emitting light 250.

【0067】 When reflected light L1 is totally reflected on an outer surface 252b, incident light L1 may be directed toward an inner surface 252a without being emitted to the outside of a toothed lens 252.

【0068】 An inner surface 252a may refract the light L2 (incident angle i_2) totally reflected on an outer surface 252b (refraction angle α) and direct the refracted light to a light receiver 220. Reflecting the properties of material (e.g., a refractive index, the distance R_n between a toothed lens 252 and the center point O) of a Fresnel lens 250 for emitting light, the disposition angle, length, or curvature of the inner surface 252a may be determined.

【0069】 Refracted light L3 may flow into a light receiver 220 and be converted into an electrical signal.

【0070】 A convergent angle θ formed by the light L3 refracted through an inner surface 252a and the normal 130a1 of a sensor plane 130a may vary depending on the angle of incidence i_1 . Through the convergent angle θ , the angle of the inner surface 252a and the outer surface 252b of a toothed lens 252 that generates total reflection of incident light L1 may also be determined.

【0071】 The relationship between the angle of incidence and the angle of reflection may be determined by the following equations (1) and (2).

【0072】 Equation (1)

$$\text{【0073】 } i_1 = \tan^{-1} \frac{\tan \theta}{(n(\sqrt{1 + \tan^2 \theta}) - 1)}$$

【0074】 Equation (2)

$$\text{【0075】 } i_2 = \sin^{-1} \frac{1}{(n(\sqrt{1 + \tan^2 \theta}))}$$

【0077】 For example, if a first angle of incidence i_1 is about 42 degrees, the convergent angle θ of a Fresnel lens 250 for receiving light may be about 54.59 degrees, and a second angle of incidence i_2 may be about 22.95 degrees. Here, $\tan \theta$ may be determined by the distance R_n between the outer surface 252b of a toothed lens 252 and the center point θ of the Fresnel lens 250 for receiving light, and the focal length F of the Fresnel lens 250 for receiving light [$\tan(\theta) = R_n/F$].

【0078】 A Fresnel lens 250 for receiving light made of PMMA material may

cause total reflection on an outer surface 252b when a first angle of incidence i_1 is greater than about 42 degrees. The PMMA-material Fresnel lens 250 for receiving light may use a convergent angle θ calculated when the first angle of incidence i_1 is greater than about 42 degrees to determine the angle or shape of the inner surface 252a and the outer surface 252b of a toothed lens 252.

【0079】 For example, when a Fresnel lens 250 for receiving light made of poly methyl methacrylate (PMMA) is used, total reflection may occur on an outer surface 252b if $\tan \theta$ is greater than 1.4.

【0080】 FIG. 4 shows the transmittance of a lens according to the convergent angle θ of a Fresnel lens for receiving light according to various exemplary embodiments.

【0081】 Referring to FIG. 4, the light transmittance of a typical Fresnel lens 410 and the light transmittance of a Fresnel lens 420 supporting total reflection may vary depending on a convergent angle θ . For example, if the converging angle θ is about 30 degrees or less, the light transmittance of a typical Fresnel lens 410 may be greater than that of a Fresnel lens 420 that supports total reflection. On the other hand, If the convergent angle θ is about 30 degrees or greater, the light transmittance of the Fresnel lens 420 which supports total reflection may be greater than that of the typical Fresnel lens 410. In a mounting environment where the convergent angle θ is about 30 degrees or greater, the optical transmission efficiency may be increased when a Fresnel lens 420 supporting total reflection is used.

【0082】 FIG. 5 illustrates the structure of a notch formed in a Fresnel lens

according to various exemplary embodiments. FIG. 5 mainly describes a Fresnel lens 250 for receiving light, but may also be applied to a Fresnel lens 260 for emitting light.

【0083】 Referring to FIG. 5, a Fresnel lens 250 for receiving light may include a notch 255. The notch 255 may prevent the light output from a light emitter 210 from directly flowing into a light receiver 220 without being reflected to an external object (i.e., cross-talk).

【0084】 A notch 255 may be disposed between a central area 250a of a Fresnel lens 250 for receiving light and a peripheral area 250b thereof. The notch 255 may have a circular or arc shape surrounding the central area 250a. The notch 255 may have a groove shape formed on a surface where the Fresnel lens 250 for receiving light faces a light receiver 220.

【0085】 According to various exemplary embodiments, a Fresnel lens 250 may include a support structure 258 (or a non-grooved portion of a notch 255). The support structure 258 may separate the notch 255. The support structure 258 may prevent the Fresnel lens 250 for receiving light from breaking as the notch 255 is formed. The support structure 258 may be formed to be level with a surface where the Fresnel lens 250 for receiving light faces a light receiver 220. The support structure 258 may be a portion in which the notch 255 is not formed and a central area 250a and a peripheral area 250b are connected by a plane.

【0086】 FIG. 6 is an exemplary view of inserting a reinforcement into a notch according to various exemplary embodiments.

【0087】 Referring to FIG. 6, an optical sensor 601 (e.g., the optical sensor 130 of FIG. 1A or the optical sensor 180 of FIG. 1B) may include a light emitter 210, a light receiver 220, and a plurality of Fresnel lenses 270 (including a Fresnel lens 250 for receiving light and a Fresnel lens 260 for emitting light).

【0088】 According to various exemplary embodiments, a Fresnel lens 260 for emitting light and a Fresnel lens 250 for receiving light may be integrally formed.

【0089】 According to various exemplary embodiments, a Fresnel lens 260 for emitting light and a Fresnel lens 250 for receiving light may include notches 265 and 255, respectively. The notches 265 and 255 formed between the Fresnel lens 260 for emitting light and the Fresnel lens 250 for receiving light may be integrated into one groove.

【0090】 Notches 255 and 265 may prevent the light output from a light emitter 210 from directly flowing into a light receiver 220 without being reflected to an external object (i.e., cross-talk).

【0091】 According to various exemplary embodiments, notches 255 and 265 may be filled with reinforcements 255a and 266a having good light absorption. The notches 255 and 265 may be filled with the reinforcements 255a and 266a in their entirety or only in part.

【0092】 FIG. 7 illustrates a configuration form of an optical sensor having one light emitter and a plurality of light receivers according to various exemplary embodiments. Fig. 7 is illustrative and not limited thereto.

【0093】 Referring to FIG. 7, an optical sensor 701 (e.g., the optical sensor 130 of

FIG. 1A or the optical sensor 180 of FIG. 1B) may include one light emitter 210, one Fresnel lens 260 for emitting light, and a plurality of light receivers 220.

【0094】 A light emitter 210 may be disposed at the center of an optical sensor 701. In one exemplary embodiment, the light emitter 210 may be in the form of a plurality of small light sources combined. A Fresnel lens 260 for emitting light may be disposed on the upper part (a surface on which light is output, a surface facing a sensor plane) of the light emitter 210.

【0095】 A Fresnel lens 260 for emitting light may include a notch 265. The notch 265 may be disposed between a light emitter 210 and each of light receivers 220.

【0096】 A plurality of light receivers 220 may convert reflected light in which light generated from a light emitter 210 is reflected to an external object into an electrical signal. The plurality of light receivers 220 may collect different reflected light depending on the location where they are disposed. A processor may collect biometric information of the user by comparing and analyzing the information collected at each light receiver 220 with the location information at which each light receiver 220 is disposed.

【0097】 A separate partition for light separation may not be disposed between a light emitter 210 and a plurality of light receivers 220. Light straightness may be improved through a Fresnel lens 260 for emitting light, so that the possibility of light directly flowing into the plurality of surrounding light receivers 220 may be reduced. In addition, through a notch 265, light separation may be facilitated and light interference (crosstalk) may be reduced.

【0098】 The distance between a light emitter 210 and a plurality of light receivers 220 may be closer than that when a partition is disposed, and the mounting space of an optical sensor 701 may be reduced.

【0099】 According to various exemplary embodiments, a Fresnel lens 260 may be equipped with one or more indium tin oxide (ITO) electrodes. The indium tin oxide (ITO) electrode is a transparent film and may pass light through. The ITO electrode may be connected to at least one of a touch sensor, an electrocardiogram (ECG) sensor, or a body fat/ skeletal muscle mass (BIA) sensor. Where there is a plurality of ITO electrodes, capacitance may be formed between the ITO electrodes. A touch sensor, an electrocardiogram (ECG) sensor, or a fat/skeletal muscle mass (BIA) sensor may detect a change in capacitance between the ITO electrodes to recognize whether a touch is caused by a part of the user's body. Various sensing information may be collected. For example, an electrocardiogram (ECG) sensor or a body fat/skeletal muscle mass (BIA) sensor may measure an electrocardiogram (ECG) or a body fat/skeletal muscle mass (BIA) by connecting one ITO electrode to (+), and the other electrode to (-).

【0100】 FIG. 8 shows a form including a Fresnel lens in a light emitter and a light receiver, respectively, according to various exemplary embodiments. FIG. 8 is illustrative and not limited thereto.

【0101】 Referring to FIG. 8, an optical sensor 801 (e.g., the optical sensor 130 of FIG. 1A or the optical sensor 180 of FIG. 1B) may further include a Fresnel lens 250 for receiving light in each of a plurality of light receivers 220, as opposed to an optical lens 701 in FIG. 7. Each Fresnel lens 250 for receiving light may include a notch 255.

【0102】 If a Fresnel lens is applied to a light emitter 210 and a light receiver 220, respectively, the light transmittance efficiency may be increased. For example, the Fresnel lens 260 for emitting light for the light emitter 210 may convert the light generated from the light emitter 210 into collimated light and direct it to a sensor plane as much as possible. The Fresnel lens 250 for receiving light for the light receiver 220 may concentrate the light reflected from an external object at the light receiver 220 to facilitate light collection from the light receiver 220. This allows the signal-to-noise ratio to be maximized.

【0103】 FIG. 9 illustrates an optical sensor including one light emitter and one light receiver according to various exemplary embodiments. FIG. 9 is illustrative and not limited thereto.

【0104】 Referring to FIG. 9, an optical sensor 901 (e.g., the optical sensor 130 of FIG. 1A or the optical sensor 180 of FIG. 1B) may include one light emitter 210, one Fresnel lens 260 for emitting light, one light receiver 220, and one Fresnel lens 250 for receiving light. The Fresnel lens 260 for emitting light and the Fresnel lens 250 for receiving light may include notches 265 and 255, respectively.

【0105】 The optical sensor 901 is equipped with one light emitter 210 and one light receiver 220, so that it may be mounted in a space smaller than the optical sensors 701 and 801 in FIGS. 7 and 8. The light emitter 210 and the light receiver 220 may be installed without a separate partition, so that mounting efficiency may be improved. For example, the optical sensor 901 may be mounted on a wearable device, such as a smart necklace or a smart ring, with a relatively small mounting space.

【0106】 FIG. 10 shows an optical sensor having a Fresnel lens for emitting light for each of a plurality of light emitters according to various exemplary embodiments. FIG. 10 is illustrative and not limited thereto.

【0107】 Referring to FIG. 10, a plurality of light emitters 210 may be disposed in a designated shape (e.g., in a square or triangular shape). A Fresnel lens 260 for emitting light may be disposed for each of the plurality of light emitters 210.

【0108】 Light emitted through a plurality of light emitters 210 and a Fresnel lens 260 for emitting light may be reflected by an external object and transmitted to a plurality of surrounding light receivers 220. Each of the plurality of light receivers 220 may receive the light generated from an adjacent light emitter 210 as the most intense reflected light.

【0109】 FIG. 11 is an exemplary view in which a patterned surface of a Fresnel lens is disposed to face a sensor plane according to various exemplary embodiments. FIG. 11 is illustrative and not limited thereto.

【0110】 Referring to FIG. 11, an optical sensor 1101 (e.g., the optical sensor 130 of FIG. 1A or the optical sensor 180 of FIG. 1B) may include a light emitter 1110, a light receiver 1120, and a plurality of Fresnel lenses 1130 (including a Fresnel lens 1131 for emitting light and a Fresnel lens 1132 for receiving light).

【0111】 A light emitter 1110 may generate infrared light. In one exemplary embodiment, the light emitter 1110 may output collimated light. The light generated from the light emitter 110 may be radiated to the outside through a sensor plane 130a.

【0112】 A light receiver 1120 may collect incoming light from the outside and convert it into an electrical signal. In one exemplary embodiment, the light receiver 1120 may collect the light generated from a light emitter 1110 and reflected to an external object (e.g., the user's body) and convert it into an electrical signal.

【0113】 A Fresnel lens 1131 for emitting light may be disposed at the top of a light emitter 1110 (between a sensor plane 130a and the light emitter 1110). The toothed, patterned surface of the Fresnel lens 1131 for emitting light may be disposed to face the sensor plane 130a. The Fresnel lens 1131 for emitting light may totally reflect and refract the light generated from the light emitter 1110 to cause it to be incident on the sensor plane 130a.

【0114】 A Fresnel lens 1131 for emitting light supports total reflection, allowing the light output from a light emitter 1110 to turn to a different direction up to about 90 degrees. This allows light incident parallel to the Fresnel lens 1131 for emitting light from the light emitter 1110 to be concentrated at a first point A of a sensor plane 130a.

【0115】 A Fresnel lens 1132 for receiving light may be disposed at the top of a light receiver 1120 (between a sensor plane 130a and the light receiver 1120). The toothed, patterned surface of the Fresnel lens 1132 for receiving light may be disposed to face the sensor plane 130a. The Fresnel lens 1132 for receiving light may refract and totally reflect the light reflected from an external object (e.g., the user's body) to direct it to the light receiver 1120. The Fresnel lens 1132 for receiving light may allow the light reflected from a second point B of the sensor plane 130a to spread evenly across the entire area of the light

receiver 1120.

【0116】 FIG. 11 illustrated an exemplary case in which both a Fresnel lens 1131 for emitting light and a Fresnel lens 1132 for receiving light face a sensor plane 130a, but is not limited thereto. For example, one of the Fresnel lens 1131 for emitting light and the Fresnel lens 1132 for receiving light may be disposed to face the sensor plane 130a and the other to face a light emitter 1110 or a light receiver 1120.

【0117】 FIG. 12 is a block diagram of an electronic device 2001 in a network environment 2000 according to various exemplary embodiments.

【0118】 Referring to FIG. 12, in a network environment 2000, an electronic device 2001 (e.g., the electronic devices 101 and 102 of FIG. 1) may communicate with an electronic device 2002 via a first network 2098 (e.g., a wireless LAN), or with an electronic device 2004 or a server 2008 via a second network 2099 (e.g., a wireless WAN). According to one exemplary embodiment, the electronic device 2001 may communicate with the electronic device 2004 via the server 2008. According to one exemplary embodiment, the electronic device 2001 may include a processor 2020, a memory 2030, an input device 2050, a sound output device 2055, an indication device 2060, an audio module 2070, a sensor module 2076, an interface 2077, a haptic module 2079, a camera module 2080, a power management module 2088, a battery 2089, a communication module 2090, a subscriber identification module 2096, and an antenna module 2097. In some exemplary embodiments, at least one (e.g., an indication device 2060 or a camera module 2080) of these components may be omitted from, or other components may be added to, the electronic device 2001. In some exemplary embodiments, for example, as in the case of a sensor module 2076 (e.g., a

fingerprint sensor, an iris sensor, or an illuminance sensor) embedded in an indication device 2060 (e.g., a display), some components may be integrated and implemented,

【0119】 A processor 2020 may, for example, drive software (e.g., a program 2040) to control at least one different component (e.g., a hardware or software component) of an electronic device 2001 connected to the processor 2020 and to perform various data processing and operations. The processor 2020 may load the commands or data received from other components (e.g., a sensor module 2076 or a communication module 2090) into a volatile memory 2032 to process them and store the resulting data in a non-volatile memory 2034. According to one exemplary embodiment, the processor 2020 may include a main processor 2021 (e.g., a central processing unit or an application processor), and an auxiliary processor 2023 (e.g., a graphics processing device, an image signal processor, a sensor hub processor, or a communication processor) that is operated independently of the main processor 2021, and that in addition to or as a replacement for the main processor, uses lower power than the main processor 2021 or is specialized in a designated function. Here, the auxiliary processor 2023 may be operated separately from, or while being embedded in, the main processor 2021.

【0120】 In this case, an auxiliary processor 2023 may control at least a portion of the functions or states associated with at least one of the components (e.g., an indication device 2060, a sensor module 2076, or a communication module 2090) of an electronic device 2001, instead of a main processor 2021 while the main processor 2021 is in an inactive (e.g., sleep) state, or in conjunction with the main processor 2021 while the main processor 2021 is in an active (e.g., application running) state. According to one exemplary

embodiment, the auxiliary processor 2023 (e.g., an image signal processor or a communication processor) may be implemented as a part of other components (e.g., a camera module 2080 or a communication module 2090) that are functionally relevant. The memory 2030 may store various data, for example, software (e.g., a program 2040) and input or output data for commands related to the software, which are used by at least one component of the electronic device 2001 (e.g., a processor 2020 or a sensor module 2076). The memory 2030 may include a volatile memory 2032 or a non-volatile vocal memory 2034.

【0121】 A program 2040 is a software stored in a memory 2030, which may include, for example, an operating system 2042, middleware 2044, or an application 2046.

【0122】 An input device 2050 may include, for example, a microphone, a mouse, or a keyboard, as a device for receiving commands or data to be used in components (e.g., a processor 2020) of an electronic device 2001 from the outside (e.g., a user) of the electronic device 2001.

【0123】 A sound output device 2055 is a device for outputting a sound signal to the outside of an electronic device 2001, and may include, for example, a speaker used for general purposes, such as multimedia playback or recording playback, and a receiver used exclusively for answering a phone. According to one exemplary embodiment, the receiver may be formed integrally with or separately from the speaker.

【0124】 An indication device 2060 (e.g., the display 110 of FIG. 1) is a device

for visually providing information to a user of an electronic device 2001, and may include, for example, a display, a hologram device, or a projector and a control circuit for controlling that device. According to one exemplary embodiment, the indication device 2060 may include a touch circuit (touch circuitry) or a pressure sensor capable of measuring the intensity of pressure to the touch.

【0125】 An audio module 2070 may convert sound and electrical signals interactively. According to one exemplary embodiment, the audio module 2070 may acquire a sound through an input device 2050, or output a sound through a sound output device 2055 or an external electronic device (e.g., an electronic device 2002, such as speaker or headphone) connected to an electronic device 2001 wired or wirelessly.

【0126】 A sensor module 2076 may generate an electrical signal or data value corresponding to an internal operating state (e.g., power or temperature) of an electronic device 2001 or to an external environmental state. The sensor module 2076 may include, for example, a gesture sensor, a gyro sensor, a barometric sensor, a magnetic sensor, an acceleration sensor, a grip sensor, a proximity sensor, a color sensor, an infrared (IR) sensor, a biosensor, a temperature sensor, a humidity sensor, or an illuminance sensor.

【0127】 An interface 2077 may support a specified protocol that may be wired or wirelessly connected with an external electronic device (e.g., an electronic device 2002). According to one exemplary embodiment, the interface 2077 may include a high definition multimedia interface (HDMI), a universal serial bus (USB) interface, an SD card interface,

or an audio interface.

【0128】 A connection terminal 2078 may include a connector capable of physically connecting an electronic device 2001 to an external electronic device (e.g., an electronic device 2002), for example, an HDMI connector, a USB connector, an SD card connector, or an audio connector (e.g., a headphone connector).

【0129】 A haptic module 2079 may convert an electrical signal into a mechanical stimulus (e.g., vibration or movement) or an electrical stimulus that a user may perceive through a sense of touch or movement. The haptic module 2079 may include, for example, a motor, a piezoelectric element, or an electrical stimulation device.

【0130】 A camera module 2080 may capture a still image and a moving image. According to one exemplary embodiment, the camera module 2080 may include one or more lenses, image sensors, image signal processors, or flashes.

【0131】 A power management module 2088 is a module for managing the power supplied to an electronic device 2001, and may be configured as at least a part of a power management integrated circuit (PMIC), for example.

【0132】 A battery 2089 is a device for supplying power to at least one component of an electronic device 2001, and may include, for example, a non-rechargeable primary battery and a rechargeable secondary battery or fuel cell.

【0133】 A communication module 2090 may support the establishment of wired or wireless communication channels between an electronic device 2001 and an external electronic device (e.g., an electronic device 2002, an electronic device 2004, or a server

2008), and the communication through the established communication channels. The communication module 2090 may include one or more communication processors that support wired or wireless communication, operating independently of a processor 2020 (e.g., an application processor). According to one exemplary embodiment, the communication module 2090 may include a wireless communication module 2092 [e.g., a cellular communication module, a wireless LAN module, or a global navigation satellite system (GNSS) communication module] or a wired communication module 2094 [e.g., a local area network (LAN) communication module, or a power line communication module], and may use one of the above applicable communication modules to communicate with an external electronic device via a first network 2098 [e.g., a local area network, such as Bluetooth, WiFi direct or infrared data association (IrDA)] or a second network 2099 [e.g., a wide area network (WAN), such as a cellular network, the internet, or a computer network such as LAN or WAN]. The various types of communication modules 2090 described above may be implemented as a single chip, or each as a separate chip.

【0134】 According to one exemplary embodiment, a wireless communication module 2092 may use user information stored in a subscriber identification module 2096 to distinguish and authenticate an electronic device 2001 within the communication network.

【0135】 An antenna module 2097 may include one or more antennas for transmitting a signal or power to the outside or for receiving it from the outside. According to one exemplary embodiment, a communication module 2090 (e.g., a wireless communication module 2092) may transmit a signal to an external electronic device or receive it therefrom via an antenna suitable for the communication scheme.

【0136】 Some of the above components may be connected to each other via a communication scheme between peripheral devices [e.g. a bus, a general purpose input/output (GPIO), a serial peripheral interface (SPI), or a mobile industry processor interface (MIPI)] to exchange signals (e.g., commands or data) with each other.

【0137】 According to one exemplary embodiment, a command or data may be transmitted or received between an electronic device 2001 and an external electronic device 2004 via a server 2008 connected to a second network 2099. Each of the electronic devices 2002 and 2004 may be the same type of device as, or a different type of device from, the electronic device 2001. According to one exemplary embodiment, all or part of the operations carried out in the electronic device 2001 may be executed in another one or a plurality of external electronic devices. According to one exemplary embodiment, if an electronic device 2001 has to perform a function or service automatically or upon request, the electronic device 2001 may request an external electronic device to perform at least some functions associated with the function or service, instead of or in addition to executing the function or service on its own. The external electronic device having received the request may execute the requested or an additional function and transmit the result to the electronic device 2001. The electronic device 2001 may process the received result as is or additionally to provide the requested function or service. To this end, for example, cloud computing, distributed computing, or client-server computing technology may be utilized.

【0138】 An electronic device (e.g., the electronic device 101 of FIG. 1A or the electronic device 102 of FIG. 1B) according to various exemplary embodiments may include a housing (e.g., the housing 120 of FIG. 1A or the housing 170 of FIG. 1B) including a

sensor plane (e.g., the sensor plane 130a of FIG. 2A); a light emitter (e.g., the light emitter 210 of FIG. 2A) generating the light radiated to the outside via the sensor plane; a light receiver (e.g., the light receiver 220 of FIG. 2A) collecting the light reflected from an external object in contact with the sensor plane; and a first Fresnel lens (e.g., the Fresnel lens 250 of FIG. 2A) disposed between the light receiver and the sensor plane. In this regard, a first surface of the first Fresnel lens may totally reflect the reflected light flowing in a direction perpendicular to the sensor plane, and a second surface thereof may refract the totally reflected light, allowing it to flow into the light receiver.

【0139】 According to various exemplary embodiments, the first Fresnel lens may include a notch between a point corresponding to the light emitter and a point corresponding to the light receiver. The first Fresnel lens may further include a support for separating the notch. The notch may be filled with a reinforcement that satisfies the specified light absorption rate.

【0140】 According to various exemplary embodiments, the first Fresnel lens may include one material among poly methyl methacrylate (PMMA), acryl, and glass.

【0141】 According to various exemplary embodiments, at least a portion of the first Fresnel lens may include a toothed shape, which may protrude toward the light receiver. According to various exemplary embodiments, the toothed shape may generate total reflection on a first surface of a first distance at the center of the first Fresnel lens and refraction on a second surface of a second distance shorter than the first distance, with respect to the light incident perpendicularly to the sensor plane.

【0142】 According to various exemplary embodiments, at least a portion of the first Fresnel lens may include a toothed shape, which may protrude toward the sensor plane.

【0143】 According to various exemplary embodiments, the first Fresnel lens may include a convex lens shape in a central area aligned with the light receiver.

【0144】 According to various exemplary embodiments, the first Fresnel lens may extend between the light emitter and the sensor plane.

【0145】 According to various exemplary embodiments, the electronic device may further include a second Fresnel lens disposed between the light emitter and the sensor plane.

【0146】 According to various exemplary embodiments, a notch may be included between the first Fresnel lens and the second Fresnel lens.

【0147】 An electronic device (e.g., the electronic device 101 of FIG. 1A or the electronic device 102 of FIG. 1B) according to various exemplary embodiments may include a housing (e.g., the housing 120 of FIG. 1A or the housing 170 of FIG. 1B) including a sensor plane (e.g., the sensor plane 130a of FIG. 2C); a light emitter (e.g., the light emitter 210 of FIG. 2C) generating the light radiated to the outside via the sensor plane; a light receiver (e.g., the light receiver 220 of FIG. 2C) collecting the light reflected from an external object in contact with the sensor plane; and a first Fresnel lens (e.g., the Fresnel lens 260 of FIG. 2C) disposed between the light emitter and the sensor plane. In this regard, a first surface of the first Fresnel lens may refract the light generated from the light emitter

and a second surface thereof may totally reflect the refracted light, allowing it to be emitted perpendicularly to the sensor plane.

【0148】 According to various exemplary embodiments, the first Fresnel lens may include a notch between a point corresponding to the light emitter and a point corresponding to the light receiver.

【0149】 According to various exemplary embodiments, the first Fresnel lens may further include a support for separating the notch.

【0150】 According to various exemplary embodiments, at least a portion of the first Fresnel lens may include a toothed shape, which may protrude toward the light emitter. The toothed shape may refract the light output from the light emitter on a first surface of a first distance at the center of the first Fresnel lens and allow the light refracted on the first surface to be totally reflected on a second surface of a second distance longer than the first distance.

【0151】 According to various exemplary embodiments, at least a portion of the first Fresnel lens may include a toothed shape, which may protrude toward the sensor plane.

【0152】 According to various exemplary embodiments, the first Fresnel lens may include a convex lens shape in a central area aligned with the light emitter.

【0153】 According to various exemplary embodiments, the first Fresnel lens may extend between the light receiver and the sensor plane.

【0154】 Each component (e.g., a module or program) according to various

exemplary embodiments may be composed of a single or a plurality of objects, and some of the sub-components described above may be omitted from, or other sub-components may be further included in, various embodiments. Alternatively or additionally, some components (e.g., modules or programs) may be integrated into one object, performing the same or similar functions carried out by each corresponding component before the integration. According to various exemplary embodiments, operations performed by modules, programs, or other components may be executed sequentially, in parallel, repetitively, or heuristically; at least some operations may be executed in a different order or omitted; or other operations may be added.

【What Is Claimed Is】

【Claim 1】

An electronic device comprising:
a housing including a sensor plane;
a light emitter that generates the light radiated to the outside through the sensor plane;
a light receiver that collects the light reflected from an external object abutting the sensor plane; and
a first Fresnel lens disposed between the light receiver and the sensor plane,
wherein a first surface of the first Fresnel lens totally reflects the reflected light flowing in a direction perpendicular to the sensor plane, and a second surface thereof refracts the totally reflected light, allowing it to flow into the light receiver.

【Claim 2】

The electronic device of claim 1,
wherein the first Fresnel lens comprises a notch between a point corresponding to the light emitter and a point corresponding to the light receiver.

【Claim 3】

The electronic device of claim 2,
wherein the first Fresnel lens further comprises a support separating the notch.

【Claim 4】

The electronic device of claim 2,
wherein the notch is filled with a reinforcement that satisfies a specified light absorption rate.

【Claim 5】

The electronic device of claim 1,
wherein the first Fresnel lens comprises one material among poly methyl methacrylate (PMMA), acryl, and glass.

【Claim 6】

The electronic device of claim 1,
wherein at least a portion of the first Fresnel lens comprises a toothed shape and the toothed shape protrudes toward the light receiver.

【Claim 7】

The electronic device of claim 6,
wherein the toothed shape may generate total reflection on a first surface of a first distance at the center of the first Fresnel lens and refraction on a second surface of a second distance shorter than the first distance, with respect to the light incident perpendicularly to the sensor plane.

【Claim 8】

The electronic device of claim 1,
wherein at least a portion of the first Fresnel lens comprises a toothed shape and the toothed shape protrudes toward the sensor plane.

【Claim 9】

The electronic device of claim 1,
wherein the first Fresnel lens comprises a convex lens shape in a central area aligned with the light receiver.

【Claim 10】

The electronic device of claim 1,
wherein the first Fresnel lens extends between the light emitter and the sensor plane.

【Claim 11】

The electronic device of claim 1, further comprising:

a second Fresnel lens disposed between the light emitter and the sensor plane.

【Claim 12】

The electronic device of claim 11, comprising a notch between the first Fresnel lens and the second Fresnel lens.

【Claim 13】

An electronic device, comprising:

a housing including a sensor plane;

a light emitter that generates the light radiated to the outside through the sensor plane;

a light receiver that collects the light reflected from an external object abutting the sensor plane; and

a first Fresnel lens disposed between the light emitter and the sensor plane,

wherein a first surface of the first Fresnel lens refracts the light generated from the light emitter and a second surface totally reflect the refracted light, allowing it to be emitted perpendicularly to the sensor plane.

【Claim 14】

The electronic device of claim 13,

wherein the first Fresnel lens comprises a notch between a point corresponding to the light emitter and a point corresponding to the light receiver.

【Claim 15】

The electronic device of claim 14,

wherein the first Fresnel lens further comprises a support separating the notch.

【Claim 16】

The electronic device of claim 1,
wherein at least a portion of the first Fresnel lens comprises a toothed shape and the toothed shape protrudes toward the light emitter.

【Claim 17】

The electronic device of claim 16,
wherein the toothed shape may refract the light output from the light emitter on a first surface of a first distance at the center of the first Fresnel lens and allow the light refracted on the first surface to be totally reflected on a second surface of a second distance longer than the first distance.

【Claim 18】

The electronic device of claim 13,
wherein at least a portion of the first Fresnel lens comprises a toothed shape and the toothed shape protrudes toward the sensor plane.

【Claim 19】

The electronic device of claim 13,
wherein the first Fresnel lens comprises a convex lens shape in a central area aligned with the light emitter.

【Claim 20】

The electronic device of claim 13,
wherein the first Fresnel lens extends between the light receiver and the sensor plane.

【Abstract】

【Abstract】

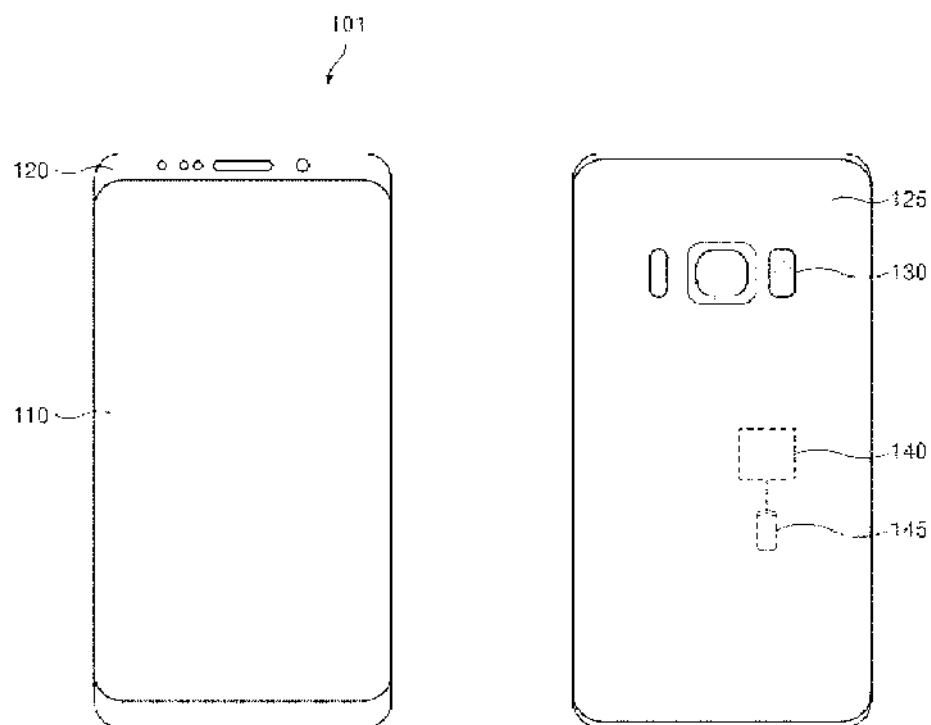
An electronic device according to various exemplary embodiments of the present invention includes a housing comprising a sensor plane, a light emitter generating the light radiated to the outside through the sensor plane, a light receiver collecting reflected light from an external object in contact with the sensor plane, and a first Fresnel lens disposed between the light receiver and the sensor plane. In this regard, a first surface of the first Fresnel lens may totally reflect the reflected light flowing in a direction perpendicular to the sensor plane and a second surface thereof may refract the totally reflected light to cause the light to flow into the light receiver.

【Figure Accompanying the Abstract】

FIG. 2A

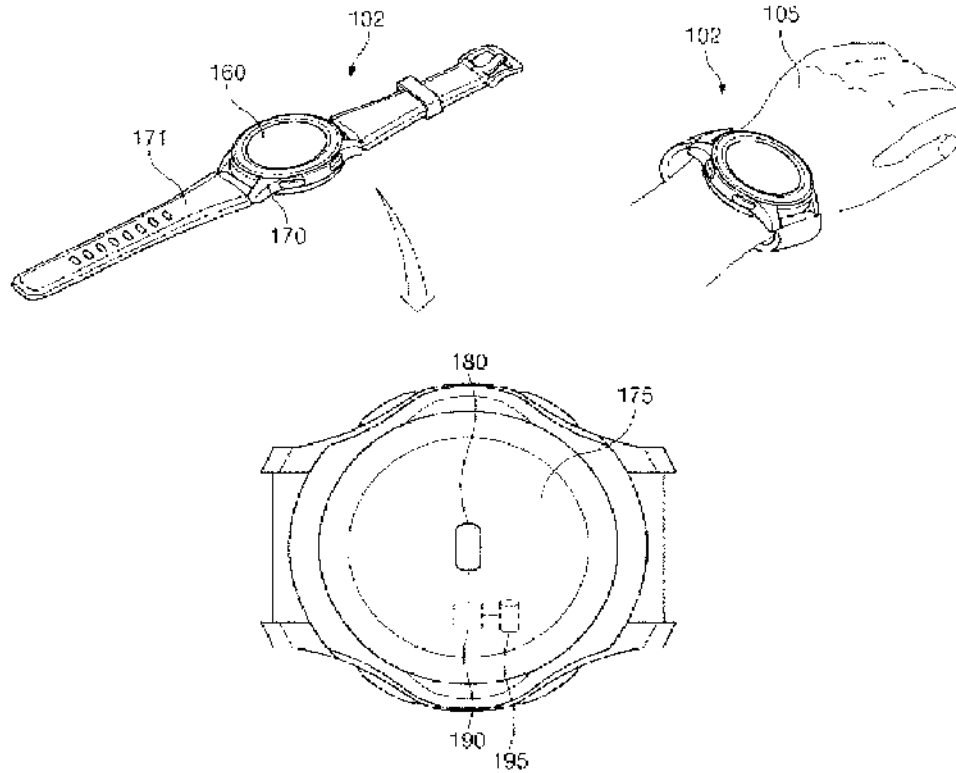
【Drawings】

【FIG. 1A】

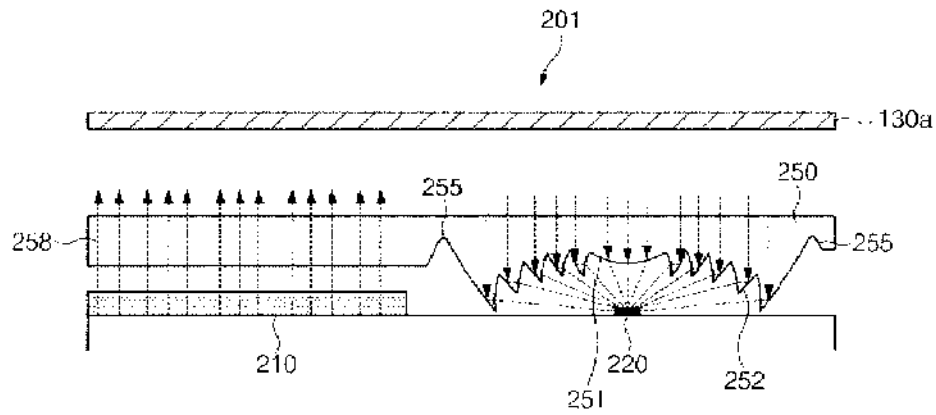


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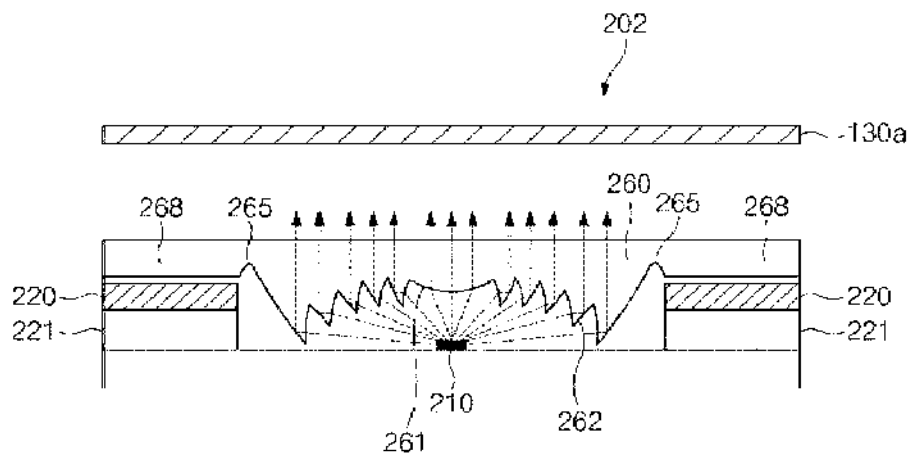
【FIG. 1B】



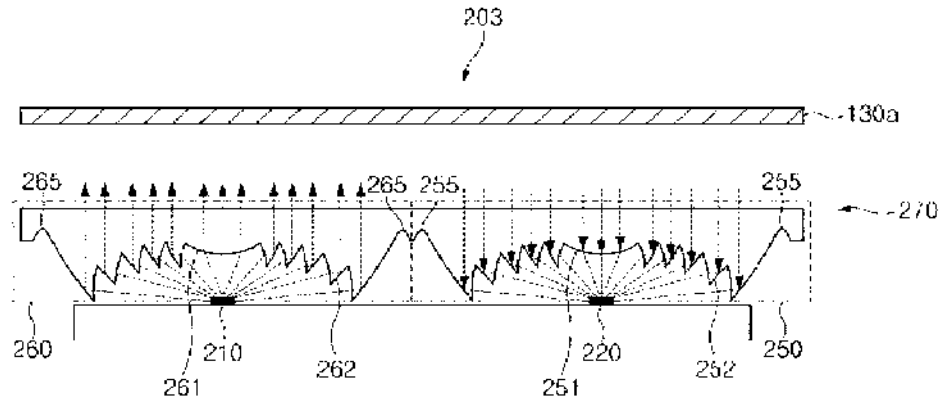
【FIG. 2A】



【FIG. 2B】

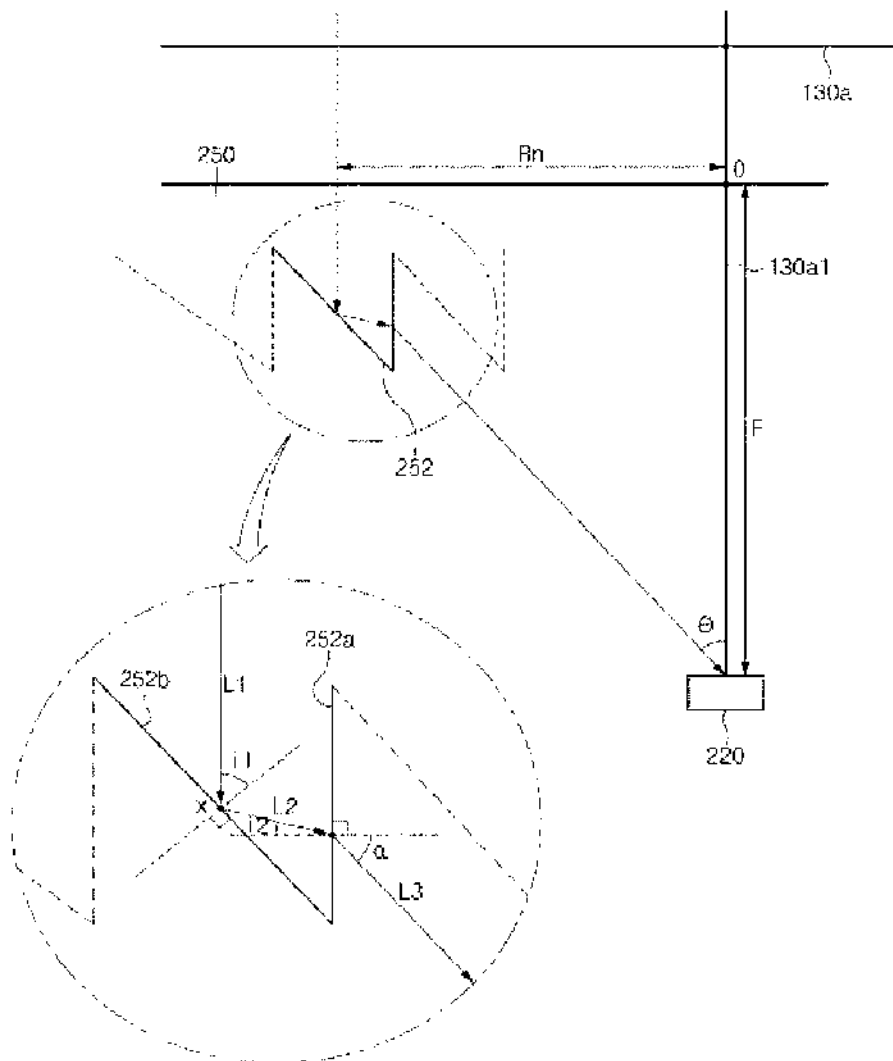


【FIG. 2C】



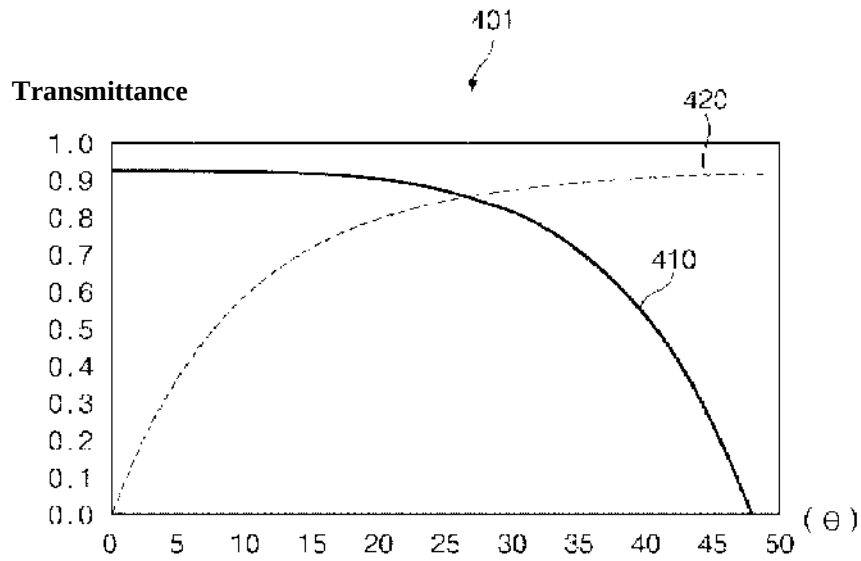
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【FIG. 3】

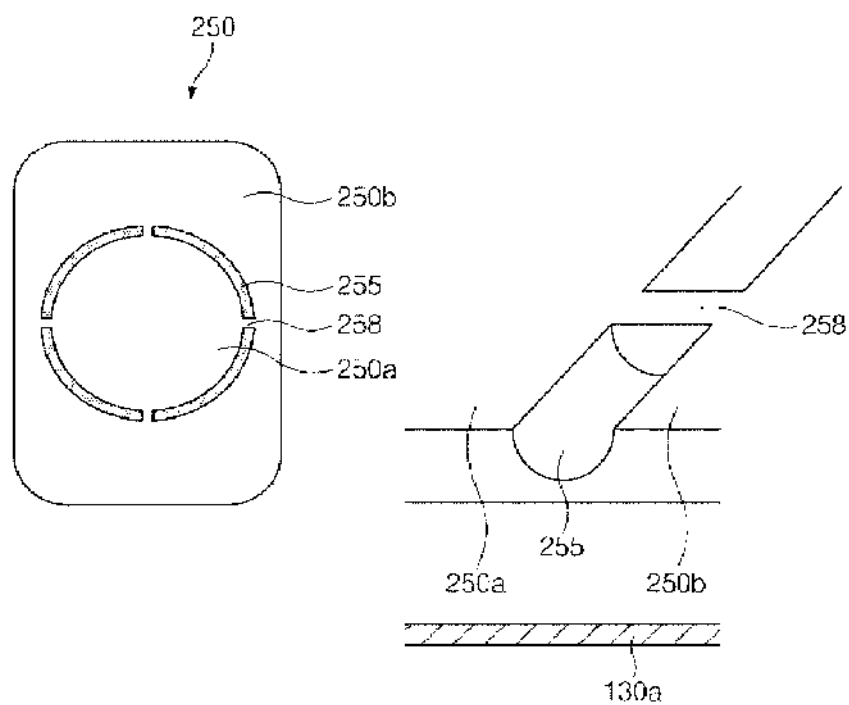


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【FIG. 4】

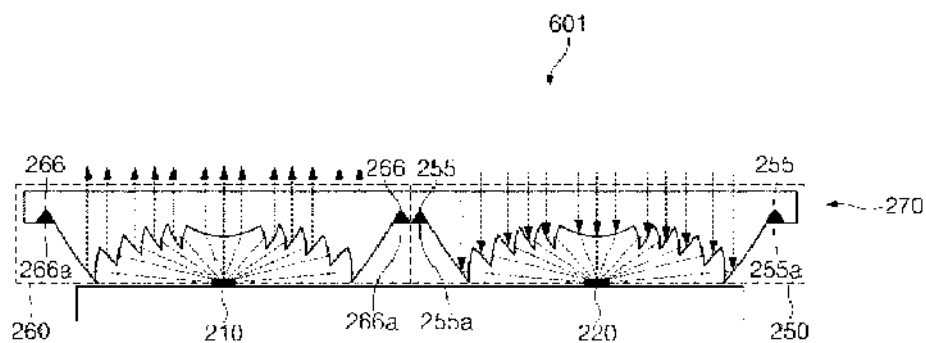


【FIG. 5】



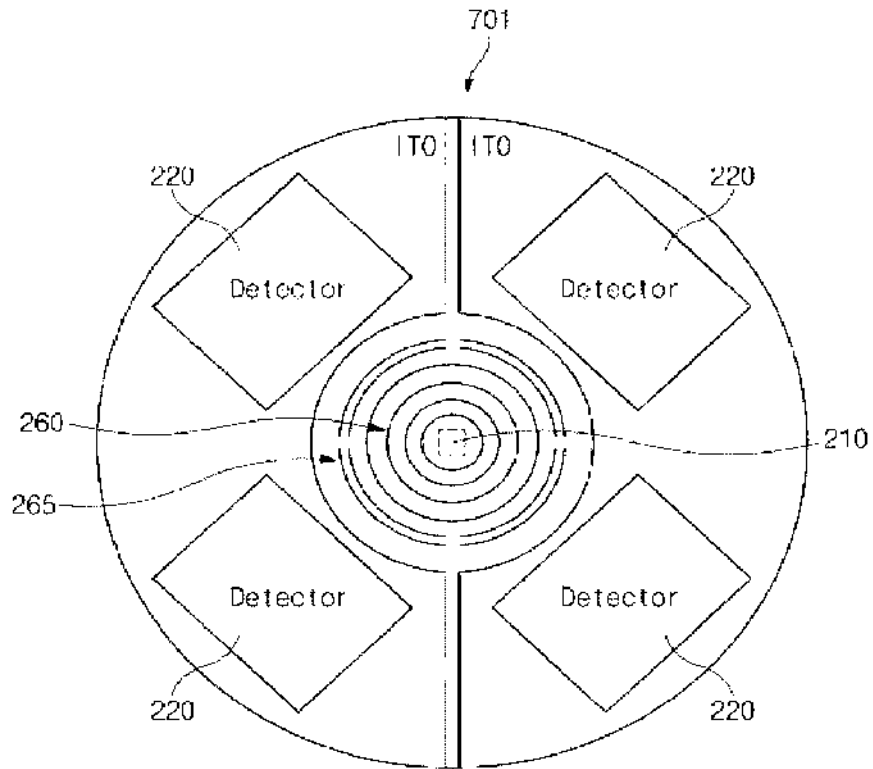
60-53

【FIG. 6】



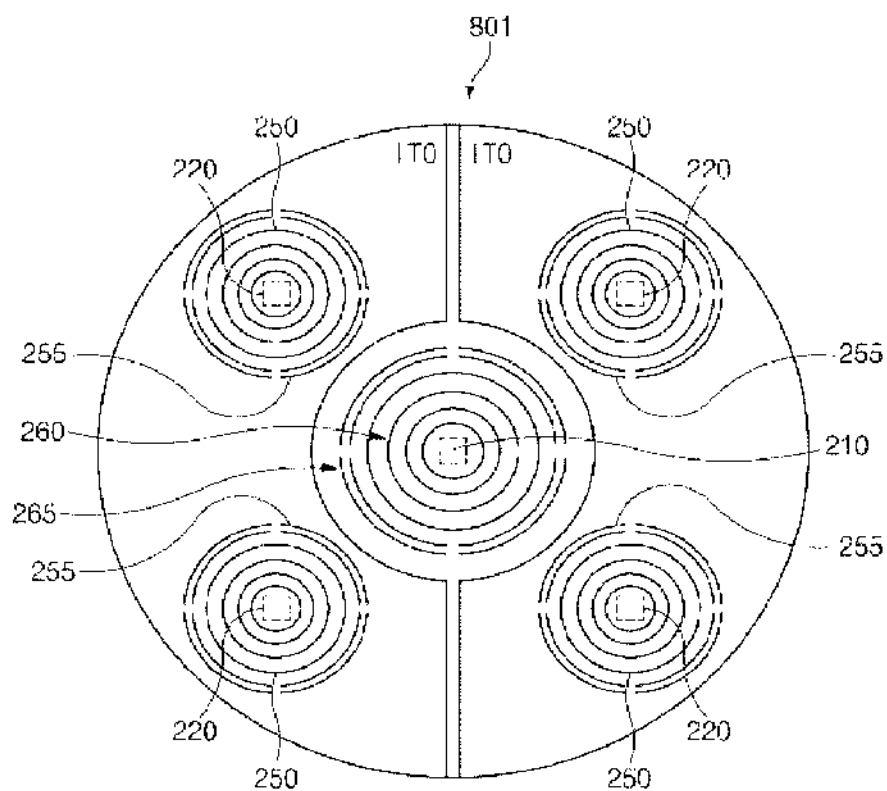
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【FIG. 7】



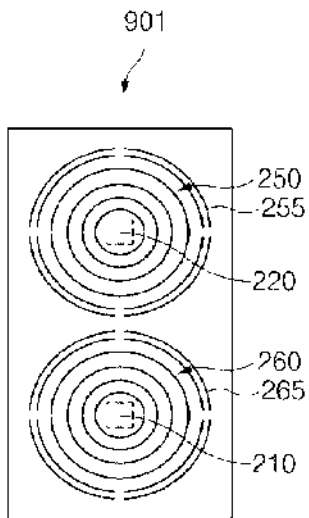
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【FIG. 8】



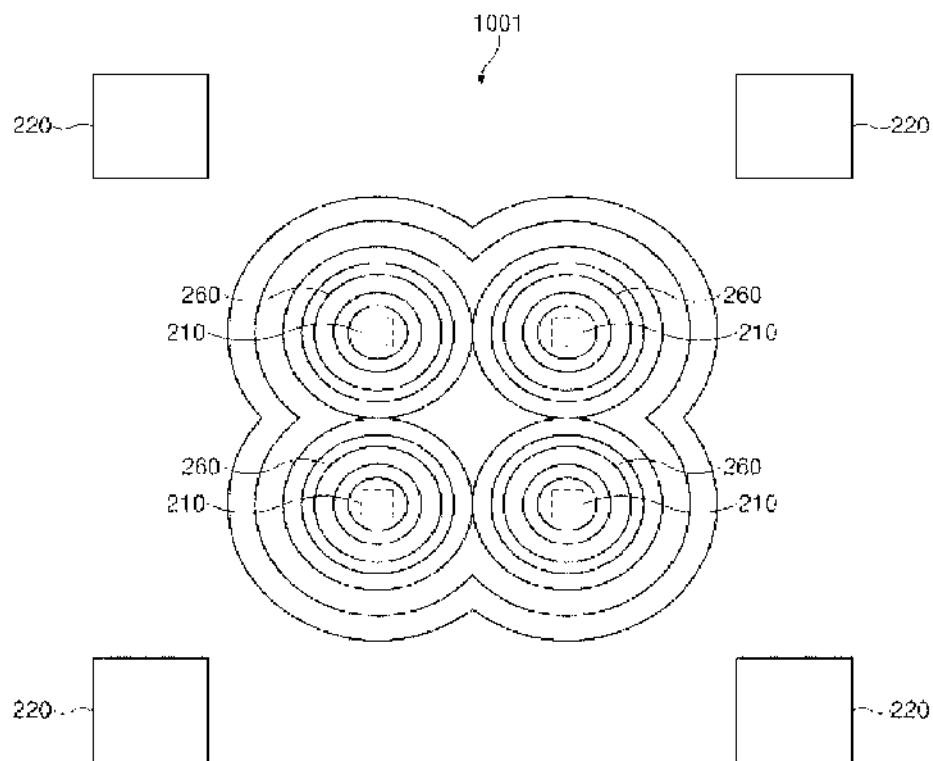
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【FIG. 9】



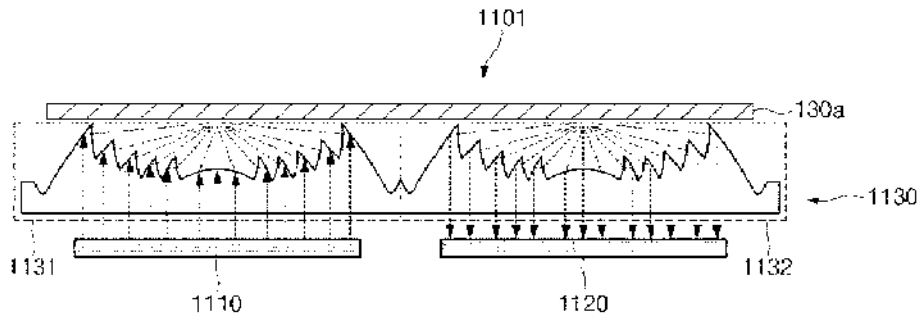
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【FIG. 10】



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【FIG. 11】



【FIG. 12】

