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Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

(54) Title: AMBIENT LIGHT SENSOR ASSEMBLY

(57) Abstract: An Ambient Light Sensor (ALS) assembly is disclosed. The ALS assembly includes a motherboard having a plurality of connectors. The ALS assembly also includes a daughterboard mounted on at least one of the plurality of connectors of the motherboard. Further, the ALS assembly includes an ALS disposed on the daughterboard to detect intensity of ambient light around a display panel. The daughterboard is configured to reduce distance between the ALS and the display panel



AMBIENT LIGHT SENSOR ASSEMBLY

BACKGROUND

5 **[0001]** Electronic devices, such as notebooks, tablets, and computers, include display panels for rendering information. The display panels include a display area and an outer region surrounding the display area. The electronic devices may also include light sensors, such as ambient light sensors, that may be deployed behind the display panels. The ambient light sensors
10 facilitate in automatically adjusting brightness of the display panel based on the ambient light. Further, the display panels may include an aperture in the outer region for allowing the ambient light sensors to receive the ambient light.

BRIEF DESCRIPTION OF DRAWINGS

15 **[0002]** The following detailed description references the drawings, wherein:

[0003] FIG. 1 illustrates a perspective view of an ambient light sensor (ALS) assembly, according to an example of the present subject matter.

[0004] FIG. 2 illustrates a perspective view of a display panel
20 implementing the ALS assembly of FIG. 1, according to another example of the present subject matter.

[0005] FIGS. 3A and 3B illustrate different perspective views of an electronic device implementing the ALS assembly of FIG. 1, according to another example of the present subject matter.

DETAILED DESCRIPTION

- [0006]** Ambient light sensors of different sizes are used in various electronic devices to detect ambient light around the electronic devices. The ambient light may be detected for controlling brightness of a display panel of an electronic device. For example, based on the ambient light detected by the ambient light sensors, the brightness of the display panel may be adjusted to maintain uniform brightness of the display panel under all lighting conditions. Examples of the electronic devices may include, but are not limited to, a tablet, a notebook, a laptop, and a cellular phone. The ambient light sensors are deployed behind a display panel of the electronic devices. In an example, the ambient light sensors are disposed on a circuit board, such as a motherboard of the electronic device. The ambient light sensors receive the ambient light through an aperture that may be created near the display panel of the electronic device.
- [0007]** Generally, the ambient light sensors are positioned on a printed circuit board, such as a motherboard of the electronic device. As the motherboard connects together various components of the electronic devices, the motherboard is located at a position which is convenient for connecting all components of the electronic device. Such a position of the motherboard may cause the ambient light sensor to be placed away from the display panel of the electronic device. As a result, the ambient light may have to travel larger distance within the electronic device to reach the ambient light sensor. Generally, an output of the ambient light sensors depicts an intensity of the ambient light. Due to the large distance, the ambient light sensors may be unable to detect the intensity correctly. This may lead to electrical noise in the output that may be generated by the ambient light sensors.

[0008] In cases where the ambient light sensors are diametrically small in size, due to the large distance to be covered by the ambient light, the ambient light sensors may be unable to correctly detect the ambient light. In another cases, the aperture may be small in size which may cause hindrance in allowing sufficient ambient light to reach to the ambient light sensors, especially when the ambient light sensors have small diameter. In the above such cases, replacing the small sized ambient light sensors with different sized ambient light sensors in the electronic devices may be inconvenient and costly. Alternatively, to enable sufficient ambient light to reach the ambient light sensor, a larger aperture may have to be created near the display panel. A bigger aperture near the display panel of the electronic device may not aesthetically appeal to users.

[0009] According to the present subject matter, an ambient light sensor (ALS) assembly, a display panel implementing the ALS assembly, and an electronic device implementing the ALS assembly are disclosed. The electronic device may include a display panel having a display area and an outer region surrounding the display area. The electronic device may further include an aperture that may be defined in the outer region of the display panel. The aperture may facilitate the ambient light to enter the electronic device to the ALS. Further, the electronic device may include the ALS assembly.

[0010] The ALS assembly may include a main circuit board having a plurality of connectors. In an example, the main circuit board is a motherboard. Further, the ALS assembly may include a secondary circuit board mounted on at least one of the plurality of connectors of the main circuit board. The secondary circuit board may extend substantially perpendicularly from the main circuit board. In an implementation, the

secondary circuit board is a daughterboard that may be surface mounted on the motherboard.

[0011] The ALS assembly may further include an ALS disposed on the secondary circuit board. The secondary circuit board is configured to move
5 the ALS away from the main circuit board and towards the display panel. For example, the secondary circuit board raises the ALS away from the motherboard to reduce a distance between the ALS and the display panel. According to an aspect of the present subject matter, the ALS may be disposed below the aperture to maintain a large angle of view for the ALS.
10 This may allow the ALS to receive sufficient ambient light. Thus, a smaller aperture can be provided on the display panel of the electronic device.

[0012] In an example, the electronic device may include a controller that may be coupled to the ALS to adjust brightness of the display panel based on an output received from the ALS. As described in the above
15 paragraph, as the distance between the ALS and the display panel is reduced, the output generated by the ALS may have minimum electrical noise. This may facilitate the controller to effectively adjust the brightness of the display panel.

[0013] Accordingly, the present subject matter facilitates in providing a
20 cost efficient way to reduce the distance between the ALS and the display panel in existing devices without changing the ALS and/or the thickness of the motherboard. Further, the placement of the ALS closer to the display panel facilitates in reducing the electrical noise. In addition, the raised position of the ALS allows in maintaining wider angle of view for the ALS.

25 **[0014]** The various systems are further described in conjunction with the following figures. It should be noted that the description and figures

merely illustrate the principles of the present subject matter. Further, various arrangements may be devised that, although not explicitly described or shown herein, embody the principles of the present subject matter and are included within its scope. The manner in which the systems depicting various implementation of an ALS assembly are explained in detail with respect to FIG. 1, FIG. 2, FIG. 3A, and FIG. 3B.

[0015] FIG. 1 illustrates a perspective view of an ambient light sensor (ALS) assembly 100, according to an example of the present subject matter. In one example, the ALS assembly 100 may be implemented in a display panel of an electronic device, such as a laptop, a tablet, and a notebook, and the like.

[0016] The ALS assembly 100 may include a motherboard 102 having a plurality of connectors 104. In an example, the motherboard 102 is a printed circuit board. The plurality of connectors 104 may be configured to facilitate connection of different components of a device in which the ALS assembly 100 may be implemented, with the motherboard 102. In another example, the motherboard 102 may include multiple contact pads (not shown) for connecting different components with the motherboard 102.

[0017] The ALS assembly 100 may also include a daughterboard 106 that may be mounted on some of the plurality of connectors 104. In an example, the daughterboard 106 is a circuit board that plugs into and extends the circuitry of another circuit board, such as the motherboard 102. In an implementation, the daughterboard 106 may be surface mounted on the motherboard 102. In an aspect of the present subject matter, the daughterboard 106 may also include connectors or contact pads for being soldered with corresponding connectors 104 or contact pads of the motherboard 102. Though the daughterboard 106 is described as being

surface mounted on the motherboard 102, the daughterboard 106 may be mounted in any other manner.

[0018] In an implementation, the daughterboard 106 may extend substantially perpendicularly from the motherboard 102. In another implementation, the daughterboard 106 may be horizontally mounted on the motherboard 102. In an example, the daughterboard 106 may be of different configurations based on where the ALS assembly 100 may be implemented. For example, the daughterboard 106 may have a height of 1.6mm or 2.0mm or 2.4mm.

[0019] Further, the ALS assembly 100 may include an ALS 108 disposed on the daughterboard 106. The ALS 108 may be configured to detect ambient light around the electronic device in which the ALS assembly 100 may be implemented. Based on the detected intensity of the ambient light, the ALS 108 facilitates in adjusting brightness of a display of the electronic device. In the present implementation, the daughterboard 106 may be configured to move the ALS 108 closer to the display of the electronic device. In an example, based on the distance between the ALS 108 and the display, the daughterboard 106 of a different height may be used. For example, the daughterboard 106 may be used to raise the height of ALS 108 by 1.6 millimeters (mm), 2.0 mm, and 2.4 mm, etc. This may allow the ambient light to travel a smaller distance in order to reach the ALS 108. The smaller distance may facilitate in reducing electrical noise in an output generated by the ALS 108.

[0020] In an example, the daughterboard 106 may electrically couple the ALS 108 with the motherboard 102. Further, as the ALS assembly 100 may be disposed below an aperture (not shown) of the electronic device. Specifically, the aperture may be defined near the display of the electronic

device. As the daughterboard 106 brings the ALS 108 closer to the aperture as well, a large angle of view for the ALS 108 may be maintained. Further, the positioning of the ALS assembly 100 allows to maintain the same view angle of the ALS 108 in any implementation.

5 **[0021]** Referring to FIG. 2, a perspective view 200 of a display panel 202 implementing the ALS assembly 100 of FIG. 1 is illustrated, according to another example of the present subject matter. In an example, the display panel 202 may be an electroluminescent display, a Liquid Crystal Display (LCD), a Thin Film Transistor (TFT) LCD, a Light Emitting Diode (LED)
10 display, an Organic LED (OLED), and the like. The display panel 202 may include a front surface 204 and a rear surface 206. Further, the front surface 204 of the display panel 202 may include a display area 208 and an outer region 210 surrounding the display area 208. The outer region 210 may be understood as a dark colored panel bordering the display area 208. In an
15 example, the outer region 210 of the display panel 202 may be layered with a black ink or thin layer of black paint or black sheet to absorb the ambient light.

[0022] In an implementation, the outer region 210 may include an aperture 212. The aperture 212 may extend through the display panel 202 from the front surface 204 to the rear surface 206. The aperture 212 is
20 configured to allow the ambient light to enter the display panel 202. In an example, in order to focus the ambient light at a particular point, such as the ALS 108, a lens (not shown) may be placed above the aperture 212.

[0023] Further, the display panel 202 may include the ALS assembly 100. In an example, the ALS assembly 100 may be placed behind the front
25 surface 204 of the display panel 202. The ALS assembly 100 includes the ALS 108 to detect the ambient light around the display panel 202. In the present example, the ALS 108 may receive the ambient light through the

aperture 212. In an aspect of the present subject matter, the ALS assembly 100 may be positioned in such a manner that the ALS 108 may be disposed below the aperture 212. The positioning of the ALS assembly 100 below the aperture 212 enables in defining the aperture 212 having a small size while
5 receiving sufficient amount of ambient light to reach the ALS 108. The display panel 202 having a small sized aperture 212 increases the aesthetic appeal of the display panel 202 by hiding the ALS 108 from a user.

[0024] The ALS assembly 100 may further include the daughterboard 106. The daughterboard 106 is electrically coupled to the ALS 108. Further,
10 the ALS assembly 100 may include the motherboard 102. In an example, the daughterboard 106 may be mounted on the motherboard 102 for raising the ALS 108 towards the rear surface 206 of the display panel 202. The daughterboard 106, by keeping the ALS 108 close to the display panel 202, facilitates in reducing electrical noise in an output provided by the ALS 108.

15 **[0025]** In an implementation, the display panel 202 may also include a controller 214. The controller 214 may be coupled to the ALS 108. In an example, the controller 214 may be configured to adjust the brightness of the display area 208 based on the ambient light detected by the ALS 108.

[0026] In operation, the outer region 210 of the display panel 202
20 absorbs nearly all of the ambient light that may be incident on the outer region 210. A small amount of the ambient light that gets through the outer region 210 to the ALS 108 may be used by the ALS 108 for providing an output to the controller 214. The output is indicative of the intensity of the ambient light that may be received by the ALS 108. In an example, as the
25 ALS assembly 100 is positioned near the aperture 212, sufficient amount of ambient light may be received by the ALS 108 to generate the output. Based on the output, the controller 214 may adjust the brightness of the display

panel 202. For example, in bright sunlight, the controller 214 may increase the brightness of the display panel 202 and in a dark room, the controller 214 may decrease the brightness of the display panel 202.

[0027] FIGS. 3A and 3B illustrate different perspective views of an electronic device 300 implementing the ALS assembly 100 of FIG. 1, according to another example of the present subject matter. FIGS. 3A and 3B depict the electronic device 300 as a tablet, however, the electronic device 300 may include, but is not limited to, a personal digital assistant (PDA), a laptop, a personal computer, a tablet, a notebook, a digital watch, and a mobile phone. The electronic device 300 may include a display panel 302. The display panel 302 may include a front surface 302-1 and a rear surface 302-2. The front surface 302-1 of the display panel 302 may include a display area 304 and an outer region 306 surrounding the display area 304. In an example, the outer region 306 of the display panel 302 may be of a dark color for enabling absorption ambient light.

[0028] In an implementation, the outer region 306 may include an aperture 308. The aperture 308 may extend through the display panel 302 from the front surface 302-1 to the rear surface 302-2. The aperture 308 may be configured to allow the ambient light to enter the display panel 302. Based on the distance between the display panel 302 and a light sensor, such as an ambient light sensor, the size of the aperture 308 may be defined.

[0029] Further, the electronic device 300 may include the ALS assembly 100. In an example, the ALS assembly 100 may be placed behind the front surface 302-1 of the display panel 302. As described above, the ALS assembly 100 includes a main circuit board, such as the motherboard 102. The motherboard 102 may have a plurality of terminals thereon. The plurality

of terminals facilitate in connecting different components of the electronic device 300 with the motherboard 102.

[0030] Further, the ALS assembly 100 may include a secondary circuit board, such as the daughterboard 106. The daughterboard 106 may be
5 mounted on some of the terminals of the motherboard 102. In an example, the daughterboard 106 may be surface mounted on the motherboard 102. Though the daughterboard 106 is described as being surface mounted on the motherboard 102, the daughterboard 106 may be mounted in any other manner. In an implementation, the daughterboard 106 may extend
10 substantially perpendicularly from the motherboard 102. In another implementation, the daughterboard 106 may be horizontally mounted on the motherboard 102.

[0031] Further, the ALS assembly 100 may include an ALS 108 disposed on the daughterboard 106. The ALS 108 is configured to detect
15 intensity of the ambient light around the display panel 302. In the present example, the ALS 108 may receive the ambient light through the aperture 308. The daughterboard 106 is designed to move the ALS 108 away from the motherboard 102 and towards the rear surface 302-2 of the display panel 302. In an example, the daughterboard 106 may reduce the distance between
20 the ALS 108 and the display panel 302 by 1.6mm or 2.0mm or 2.4mm. Based on the electronic device 300, the distance between the ALS 108 and the display panel 302 may be varied.

[0032] In an aspect of the present subject matter, the ALS assembly 100 may be positioned in such a manner that the ALS 108 may be disposed
25 below the aperture 308. The positioning of the ALS assembly 100 below the aperture 308 enables in creating the aperture 308 of a small size while receiving sufficient amount of ambient light to reach the ALS 108. The display

panel 302 having a small sized aperture 308 may enhance an aesthetic appeal of the electronic device 300. Further, the daughterboard 106, by keeping the ALS 108 close to the display panel 302, facilitates in reducing electrical noise in the output provided by the ALS 108.

5 **[0033]** In an implementation, the electronic device 300 may also include a controller 310. The controller 310 may be similar to the controller 214. In an example, the controller 310 may be coupled to the ALS 108 to receive an output of the ALS 108. Based on the output received, the controller 310 may adjust the brightness of the display area 304 of the display
10 panel 302. In the present example, the output may be generated based on the ambient light received by the ALS 108. The output is indicative of the intensity of the ambient light around the electronic device 300.

15 **[0034]** Although implementations of ambient light sensor assembly, have been described in language specific to structural features and/or methods, it is to be understood that the present subject matter is not necessarily limited to the specific features or methods described. Rather, the specific features and methods are disclosed and explained in the context of a few example implementations for ambient light sensor assembly.

I/We claim:

- 5 1. An Ambient Light Sensor (ALS) assembly comprising:
 a motherboard having a plurality of connectors;
 a daughterboard mounted on at least one of the plurality of
 connectors of the motherboard; and
 an ALS disposed on the daughterboard to detect intensity of
10 ambient light around a display panel, wherein the daughterboard
 reduces distance between the ALS and the display panel.
2. The ALS assembly as claimed in claim 1, wherein the daughterboard
 is surface mounted on the motherboard.
3. The ALS assembly as claimed in claim 1, wherein the ALS is disposed
15 below an aperture defined on a surface of the display panel.
4. The ALS assembly as claimed in claim 1, wherein the daughterboard
 reduces the distance between the ALS and the display panel by one of
 a 1.6 millimeters, 2.0 millimeters, and 2.5 millimeters.
5. A display panel comprising:
20 a front surface having a display area; and
 an ambient light sensor (ALS) assembly mounted behind the
 front surface, the ALS assembly comprising:
 an ALS to detect intensity of ambient light around the
 display panel;
25 a daughterboard electrically coupled to the ALS; and
 a motherboard having a plurality of connectors, wherein
 the daughterboard is mounted on the motherboard to raise the
 ALS towards the front surface.

6. The display panel as claimed in claim 5, wherein the front surface comprises an outer region surrounding the display area, the outer region having an aperture to enable the ALS to receive the ambient light.
- 5 7. The display panel as claimed in claim 5 further comprising a controller connected to the ALS to adjust brightness of the display area based on the ambient light detected by the ALS.
8. An electronic device comprising:
- 10 a display panel comprising a display area and an outer region surrounding the display area;
- an aperture in the outer region of the display panel for receiving ambient light; and
- an ambient light sensor (ALS) assembly arranged below the display panel, the ALS assembly comprising:
- 15 a main circuit board having a plurality of terminals thereon;
- a secondary circuit board mounted on at least one of the plurality of terminals of the main circuit board; and
- an ALS disposed on the secondary circuit board, wherein
- 20 the secondary circuit board moves the ALS away from the main circuit board and towards the display panel.
9. The electronic device as claimed in claim 8 further comprising a controller coupled to the ALS to adjust brightness of the display area based on detection of ambient light by the ALS.
- 25 10. The electronic device as claimed in claim 8, wherein the ALS is disposed below the aperture.

11. The electronic device as claimed in claim 8, wherein the ALS is electrically coupled to the display panel and the main circuit board.

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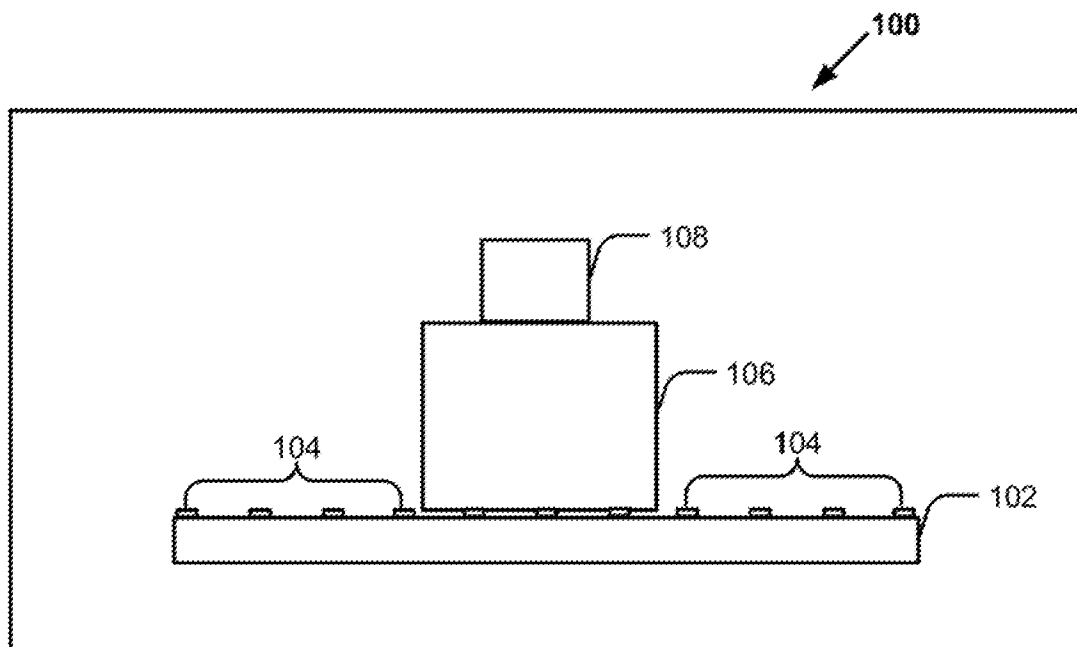


FIG. 1

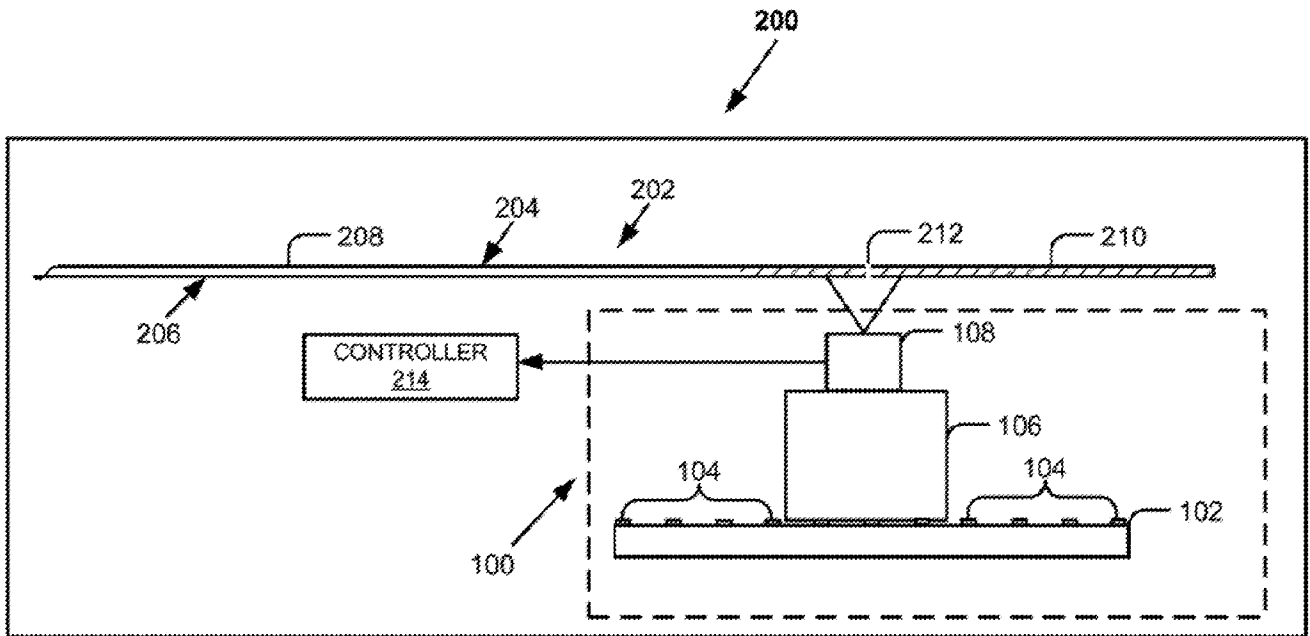


FIG. 2

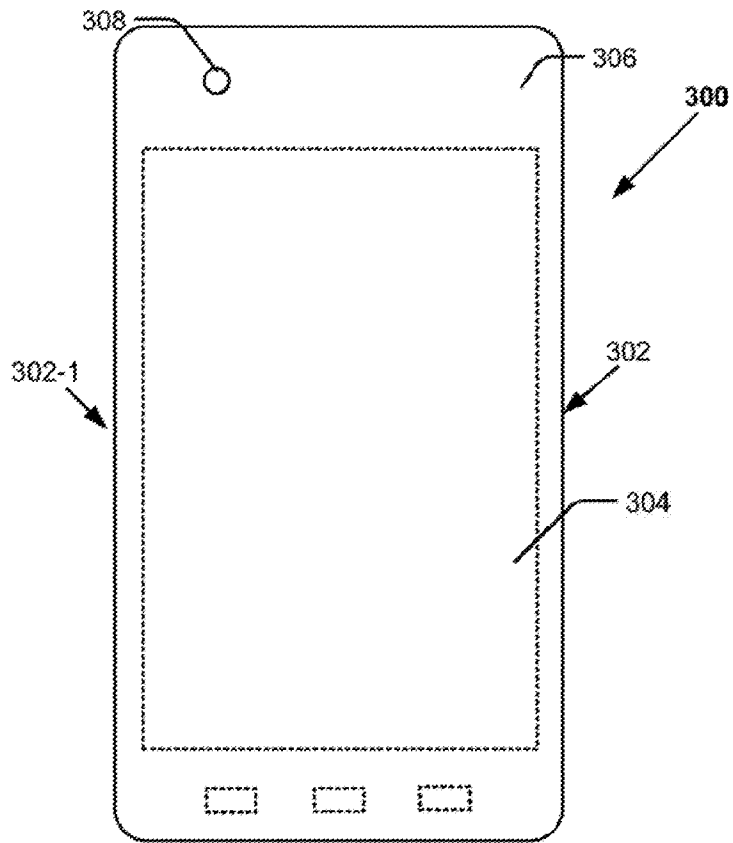


FIG. 3A

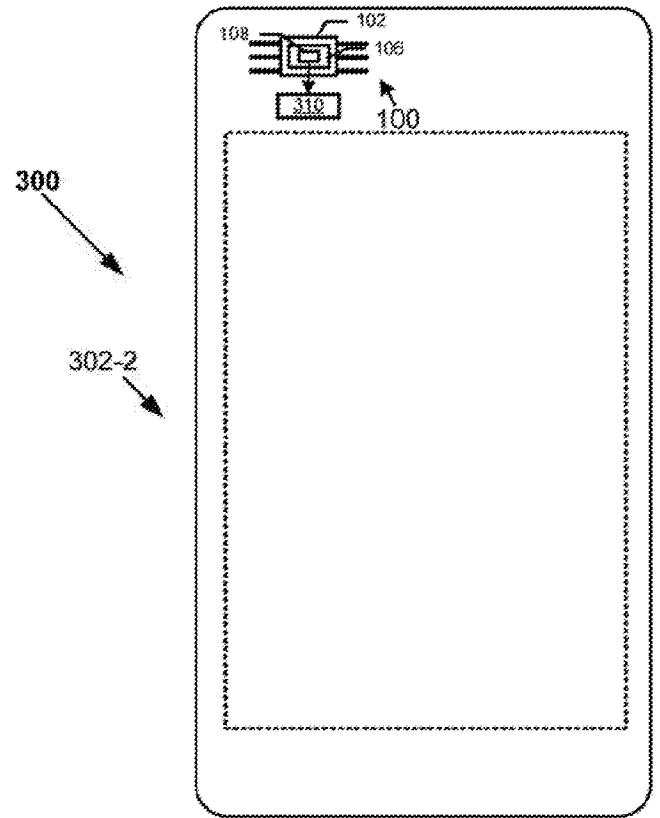


FIG. 3B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2016/043974

A. CLASSIFICATION OF SUBJECT MATTER				
G09G 3/00 (2006.01)				
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)				
G09G 3/00-3/38, 5/00-5/42				
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched				
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)				
PatSearch (RUPTO internal), USPTO, PAJ, Esp@cenet, DWPI, EAPATIS, PATENTSCOPE, Information Retrieval System of FIPS				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
X	US 2014/0152632 A1 (APPLE INC.) 05.06.2014, [0032], [0052]-[0058], fig.1, 6	1-11		
X	US 2014/0267202 A1 (APPLE INC) 18.09.2014, [0049], fig.3	1-11		
X	US 2007/0070264 A1 (SANYO EPSON IMAGING DEVICES CORPORATION) 29.03.2007, [0036]-[0040], [0085], fig.1	1-11		
A	US 2015/0378487 A1 (GOOGLE TECHNOLOGY HOLDING LLC) 31.12.2015	1-11		
☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.				
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"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		
18 April 2017 (18.04.2017)		04 May 2017 (04.05.2017)		
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