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(54) **SENSOR PACKAGE MODULE AND ORGANIC LIGHT-EMITTING DISPLAY HAVING SAME**

(71) Applicant: **LG Display Co., Ltd.**, Seoul (KR)

(72) Inventors: **EunJung KIM**, Seoul (KR); **JongHee HWANG**, Gyeonggi-do (KR); **BuYeol LEE**, Gyeonggi-do (KR); **Sujin KWON**, Seoul (KR)

(73) Assignee: **LG Display Co., Ltd.**, Seoul (KR)

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(57) **ABSTRACT**

An organic light-emitting display device includes a display panel includes an active area in which a plurality of subpixels are arrayed, and a bezel area in which lines, through which a signal and a voltage to be supplied to the subpixels are transferred, are disposed, wherein each subpixels has a cathode and an anode; a data driver supplying a data signal to the subpixels; a gate driver supplying a data signal to the subpixels; a timing controller controlling the data driver and the gate driver; and a sensor package module having a portion that overlaps the active area.

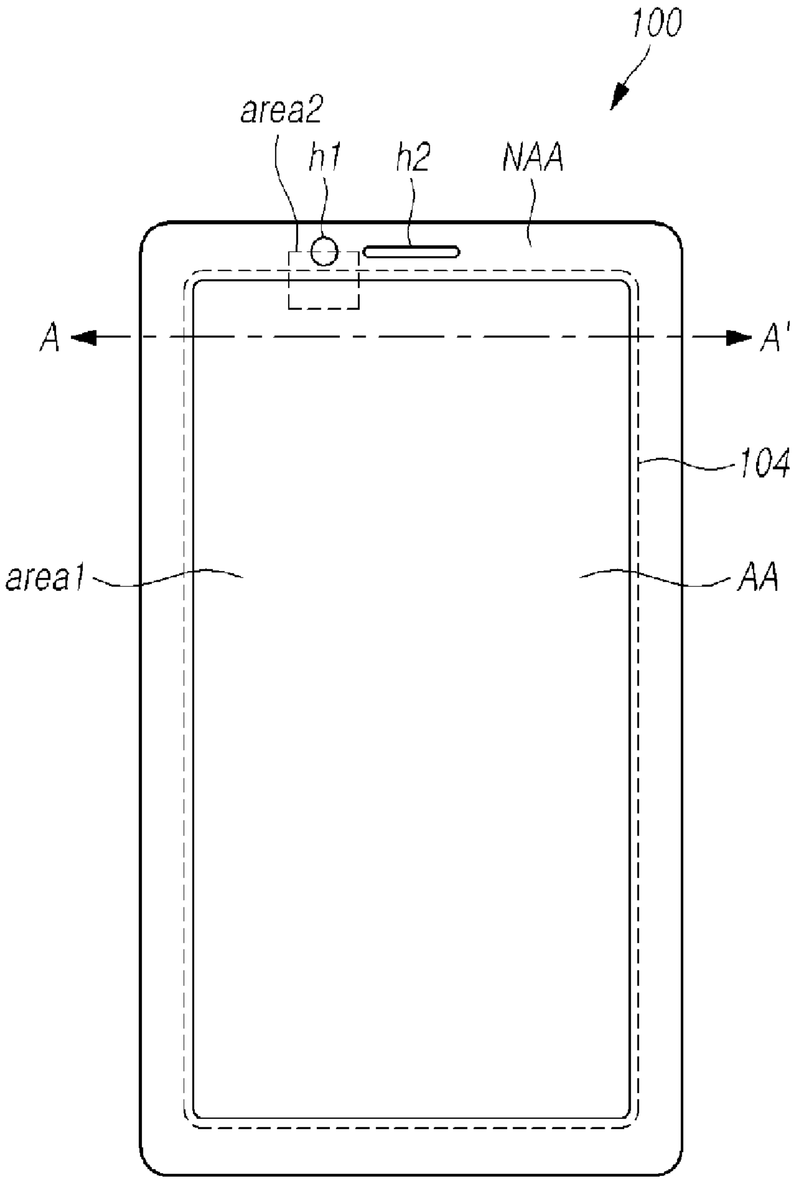


FIG. 1

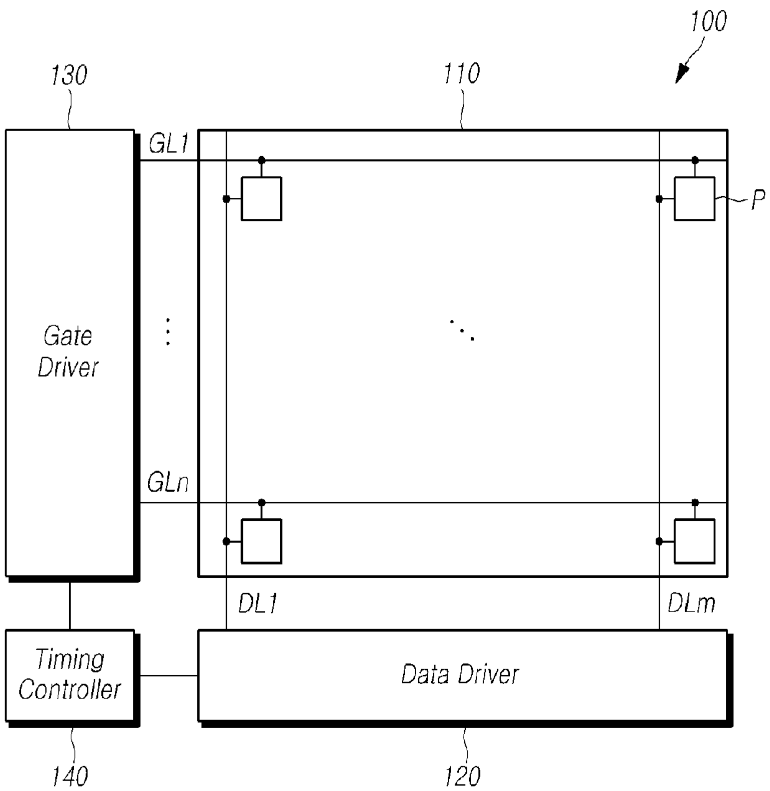

100
130
110
GL1
P
Gate
Driver
GLn
DL1
DLm
Timing
Controller
Data Driver
140
120

FIG.2

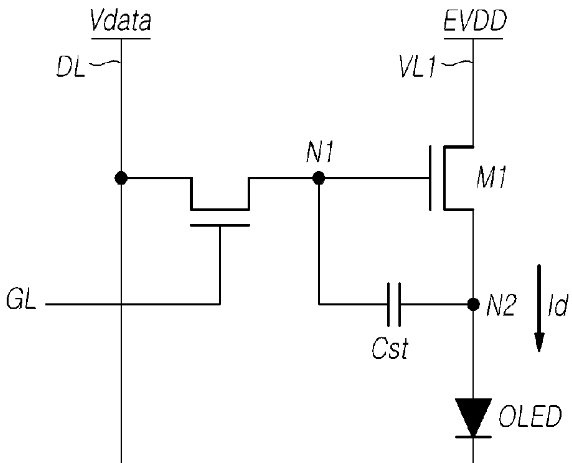


FIG.3

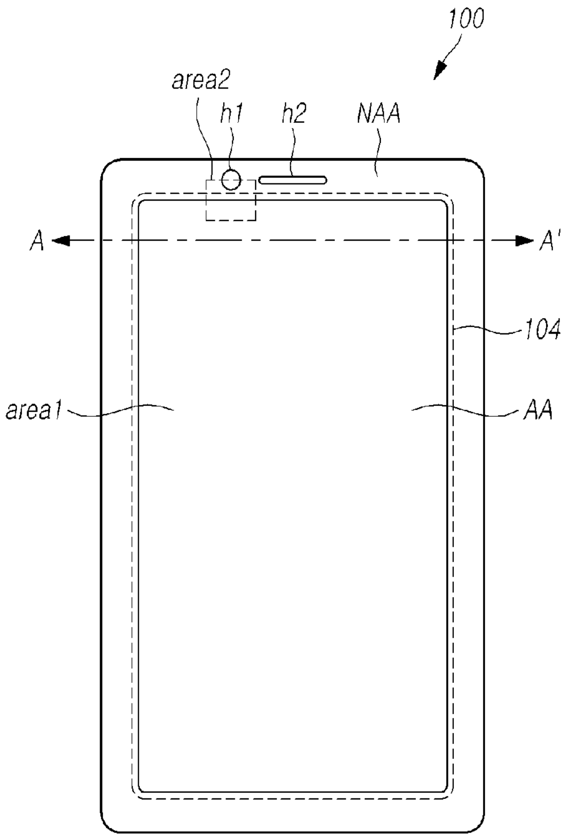


FIG.4

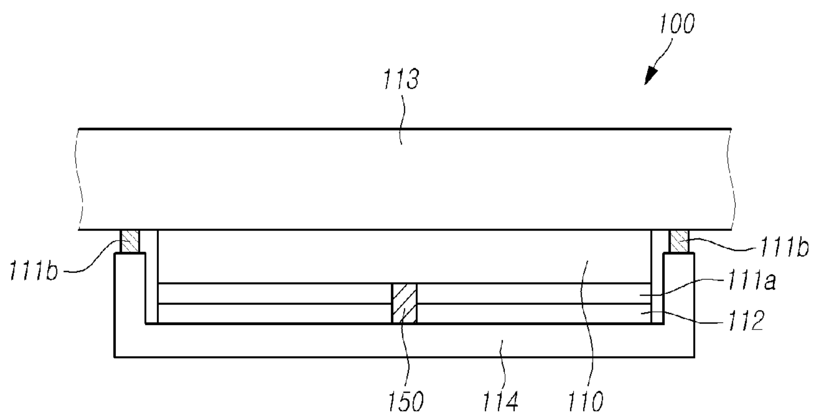


FIG.5

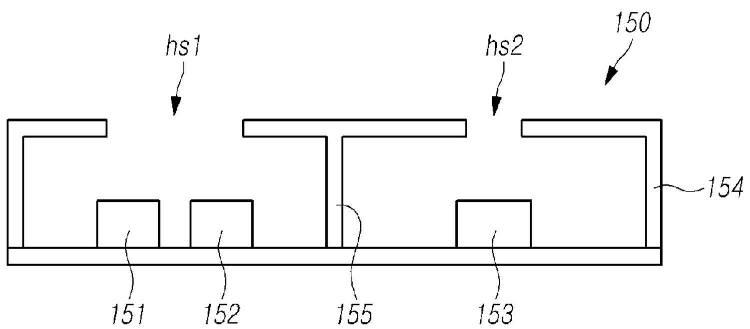
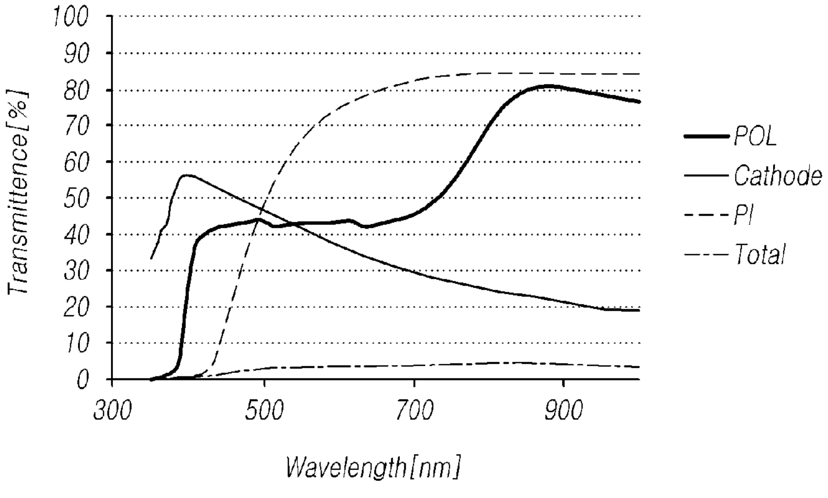


FIG.6

FIG. 7



Transmittence[%]
100
90
80
70
60
50
40
30
20
10
0
300
500
700
900
Wavelength[nm]
POL
Cathode
PI
Total

FIG.8

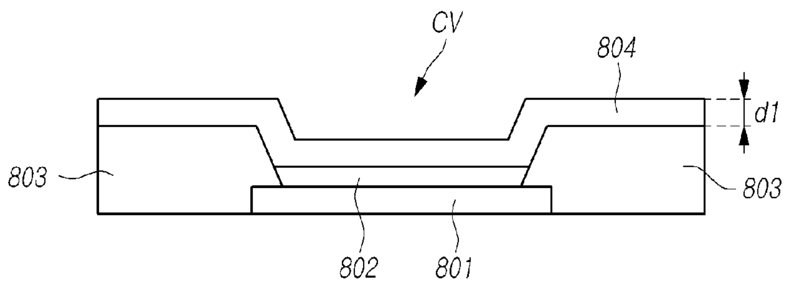


FIG.9

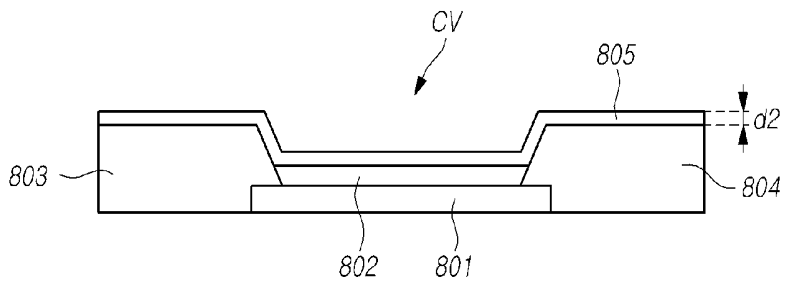


FIG.10

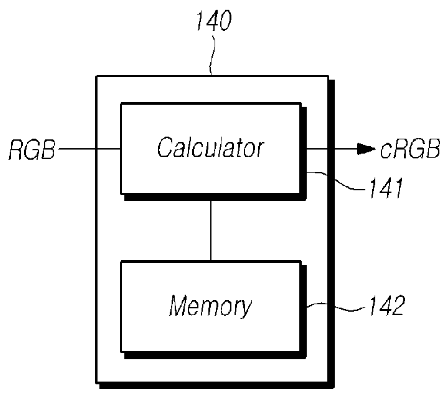


FIG.11

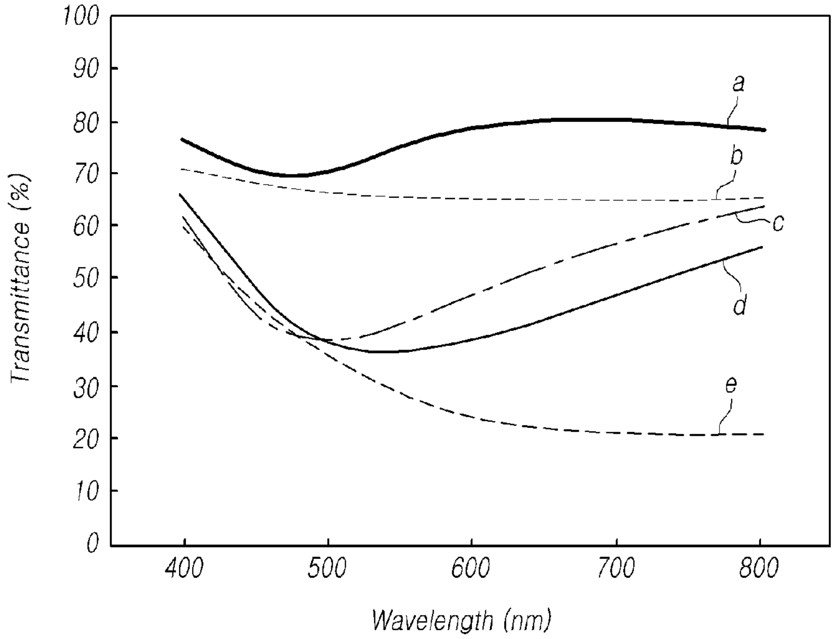

100
90
80
70
60
50
40
30
20
10
0
Transmittance (%)
400
500
600
700
800
Wavelength (nm)
a
b
c
d
e

FIG. 12

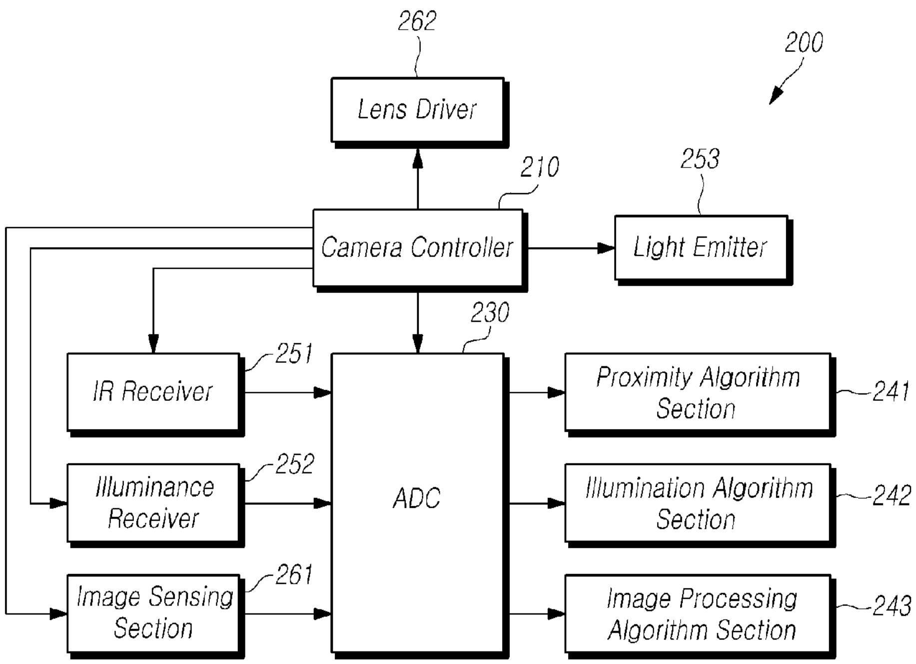

262
Lens Driver
200
210
253
Camera Controller
Light Emitter
230
IR Receiver
251
Illuminance Receiver
252
Image Sensing Section
261
ADC
Proximity Algorithm Section
241
Illumination Algorithm Section
242
Image Processing Algorithm Section
243

FIG. 13

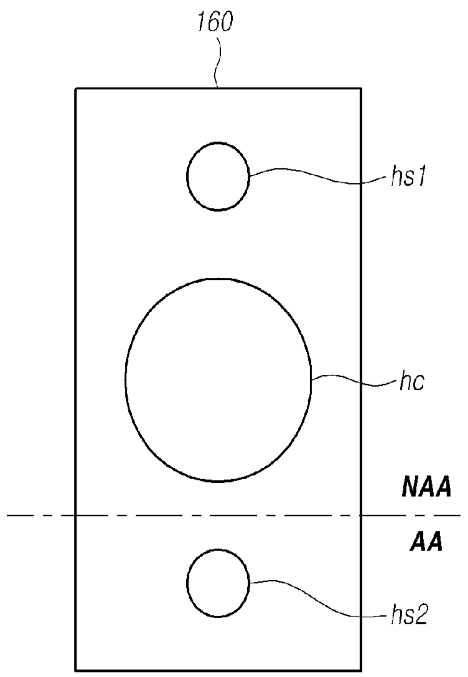


FIG. 14

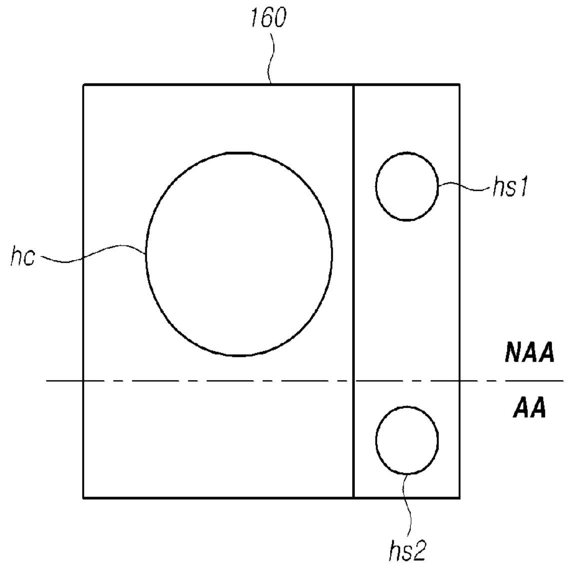


FIG. 15

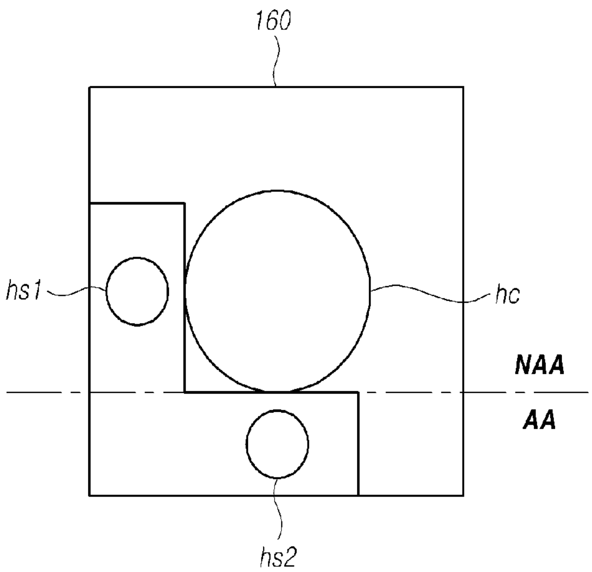


FIG. 16

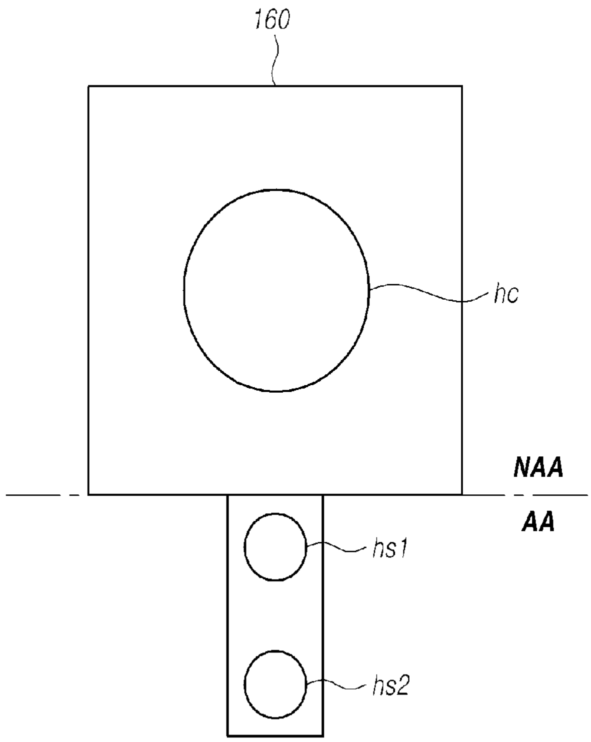
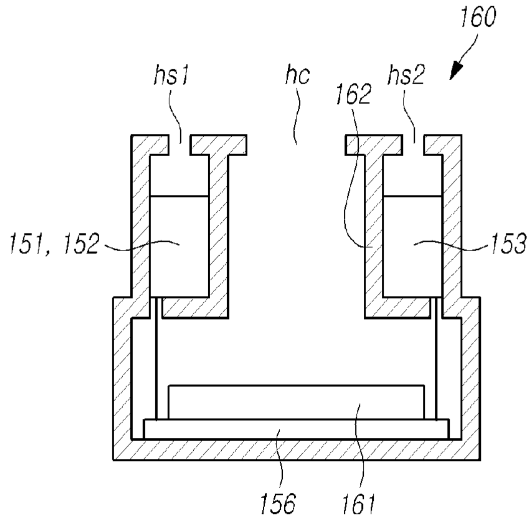


FIG. 17



SENSOR PACKAGE MODULE AND ORGANIC LIGHT-EMITTING DISPLAY HAVING SAME

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to Korean Patent Application No. 10-2018-0115745, filed on Sep. 28, 2018, which is hereby incorporated by reference in its entirety for all purposes as if fully set forth herein.

BACKGROUND

Field of the Disclosure

[0002] Exemplary aspects relate to a sensor package module and an organic light-emitting display having the same.

Description of the Background

[0003] With the development of the information society, demand for a variety of types of display devices for displaying images is increasing. In this regard, flat panel display devices, such as liquid crystal display (LCD) devices, and organic light-emitting diode (OLED) display devices, have come into widespread use.

[0004] Among flat panel display devices, organic light-emitting display devices have recently come into prominence, since they have superior properties, such as wide viewing angles, excellent contrast ratios, and the like, and can be provided with a thin profile. The organic light-emitting display devices can emit light to reproduce images by supplying a driving current to self-emissive organic light-emitting diodes.

[0005] The display devices include various sensors. In particular, the sensors receive light or emit light to perform proximity processing, or detect the intensity of external light to allow various programs to be executed.

[0006] A display device to which a narrow bezel that maximizes the display area while minimizing the non-display area as much as possible has been applied due to easiness in use and recent design trends has been widely developed.

[0007] However, since holes must be formed in the bezel area such that the sensors can receive or emit light, the application of the narrow bezel is limited due to the area occupied by the holes.

SUMMARY

[0008] The present disclosure provides a sensor package module for implementing a thin bezel and an organic light-emitting display device using the same.

[0009] The present disclosure also provides an organic light-emitting display device capable of preventing an increase in power consumption and deterioration in image quality.

[0010] According to an aspect, exemplary aspects may provide an organic light-emitting display device includes a display panel includes an active area in which a plurality of subpixels are arrayed, and a bezel area in which lines, through which a signal and a voltage to be supplied to the subpixels are transferred, are disposed, wherein each subpixels has a cathode and an anode; a data driver supplying a data signal to the subpixels; a gate driver supplying a data signal to the subpixels; a timing controller controlling the data driver and the gate driver; and a sensor package module having a portion that overlaps the active area.

[0011] According to another aspect, exemplary aspects may provide a sensor package module includes a camera module including an image sensing section that drives an image sensor, a lens driver that drives a lens to project light to the image sensor, and a camera controller that controls the image sensing section and the lens driver; and a proximity sensor including a light receiver that drives a light receiving sensor to sense light and a light emitter that drives a light-emitting device to emit light, wherein the camera controller controls the light receiver and the light emitter.

[0012] According to exemplary aspects, the sensor package module for implementing a thin bezel and the organic light-emitting display device using the same can be provided.

[0013] According to exemplary aspects, the organic light-emitting display device is capable of preventing an increase in power consumption and deterioration in image quality.

DESCRIPTION OF DRAWINGS

[0014] The above and other objects, features, and advantages of the present disclosure will be more clearly understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

[0015] FIG. **1** is a schematic view illustrating a structure of an organic light-emitting display device according to the present disclosure;

[0016] FIG. **2** is a circuit diagram illustrating an exemplary aspect of the subpixel illustrated in FIG. **1**;

[0017] FIG. **3** is a plan view illustrating an exemplary aspect of an electronic device employing the organic light-emitting display device illustrated in FIG. **1**;

[0018] FIG. **4** is a cross-sectional view illustrating an exemplary cross-sectional structure taken along line A-A' of the electronic device illustrated in FIG. **3**;

[0019] FIG. **5** is a cross-sectional view illustrating a sensor package module employed in the electronic device illustrated in FIG. **4**;

[0020] FIG. **6** is a cross-sectional view illustrating the display panel illustrated in FIG. **1**;

[0021] FIG. **7** is a graph illustrating the transmittance of the display panel;

[0022] FIG. **8** is a cross-sectional view illustrating a first area of the active area of the electronic device illustrated in FIG. **3**;

[0023] FIG. **9** is a cross-sectional view illustrating a second area of the active area of the electronic device illustrated in FIG. **3**;

[0024] FIG. **10** is a block diagram illustrating an exemplary aspect of the timing controller illustrated in FIG. **1**;

[0025] FIG. **11** is a graph illustrating the transmittance of a cathode according to metals;

[0026] FIG. **12** is a view illustrating a structure of a sensor package module according to an exemplary aspect;

[0027] FIG. **13** is a plan view illustrating a first aspect of the sensor package module employing the sensor package illustrated in FIG. **11**;

[0028] FIG. **14** is a plan view illustrating a second aspect of the sensor package module employing the sensor illustrated in FIG. **11**;

[0029] FIG. **15** is a plan view illustrating a third aspect of the sensor package module employing the sensor illustrated in FIG. **11**;

[0030] FIG. **16** is a plan view illustrating a fourth aspect of the sensor package module employing the sensor illustrated in FIG. **11**; and

[0031] FIG. **17** is a cross-sectional view illustrating an exemplary aspect of the sensor package module illustrated in FIG. **11**.

DETAILED DESCRIPTION

[0032] Hereinafter, reference will be made to aspects of the present disclosure in detail, examples of which are illustrated in the accompanying drawings. Throughout this document, reference should be made to the drawings, in which the same reference numerals and symbols will be used to designate the same or like components. In the following description of the present disclosure, detailed descriptions of known functions and components incorporated into the present disclosure will be omitted in the case that the subject matter of the present disclosure may be rendered unclear thereby.

[0033] It will also be understood that, while terms, such as "first," "second," "A," "B," "(a)," and "(b)," may be used herein to describe various elements, such terms are merely used to distinguish one element from other elements. The substance, sequence, order, or number of such elements is not limited by these terms. It will be understood that when an element is referred to as being "connected," "coupled," or "linked" to another element, not only can it be "directly connected, coupled, or linked" to the other element, but it can also be "indirectly connected, coupled, or linked" to the other element via an "intervening" element. In the same context, it will be understood that when an element is referred to as being formed "on" or "under" another element, not only can it be directly located on or under the other element, but it can also be indirectly located on or under the other element via an intervening element.

[0034] FIG. **1** is a schematic view illustrating a structure of an organic light-emitting display (OLED) device according to an exemplary aspect.

[0035] Referring to FIG. **1**, the OLED device **100** may include a display panel **110**, a data driver **120**, a gate driver **130**, and a timing controller **140**.

[0036] The display panel **110** may include a plurality of gate lines GL**1** to GLn and a plurality of data lines DL**1** to DLm which intersect with each other. The display panel **110** includes a plurality of subpixels P provided corresponding to an area in which the plurality of gate lines GL**1**, . . . , and GLn and the plurality of data lines DL**1**, . . . , and DLm intersect with each other. The plurality of subpixels P may include an organic light-emitting diode (not shown) and a pixel circuit (not shown) for supplying a driving current to the organic light-emitting diode. The pixel circuit may be connected to the gate lines GL**1**, . . . , and GLn and the data lines DL**1**, . . . , and DLm to supply a driving current to the organic light-emitting diodes. Here, lines disposed in the display panel **110** are not limited to the plurality of gate lines GL**1**, . . . , and GLn and the plurality of data lines DL**1**, . . . , and DLm.

[0037] The data driver **120** may apply a data signal to the plurality of data lines DL**1**, . . . , and DLm. The data signal may correspond to the gradation, and a voltage level of the data signal may be determined according to the corresponding gradation. The voltage of the data signal may be referred to as a data voltage.

[0038] Here, although the data driver **120** is illustrated as a single data driver, the present disclosure is not limited thereto. Two or more data drivers may be provided, depending on the size and resolution of the display panel **110**. In addition, the data driver **120** may be implemented as an integrated circuit.

[0039] The gate driver **130** may apply a gate signal to the plurality of gate lines GL**1**, . . . , and GLn. The subpixel P corresponding to the plurality of gate lines GL**1**, . . . , and GLn to which the gate signal is applied can receive the data signal. In addition, the gate driver **130** may transfer a sensing signal to the subpixel P. The subpixel P, having received the sensing signal output from the gate driver **130**, may receive a sensing voltage output from the data driver **120**. Here, although the gate driver **130** is illustrated as a single gate driver, the present disclosure is not limited thereto. At least two gate drivers may be provided. The gate drivers **130** may be disposed on both sides of the display panel **110**, respectively, such that one of the gate drivers **130** is connected to the odd-numbered gate lines among the plurality of gate lines GL**1** to GLn, and the other of the gate drivers **130** may be connected to even-numbered gate lines among the plurality of gate lines GL**1** to GLn. However, the present disclosure is not limited thereto. The gate driver **130** may be implemented as an integrated circuit.

[0040] The timing controller **140** may control the data driver **120** and the gate driver **130**. In addition, the timing controller **140** may transfer image data, corresponding to the data signal, to the data driver **120**. The image data may be a digital signal. The timing controller **140** may correct the image signal and transfer the corrected image signal to the data driver **120**. The operation of the timing controller **140** is not limited thereto. The timing controller **140** may be implemented as an integrated circuit.

[0041] FIG. **2** is a circuit diagram illustrating an exemplary aspect of the subpixel illustrated in FIG.**1**.

[0042] Referring to FIG. **2**, the subpixel P may include an organic light-emitting diode (OLED) and a pixel circuit for driving the OLED. The pixel circuit may include a first transistor M**1**, a second transistor M**2**, and a capacitor Cs.

[0043] The first transistor M**1** has a first electrode connected to a first power supply line VL**1**, through which a pixel high potential voltage EVDD is transferred, a gate electrode connected to a first node N**1**, and a second electrode connected to a second node N**2**. The first transistor M**1** may cause a current to flow to the second node N**1**, in response to a voltage being transferred to the second node N**2**. The first electrode of the first transistor M**1** may be a drain electrode and the second electrode may be a source electrode. However, the present disclosure is not limited thereto.

[0044] The current flowing to the second node N**2** may correspond to the following Equation 1:

$$Id=k(V_{GS}-V\text{th})^2 \tag{1}$$

where Id denotes the amount of current flowing through the second node N**2**, k denotes electron mobility of the transistor, VGS denotes a voltage difference between the gate electrode and the source electrode of the first transistor M**1**, and Vth denotes a threshold voltage of the first transistor M**1**.

[0045] Therefore, since the amount of current varies depending on the deviation of the electron mobility and the threshold voltage, it is possible to prevent the deterioration of the image quality by correcting the data signal depending on the deviation of the electron mobility and the threshold voltage.

[0046] The second transistor M**2** has a first electrode connected to the data line DL, a gate electrode connected to the gate line GL, and a second electrode connected to a first node N**1**. Thus, the second transistor M**2** may cause a data voltage Vdata corresponding to the data signal to the first node N**1**, in response to a gate signal being transferred through the gate line GL. The first electrode of the second transistor M**2** may be a drain electrode and the second electrode may be a source electrode. However, the present disclosure is not limited thereto.

[0047] The capacitor Cs may be connected between the first node N**1** and the second node N**2**. The capacitor Cs may maintain the voltages of the gate electrode and the source electrode of the first transistor M**1** constant.

[0048] The organic light-emitting diode OLED may have an anode connected to the second node N**2** and a cathode connected to a pixel low potential voltage EVSS. Here, the pixel low potential voltage EVSS may be a ground voltage. However, the present disclosure is not limited thereto. When an electric current flows from the anode to the cathode, the organic light-emitting diode (OLED) may emit light depending on the amount of current. The organic light-emitting diode (OLED) may emit light of any one of red, green, blue, and white. However, the present disclosure is not limited thereto.

[0049] The circuit of the subpixel employed in the organic light-emitting display device **100** is not limited thereto.

[0050] FIG. **3** is a plan view illustrating an exemplary aspect of an electronic device employing the organic light-emitting display device illustrated in FIG. **1**.

[0051] Referring to FIG. **3**, the electronic device **300** may include an active area AA on which an image is displayed and a bezel area NAA in which lines for transferring signals and voltages to the active area AA are disposed. The active area AA may be an area in which the display panel **110** illustrated in FIG. **1** is exposed and a user can recognize the displayed image. Although the shape of the active area AA is illustrated as being rectangular, it is not limited thereto. A transparent material may be disposed on the active area AA. A touch electrode (not shown) may be disposed on the active area AA. The electronic device **300** may have a first hole h**1** provided in the upper portion of the bezel area NAA. When the electronic device **300** includes a camera, a lens of the camera may be disposed in the first hole h**1**. In addition, a second hole h**2** may be disposed in the bezel area NAA. In a case in which the electronic device **300** is a smart phone, the second hole h**2** may be a hole holding a speaker for outputting a voice during a conversation. However, the hole disposed in the bezel area NAA is not limited thereto.

[0052] A cathode **104** may be disposed on the active area AA. The cathode **104** may correspond to a cathode of the organic light-emitting diode (OLED) illustrated in FIG. **2**. The cathode **104** may be provided as a common electrode and may be disposed on the active area AA. Further, the electronic device **300** may have a sensor package module disposed in a location in which at least a portion of the electronic device **300** overlaps the active area AA.

[0053] The sensor package module may include a plurality of sensors. In addition, the sensor package module may include a light-emitting device. The sensor package module may serve to detect the proximity of an object and the intensity of external light by detecting infrared (IR) radiation and visible light, and may emit IR radiation. The sensor package module may be a proximity sensor. Therefore, the sensor package module can emit or receive light. When the sensor package module to emit light or receive light is disposed in the bezel area NAA, separate holes should be provided in the bezel area NAA to allow the sensor package module to emit light or receive light. If a hole is formed in the bezel area NAA, the area occupied by the hole is required for the bezel area NAA, which limits the width of the bezel area NAA. This may interfere with the implementation of a narrow bezel. However, if the holes required for the sensor package module are not disposed in the bezel area NAA, the number of holes provided in the bezel area NAA may be reduced so that the bezel area NAA of the electronic device **300** may be thinned accordingly. Here, narrowing the bezel area NAA may mean that the width of the bezel area NAA in the direction perpendicular to the sides of the electronic device is made thinner. However, the present disclosure is not limited thereto.

[0054] In a case in which the active area AA of the electronic device **300** is designed to allow a sufficient amount of light to pass there through, the sensor package module **150** can use the light that has passed through the active area AA. Therefore, when the active area AA of the electronic device **300** has a predetermined degree of transmittance, the sensor package module **150** may be disposed to overlap the active area AA. It is not necessary to form the holes, through which the sensor package module **150** is irradiated with light, in the bezel area NAA. This makes it easier to implement a narrow bezel.

[0055] The sensor package module may detect light from the active area AA. The sensor package module may emit IR radiation and receive reflected IR radiation from an object, or receive visible light contained in natural light.

[0056] An area, in the active area AA of the electronic device **300**, not overlapping the sensor package module, may be referred to as a first area area**1**, while an area overlapping the sensor package module may be referred to as a second area area**2**. A portion of the second area area**2** may overlap the active area AA. Also, the second area area**2** may be an area corresponding to a specific part of the sensor package module on the active area AA. That is, only a part of the area overlapping the sensor package module may be the second area area**2**.

[0057] FIG. **4** is a cross-sectional view illustrating an exemplary cross-sectional structure taken along line A-A' of the electronic device illustrated in FIG. **3**.

[0058] Referring to FIG. **4**, the electronic device **300** may include a display panel **110** and a mid-frame **114** protecting the display panel **110**. A first foam pad **111***a* and a heat sink **112** may be disposed between the display panel **110** and the mid-frame **114**. However, the structures disposed between the display panel **110** and the mid-frame **114** is not limited thereto. A cover glass **113** may be disposed on the display panel **110**. The cover glass **113** may be disposed on the display panel **110** after a touch sensor (not shown) is disposed on the display panel **110**. A second foam pad **111***b* may be disposed on a surface of the mid-frame **114** which is in contact with the cover glass **113**. However, the present disclosure is not limited thereto.

[0059] The light emitted from the display panel **110** may be radiated toward the cover glass **113**. A surface of the display panel **110** which is in contact with the cover glass

113 may be referred to as a front surface and a surface in contact with the first foam pad **111***a* may be referred to as a back surface. The back surface of the display panel **110** on which the sensor package module **150** is disposed may be the second area area**2** illustrated in FIG. **3**. In order to allow the sensor package module **150** to be disposed on the back surface of the display panel **110**, a portion of the first foam pad **111***a* and the heat sink **112** may be removed.

[0060] The sensor package module **150** may be disposed in the portion, from which portions of the first foam pad **111***a* and the heat sink **112** are removed, such that the sensor package module **150** is in contact with the back surface of the display panel **110**. Accordingly, the sensor package module **150** can receive the light that has passed through the display panel **110** or irradiate the light toward the cover glass **113**. The display panel **110** may be disposed at a position corresponding to the active area AA in FIG. **3**.

[0061] FIG. **5** is a cross-sectional view illustrating a sensor package module employed in the electronic device illustrated in FIG. **4**.

[0062] Referring to FIG. **5**, the sensor package module **150** may include a housing **155**, light receiving sensors **151** and **152**, and a light-emitting device **153**. The light receiving sensors **151** and **152** may be a proximity sensor. However, the present disclosure is not limited thereto. Further, the light-emitting device **153** may be a device that emits IR radiation. However, the present disclosure is not limited thereto. The housing **155** may accommodate the light receiving sensors **151** and **152** and the light-emitting device **153** therein. The housing **155** may have a first hole hs**1** and a second hole hs**2** corresponding to and located above the light receiving sensors **151** and **152** and the light-emitting device **153**, which are accommodated in the housing **155**. In addition, the housing **155** may has a partition wall **155** disposed between the light receiving sensors **151** and **152** and the light-emitting device **153**.

[0063] The partition wall **155** may prevent the light emitted from the light-emitting device **153** from directly striking the light receiving sensors **151** and **152** without passing through the first hole hs**1** and the second hole hs**2**. Each of the first hole hs**1** and the second hole hs**2** provided in the housing **154** may be a circular hole with a diameter of 1 mm. However, the size and shape of the first hole hs**1** and the second hole hs**2** are not limited thereto. The light receiving sensors **151** and **152** and the light-emitting device **153** may be provided on a substrate, and the lower portion of the housing **155** may be provided with the substrate on which lines for supplying signals and voltages to the light receiving sensors **151** and **152** and the light-emitting device **153** are provided. However, the present disclosure is not limited thereto.

[0064] The light receiving sensors **151** and **152** are categorized as a first light receiving sensor **151** and a second light receiving sensor **152**. The first light receiving sensor **151** receives visible light from natural light and the second light receiving sensor **152** receives IR radiation. The IR radiation received by the second light receiving sensor **152** may be IR radiation emitted from the light-emitting device **153**. However, the light received by the light receiving sensors **151** and **152** and emitted from the light-emitting device **153** is not limited thereto.

[0065] FIG. **6** is a cross-sectional view illustrating the display panel illustrated in FIG. **1**.

[0066] Referring to FIG. **6**, the display panel **110** may include a substrate **601**, a device layer **602** on which the first and second transistors M1 and M2 and the capacitor Cst illustrated in FIG. **2** are fabricated, an organic light-emitting layer **603** emitting light by receiving a current from the device layer **602**, a cathode layer **604**, and an insulating layer **605**. Further, the display panel may further include a polarizing film **606**. The substrate **601**, the cathode layer **604**, and the polarizing film **606** may be formed over the entire area of the display panel **110**. Since the cathode layer **604** is made of low work function metals, such as calcium (Ca), aluminum (Al)/lithium (Li), magnesium (Mg)/silver (Ag), or the like, the transmittance thereof is low.

[0067] FIG. **7** is a graph illustrating the transmittance of the substrate **601**, the cathode layer **604**, and the polarizing film **606**. Referring to FIG. **7**, it can be appreciated that the transmittance of the cathode layer **604** is the lowest. In addition, it can also be appreciated that the cathode layer **604** exhibits a transmittance in the range of 30% to 50% in the visible light range of 525 nm to 560 nm and a transmittance in the range of 20% to 25% in the infrared range of 850 nm to 950 nm. Therefore, it can be understood that increasing the transmittance of the cathode layer **604** is the most effective method of increasing the transmittance of the display panel **110**.

[0068] As the thickness of the cathode layer **604** is thinner, the transmittance increases. That is, if the thickness of the cathode layer **604** is reduced such that the transmittance of the display panel **110** is 10% or more in a visible light wavelength band and the transmittance in an infrared wavelength band is 30% or more, the sensor package module **150** can be disposed to overlap the active area AA as illustrated in FIG. **3**. Here, the cathode layer **604** is a layer in which the cathode **104** illustrated in FIG. **3** is formed.

[0069] FIG. **8** is a cross-sectional view illustrating a first area of the active area of the electronic device illustrated in FIG. **3**, and FIG. **9** is a cross-sectional view illustrating a second area of the active area of the electronic device illustrated in FIG. **3**.

[0070] Referring to FIGS. **8** and **9**, a pixel defining layer **803** may be provided on an anode **801**. The anode **801** may correspond to the anode of the organic light-emitting diode (OLED) illustrated in FIG. **2**. A device layer (not shown) may be provided under the anode **801** and may be supplied with a driving current from the source/drain electrodes provided on the device layer. A cavity CV may be formed in the pixel defining layer **803**. The organic light-emitting layer **802** may be disposed in the cavity CV. Here, although the organic light-emitting layer **802** is illustrated as being a single layer, the present disclosure is not limited thereto. Further, the organic light-emitting layer **802** may emit red, green, and blue light depending on the material. The color of light emitted from the organic light-emitting layer **802** is not limited thereto.

[0071] A cathode **804** may be disposed on the organic light-emitting layer **802**. The cathode **804** may be the cathode of the organic light-emitting diode (OLED) illustrated in FIG. **2**. The cathode **804** may be an electrode that is disposed in the active area AA as illustrated in FIG. **3** to be common to all of the subpixels. In this case, the thickness of the cathode **804** in the first area may have a first thickness dl as illustrated in FIG. **8**. Further, the thickness of the cathode **804** may have a second thickness d**2** as illustrated in FIG. **9**. The second thickness d**2** may be thinner than the first thickness d**1**.

[0072] When the thickness of the cathode **804** is reduced, the transmittance of the cathode **804** may be increased, but the surface resistance of the cathode **804** may be increased to increase power consumption. Thus, the cathode **804** may have a first thickness d**1** in the first area area**1** and a second thickness d**2** in the second area area**2** in the active area AA as illustrated in FIG. **3**. In addition, compensation driving may be performed on the subpixels P disposed in a location corresponding to the second area area**2**, in which the thickness of the cathode **804** is thin, to prevent the brightness from being lowered. The compensation driving may be performed by varying the voltage level of the data voltage transferred to the subpixel P disposed in the second area area**2**. The second area area**2** may be an area corresponding to at least one of the first hole hs**1** or the second hole hs**2** of the sensor package module illustrated in FIG. **5** in the active area AA.

[0073] FIG. **10** is a block diagram illustrating an exemplary aspect of the timing controller illustrated in FIG. **1**.

[0074] Referring to FIG. **10**, the timing controller **140** may include a memory **142** storing compensation algorithm and information regarding the position of the second area area**2** of the display panel **110** and a calculator **141** calculating information regarding the compensated image signal corresponding to the information and the compensation algorithm about the position of the second area area**2**.

[0075] The memory **142** may include a lookup table in which the addresses corresponding to the positions of the subpixels in the active area AA and the positions of the first area area**1** and the second area area**2** corresponding to the addresses may be stored. The memory **142** may store a compensation algorithm for calculating information regarding an image signal to be compensated for depending on the gradation and the color information.

[0076] The calculator **141** may receive the image signal RGB, calculate the position information and the compensation algorithm for the second area area**2**, and output a compensated image signal cRGB. The compensated image signal cRGB may be transferred to the data driver **120**. The compensated image signal cRGB compensated in the calculator **141** is not compensated only by the information regarding the second area area**2**.

[0077] FIG. **11** is a graph illustrating the transmittance of a cathode according to the metal material.

[0078] Referring to FIG. **11**, the cathode **104** illustrated in FIG. **3** may be formed of various metals. a represents a case in which the cathode **104** is a double layer of calcium (Ca)/silver (Ag), b represents a case in which the cathode **104** is a double layer of barium (Ba)/silver (Ag), c represents a case in which the cathode **104** is a double layer of magnesium (Mg)/silver (Ag), and d and e represent cases in which the cathode **104** is a single layer of silver (Ag). The thicknesses of calcium (Ca) and silver (Ag) in the case a are respectively 10 nm, the thicknesses of barium (Ba) and silver (Ag) in the case b are respectively 10 nm, and the thicknesses of magnesium (Mg) and silver (Ag) in the case a are respectively 10 nm. In addition, the case d represents that the thickness of silver (Ag) is 10 nm and the case e represents that the thickness of silver (Ag) is 20 nm.

[0079] It can be appreciated that, in the case in which the cathode **104** is the double layer of calcium (Ca)/silver (Ag) or the double layer of barium (Ba)/silver (Ag), the transmittance is higher than in the case in which the cathode **104** is the double layer of magnesium (Mg)/silver (Ag) or the single layer of silver (Ag).

[0080] Therefore, in a case the cathode **104** is a double layer of calcium (Ca)/silver (Ag) or a double layer of barium (Ba)/silver (Ag), the transmittance of the display panel **110** is high even when the thickness of the cathode **104**, positioned to correspond to the holes hs**1** and hs**2** of the sensor package module **150** illustrated in FIG. **5**, is not as reduced as illustrated in FIG. **9**. Thus, the light receiving sensors **151** and **152** may easily receive IR radiation or visible light, and IR radiation emitted from the light-emitting device **153** may easily pass through the display panel **110**. Accordingly, the cathode **104** of the electronic device **300** may have a constant thickness in the active area AA regardless of the position of the sensor package module **150**. Here, the constant thickness means that there may be a thickness difference within an error range that may occur in the process.

[0081] FIG. **12** is a view illustrating a structure of the sensor package module according to an exemplary aspect.

[0082] Referring to FIG. **12**, the sensor package module **200** includes a camera module having an image sensing section **261**, a lens driver **262**, and a camera controller **210** for controlling the image sensing section **261** and the lens driver **262**, and a proximity sensor having light receivers **251** and **252** for detecting light and a light emitter **253** for emitting light. The light receivers **251** and **252** and the light emitter **253** may be controlled by the camera controller **210**.

[0083] The image sensing section **261** may drive an image sensor. The image sensing section **261** may supply at least one of power or a signal to the image sensor to control the image sensor to generate an analog image signal. The image sensing section **261** may be at least one of a device for driving the image sensor or a program for driving the device. In addition, the image sensing section **261** may include the image sensor.

[0084] The lens driver **262** drives a lens. The lens driver **262** receives the distance information regarding a subject and may control the focus of the lens according to the image sensor. In addition, the lens driver may control the aperture depending on the intensity of external light. The lens driver **262** may be at least one of a device for driving the lens or a program for driving the device.

[0085] The camera controller **210** may control the image sensing section **261** and the lens driver **262** by transmitting control signals to the image sensing section **261** and the lens driver **262**. The camera controller **210** may be a calculating or computing device operated by a specific program.

[0086] The light receivers **251** and **252** may drive light receiving sensors. The light receivers **251** and **252** may include an IR radiation receiver **251** for driving an IR radiation receiving sensor to receive IR radiation and an illuminance receiver **252** for driving an illuminance sensor to receive visible light. The IR radiation receiver **251** and the illuminance receiver **252** operate in response to the control signal received from the camera controller **210**. The IR radiation receiver **251** and the illuminance receiver **252** generate an analog sensing signal, respectively. The light receivers **251** and **252** may be at least one of a device for driving the IR radiation receiving sensor and the illuminance sensor or a program for driving the element. The light receivers **251** and **252** may include an IR radiation receiving sensor and an illuminance sensor.

[0087] The light emitter **253** may drive the light-emitting device. The light emitter **253** may be at least one of a device for driving the light-emitting device or a program for driving the device. The light emitter **253** may be controlled by the camera controller **210**.

[0088] The sensor package module **200** may include an ADC **230** that converts an analog image signal output from the image sensor into a digital image signal and converts an analog sensing signal received from the light receiver into a digital sensing signal. That is, the single ADC **230** may convert the analog image signal and the analog sensing signal into the digital image signal and the digital sensing signal. The camera controller **210** may control the camera module and the proximity sensor to be driven in a time-division manner. Accordingly, the camera module and the proximity sensor are not driven at the same time, so that the analog image signal is converted into the digital image signal and the analog sensing signal received from the light receivers **251** and **252** is converted into the digital sensing signal by the single ADC **230**. The camera controller **210** may control the lens driver **262** by controlling the focus and aperture of the lens using information regarding the illuminance received from the light receiver and distance information.

[0089] The sensor package module **200** may include a proximity algorithm section **241**, an illuminance algorithm section **242**, and an image processing algorithm section **243**. The proximity algorithm section **241** may detect the proximity and position using information detected by the IR radiation receiver **252**. The illuminance algorithm section **242** may determine the intensity of external light using the information detected by the illumination light receiver **252**. The image processing algorithm section **243** may generate information regarding the image using the information detected by the image sensing section **261**.

[0090] FIG. **13** is a plan view illustrating a first aspect of the sensor package module employing the sensor package illustrated in FIG. **11**, FIG. **14** is a plan view illustrating a second aspect of the sensor package module employing the sensor illustrated in FIG. **11**, FIG. **15** is a plan view illustrating a third aspect of the sensor package module employing the sensor illustrated in FIG. **11**, FIG. **16** is a plan view illustrating a fourth aspect of the sensor package module employing the sensor illustrated in FIG. **11**, and FIG. **17** is a cross-sectional view illustrating an exemplary aspect of the sensor package module illustrated in FIG. **11**.

[0091] The sensor package module **160** may include light receiving sensors **151** and **152** for receiving at least one of IR radiation or visible light and a light-emitting device **153** for emitting IR radiation. In addition, the sensor package module **160** may include an image sensor **156** that generates an image using light passing through a lens (not shown). The sensor package module **160** may be a device including the light receiving sensors **151** and **152**, the light-emitting device **153**, and the image sensor **156**, and may include a device for controlling the sensor package module and a program for controlling the device.

[0092] The image sensor **1456** may be disposed on the substrate **154** and the light receiving sensors **151** and **152** and the light-emitting device **153** may also be connected to the substrate **154** through lines respectively. However, the present disclosure is not limited thereto. The sensor package module **160** may be provided with a lens holder **162** at a position corresponding to the image sensor **156**. The lens holder **162** supports a plurality of lenses and may be operated by a lens driver. In the sensor package module **160**, the light receiving sensors **151** and **152** and the light-emitting device **153** may be disposed in the upper and lower portions of the lens holder **162** as illustrated in FIG. **13**. Therefore, the sensor package module **160** has the first hole hs**1** and the second hole hs**2** corresponding to the light receiving sensors **151** and **152** and the light-emitting device **153**, and a third hole hc serving as the lens holder **162** in which the lens is disposed. The first and second holes may be disposed above and below the third hole hc. In this case, the lens holder **162** has a predetermined height and can serve as the partition wall **155** illustrated in FIG. **5**. The first hole hs**2** and the third hole hc may be disposed in the bezel area NAA illustrated in FIG. **3**, and the second hole hs**2** may be disposed in the active area AA illustrated in FIG. **3**.

[0093] The light receiving sensors **151** and **152** and the light-emitting device **153** may be disposed in the right portion of the sensor package module **160** as illustrated in FIG. **14**. In this case, the first hole hs**1** and the third hole hc may be disposed in the bezel area NAA illustrated in FIG. **3**, and the second hole hs**2** may be disposed in the active area AA illustrated in FIG. **3**.

[0094] In addition, the light receiving sensors **151** and **152** and the light-emitting device **153** may be disposed in the lower left portion of the sensor package module **160**, arranged in the shape of an "L," as illustrated in FIG. **15**. In this case, the first hole hs**1** and the third hole hc may be disposed in the bezel area NAA illustrated in FIG. **3**, and the second hole hs**2** may be disposed in the active area AA illustrated in FIG. **3**. However, the present disclosure is not limited thereto, and the first hole hs**1** and the second hole hs**2** may be disposed in the active area AA corresponding to the shape of the bezel area NAA.

[0095] In addition, the light receiving sensors **151** and **152** and the light-emitting device **153** may be disposed in the bottom of the sensor package module **160**, arranged in the shape of in an "I," as illustrated in FIG. **16**. In this case, the third hole hc may be disposed in the bezel area NAA illustrated in FIG. **3**, and the first hole hs**1** and the second hole hs**2** may be disposed in the active area AA illustrated in FIG. **3**.

[0096] However, the arrangement of the light receiving sensors **151** and **152** and the light-emitting device **153** is not limited to FIGS. **14** to **16**. The first hole hs**1** and the third hole hc or the third hole hc may be disposed at the position corresponding to the first hole h**1** disposed in the bezel area NAA illustrated in FIG. **3**.

[0097] The foregoing descriptions and the accompanying drawings have been presented in order to explain certain principles of the present disclosure by way of example. A person having ordinary skill in the art to which the present disclosure relates could make various modifications and variations by combining, dividing, substituting for, or changing the elements without departing from the principle of the present disclosure. The foregoing aspects disclosed herein shall be interpreted as being illustrative, while not being limitative, of the principle and scope of the present disclosure. It should be understood that the scope of the present disclosure shall be defined by the appended Claims and all of their equivalents fall within the scope of the present disclosure.

What is claimed is:

1. An organic light-emitting display device comprising:

a display panel comprising an active area in which a plurality of subpixels are arrayed, and a bezel area in which lines, through which a signal and a voltage to be supplied to the subpixels are transferred, are disposed, wherein each subpixels has a cathode and an anode;

a data driver supplying a data signal to the subpixels;

a gate driver supplying a data signal to the subpixels;

a timing controller controlling the data driver and the gate driver; and

a sensor package module having a portion that overlaps the active area.

2. The organic light-emitting display device according to claim **1**, wherein the display panel has a transmittance of 10% or more in a visible light wavelength band a transmittance of 30% or more in an infrared wavelength band in the active area with respect to the cathode in the subpixels.

3. The organic light-emitting display device according to claim **1**, wherein the active area has a first area that does not overlapping the sensor package module and a second area that overlaps the sensor package module, and a thickness of the cathode in the second area is thinner than a thickness of the cathode in the first area.

4. The organic light-emitting display device according to claim **3**, wherein the sensor package module has two holes, and the second area is disposed at a position corresponding to the two holes.

5. The organic light-emitting display device according to claim **1**, wherein the subpixel has a light-emitting layer disposed between the cathode and the anode.

6. The organic light-emitting display device according to claim **1**, wherein the sensor package module is disposed on a rear surface of the display panel.

7. The organic light-emitting display device according to claim **1**, wherein the sensor package module includes,

a camera module including an image sensing section that drives an image sensor, a lens driver that drives a lens to project light to the image sensor and a camera controller that controls the image sensing section and the lens driver, and

a proximity sensor including a light receiver that drives a light receiving sensor to detect light and a light emitter that drives a light-emitting device to emit light,

wherein the camera controller controls the light receiver and the light emitter.

8. The organic light-emitting display device according to claim **7**, wherein the sensor package module includes a housing accommodating the image sensor, the light receiving sensor, and the light-emitting device, and

wherein the housing includes a lens holder that supports the lens and is disposed between the light receiving sensor and the light-emitting device.

9. The organic light-emitting display device according to claim **8**, wherein the hole corresponding to the lens holder is disposed to overlap the bezel area, and at least one of the light receiving sensor or the light-emitting device is disposed to overlap the active area.

10. The organic light-emitting display device according to claim **7**, further comprising an analog-digital converter converting an analog image signal into a digital image signal and converting an analog sensing signal to a digital sensing signal,

wherein the analog image signal is output from the image sensor and the analog sensing signal is processed in the light receiver.

11. The organic light-emitting display device according to claim **10**, wherein the camera controller controls the camera module and the proximity sensor to be driven in a time-division manner.

12. The organic light-emitting display device according to claim **3**, wherein the sensor package module includes a light-emitting device emitting light, a light receiving sensor receiving light, and a housing accommodating the light-emitting device and the light receiving sensor, and

wherein the housing has a first hole allowing the light from the light-emitting device to exit therethrough and a second hole allowing the light to enter the light receiving sensor, and the second area is disposed at a position corresponding to the first hole and the second hole.

13. The organic light-emitting display device according to claim **1**, further comprising a support member disposed on a lower portion of a rear surface of the display panel, and a foam pad disposed between the display panel and the support member,

wherein the sensor package module is disposed on a portion of the rear surface of the display panel where a portion of the foam pad is removed.

14. The organic light-emitting display device according to claim **3**, wherein the timing controller includes,

a memory storing information regarding a position of the second area of the display panel, and

a calculator calculating information regarding a compensated image signal corresponding to information regarding a position of the second area.

15. A sensor package module comprising:

a camera module including an image sensing section that drives an image sensor, a lens driver that drives a lens to project light to the image sensor, and a camera controller that controls the image sensing section and the lens driver; and

a proximity sensor including a light receiver that drives a light receiving sensor to sense light and a light emitter that drives a light-emitting device to emit light,

wherein the camera controller controls the light receiver and the light emitter.

16. The sensor package module according to claim **15**, further comprising an analog-digital converter converting an analog image signal into a digital image signal and converting an analog sensing signal to a digital sensing signal,

wherein the analog image signal is output from the image sensor and the analog sensing signal is processed in the light receiver.

17. The sensor package module according to claim **15**, wherein the camera controller controls the camera module and the proximity sensor to be driven in a time-division manner.

18. The sensor package module according to claim **15**, wherein the light receiving sensor includes a first light receiving sensor sensing infrared radiation and a second light receiving sensor receiving visible light, and

Wherein the light-emitting device emits infrared radiation.

19. The sensor package module according to claim **15**, further comprising a housing accommodating the image sensor, the light receiving sensor, and the light-emitting device,

wherein the housing includes a lens holder disposed above the image sensor and between the light-emitting device and the light receiving sensor within the housing, and

wherein three holes respectively corresponding to the lens holder, the light-emitting device and the light receiving sensor are provided in an upper portion of the housing.

20. The sensor package module according to claim **19**, wherein the lens holder is disposed between the holes among the three holes that correspond to the light-emitting device and the light receiving sensor.

* * * * *

专利名称(译)	传感器封装模块和具有该传感器封装模块的有机发光显示器		
公开(公告)号	US20200105194A1	公开(公告)日	2020-04-02
申请号	US16/532586	申请日	2019-08-06
[标]申请(专利权)人(译)	乐金显示有限公司		
申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
当前申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
[标]发明人	KIM EUNJUNG HWANG JONGHEE LEE BUYEOL KWON SUJIN		
发明人	KIM, EUNJUNG HWANG, JONGHEE LEE, BUYEOL KWON, SUJIN		
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摘要(译)

有机发光显示装置包括：显示面板，该显示面板包括：有源区域，在该有源区域中排列有多个子像素；以及边框区域，在该边框区域中布置有传输线，通过该传输线传输要提供给子像素的信号和电压。 ，其中每个子像素具有阴极和阳极； 数据驱动器，向子像素提供数据信号； 栅极驱动器向子像素提供数据信号； 时序控制器控制数据驱动器和栅极驱动器； 传感器封装模块具有与有源区域重叠的部分。