US 20190293484A1

(19) **United States**
(12) **Patent Application Publication**
ZHANG

(10) **Pub. No.: US 2019/0293484 A1**
(43) **Pub. Date: Sep. 26, 2019**

(54) **ELECTRONIC DEVICE AND MANUFACTURING METHOD FOR ELECTRONIC DEVICE**

(71) Applicant: **GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP., LTD.**, DONGGUAN (CN)

(72) Inventor: **Haiping ZHANG**, DONGGUAN (CN)

(21) Appl. No.: **16/186,889**

(22) Filed: **Nov. 12, 2018**

(30) **Foreign Application Priority Data**

Mar. 21, 2018 (CN) 201810234679.9

Publication Classification

(51) **Int. Cl.**

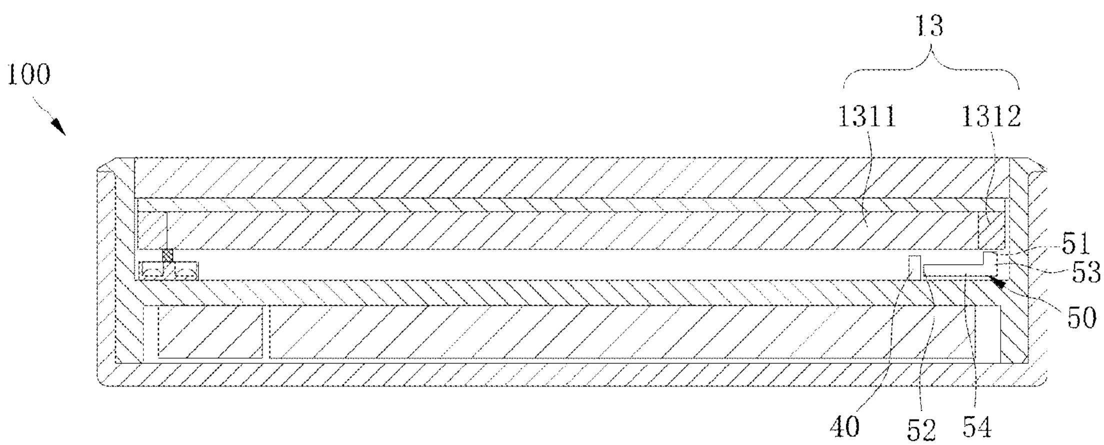
G01J 1/02	(2006.01)
G01J 1/42	(2006.01)
G01J 1/04	(2006.01)
G01C 3/08	(2006.01)
G01V 8/12	(2006.01)

(52) **U.S. Cl.**

CPC ***G01J 1/0204*** (2013.01); ***G01J 1/4204*** (2013.01); ***G01V 8/12*** (2013.01); ***G01C 3/08*** (2013.01); ***G01J 1/0407*** (2013.01)

(57) **ABSTRACT**

The present disclosure provides an electronic device and a manufacturing method thereof. The electronic device includes: a display screen, the display screen including a display area and a non-display area surrounding the display area; a light sensor arranged below the display area; and a light guiding element arranged below the display screen, the light guiding element being configured to transmit light penetrating the non-display area to the light sensor.



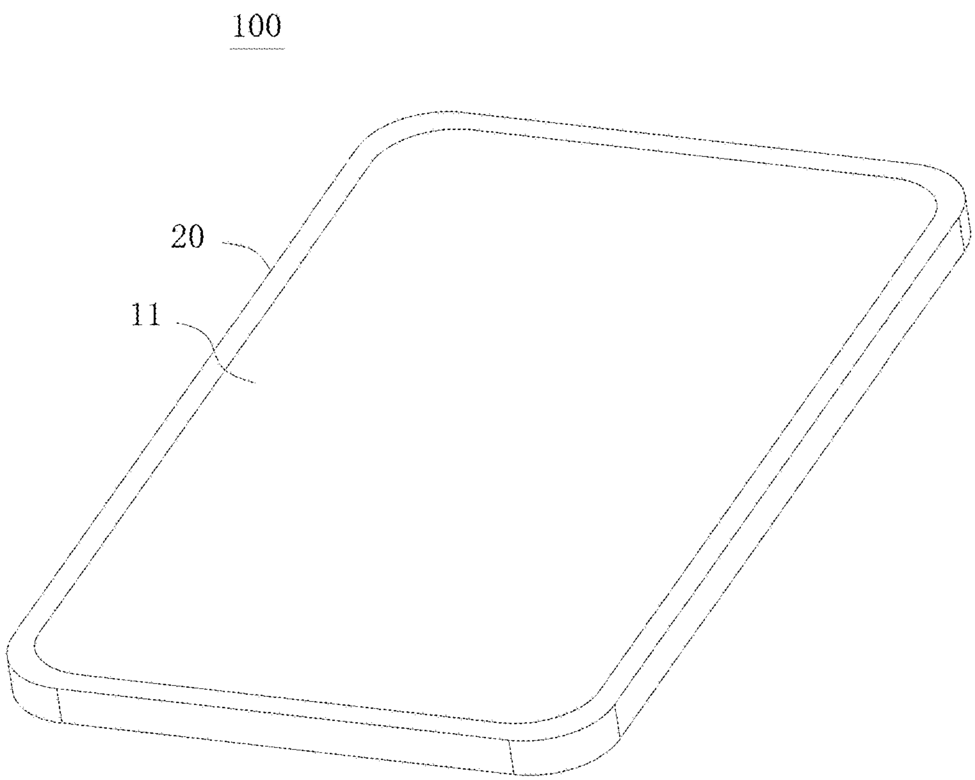


Fig. 1

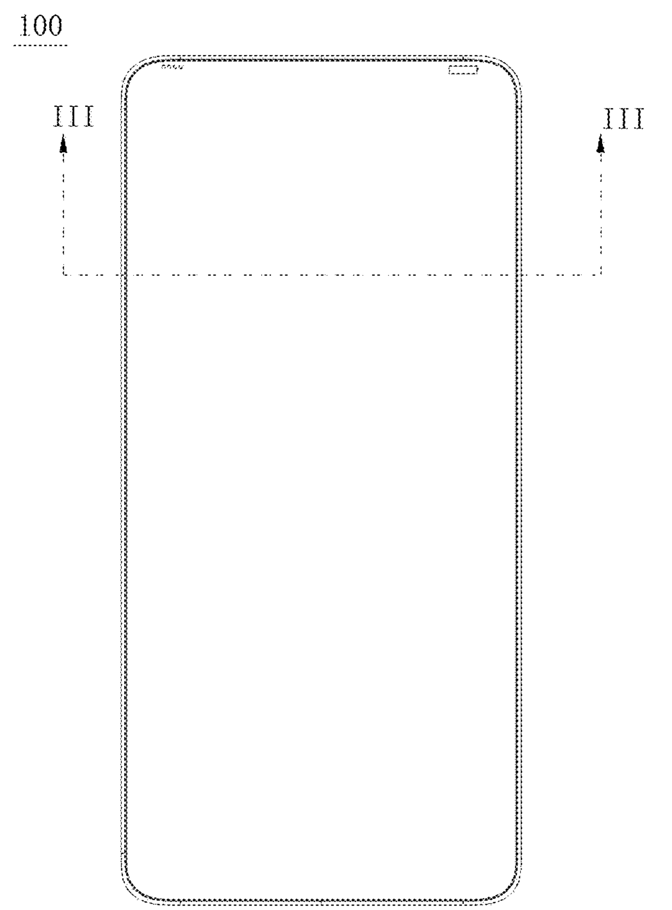

100
III
III

Fig. 2

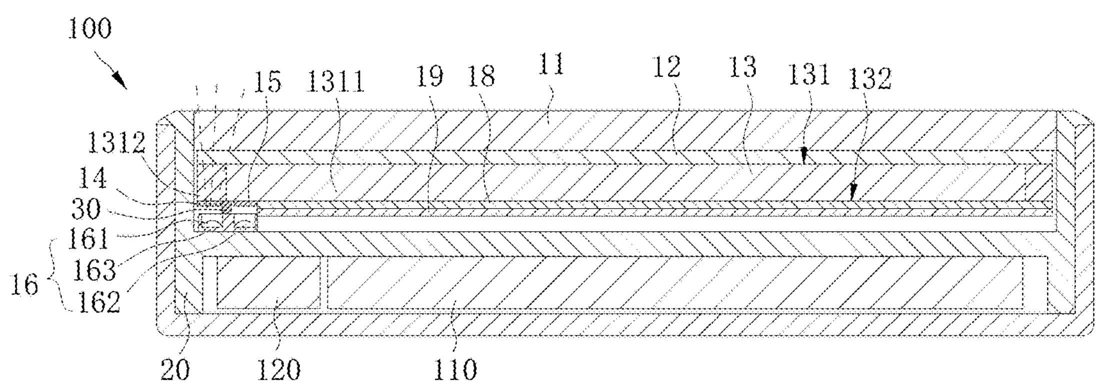

100
15
1311
19
18
11
12
13
131
132
1312
14
30
161
163
162
16
20
120
110

Fig. 3

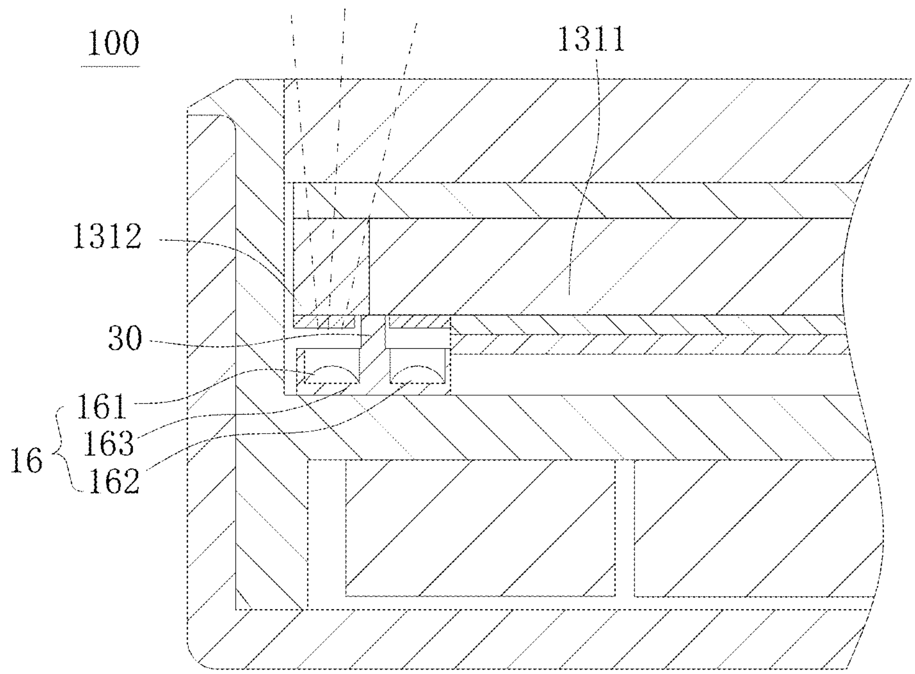


Fig. 4

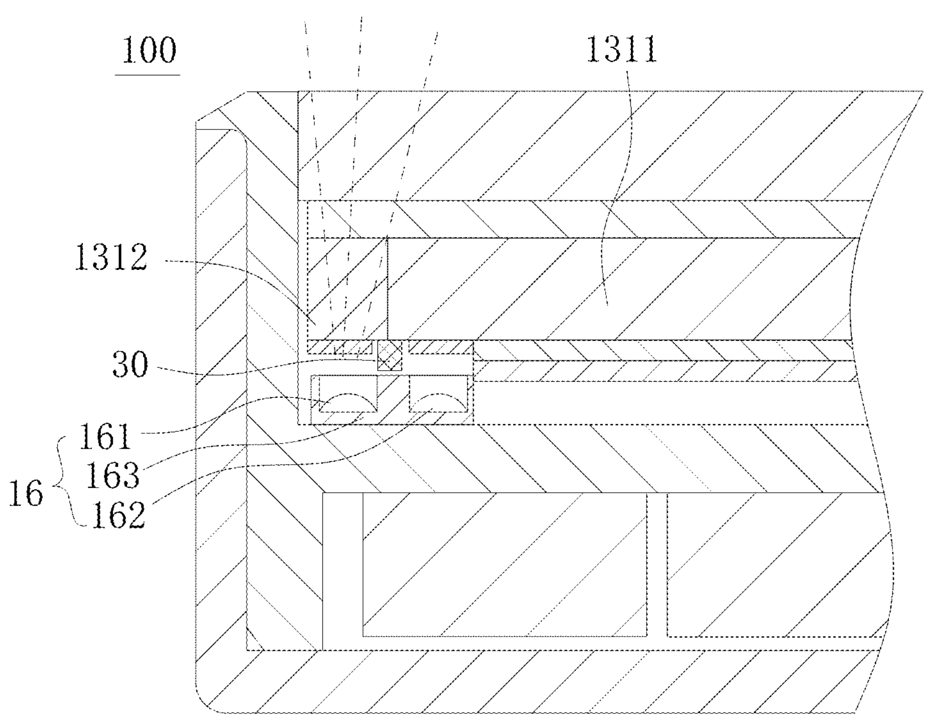


Fig. 5

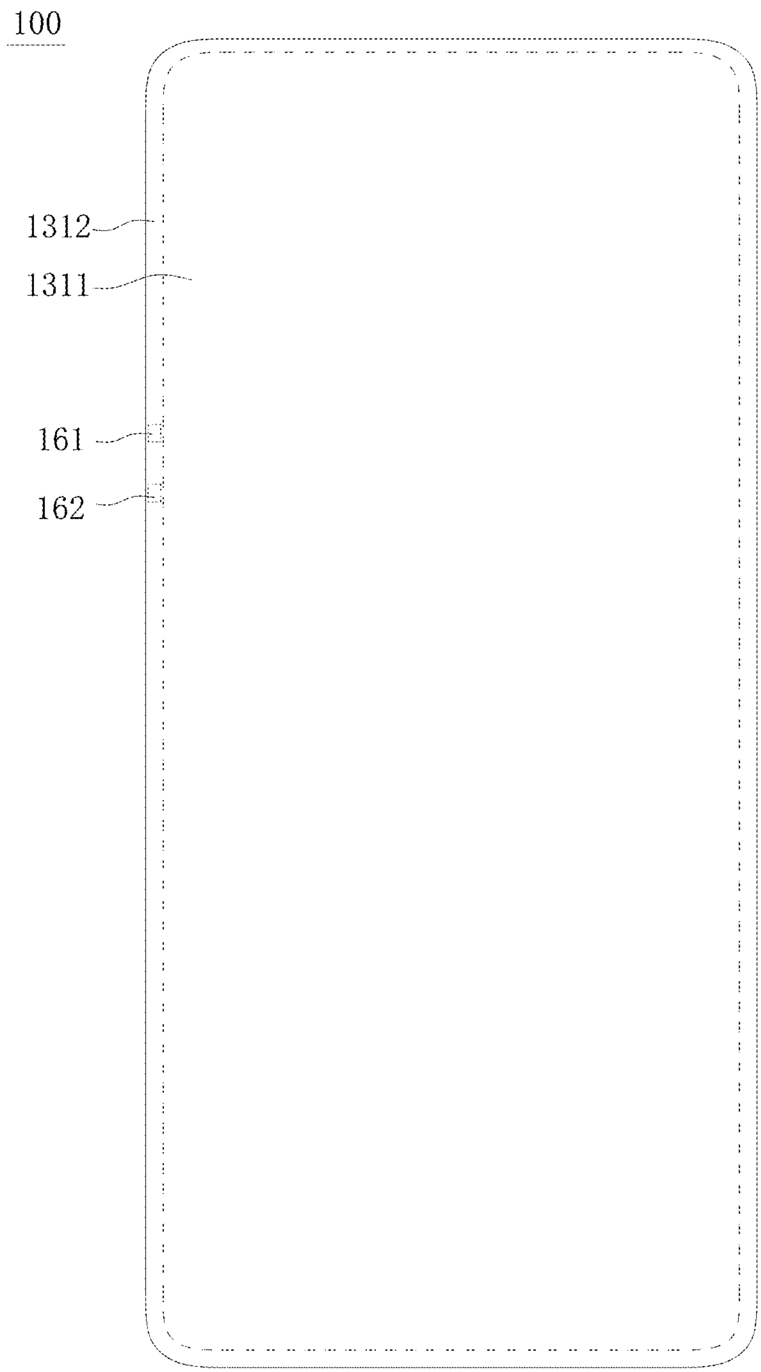


Fig. 6

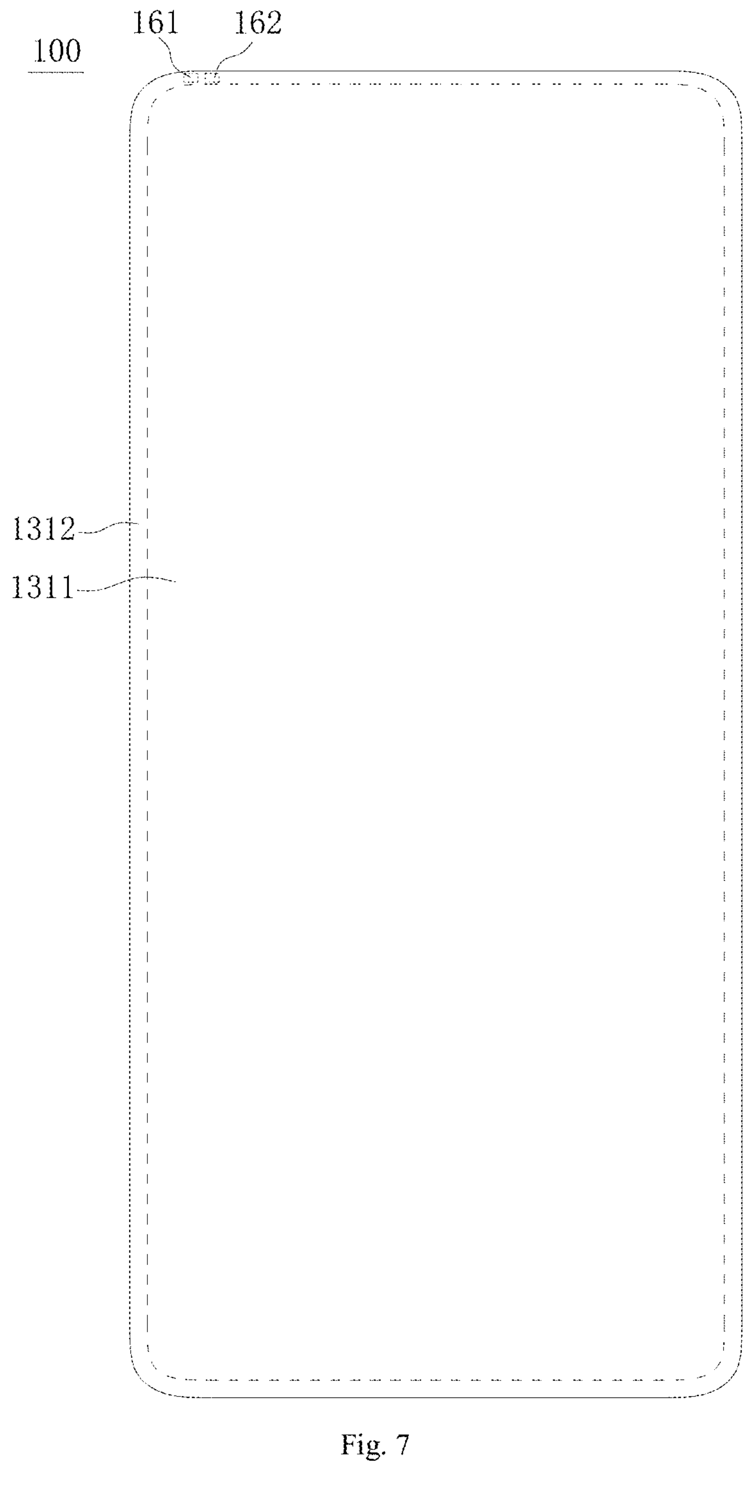


Fig. 7

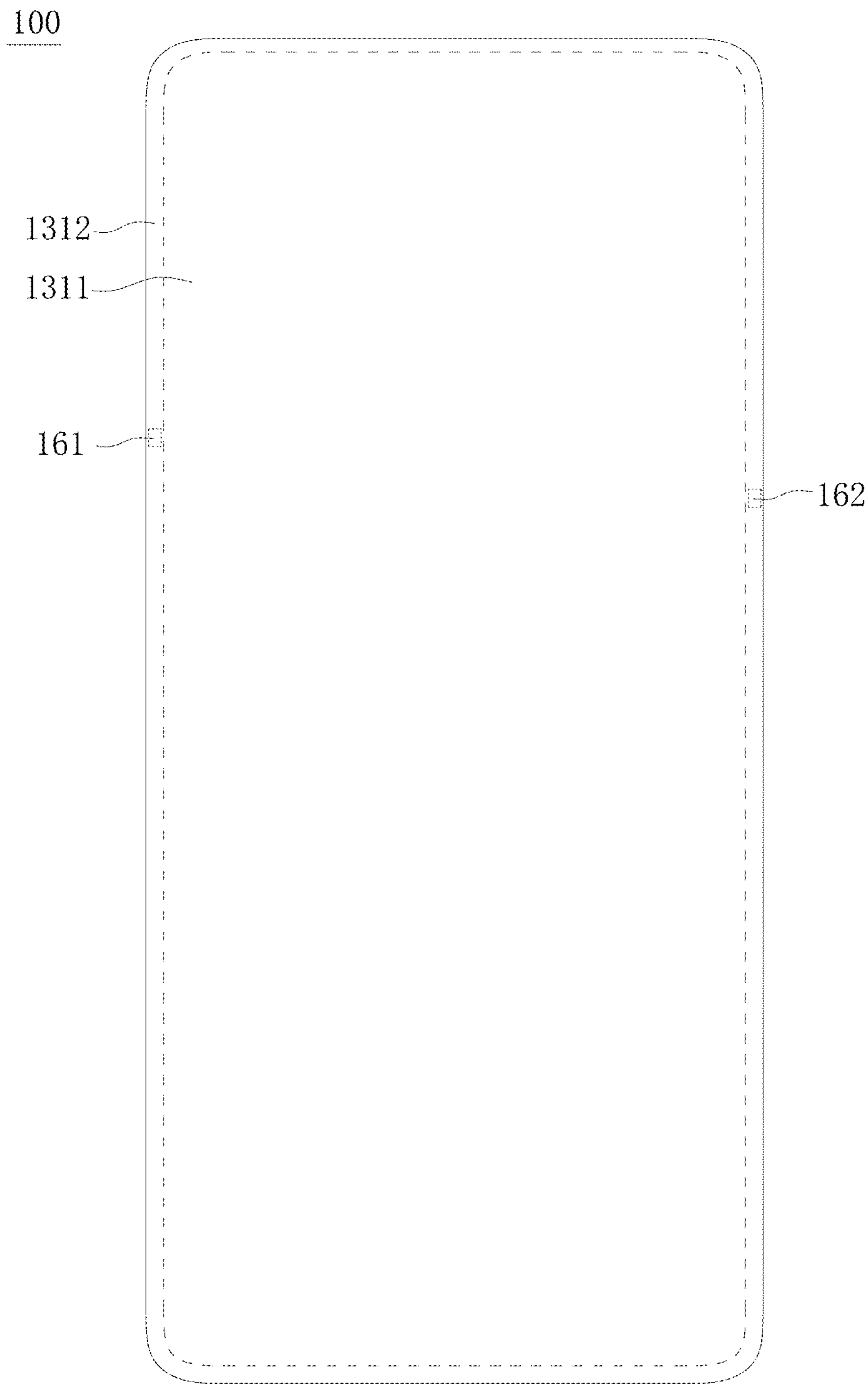


Fig. 8

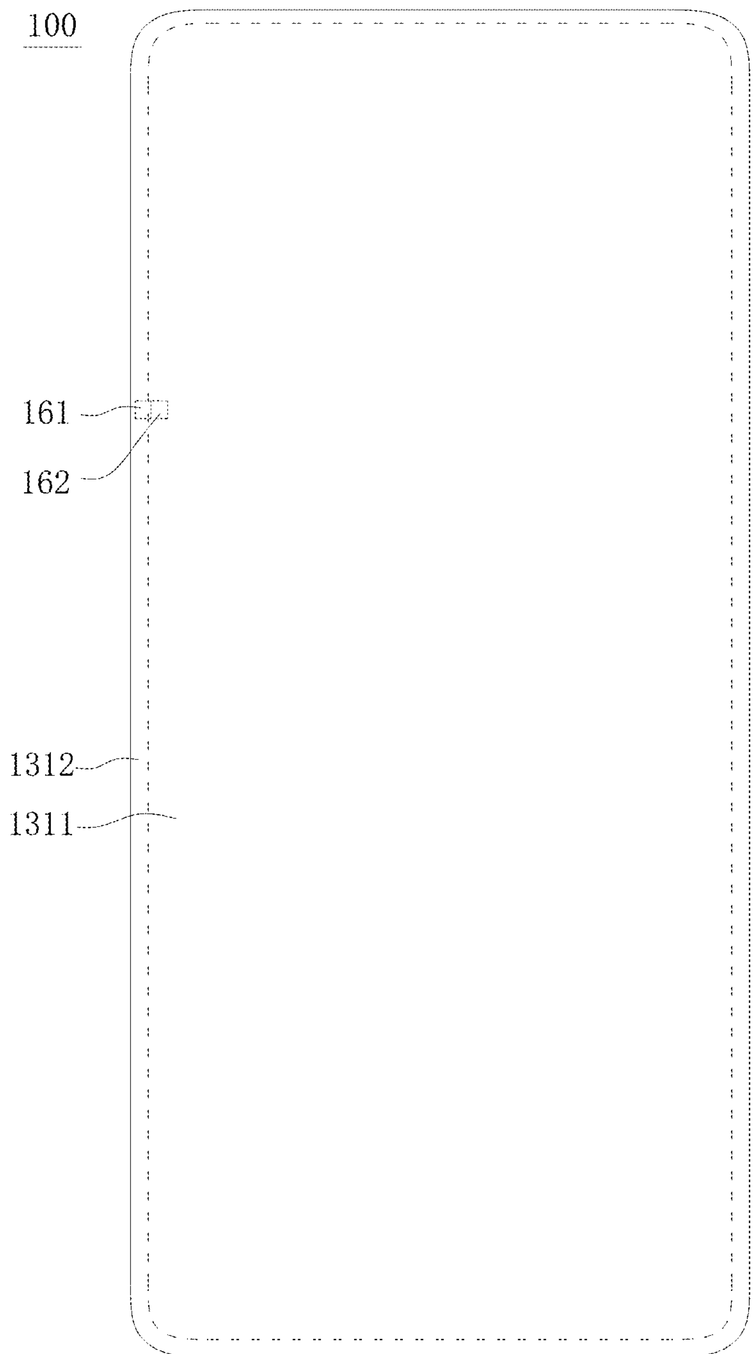


Fig. 9

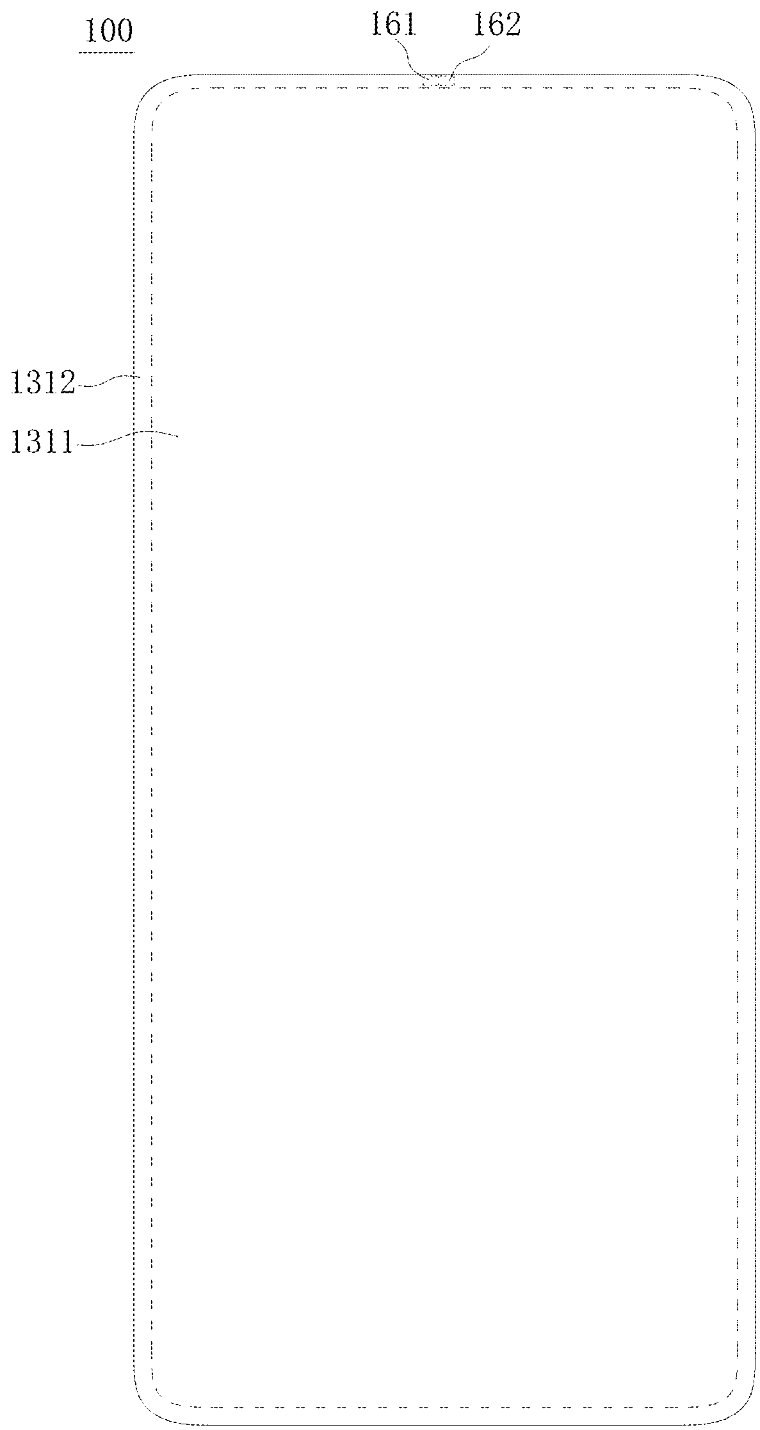


Fig. 10

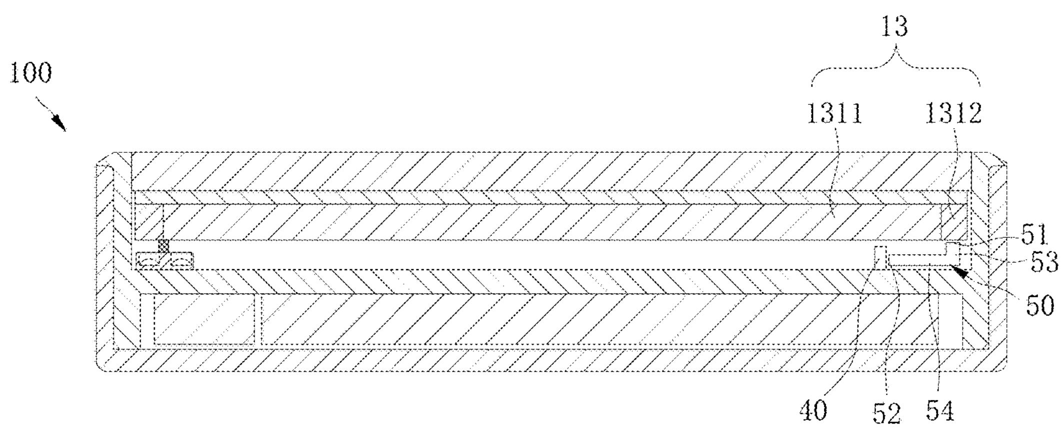


Fig. 11

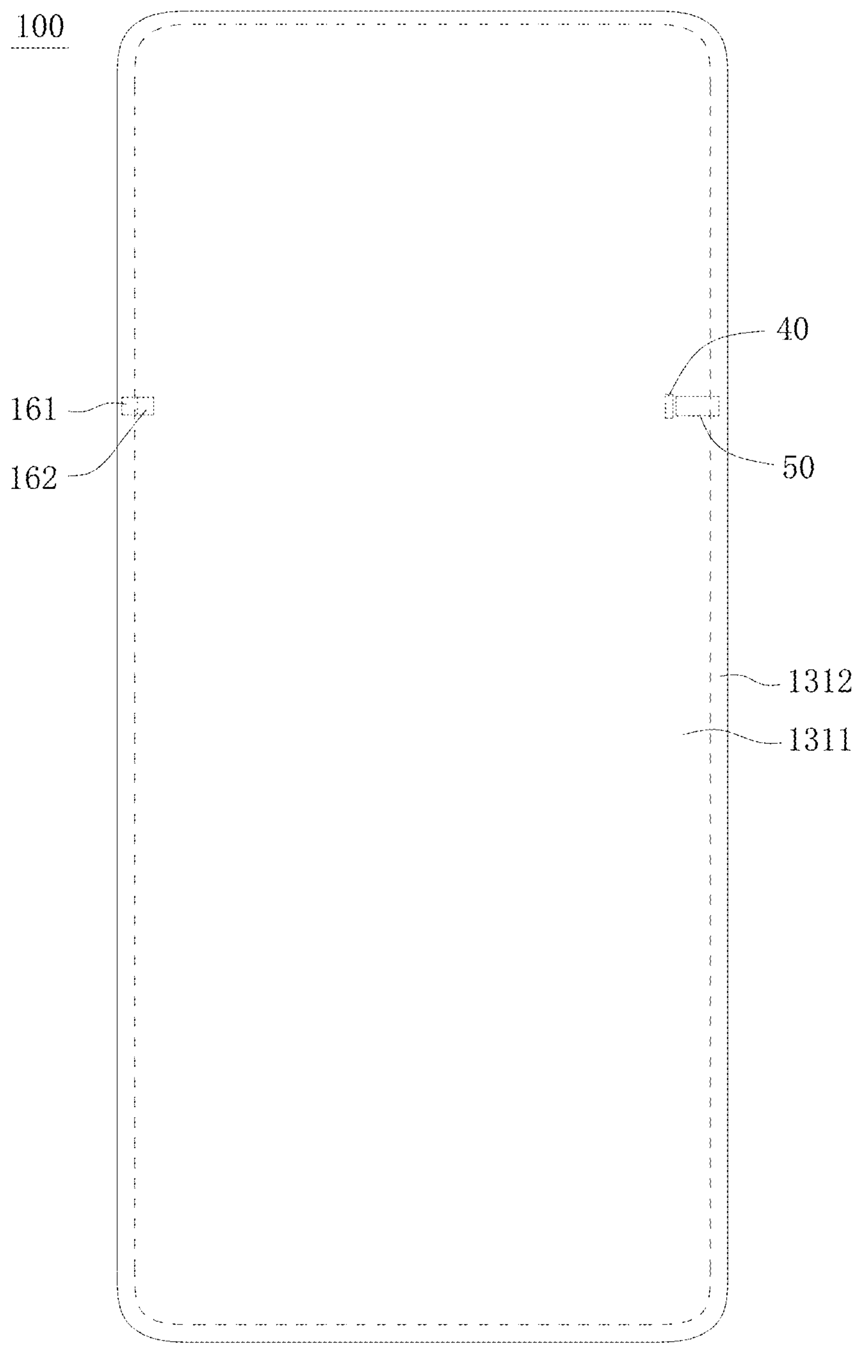


Fig. 12

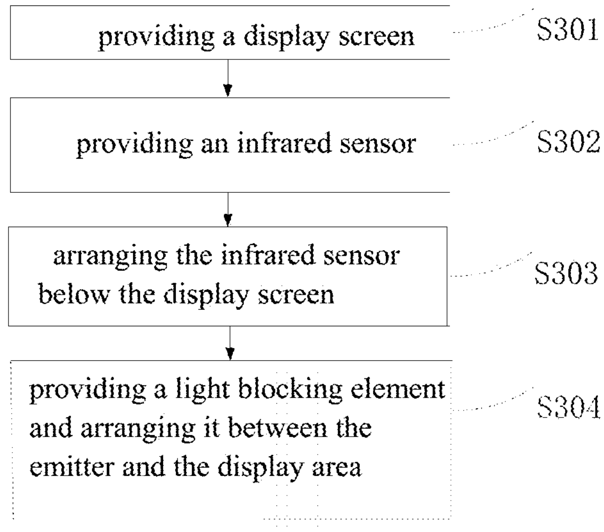

providing a display screen
S301
providing an infrared sensor
S302
arranging the infrared sensor below the display screen
S303
providing a light blocking element and arranging it between the emitter and the display area
S304

Fig. 13

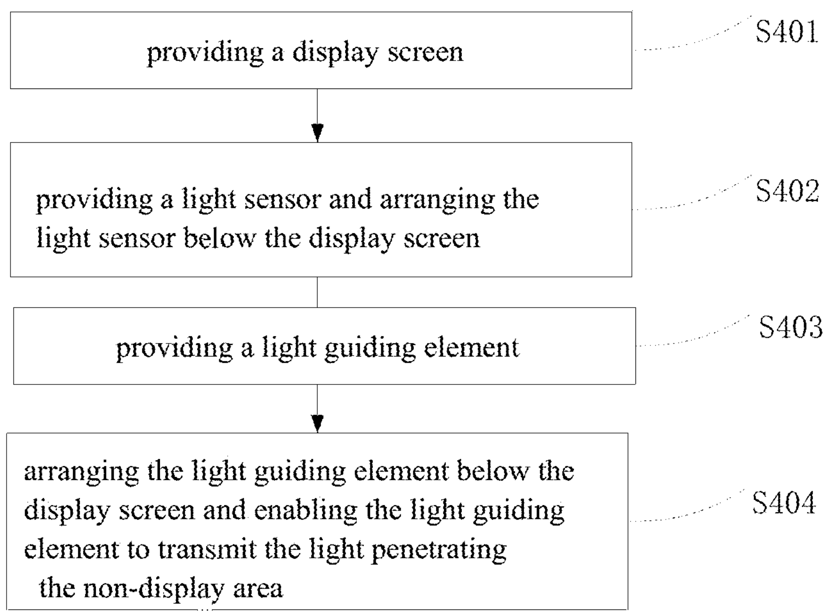

providing a display screen
S401
providing a light sensor and arranging the light sensor below the display screen
S402
providing a light guiding element
S403
arranging the light guiding element below the display screen and enabling the light guiding element to transmit the light penetrating the non-display area
S404

Fig. 14

ELECTRONIC DEVICE AND MANUFACTURING METHOD FOR ELECTRONIC DEVICE

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The application claims priority to Chinese Patent Application Serial No. 201810234679.9, filed with the State Intellectual Property Office of P. R. China on Mar. 21, 2018, the entire disclosure of which is incorporated herein by reference.

FIELD

[0002] The present disclosure relates to a field of electronic technology, and more particularly to an electronic device and a manufacturing method for an electronic device.

BACKGROUND

[0003] Generally, an electronic device such as a mobile phone includes elements such as a display screen and a light sensor, and the light sensor can be used for detecting ambient brightness around the electronic device. With the development of mobile phone technology and the needs of users, a full-screen mobile phone has become a development trend of mobile phones, but the position of sensors such as light sensors makes the screen-to-body ratio of mobile phones relatively small. Therefore, how to properly position the various sensors has become an urgent problem.

SUMMARY

[0004] The embodiments of the present disclosure provide an electronic device and a manufacturing method for the electronic device.

[0005] The electronic device according to embodiments of the present disclosure includes:

[0006] a display screen including a first surface and a second surface opposite to the first surface, and the display screen including a display area and a non-display area surrounding the display area;

[0007] a light sensor arranged adjacent to the second surface and opposite to the display area; and

[0008] a light guiding element arranged adjacent to the light sensor, the light guiding element being configured to transmit ambient light, penetrating the non-display area from the first surface, to the light sensor. Another electronic device according to embodiments of the present disclosure includes:

[0009] a display screen, including a first surface and a second surface opposite to the first surface, and the display screen including a display area and a non-display area surrounding the display area; a light sensor arranged adjacent to the second surface and opposite to the display area; and a light guiding element arranged adjacent to the second surface, the light guiding element being configured to transmit light, penetrating the non-display area from the first surface, to the light sensor.

[0010] The manufacturing method for the electronic device according to embodiments of the present disclosure including following operations:

[0011] providing a display screen, the display screen including a display area and a non-display area surrounding the display area, and the display screen including a first surface and a second surface opposite to the first surface;

[0012] providing a light sensor and arranging the light sensor adjacent to the second surface and opposite to the display area; and

[0013] providing a light guiding element;

[0014] arranging the light guiding element adjacent to the second surface and enabling the light guiding element to guide the light, penetrating the non-display area from the first surface to the light sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] These and other aspects and advantages of embodiments of the present disclosure will become apparent and more readily appreciated from the following descriptions made with reference to the drawings, in which:

[0016] FIG. **1** is a perspective view of an electronic device according to embodiments of the present disclosure;

[0017] FIG. **2** is a plan view of an electronic device according to embodiments of the present disclosure;

[0018] FIG. **3** is a sectional view of the electronic device in FIG. **2** along direction;

[0019] FIG. **4** is a partial sectional view of an electronic device according to embodiments of the present disclosure;

[0020] FIG. **5** is a another partial sectional view of an electronic device according to embodiments of the present disclosure;

[0021] FIG. **6** is a plan view of an electronic device according to embodiments of the present disclosure;

[0022] FIG. **7** is another plan view of an electronic device according to embodiments of the present disclosure;

[0023] FIG. **8** is yet another plan view of an electronic device according to embodiments of the present disclosure;

[0024] FIG. **9** is a further plan view of an electronic device according to embodiments of the present disclosure;

[0025] FIG. **10** is a further plan view of an electronic device according to embodiments of the present disclosure;

[0026] FIG. **11** is a sectional view of an electronic device according to embodiments of the present disclosure;

[0027] FIG. **12** is a further plan view of an electronic device according to embodiments of the present disclosure;

[0028] FIG. **13** is a flow diagram of a manufacturing method of an electronic device according to the present disclosure;

[0029] FIG. **14** is a flow diagram of a manufacturing method of an electronic device according to the present disclosure.

[0030] Reference numerals for main elements: electronic device **100**, cover plate **11**, touch layer **12**, display screen **13**, upper surface **131**, lower surface **132**, display area **1311**, non-display area **1312**, first coating layer **14**, second coating layer **15**, infrared sensor **16**, emitter **161**, receiver **162**, encapsulation body **163**, buffer layer **17**, metal sheet **18**, housing **20**, light blocking element **30**, light sensor **40**, light guiding element **50**, light incident end **51**, light exit end **52**, vertical portion **53**, horizontal portion **54**, battery **110**, main circuit board **120**.

DETAILED DESCRIPTION

[0031] Embodiments of the present disclosure will be described in detail and examples of the embodiments will be illustrated in the accompanying drawing. The same or similar elements and the elements having same or similar functions are denoted by like reference numerals throughout the descriptions. The embodiments described herein with reference to the drawings are explanatory, which aim to illustrate the present disclosure, but shall not be construed to limit the present disclosure.

[0032] Electronic apparatus such as a mobile phone or a tablet computer or the like usually detect a distance between the electronic apparatus and a user by having an infrared sensor installed. In the case of the mobile phone, the infrared sensor is provided in an upper area of the mobile phone. When the user makes a voice call or performs related operations, the mobile phone is close to the head, the infrared sensor feeds distance information back to a processor, and the processor executes corresponding instructions, such as turning off light of the display screen component. In related art, it is required to provide corresponding hole in a housing for emitting and receiving infrared light signal when the infrared sensor is provided in the electronic apparatus. With the development of electronic apparatus, people have higher and higher requirements for the appearance and operation experience of the mobile phone. The mobile phone has developed toward a trend of a full screen. An ultra-narrow bezel forms between the housing and a display screen assembly in the full-screen mobile phone. Since a width of the ultra-narrow bezel is too small, there may not be enough space to provide the hole, overall strength of the bezel is reduced even if the hole is provided, and then reliability of the electronic apparatus is relatively.

[0033] The embodiments of the present disclosure provide an electronic device and a manufacturing method for the electronic device.

[0034] The electronic device according to embodiments of the present disclosure includes:

[0035] a display screen including a first surface and a second surface opposite to the first surface, and the display screen including a display area and a non-display area surrounding the display area;

[0036] a light sensor arranged adjacent to the second surface and opposite to the display area; and

[0037] a light guiding element arranged adjacent to the light sensor, the light guiding element being configured to transmit ambient light, penetrating the non-display area from the first surface, to the light sensor.

[0038] Another electronic device according to embodiments of the present disclosure includes: a display screen, the display screen including a display area and a non-display area surrounding the display area, and the display screen including a first surface and a second surface opposite the first surface; a light sensor arranged adjacent to the second surface and opposite to the display area; a light guiding element arranged adjacent to the second surface, the light guiding element being configured to transmit light, penetrating the non-display area from the first surface, to the light sensor.

[0039] The manufacturing method for the electronic device according to embodiments of the present disclosure includes following operations:

[0040] providing a display screen, the display screen including a display area and a non-display area surrounding the display area, and the display screen including a first surface and a second surface opposite to the first surface;

[0041] providing a light sensor and arranging the light sensor adjacent to the second surface and opposite to the display area;

[0042] providing a light guiding element; and

[0043] arranging the light guiding element adjacent to the second surface and enabling the light guiding element to guide the light, penetrating the non-display area from the first surface, to the light sensor.

[0044] Referring to FIG. **1** and FIG. **2**, embodiments of the present disclosure provide the electronic device **100** and a housing **20**. The electronic device **100** can be a mobile phone or a tablet computer or the like. The electronic device **100** according to embodiments of the present disclosure is illustrated by taking the mobile phone as an example. Certainly, the electronic device **100** can also be other specific forms, which are not limited herein.

[0045] Referring to FIG. **3**, the electronic device **100** includes a display screen **13**, an infrared sensor **16** and a light blocking element **30**. The display screen **13** includes a display area **1311** and a non-display area **1312**, and the non-display area **1312** surrounds the display area **1311**. The infrared sensor **16** is located below the display screen **13** and includes an emitter **161** and a receiver **162**, and the emitter **161** is configured to emit infrared light. For example, the emitter **161** emits the infrared light through the non-display area **1312**. The receiver **162** is configured to receive the infrared light. For example, the receiver **162** receives the infrared light through the display area **1311**. The light blocking element **30** is disposed between the emitter **161** and the display area **1311**, and the light blocking element **30** is configured to block the infrared light emitted from the emitter **161** from entering into the display area **1311**.

[0046] It could be understood that the display screen **13** includes an upper surface **131** (as an example for a first surface of the display screen) and a lower surface **132** (as an example for a second surface of the display screen), and the display screen **13** is used for luminescence display through the upper surface **131**. The display screen **13** is light permeable so that the infrared light emitted by the emitter **161** can penetrate the display screen **13**, and similarly, the reflected infrared light can be received by the receiver **162** through the display screen **13**.

[0047] The emitter **161** is configured to emit the infrared light. When the emitted infrared light meets barriers in a detection direction, a part of the infrared light is reflected back and received by the receiver **162**. By calculating a time between the emission and return-by-reflection of the infrared light by means of a processor, a distance between the electronic device **100** and the barriers can be determined and adjusted. In an example, when a user answers or makes a call, the electronic device **100** approaches a head, the emitter **161** emits the infrared light, and the receiver **162** receives the infrared light reflected by the head, by calculating the time between the emission and return-by-reflection of the infrared light by means of the processor, corresponding commands are sent to control the backlight of the screen to be turned off. When the electronic device **100** is away from the head, the processor performs the calculation and sends commands according to the feedback data again, and the screen backlight is reopened. Thus, not only the user's misoperation is prevented, but also the power of the mobile phone is saved.

[0048] As the emitter **161** has a certain emission angle, even though the emitter **161** is located outside the display area **1311**, it cannot be guaranteed that the infrared light emitted by the emitter **161** doesn't enter the display area **1311**. Thus, the light blocking element **30** blocks the infrared light emitted by the emitter **161** from entering the display area **1311**, preventing the infrared light from causing bad influence on photoelectric elements in the display area **1311**. In an example, the light blocking element **30** is foam. Certainly, the light blocking element **30** can be other light proof material such as plastic.

[0049] In the electronic device **100**, the receiver **162** servers as an input element of the electronic device **100**. The receiver **162** can receive infrared signal and input the signal to the electronic device **100**. The display screen **13** serves as an output element of the electronic device **100**, the display screen **13** can output display content outside the display screen **13** so as to allow the user to obtain corresponding information.

[0050] The housing **20** is configured to accommodate the electronic device **100** so as to protect electronic device **100**. By arranging the electronic device **100** in the housing **20**, the electronic device **100** is surrounded by the housing **20**, thus preventing outside factors from damaging inside elements of the electronic device **100** directly. The housing **20** can be formed by machining aluminum alloy by means of CNC machined tool, and can also be injection-molded with polycarbonate (PC) or PC+ABS material.

[0051] At mentioned above, in the electronic device **100** according to embodiments of the present disclosure, the display screen **13** allows the infrared sensor **16** to be arranged below the display screen **13** so as to guarantee full-screen effect of the electronic device **100**. In addition, an orthographic projection of the emitter **161** of the infrared sensor **16** in the lower surface **132** of the display screen **13** is located outside the display area **1311** and the light blocking element **30** blocks the infrared light from entering the display area **1311**, which can prevent the infrared light emitted by the emitter **161** from influencing operation stability of TFT of the display area **1311**, so that the display screen **13** and the infrared sensor **16** can realize respective functions without interfering each other.

[0052] Specifically, the electronic device **100** further includes a battery **110** and a main circuit board **120**. The battery **110** and the main circuit board **120** are disposed at a same side of the housing **20**, and the battery **110** and the display screen **13** are disposed at two opposite sides of the housing **20**. The battery **110** is used for providing electric energy for the electronic device **100**, and the main circuit board **120** is configured to control operation state of the electronic device **100**, for example, the main circuit board **120** controls the display screen **13** to play video content.

[0053] In some embodiments, the display screen **13** includes OLED screen.

[0054] Specifically, Organic Light-Emitting Diode (OLED) screen has better light transparency and is permeable to visible light and infrared light. Thus, the OLED screen does not affect the infrared sensor transmitting and receiving the infrared light while displaying content and effect. The display screen **13** can also adopt a Micro LED screen, and the Micro LED screen also has good light transmittance to the visible light and the infrared light. Certainly, these display screens are merely exemplary and the embodiments of the present disclosure are not limited thereto.

[0055] Referring to FIG. **4**, in some embodiments, the light blocking element **30** is attached and fixed to a joint of the display area **1311** and the non-display area **1312**. Thus, a fixed method of the light blocking element **30** can be achieved easily, so that the electronic device **100** can be manufactured easily. In an example, during the fixation of the light blocking element **30** to the lower surface **132** of the display screen **13**, a double-sided tape can be attached to one surface of the light blocking element **30**, and the light blocking element **30** is attached and fixed to the joint of the display area **1311** and the non-display area **1312** through the double-sided tape.

[0056] Referring to FIG. **3**, in some embodiments, the infrared sensor **16** includes an encapsulation body **163** encapsulating the emitter **161** and the receiver **162**. The light blocking element **30** is fixed to the encapsulation body **163** and located between the emitter **161** and the receiver **162**. Thus, the light blocking element **30** is installed and fixed, which makes it convenient to integrate the infrared sensor **16** and the light blocking element **30** as a whole so as to be fitted with the display screen **13**.

[0057] In some embodiments, the light blocking element **30** is soft material, and the light blocking element **30** is abutted against the lower surface **132**. Thus, the light blocking element **30** has better light blocking effect, and it is guaranteed that the infrared light emitted by the emitter **161** cannot enter the display area **1311**. In addition, it makes the infrared sensor **16** to be fitted with the display screen **13** in a more compact structure.

[0058] Referring to FIG. **5**, in some embodiments, the light blocking element **30** and the encapsulation body **163** are integral structures. Thus, the light blocking element **30** can be made of same material as the encapsulation body **163**, the light blocking element **30** can be formed while manufacturing the infrared sensor **16**, which can reduce an amount of parts of the electronic device **100** so as to improve assembly efficiency of the electronic device **100**.

[0059] In some embodiments, an orthographic projection of the receiver **162** in the lower surface **132** is located in the display area **1311**, and the receiver **162** is configured to receive the infrared light penetrating the display area **1311**. Thus, there is enough space to arrange the receiver **162**. Certainly, in some embodiments, the orthographic projection of the receiver **162** in the lower surface **132** can also be located at a position corresponding to the non-display area **1312**, as illustrated in FIG. **6**.

[0060] Referring to FIG. **3**, in some embodiments, the electronic device **100** further includes a touch layer **12** and a cover plate **11**. The cover plate **11** is formed on the touch layer **12**, the touch layer **12** is disposed to the display screen **13**, the upper surface **131** of the display screen **13** faces the touch layer **12**, and the touch layer **12** and the cover plate **11** both have light transmittance to the visible light and the infrared light of more than 90%.

[0061] Specifically, the touch layer **12** is mainly used for receiving input signal generated when the user touches the touch layer **12** and transmitting the input signal to the circuit board for data processing, so as to obtain a specific position where the user touches the touch layer **12**. The touch layer **12** can be attached to the display screen **13** by using In-Cell or On-Cell bonding technology, which can effectively reduce the weight of the display screen and reduce the overall thickness of the display screen. In addition, the cover plate **11** is disposed to the touch layer **12**, which can effectively protect the touch layer **12** and its internal structures, preventing external forces from damaging the touch layer **12** and the display screen **13**. The cover plate **11** and the touch layer **12** both have light transmittance to the visible light and the infrared light of more than 90%, which is not only beneficial for the display screen **13** to better display the content and effect, but also convenient for the infrared sensor **16** arranged below the display screen **13** to emit and receive the infrared light stably, guaranteeing the normal operation of the infrared sensor **16**.

[0062] In some embodiments, the display screen **13** is used for luminescence display through the display area **1311**, and an area ratio of the display area **1311** to the cover plate **11** is greater than 90%. For example, the area ratio of the display area **1311** to the cover plate **11** is values such as 95%, 96% or the like.

[0063] Specifically, by setting the ratio of the display area **1311** to the cover plate **11**, when the cover plate **11** is attached to the display screen **13**, the display area **1311** can display the content and effect with a larger size and area, which not only improves the user experience, but also effectively increase the screen-to-body-ratio of the electronic device **100**, thus realizing full-screen effect. The non-display area **1312** can also be used to block other components and metal lines below the display screen **13**, so that the appearance of the product remains consistent. The non-display area **1312** can enhance the optical density of the display screen **13** by printing ink, which also builds up good visual effect while ensuring the function of light blocking.

[0064] Referring to FIG. **3**, in some embodiments, the electronic device **100** further includes a first coating layer **14**, the first coating layer **14** is coated onto the lower surface **132** and covers the emitter **161**. The first coating layer **14** is configured to be permeable to the infrared light and intercept visible light, and the emitter **161** is configured to emit the infrared light through the first coating layer **14**.

[0065] Specifically, during the technique assembly, the installation of the emitter **161** usually requires assembling clearance to be reserved, which causes that a gap appears between the emitter **161** and other elements, the visible light enters through the gap, and light leak phenomenon appears. Thus, in a stack direction of the emitter **161** and the display screen **13**, an area of an orthographic projection of the first coating layer **14** in the lower surface **132** covers an area of an orthographic projection of the emitter **161** in the lower surface **132**, so that the first coating layer **14** can be allowed to fully block the emitter **161** without influencing the normal operation of the emitter **161**, realizing the effect that the emitter **161** is invisible when the electronic device **100** is looked from outside.

[0066] The first coating layer **14** is permeable to the infrared light, so that when the emitter **161** emits the infrared light outside for detection, the infrared light has smaller intensity attenuation when penetrating the first coating layer **14**, or the attenuation degree doesn't cause influence on the detection process, so that the normal operation of the emitter **161** is guaranteed. The first coating layer **14** intercepts the visible light to make the visible light to be not able to pass through the first coating layer **14**, and the emitter **161** is blocked visually, thus realizing the effect that the emitter **161** is invisible when the electronic device **100** is looked outside.

[0067] In some embodiments, the infrared sensor **16** includes a proximity sensor, the emitter **161** is configured to emit the infrared light through the first coating layer **1311** and the non-display area **1312**, and the receiver **162** is configured to receive the infrared light reflected by objects so as to detect a distance between the object and the upper surface **131**.

[0068] Specifically, in an example, when the user answers or makes a call, the electronic device **100** approaches the head, the emitter **161** emits the infrared light, and the receiver **162** receives the infrared light reflected back, the processor calculates the time between the emission and return-by-reflection of the infrared light, and sends corresponding commands to control the backlight of the screen to be turned off. When the electronic device **100** is away from the head, the processor performs the calculation and sends commands according to the feedback data again, and the screen backlight is reopened. Thus, not only the user's misoperation is prevented, but also the power of the mobile phone is saved.

[0069] In some embodiments, the first coating layer **14** includes IR ink, the IR ink has a light transmittance to the infrared light of more than 85%, and a light transmittance to the visible light of less than 6%. The IR ink is permeable to the infrared light with a wave length of 850 nm-940 nm.

[0070] Specifically, as the IR ink has the characteristic of low light transmittance to the visible light, when the electronic device **100** is looked outside, the emitter **161** arranged below the first coating layer **14** cannot be viewed based on human eye vision. Meanwhile, the IR ink also has the characteristic of high light transmittance to the infrared light, so that the emitter **161** can emit the infrared light stably, guaranteeing the normal operation of the emitter **161**.

[0071] Referring to FIG. **6**, in some embodiments, the emitter **161** and the receiver **162** are separated structures.

[0072] Specifically, as the emitter **161** and the receiver **162** are separated structures, when arranging the emitter **161** and the receiver **162**, the emitter **161** and the receiver **162** can be arranged compactly or dispersedly, which is not only beneficial for the electronic device **100** to distribute spatial position of each element sufficiently and apply the emitter **161** and the receiver **162** of various shapes, but also beneficial for the emitter **161** and the receiver **162** to spare possible positions for other elements of the electronic device **100**.

[0073] In an example, the separated emitter **161** and receiver **162** are both disposed below a length edge of the non-display area **1312**, as illustrated in FIG. **6**.

[0074] In another example, the separated emitter **161** and receiver **162** are both arrange below a position corresponding to a corner of the non-display area **1312**, as illustrated in FIG. **7**.

[0075] In yet another example, the separated emitter **161** and receiver **162** are arranged below two length edges of the non-display area **1312** respectively, as illustrated in FIG. **8**.

[0076] Referring to FIG. **9**, in some embodiments, the emitter **161** and the receiver **162** are integral structures.

[0077] Specifically, the emitter **161** and the receiver **162** are integral structures, which can omit the line connection between the separated structures, which is beneficial to reduce the line technical process, improve the production efficiency of the product, and reduce the production cost.

[0078] In the example illustrated in FIG. **9**, in the infrared sensor **16**, the emitter **161** is located at a position corresponding to the non-display area **1312**, and the receiver **162** is located at a position corresponding to the display area **1311**.

[0079] In the example in FIG. **10**, the emitter **161** and the receiver **162** in integral structures are both disposed at a position corresponding to a width edge of the non-display area **1312**.

[0080] Referring to FIG. **3** again, in some embodiments, the electronic device **100** further includes a second coating layer **15** being coated onto the lower surface **132** and covering the receiver **162**, the second coating layer **15** is configured to be permeable to the infrared light and intercept the visible light, and the receiver **162** is configured to receive the infrared light through the display area **1311** and the second coating layer **15**.

[0081] Specifically, during the technique assembly, the installation of the receiver **162** usually requires assembling clearance to be reserved, which causes that a gap appears between the receiver **162** and other elements, the visible light enters through the gap, and light leak phenomenon appears. Thus, in a stack direction of the receiver **162** and the display screen **13**, an area of an orthographic projection of the second coating layer **15** in the lower surface **132** covers an area of an orthographic projection of the receiver **162** in the lower surface **132**, so that the second coating layer **15** can be allowed to fully block the receiver **162** without influencing the normal operation of the receiver **162**, realizing the effect that the receiver **162** is invisible when the electronic device **100** is looked from outside.

[0082] The second coating layer **15** can also adopt the IR ink. As the IR ink has the characteristic of the low light transmittance to the visible light, when the electronic device **100** is looked outside, the receiver **162** arranged below the second coating layer **15** cannot be viewed based on human eye vision. Meanwhile, the IR ink also has the characteristic of high light transmittance to the infrared light, so that the receiver **162** can receive the infrared light stably, guaranteeing the normal operation of the receiver **162**.

[0083] In some embodiments, the electronic device **100** further includes a buffer layer **17** covering the lower surface **132** and avoiding the infrared sensor **16**.

[0084] Specifically, the buffer layer **17** is used to mitigate impact and shock to protect the touch layer **12** and the display screen **13** and their internal structures, so as to prevent the display screen **13** from being damaged by being subject to external impact. The buffer layer **17** can be made of foam, or foam plastic or rubber or other soft material. Certainly, these cushioning materials are merely exemplary and the embodiments of the present disclosure are not limited thereto. In addition, the infrared sensor **16** is avoided when arranging the buffer layer **17** so as to prevent the buffer layer **17** from intercepting the signal reception by the infrared sensor **16**, lest the infrared sensor **16** is affected in the process of receiving the infrared light.

[0085] In some embodiments, the electronic device **100** further includes a metal sheet **18** covering the buffer layer **17** and avoiding the infrared sensor **16**.

[0086] Specifically, the metal sheet **18** is configured to shield electromagnetic interference and connect ground and has a function of diffusing temperature rise. The metal sheet **17** can be formed by cutting a metal material such as copper foil or aluminum foil. Certainly, these metal materials are merely exemplary and embodiments of the present disclosure are not limited thereto. In addition, the infrared sensor **16** is avoided when arranging the metal sheet **18** so as to prevent the metal sheet **18** from intercepting the signal reception by the infrared sensor **16**, lest the infrared sensor **16** is affected in the process of receiving the infrared light.

[0087] Referring to FIG. **11** and FIG. **12**, in some embodiments, the electronic device **100** includes a light sensor **40** and a light guiding element **50**, the light sensor **40** is disposed below the display area **1311**, the light guiding element **50** is disposed below the display screen **13**, and the light guiding element **50** is configured to guide the light penetrating the non-display area **1312** to the light sensor **40**.

[0088] Thus, the light sensor **40** is arranged below the display area **1311** so as to ensure that the electronic device **100** realizes the full-screen effect. In addition, the light guiding element **50** guides the light to the light sensor **40** through the non-display area **1312**, so that the light sensor **40** can sense and detect the ambient light intensity around the electronic device **100**, thus preventing the light emitted from the display area **1311** from causing bad effect on the light sensor **40**.

[0089] If the light sensor **40** is arranged below the display area **1311** and detects the ambient light intensity through the display area **1311**, in this case, as a part of the light emitted from an organic light emitting layer of the display area **1311** is reflected downwards the display area **1311**, the light sensor **40** detects the intensity of outside ambient light and intensity of the light generated by the display area **1311**, so that the accuracy of the detection for the outside ambient light by the light sensor **40** is relatively low.

[0090] Specifically, the light guiding element **50** can be made of transparent light guiding material. For example, the material of the light guiding element **50** can be plastic or glass. The amount of the light guiding element **50** can be set according to specific requirements. For example, the amount of the light guiding element **50** can be one or two or the like. The light guiding element **50** includes a light incident end **51** and a light exit end **52**, the light incident end **51** faces the non-display area **1312**, the light exit end **52** faces the light sensor **40** so that the light guiding element **50** guides the visible light penetrating the non-display area **1312** to the light sensor **40**.

[0091] When the light sensor **40** receives different light intensity, current of different intensity is generated so that the ambient light brightness is sensed. For example, when the user is in the sun, the ambient light is strong, the light sensor **40** feeds the ambient light intensity back to the processor, and the processor executes corresponding instructions to enhance the brightness of the display screen to adapt to the light intensity of the current environment, so that contents in the screen viewed by the user is more clear. When the user is in darker environment, the ambient light is weak, the light sensor **40** feeds the ambient light intensity back to the processor, and the processor executes corresponding instructions to lower the brightness of the display screen to adapt to the light intensity of in the current environment, so that the user does not feel glare when viewing the screen content, thus giving the user best visual effect. In this way, not only the user's vision is protected, but also the power of the mobile phone is saved and the function of further prolonging the service life of the battery is realized. Further, when the user uses the photographing function, the light sensor **40** can also be configured to adjust white balance.

[0092] In some embodiments, the light guiding element **50** includes a vertical portion **53** and a horizontal portion **54** connected with the vertical portion **53**, the vertical portion **53** faces the non-display area **1312** directly, and the horizontal portion **54** bends towards the light sensor **40** at a bottom end of the vertical portion **53**.

[0093] Thus, the light guiding element **50** forms substantially to be an L shape, so that the light sensor **40** can be arranged below the display area **1311** more easily. Certainly, in some embodiments, the light guiding element **50** can also form into other shapes such as an arc shape, as long as the light penetrating the non-display area **1312** can be guided to the light sensor **40**.

[0094] In some embodiments, a light incident direction of the light guiding element **50** is perpendicular to the non-display area **1312**, and/or a light exit direction of the light guiding element **50** is perpendicular to the light sensor **40**.

[0095] That is, in some embodiments, the light incident direction of the light guiding element **50** is perpendicular to the non-display area **1312**. Or, in some embodiments, the light exit direction of the light guiding element **50** is perpendicular to the light sensor **40**. Or, in some embodiments, the light incident direction of the light guiding element **50** is perpendicular to the non-display area **1312** and the light exit direction of the light guiding element **50** is perpendicular to the light sensor **40**.

[0096] Thus, most of the visible light penetrating the non-display area **1312** passes through the light guiding element **50** and reaches the light sensor **40**, so that the accuracy for detecting the ambient light by means of the light sensor **40** is relatively high.

[0097] In some embodiments, a peripheral surface of the light guiding element **50** is coated with a black coating. Thus, it is possible to prevent the visible light from being emitted through the peripheral surface of the light guiding element **50** and the accuracy of the ambient light detection by the light sensor **40** is reduced.

[0098] In some embodiments, a light sensing face of the light sensor **40** is opposite to the display area **1311**. Thus, it is possible to prevent the light sensor **40** from being subjected to the visible light emitted from the display area **1311** and causing a bed effect.

[0099] It is to be noted that the light sending face of the light sensor **40** being opposite to the display area **1311** means that an included angle between the light sensing face of the light sensor **40** and the lower surface of the display area **1311** is larger than or equal to 90 degree and less than or equal to 180 degree so as to prevent the light generated in the display area **1311** from being transmitted to the light sensing face of the light sensor **40**.

[0100] In some embodiments, the light sensor **40** includes an ambient light sensor, the ambient light sensor is configured to sense ambient light, and the processor is configured to adjust brightness of the display screen according to light intensity sensed by the ambient light sensor.

[0101] Specifically, when the user is in the sun, the ambient light is strong, the ambient light receiver feeds the ambient light intensity back to the processor, and the processor executes corresponding instructions to enhance the brightness of the display screen to adapt to the light intensity of the current environment, so that contents in the screen viewed by the user is more clear. When the user is in darker environment, the ambient light is weak, the ambient light receiver feeds the ambient light intensity back to the processor, and the processor executes corresponding instructions to lower the brightness of the display screen to adapt to the light intensity of in the current environment, so that the user does not feel glare when viewing the screen content, thus giving the user best visual effect. In this way, not only the user's vision is protected, but also the power of the mobile phone is saved and the function of further prolonging the service life of the battery is realized.

[0102] Referring to FIG. **3** and FIG. **13**, embodiments of the present disclosure provide a manufacturing method for the electronic device **100**, and the method includes the following operations at blocks S**301** to S**304**.

[0103] At the block S**301**, a display screen **13** is provided. The display screen **13** includes a display area **1311** and a non-display area **1312** surrounding the display area.

[0104] At the block S**302**, an infrared sensor **16** is provided. The infrared sensor **16** includes an emitter **161** configured to emit infrared light and a receiver **162** configured to receive the infrared light.

[0105] At the block S**303**, the infrared sensor **16** is arranged below the display screen **13** so that the emitter **161** is located in the non-display area **1312**.

[0106] At the block S**304**, a light blocking element **30** is provided and arranged between the emitter **161** and the display area **1311**, and the light blocking element **30** is configured to block the infrared light emitted from the emitter **161** from entering the display area **1311**.

[0107] Specifically, the electronic device **100** adopts the display screen **13**, the infrared sensor **16** can be arranged below the display screen **13** in the case of the full-screen. In addition, it is possible to prevent the infrared light emitted from the emitter **161** from influencing operation stability of TFT of the display area **1311** by arranging the emitter **161** of the light sensor **16** in the non-display area **1312**, so as to allow the display screen **13** and the infrared sensor **16** to realize their respective functions without interfering each other. The display screen **13** can be an Organic Light-Emitting Diode (OLED) screen, the OLED screen has better optical transparency and is permeable to visible light and infrared light. Thus, the OLED screen doesn't influence the infrared sensor in emitting and receiving the infrared light. The display screen **13** can also adopt the Micro LED screen, and the Micro LED screen also has good light transmittance to the visible light and the infrared light. Certainly, these display screens are merely exemplary and the embodiments of the present disclosure are not limited thereto. In addition, the upper surface **131** of the display screen **13** is configured to be permeable to visible light so as to display content and effect on one aspect, and to be permeable to the infrared light so as to allow the infrared sensor **16** to emit and receive the infrared light normally.

[0108] In some embodiments, the manufacturing method for the electronic device **100** further includes operations of providing the touch layer **12** to the display screen **13** and providing the cover plate **11** to the touch layer **12**.

[0109] Specifically, the touch layer **12** is mainly used for receiving input signal generated when the user touches the touch layer **12** and transmitting the input signal to the circuit board for data processing, so as to obtain a specific position where the user touches the touch layer **12**. The touch layer **12** can be attached to the display screen **13** by using In-Cell or On-Cell bonding technology, which can effectively reduce the weight of the display screen and reduce the overall thickness of the display screen. In addition, the cover plate **11** is disposed to the touch layer **12**, which can protect the touch layer **12** and its internal structures, preventing external forces from damaging the touch layer **12** directly.

[0110] In some embodiments, before the operation at the block S**303**, the manufacturing method for the electronic device **100** further includes an operation of applying the lower surface **132** with the first coating layer **14**.

[0111] Specifically, at the block S303, the infrared sensor **16** is arranged below the display screen **13** so as to enable the first coating layer **14** to cover the emitter **161**, and the emitter **161** is configured to emit the infrared light through the first coating layer **14**.

[0112] Specifically, the first coating layer **14** may adopt IR ink. As the IR ink has the characteristic of a low light transmittance to the visible light, when the electronic device **100** is looked outside, the emitter **161** arranged below the first coating layer **14** cannot be viewed based on human eye vision. Meanwhile, the IR ink also has the characteristic of high light transmittance to the infrared light, so that the emitter **161** can emit the infrared light stably, guaranteeing the normal operation of the emitter **161**.

[0113] Referring to FIG. **11** and FIG. **14**, in some embodiments, embodiments of the present disclosure provide a manufacturing method for the electronic device **100**, which includes the following operations at blocks S**401** to S**404**.

[0114] At the block S**401**, a display screen **13** is provided. The display screen **13** includes a display area **1311** and a non-display area **1312** surrounding the display area **1311**.

[0115] At the block S**402**, a light sensor **40** is provided and the light sensor **40** is arranged below the display screen **13**.

[0116] At the block S**403**, a light guiding element **50** is provided.

[0117] At the block S**404**, the light guiding element **50** is arranged below the display screen **13** and enabled to guide the light penetrating the non-display area **1312** to the light sensor **40**.

[0118] In the present disclosure, unless specified or limited otherwise, a structure in which a first feature is "on" or "below" a second feature may include an embodiment in which the first feature is in direct contact with the second feature, and may also include an embodiment in which the first feature and the second feature are not in direct contact with each other, but are contacted via an additional feature formed therebetween. Furthermore, a first feature "on," "above," or "on top of" a second feature may include an embodiment in which the first feature is right or obliquely "on," "above," or "on top of" the second feature, or just means that the first feature is at a height higher than that of the second feature; while a first feature "below," "under," or "on bottom of" a second feature may include an embodiment in which the first feature is right or obliquely "below," "under," or "on bottom of" the second feature, or just means that the first feature is at a height lower than that of the second feature.

[0119] Various embodiments and examples are provided in the description to implement different structures of the present disclosure. In order to simplify the present disclosure, certain elements and settings will be described. However, these elements and settings are only by way of example and are not intended to limit the present disclosure. In addition, reference numerals may be repeated in different examples in the present disclosure. This repeating is for the purpose of simplification and clarity and does not refer to relations between different embodiments and/or settings. Furthermore, examples of different processes and materials are provided in the present disclosure. However, it would be appreciated by those skilled in the art that other processes and/or materials may be also applied.

[0120] In the specification, it is to be understood that terms such as "central," "longitudinal," "lateral," "length," "width," "thickness," "upper," "lower," "front," "rear," "left," "right," "vertical," "horizontal," "top," "bottom," "inner," "outer," "clockwise," "counterclockwise," "axial," "radial," and "circumferential" should be construed to refer to the orientation or position as then described or as illustrated in the drawings under discussion. These relative terms are for convenience of description, and do not indicate or imply that the device or element referred to must have a particular orientation or be constructed and operated in a particular orientation, and hence cannot be constructed to limit the present disclosure. In addition, terms such as "first" and "second" are used herein for purposes of description and are not intended to indicate or imply relative importance or significance or to imply the number of indicated technical features. Thus, the feature defined with "first" and "second" may comprise one or more of this feature. In the description of the present disclosure, "a plurality of" means two or more than two, unless specified otherwise. It should also be understood that, as used herein, the term "and/or" represents and contains any one and all possible combinations of one or more associated listed items.

[0121] In the description of the present disclosure, it should be understood that, unless specified or limited otherwise, the terms "mounted," "connected," and "coupled" and variations thereof are used broadly, and may be, for example, fixed connections, detachable connections, or integral connections; may also be mechanical or electrical connections; may also be direct connections or indirect connections via intervening structures; may also be inner communications of two elements, which can be understood by those skilled in the art according to specific situations.

[0122] Reference throughout this specification to "an embodiment," "some embodiments," "an illustrative embodiment," "an example," "a specific example," or "some examples," means that a particular feature, structure, material, or characteristic described in connection with the embodiment or example is included in at least one embodiment or example of the present disclosure. Thus, the appearances of the phrases such as "in some embodiments," "in one embodiment", "in an embodiment", "in another example," "in an example," "in a specific example," or "in some examples," in various places throughout this specification are not necessarily referring to the same embodiment or example of the present disclosure. Furthermore, the particular features, structures, materials, or characteristics may be combined in any suitable manner in one or more embodiments or examples.

[0123] Although embodiments have been illustrated and described, it would be appreciated by those skilled in the art that changes, modifications, alternatives and variants can be made in the embodiments without departing from principles and purposes of the present disclosure. The protection scope of the present disclosure is defined by the claims or the like.

What is claimed is:

1. An electronic device, comprising:

a display screen comprising a first surface and a second surface opposite to the first surface, and the display screen comprising a display area and a non-display area surrounding the display area;

a light sensor arranged adjacent to the second surface and opposite to the display area; and

a light guiding element arranged adjacent to the light sensor, the light guiding element being configured to transmit ambient light, penetrating the non-display area from the first surface, to the light sensor.

2. The electronic device according to claim **1**, wherein the light guiding element is formed into an L shape.

3. An electronic device, comprising:

a display screen comprising a first surface and a second surface opposite to the first surface, and the display screen comprising a display area and a non-display area surrounding the display area;

a light sensor arranged adjacent to the second surface and opposite to the display area; and

a light guiding element arranged adjacent to the second surface, the light guiding element being configured to transmit light, penetrating the non-display area from the first surface, to the light sensor.

4. The electronic device according to claim **3**, wherein the light guiding element comprises a vertical portion and a horizontal portion connected with the vertical portion, the vertical portion is located opposite to the non-display area, and the horizontal portion bends from a bottom end of the vertical portion towards the light sensor.

5. The electronic device according to claim **3**, wherein a light incident direction of the light guiding element is perpendicular to the non-display area, and/or a light exit direction of the light guiding element is perpendicular to the light sensor.

6. The electronic device according to claim **3**, wherein a peripheral surface of the light guiding element is coated with a black coating.

7. The electronic device according to claim **3**, wherein an included angle between a light sensing face of the light sensor and the second surface ranges from 90° to 180°.

8. The electronic device according to claim **3**, further comprising a touch layer and a cover plate arranged on the touch layer, the touch layer being arranged between the display screen and the cover plate, and the touch layer and the cover plate both having light transmittance to visible light and infrared light of more than 90%.

9. The electronic device according to claim **8**, wherein an area ratio of the display area to the cover plate is greater than 90%.

10. The electronic device according to claim **3**, wherein the electronic device comprises an infrared sensor and a light blocking element, the infrared sensor comprises an emitter and a receiver, the emitter is located adjacent to the second surface and opposite to the non-display area, the emitter is configured to emit infrared light, and the receiver is configured to receive the infrared light;

wherein the light blocking element is arranged between the emitter and the display area, and the light blocking element is configured to block the infrared light emitted from the emitter from entering the display area.

11. The electronic device according to claim **10**, wherein the infrared sensor comprises an encapsulation body encapsulating the emitter and the receiver, and the light blocking element is fixed to the encapsulation body and located between the emitter and the receiver.

12. The electronic device according to claim **11**, wherein the light blocking element is abutted against the second surface

13. The electronic device according to claim **11**, wherein the light blocking element and the encapsulation body form an integral structure.

14. The electronic device according to claim **10**, further comprising a first coating layer, the first coating layer being coated on the second surface and covering the emitter, the first coating layer being configured to be permeable to the infrared light and intercept visible light, and the emitter being configured to emit the infrared light through the first coating layer.

15. The electronic device according to claim **14**, wherein the infrared sensor is a proximity sensor, the emitter is configured to emit the infrared light through the first coating layer, and the receiver is configured to receive the infrared light reflected by an object so as to detect a distance between the object and the first surface.

16. The electronic device according to claim **10**, further comprising a second coating layer being coated on the second surface and covering the receiver, the second coating layer being configured to be permeable to the infrared light and intercept visible light, and the receiver being configured to receive the infrared light through the display area and the second coating layer.

17. The electronic device according to claim **3**, further comprising a buffer layer covering the second surface.

18. The electronic device according to claim **17**, further comprising a metal sheet covering the buffer layer.

19. A manufacturing method for an electronic device, comprising following operations:

providing a display screen, the display screen comprising a display area and a non-display area surrounding the display area, and the display screen comprising a first surface and a second surface opposite to the first surface;

providing a light sensor and arranging the light sensor adjacent to the second surface and opposite to the display area; and

providing a light guiding element;

arranging the light guiding element adjacent to the second surface and enabling the light guiding element to guide light, penetrating the non-display area from the first surface, to the light sensor.

20. The manufacturing method for the electronic device according to claim **19**, further comprising following operations:

providing an infrared sensor, the infrared sensor comprising an emitter configured to emit infrared light and a receiver configured to receive the infrared light, the emitter being located opposite to the non-display area; and

providing a light blocking element, locating the light blocking element between the emitter and the display area, the light blocking element being configured to prevent the infrared light emitted from the emitter from entering the display area.

* * * * *