

DISPLAY SCREEN, DISPLAY DEVICE AND MOBILE TERMINAL

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FIELD

The present disclosure relates to a field of display technology, and specifically to a display screen, a display device and a mobile terminal.

BACKGROUND

10 With the rocketing development of the information era, people pay more and more attention to information security issues. The mobile terminals are mostly provided with a fingerprint recognition module used for fingerprint recognition for a user of the mobile terminal, so as to improve the security of the mobile terminal. In the related art, the fingerprint recognition module is disposed out of a display area of a display panel so as to be prevented from hindering the display. A display area-to-screen ratio (the ratio of the display area to the whole display screen) is small with such a structure design, which influences the user experience. Therefore, with such a method that the fingerprint module and the display screen are disposed in a superposition manner, the display area-to-screen ratio can be increased. However, in such a structure, the display screen blocks a sensing signal of the fingerprint module, which causes low fingerprint acquisition efficiency of the fingerprint module and reduces the user experience.

SUMMARY

Aiming at the above-mentioned problems, an objective of the present disclosure is to provide a display screen, a display device and a mobile terminal, so as to improve fingerprint acquisition efficiency of the fingerprint module.

In order to solve the existing problems mentioned in the background, the present disclosure provides a display screen, including a display layer and a light shielding layer. The display layer includes an upper surface and a lower surface opposite to the upper surface, the upper surface is configured to face a user, the light shielding layer is arranged to the lower surface of the display layer, the light shielding layer has a hole to allow a sensing signal of a fingerprint module to pass through.

The present disclosure provides a display screen, including the above-mentioned display screen, and further including a fingerprint module for recognizing fingerprints from a user and a frame. The display screen and the fingerprint module are fastened to the frame, and the fingerprint

module is disposed at a side of the light shielding layer away from the display layer and located at a position corresponding to the hole. The fingerprint module includes a light emitter and a light inductor, and a first light signal emitted by the light emitter and a second light signal received by the light inductor can pass through the hole.

5 The present disclosure further provides a mobile terminal, including the above-mentioned display device.

 The display screen provided in embodiments of the present disclosure includes the display layer and the light shielding layer, the light shielding layer is arranged to the lower surface of the display layer, and the light shielding layer has the hole, allowing the fingerprint module to emit
10 and acquire the sensing signal through the hole and the display layer, thus improving the fingerprint acquisition efficiency of the fingerprint module.

 The display device provided in embodiments of the present disclosure includes the display screen and the fingerprint module disposed below the display screen. The display screen includes the display layer and the light shielding layer, the light shielding layer is fastened to the lower
15 surface of the display layer, and the light shielding layer is provided with the hole. The fingerprint module is located at a position corresponding to the hole. The fingerprint module includes the light emitter and the light inductor, so as to make it convenient for the light signal emitted by the light emitter to be transmitted to the fingerprint through the hole and the display layer, and to be received by the light inductor through the display layer and the hole after being reflected by the
20 fingerprint, thus realizing the fingerprint recognition function.

 The mobile terminal provided in embodiments of the present disclosure includes the display device. The display device includes the display screen and the fingerprint module disposed below the display screen. The display screen includes the display layer and the light shielding layer, the light shielding layer is fastened to the lower surface of the display layer, and the light shielding
25 layer is provided with the hole. The fingerprint module is located at a position corresponding to the hole. The fingerprint module includes the light emitter and the light inductor, so as to make it convenient for the light signal emitted by the light emitter to be transmitted to the fingerprint through the hole and the display layer, and to be received by the light inductor through the display layer and the hole after being reflected by the fingerprint, thus realizing the fingerprint recognition
30 function.

BRIEF DESCRIPTION OF THE DRAWINGS

To describe the technical solutions in the embodiments of the present disclosure more clearly, the accompanying drawings required for describing the embodiments are briefly

introduced in the following. Apparently, the accompanying drawings in the following description show merely some embodiments of the present disclosure, those ordinarily skilled in the art can also derive other drawings from these accompanying drawings without creative efforts.

Fig. 1 is a sectional schematic view of a display screen provided in an embodiment of the present disclosure.

Fig. 2 is a top view of a display screen provided in an embodiment of the present disclosure.

Fig. 3 is a sectional schematic view of a display screen provided in an embodiment of
10 the present disclosure.

Fig. 4 is a schematic view of a display screen provided in a first embodiment of the present disclosure.

Fig. 5 is a sectional schematic view of a light shielding sheet provided in an embodiment of the present disclosure.

15 Fig. 6 is a schematic view of a display screen provided in a second embodiment of the present disclosure.

Fig. 7 is a schematic view of a display screen provided in a third embodiment of the present disclosure.

Fig. 8 is a sectional schematic view of a display device provided in an embodiment of
20 the present disclosure.

Fig. 9 is a schematic view of a display device provided in a first embodiment of the present disclosure.

Fig. 10 is a schematic view of a display device provided in a second embodiment of the present disclosure.

25 Fig. 11 is a schematic view of a display device provided in a third embodiment of the present disclosure.

Fig. 12 is a schematic view of a mobile terminal provided in an embodiment of the present disclosure.

30 **DETAILED DESCRIPTION**

The technical solutions of the embodiments of the present disclosure are clearly and completely described below with reference to the accompanying drawings in the embodiments of the present disclosure.

Referring to Fig. 1, Fig. 1 illustrates a display screen 100 provided by an embodiment of

the present disclosure. The display screen 100 includes a display layer 110 and a light shielding layer 120. The display layer 110 includes an upper surface 111 and a lower surface 112 opposite to the upper surface, and the upper surface 111 of the display layer 110 is configured to face a user. The light shielding layer 120 is fastened to the lower surface 112 of the display layer 110. In an embodiment, the light shielding layer 120 is affixed to the lower surface 112 of the display layer 110 and configured to block light from penetrating the display layer 110, so as to hide inner structures below the display layer 110 from view and display a color of the light shielding layer 120 when the display layer 110 is in a non-luminous state. The light shielding layer 120 has a hole 121 to allow a sensing signal of a fingerprint module to pass through. In the present embodiment, the fingerprint module is an optical fingerprint recognition module, and the hole 121 is configured to allow a light signal emitted and received by the fingerprint module to pass through.

Referring to Fig. 2, the display layer 110 mentioned in embodiment of the present application refers to a portion, configured to display an image, of the display screen 100. The display screen 100 can also include a non-display layer 113 disposed surrounding the display layer 110. The non-display layer 113 is disposed surrounding the display layer 110 and can be used to mount some electronic elements and components that are not disposed in the display layer 110, such as a camera module, an amplifier, or a telephone receiver and the like.

It could be understood that the display layer 110 mentioned in embodiment of the present application is a light-transparent layer, so as to make it convenient for the fingerprint module to emit and receive the light signal through the display layer 110. As the display layer 110 is the light-transparent layer, in order to prevent structures below the display screen 100 (such as the electronic circuits) from being seen, the light shielding layer 120 is usually disposed below the display layer 110. The light shielding layer 120 can be a light-shielding foam layer, or a lightproof ink layer. The light shielding layer 120 can hide structures (such as the electronic circuits) below the display screen 100 from view and enables the display layer 110 to present the color of the light shielding layer 120 when the display screen 100 is in the non-luminous state. The light shielding layer 120 can be black, white or other colors.

Referring to Fig. 3, the display layer 110 includes an upper covering plate 114, a touch sensitive layer 115, an organic luminous layer 116, and a lower covering plate 117 superposed in sequence. The light shielding layer 120 can be affixed to the lower covering plate 117. In an embodiment, the light shielding layer 120 is the lightproof ink layer. The

hole 121 is disposed in the lightproof ink layer 120, that is, a patterned lightproof ink layer is disposed to the lower covering plate 117, and the patterned lightproof ink layer can be formed on the lower covering plate 117 in a printing, spin coating, coating, or evaporation method. In another embodiment, the light shielding layer 120 is the foam layer, and the foam layer 120 can play a cushioning and damping role between the lower covering plate 117 and other electronic elements and components. The foam layer 120 can be affixed to the lower covering plate 117 by means of a sealant. The hole 121 can be processed and formed in the foam layer after the processing of the foam layer is finished, or during the processing of the foam layer.

Further, the hole 121 can be a circular hole, a square hole, an oval hole or an irregular shaped hole. The irregular shaped hole can be a shape adapted to a shape of a contact surface of a fingerprint face contacting with the display screen 100.

Further, referring to Fig. 4, the display screen 100 further includes a light shielding sheet 130. The light shielding sheet 130 is disposed between the display layer 110 and the fingerprint module in the superposition manner and covers the hole 121, so as to hide the fingerprint module and enhance a visual effect of the display screen 100. Specifically, the light shielding sheet 130 covers the hole 121 and is permeable to the light signal, so as to enable the light signal emitted and received by the fingerprint module disposed below the hole 121 to penetrate, and reflect light to hide the fingerprint module. Preferably, reflected light of the light shielding sheet 130 has the same color as reflected light of the light shielding layer 120, so as to make an area of the hole 121 have the same display color as other non-perforated areas of the light shielding layer 120 when the display layer 110 is in a non-display state for example a screen-off state of the mobile terminal, thus reducing visual influence of the hole 121 on the user and enhancing user experience.

In an embodiment, referring to Fig. 5, the light shielding sheet 130 include a light shielding pigment 131 and a light-transparent material 132. The light shielding pigment 131 has a similar color to the light shielding layer 120. It could be understood that the color of the light shielding pigment 131 and the color of the light shielding layer 120 are the same when sensed by the user's naked eyes. The color of the light shielding layer 120 can be black, white or other colors, and correspondingly, the color of the light shielding pigment 131 can also be black, white or other colors. Specifically, when the color of the light shielding layer 120 is black, the color of the light shielding pigment 131 is also black, so that the color of the area of the hole 121 and the color of other non-perforated areas of the light shielding layer 120 are consistent, thus reducing the visual influence.

The light-transparent material 132 forms a light-penetrating passage 133, the light-penetrating passage 133 is along a thickness direction of the display screen 100, and the fingerprint module emits and receives the light signal through the light-penetrating passage 133. The light-penetrating passage 133 can increase light transmittance of the light shielding sheet 130. The increase of the light transmittance of the light shielding sheet 130 increases transmittance of an incident light emitted from the fingerprint module to the fingerprint, thereby strength of the reflected light from the fingerprint is increased, and transmittance of the reflected light is increased, thus improving accuracy of fingerprint recognition.

The light-transparent material 132 can be a transparent material such as resin particles, glass powders, or a mixture of resin particles and glass powders. These transparent materials have a certain light transmission property and allow light (arrow part in FIG. 5) to pass through. When the light shielding sheet 130 is added with the light-transparent material 132, the light transmission property of the light shielding sheet 130 can be increased. The light-transparent material 132 is formed to be granular. If a granule of the light-transparent material 132 is too small, the light transmission cannot be achieved. If the granule of the light-transparent material 132 is too large, a color difference exists between the light shielding sheet 130 and the light shielding layer 120. Therefore, optionally, a size of the granule of the light-transparent material 132 is 1~20 μ m. Further, if a ratio of the light-transparent material 132 to the light shielding sheet 130 is too low, the light transmission property of the light shielding sheet 130 cannot be increased effectively. If the ratio of the light-transparent material 132 to the light shielding sheet 130 is too high, the color of the light shielding sheet 130 will be influenced. Therefore, a mass percent of the light-transparent material 132 to the light shielding sheet 130 is 1%~20%.

Further, the light shielding sheet 130 can be manufactured to be a membrane or a sheet having the light-penetrating passage 133 and then be stuck onto a substrate, and an optical cement can be used for sticking. The light-penetrating passage 133 is processed in the membrane or the sheet of the light shielding sheet 130, and thus the display screen 100 is not influenced.

First embodiment

Referring to Fig. 4, the light shielding sheet 130 is disposed between the display layer 110 and the light shielding layer 120 in the superposition manner. Specifically, the light shielding sheet 130 can be affixed to the lower covering plate 117 of the display layer 110, or the light shielding sheet 130 can be affixed to an upper surface 122 of the light shielding

layer 120. In the present embodiment, the light shielding sheet 130 is disposed between the display layer 110 and the light shielding layer 120, and such a structure design allows the lower covering plate 117 of the display layer 110 to serve as the substrate for affixing of the light shielding sheet 130, thus realizing formation of the light shielding sheet 130 at a lower surface of the lower covering plate 117, which can avoid destroying the structure of the display screen 100 and simplify production process and cost of the light shielding sheet 130.

Second embodiment

Referring to Fig. 6, the light shielding sheet 130 is fastened to a first surface 123 of the light shielding layer 120, and the first surface 123 is disposed at a side away from the display layer 110. In the present embodiment, the light shielding sheet 130 is disposed at a side of the light shielding layer 120 away from the display layer 110, and with such a structure design, the light shielding layer 120 can be fastened to the display layer 110 and then be affixed to the light shielding sheet 130, that is, the affixation of the light shielding sheet 130 is performed after a position and shape of the hole 121 is determined, which can improve accuracy of covering the hole 121 by the light shielding sheet 130 and reduce technique difficulty of covering the hole 121 by the light shielding sheet 130.

Third embodiment

Referring to Fig. 7, the light shielding sheet 130 is filled in the hole 121. In an embodiment, the hole 121 is fully filled with the light shielding sheet 130, that is, a size and shape of the light shielding sheet 130 is consistent with a size and shape of the hole 121, and the light shielding sheet 130 and the light shielding layer 120 are in a common layer and have the same thickness. Such a structure design allows the light shielding sheet 130 and the light shielding layer 120 to be in the same layer, so that respective thicknesses of the light shielding sheet 130 and the light shielding layer 120 are decreased significantly and flatness of the light shielding layer 120 is increased on one aspect, hence decreasing the thickness of the display screen 100, and promoting light and thin development of the mobile terminal.

Referring to Fig. 8, embodiments of the present disclosure provide a display device 200, which includes the display screen 100 according to any one of the above-mentioned embodiments, and further includes a fingerprint module 210 for recognizing fingerprints from a user and a frame 211. The display screen 100 and the fingerprint module 210 are fastened to the frame 211. The fingerprint module 210 is disposed at a side of the light shielding layer 120 away from the display layer 110 and located at a position corresponding to the hole 121. The fingerprint module 210 includes a light emitter 213 and a light inductor 212, and a first light signal emitted by the light emitter 213 and a second light signal

received by the light inductor 212 pass through the hole 121. It could be understood that the fingerprint module 210 is an optical fingerprint recognition module. The light emitter 213 can be a light source such as an LED and the like and be configured to emit incident light to the fingerprint 214. The LED light source can be disposed at a position corresponding to the
5 light-penetrating passage 133, the LED source light can also be converted into an area light source by means of a light guide plate so as to increase the transmittance of the incident light in the light shielding sheet 130. The light inductor 212 can be a photosensitive sensor for receiving reflected light b formed by the fingerprint 214. The light inductor 212 is fastened at a top of the fingerprint module 210, i.e. in a place adjacent to the hole 121.

10 When a finger is pressed on the display screen 100, light emitted by the light emitter 213 forms the incident light a. The incident light a is cast on the fingerprint 214 through the light inductor 212, the hole 121 and the display layer 110. The reflected light b is formed by the reflection of the fingerprint 214, the reflected light b is received by the light inductor 212, and a fingerprint image of fingerprint 214 is obtained after the reflected light b is processed.

15 In an embodiment, referring to Fig. 9, the display screen 100 further includes the light shielding sheet 130. The light shielding sheet 130 is disposed between the display layer 110 and the fingerprint module in the superposition manner and covers the hole 121, so as to hide the fingerprint module 210 and enhance the visual effect of the display screen 100. The light shielding sheet 130 includes the light shielding pigment 131 and the light-transparent
20 material 132, the light-penetrating passage 133 is formed by the light-transparent material 132, the light-penetrating passage 133 is along the thickness direction of the display screen 100, and the fingerprint module 210 emits or receives the light signal through the light-penetrating passage 133. The light-penetrating passage 133 can increase the light transmittance of the light shielding sheet 130. The light shielding pigment 131 has a similar
25 color to the light shielding layer 120, thus reducing the visual influence.

Referring to Fig. 9, when the finger contacts a surface of the display screen 100, the light emitted by the light emitter 213 forms the incident light a, and the incident light a is cast on the fingerprint 214 through the light inductor 212, the light shielding sheet 130, the hole 121 and the display layer 110 in sequence. As the light-transparent material 132 is
30 added to the light shielding sheet 130, the light-transparent material 132 can improve the transmittance of the light shielding sheet 130. Therefore, the light shielding sheet 130 has less influence on the incident light a, and the strength of the incident light a cast on the fingerprint 214 is higher. Correspondingly, the strength of the reflected light b formed by the incident light a being reflected by the fingerprint 214 is also higher. In addition, the reflected

light b formed by the reflection of the fingerprint 214 is cast on the light inductor 212 passing through the display layer 110, the hole 121, and the light shielding sheet 130 in sequence, and is received by the light inductor 212 and forms the fingerprint image.

First embodiment

5 Referring to Fig. 9, the light shielding sheet 130 is disposed between the display screen 100 and the fingerprint module 210 in the superposition manner. Specifically, the light shielding sheet 130 is disposed between a bottom 215 of the frame 211 and the light shielding layer 120 in the superposition manner.

Second embodiment

10 Referring to Fig. 10, the light shielding sheet 130 is fastened between the display screen 100 and the fingerprint module 210. Specifically, the fingerprint module 210 includes a second surface 216, the second surface 216 is adjacent to the hole 121, and the light shielding sheet 130 can be affixed to the second surface 216.

Third embodiment

15 Referring to Fig. 11, the light shielding sheet 130 is disposed in the hole 121. The light shielding sheet 130 can be fully filled in the hole 121, that is, the size and shape of the light shielding sheet 130 are consistent with those of the hole 121, and the light shielding sheet 130 and the light shielding layer 120 are in the same layer and have the same thickness. An orthographic projection of the light shielding sheet 130 on the fingerprint module 210 covers
20 the light inductor 212 and the light emitter 213, so as to make it convenient for the incident light emitted by the light emitter 213 to be cast on the fingerprint 214 through the hole 121 and the light shielding sheet 130, and for the light reflected by the fingerprint 214 to be cast on the light inductor 212 through the hole 121 and the light shielding sheet 130.

Referring to Fig. 12, embodiments of the present disclosure provide a mobile terminal
25 300, including the display device 200 in any one of the above-mentioned embodiments.

Regarding the display screen 100, the display device 200 and the mobile terminal 300 provided in embodiments of the present disclosure, the display device 200 includes the display screen 100 and the fingerprint module 210 disposed below the display screen 100. The display screen 100 includes the display layer 110 and the light shielding layer 120, the
30 light shielding layer 120 is fastened to the lower surface 112 of the display layer 110, and the light shielding layer 120 has the hole 121. The fingerprint module 210 is located at the position corresponding to the hole 121. The fingerprint module 210 includes the light emitter 213 and the light inductor 212, the light signal emitted by the light emitter 213 is transmitted to the fingerprint 214 through the hole 121 and the display layer 110, and then is received by

the light inductor 212 through the display layer 110 and the hole 121 after being reflected by the fingerprint 214, thus improving the fingerprint acquisition and recognition efficiency of the fingerprint module 210. In addition, by providing the light shielding sheet 130 to cover the hole 121 so as to hide the fingerprint module 210, the visual influence of the hole 121 on the user is reduced and the user experience is enhanced.

In summary, the preferred embodiments of the present disclosure has been disclosed as above, but the preferred embodiments are not intended to limit the present disclosure, those ordinarily skilled in the art can make carious changes and retouched without departing from the spirit and scope of the present disclosure. Therefore, the protection scope of the present disclosure is defined by the claims.

CLAIMS

What is claimed is:

1. A display screen (100), comprising a display layer (110) and a light shielding layer (120), the
5 display layer (110) having an upper surface (111) and a lower surface (112) opposite to the upper
surface (111), the upper surface (111) being configured to face a user, the light shielding layer
(120) being arranged to the lower surface (112) of the display layer (110), the light shielding layer
(120) having a hole (121) to allow a sensing signal of a fingerprint module (210) to pass through.
2. The display screen (100) according to claim 1, wherein the light shielding layer (120) is light
10 shielding layer (120) configured to block light from penetrating the display layer (110), the
fingerprint module (210) is an optical fingerprint module (210), and the hole (121) is configured
to allow a light signal emitted and received by the fingerprint module (210) to pass through.
3. The display screen (100) according to claim 1, wherein the light shielding layer (120) is
selected from a group consisting of a lightproof ink layer and a foam layer.
- 15 4. The display screen (100) according to claim 1, wherein the display layer (110) comprises an
upper covering plate (114), a touch sensitive layer (115), an organic luminous layer (116), and a
lower covering plate (117) superposed in sequence.
5. The display screen (100) according to claim 2, further comprising a light shielding sheet (130),
wherein the light shielding sheet (130) is disposed between the display layer (110) and the
20 fingerprint module (210) in the superposition manner and covers the hole (121); the light
shielding sheet (130) comprises a light shielding pigment (131) and a light-transparent material, a
light-penetrating passage (133) is formed by the light-transparent material, the fingerprint module
(210) emits and receives the light signal through the light-penetrating passage (133), and the light
shielding pigment (131) has a similar color to the light shielding layer (120).
- 25 6. The display screen (100) according to claim 5, wherein the light shielding sheet (130) is
disposed between the display layer (110) and the light shielding layer (120) in the superposition
manner.
7. The display screen (100) according to claim 5, wherein the light shielding layer (120) has a first
surface (123) away from the display layer (110), and the light shielding sheet (130) is affixed to
30 the first surface (123) of the light shielding layer (120).
8. The display screen (100) according to claim 5, wherein the light shielding sheet (130) is
disposed in the hole (121).
9. The display screen (100) according to claim 5, wherein the fingerprint module (210) has a
second surface (216) adjacent to the hole (121), and the light shielding sheet (130) is affixed to the

second surface (216).

10. A display device, comprising a display screen (100) according to claim 1, and further comprising a fingerprint module (210) for recognizing fingerprints from a user and a frame (211), the display screen (100) and the fingerprint module (210) being fastened to the frame (211), the fingerprint module (210) being disposed at a side of the light shielding layer (120) away from the display layer (110) and located at a position corresponding to the hole (121), the fingerprint module (210) comprising a light emitter (213) and a light inductor (212), and a first light signal emitted by the light emitter (213) and a second light signal received by the light inductor (212) passing through the hole (121).
11. The display device according to claim 10, further comprising a light shielding sheet (130), wherein the light shielding sheet (130) is disposed between the display layer (110) and the fingerprint module (210) in a superposition manner and covers the hole (121); the light shielding sheet (130) comprises a light shielding pigment (131) and a light-transparent material, a light-penetrating passage (133) is formed by the light-transparent material, the fingerprint module (210) emits and receives the light signal through the light-penetrating passage (133), and the light shielding pigment (131) has a similar color to the light shielding layer (120).
12. The display device according to claim 11, wherein a size of a granule of the light-transparent material is 1~20 μ m.
13. The display device according to claim 11, wherein a mass percent of the light-transparent material to the light shielding sheet (130) is 1%~20%.
14. The display device according to claim 11, wherein the fingerprint module (210) has a second surface (216) adjacent to the hole (121), and the light shielding sheet (130) is affixed to the second surface (216).
15. A mobile terminal, comprising a display device according to any one of claims 10 to 14.