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Display device and electronic device having display layer, second driving layer, and first driving layer stacked in sequence

Abstract

A display device includes a display layer, a first driving layer, and a second driving layer. The display layer includes a plurality of first pixels disposed in the first display area and a plurality of second pixels disposed in the second display area. The first driving layer includes a plurality of first driving units disposed in the second display area. The second driving layer includes a plurality of second driving units disposed in the second display area and is provided with a plurality of via holes penetrating the second driving layer. The via holes are configured for a plurality of signal lines to pass through to electrically connect the first driving units and the first pixels. An electronic device includes a display device.

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Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS (1) This application is a continuation of International Application No. PCT/CN2020/118940 filed on Sep. 29, 2020, which claims priority to Chinese Patent Application Nos. 201911050809.4 and 201921868153.2, entitled “DISPLAY DEVICE AND ELECTRONIC DEVICE”, both of which were filed on Oct. 31, 2019, the entire contents of which are incorporated herein by reference in their entireties.

FIELD OF TECHNOLOGY
(1) The present disclosure relates to the field of electronic technology, and particularly to a display device and an electronic device.
BACKGROUND
(2) With the development of communication technology, electronic devices such as smart phones are becoming more and more popular. During use of the electronic devices, the electronic devices can display images through their display screens. For better display and user experience, sizes of the display screens are getting bigger and bigger. However, when the display screens exceed a certain size, the electronic devices are difficult to hold. Therefore, it is more and more important to increase screen-to-body ratios of the display screens.
(3) In the related art, a camera is disposed on a back of a display device. The display device is provided with a light transmission channel corresponding to the camera, such as a notch or an opening. The camera is configured to obtain external light signals through the light transmission channel for imaging. The light transmission channel occupies an area of a display surface of the display device.
SUMMARY
(4) The present disclosure provides a display device and an electronic device whose screen-to-body ratios are increased.
(5) The present disclosure provides a display device comprising a first display area and a second display area and further comprising a display layer, a first driving layer, and a second driving layer. The display layer comprises a plurality of first pixels disposed in the first display area and a plurality of second pixels disposed in the second display area. The first driving layer comprises a plurality of first driving units disposed in the second display area. The first driving units are configured to drive the first pixels. The second driving layer comprises a plurality of second driving units disposed in the second display area. The second driving layer is provided with a plurality of via holes penetrating the second driving layer in a thickness direction of the second

driving layer, wherein the second driving units are configured to drive the second pixels. At least some of the via holes are located in the second display area and are configured for a plurality of signal lines to pass through to electrically connect the first driving units and the first pixels. The display layer, the second driving layer, and the first driving layer are stacked in sequence.
(6) The present disclosure provides an electronic device comprising a display device and a functional device. The display device comprising a first display area and a second display area, and further comprises a display layer, a first driving layer, and a second driving layer. The display layer comprises a plurality of first pixels disposed in the first display area. The first driving layer is disposed below the display layer and comprises a plurality of first driving units disposed in the second display area. The first driving units are configured to drive the first pixels. The second driving layer is disposed between the display layer and the first driving layer. The second driving layer is provided with a plurality of via holes penetrating the second driving layer. The via holes are configured for a plurality of signal lines to pass through to electrically connect the first driving units and the first pixels. The functional device is configured to transmit a light signal through the first display area.

Description

BRIEF DESCRIPTION OF DRAWINGS
(1) In order to more clearly illustrate technical solutions in embodiments of the present disclosure, a brief description of accompanying drawings used in a description of the embodiments will be given below.
(2) FIG. **1** is a schematic structural diagram of an electronic device according to an embodiment of the present disclosure.
(3) FIG. **2** is a schematic structural diagram of a display device in the electronic device shown in FIG. **1**.
(4) FIG. **3** is a cross-sectional view of the display device shown in FIG. **2** along a line P**2**-P**2**.
(5) FIG. **4** is a partial schematic diagram of the display device shown in FIG. **2**.
(6) FIG. **5** is another partial schematic diagram of the display device shown in FIG. **2**.
(7) FIG. **6** is a schematic diagram of a first arrangement of a first display unit in a first display area of the display device shown in FIG. **2**.
(8) FIG. **7** is a schematic diagram of a second arrangement of the first display unit in the first display area of the display device shown in FIG. **2**.
(9) FIG. **8** is a schematic diagram of a third arrangement of the first display unit in the first display area of the display device shown in FIG. **2**.
(10) FIG. **9** is a schematic diagram of a fourth arrangement of the first display unit in the first display area of the display device shown in FIG. **2**.
(11) FIG. **10** is another schematic structural diagram of the display device according to an embodiment of the present disclosure.
(12) FIG. **11** is a cross-sectional view of the display device shown in FIG. **10** along a line P**6**-P**6**.
(13) FIG. **12** is a first partial schematic diagram of the display device shown in FIG. **10**.
(14) FIG. **13** is a second partial schematic diagram of the display device shown in FIG. **10**.
(15) FIG. **14** is a third partial schematic diagram of the display device shown in FIG. **10**.
(16) FIG. **15** is a first schematic structural diagram of a cooperation of the display device in the electronic device and a camera according to an embodiment of the present disclosure.
(17) FIG. **16** is a second schematic structural diagram of the cooperation of the display device in the electronic device and the camera according to an embodiment of the present disclosure.
(18) FIG. **17** is a cross-sectional view of the display device shown in FIG. **2** along a line P**4**-P**4**.
(19) FIG. **18** is a third schematic structural diagram of the cooperation of the display device in the

electronic device and the camera according to an embodiment of the present disclosure.
(20) FIG. **19** is a fourth schematic structural diagram of the cooperation of the display device in the electronic device and the camera according to an embodiment of the present disclosure.
(21) FIG. **20** is a fifth schematic structural diagram of the cooperation of the display device in the electronic device and the camera according to an embodiment of the present disclosure.
DETAILED DESCRIPTION OF EMBODIMENTS
(22) The present disclosure provides a display device and an electronic device. The electronic device may comprise the display device and a camera. The camera may be disposed under the display device. That is, the camera can collect images through the display device. It is understandable that a conventional display device has a relatively low light transmittance, and an effect of the camera collecting images through the display device is not good. In this regard, in the present disclosure, the display device may be partitioned.
(23) For example, a light transmittance of a part of the display device corresponding to the camera is set to be greater than a light transmittance of other portions of the display device, which can improve an effect of the camera collecting images. Technical solutions in embodiments of the present disclosure will be clearly and completely described below in conjunction with accompanying drawings in the embodiments of the present disclosure.
(24) Please refer to FIG. **1**. FIG. **1** is a first schematic structural diagram of an electronic device **10** according to an embodiment of the present disclosure. The electronic device **10** may be a computing device such as a handheld or portable electronic device (such as a laptop computer, a computer monitor containing an embedded computer, a tablet computer, a cell phone, or a media player), a small device (such as a wrist watch device, a hanging device, an earphone or earpiece device, a device embedded in a glasses, a device worn on a user's head, or other wearable or miniature device), a televisions, a computer monitor that does not contain an embedded computer, a game device, a navigation device, an embedded system (such as a system in which an electronic device with a display device is installed in a kiosk or a car), a device that implements functions of two or more of the above devices, or other electronic device. In an exemplary configuration of FIG. **1**, the electronic device **10** is a portable device, such as a cell phone, a media player, a tablet computer, or other portable computing device. Other configurations are available to the electronic device **10**, if desired. FIG. **1** is only exemplary.
(25) It should be understood that a term “a plurality of” mentioned herein means “two or more”.
(26) Please refer to FIG. **1**, the electronic device **10** comprises a display device **20**. The display device **20** can display images. The display device **20** may be an organic light-emitting diode (OLED) display device. A display surface of the display device **20** may have a larger display area and a narrower non-display area. In other words, the display device **20** has a narrower black border. The display surface of the display device **20** may also be a display area, and no non-display area is provided. That is, the display device **20** may have a full screen. A display device cover layer, such as a transparent glass layer, light-transmitting plastic, sapphire, or other transparent dielectric layer, may be used to protect the display device **20**.
(27) The display device **20** may have a regular shape, such as a rectangle, a rounded rectangle, or a circle.
(28) In some embodiments, the display device **20** may have an irregular shape, which is not limited in this embodiment.
(29) Please refer to FIG. **2**. FIG. **2** is a schematic structural diagram of the display device **20** in the electronic device **10** shown in FIG. **1**. The display device **20** may comprises a first display area **240** and a second display area **220**. Both the first display area **240** and the second display area **220** can display images. The first display area **240** and the second display area **220** may display a same image or different images.
(30) The first display area **240** and the second display area **220** may be adjacent to each other.
(31) For example, a periphery of the first display area **240** is surrounded by the second display area

220.
(32) For another example, a part of the first display area **240** is surrounded by the second display area **220**, that is, the first display area **240** is located at an end surface or a junction of end surfaces of the display device **20**. It can be understood that the junction of the end surfaces of the display device **20** is a position where two end surfaces of the display device **20** are connected to each other, and it may include parts of the two end surfaces connected to each other. It should be noted that there may be one or multiple first display areas **240**. When there are multiple first display areas **240**, the first display areas **240** may be located on one same end surface of the display device **20**, may be located on multiple end surfaces of the display device **20**, or may be located on multiple junctions of the end surfaces of the display device **20**. Alternatively, some of the first display areas **240** are located at the junctions of the end surfaces of the display device **20**, and some of the first display areas **240** are located at the end surfaces of the display device **20**.
(33) In this embodiment, an area of the second display area **220** may be set to be greater than an area of the first display area **240**. The second display area **220** may be used as a main display area of the display device **20**. The first display area **240** may be used as an auxiliary display area or a function display area of the display device **20**.
(34) For example, a light transmittance of the first display area **240** may be set to be greater than a light transmittance of the second display area **220**. thereby greatly improving the light transmittance of the first display area **240** in a non-display state of the first display area **240**. A functional component of the electronic device **10**, such as a camera **60**, a sensor, or other component, may be disposed in the first display area **240** to improve a quality of signal transmission of the camera **60**, the sensor, or other device through the first display area **240**.
(35) It should be noted that in some embodiments, the area of the first display area **240** and the area of the second display area **220** may be set to be same, or the area of the first display area **240** may be set to be greater than the area of the second display area **220**.
(36) In this embodiment, the functional component such as the camera **60** or the sensor may be disposed at a corresponding position of the first display area **240** (such as under the first display area **240**). When the first display area **240** is in the non-display state, the functional component such as the camera **60** or the sensor can perform signal transmission (such as image collection) through the first display area **240**. Furthermore, the first display area **240** can also display images according to requirements, so that an integrity of the display device **20** and an integrity of a display area are realized. This not only realizes a hidden design of the functional component such as the camera **60** or the sensor, but also increases a screen-to-body ratio of the electronic device **10**.
(37) It should be noted that the functional component of the electronic device **10**, such as the camera **60** or the sensor, is not limited to be disposed under the first display area **240**, and it may be disposed away from the first display area **240**. A light guide rod may be disposed between the functional component, such as the camera **60** or the sensor, and the first display area **240** to realize signal transmission. The light guide rod can transmit light signals emitted by the functional component, such as the camera **60** or the sensor, to the first display area **240** and transmit the light signals to an outside of the electronic device **10** through the first display area **240**. The light guide rod can also transmit an external light signal passing through the first display area **240** to the functional component such as the camera **60** or the sensor. The light guide rod may have a cylindrical structure or a multi-segment structure. When the light guide rod has a multi-segment structure, it may have at least one light guide surface to realize reflection of the light signals.
(38) In order to set the light transmittance of the first display area **240** to be greater than the light transmittance of the second display area **220**, in this embodiment, driving units such as thin film transistors (TFTs) in the display device **20** that drive the first display area **240** may be disposed outside the first display area **240**.
(39) For example, the driving units are disposed in a driving layer that is disposed in the display device **20** to drive the second display area **220**. For another example, the driving units are disposed

on a side or a periphery of the display device **20**. For yet another example, the driving units are disposed in a non-display area of the display device **20**. For still another example, a double-layer driving structure is disposed in the display device **20**, and the driving units such as TFTs driving the first display area **240** are disposed in a part of the double-layer driving structure corresponding to the second display area **220** through via holes.

(40) Please refer to FIG. **3**. FIG. **3** is a cross-sectional view of the display device **20** shown in FIG. **2** along a line P**2**-P**2**. The display device **20** may include an upper substrate **250**, a display layer **210**, a driving layer **230**, and a lower substrate **270** that are sequentially stacked. In the display device **20**, the driving layer **230** drives the display layer **210** to display images. Both the upper substrate **250** and the lower substrate **270** may be made of a transparent material, such as transparent glass. The lower substrate **270** may be defined as a first substrate, and the upper substrate **250** may be defined as a second substrate.

(41) Please refer to FIG. **3** and FIG. **4**. FIG. **4** is a partial schematic diagram of the display device shown in FIG. **2**. The display layer **210** may include multiple pixels. The display layer **210** includes a second display portion **212** located in the second display area **220** and a first display portion **214** located in the first display area **240**. That is, the display layer **210** may include a plurality of second pixels **222** disposed in the second display area **220** and a plurality of first pixels **242** disposed in the first display area **240**. The second pixels **222** may be disposed in an array, and the first pixels **242** may be disposed in an array. An arrangement of the first pixels **242** in the first display area **240** may be a standard RGB arrangement, a Pentile arrangement, or a Delta arrangement. An arrangement of the second pixels **222** in the second display area **220** may be a standard RGB arrangement, a Pentile arrangement, or a Delta arrangement. It should be noted that the first pixels **242** in the first display area **240** may be arranged in other ways, and the second pixels **222** in the second display area **220** may also be arranged in other ways.

(42) Please refer to FIG. **3**. It can be understood that the first display portion **214** and the second display portion **212** are only used to define positions of portions of the display layer **210**. The first display portion **214** may include pixels, and the second display portion **212** may also include pixels. Both the first display portion **214** and the second display portion **212** have a same function as the display layer **210**.

(43) Please refer to FIG. **3** and FIG. **4**. In order to further increase the light transmittance of the first display area **240**, the first pixels **242** in the first display area **240** may be made of a light-transmitting material in this embodiment.

(44) In some embodiments, the first pixels **242** may be arranged more sparsely than the second pixels **222**. That is, an arrangement density of the first pixels **242** may be less than an arrangement density of the second pixels **222**.

(45) The driving layer **230** may include multiple driving units. Each driving unit can drive at least one pixel. The driving layer **230** includes a plurality of first driving units for driving the first display area **240** and a plurality of second driving units for driving the second display area **220**. Each of the first driving units may be electrically connected to one first pixel **242** and can drive one first pixel **242**. Each of the second driving units may be electrically connected to one second pixel **222** and can drive one second pixel **222**. The driving layer **230** may further include a second driving portion **232** located in the second display area **220** and a first driving portion **234** located in the first display area **240**. The second driving units may be disposed in the second driving portion **232**, and the first driving units may be disposed in the first driving portion **234**.

(46) The driving units may adopt one of 2T1C, 5T1C, 7T1C, and other driving circuit.

(47) For example, the first driving units may adopt 2T1C, 5T1C, or 7T1C. The second driving units may adopt 2T1C, 5T1C, or 7T1C. T represents a thin film transistor, and C represents a capacitor. In order to increase the light transmittance of the first display area **240**, a driving circuit of each of the first driving units in the first display area **240** may be simpler than a driving circuit of each of the second driving units in the second display area **220**.

(48) For example, a number of thin film transistors in each of the first driving units is less than a number of thin film transistors in each of the second driving units.
(49) For example, the first driving units may adopt 2T1C or 5T1C, and the second driving unit may adopt 7T1C. The fewer the number of opaque thin film transistors in each of the first driving units, the less the opaque parts of the first display area **240**. Therefore, the light transmittance of the first display area **240** is increased.
(50) A physical structure of each of the second pixels **222** in the second display area **220** may be same as a physical structure of each of the first pixels **242** in the first display area **240**. In other words, the second display area **220** may have a same pixel physical structure as the first display area **240**.
(51) For example, a size of each of the second pixels **222** is same as a size of each of the first pixels **242**, and an arrangement of the second pixel **222** is same as an arrangement of the first pixel **242**. The second pixel **222** and the first pixel **242** may be formed in a same process. It should be noted that the physical structure of each of the second pixels **222** in the second display area **220** may be different from the physical structure of each of the first pixels **242** in the first display area **240**.
(52) For example, the size of each of the second pixels **222** is greater than the size of each of the first pixels **242**. For another example, the arrangement density of the second pixels **222** is greater than the arrangement density of the first pixels **242**. It should be noted that FIG. **4** only shows some pixels of the display device **20**. In FIG. **4**, a size of a region formed by the arranged first pixels **242** is substantially same as a size of a region formed by the arranged second pixels **222**.
(53) The first display area **240** may have a plurality of first pixel groups **244**. Each of the first pixel groups **244** may include some of the first pixels **242** connected in parallel. In other words, some of first pixels **242** are connected in parallel to form one first pixel group **244**. One first pixel group **244** may include at least two first pixels **242**. The at least two first pixels **242** in one first pixel group **244** may have a same color, for example, may be red pixels. The at least two first pixels **242** in one first pixel group **244** may have different colors, for example, may be red pixels and green pixels. The first pixels **242** in one first pixel group **244** may be connected together by a plurality of signal lines. The signal lines may be made of a light-transmitting material.
(54) Please refer to FIG. **5**. FIG. **5** is another partial schematic diagram of the display device **20** shown in FIG. **2**. FIG. **5** shows the second driving units **224** in the second display area **220** and the first driving units **246** in the first display area **240**. Each of the second driving units **224** may be electrically connected to one second pixel **222**. Each of the second driving units **224** may drive one second pixel **222**. Each of the first pixel group **244** may be electrically connected to one first driving unit **246**. Each of the first driving units **246** may drive one first pixel group **244**. That is, each of the first driving units **246** may drive all the first pixels **242** in one first pixel group **244**. Compared with one driving unit driving one pixel, this embodiment reduces a number of first driving units **246**. In this embodiment, the first driving units **246** may be disposed in the first display area **240**, for example, in the first driving portion **234**. Because fewer first driving units **246** are configured to drive the first pixels **242** in the first display area **240**, the light transmittance of the first display area **240** is improved. It should be noted that FIG. **5** only shows some of the second driving units **224** and some of the first driving units **246** in the display device **20**. In FIG. **5**, a size of a region formed by the arranged first driving units **246** is substantially same as a size of a region formed by the arranged second driving units **224**.
(55) In this embodiment, each of the first pixel groups **244** may be used as a first display unit in the first display area **240**, that is, a smallest unit for displaying images in the first display area **240**.
(56) For example, each of the first pixel groups **244** as one first display unit includes four first pixels **242** of a same color, or sixteen first pixels **242** of a same color. For another example, each of the first pixel groups **244** as one first display unit includes multiple first pixels **242** with different colors. The second pixels **222** in the second display area **220** may form a second display unit, or a second pixel unit.

(57) For example, the second pixel unit in the second display area **220** includes a red pixel, a green pixel, and a blue pixel. The second pixel unit in the second display area **220** may further include other pixel, such as a white pixel or a yellow pixel.
(58) In this embodiment, multiple first pixel groups **244** may be used as one first display unit.
(59) For example, three first pixel groups **244** may be used as one first display unit. For another example, four first pixel groups **244** may be used as one first display unit. Each of the first pixel groups **244** in one first display unit may include four first pixels **242** of the same color or sixteen first pixels **242** of the same color.
(60) For example, one first display unit includes three first pixel groups **244**. Among the three first pixel groups **244**, one first pixel group **244** includes four red pixels, another first pixel group **244** includes four green pixels, and the other first pixel group **244** includes four blue pixels.
(61) Please refer to FIG. **6**. FIG. **6** is a schematic diagram of a first arrangement of a first display unit in a first display area of the display device shown in FIG. **2**. One first display unit **216***a* in the first display area **240** may include three first pixel groups **244**, which may be a first pixel group **244***a*, a first pixel group **244***b*, and a first pixel group **244***c*. The first pixel group **244***a* may include four red pixels **242** (R). The first pixel group **244***b* may include four green pixels **242** (G). The first pixel group **244***c* may include four blue pixels **242** (B). It should be noted that an arrangement of multiple first pixel groups in one first display unit is not limited to this arrangement.
(62) Please refer to FIG. **7**. FIG. **7** is a schematic diagram of a second arrangement of the first display unit in the first display area of the display device shown in FIG. **2**. One first display unit **216***b* in the first display area **240** may include three first pixel groups **244**, which may be a first pixel group **244***d*, a first pixel group **244***e*, and a first pixel group **244***f*. The first pixel group **244***d* may include four red pixels **242** (R). The first pixel group **244***e* may include four green pixels **242**(G). The first pixel group **244***f* may include four blue pixels **242** (B).
(63) FIG. **8** is a schematic diagram of a third arrangement of the first display unit in the first display area of the display device shown in FIG. **2**. One first display unit **216***c* in the first display area **240** may include three first pixel groups **244**, which may be a first pixel group **244***h*, a first pixel group **244***i*, and a first pixel group **244***j*. The first pixel group **244***h* may include four red pixels **242** (R). The first pixel group **244***i* may include four green pixels **242**(G). The first pixel group **244***j* may include four blue pixels **242** (B).
(64) FIG. **9** is a schematic diagram of a fourth arrangement of the first display unit in the first display area of the display device shown in FIG. **2**. One first display unit **216***d* in the first display area **240** may include three first pixel groups **244**, which may be a first pixel group **244***k*, a first pixel group **244***m*, and a first pixel group **244***n*. The first pixel group **244***k* may include four red pixels **242** (R). The first pixel group **244***m* may include four green pixels **242**(G). The first pixel group **244***n* may include four blue pixels **242** (B).
(65) It can be understood that when one first display unit in the first display area **240** includes four first pixel groups **244**, the first pixels **242** in each of the four first pixel groups **244** have a same color.
(66) For example, one first pixel group **244** includes a plurality of red pixels, another first pixel group **244** includes a plurality of green pixels, yet another first pixel group **244** includes a plurality of blue pixels, and the other first pixel group **244** includes a plurality of white pixels. Alternatively, the other first pixel group **244** includes a plurality of yellow pixels.
(67) FIG. **6** to FIG. **9** only show some arrangements of one first display unit in the first display area **240** of the display device **20**. In this embodiment, one first display unit in the first display area **240** may have other arrangements.
(68) It should be noted that, in some solutions, in order to improve the light transmittance of the first display area, the size of the first pixels in the first display area may be set to be greater than the size of the second pixels in the second display area, and the first pixels in the first display area may be arranged more sparsely than the second pixels in the second display area. Therefore, the first

pixels in the first display area and the second pixels in the second display area have different pixel physical structures. In an actual manufacturing process, because the first pixels in the first display area and the second pixels in the second display area have different pixel physical structures, the pixel physical structures need to be formed through a series of processes such as exposure, development, and cleaning using different masks.

(69) For example, the first pixels in the first display area need to be formed by a first type of mask through a first set of processes. The second pixels in the second display area need to be formed by a second type of mask through a second set of processes. This not only requires additional masks and tools, but also increases processes, increases processing cost and complexity, and reduces a yield of the pixels formed.

(70) In order to save tools and processes, the first pixels in the first display area and the second pixels in the second display area may be formed with a same tool, such as a mask, in a same process, so that the physical structure of each of the first pixels in the first display area is same as the physical structure of each of the second pixels in the second display area. However, when the physical structure of each of the first pixels in the first display area is same as the physical structure of each of the second pixels in the second display area, and the first pixels in the first display area and the second pixels in the second display area are driven in a same way, the first display area needs to be provided with too many wires and the first driving units. Too many wires will affect the light transmittance of the first display area.

(71) In another solution, in order to reduce processes, process cost, and a number of signal lines in the first display area, facilitate an arrangement of the signal lines in the first display area, and improve the light transmittance of the first display area, In this embodiment, at least two first pixels in the first display area are connected in parallel to form one first pixel group. Multiple first pixels may be connected to one same signal line after being connected in parallel. Compared with each first pixel being connected to one signal line, the number of the signal lines may be greatly saved, the arrangement of the signal lines is facilitated, and the light transmittance of the first display area is improved.

(72) Accordingly, in this embodiment, at least two first pixels in the first display area are connected in parallel to form one first pixel group, which changes a wiring in a part of the display layer in the first display area without changing a pixel physical structure of the entire display device, so as to greatly reduce the number of the signal lines arranged in the first display area, thereby improving the light transmittance of the first display area.

(73) In order to further improve the light transmittance of the first display area **240**, some of all the first driving units for driving the first display area **240** may be disposed in the first display area **240**, and others may be disposed in other positions, such as the second display area **220**.

(74) For example, some of the first driving units are disposed in the first driving portion **234**, and the others are disposed in the second driving portion **232**.

(75) In this embodiment, all the first driving units for driving the first display area **240** may be disposed in other positions.

(76) For example, all the first driving units may be disposed in the second display area **220**.

(77) It should be noted that if the first driving units **246** for driving the first pixels **242** in the first display area **240** is disposed in the second display area **220**, such as the second driving portion **232**, wires need to be disposed. Considering that the wires will occupy a space where the first display area **240** and the second display area **220** are connected, if there are too many wires, the space may not be enough to dispose the wires, and it is necessary to increase a thickness of the driving layer **230** to dispose more wires. In order not to increase the thickness of the driving layer **230** where the wires are located, and to ensure that there is enough space for wiring at a connection between the first display area **240** and the second display area **220**. At least two first pixels **242** in the first display area **240** may be connected in parallel to form one first pixel group **244** and then connected to one same signal line, which can greatly reduce the number of the signal lines and the space

occupied by the signal lines. Therefore, the first driving units **246** for driving the first pixels **242** in the first display area **240** are disposed in the second display area **220**.

(78) However, considering that the second display area **220** is the main display area of the display device **20**, if all the first driving units **246** for driving the first display area **240** are disposed in the second display area **220**, a setting of the second driving portion **232** in the second display area **240** will be affected, and a wiring process of the second driving portion **232** be affected. This may affect a quality and effect of images displayed in the second display area **220**. In this embodiment, in order to reduce an influence of the first driving units **246** on the second display area **220**, a third display area may be disposed between the second display area **220** and the first display area **240** to form a transition area. The first driving units **246** may be disposed in the third display area to reduce the influence of the first driving units **246** on the second display area **220**.

(79) Please refer to FIG. **10**. FIG. **10** is another schematic structural diagram of the display device according to an embodiment of the present disclosure. The display device **20** may further include a third display area **260**, which may also be referred to as a transition area. The third display area **260** may connect the second display area **220** and the first display area **240**. The third display area **260** may be connected between the second display area **220** and the first display area **240**. In this embodiment, the third display area **260** may separate the second display area **220** from the first display area **240**, so that the second display area **220** and the first display area **240** are not directly connected. In this embodiment, the third display area **260** may be connected to a part of the second display area **220** and a part of the first display area **240**, and the other part of the second display area **220** may be connected to the other part of the first display area **240**. A size of the third display area **260** may be much less than a size of the second display area **220**. The first display area **240** and the third display area **260** may together form an auxiliary display area of the display device **20**. The first display area **240** and the third display area **260** may be defined as auxiliary display areas, or function display areas.

(80) Please refer to FIG. **11**. FIG. **11** is a cross-sectional view of the display device shown in FIG. **10** along a line P**6**-P**6**. The display layer **210** may further include a third display portion **216** in the third display area **260**. The third display part **216** may be provided with a plurality of third pixels. An arrangement of the third pixels may be a standard RGB arrangement, a Pentile arrangement, or a Delta arrangement. The third pixels may be arranged in other ways. The driving layer **230** may further include a third driving portion **236**. The third driving portion **236** may be provided with a plurality of driving units.

(81) For example, the third driving portion **236** is provided with a plurality of third driving units, each of the third driving units may be electrically connected to one third pixel, and each of the third driving units may drive one third pixel. The third driving units may adopt 2T1C, 5T1C, or 7T1C.

(82) For example, the third drive units adopt 5T1C. In this embodiment, the third display area **260** may adopt 5T1C, the first display area **240** may adopt 2T1C, and the second display area **220** may adopt 7T1C, so that the quality of the images displayed in the second display area **220** is greater than a quality of images displayed in the third display area **260**, and the quality of the images displayed in the third display area **260** is greater than a quality of images displayed in the first display area **240**. Therefore, a transition is presented between the first display area **240** and the second display area **220**.

(83) Driving manners of the first display area **240**, the second display area **220**, and the third display area **260** are not limited to the above driving manners.

(84) For example, the first display area **240** and the third display area **260** both adopt 5T1C, and the second display area **220** adopts 7T1C.

(85) Please refer to FIG. **12**. FIG. **12** is a first partial schematic diagram of the display device shown in FIG. **10**. An arrangement of the third pixels **262** in the third display area **260** may be same as the arrangement of the second pixels **222** in the second display area **220**, and may also be same as the arrangement of the first pixels **242** in the first display area **240**.

(86) For example, the second display area **220**, the third display area **260**, and the first display area **240** have a same pixel physical structure. The pixels in the second display area **220**, the third display area **260**, and the first display area **240** may be formed in a same process. It should be noted that the arrangement of the third pixels **262** in the third display area **260** may be different from the arrangement of the second pixels **222** in the second display area **220** or the arrangement of the first pixels **242** in the first display area **240**. It should be noted that FIG. **11** only shows some pixels of the display device **20**. In FIG. **11**, a size of a region formed by the arranged first pixels **242**, a size of a region formed by the arranged third pixels **262**, and a size of a region formed by the arranged second pixels **222** are substantially same.
(87) In this embodiment, all the first driving units **246** for driving the first display area **240** may be disposed in the third display area **260**.
(88) For example, the first driving units **246** are disposed in the third display portion **236**, so that a part of the driving layer **230** in the first display area **240** has no first driving units **246**.
(89) For example, the first driving portion **234** in the first display area **240** has no thin film transistors. This can greatly improve the light transmittance of the first display area **240**. Furthermore, this can avoid other problems caused by disposing the first driving units in the first display area **240**, such as diffraction caused by the periodically arranged first driving units **246** to imaging of the camera **60**, and stray light caused by reflection and refraction of the first driving units **246** to the imaging of the camera **60**.
(90) It should be noted that, the third display area **260** is provided with the third driving units, and the third driving units occupy a space of the third driving portion **236**. In the present disclosure, the first driving units disposed in the third driving portion **236** also occupy the space of the third driving portion **236**, and signal lines also occupy the space of the third driving portion **236**. In order to ensure that the first driving units can be disposed in the third driving portion **236**, the signal lines in the third driving portion **236** may be set thinner, thereby reducing a space occupied by each signal line and accommodating more signal lines.
(91) In this embodiment, a number of third driving units in the third display area **260** may be reduced, so that the first driving units can be disposed in the third driving portion **236** without changing a thickness of the signal lines in the third driving portion **236**, and the wiring requirements can be met.
(92) Please refer to FIG. **12**, the third display area **260** may be provided with a plurality of third pixel groups **264**. Each of the third pixel groups **264** may include at least two third pixels **262** connected in parallel, and may include at least two third pixels **262** of a same color, such as red pixels. Each of the third pixel groups **264** may include at least two third pixels **262** of different colors, such as red pixels and green pixels. The third pixels **262** in one third pixel group **264** may be connected together by a plurality of signal lines. A number of the third pixels **262** in each of the third pixel groups **264** may be more than a number of the first pixels **242** in each of the first pixel groups **244**.
(93) For example, each of the third pixel groups **264** includes four third pixels **262**, and each of the first pixel groups **244** includes sixteen first pixels **242**.
(94) In addition, the number of the third pixels **262** in each of the third pixel groups **264** may be same as the number of the first pixels **242** in each of the first pixel groups **244**.
(95) In this embodiment, each of the third pixel groups **264** may be used as a third display unit in the third display area **260**.
(96) For example, each of the third pixel groups **264** as one third display unit includes two third pixels **262** of the same color, or four third pixels **262** of the same color. For another example, each of the third pixel groups **264** as one third display unit includes multiple third pixels **262** with different colors.
(97) In this embodiment, multiple third pixel groups **264** may be used as one third display unit.
(98) For example, three third pixel groups **264** may be used as one third display unit. For another

example, four third pixel groups **264** may be used as one third display unit. Each of the third pixel groups **264** in one third display unit may include two third pixels **262** of the same color or four third pixels **262** of the same color.

(99) For example, one third display unit includes three third pixel groups **264**. Among the three third pixel groups **264**, one third pixel group **264** includes four red pixels, another third pixel group **264** includes four green pixels, and the other third pixel group **264** includes four blue pixels. Regarding a number of the third pixel groups **264** included in one third display unit and an arrangement of the third pixels **262** in one third display unit, reference may be made to structures of the first display unit shown in FIG. **6** to FIG. **9**, which will not be described in detail herein.

(100) It can be understood that when one first display unit in the third display area **260** includes four third pixel groups **264**, the first pixels **242** in each of the four third pixel groups **264** have a same color.

(101) For example, one third pixel group **264** includes a plurality of red pixels, another third pixel group **264** includes a plurality of green pixels, yet another third pixel group **264** includes a plurality of blue pixels, and the other third pixel group **264** includes a plurality of white pixels. Alternatively, the other third pixel group **264** includes a plurality of yellow pixels.

(102) Please refer to FIG. **13**. FIG. **13** is a second partial schematic diagram of the display device shown in FIG. **10**. FIG. **13** shows the second driving units **224** in the second display area **220**, and the third driving units **266** and the first driving units **246** in the third display area **260**. For the second driving units **224**, please refer to the above description of FIG. **5**, which will not be described in detail herein. The third driving units **266** and the first driving units **246** are disposed in the third display area **260**, for example, in the third driving portion **236**.

(103) The third driving units **266** are configured to drive the third display area **260**. Each of the third driving units **266** may be electrically connected to one third pixel group **264**. Each of the third driving units **266** may drive one third pixel group **264**. That is, each of the third driving units **266** may drive all the third pixels **262** in one third pixel group **264**. Compared with one driving unit driving one pixel, this embodiment reduces a number of third driving units **266**, thereby reducing a space of the third driving portion **236** occupied by the third driving units **266**, so as to dispose the first driving units **246**.

(104) For example, each of the third driving units **266** includes four third pixels **262** connected in parallel. One third driving unit **266** may occupy a space of the third driving portion **236** corresponding to one third pixel **262**, or a space of the third driving portion **236** slightly smaller than the space of the third driving portion **236** corresponding to the third pixel **262**. Therefore, for one third pixel group **264**, the third driving portion **236** may have empty spaces corresponding to at least three third pixels **262**. Multiple first driving units **246**, such as three first driving units **246**, may be disposed in the empty spaces. The empty spaces corresponding to the three third pixels **262** may be in a one-to-one correspondence with the three first driving units **246**.

(105) Accordingly, in this embodiment, at least two third pixels **262** in the third display area **260** may be connected in parallel to form one third pixel group **264**, the third pixels **262** in one third pixel group **264** may be driven by one third driving unit **266**, so that sufficient space is reserved in the third driving portion **236** for disposing the first driving units **246**. Therefore, opaque thin film transistors in the first display area **240** may be disposed in the third display area **260** that does not need to collect light signals through cameras and the like. The size of the third display area **260** may be set smaller, and connects the first display area **240** and the second display area **220**. Therefore, under a condition that images displayed in the second display area **220** is not greatly affected, a deterioration of a quality of images displayed in the third display area **260** will not have a significant impact on a display effect of the entire display device **20**.

(106) In addition, a number of the third pixels **262** connected in parallel in the third display area **260** may be less than a number of the first pixels **242** connected in parallel in the first display area **240**, so that a display transition between the first display area **240** and the second display area **220**

is smoother.
(107) It should be noted that, in this embodiment, the first driving units **246** are not limited to be disposed in the third display area **260**.
(108) For example, some of the first driving units **246** are disposed in the third display area **260**, and the other first driving units **246** are disposed in the first display area **240**. For another example, some of the first driving units **246** are disposed in the third display area **260**, and the other first driving units **246** are disposed in the second display area **220**. For yet another example, the first driving units **246** are divided into three parts, which are disposed in the first display area **240**, the third display area **260**, and the second display area **220**, respectively.
(109) It should also be noted that, in this embodiment, the first driving units **246** are not limited to be disposed in a display area. The first driving units **246** may be disposed in a side or a non-display area of the display device **20**.
(110) Please refer to FIG. **14**. FIG. **14** is a third partial schematic diagram of the display device shown in FIG. **10**. The display device **20** may further include a non-display area **280**. The first driving units **246** for driving the first display area **240** may be disposed in the non-display area **280**. The display device **20** may have a full screen. That is, a front surface of the display device **20** is substantially a display area. Viewed from a front surface of the electronic device **10**, the front surface of the display device **20** is substantially equal to a display surface of the electronic device **10**. However, even if the display device **20** has a full screen, the non-display area **280** still exists at an edge of the display device **20**. The non-display area **280** may be understood as a black border of the display device **20**. A width of the black border may be very narrow, for example, the width of the black border is less than 1 mm, 0.5 mm, or the like. Because the area of the first display area **240** is small, a number of the first pixels **242** in the first display area **240** is relatively small. Furthermore, multiple first pixels **242** in the first display area **240** may be connected in parallel. Therefore, the number of the first driving units **246** for driving the first display area **240** is reduced. Accordingly, the first driving units **246** may be disposed in the black border, which can improve the light transmittance of the first display area **240** without affecting the second display area **220** or the third display area **260**. Multiple first driving units **246** need to be disposed corresponding to the first pixels **242** in the first display area **240**, and all the first driving units **246** may be disposed in the black border.
(111) In order to make the black border better accommodate all the first driving units **246**, simpler first drive units **246** may be used.
(112) For example, the first driving units **246** may adopt 2T1C, 5T1C, or other driving circuit, so that a number of thin film transistors in each of the first driving units **246** is small, and one first driving unit **246** requires less space. An arrangement density of the first pixels **242** in the first display area **240** may be set smaller, so that a total number of the first driving units **246** configured to drive the first display area **240** is smaller. It should be noted that some of the first driving units **246** may be disposed in the non-display area **280** and the other first driving units **246** may be disposed in other position, such as the first display area **240** or the third display area **260**.
(113) It should be noted that, in this embodiment, a method of improving the light transmittance of the first display area **240** is not limited to the above method, and other methods may be used.
(114) For example, wires in the first display area **240** of the display device **20** may be set to be transparent, so as to increase the light transmittance of the first display area **24**. For another example, the first display area **240** may not be provided with a polarizing structure. For still another example, the first driving units **246** for driving the first display area **240** may be driven by passive driving, which greatly reduce the wires in the first display area **240** and components in the first driving units **246**. It can be understood that solutions of improving the light transmittance of the first display area **240** by increasing a light transmittance of a material and changing an arrangement of wires fall within the claimed scope of the present application.
(115) In this embodiment, the second display area **220** may be an active-driving (i.e. active-matrix

organic light-emitting diode, AMOLED) display area, and the first display area **240** may be an active-driving display area or a passive-driving (i.e. passive-matrix organic light-emitting diode, PMOLED) display area. In this embodiment, the area of the first display area **240** may be set to be less than the area of the second display area **220**, so that a display content of the first display area **240** is less than a display content of the second display area **220**, and an importance of the display content of the first display area **240** is lower than an importance of the display content of the second display area **220**. Therefore, in this embodiment, using AMOLED in the second display area **220** can ensure that the main display area of the display device **20** have a better display effect. Furthermore, the first display area **240** adopts PMOLED. The passive-driving first display area **240** can be driven by only one thin film transistor, so that a number of opaque thin film transistors is small, which greatly improve the light transmittance of the first display area **240**. Moreover, the area of the first display area **240** may be much less than the area of the second display area **220**. If a quality of images displayed in the first display area **240** is reduced, an entire display of the display device **20** will not be greatly affected. It should be noted that the first display area **240** may be active-driving, so that a display effect of the first display area **240** is close to a display effect of the second display area **220**.

(116) In this embodiment, the third display area **260** may be configured as an active-driving display area or a passive-driving display area as required. Because a physical structure of each of the third pixels **262** in the third display area **260** is same as and the physical structure of each of the first pixels **242** in the first display area **240**, the third display area **260** and the first display area **240** may be driven in a same manner.

(117) For example, the third display area **260** and the first display area **240** may be passive-driving display areas. If the area of the third display area **260** is larger, or in order to improve a display quality of the third display area **260**, the third display area **260** and the second display area **220** may be driven in a same manner, for example, may be active-driving display areas.

(118) A size and shape of the first pixels **242** in the first display area **240** may be set as required.

(119) For example, each of the first pixels **242** may be shaped as a rectangle or a circle-like shape. Each of the circle-like first pixel **242** may be shaped as a circle, an ellipse, a rounded rectangle, or the like. The circle-like first pixels **242** can improve a diffraction problem of the first display area **240** because their edges are arc-shaped.

(120) In this embodiment, the functional component of the electronic device **10**, such as the camera **60** or the sensor, may be disposed inside the display device **20**.

(121) For example, a lens of the camera **60** faces the lower substrate **270** of the display device **20**, and the camera **60** is disposed corresponding to the first display area **240**. In other words, the camera **60** is located below the lower substrate **270** in the first display area **240**. The camera **60** can acquire external light signals passing through the first display area **240** for imaging. In this embodiment, the lens of the camera **60** and the lower substrate **270** may be spaced apart. Alternatively, the lens of the camera **60** may be a part of the lower substrate **270**.

(122) For example, a part of the lower substrate **270** corresponding to the first display area **240** is formed into an arc-shaped structure.

(123) In order to reduce a space of the electronic device **10** occupied by the camera **60**, the lens of the camera **60** may be disposed close to or adjacent to the lower substrate **270** of the display device **20**. The lower substrate **270** of the display device **20** is mainly configured to carry other layers of the display device **20** and does not need to have any special function.

(124) Please refer to FIG. **15**. FIG. **15** is a first schematic structural diagram of a cooperation of the display device in the electronic device and a camera according to an embodiment of the present disclosure. In order to further reduce a space inside the electronic device **10** occupied by the camera **60**, a part of the lower substrate **270** corresponding to the camera **60** may be provided with a first mounting hole **272**. The camera **60** may be disposed at least partially in the first mounting hole **272**. The first mounting hole **272** may be a blind hole. That is, a thickness of the part of the

lower substrate **270** corresponding to the camera **60** is less than a thickness of other parts of the lower substrate **270**. The lower substrate **270** is still a complete substrate, its function of carrying other layers of the display device **20** is not affected, and a part of its space is vacated to accommodate the camera **60**. The first mounting hole **272** and the camera **60** may be installed according to a size of the first mounting hole **272** and a size of the camera **60**.

(125) For example, if a space of the first mounting hole **272** is not enough to install an entirety of the camera **60**, the lens of the camera **60** may be disposed in the first mounting hole **272**. If the camera **60** is small enough, the entirety of the camera **60** may be disposed in the first mounting hole **272**.

(126) It should be noted that the camera **60** may be replaced with another functional device of the electronic device **10**, such as a sensor. That is, at least a part of the sensor of the electronic device **10** may be disposed in the first mounting hole **272**.

(127) Please refer to FIG. **16**. FIG. **16** is a second schematic structural diagram of the cooperation of the display device in the electronic device and the camera according to an embodiment of the present disclosure. Because the part of the driving layer **230** in the first display area **240** may not be provided with the first driving units, the camera **60** may be installed in the driving layer **230**. Specifically, the first mounting hole **272** opened in the lower substrate **270** is a through hole. The part of the driving layer **230** in the first display area **240** is provided with a second mounting hole **238** corresponding to the camera **60**. The first mounting hole **272** communicates with the second mounting hole **238**. The camera **60** may be disposed at least partially in the second mounting hole **238**.

(128) For example, the lens of the camera **60** is disposed in the first mounting hole **272** and the second mounting hole **238**. The second mounting hole **238** may be a through hole or a blind hole. The first mounting hole **272** and the second mounting hole **238** may be formed after some layers of the display device **20** are formed.

(129) For example, after the driving layer **230** and the display layer **210** of the display device **20** are disposed on the lower substrate **270**, the first mounting hole **272** and the second mounting hole **238** are formed in the parts of the driving layer **230** and the display layer **210** corresponding to the lens of the camera **60** using a laser or the like.

(130) It should be noted that the camera **60** may be replaced with another functional device of the electronic device **10**, such as a sensor. That is, at least a part of the sensor of the electronic device **10** may be disposed in the first mounting hole **272** and the second mounting hole **238**.

(131) It can be understood that the camera **60** corresponding to the first display area **240** may be used as a front camera of the electronic device **10**. A current front camera is generally a camera with a lens that cannot be moved. Because the lower substrate **270** and the driving layer **230** of the display device **20** may be respectively provided with the first mounting hole **272** and the second mounting hole **238**, the camera **60** corresponding to the first display area **240** may be a camera with a movable lens. The lens of the camera **60** can be moved to realize functions such as auto focus. It should be noted that the camera **60** may be a rear camera. That is, the electronic device **10** may be provided with two opposite display devices **20**.

(132) The first display area **240** may be provided with one camera **60** or multiple cameras **60**. The multiple cameras **60** may be cameras that cooperate with each other, such as two identical cameras, a normal camera, and a bokeh camera or a black-and-white camera.

(133) In addition to the camera **60**, the first display area **240** may be further provided with other functional devices, such as a proximity sensor, a light sensor, a ranging sensor, a fingerprint recognition sensor, and the like.

(134) In this embodiment, multiple driving layers may also be used to improve the light transmittance of the first display area **240**.

(135) For example, a display device is provided with two driving layers. A plurality of first driving units for driving a first display area are disposed in one of the driving layers and away from the

first display area. And, a plurality of second driving units for driving a second display area is disposed in the other driving layer and away from the first display area. Therefore, the first and second driving units are disposed away from the first display area, which greatly improves a light transmittance of the first display area. A solution for improving the light transmittance of the first display area by using two driving layers will be described in detail below with reference to the accompanying drawings.

(136) Please refer to FIG. **17**. FIG. **17** is a cross-sectional view of the display device shown in FIG. **2** along a line P**4**-P**4**. The display device **20** may include an upper substrate **250**, a display layer **210**, a second driving layer **230**, a first driving layer **290**, and a lower substrate **270** which are stacked in sequence. In the display device **20**, the first driving layer **290** and the second driving layer **230** can drive the display layer **210** to display images. The display layer **210** shown in FIG. **17** may refer to the display layer **210** shown in FIG. **3**, the upper substrate **250** shown in FIG. **17** may refer to the upper substrate **250** shown in FIG. **3**, and the lower substrate **270** shown in FIG. **17** may refer to the lower substrate **270** shown in FIG. **3**, which will not be described in detail herein.

(137) The second driving layer **230** shown in FIG. **17** may include a second light-transmitting portion **234** and a second driving portion **232**. The second driving portion **232** may be provided with a plurality of second driving units. The second driving units disposed in the second driving portion **232** can drive a plurality of second pixels in the second display area **220**. The second driving portion **232** may be disposed in the second display area **220**. In other words, the second driving portion **232** may be disposed corresponding to the second display portion **212**.

(138) For example, the second driving portion **232** and a second display portion **212** are stacked. It should be noted that the second light-transmitting portion **234** and the second driving portion **232** are used to define positions of portions of the second driving layer **230**. The second driving layer **230** may be provided not only with driving units, but also with wires.

(139) At least a part of the second light-transmitting portion **234** may be disposed in the first display area **240**.

(140) For example, the second light-transmitting portion **234** is disposed in the first display area **240**. In other words, the second light-transmitting portion **234** may be disposed corresponding to a first display portion **214**.

(141) For example, the second light-transmitting portion **234** and the first display portion **214** are stacked. The second light-transmitting portion **234** may not be provided with driving units, so as to increase a light transmittance of the second light-transmitting portion **234**, thereby increasing the light transmittance of the first display area **240**.

(142) In some embodiments, a size of the second light-transmitting portion **234** is same as a size of the first display portion **214**. The second light-transmitting portion **234** overlaps the first display portion **214** in a direction perpendicular to the display device **20**. In other words, a projection of the second light-transmitting portion **234** on the display layer **210** overlaps with the first display portion **214**. The size of the first display portion **214** may be slightly smaller than the size of the second light-transmitting part **234**.

(143) For example, a projection of the first display portion **214** on the lower substrate **270** is located inside a projection of the second light-transmitting portion **234** on the lower substrate **270**. In this embodiment, the size of the first display portion **214** is set to be smaller than or equal to the size of the second light-transmitting portion **234** to ensure that a part of the second driving layer **230** corresponding to the first display portion **214** has no driving unit, thereby improving the light transmittance of the first display area **240**.

(144) It should be noted that a part of the second light-transmitting portion **234** may be disposed corresponding to the second display portion **212**, as long as it is ensured that the part of the second driving layer **230** corresponding to the first display portion **214** has no driving unit.

(145) Please refer to FIG. **17**, the second driving layer **230** is provided with a plurality of via holes

2322, and the via holes **2322** penetrate the second driving layer **230** in a thickness direction of the second driving layer **230**. One or more signal lines may be disposed in each of the via holes **2322**. The via holes **2322** may be provided in the second driving portion **232** but not provided in the second transparent portion **234**, which can ensure that the second light-transmitting portion **234** has no driving circuit, so that a number of wires in the second light-transmitting portion **234** are reduced, or no wires are disposed in the second light-transmitting portion **234**.

(146) The first driving layer **290** shown in FIG. **17** may include a first driving portion **292** and a first light-transmitting portion **294**. The first driving portion **292** may be provided with a plurality of first driving units. The first driving units disposed in the first driving portion **292** can drive the first pixels in the first display area **240**. The first driving portion **292** may be disposed in the second display area **220**. In other words, the first driving portion **292** may be disposed corresponding to the second display portion **212**.

(147) For example, the first driving portion **292**, the second driving portion **232**, and the second display portion **212** are stacked in sequence. It should be noted that the first driving portion **292** and the first light-transmitting portion **294** are used to define positions of portions of the first driving layer **290**. The first driving portion **292** may be provided not only with driving units, but also with wires.

(148) At least a part of the first light-transmitting portion **294** may be disposed in the first display area **240**.

(149) For example, the first light-transmitting portion **294** is disposed in the first display area **240**. In other words, the first light-transmitting portion **294** may be disposed corresponding to a first display portion **214**.

(150) For example, the first light-transmitting portion **294**, the second light-transmitting portion **234**, and the first display portion **214** are stacked in sequence. The first light-transmitting portion **294** may not be provided with driving units, so as to increase a light transmittance of the first light-transmitting portion **294**, thereby increasing the light transmittance of the first display area **240**.

(151) In some embodiments, a size of the first light-transmitting portion **294** is same as a size of the first display portion **214**. The first light-transmitting portion **294** overlaps the first display portion **214** in a direction perpendicular to the display device **20**. In other words, a projection of the first light-transmitting portion **294** on the display layer **210** overlaps with the first display portion **214**. The size of the first display portion **214** may be slightly smaller than the size of the second light-transmitting part **234**.

(152) For example, a projection of the first display portion **214** on the lower substrate **270** is located inside a projection of the first light-transmitting portion **294** on the lower substrate **270**. In this embodiment, the size of the first display portion **214** is set to be smaller than or equal to the size of the first light-transmitting portion **294** to ensure that a part of the second driving layer **230** corresponding to the first display portion **214** has no driving unit, thereby improving the light transmittance of the first display area **240**.

(153) It should be noted that a part of the first light-transmitting portion **294** may be disposed corresponding to the second display portion **212**, as long as it is ensured that the part of the first driving layer **290** corresponding to the first display portion **214** has no driving unit.

(154) It should be noted that, in this embodiment, the second light-transmitting portion **234** is located between the first light-transmitting portion **294** and the first display portion **214**. The first light-transmitting portion **294**, the second light-transmitting portion **234**, and the first display portion **214** may have a same size and overlap with each other, but a size relationship of the first light-transmitting portion **294**, the second light-transmitting portion **234**, and the first display portion **214** is not limited thereto.

(155) For example, sizes of the first light-transmitting portion **294**, the second light-transmitting portion **234**, and the first display portion **214** may be sequentially reduced. For another example, the size of the first light-transmitting portion **294** is smaller than the sizes of the second light-

transmitting portion **234** and the first display portion **214**, and the size of the second light-transmitting portion **234** is same as the size of the first display portion **214**. For yet another example, the size of the first light-transmitting portion **294** is same as the size of the second light-transmitting portion **234**, and the sizes of the first light-transmitting portion **294** and the second light-transmitting portion **234** are smaller than the size of the first display portion **214**.

(156) In this embodiment, the signal lines may be inserted into the via holes **2322**. The signal lines may electrically connect the first pixels in the first display area **240** with the first driving units in the first driving layer **290**.

(157) For example, the signal lines may electrically connect the first pixels in the first display portion **214** with the first driving units in the first driving portion **292**, so that the first driving units in the first driving portion **292** can drive the first pixels. For the first pixels, please refer to the aforementioned first pixels **242**, and for the first driving units, please refer to the aforementioned first driving units **246**, which will not be described in detail herein.

(158) One end of each of the signal lines may be electrically connected to one first pixel in the first display area **240**. The signal lines electrically connected to the first pixels may be disposed in the second display area **220** and pass through the via holes **2322** in the second display area **220**. The other end of each of the signal lines may be electrically connected to one first driving unit in the second display area **240**.

(159) For example, one end of each of the signal lines is electrically connected to one first pixel in the first display portion **214**. The signal lines may be disposed from the second light-transmitting portion **234** to the second driving portion **232**, pass through the via holes **2322** in the second driving portion **232** to the first driving portion **292**, and be electrically connected with the first driving units in the first driving part **292**. Therefore, the first driving units are not disposed in the first display area **214**, but drive the first pixels in the first display area **214**. It should be noted that in an actual wiring process, the first pixels may be arranged more sparsely than the second pixels, or the size of the first pixels may be set to be greater than the size of the second pixels, or multiple first pixels may be connected in parallel, so that a number of the signal lines is greatly reduced, and the signal lines can be disposed in the second light-transmitting portion **234** and pass through the via holes **2322**.

(160) Accordingly, in this embodiment, the display device **20** shown in FIG. **17** is provided with two driving layers, and the driving units are disposed in the second display area **220** instead of the first display area **240**, which improves the light transmittance of the first display area **240**.

(161) The via holes **2322** may be arranged in the second driving portion **232** and may be arranged around the second light-transmitting portion **234**.

(162) For example, the via holes **2322** are arranged around the second light-transmitting portion **234** at equal intervals. Compared with arranging the via holes **2322** at a certain position, in this embodiment, the via holes **2322** are arranged around the second light-transmitting portion **234** to disperse the via holes **2322**, which not only facilitates an arrangement of signal lines, but also reduces lengths of the signal lines. It should be noted that an internal space of the display device **20** is limited. When the via holes **2322** are arranged at a same position, more space of the second driving layer **230** is occupied, thereby affecting an arrangement of wires in the second driving layer **230**. In this embodiment, the via holes **2322** are arranged at intervals to reduce an influence of the via holes **2322** on the arrangement of the wires in the second driving layer **230**, which is easier to implement.

(163) It can be understood that if the via holes **2322** are arranged in the second driving portion **232**, the second driving portion **232** will be provided with multiple second driving units. The second driving units will occupy a space of the second driving portion **232**. However, a free space in the second driving portion **232** is limited. Therefore, in this embodiment, the via holes **2322** may be disposed between the second driving units.

(164) For example, one, two, or three via holes **2322** are arranged between four second driving

units. It should be noted that, the via holes **2322** may be arranged between thin film transistors of the second driving units.
(165) In order to further improve the light transmittance of the first display area **240**, the size of the first pixels in the first display area **240** may be set to be greater than the size of the second pixels in the second display area **220**.
(166) For example, the size of the first pixels is four times, sixteen times, etc., the size of the second pixels. This can reduce the number of the first pixels in the first display portion **214**, and can reduce the number of the wires and the number of the first driving units in the first display portion **214**. Therefore, it is easier to connect the first pixels in the first display portion **214** to the signal lines, and to connect the signal lines to the first driving units through the via holes **2322**. Furthermore, the number of the wires in the first display portion **214** may be reduced to further improve the light transmittance of the first display area **240**.
(167) It should be noted that the arrangement and size of the first pixels in the first display area **214** and the arrangement and size of the second pixels in the second display area **212** may be same. That is, the first display area **214** and the second display area **212** may have a same pixel physical structure. If the first display area **214** and the second display area **212** have the same pixel physical structure, the first pixels in the first display area **214** and the second pixels in the second display area **212** may refer to FIG. **4** to FIG. **9** and their corresponding contents for details, which will not be described in detail herein.
(168) For example, sixteen first pixels in the first display area **214** are connected in parallel to form one first pixel group, one first pixel group may be electrically connected to one first driving unit, and the sixteen first pixels in one first pixel group may have a same color. Three first pixel groups may form one display unit in the first display area **214**, wherein the first pixels in one first pixel group may be red pixels, the first pixels in another first pixel group may be green pixels, and the first pixels in the other first pixel group may be blue pixels. Therefore, the number of the first driving units is reduced, the number of the via holes **2322** is reduced, and the number of the wires in the first display area **240** or the first display portion **214** is reduced. It is easier to connect the first pixels in the first display portion **214** to the signal lines, and to connect the signal lines to the first driving units through the via holes **2322**. Furthermore, the wires in the first display portion **214** may be reduced to further improve the light transmittance of the first display area **240**.
(169) Accordingly, in this embodiment, if the display device **20** is combined with a functional device such as the camera **60** or a sensor, the functional device such as the camera **60** or the sensor can more easily transmit optical signals through the first display area **240** of the display device **20**.
(170) It can be understood that because the first light-transmitting portion **294** and the second light-transmitting portion **234** are not provided with the driving units, the functional device of the electronic device **10** may be disposed in the first light-transmitting portion **294** and the second light-transmitting portion **234**.
(171) Please refer to FIG. **18**. FIG. **18** is a third schematic structural diagram of the cooperation of the display device in the electronic device and the camera according to an embodiment of the present disclosure. In this embodiment, a hole **271** may be provided in the lower substrate **270**, a hole **2942** may be provided in the first light-transmitting portion **294**, and a hole **2342** may be provided in the second light-transmitting portion **234**. The hole **271** of the lower substrate **270**, the hole **2942** of the first light-transmitting portion **294**, and the hole **2342** of the second light-transmitting portion **234** may communicate with each other. In this embodiment, a part or all of a functional device such as the camera **60** or a sensor may be installed in the hole **2942**, the hole **2342**, and the hole **271**.
(172) It can be understood that the hole **2942** of the first light-transmitting portion **294** may be referred to as a first hole **2942**, and its size may be set according to a requirement of the functional device such as the camera **60**.
(173) For example, the first hole **2942** is slightly smaller than the first light-transmitting portion

294. The hole **2342** of the second light-transmitting portion may be referred to as a second hole **2342**, and its size may be set according to the requirement of the functional device such as the camera **60**.
(174) For example, the second hole **2342** is slightly smaller than the second light-transmitting portion **234**. The hole **271** of the lower substrate **270** may be referred to as a third hole **271**.
(175) It should be noted that when the functional device such as the camera **60** are installed, the camera **60** is generally composed of a lens and a base. A volume of the lens is generally smaller than a volume of the base.
(176) For example, a cross section of the lens is smaller than a cross section of the base. Therefore, a space required for accommodating the lens of the camera **60** is smaller than a space required for accommodating the base of the camera **60**. Therefore, in this embodiment, an area of the first hole **2942** parallel to the display surface of the display device **20** may be set to be greater than an area of the second hole **2342** parallel to the display surface of the display device **20**, and an area of the third hole **271** parallel to the display surface of the display device **20** may be set to be greater than the area of the first hole **2942** parallel to the display surface of the display device **20**. It can be understood that in this embodiment, the area of the second hole **2342** parallel to the display surface of the display device **20** may be set to be greater than an area of the first display portion **214** parallel to the display surface of the display device **20**. In other words, a projection of the third hole **271** on the display layer **210** covers a projection of the first hole **2942** on the display layer **210**, and the projection of the first hole **2942** on the display layer **210** covers a projection of the second hole **2342** on the display layer **210**.
(177) It should be noted that the projection of the second hole **2342** on the display layer **210** covers the first display area **240**. The first display area **240** is spatially located within the second hole **2342**, so as to facilitate the functional device such as the camera **60** to transmit signals.
(178) For example, the first hole **2942**, the second hole **2342**, and the third hole **271** are all circular holes. A diameter of the third hole **271** may be greater than a diameter of the first hole **2942**. The diameter of the first hole **2942** may be greater than a diameter of the second hole **2342**.
(179) It can be understood that in this embodiment, the first hole **2942**, the second hole **2342**, and the third hole **271** may be set to be substantially same.
(180) For example, the diameters of the first hole **2942**, the second hole **2342**, and the third hole **271** are same. In this embodiment, the area of the second hole **2342** parallel to the display surface of the display device **20** may be set to be equal to the area of the first display portion **214** parallel to the display surface of the display device **20**.
(181) Please refer to FIG. **19**. FIG. **19** is a fourth schematic structural diagram of the cooperation of the display device in the electronic device and the camera according to an embodiment of the present disclosure. In this embodiment, a third hole **271** may be provided in the lower substrate **270**, and a first hole **2942** may be provided in the first light-transmitting portion **294**. The first hole **2942** and the third hole **271** communicate with each other. The first hole **2942** may refer to the first hole **2942** shown in FIG. **18**. It should be noted that when the first hole **2942** is a blind hole, an opening of the first hole **2942** is away from the second driving layer **230** to ensure that the first hole **2942** and the third hole **271** communicate with each other. In this embodiment, a part or all of a functional device such as the camera **60** or a sensor may be installed in the hole **2942** and the hole **272**.
(182) In this embodiment, it is also possible to provide only the third hole **271** in the lower substrate **270**. Please refer to FIG. **20**, which is a fifth schematic structural diagram of the cooperation of the display device in the electronic device and the camera according to an embodiment of the present disclosure. The third hole **270** provided in the lower substrate **270** may correspond to the first light-transmitting portion **294** and the second light-transmitting portion **234**. A part or all of a functional device such as the camera **60** or a sensor may be installed in the hole **272**.

(183) Please refer to FIG. **1**, the electronic device **10** may further include a housing **40**. The housing **40** may be made of plastic, glass, ceramic, a fiber composite, a metal (e.g. stainless steel and aluminum), other suitable material, or a combination of any two or more of these materials. The housing **40** may be integrally formed. In an integrally formed process, some or all of the housing **40** is machined or molded as a single structure, or may be formed from multiple structures (e.g., an inner frame structure, and one or more structures forming an outer housing surface). The housing **40** may be provided with a receiving cavity to receive components of the electronic device **10** such as a battery, a circuit board, and the like. The housing **40** may carry the display device **20**.
(184) The display device and the electronic device provided by the present disclosure are described in detail above. The present disclosure uses specific examples to describe principles and embodiments of the present disclosure.
(185) The above description of the embodiments is only for helping to understand the present disclosure. Furthermore, those skilled in the art may make modifications to the specific embodiments and applications according to ideas of the present disclosure. In conclusion, the present specification should not be construed as a limitation to the present disclosure.

Claims

1. A display device, comprising a first display area and a second display area, and further comprising: a display layer comprising a plurality of first pixels disposed in the first display area and a plurality of second pixels disposed in the second display area, wherein the first pixels form a plurality of first pixel groups, and the first pixels in each of the first pixel groups are connected in parallel; a first driving layer comprising a plurality of first driving units disposed in the second display area, wherein the first driving units are configured to drive the first pixels; and a second driving layer comprising a plurality of second driving units disposed in the second display area and provided with a plurality of via holes penetrating the second driving layer in a thickness direction of the second driving layer, wherein the second driving units are configured to drive the second pixels, and at least some of the via holes are located in the second display area and are configured for a plurality of signal lines to pass through to electrically connect the first driving units and the first pixels; wherein the display layer, the second driving layer, and the first driving layer are stacked in sequence, and each of the first driving units is electrically connected to one first pixel group through one signal line and is configured to drive all the first pixels in the first pixel group.
2. The display device according to claim 1, further comprising a plurality of display units disposed in the first display area, each of the display units disposed in the first display area comprises at least three of the first pixel groups, in each of the display units, the first pixels in each of the first pixel groups have a same color, and the first pixels in different first pixel groups have different colors.
3. The display device according to claim 2, wherein the first display area has a same pixel physical structure as the second display area, each of the first pixel groups comprises only sixteen first pixels of a same color.
4. The display device according to claim 2, wherein a size of each of the first pixels is four times a size of each of the second pixels, each of the first pixel groups comprises only four first pixels of a same color.
5. The display device according to claim 1, wherein a size of each of the first pixels is greater than a size of each of the second pixels.
6. The display device according to claim 1, wherein the via holes are all located in the second display area.
7. The display device according to claim 6, wherein the via holes are all arranged at intervals between the second driving units.
8. The display device according to claim 6, wherein the via holes are arranged around the first display area.

9. The display device according to claim 1, wherein the first driving layer is provided with a first hole, the first hole is located in the first display area, and an opening of the first hole is located away from the second driving layer.
10. The display device according to claim 1, wherein the first driving layer is provided with a first hole, the second driving layer is provided with a second hole, the first hole and the second hole are both located in the first display area and communicate with each other.
11. The display device according to claim 10 wherein a projection of the first hole on the display layer covers a projection of the second hole on the display layer, and the projection of the second hole on the display layer covers the first display area.
12. An electronic device, comprising: a display device comprising a first display area and a second display area and further comprising: a display layer comprising a plurality of first pixels disposed in the first display area, wherein the first pixels form a plurality of first pixel groups, and the first pixels in each of the first pixel groups are connected in parallel; a first driving layer disposed below the display layer and comprising a plurality of first driving units disposed in the second display area, wherein the first driving units are configured to drive the first pixels; and a second driving layer disposed between the display layer and the first driving layer and provided with a plurality of via holes penetrating a portion of the second driving layer in the second display area, wherein the via holes are configured for a plurality of signal lines to pass through to electrically connect the first driving units and the first pixels; and a functional device configured to transmit a light signal through the first display area, wherein each of the first driving units is electrically connected to one first pixel group through one signal line and is configured to drive all the first pixels in the first pixel group.
13. The electronic device according to claim 12, wherein the first pixels in each of first pixel groups have a same color, the display device further comprises a plurality of display units disposed in the first display area, each of the display units disposed in the first display area comprises at least three of the first pixel groups, and in each of the display units, the first pixels in different first pixel groups have different colors.
14. The electronic device according to claim 13, wherein the first display area has a same pixel physical structure as the second display area, each of the first pixel groups comprises only sixteen first pixels of a same color.
15. The electronic device according to claim 13, wherein the display layer further comprises a plurality of second pixels disposed in the second display area, and a size of each of the first pixels is four times a size of each of the second pixels, each of the first pixel groups comprises only four first pixels of a same color.
16. The electronic device according to claim 13, wherein the display layer further comprises a plurality of second pixels disposed in the second display area, and a size of each of the first pixels is greater than a size of each of the second pixels, the second driving layer further comprises a plurality of second driving units disposed in the second display area, the second driving units are configured to drive the second pixels, and the via holes are all arranged at intervals between the second driving units.
17. The electronic device according to claim 12, wherein the display device further comprises a first substrate, the first substrate is provided with a hole, and the functional device is at least partially disposed in the hole.
18. The electronic device according to claim 17, wherein the first driving layer is provided with a first hole, the first hole is located in the first display area, an opening of the first hole is located away from the second driving layer, the hole communicates with the opening of the first hole, and the functional device is at least partially disposed in the first hole and the hole.
19. The electronic device according to claim 17, wherein the first driving layer is provided with a first hole, the second driving layer is provided with a second hole, the first hole and the second hole are both located in the first display area and communicate with each other, the hole communicates

with the first hole and the second hole, and the functional device is at least partially disposed in the first hole, the second hole, and the hole.