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Display panels and display apparatus

Abstract

The present disclosure relates to a display panel and a display apparatus. The display panel has a display region and a bezel region. The display region is adjacent to the bezel region. The display panel includes a base, drive arrays, cathodes, a shielding layer, transfer traces, touch portions and touch lines. The drive arrays are on the base, and configured to drive the display panel to emit light. Cathodes are on a side of the drive arrays away from the base. The transfer traces is on a side of the cathodes away from the base, and is in the bezel region. The touch lines are used to send touch signals and are respectively electrically connected with the transfer traces. The shielding layer is between the cathodes and the transfer traces and is in the bezel region. A projection of the drive arrays in the bezel region onto the base is in a projection of the shielding layer onto the base. The shielding layer is configured to shield noise signals. At least two independent touch portions each include a plurality of first touch lines and a plurality of second touch lines. The plurality of first touch lines and the plurality of second touch lines respectively extend in a first direction and a second direction that are intersected.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS

(1) This application is a national stage of international PCT Application No. PCT/CN2022/120676, filed on Sep. 22, 2022, the entire contents of which are incorporated herein by reference.

TECHNICAL FIELD

(2) The present disclosure relates to the field of display technologies, and particularly to a display panel and display apparatus.

BACKGROUND

(3) In the related arts, organic light emitting diodes (OLEDs) have many advantages such as lightness, fast response, wide color gamut, wide viewing angle, low power consumption and curlability.

(4) In recent years, operations of active capacitive styluses are also increasingly becoming routine applications, in applications of the mid-to-high-end tablets and notebooks. However, there are problems with poor touch performance in OLED touch integrated panels, particularly with styluses.

SUMMARY

(5) A display panel and a display apparatus are provided in the present disclosure to address all or part of deficiencies in the related arts.

(6) According to a first aspect of embodiments of the present disclosure, a display panel is provided, where the display panel has a display region and a bezel region, and the display region is adjacent to the bezel region: the display panel includes: a base; drive arrays on the base, configured to drive the display panel to emit light; cathodes on a side of the drive arrays away from the base; transfer traces on a side of the cathodes away from the base, in the bezel region; touch lines respectively electrically connected with the transfer traces; a shielding layer between the cathodes and the transfer traces and in the bezel region; a projection of the drive arrays in the bezel region onto the base, being in a projection of the shielding layer onto the base: the shielding layer being configured to shield noise signals.

(7) In some embodiments, the display panel further includes one or more control units, the one or more control units including ground pins, the ground pins being configured to be grounded; the shielding layer is connected with the drive arrays and connected with the ground pins through the one or more drive arrays.

(8) In some embodiments, the display panel further includes one or more control units, the one or more control units including shield pins, where the shield pins are configured to transmit shield signals, and the shield signals are in an opposite direction to signals transmitted in the transfer traces: the shielding layer is connected with the drive arrays and connected with the shield pins through the drive arrays.

(9) In some embodiments, the display panel further has a bending region adjacent to the bezel region and on a side of the bezel region away from the display region: a portion of the display panel in the bending region is configured to be bent to a side of the base away from the cathode: the display panel further includes a flexible circuit board on a side of the bending region away from the bezel region: the display panel further includes one or more control units including ground pins, and the ground pins are configured to be grounded: the shielding layer is connected with the flexible circuit board through leads in the bending region and connected with the ground pins through the flexible circuit board.

(10) In some embodiments, the display panel further includes an encapsulation layer on a side of the cathode away from the base: where the shielding layer is between the cathodes and the encapsulation layer, and the encapsulation layer covers the shielding layer.
(11) In some embodiments, the display panel further includes anodes and a planarization layer: where the anodes are on a side of the cathodes facing the base and the planarization layer is between the anodes and the base: the shielding layer covers edges of the cathodes: a projection of a portion of the shielding layer onto the base is outside projections of the cathodes onto the base, the portion of the shielding layer is electrically connected with the drive arrays through vias of the anodes and the planarization layer.
(12) In some embodiments, the shielding layer includes at least one layer having a metal layer and a dielectric layer that are stacked, the metal layer being connected with the drive arrays.
(13) In some embodiments, the dielectric layer includes silicon nitride or silicon oxide, and the metal layer includes at least one of gold, silver, copper, titanium, molybdenum, aluminium, or tungsten.
(14) In some embodiments, the display panel further includes at least two touch portions, the touch portions each including a plurality of first touch lines and a plurality of second touch lines: where the plurality of the first touch lines extend in a first direction and the plurality of the second touch lines extend in a second direction, and the first direction intersects the second direction: the touch portions are independent of each other.
(15) In some embodiments, borders of two adjacent touch portions are interdigitated.
(16) In some embodiments, a gap is provided between the two adjacent touch portions, and the gap is the borders of the two adjacent touch portions: portions of the first touch lines or portions of the second touch lines on two sides of the gap extend in a direction facing the gap and each form at least one protruding portion, and the protruding portion extends into a groove in a corresponding first touch line or a corresponding second touch line on other side of the gap.
(17) In some embodiments, a shape of the protruding portion is a triangle, a rectangle or a star, and sizes of protruding portions are same or different.
(18) In some embodiments, the first touch lines include first touch electrodes and first connectors that both are arranged alternately in the first direction, and the second touch lines include second touch electrodes and second connectors that both are arranged alternately in the second direction: the gap respectively divides the first touch electrodes or the second touch electrodes through which the gap extends into two parts: the first touch electrodes or portions of the second touch electrodes on two sides of the gap extend in a direction facing the gap and each form at least one protruding portion, and the protruding portion extends into a groove in a corresponding first touch electrode or a corresponding second touch electrode on other side of the gap; geometric centers of the first touch electrodes or the second touch electrodes are center points: in directions away from the central points, extending sizes of protruding portions gradually decrease.
(19) In some embodiments, the display panel includes at least two control units: the transfer traces are on a circumference of the touch portions and the control units are electrically connected with at least one of the touch portions through the transfer traces, and a control unit is electrically connected with a portion of the touch portions: the control units are configured to turn the plurality of the first touch lines and the plurality of the second touch lines on or off in the touch portions.
(20) In some embodiments, the display panel further includes four touch portions arranged in an array: where every two of the touch portions are electrically connected with a control unit through the transfer traces: two control units are configured to independently drive two different touch portions.
(21) In some embodiments, the display panel further includes four touch portions arranged in an array, switch units, one or more control units and a level conversion unit: the touch portions each are electrically connected with a corresponding switch unit through transfer traces: all of the switch units are electrically connected with the level conversion unit and the switch units each are

electrically connected with the one or more control units through the level conversion unit; every two of the touch portions are in a touch group: the one or more control units are configured to drive the first touch lines and the second touch lines in a touch group at different periods.
(22) In some embodiments, every two of the four touch portions arranged in an array, adjacent to each other in the first direction, are in a touch group: the one or more control units are configured to drive the first touch lines and the second touch lines in a touch group for a first period and drive the first touch lines and the second touch lines in other touch group for a second period.
(23) In some embodiments, every two of the four touch portions arranged in an array, adjacent to each other in the second direction, are in a touch group: the one or more control units are configured to drive the first touch lines and the second touch lines in a touch group for a first period and drive the first touch lines and the second touch lines in other touch group for a second period.
(24) In some embodiments, every two of the four touch portions arranged in an array, at opposite corners of the array, are in a touch group:
(25) the one or more control units are configured to drive the first touch lines and the second touch lines in a touch group for a first period and drive the first touch lines and the second touch lines in other touch group for a second period.
(26) In some embodiments, the switch units each include at least two thin film transistors connected in parallel.
(27) According to a second aspect of the embodiments of the present disclosure, a display apparatus including any of the above display panels is provided.
(28) According to the above embodiments, by providing a shielding layer in the bezel region, the shielding layer is on the side of the cathode away from the base, and the projection of the drive array in the bezel region onto the base is in the projection of the shielding layer onto the base. The shielding layer may be configured to shield noise signals, may effectively prevent the generation of parasitic capacitance between the transfer traces and the cathodes, and may effectively avoid, the electromagnetic wave signals radiated from the drive arrays, from coupling into the transfer traces through the parasitic capacitance between the transfer traces and the cathodes, thus, may effectively reduce the noise signal strength in the transfer traces and the touch lines, improve the signal-to-noise ratio in the touch lines, and in turn, may improve the touch performance of the display panel, especially may improve the performance of the display panel when the active stylus is used.
(29) It will be understood that the above general descriptions and the following detailed descriptions are merely for exemplary and explanatory purposes, and cannot limit this application.

Description

BRIEF DESCRIPTION OF DRAWINGS
(1) The accompanying drawings, which are incorporated in and constitute a part of the present description, illustrate examples consistent with the present disclosure and serve to explain the principles of the present disclosure together with the description.
(2) FIG. **1** is a schematic diagram illustrating a display panel in accordance with an embodiment of the present disclosure.
(3) FIG. **2** is a sectional view of a portion of a display panel in a bezel region.
(4) FIG. **3** is a schematic diagram illustrating a display panel in accordance with an embodiment of the present disclosure.
(5) FIG. **4**A is a schematic diagram illustrating a structure of a shielding layer in accordance with an embodiment of the present disclosure.
(6) FIG. **4**B is a schematic diagram illustrating a structure of another shielding layer in accordance with an embodiment of the present disclosure.

(7) FIG. **5** is a schematic diagram illustrating a structure of a touch portion in accordance with an embodiment of the present disclosure.
(8) FIG. **6** is a schematic diagram illustrating a structure of another touch portion in accordance with an embodiment of the present disclosure.
(9) FIG. **7**A is a schematic diagram illustrating a shape of a touch electrode in accordance with an embodiment of the present disclosure.
(10) FIG. **7**B is a schematic diagram illustrating a shape of another touch electrode in accordance with an embodiment of the present disclosure.
(11) FIG. **7**C is a schematic diagram illustrating a shape of another touch electrode in accordance with an embodiment of the present disclosure.
(12) FIG. **7**D is a schematic diagram illustrating a shape of another touch electrode in accordance with an embodiment of the present disclosure.
(13) FIG. **8** is a schematic diagram illustrating another display panel in accordance with an embodiment of the present disclosure.
(14) FIG. **9** is a schematic diagram illustrating a manner of connecting a control unit with switch units in accordance with an embodiment of the present disclosure.
(15) FIG. **10** is a timing diagram of control units controlling switch units in accordance with an embodiment of the present disclosure.
(16) FIG. **11** is a timing diagram of other control units controlling switch units in accordance with an embodiment of the present disclosure.
(17) FIG. **12** is a timing diagram of other control units controlling switch units in accordance with an embodiment of the present disclosure.

DETAILED DESCRIPTION

(18) Examples of embodiments will be described in detail here, examples of which are illustrated in the accompanying drawings. When the following description relates to the accompanying drawings, unless specified otherwise, the same numerals in different drawings represent the same or similar elements. The implementations described in the following example embodiments do not represent all implementations consistent with the present disclosure. On the contrary, they are merely examples of an apparatus and a method consistent with some aspects of the present disclosure described in detail in the appended claims.
(19) A display panel is provided in embodiments of the present disclosure, FIG. **1** shows a top view of the display panel. As shown in FIG. **1**, the display panel **10** has a display region **100** and a bezel region **200**. The display region **100** is adjacent to the bezel region **200**, and a portion of the display panel **10** in the display region **100** is configured to perform a display function.
(20) FIG. **2** shows a sectional view of the portion of the display panel in the bezel region. As shown in FIGS. **1** and **2**, the display panel includes a base **11**, drive arrays **12**, anodes **13**, cathodes **14**, a shielding layer **15**, transfer traces **16**, touch lines **17**, ground traces **18**, and control units **31**. The drive array **12** is on the base **11** and is configured to drive the display panel **10** to emit light. The cathode **14** is on a side of the drive array **12** away from the base **11** and the shielding layer **15** is on a side of the cathode **14** away from the base **11**. The touch line **17** is in the display region **100** and on a side of the shielding layer **15** away from the cathode **14**. The transfer trace **16** and the ground trace **18** are in the bezel region **200**, and both the transfer trace **16** and the ground trace **18** are on the side of the shielding layer **15** away from the cathode **14**. It will be noted that, for the clarity of what is shown in FIG. **1**, the ground traces **18** are not shown in FIG. **1**, but in specific embodiments, the ground traces **18** may also be in the positions in FIG. **1** corresponding to FIG. **2**.
(21) The transfer traces **16** include first transfer traces **161** and second transfer traces **162**. Meanwhile, ground traces **18** are between the first transfer traces **161** and the second transfer traces **162**, a side of the first transfer traces **161** away from the second transfer traces **162** and a side of the second transfer traces **162** away from the first transfer traces **161** are also provided with ground traces **18**. In addition to being grounded by connecting with ground pins of the control unit **31**,

respective ground traces **18** between the first transfer traces **161** and the second transfer traces **162** are further configured to isolate signals transmitted in the first transfer traces **161** and the second transfer traces **162**, and the ground traces **18** on the side of the second transfer traces **162** away from the first transfer traces **161** are further configured to prevent static discharge in the display panel **10**. Meanwhile, the ground traces **18** on the side of the first transfer traces **161** away from the second transfer traces **162**, may be or be not provided according to actual needs of the embodiments.

(22) The touch lines **17** are respectively electrically connected with the transfer traces **16**. The touch lines **17** are configured to generate touch signals.

(23) It will be noted that relative positions of the first transfer traces **161** and the second transfer traces **162** shown in FIG. **2** are only one embodiment, and positions of the first transfer traces **161** and the second transfer traces **162** may also be interchanged. The interchange between the positions of the first transfer traces **161** and the positions of the second transfer traces **162** does not affect the positions of the above ground traces **18** in the entire display panel **10**, and numbers of the first transfer traces **161**, the second transfer traces **162** and the ground traces **18** are also merely exemplary, and the numbers of the first transfer traces **161**, the second transfer traces **162** and the ground traces **18** are not limited herein.

(24) The display panel **10** further includes an encapsulation layer **20**, a buffer layer **21**, a planarization layer **22**, a pixel defining layer **23** and dams **29**. The encapsulation layer **20** includes a glass cover **206**, an insulating layer **201**, an encapsulation buffer layer **202**, a first inorganic encapsulation layer **203**, an organic encapsulation layer **204** and a second inorganic encapsulation layer **205**. The encapsulation layer **20** encapsulates and protects the display panel **10**. The first inorganic encapsulation layer **203** and the second inorganic encapsulation layer **205** may be formed by chemical vapour deposition and the organic encapsulation layer **204** may be formed by inkjet printing.

(25) The dams **29** are on the circumference of the first inorganic encapsulation layer **203**, the organic encapsulation layer **204** and the second inorganic encapsulation layer **205** and are configured to block the movement of the encapsulation layer **20** relative to the rest of structures of the display panel **10**. The dams **29** include first dams **291** and second dams **292**. The first dams **291** are on the circumference of and adjacent to the first inorganic encapsulation layer **203**, the organic encapsulation layer **204** and the second inorganic encapsulation layer **205**, and the first dams **291** are further configured to block the relative movement of the organic encapsulation layer **204**.

(26) As the drive arrays **12** in the bezel region **200** at the edge of the display panel **10** are generally configured to transmit high frequency signals, which generate electromagnetic radiation when jumped. And, as parasitic capacitance is generated between the transfer traces **16** and the cathodes **14** and between the touch lines **17** and the cathodes **14**, electromagnetic wave signals radiated from the drive arrays **12** are coupled into the transfer traces **16** and the touch lines **17** by parasitic capacitance between the transfer traces **16** and the cathodes **14** and between the touch lines **17** and the cathodes **14**, thus, causing these electromagnetic wave signals to couple into the transfer traces **16** and the touch lines **17**, creating noise signals. Meanwhile, as the high frequency signals are mainly transmitted by a portion of the drive arrays **12** in the bezel region **200**, the noise signals generated by the drive arrays **12** in the bezel region **200** are the strongest and, accordingly, the noise signals in the touch lines **17** are also the strongest.

(27) In addition, when the active stylus is used to operate on the display panel **10**, the active stylus needs to couple touch signals operating at a specific frequency into the transfer traces **16** and touch lines **17**, to achieve touch control of the display panel **10**. As a result, the touch signals of the active stylus tend to interfere significantly with the noise signals in the display panel **10**, making the interference of the noise signals to the active stylus more serious.

(28) In view of the above problems, in this embodiment, by providing a shielding layer **15** in the bezel region **200**, the shielding layer **15** is on the side of the cathode **14** away from the base **11**, and

the orthographic projection of the drive arrays **12** in the bezel region **200** onto the base **11** is in the orthographic projection of the shielding layer **15** onto the base **11**. The shielding layer **15** may be configured to shield noise signals, may effectively prevent the generation of parasitic capacitance between the transfer traces **16** and the cathodes **14**, and may effectively avoid, the electromagnetic wave signals radiated from the drive arrays **12**, from coupling into the transfer traces **16** through the parasitic capacitance between the transfer traces **16** and the cathodes **14**, thus, may effectively reduce the noise signal strength in the transfer traces **16** and the touch lines **17**, improve the signal-to-noise ratio in the touch lines **17**, and in turn, may improve the touch performance of the display panel **10**, especially the performance of the display panel **10** when the active stylus is used.

(29) In some embodiments, the control unit **31** includes ground pins **311** configured to be grounded, and the shielding layer **15** is connected with the drive arrays **12** and connected with the ground pins **311** through the drive arrays **12**. The shielding layer **15** is connected with the ground pins **311** through the drive arrays **12**, allowing the shielding layer **15** to be grounded. And as the shielding layer **15** is grounded and the shielding layer **15** is between the transfer traces **16** and the cathodes **14**, the generation of parasitic capacitance between the transfer traces **16** and the cathodes **14** may be prevented, and received noise signals may also be eliminated by grounding the shielding layer **15**, As a result, the electromagnetic wave signals radiated from the drive arrays **12** may be further effectively avoided from coupling into the transfer traces **16** through the parasitic capacitance between the transfer traces **16** and the cathodes **14**, the noise signal strength in the transfer traces **16** and the touch lines **17** may be further effectively reduced, thus further improving the signal-to-noise ratio in the touch lines **17**. In turn, the touch performance of the display panel **10** may be further improved, especially the performance of the display panel **10** when the active stylus is used.

(30) In some embodiments, the control unit **31** includes shield pins **312**. The shield pins **312** are configured to transmit shield signals, and the shield signals are in an opposite direction to the signals transmitted in the transfer traces **16**. The shielding layer **15** is connected with the drive arrays **12** and connected with the shield pins **312** through the drive arrays **12**. The shielding layer **15** is connected with the shield pins **312** through the drive arrays **12**, allowing the shielding layer **15** to transmit signals in the opposite direction to the signals transmitted in the transfer traces **16**. And as the shielding layer **15** may transmit signals in the opposite direction to the signals transmitted in the transfer traces **16** and the shielding layer **15** is between the transfer traces **16** and the cathodes **14**, the generation of parasitic capacitance between the transfer traces **16** and the cathodes **14** may be prevented. As a result, the electromagnetic wave signals radiated from the drive arrays **12**, may be further effectively avoided from coupling into the transfer traces **16** through the parasitic capacitance between the transfer traces **16** and the cathodes **14**, and the noise signal strength in the transfer traces **16** and the touch lines **17** may be further effectively reduced, thus improving the signal-to-noise ratio in the touch lines **17**. In turn, the touch performance of the display panel **10** may be further improved, especially the performance of the display panel **10** when the active stylus is used.

(31) In some embodiments, as shown in FIG. **3**, the display panel **10** further includes a bending region **400**. The bending region **400** is adjacent to the bezel region **200** and on the side of the bezel region **200** away from the display region **100**. The portion of the display panel **10** in the bending region **400** is configured to be bent to the side of the base **11** away from the cathodes **14**. The display panel **10** further includes a flexible circuit board **19** on the side of the bending region **400** away from the bezel region **200**. The control unit **31** includes ground pins **311**, which are configured to be grounded. The shielding layer **15** is connected with the flexible circuit board **19** through leads **500** in the bending region **400** and connected with the ground pins **311** through the flexible circuit board **19**. In the bending region **400**, traces in respective layers need to be in a same layer, the shielding layer **15** may be connected to the flexible circuit board **19** through leads instead of vias, and connected to the ground pins **311** of the control unit **31**, thus making it easier to avoid,

the electromagnetic wave signals radiated from the drive arrays **12**, from coupling into the transfer traces **16** through the parasitic capacitance between the transfer traces **16** and the cathodes **14**. The noise signal strength in the transfer traces **16** and the touch lines **17** may be further effectively reduced, thus further improving the signal-to-noise ratio in the touch lines **17**. In turn, the touch performance of the display panel **10** may be further improved, especially the performance of the display panel **10** when the active stylus is used.

(32) In some embodiments, the display panel **10** further includes an encapsulation layer **20**. The encapsulation layer **20** is on the side of the cathodes **14** away from the base **11**. The shielding layer **15** is between the cathodes **14** and the encapsulation layer **20**, which covers the shielding layer **15**.

(33) In some embodiments, the display panel **10** further includes anodes **13** and a planarization layer **22**. The anode **13** is on a side of the cathodes **14** facing the base **11** and the planarization layer **22** is between the anodes **13** and the base **11**. The shielding layer **15** covers edges of the cathodes **14**. An orthographic projection of a portion of the shielding layer **15** onto the base **11** is outside the orthographic projections of the cathodes **14** onto the base **11**, and the portion of the shielding layer **15** is electrically connected with the drive arrays **12** through vias of the anodes **13** and the planarization layer **22**.

(34) In some embodiments, as shown in FIGS. **4**A and **4**B, the shielding layer **15** includes at least one metal layer **151** and at least one dielectric layer **152** that are stacked, for example, the shielding layer **15** may include one metal layer **151** and one dielectric layer **152** that are stacked, or the shielding layer **15** may include two metal layers **151** and two dielectric layers **152** that are stacked, or the shielding layer **15** may include three metal layers **151** and three dielectric layers **152** that are stacked, but this is not limited herein. FIG. **4**A illustrates a case where the shielding layer includes one metal layer **151** and one dielectric layer **152** that are stacked. FIG. **4**B illustrates a case where the shielding layer **15** may include two metal layers **151** and two dielectric layers **152** that are stacked, with the metal layers **151** and the dielectric layers **152** stacked alternatively. The metal layers **151** are connected with each other through vias and the metal layers **151** are connected with the drive arrays **12**.

(35) In some embodiments, the dielectric layer includes silicon nitride or silicon oxide, and the metal layer **151** includes at least one of gold, silver, copper, titanium, molybdenum, aluminium, or tungsten.

(36) In some embodiments, the material of the metal layer **151** may be a high-density mesh metal.

(37) In some embodiments, as shown in FIG. **1**, the display panel **10** further includes at least two touch portions **300**, for example, the display panel **10** may include two touch portions **300**, or, the display panel **10** may include three touch portions **300**, or, the display panel **10** may include four touch portions **300**, or, the display panel **10** may include five touch portions **300**, but this is not limited herein. Preferably, the display panel **10** may include four touch portions **300**, and the four touch portions **300** are arranged in an array. The touch lines **17** include a plurality of first touch lines **171** and a plurality of second touch lines **172**. The plurality of first touch lines **171** extend in a first direction X and the plurality of second touch lines **172** extend in a second direction Y, with the first direction X intersecting the second direction Y in a same plane. Specifically, the first direction X and the second direction Y may be perpendicular to each other. Each touch portion **300** includes a plurality of first touch lines **171** and a plurality of second touch lines **172**, and the touch portions **300** are independent of each other.

(38) FIG. **5** shows an enlarged view of the Q**1** region in FIG. **1**. As shown in FIG. **5**, both the first touch line **171** and the second touch line **172** include touch electrodes. Specifically, the first touch line **171** includes a first touch electrode **173** and a first connector **175**, and the first touch electrodes **173** and the first connectors **175** that both are arranged alternately in the first direction X. The second touch line **172** includes a second touch electrode **174** and a second connector **176**, and the second touch electrodes **174** and the second connectors **176** that both are arranged alternately in the second direction Y. The first connectors **175** are configured to respectively electrically connect two

adjacent first touch electrodes **173** in respective touch portions **300**, and the second connectors **176** are configured to respectively electrically connect two adjacent second touch electrodes **174** in respective touch portions **300**. There is a gap **30** between two adjacent touch portions **300**, and the gap **30** is a boundary between adjacent two touch portions **300**. The gap **30** respectively divides the first touch electrodes **173** and the second touch electrodes **174** through which the gap **30** extends into two parts, i.e., the first touch electrodes **173** and the second touch electrodes **174** on an extension path of the gap **30** are respectively divided by the gap **30** into two parts on two sides of the gap **30**. It will be noted that the first touch electrode **173** or the second touch electrode **174**, which is divided into two parts by the gap **30**, is regarded as a first touch electrode **173** or a second touch electrode **174** belonging to the touch portion **300** on two sides of the gap **30**, respectively. It will also be noted that although FIG. **5** shows only an enlarged view of the region Q**1** in FIG. **1**, other parts of the display panel **10** may also refer to the structure illustrated in FIG. **5**.

(39) By dividing respective first touch lines **171** and respective second touch lines **172** of the display panel **10** into at least two touch portions **300**, it is equivalent to dividing an area of the original touch lines **17** as a whole relative to an area of the cathodes **14** into an area of at least two touch portions **300** relative to the area of the cathodes **14**, and since the relative area of respective touch portions **300** to the cathodes **14** is reduced compared to the relative area of the original touch lines **17** as a whole to the cathodes **14**, the parasitic capacitance generated between the touch portions **300** and the cathodes **14** is reduced. Since the parasitic capacitance is reduced, the noise signals in the display panel **10** coupled into the touch lines **17** through the parasitic capacitance will also be reduced, thus, it may effectively reduce the noise signal strength in the transfer traces **16** and the touch lines **17**, improve the signal-to-noise ratio in the touch lines **17**, and in turn, may improve the touch performance of the display panel **10**, especially may improve the performance of the display panel **10** when the active stylus is used.

(40) In some embodiments, FIG. **6** illustrates another view of an enlarged view of the Q**1** region in FIG. **1**. As shown in FIG. **6**, borders of two adjacent touch portions **300** are interdigitated. When the display panel **10** adopts the structure illustrated in FIG. **5**, if the touch points contacting the display panel **10** is at the gap **30**, or, if the track formed by the touch points contacting the display panel **10** passes through the gap **30**, since the two side of the gap **30** have different touch portions **300**, the measurement and calculation of exact coordinates of the touch points may be affected, thus, affecting the degree of accuracy of the touch control. When active stylus control is used for the display panel **10** illustrated in FIG. **5**, as the active stylus has a finer tip, it is more likely that the accuracy will be reduced due to the gap **30**. And by making the borders of the two adjacent touch portions **300** interdigitated, a distance that the gap **30** extends in a single direction may be reduced, the probability of touch points in the gap **30** may be correspondingly reduced, and in turn, the problem of reduced accuracy of the display panel **10** at the gap **30** may be improved. It will be noted that, while the above design is used, by measuring the signal variation of respective touch portions **300** and combining it with a track algorithm, the control unit **31** may also compensate algorithmically for the track of the touch points at the gap **30**.

(41) In some embodiments, as shown in FIG. **6**, portions of the first touch lines **171** or portions of the second touch lines **172** on two sides of the gap **30** extend in a direction facing the gap **30** and each form at least one protruding portion **177**, and the protruding portion **177** extends into a groove **178** in a corresponding first touch line **171** or a corresponding second touch line **172** on the other side of the gap. Specifically, a portion of a first touch electrode **173** on a side of the gap **30** forms a protruding portion **177**, and a first touch electrode **173** on the other side of the gap **30** corresponding to the above first touch electrode **173** is provided with a groove **178**. The above protruding portion **177** extends in the direction facing the gap **30** and extends into the groove **178**. A protruding portion **177** and a groove **178** of the second touch electrode **174** may be referred to in the previous description of the protruding portion **177** and the groove **178** of the first touch electrode **173**. It will be noted that the first touch electrode **173** or the second touch electrode **174**,

which is divided into two parts by the gap **30**, is regarded as a first touch electrode **173** or a second touch electrode **174** belonging to the touch portion **300** on two sides of the gap **30**, respectively. In this way, the distance that the gap **30** extends in a single direction may be reduced, thus, the probability of touch points in the gap **30** may be correspondingly reduced, and in turn, the problem of reduced accuracy of the display panel **10** at the gap **30** may be improved.

(42) In some embodiments, a shape of an orthographic projection of the protruding portion **177** onto the base is a triangle, a rectangle or a star. For example, the shape of the orthographic projection of the protruding portion **177** onto the base may be a triangle, or the shape of the protruding portion **177** may be a rectangle, or the shape of the protruding portion **177** may be a star, or the shape of the protruding portion **177** may be a part of a triangle or a part of a rectangle, or the shape of the protruding portion **177** may be a part of a triangle or a part of a star, but this is not limited herein. Furthermore, sizes of the protruding portions **177** may be same or, the sizes of the protruding portions **177** may be different from each other. FIGS. **7**A and **7**B show two specific manners of disposing the protruding portions **177** and the grooves **178**. FIG. **7**A shows the protruding portions **177** with a same shape and size, FIG. **7**B shows the protruding portions **177** with a same shape but different sizes, FIG. **7**C shows the protruding portions **177** with a same shape and size evenly distributed, and FIG. **7**D shows the protruding portions **177** with a partial star shape.

(43) In some embodiments, as shown in FIG. **7**B with FIG. **7**C, a geometric center of the first touch electrode **173** or the second touch electrode **174** is a center point Z. In a direction away from the central point Z, extending sizes of at least parts of the protruding portions **177** decrease. The sizes of the protruding portions **177** varied with the distance between the edge of the touch electrode away from the gap **30** and the gap **30**. In this way, the distance that the gap **30** extends in a single direction may be further reduced, thus, the probability of touch points in the gap **30** may be further correspondingly reduced, and in turn, the problem of reduced accuracy of the display panel **10** at the gap **30** may be further improved.

(44) In some embodiments, as shown in FIG. **1**, the display panel **10** further includes at least two control units **31**, for example, the display panel **10** may include two control units **31**, or, the display panel **10** may include three control units **31**, or, the display panel **10** may include four control units **31**, but this is not limited herein. Preferably, the display panel **10** may include two control units **31**. The transfer traces **16** are on a circumference of the touch portions **300** and the control unit **31** is electrically connected with at least one of the touch portions **300** through the transfer traces **16**, and a control unit **31** is electrically connected with a portion of the touch portions **300**.

(45) Specifically, the display panel **10** includes an array of four touch portions **300** and two control units **31**, and the touch portions **300** include a first touch portion **301**, a second touch portion **302**, a third touch portion **303** and a fourth touch portion **304**. Every two touch portions **300** are electrically connected with a control unit **31** through transfer traces **16**, for example, the first touch portion **301** and the second touch portion **302** are electrically connected with a control unit **31** and the third touch portion **303** and the fourth touch portion **304** is electrically connected with another control unit **31**, or, the first touch portion **301** and the third touch portion **303** are electrically connected with a control unit **31** and the second touch portion **302** and the fourth touch portion **304** are electrically connected with another control unit **31**, or, the first touch portion **301** and the fourth touch portion **304** are electrically connected with a control unit **31** and the second touch portion **302** and the third touch portion **303** are electrically connected with another control unit **31**. The control unit **31** is configured to control the first touch line **171** and the second touch line **172** in the touch portion **300** on/electrified or off/unelectrified.

(46) The first transfer traces **161** are configured to electrically connect the first touch lines **171** of the respective touch portions **300** to the control units **31** and the second transfer traces **162** are configured to electrically connect the second touch lines **172** of the respective touch portions **300** to the control units **31**. The touch portions **300** being electrically connected with the control units **31**

through the transfer trances **16** may be that the touch portions **300** are electrically connected with the flexible circuit board **19** through the transfer traces **16** and the transfer traces **16** are electrically connected with the control units **31** through the flexible circuit board **19**. Meanwhile, two control units **31** may be provided with clock signal lines (not shown in the figures), which ensure synchronous operation of the two control units **31** by transmitting clock signals. By providing two control units **31**, the two control units **31** are configured to independently drive two different touch portions **300**, i.e., the two control units **31** are configured to independently turn the first touch lines **171** and the second touch lines **172** on and off in the two different touch portions **300**, and, driving timings of the two control units **31** are synchronised, an envelope curve of sensing signals of the touch points in a same frame may be obtained, thus, complete reporting point coordinates of all positions in the display panel **10** in the same frame signal may be obtained, and in turn, the driving complexity may be reduced.

(47) In some embodiments, FIGS. **8** and **9** illustrate another embodiment of the display panel **10**. As shown in FIGS. **8** and **9**, the display panel **10** further includes four touch portions **300** arranged in an array, switch units **32**, a level conversion unit **33** and a power management unit **34**. Each touch portion **300** is electrically connected with a corresponding switch unit **32** through transfer traces **16**. Specifically, a first switch unit **321** may be electrically connected with the first touch portion **301**, a second switch unit **322** may be electrically connected with the second touch portion **302**, a third switch unit **323** may be electrically connected with the third touch portion **303**, and a fourth switch unit **324** may be electrically connected with the fourth touch portion **304**. All switch units **32** are electrically connected with the level conversion unit **33** and each switch unit **32** is electrically connected with the control unit **31** through the level conversion unit **33**. That is, each touch portion **300** is independently connected with a channel pin of the control unit **31**. Therefore, the control unit **31** may control respective switch units **32** to be fully turned off or partially turned off, to independently turn the first touch lines **171** and the second touch lines **172** on and off in each of the touch portions **300**. Moreover, the switch units **32** are configured to turn all the first touch lines **171** and second touch lines **172** on and off in a corresponding touch portion **300**. Every two touch portions **300** are in a touch group **305**. Specifically, four touch portions **300** arranged in an array may be divided into a first touch group **3051** and a second touch group **3052**. The control unit **31** is configured to control a touch group **305** at different periods. The power management unit **34** is electrically connected with the level conversion unit **33** and is configured to perform functions of power management.

(48) Specifically, FIG. **10** illustrates a timing diagram for the control unit **31** to drive respective switch units **32**. As shown in FIG. **10**, the control unit **31** may first turn on and drive the first touch group **3051**, which includes the first switch unit **321** and the fourth switch unit **324**, and then turn on and drive the second touch group **3052**, which includes the second switch unit **322** and the third switch unit **323**. That is, the control unit **31** drives the first touch portion **301** and the fourth touch portion **304**, and then drive the second touch portion **302** and the third touch portion **303**, to achieve alternate driving of the touch portions **300** at opposite corners. In this way, during a period of sending control signals by respective switch units **32**, the control unit **31** simultaneously drives a portion of the touch portions **300** of the display panel **10** through the switch units **32**, so that the relative area of the touch portions **300** driven simultaneously to the cathodes **14** may be further reduced, so that the parasitic capacitance generated between the touch portions **300** and the cathodes **14** is further reduced. Thus, the noise signals in the display panel **10** coupled into the touch lines **17** through the parasitic capacitance may also be reduced, it may effectively reduce the noise signal strength in the transfer traces **16** and the touch lines **17**, improve the signal-to-noise ratio in the touch lines **17**, and may improve the touch performance of the display panel **10**, especially may improve the performance of the display panel **10** when the active stylus is used. Moreover, since a touch group **305** including two touch portions **300** at opposite corners in the four touch portions **300** arranged in an array are alternatively driven, adverse effects of the gap **30**

between the touch lines **17** may be reduced.
(49) It will be noted that the control unit **31** is not limited to turning on and driving the first switch unit **321** and the fourth switch unit **324** first, and then turning on and driving the second switch unit **322** and the third switch unit **323**, but the control unit **31** may also use other driving sequences. FIG. **11** shows a timing diagram for another control unit to drive the respective switch units. As shown in FIG. **11**, the control unit **31** may also first turn on and drive the first touch group **3051**, which includes the first switch unit **321** and the third switch unit **323**, and then turn on and drive the second touch group **3052**, which includes the second switch unit **322** and the fourth switch unit **324**, to achieve alternate driving of adjacent two touch portions **300** in the first direction X. Alternatively, FIG. **12** shows a timing diagram for another control unit to drive the respective switch units. As shown in FIG. **12**, the control unit **31** may also first turn on and drive the first touch group **3051**, which includes the first switch unit **321** and the second switch unit **322**, and then turn on and drive the second touch group **3052**, which includes the third switch unit **323** and the fourth switch unit **324**, to achieve alternate driving of adjacent two touch portions **300** in the second direction Y.
(50) In some embodiments, each switch unit **32** includes at least two thin film transistors connected in parallel. In this way, at least two thin film transistors may be connected in parallel to increase a current of the overall load of the switch units **32**, thus, the time delay of the touch signals caused by the switch units **32** may be reduced, and in turn, the effect of the switch units **32** on the touch signals may be reduced.
(51) In some embodiments, an amplitude of an output voltage of the switch unit **32** is not less than 9 volts. In this way, a rising edge time and a falling edge time of the switch signals transmitted from the switch units **32** may be increased, thus, the time delay of the touch electrode signals caused by the switch units **32** may be reduced, and in turn, the effect of the switch units **32** on the touch signals may be reduced.
(52) In some embodiments, the gap **30** between two adjacent touch portions **300** is no greater than 10 microns. Specifically, in the first direction X and the second direction Y, a distance of the gap **30** between two adjacent touch portions **300** may be from 1 micron to 50 micron, for example, in the first direction X and the second direction Y, the distance of the gap **30** between the two adjacent touch portions **300** may be 1 micron, or, in the first direction X and the second direction Y, the distance of the gap **30** between the two adjacent touch portions **300** may be 10 microns, or, in the first direction X and the second direction Y, the distance of the gap **30** between the two adjacent touch portions **300** may be 20 microns, or, in the first direction X and the second direction Y, the distance of the gap **30** between the two adjacent touch portions **300** may be 30 microns, or, in the first direction X and the second direction Y, the distance of the gap **30** between the two adjacent touch portions **300** may be 40 microns, or, in the first direction X and the second direction Y, the distance of the gap **30** between the two adjacent touch portions **300** may be 50 microns, but this is not limited herein.
(53) A display apparatus including any of the above display panels **10** is also provided in the present disclosure. The display apparatus further includes a housing, and the display panel is in the housing.
(54) The display apparatus improves the signal-to-noise ratio of active styluses that support the MPP2.0 protocol, but this is not limited herein. The display apparatus may also be synchronised with all other active stylus protocols, including the USI, HPP, AES and WGP protocols.
(55) In some embodiments, the display apparatus includes a display panel **10** of not less than 10-inch. The problem of noise signals in the display panel **10** is more prominent in display panels **10** of sizes no smaller than 10-inch. Thus, the solution of applying the above display panel **10** in such display apparatuses may better solve the problem of low signal-to-noise ratio due to noisy signals.
(56) The above embodiments of the present disclosure are complementary to each other where no conflict arises.

(57) It is to be noted that in the accompanying drawings, the dimensions of layers and regions may be exaggerated for clarity of illustration. It will be understood that when an element or a layer is referred to as being “above” or “on” another element or layer, it may be directly on the other element, or intervening layers may be present. In addition, it will be understood that when an element or a layer is referred to as being “under” or “below” another element or layer, it may be directly under the other element, or one or more intervening layers or elements may be present. In addition, it will also be understood that when a layer or an element is referred to as being “between” two layers or two elements, it may be the only layer between the two layers or two elements, or one or more intervening layers or elements may be present. Like reference numerals indicate like elements throughout.
(58) The term “a plurality.” indicates two or more, unless specifically defined otherwise.
(59) Those skilled in the art will readily conceive other embodiments of the present disclosure upon consideration of the specification and practice of the various embodiments disclosed herein. The present disclosure is intended to cover any variations, uses, modification or adaptations of the present disclosure that follow the general principles thereof and include common knowledge or conventional technical means in the related art that are not disclosed in the present disclosure. The specification and examples are considered as exemplary only, with a real scope and spirit of the present disclosure being indicated by the following claims.
(60) It will be understood that the present disclosure is not limited to the precise structure that has been described above and shown in the drawings, and various modifications and changes can be made without departing from its scope. The scope of the present disclosure is limited only by the appended claims.

Claims

1. A display panel, wherein the display panel has a display region and a bezel region, and the display region is adjacent to the bezel region; the display panel comprises: a base; drive arrays on the base, configured to drive the display panel to emit light; cathodes on a side of the drive arrays away from the base; transfer traces on a side of the cathodes away from the base and located in the bezel region; touch lines respectively electrically connected with the transfer traces; and a shielding layer between the cathodes and the transfer traces and in the bezel region; an orthographic projection of the drive arrays in the bezel region onto the base, being in an orthographic projection of the shielding layer onto the base; the shielding layer being configured to shield noise signals; wherein the display panel further comprises one or more control units, the one or more control units comprising ground pins, the ground pins being configured to be grounded; and the shielding layer is connected with the drive arrays and connected with the ground pins through the drive arrays.
2. The display panel according to claim 1, wherein the one or more control units comprise shield pins, wherein the shield pins are configured to transmit shield signals, and the shield signals are in an opposite direction to signals transmitted in the transfer traces; and the shielding layer is connected with the drive arrays and connected with the shield pins through the drive arrays.
3. The display panel according to claim 1, wherein the display panel further has a bending region adjacent to the bezel region and on a side of the bezel region away from the display region; a portion of the display panel in the bending region is configured to be bent to a side of the base away from the cathodes; the display panel further comprises a flexible circuit board on a side of the bending region away from the bezel region; and in the bending region, the shielding layer is connected with the flexible circuit board through leads and connected with the ground pins through the flexible circuit board.
4. The display panel according to claim 1, further comprising an encapsulation layer on a side of the cathodes away from the base; wherein the shielding layer is between the cathodes and the

encapsulation layer, and the encapsulation layer covers the shielding layer.

5. A display panel, wherein the display panel has a display region and a bezel region, and the display region is adjacent to the bezel region; the display panel comprises: a base; drive arrays on the base, configured to drive the display panel to emit light; cathodes on a side of the drive arrays away from the base; transfer traces on a side of the cathodes away from the base and located in the bezel region; touch lines respectively electrically connected with the transfer traces; and a shielding layer between the cathodes and the transfer traces and in the bezel region; an orthographic projection of the drive arrays in the bezel region onto the base, being in an orthographic projection of the shielding layer onto the base; the shielding layer being configured to shield noise signals; wherein the display panel further comprises anodes and a planarization layer; wherein the anodes are on a side of the cathodes facing the base and the planarization layer is between the anodes and the base; the shielding layer covers edges of the cathodes; an orthographic projection of a portion of the shielding layer onto the base is outside orthographic projections of the cathodes onto the base, and the portion of the shielding layer is electrically connected with the drive arrays through vias penetrating the anodes and the planarization layer.

6. The display panel according to claim 1, wherein the shielding layer comprises at least one metal layer and at least one dielectric layer that are stacked, the at least one metal layer being connected with the drive arrays.

7. The display panel according to claim 6, wherein the at least one dielectric layer comprises silicon nitride or silicon oxide, and the at least one metal layer comprises at least one of gold, silver, copper, titanium, molybdenum, aluminium, or tungsten.

8. The display panel according to claim 1, further comprising: at least two touch portions, the touch portions each comprising a plurality of first touch lines and a plurality of second touch lines; wherein the plurality of first touch lines extend in a first direction and the plurality of second touch lines extend in a second direction, and the first direction intersects the second direction in a same plane; and the touch portions are independent of each other.

9. The display panel according to claim 8, wherein borders of two adjacent touch portions are interdigitated.

10. The display panel according to claim 9, wherein a gap is provided between the two adjacent touch portions, and the gap is borders of the two adjacent touch portions; portions of the first touch lines or portions of the second touch lines on two sides of the gap extend in a direction towards the gap and each form at least one protruding portion that respectively extends into a groove in a corresponding first touch line or a corresponding second touch line on other side of the gap.

11. The display panel according to claim 10, wherein a shape of an orthographic projection of the protruding portion onto the base is a triangle, a rectangle or a star, and sizes of protruding portions are same or different.

12. The display panel according to claim 10, wherein the first touch lines each comprise first touch electrodes and first connectors that both are arranged alternately in the first direction, and the second touch lines each comprise second touch electrodes and second connectors that both are arranged alternately in the second direction; the gap divides the first touch electrodes or the second touch electrodes through which the gap extends into two parts respectively; portions of the first touch electrodes or portions of the second touch electrodes on the two sides of the gap extend in a direction towards the gap and each form at least one protruding portion that respectively extends into a groove in a corresponding first touch electrode or a corresponding second touch electrode on the other side of the gap; geometric centers of the first touch electrodes or the second touch electrodes are center points of the first touch electrodes or the second touch electrodes; in directions away from the center points, an extending size of at least part of the at least one protruding portion decreases.

13. The display panel according to claim 8, wherein the one or more control unit comprises at least two control units; wherein the transfer traces are on a circumference of the touch portions and the

control units are electrically connected with at least one of the touch portions through the transfer traces, and each of the control units is electrically connected with a portion of the touch portions and is configured to turn the plurality of first touch lines and the plurality of second touch lines in the portion of the touch portions on or off.

14. The display panel according to claim 13, wherein the touch portions comprise four touch portions arranged in an array; wherein every two of the four touch portions are electrically connected with a control unit through the transfer traces respectively; the control unit is configured to independently drive corresponding two touch portions.

15. A display panel, wherein the display panel has a display region and a bezel region, and the display region is adjacent to the bezel region; the display panel comprises: a base; drive arrays on the base, configured to drive the display panel to emit light; cathodes on a side of the drive arrays away from the base; transfer traces on a side of the cathodes away from the base and located in the bezel region; touch lines respectively electrically connected with the transfer traces; a shielding layer between the cathodes and the transfer traces and in the bezel region; an orthographic projection of the drive arrays in the bezel region onto the base, being in an orthographic projection of the shielding layer onto the base; the shielding layer being configured to shield noise signals; and four touch portions arranged in an array and each comprising a plurality of first touch lines and a plurality of second touch lines; wherein the plurality of first touch lines extend in a first direction and the plurality of second touch lines extend in a second direction, and the first direction intersects the second direction in a same plane; and the four touch portions are independent of each other; wherein the display panel further comprises switch units, one or more control units and a level conversion unit; wherein the four touch portions each are electrically connected with a corresponding switch unit through the transfer traces; all of the switch units are electrically connected with the level conversion unit and the switch units each are electrically connected with the one or more control units through the level conversion unit; and every two of the four touch portions form a touch group; the one or more control units are configured to drive the first touch lines and the second touch lines in touch groups at different periods.

16. The display panel according to claim 15, wherein every two of the four touch portions arranged in an array which are adjacent to each other in the first direction, form a touch group; the one or more control units are configured to drive the first touch lines and the second touch lines in one touch group for a first period and drive the first touch lines and the second touch lines in other touch group for a second period; or every two of the four touch portions arranged in an array and adjacent to each other in the second direction, form a touch group; the one or more control units are configured to drive the first touch lines and the second touch lines in one touch group for a first period and drive the first touch lines and the second touch lines in other touch group for a second period.

17. The display panel according to claim 15, wherein every two of the four touch portions arranged in an array, which are at opposite corners of the array, form a touch group; the one or more control units are configured to drive the first touch lines and the second touch lines in one touch group for a first period and drive the first touch lines and the second touch lines in other touch group for a second period.

18. The display panel according to claim 15, wherein the switch units each comprise at least two thin film transistors connected in parallel.

19. A display apparatus comprising: the display panel according to claim 1; and a housing, wherein the display panel is in the housing.

20. A display apparatus comprising: the display panel according to claim 5; and a housing, wherein the display panel is in the housing.