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(54) PHYSICAL FEEDBACK SYSTEM, CONTROL METHOD AND DEVICE, DISPLAY ASSEMBLY AND ELECTRONIC DEVICE

PHYSISCHES RÜCKMELDUNGSSYSTEM, STEUERUNGSVERFAHREN UND -VORRICHTUNG, ANZEIGEANORDNUNG UND ELEKTRONISCHE VORRICHTUNG

SYSTÈME DE RÉTROACTION PHYSIQUE, PROCÉDÉ ET DISPOSITIF DE COMMANDE, ENSEMBLE D'AFFICHAGE ET DISPOSITIF ÉLECTRONIQUE

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(73) Proprietor: **Xiaomi Inc.**
Beijing 100085 (CN)

(72) Inventor: **ZHANG, Xu**
Beijing 100085 (CN)

(74) Representative: **Millburn, Julie Elizabeth et al**
Reddie & Grose LLP
The White Chapel Building
10 Whitechapel High Street
London E1 8QS (GB)

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to the field of display screens and, more particularly, to a physical feedback system suitable for a flexible touch screen, a control method, a control apparatus, a display assembly and an electronic device.

BACKGROUND

[0002] A touch display screen is an external part that is most frequently used by a mobile terminal such as a mobile phone, a tablet, an e-book reader. The touch display screen not only can display information for a user, but also can provide a touch input function for the user.

[0003] Because the touch display screen is usually a rigid screen, the user while using the touch input function of the touch display screen, can only perform such operations similar to tapping, swiping, dragging and multi-finger touching on the flat and rigid outer surface of the touch display screen, the biggest imperfection of which is lacking a due physical feedback. However, with the development of the touch display screen technology, a flexible touch display screen has been gradually put forward in recent years, thus emerging a touch display device including a physical feedback system.

[0004] Referring to Fig. 1, which illustrates a structural schematic diagram of a touch display device including a physical feedback system, the touch display device includes a plastic flexible layer 101, an electrified liquid medium 102, a plastic hard layer 103, a LCD (Liquid Crystal Display) panel 104 and an internal component 105 for supporting the display of the LCD, which are placed from the outside to the inside in sequence in a housing. Wherein, both the plastic flexible layer 101 functioning as a touch layer and the plastic hard layer 103 functioning as a display layer are provided with a conducting loop and a node, which is similar to two poles of a capacitor. When a certain region of the screen is charged, the electrified liquid medium 102 will be attracted and aggregated, thus being capable of causing the volumetric expansion of the interior of the screen region, so that a protrusion 106 is formed at the corresponding position of the plastic flexible layer 101. The user can feel a sense of touch similar to a button while performing a touch operation on the protrusion 106. Moreover, when the protrusion 106 is pressed, the voltage of the structure similar to a capacitor formed by the plastic flexible layer 101 and the plastic hard layer 103 will be

[0005] changed, thus being capable of obtaining an on-off control signal and feeding the signal back to the system.

[0006] In the process of achieving the present disclosure, it is found that the related art at least has the following defects: since the electrified liquid medium is used to implement physical feedback, the response time for generating physical deformation on the touch display screen is relatively long. That is, when the user performs a touch operation on the touch display screen, if the display contents of the screen are changed, a relatively long time is needed to complete the refreshing process of the physical deformation on the touch display screen.

Document US 2010/0162109 A1 discloses a user interface having changeable topography, document US 2011/0304550 A1 discloses an auto-morphing adaptive user interface device and methods, document US 2012/0105333 A1 discloses methods and systems for providing haptic control.

SUMMARY

[0007] In order to overcome the problem of long response time for implementing the physical feedback system by using an electrified liquid medium, embodiments of the present disclosure provide a physical feedback system suitable for a flexible touch screen, a control method and apparatus, a display assembly and an electronic device. The technical solutions are as follows.

[0008] The present invention relates to a control method for a physical feedback system, an apparatus for controlling a physical feedback system, and a computer program for controlling a physical feedback system according to the independent claims. The dependent claims define further embodiments of the invention.

[0009] The technical solutions provided by the embodiments of the present disclosure may include the following advantageous effects:

the present disclosure implements the physical feedback of the flexible touch screen through the physical feedback unit including the armature part and the coil part, solves the problem of long response time for implementing the physical feedback system by using an electrified liquid medium, and achieves the effect of enabling the flexible touch screen to be physically deformed quickly so as to greatly shorten the response time by energizing the coil part only.

[0010] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, which is solely defined by the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] In order to explain the technical solutions in the embodiments of the present disclosure more clearly, the drawings used in the descriptions of the embodiments will be simply introduced hereinafter. The main embodiments according to the claimed subject-matter are illustrated in Fig. 6, steps 602 to 606, Fig. 9, modules 820 to 860, and Fig. 10 and 11.

Fig. 1 is a structural schematic diagram of a touch display device including a physical feedback system.

Fig. 2A is a structural schematic diagram of a physical feedback system provided by a first embodiment of the present disclosure.

Fig. 2B is a structural schematic diagram of the physical feedback system provided by the first embodiment of the present disclosure while forming a protrusion.

Fig. 2C is a structural schematic diagram of the physical feedback system provided by the first embodiment of the present disclosure while forming a depression.

Fig. 3A is a structural schematic diagram of a physical feedback system provided by a second embodiment of the present disclosure.

Fig. 3B is a tessellation schematic diagram of a physical feedback unit provided by the second embodiment of the present disclosure.

Figs. 3C to 3F are four structural schematic diagrams of a first type physical feedback unit provided by the second embodiment of the present disclosure.

Figs. 3G and 3F are two structural schematic diagrams of a second type physical feedback unit provided by the second embodiment of the present disclosure.

Fig. 4A is a structural schematic diagram of a physical feedback system provided by a third embodiment of the present disclosure.

Fig. 4B is a tessellation schematic diagram of a physical feedback unit provided by the third embodiment of the present disclosure.

Fig. 5 is a flow chart of a control method for a physical feedback system provided by a fourth embodiment of the present disclosure.

Fig. 6 is a flow chart of a control method for a physical feedback system provided by a fifth embodiment of the present disclosure.

Fig. 7 is a correlation diagram of a key travel and a physical feedback force of an actual physical key involved in the fifth embodiment of the present disclosure.

Fig. 8 is a block diagram of an apparatus for controlling a physical feedback system provided by a sixth embodiment of the present disclosure.

Fig. 9 is a block diagram of an apparatus for controlling a physical feedback system provided by the sixth embodiment of the present disclosure.

Fig. 10 is a block diagram of a display assembly provided by a seventh embodiment of the present disclosure.

Fig. 11 is a block diagram of an electronic device provided by an eighth embodiment of the present disclosure.

DETAILED DESCRIPTION

[0012] To make the objects, technical solutions and advantages of the present disclosure more clear, the exemplary embodiments of the present disclosure will be further described in details with reference to the accompanying drawings.

First embodiment

[0013] Referring to Fig. 2A, which illustrates a structural schematic diagram of a physical feedback system provided by the first embodiment of the present disclosure, the physical feedback system is implemented to become a part of an electronic device including a flexible touch screen. The electronic device may be any one of a smartphone, a tablet, an e-book reader, a laptop computer or a desktop display. The physical feedback system includes: at least one physical feedback unit 240 below a flexible touch screen 220.

[0014] The physical feedback unit 240 includes an armature part 242 and a coil part 244, at least one of the armature part 242 and the coil part 244 is in an active state, and an initial relative distance between the armature part 242 and the coil part 244 is a predetermined value.

[0015] When the coil part 244 is energized, the relative distance between the armature part 242 and the coil part 244 is changed under an electromagnetic action, and the changed relative distance is greater than or less than a predetermined value, so that a protrusion or a depression is formed at the corresponding position of the flexible touch screen 240.

[0016] The schematic diagram of forming a protrusion on the corresponding position of the flexible touch screen 240 may be as shown in Fig. 2B, and the schematic diagram of forming a depression on the corresponding position of the flexible touch screen 240 may be as shown in Fig. 2C.

[0017] In conclusion, the physical feedback system provided by the embodiment implements the physical feedback of the flexible touch screen through the physical feedback unit including the armature part and the coil part, solves the problem of long response time for implementing the physical feedback system by using an electrified liquid medium, and achieves the effect of enabling the flexible touch screen to be physically deformed quickly so as to greatly shorten the response time by energizing the coil part only.

Second embodiment

[0018] Referring to Fig. 3A, which illustrates a structural schematic diagram of a physical feedback system provided by the second embodiment of the present disclosure, the physical feedback system is implemented to become a part of an electronic device including a flexible touch screen. The electronic device may be any one of a smartphone, a tablet, an e-book reader, a laptop computer or a desktop display. The physical feedback system includes: at least one physical feedback unit 340 below a flexible touch screen 320.

[0019] The flexible touch screen 320 may be a rectan-

gular flexible touch screen. If the flexible touch screen 320 may possibly display various graphs, the physical feedback unit 340 may be disposed below the entire region of the flexible touch screen 320. For instance, the electronic device is a computer, then the flexible touch screen 320 may possibly display various interfaces, and the positions of such graphs as buttons, menus and hyperlinks on each interface are not fixed; in this case, the physical feedback unit 340 may be disposed below the entire region of the flexible touch screen 320. However, if the flexible touch screen 320 only displays several fixed graphs, then the physical feedback unit 340 may be disposed below a partial region of the flexible touch screen 320 only. For instance, the electronic device is a touch queuing machine in a bank lobby, the flexible touch screen 320 may only display several fixed sets of interfaces, and the positions of such graphs as buttons, menus and hyperlinks on the several sets of interfaces are fixed; in this case, the physical feedback unit 340 may be only disposed below a partial region of the flexible touch screen 320 corresponding to "such graphs as buttons, menus and hyperlinks". In the embodiments, disposing the physical feedback unit 340 below the entire region of the flexible touch screen 320 is exemplified only.

[0020] The number of the physical feedback unit 340 may be two or more. The physical feedback unit 340 is tessellated below the entire or a partial region of the flexible touch screen 320, as shown in Fig. 3B. The so-called "tessellation" refers to placing of different graphs without overlapping or missing to fully pave an interior of a plane without gaps or overlapping. At this time, the projection shape of each physical feedback unit 340 on the plane of the flexible touch screen 320 is a polygon. The polygon may not only include a square and/or a regular hexagon, but also include a rectangle, a regular triangle, and the like. In the embodiment, the projection shape of each physical feedback unit 340 on the plane of the flexible touch screen 320 being a regular hexagon is exemplified only.

[0021] Each physical feedback unit 340 includes an armature part and a coil part, at least one of the armature part and the coil part is in an active state, and an initial relative distance between the armature part and the coil part is a predetermined value. When the coil part is energized, the relative distance between the armature part and the coil part is changed under an electromagnetic action, the changed relative distance is greater than or less than a predetermined value, so that a protrusion or a depression is formed at the corresponding position of the flexible touch screen 320.

[0022] According to different structures and positions of the armature part and the coil part, the physical feedback unit 340 may have different implementation manners. For example, each physical feedback unit 340 may be any one of the four physical feedback units as follows.

[0023] A first type physical feedback unit 340a includes a housing 341, a coil part 342 within a lower portion of the housing 341 and in a stationary state, and an armature part 343 within an upper portion of the housing 341 and in an active state, the armature part 343 is an electromagnet or a permanent magnet, and the armature part 343 is connected with the coil part 342 through a spring 344. The structural schematic diagram of the armature part 343 being an electromagnet may be as shown in Fig. 3C or Fig. 3D; and the structural schematic diagram of the armature part 343 being a permanent magnet may be as shown in Fig. 3E or Fig. 3F. The physical feedback unit as shown in Figs. 2A to 2C is namely the first type physical feedback unit.

[0024] A second type physical feedback unit 340b includes a housing 341, a tubular coil part 345 within a lower portion of the housing 341 and in a stationary state, and a cylindrical armature part 346 within a cavity of the tubular coil part 345 and in an active state, the cylindrical armature part 346 is an electromagnet or a permanent magnet, and a lower portion of the cylindrical armature part 346 is connected with the housing 341 through a spring 347. The structural schematic diagram of the cylindrical armature part 346 being an electromagnet may be as shown in Fig. 3G; and the structural schematic diagram of the cylindrical armature part 346 being a permanent magnet may be as shown in Fig. 3H. The physical feedback unit as shown in Fig. 3A is namely the second type physical feedback unit.

[0025] A third type physical feedback unit includes a housing, an armature part within a lower portion of the housing and in a stationary state, and a coil part within an upper portion of the housing and in an active state, the armature part is a permanent magnet, and the armature part is connected with the coil part through a spring. Since the structures of the third type physical feedback unit and the first type physical feedback unit are substantially symmetric, the structural schematic diagram of the third type physical feedback unit may be obtained by exchanging the positions of the armature part 343 and the coil part 342 in Fig. 3E or Fig. 3F.

[0026] A fourth type physical feedback unit includes a housing, a tubular armature part within a lower portion of the housing and in a stationary state, and a cylindrical coil part within a cavity of the tubular armature part and in an active state, the tubular armature part is a permanent magnet, and a lower portion of the cylindrical coil part is connected with the housing through a spring. Since the structures of the fourth type physical feedback unit and the second type physical feedback unit are substantially symmetric, the block diagram of the fourth type physical feedback unit may be obtained by exchanging the positions of the tubular coil part 345 and the cylindrical armature part 346 in Fig. 3H.

[0027] It should be noted that, in the foregoing examples, it is only illustrated that one of the armature part and the coil part is in an active state and the other is in a stationary state. But in a specific embodiment, there may possibly be an implementation manner that both the armature part and the coil part are in an active state; for instance, the armature part and the coil part are connect-

ed through a spring, and one of the armature part and the coil part within the lower portion of the housing is also connected with the housing through a spring.

[0028] Moreover, it can be known with reference to the above structural schematic diagrams, the initial relative distance between the armature part and the coil part is a predetermined value, so that the flexible touch screen 320 keeps flat. When the coil part is energized with a positive current, the relative distance between the armature part and the coil part is changed to a first value under an electromagnetic action, and the first value is greater than the predetermined value, so that a protrusion is formed at the corresponding position of the flexible touch screen 320. When the coil part is energized with a negative current, the relative distance between the armature part and the coil part is changed to a second value under an electromagnetic action, and the second value is less than the predetermined value, so that a depression is formed at the corresponding position of the flexible touch screen 320. Since the relative motion between the armature part and the coil part under an electromagnetic action is very fast, the speed for generating a physical deformation on the flexible touch screen 320 is also very fast.

[0029] In conclusion, the physical feedback system provided by the embodiment implements the physical feedback of the flexible touch screen through the physical feedback unit including the armature part and the coil part, solves the problem of long response time for implementing the physical feedback system by using an electrified liquid medium, and achieves the effect of enabling the flexible touch screen to be physically deformed quickly so as to greatly shorten the response time by energizing the coil part only.

Third embodiment

[0030] Referring to Fig. 4A, which illustrates a structural schematic diagram of a physical feedback system provided by the third embodiment of the present disclosure, the physical feedback system is implemented to become a part of an electronic device including a flexible touch screen. The electronic device may be any one of a smartphone, a tablet, an e-book reader, a laptop computer or a desktop display. The physical feedback system includes: at least one physical feedback unit 440 below a flexible touch screen 420.

[0031] The flexible touch screen 420 may be a rectangular flexible touch screen. The physical feedback unit 440 may be disposed below the entire region or a partial region of the flexible touch screen 420. In the embodiment, disposing the physical feedback unit 420 below the entire region of the flexible touch screen 440 is exemplified only.

[0032] As an embodiment more preferable than that provided by the second embodiment, in the present embodiment, the number of the physical feedback unit 440 is two or more. The physical feedback units 440 are tessellated on multilayered planes adjacent from top to bottom below the entire (or partial region) of the flexible touch screen 420. The projection shape of each physical feedback unit 440 on the plane of the flexible touch screen 420 is a polygon, and the projection shape of the physical feedback unit 440 located in the lower layer on the plane of the flexible touch screen 420 is greater than or equal to the projection shape of the physical feedback unit 440 located in the upper layer on the plane of the flexible touch screen 420. In the embodiment, the projection shape of each physical feedback unit 440 on the plane of the flexible touch screen 420 being a square is exemplified only, as shown in Fig. 4B.

[0033] For example, three layers of physical feedback units 440 are disposed below the flexible touch screen 420, wherein a side length of the square of the physical feedback unit 440 in the undermost layer is *9a*; the side length of the square of the physical feedback unit 440 in the middle layer is *3a*; and the side length of the square of the physical feedback unit 440 in the upmost layer is *a.* That is, there are nine physical feedback units 440 in the middle layer disposed above one physical feedback unit 440 in the undermost layer; and there are nine physical feedback units 440 in the upmost layer disposed above one physical feedback unit 440 in the middle layer.

[0034] In this case, through energizing the physical feedback units 440 in different layers, the deformation size of the flexible touch screen 420 in a longitudinal direction is larger, for instance, given that the deformation size of the physical feedback unit in the second embodiment in the longitudinal direction is *h,* and the deformation size of the physical feedback unit in each layer in the third embodiment in the longitudinal direction is also *h,* then the deformation size of the flexible touch screen 420 in the third embodiment in the longitudinal direction will be *3h,* and the response time is still identical to that needed by the physical feedback unit provided by the second embodiment. The minimum deformation size of the flexible touch screen 420 on the plane thereof is determined by the projection shape of the physical feedback unit 440 in the upmost layer on the plane of the flexible touch screen 420.

[0035] In conclusion, the physical feedback system provided by the embodiment implements the physical feedback of the flexible touch screen through the physical feedback unit including the armature part and the coil part, solves the problem of long response time for implementing the physical feedback system by using an electrified liquid medium, and achieves the effect of enabling the flexible touch screen to be physically deformed quickly so as to greatly shorten the response time by energizing the coil part only. Meanwhile, through disposing multilayered physical feedback units below the flexible touch screen, the deformation size of the flexible touch screen in the longitudinal direction become large without changing the response time, so that the present disclosure is more suitably implemented on an electronic device including a large flexible touch screen, for example, a screen for broadcasting weather forecast, and a compu-

ter in a graphic workstation. Moreover, since the physical feedback unit achieves the physical feedback and recognizes inputted signals depending on an electromagnetic piezoelectric effect, there is no contact or junction point provided in the interior of the physical feedback unit, thus reducing losses caused by friction, and increasing the input accuracy and service life.

Fourth embodiment

[0036] Referring to Fig. 5, which illustrates a flow chart of a control method for a physical feedback system provided by the fourth embodiment of the present disclosure, the control method for a physical feedback system is applied to an electronic device including a flexible touch screen and the physical feedback system provided by the first embodiment or the second embodiment. The control method for a physical feedback system includes the following steps.

[0037] In step 502, whether a display graph on the flexible touch screen is a predetermined graph is detected, the predetermined graph including any one or a combination of a button, a frame, a tag, a menu, a hyperlink and an icon.

[0038] The electronic device detects whether a display graph on the flexible touch screen is a predetermined graph, the predetermined graph including any one or a combination of a button, a frame, a tag, a menu, a hyperlink and an icon.

[0039] In step 504, if the detection result is that the display graph is the predetermined graph, a physical feedback unit below a position of the display graph is energized, so that a relative distance between an armature part and a coil part in the physical feedback unit is changed under an electromagnetic action.

[0040] If the detection result of the electronic device is that the display graph is the predetermined graph, then the electronic device energizes the physical feedback unit below the position of the display graph, so that the relative distance between the armature part and the coil part in the physical feedback unit is changed under an electromagnetic action; in this way, a protrusion or a depression is formed at the position of the display graph on the flexible touch screen.

[0041] In conclusion, the control method for a physical feedback system provided by the embodiment implements the physical feedback of the flexible touch screen through energizing the physical feedback unit below the display graph on the flexible touch screen when the display graph is the predetermined graph, solves the problem of long response time for implementing the physical feedback system by using an electrified liquid medium, and achieves the effect of enabling the flexible touch screen to be physically deformed quickly so as to greatly shorten the response time by energizing the coil part only.

Fifth embodiment

[0042] Referring to Fig. 6, which illustrates a flow chart of a control method for a physical feedback system provided by the fifth embodiment of the present disclosure, the control method for a physical feedback system is applied to an electronic device including a flexible touch screen and the physical feedback system provided by the first embodiment or the second embodiment. The control method for a physical feedback system includes the following steps.

[0043] In step 602, whether a display graph on the flexible touch screen is a predetermined graph is detected, the predetermined graph including any one or a combination of a button, a frame, a tag, a menu, a hyperlink and an icon.

[0044] Supposing an initial state of the flexible touch screen is a flat state, an electronic device detects whether a display graph on the flexible touch screen is a predetermined graph, the predetermined graph including any one or a combination of a button, a frame, a tag, a menu, a hyperlink and an icon.

[0045] In step 604, if the detection result is that the display graph is the predetermined graph, then a current attribute corresponding to the display graph is retrieved from a pre-stored corresponding relationship between the predetermined graph and the current attribute according to the display graph, the current attribute including a current direction and a current value.

[0046] The electronic device pre-stores the corresponding relationship between the predetermined graph and the current attribute, for instance, a corresponding relationship between the predetermined graph (button) and the current attribute (positive, current value x mA", and a corresponding relationship between the predetermined graph (frame) and the current attribute (positive, current value *ya* mA, grey level *a* of the frame). When the detection result of the electronic device is that the display graph is the predetermined graph, then the electronic device retrieves the current attribute corresponding to the display graph from the pre-stored corresponding relationship between the predetermined graph and the current attribute according to the display graph, the current attribute including a current direction and a current value.

[0047] In step 606, the physical feedback unit below the position of the display graph is energized according to the inquired current attribute corresponding to the display graph, so that a relative distance between an armature part and a coil part in the physical feedback unit is changed under an electromagnetic action.

[0048] The electronic device energizes the physical feedback unit below the position of the display graph according to the retrieved current attribute corresponding to the display graph, so that the relative distance between the armature part and the coil part in the physical feedback unit is changed under an electromagnetic action; in this way, a protrusion or a depression is formed at the

position of the display graph on the flexible touch screen. At this time, the change of the relative distance H depends on the current intensity in the physical feedback unit.

[0049] In step 608, whether the current is changed is detected.

[0050] There is a big difference between the operating mode of the flexible touch screen including a physical feedback system and that of an ordinary touch screen, for instance, when a user touches one button on the ordinary touch screen, an operation that the electronic device deems the button is pressed will be triggered. However, when the user touches one button on the flexible touch screen including a physical feedback system, only the operation that the electronic device makes the cursor staying on the button and makes the button to become a highlighted state for feedback will be triggered; and only when the user performs an actual physical pressing on the button, the operation that the electronic device deems the button is pressed would be triggered. At this time, the electronic device not only needs to collect the position of the fingers of the user on the touch screen through the flexible touch screen, but also needs to collect the pressing operation of the fingers of the user on the touch screen through the physical feedback unit. When the user performs the pressing operation on the physical feedback unit through the fingers, the current in the physical feedback unit will be changed due to the reverse current reaction. The electronic device may detect whether the current inputted in the physical feedback unit is changed, so as to judge whether the user is pressing on the physical feedback unit through the fingers, and acquire such information as a displacement, a strength, a speed of pressing of the fingers of the user through the change value of the current.

[0051] In step 610, if the detection result is that the current is changed, then the display graph on the flexible touch screen is changed according to the change value of the current, and/or the current is adjusted according to the change value of the current.

[0052] If the detection result of the electronic device is that the current inputted in the physical feedback unit is changed, then different operations are triggered according to different scenes.

[0053] In such a scene as that the display contents of the flexible display screen need to be changed after the button on the display graph is pressed, if the detection result of the electronic device is that the current inputted in the physical feedback unit is changed, then the display graph on the flexible touch screen is changed according to the change value of the current.

[0054] In such a scene as providing the user with a hand feeling approximate to a real physical key after the button on the display graph is pressed, if the detection result of the electronic device is that the current inputted in the physical feedback unit is changed, then the current is re-adjusted according to the change value of the current. In one embodiment, the adjusting the current according to the change value of the current includes the two sub-steps as follows.

[0055] In first sub-step, a current attribute corresponding to a change value of the current is retrieved from a pre-stored corresponding relationship between the change value and the current attribute according to the change value, the current attribute including a current direction and a current value.

[0056] The electronic device may pre-store the corresponding relationship between the change value of the current and the current attribute needing adjustment, for example, a correlation diagram of a key travel and a physical feedback force of an actual physical key may be as shown in Fig. 7. In order to simulate the physical key, the corresponding relationship between the change value of the current and the current attribute needing adjustment may be calculated according to the correlation as shown in Fig. 7. In particular, the change value of the current is proportional to the pressing displacement of the fingers of the user. After a proportional corresponding relationship is established for the change value of the current and the key travel of the physical key, a corresponding physical feedback force may be retrieved according to the correlation as shown in Fig. 7, and then the current attribute needing adjustment may be calculated according to the retrieved physical feedback force, thus establishing the corresponding relationship between the change value of the current and the current attribute needing adjustment. The electronic device may pre-store the corresponding relationship between the change value of the current and the current attribute needing adjustment, and after one change value of the current is detected, retrieve a current attribute corresponding to the change value from the pre-stored corresponding relationship between the change value and the current attribute according to the detected change value of the current, the current attribute including a current direction and a current value.

[0057] In second sub-step, the current is adjusted according to the retrieved current attribute corresponding to the change value of the current.

[0058] Afterwards, the electronic device adjusts the current according to the retrieved current attribute corresponding to the change value of the current, so that the user obtains a more real physical feedback feeling when pressing the protrusion button formed by the physical feedback unit on the flexible touch screen.

[0059] In conclusion, the control method for a physical feedback system provided by the embodiment implements the physical feedback of the flexible touch screen through energizing the physical feedback unit below the display graph on the flexible touch screen when the display graph is the predetermined graph, solves the problem of long response time for implementing the physical feedback system by using an electrified liquid medium, and achieves the effect of enabling the flexible touch screen to be physically deformed quickly so as to greatly shorten the response time by energizing the coil part only.

Moreover, through further adjusting the display graph of the flexible display screen or re-adjusting the current in the physical feedback unit by the change value of the current in the physical feedback unit, the method enables the user to obtain a more real physical feedback feeling during the operation process, makes the operation process more real and effective, and effectively avoids misoperations.

Sixth embodiment

[0060] Referring to Fig. 8, which illustrates a block diagram of an apparatus for controlling a physical feedback system provided by the sixth embodiment of the present disclosure. The apparatus for controlling a physical feedback system is applied to an electronic device including a flexible touch screen and the physical feedback system provided by the first embodiment or the second embodiment. The apparatus for controlling a physical feedback system includes: a graph detection module 820 and a unit control module 840.

[0061] The graph detection module 820 is configured to detect whether a display graph on the flexible touch screen is a predetermined graph, the predetermined graph including any one or a combination of a button, a frame, a tag, a menu, a hyperlink and an icon.

[0062] The unit control module 840 is configured to, if the detection result of the graph detection module 820 is that the display graph is the predetermined graph, energize a physical feedback unit below the position of the display graph, so that a relative distance between an armature part and a coil part in the physical feedback unit is changed under an electromagnetic action.

[0063] In conclusion, the apparatus for controlling a physical feedback system provided by the embodiment implements the physical feedback of the flexible touch screen through energizing the physical feedback unit below the display graph on the flexible touch screen when the display graph is the predetermined graph, solves the problem of long response time for implementing the physical feedback system by using an electrified liquid medium, and achieves the effect of enabling the flexible touch screen to be physically deformed quickly so as to greatly shorten the response time by energizing the coil part only.

[0064] Referring to Fig. 9, which illustrates a block diagram of an apparatus for controlling a physical feedback system provided by the sixth embodiment of the present disclosure, the apparatus for a physical feedback system is applied to an electronic device including a flexible touch screen and the physical feedback system provided by the first embodiment or the second embodiment. The apparatus for controlling a physical feedback system includes: a graph detection module 820, a graph inquiry module 830, a unit control module 840, a current detection module 860, a display adjustment module 870 and a current adjustment module 890.

[0065] The graph detection module 820 is configured to detect whether a display graph on the flexible touch screen is a predetermined graph, the predetermined graph including any one or a combination of a button, a frame, a tag, a menu, a hyperlink and an icon.

[0066] The graph inquiry module 830 is configured to retrieve a current attribute corresponding to the display graph from a pre-stored corresponding relationship between the predetermined graph and the current attribute according to the display graph detected by the graph detection module 820, the current attribute including a current direction and a current value.

[0067] The unit control module 840 is configured to energize the physical feedback unit below the position of the display graph according to the current attribute corresponding to the display graph inquired by the graph inquiry module 840.

[0068] The current detection module 860 is configured to detect whether a current outputted by the unit control module 840 is changed.

[0069] The display adjustment module 870 is configured to, if the detection result of the current detection module 860 is that the current is changed, change the display graph on the flexible touch screen according to the change value of the current.

[0070] The current adjustment module 890 is configured to, if the detection result of the current detection module 860 is that the current is changed, adjust the current according to the change value of the current.

[0071] In one more embodiment, the apparatus further includes: a change inquiry module 880.

[0072] The change inquiry module 880 is configured to retrieve a current attribute corresponding to the change value from a pre-stored corresponding relationship between the change value and the current attribute according to the change value of the current detected by the current detection module 860, the current attribute including a current direction and a current value.

[0073] The current adjustment module 890 is configured to adjust the current according to the current attribute corresponding to the change value of the current retrieved by the change inquiry module 880.

[0074] It should be illustrated that, in some embodiments, the apparatus may not include the change inquiry module 880 and the current adjustment module 890. In some other embodiments, the apparatus may not include the display adjustment module 870.

[0075] In conclusion, the apparatus for controlling a physical feedback system provided by the embodiment implements the physical feedback of the flexible touch screen through energizing the physical feedback unit below the display graph on the flexible touch screen when the display graph is the predetermined graph, solves the problem of long response time for implementing the physical feedback system by using an electrified liquid medium, and achieves the effect of enabling the flexible touch screen to be physically deformed quickly so as to greatly shorten the response time by energizing the coil part only. Moreover, through further adjusting the display graph of the flexible display screen or re-adjusting the current in

the physical feedback unit by the change value of the current in the physical feedback unit, the method enables the user to obtain a more real physical feedback feeling during the operation process, makes the operation process more real and effective, and effectively avoids misoperations.

Seventh embodiment

[0076] Referring to Fig. 10, which illustrates a block diagram of a display assembly provided by the seventh embodiment of the present disclosure, the display assembly includes a flexible display screen 1020 and a physical feedback system 1040.

[0077] The physical feedback system 1040 may be any one of the physical feedback system provided by the first embodiment to the third embodiment.

[0078] In conclusion, the display assembly provided by the embodiment is provided with the physical feedback unit including the armature part and the coil part below the flexible touch screen, thus solves the problem of long response time for implementing the physical feedback system by using an electrified liquid medium, and achieves the effect of enabling the flexible touch screen to be physically deformed quickly so as to greatly shorten the response time by energizing the coil part only.

Eighth embodiment

[0079] Referring to Fig. 11, which illustrates a block diagram of an electronic device provided by the seventh embodiment of the present disclosure, the electronic device includes a flexible display screen 1120, a physical feedback system 1140 and an control apparatus 1160 for controlling a physical feedback system.

[0080] The physical feedback system 1140 may be any one of the physical feedback system provided by the first embodiment to the third embodiment.

[0081] The control apparatus 1160 for controlling a physical feedback system may be the apparatus provided by the fifth embodiment or the sixth embodiment.

[0082] In conclusion, the electronic device provided by the embodiment is provided with the physical feedback system including the armature part and the coil part below the flexible touch screen, thus solves the problem of long response time for implementing the physical feedback system by using an electrified liquid medium, and achieves the effect of enabling the flexible touch screen to be physically deformed quickly so as to greatly shorten the response time by energizing the coil part only.

[0083] It should be illustrated that: when the control apparatuses for controlling a physical feedback system provided in the above embodiments are controlling the physical feedback system, it is only illustrated by taking the division of each functional module as an example. During practical application, the foregoing function distribution may be completed by different functional modules according to requirements. That is, the interior of the device is divided into different functional modules so as to complete all or part of the functions described above. Moreover, the control apparatuses for controlling a physical feedback system provided by the foregoing embodiments and the embodiments of the control method for a physical feedback system belong to the same conception, and the detailed implementation process thereof is as shown in the embodiments of the method, which will not be elaborated herein.

[0084] The numbers of the foregoing embodiments of the present invention are for description only, and do not represent superior or inferior of the embodiments.

[0085] It may be understood by the person skilled in the art that the all or part steps of implementing the foregoing embodiments may be completed through hardware or may be completed through relevant hardware instructed by a program. The program may be stored in a computer readable storage medium, and the storage medium mentioned above may be a read-only memory (ROM), a magnetic tape, or an optical disk, and the like.

Claims

1. A control method for a physical feedback system, which is applied in an electronic device comprising a flexible touch screen (220, 320, 420) and the physical feedback system, the system comprising: at least one physical feedback unit (240, 340, 340a, 340b, 440) below the flexible touch screen (220, 320, 420); wherein the physical feedback unit (240, 340, 340a, 340b, 440) comprises an armature part (242, 343, 346) and a coil part (244, 342, 345) connected through a spring (344, 347), at least one of the armature part (242, 343, 346) and the coil part (244, 342, 345) is in an active state, and an initial relative distance between the armature part (242, 343, 346) and the coil part (244, 342, 345) is a predetermined value, **characterized in that** the method comprises:

   detecting (502, 602) whether a display graph on the flexible touch screen (220, 320, 420) is a predetermined graph, the predetermined graph comprising any one or a combination of a button, a frame, a tag, a menu, a hyperlink and an icon; and

   if the detection result is that the display graph is the predetermined graph, energizing (504) a physical feedback unit (240, 340, 340a, 340b, 440) below the position of the display graph, so that a relative distance between the armature part and the coil part in the physical feedback unit (240, 340, 340a, 340b, 440) is changed under an electromagnetic action and a protrusion or recession is formed at a corresponding position of the flexible touch screen (220, 320, 420), and **in that** before the energizing (504) the physical feedback unit (240, 340, 340a, 340b, 440)

below the position of the display graph, the method further comprises:

inquiring (604) a current attribute corresponding to the display graph from a pre-stored corresponding relationship between the predetermined graph and the current attribute according to the display graph, the current attribute comprising a current direction and a current value; and
the energizing (504) the physical feedback unit (240, 340, 340a, 340b, 440) below the position of the display graph comprises:
energizing (606) the physical feedback unit (240, 340, 340a, 340b, 440) below the position of the display graph according to the inquired current attribute corresponding to the display graph.

2. The method according to claim 1, **characterized in that**, after the energizing (504) the physical feedback unit (240, 340, 340a, 340b, 440) below the position of the display graph, the method further comprises:

detecting (608) whether the current is changed; and
if the detection result is that the current is changed, changing (610) the display graph on the flexible touch screen (220, 320, 420) according to the change value of the current; or
if the detection result is that the current is changed, adjusting (610) the current according to the change value of the current.

3. The method according to claim 2, **characterized in that**, before the adjusting (610) the current according to the change value of the current, the method further comprises:

inquiring a current attribute (604) corresponding to the change value of the current from a pre-stored corresponding relationship between the change value and the current attribute according to the change value, the current attribute comprising the current direction and the current value; and
the adjusting (610) the current according to the change value of the current comprises:
adjusting the current according to the inquired current attribute corresponding to the change value of the current.

4. An apparatus for controlling a physical feedback system, which is applied in an electronic device comprising a flexible touch screen (220, 320, 420) and the physical feedback system, the system comprising: at least one physical feedback unit (240, 340, 340a, 340b, 440) below the flexible touch screen (220, 320, 420); wherein the physical feedback unit (240, 340, 340a, 340b, 440) comprises an armature part (242, 343, 346) and a coil part (244, 342, 345) connected through a spring (344, 347), at least one of the armature part (242, 343, 346) and the coil part (244, 342, 345) is in an active state, and an initial relative distance between the armature part (242, 343, 346) and the coil part (244, 342, 345) is a predetermined value, **characterized in that** the apparatus further comprises:

a graph detection module (820) configured to detect whether a display graph on the flexible touch screen (220, 320, 420) is a predetermined graph, the predetermined graph comprising any one or a combination of a button, a frame, a tag, a menu, a hyperlink and an icon;
a unit control module (840) configured to, if the detection result of the graph detection module (820) is that the display graph is the predetermined graph, energize a physical feedback unit (240, 340, 340a, 340b, 440) below the position of the display graph, so that a relative distance between the armature part (242, 343, 346) and the coil part (244, 342, 345) in the physical feedback unit (240, 340, 340a, 340b, 440) is changed under an electromagnetic action and a protrusion or recession is formed at a corresponding position of the flexible touch screen (220, 320, 420);
a graph inquiry module (830) configured to inquire a current attribute corresponding to the display graph detected by the graph detection module (820) from a pre-stored corresponding relationship between the predetermined graph and the current attribute according to the display graph, the current attribute comprising a current direction and a current value; and
a unit control module (840) configured to energize the physical feedback unit (240, 340, 340a, 340b, 440) below the position of the display graph according to the current attribute corresponding to the display graph inquired by the graph inquiry module (830).

5. The apparatus according to claim 4, **characterized in that** the apparatus further comprises:

a current detection module (860) and a display adjustment module (870);
the current detection module (860) is configured to detect whether a current outputted by the unit control module (840) is changed; and
the display adjustment module (870) is configured to, if the detection result of the current detection module (860) is that the current is changed, change the display graph on the flexible touch screen (220, 320, 420) according to

the change value of the current; or
the apparatus further comprises:

a current detection module (860) and a current adjustment module (890);
the current detection module (860) is configured to detect whether a current outputted by the unit control module (840) is changed; and
the current adjustment module (890) is configured to, if the detection result of the current detection module (860) is that the current is changed, adjust the current according to the change value of the current.

6. The apparatus according to claim 5, **characterized in that** the apparatus further comprises:

a change inquiry module (880);
the change inquiry module (880) is configured to inquire a current attribute corresponding to the change value of the current detected by the current detection module (860) from a prestored corresponding relationship between the change value and the current attribute according to the change value, the current attribute comprising a current direction and a current value; and
the current adjustment module (890) is configured to adjust the current according to the current attribute corresponding to the change value of the current inquired by the change inquiry module (880).

7. An electronic device, **characterized in that** the device comprises a flexible touch screen (220, 320, 420) and a physical feedback system, the system comprising: at least one physical feedback unit (240, 340, 340a, 340b, 440) below the flexible touch screen (220, 320, 420); wherein the physical feedback unit (240, 340, 340a, 340b, 440) comprises an armature part (242, 343, 346) and a coil part (244, 342, 345) connected through a spring (344, 347), at least one of the armature part (242, 343, 346) and the coil part (244, 342, 345) is in an active state, and an initial relative distance between the armature part (242, 343, 346) and the coil part (244, 342, 345) is a predetermined value and the apparatus for controlling a physical feedback system according to any one of claims 4 to 6.

8. A computer program, which when executing on a processor of an electronic device comprising a flexible touch screen (220, 320, 420) and a physical feedback system, the system comprising: at least one physical feedback unit (240, 340, 340a, 340b, 440) below the flexible touch screen (220, 320, 420); wherein the physical feedback unit (240, 340, 340a, 340b, 440) comprises an armature part (242, 343, 346) and a coil part (244, 342, 345) connected through a spring (344, 347), at least one of the armature part (242, 343, 346) and the coil part (244, 342, 345) is in an active state, and an initial relative distance between the armature part (242, 343, 346) and the coil part (244, 342, 345) is a predetermined value, performs a method according to any one of claims 1 to 3.

Patentansprüche

1. Steuerverfahren für ein System für physische Rückmeldungen, das in einer elektronischen Vorrichtung angewendet wird, die einen flexiblen Berührungsbildschirm (220, 320, 420) und das System für physische Rückmeldungen aufweist, wobei das System Folgendes aufweist: wenigstens eine Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) unter dem flexiblen Berührungsbildschirm (220, 320, 420); wobei die Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) einen Ankerteil (242, 343, 346) und einen Spulenteil (244, 342, 345) aufweist, die durch eine Feder (344, 347) verbunden sind, wenigstens eines von dem Ankerteil (242, 343, 346) und dem Spulenteil (244, 342, 345) in einem aktiven Zustand ist und ein anfänglicher relativer Abstand zwischen dem Ankerteil (242, 343, 346) und dem Spulenteil (244, 342, 345) ein vorbestimmter Wert ist, **dadurch gekennzeichnet, dass** das Verfahren Folgendes aufweist:

Erkennen (502, 602), ob eine Anzeigegrafik auf dem flexiblen Berührungsbildschirm (220, 320, 420) eine vorbestimmte Grafik ist, wobei die vorbestimmte Grafik irgendeines oder eine Kombination von einer Schaltfläche, einem Frame, einem Tag, einem Menü, einem Hyperlink und einem Symbol aufweist; und,
wenn die Erkennung ergibt, dass die Anzeigegrafik die vorbestimmte Grafik ist, Bestromen (504) einer Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) unter der Position der Anzeigegrafik, so dass ein relativer Abstand zwischen dem Ankerteil und dem Spulenteil in der Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) unter einer elektromagnetischen Einwirkung verändert wird und an einer entsprechenden Position des flexiblen Berührungsbildschirms (220, 320, 420) ein Vorsprung oder eine Vertiefung gebildet wird,
und dadurch, dass
das Verfahren vor dem Bestromen (504) der Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) unter der Position der Anzeigegrafik ferner Folgendes aufweist:

Abfragen (604) eines Stromattributs, das der Anzeigegrafik entspricht, aus einer vorgespeicherten entsprechenden Beziehung zwischen der vorbestimmten Grafik und dem Stromattribut gemäß der Anzeigegrafik, wobei das Stromattribut eine Stromrichtung und einen Stromwert aufweist; und

das Bestromen (504) der Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) unter der Position der Anzeigegrafik Folgendes aufweist:

Bestromen (606) der Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) unter der Position der Anzeigegrafik gemäß dem abgefragten Stromattribut, das der Anzeigegrafik entspricht.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das Verfahren nach dem Bestromen (504) der Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) unter der Position der Anzeigegrafik ferner Folgendes aufweist:

Erkennen (608), ob der Strom verändert wird; und,

falls die Erkennung ergibt, dass der Strom verändert wird, Verändern (610) der Anzeigegrafik auf dem flexiblen Berührungsbildschirm (220, 320, 420) gemäß dem Änderungswert des Stroms; oder,

wenn die Erkennung ergibt, dass der Strom verändert wird, Einstellen (610) des Stroms gemäß dem Änderungswert des Stroms.

3. Verfahren nach Anspruch 2, **dadurch gekennzeichnet, dass** das Verfahren vor dem Einstellen (610) des Stroms gemäß dem Änderungswert des Stroms ferner Folgendes aufweist:

Abfragen eines Stromattributs (604), das dem Änderungswert des Stroms entspricht, aus einer vorgespeicherten entsprechenden Beziehung zwischen dem Änderungswert und dem Stromattribut gemäß dem Änderungswert, wobei das Stromattribut die Stromrichtung und den Stromwert aufweist; und

das Einstellen (610) des Stroms gemäß dem Änderungswert des Stroms Folgendes aufweist:

Einstellen des Stroms gemäß dem abgefragten Stromattribut, das dem Änderungswert des Stroms entspricht.

4. Vorrichtung zum Steuern eines Systems für physische Rückmeldungen, das in einer elektronischen Vorrichtung angewendet wird, die einen flexiblen Berührungsbildschirm (220, 320, 420) und das System für physische Rückmeldungen aufweist, wobei das System Folgendes aufweist: wenigstens eine Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) unter dem flexiblen Berührungsbildschirm (220, 320, 420); wobei die Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) einen Ankerteil (242, 343, 346) und einen Spulenteil (244, 342, 345) aufweist, die durch eine Feder (344, 347) verbunden sind, wenigstens eines von dem Ankerteil (242, 343, 346) und dem Spulenteil (244, 342, 345) in einem aktiven Zustand ist und ein anfänglicher relativer Abstand zwischen dem Ankerteil (242, 343, 346) und dem Spulenteil (244, 342, 345) ein vorbestimmter Wert ist, **dadurch gekennzeichnet, dass** die Vorrichtung ferner Folgendes aufweist:

ein Grafikerkennungsmodul (820), das konfiguriert ist zum Erkennen, ob eine Anzeigegrafik auf dem flexiblen Berührungsbildschirm (220, 320, 420) eine vorbestimmte Grafik ist, wobei die vorbestimmte Grafik irgendeines oder eine Kombination von einer Schaltfläche, einem Frame, einem Tag, einem Menü, einem Hyperlink und einem Symbol aufweist;

ein Einheitssteuermodul (840), das konfiguriert ist zum Bestromen einer Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) unter der Position der Anzeigegrafik, wenn die Erkennung durch das Grafikerkennungsmodul (820) ergibt, dass die Anzeigegrafik die vorbestimmte Grafik ist, so dass ein relativer Abstand zwischen dem Ankerteil (242, 343, 346) und dem Spulenteil (244, 342, 345) in der Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) unter einer elektromagnetischen Einwirkung verändert wird und an einer entsprechenden Position des flexiblen Berührungsbildschirms (220, 320, 420) ein Vorsprung oder eine Vertiefung gebildet wird;

ein Grafikabfragemodul (830), das konfiguriert ist zum Abfragen eines Stromattributs, das der durch das Grafikerkennungsmodul (820) erkannten Anzeigegrafik entspricht, aus einer vorgespeicherten entsprechenden Beziehung zwischen der vorbestimmten Grafik und dem Stromattribut gemäß der Anzeigegrafik, wobei das Stromattribut eine Stromrichtung und einen Stromwert aufweist; und

ein Einheitssteuermodul (840), das konfiguriert ist zum Bestromen der Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) unter der Position der Anzeigegrafik gemäß dem Stromattribut, das der durch das Grafikabfragemodul (830) abgefragten Anzeigegrafik entspricht.

5. Vorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** die Vorrichtung ferner Folgendes aufweist:

ein Stromerkennungsmodul (860) und ein Anzeigeeinstellmodul (870);
wobei das Stromerkennungsmodul (860) konfiguriert ist zum Erkennen, ob ein durch das Einheitssteuermodul (840) ausgegebener Strom verändert wird; und
wobei das Anzeigeeinstellmodul (870) konfiguriert ist zum Verändern der Anzeigegrafik auf dem flexiblen Berührungsbildschirm (220, 320, 420) gemäß dem Änderungswert des Stroms, wenn die Erkennung durch das Stromerkennungsmodul (860) ergibt, dass der Strom verändert wird; oder
die Vorrichtung ferner Folgendes aufweist:

ein Stromerkennungsmodul (860) und ein Stromeinstellmodul (890) ;
wobei das Stromerkennungsmodul (860) konfiguriert ist zum Erkennen, ob ein durch das Einheitssteuermodul (840) ausgegebener Strom verändert wird; und
wobei das Stromeinstellmodul (860) konfiguriert ist zum Einstellen des Stroms gemäß dem Änderungswert des Stroms, wenn die Erkennung durch das Stromerkennungsmodul (860) ergibt, dass der Strom verändert wird.

6. Vorrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** die Vorrichtung ferner Folgendes aufweist: ein Veränderungsabfragemodul (880);

wobei das Veränderungsabfragemodul (880) konfiguriert ist zum Abfragen eines Stromattributs, das dem durch das Stromerkennungsmodul (860) erkannten Änderungswert des Stroms entspricht, aus einer vorgespeicherten entsprechenden Beziehung zwischen dem Änderungswert und dem Stromattribut gemäß dem Änderungswert, wobei das Stromattribut eine Stromrichtung und einen Stromwert aufweist; und
wobei das Stromeinstellmodul (890) konfiguriert ist zum Einstellen des Stroms gemäß dem durch das Veränderungsabfragemodul (880) abgefragten Stromattribut, das dem Änderungswert des Stroms entspricht.

7. Elektronische Vorrichtung, **dadurch gekennzeichnet, dass** die Vorrichtung einen flexiblen Berührungsbildschirm (220, 320, 420) und ein System für physische Rückmeldungen aufweist, wobei das System Folgendes aufweist: wenigstens eine Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) unter dem flexiblen Berührungsbildschirm (220, 320, 420); wobei die Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) einen Ankerteil (242, 343, 346) und einen Spulenteil (244, 342, 345) aufweist, die durch eine Feder (344, 347) verbunden sind, wenigstens eines von dem Ankerteil (242, 343, 346) und dem Spulenteil (244, 342, 345) in einem aktiven Zustand ist und ein anfänglicher relativer Abstand zwischen dem Ankerteil (242, 343, 346) und dem Spulenteil (244, 342, 345) ein vorbestimmter Wert ist und die Vorrichtung zum Steuern eines Systems für physische Rückmeldungen nach einem der Ansprüche 4 bis 6.

8. Computerprogramm, das bei Ausführung auf einem Prozessor einer elektronischen Vorrichtung, die einen flexiblen Berührungsbildschirm (220, 320, 420) und ein System für physische Rückmeldungen aufweist, wobei das System Folgendes aufweist: wenigstens eine Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) unter dem flexiblen Berührungsbildschirm (220, 320, 420); wobei die Einheit für physische Rückmeldungen (240, 340, 340a, 340b, 440) einen Ankerteil (242, 343, 346) und einen Spulenteil (244, 342, 345) aufweist, die durch eine Feder (344, 347) verbunden sind, wenigstens eines von dem Ankerteil (242, 343, 346) und dem Spulenteil (244, 342, 345) in einem aktiven Zustand ist und ein anfänglicher relativer Abstand zwischen dem Ankerteil (242, 343, 346) und dem Spulenteil (244, 342, 345) ein vorbestimmter Wert ist, ein Verfahren nach einem der Ansprüche 1 bis 3 durchführt.

Revendications

1. Procédé de commande d'un système de rétroaction physique, qui est appliqué à un dispositif électronique comprenant un écran tactile flexible (220, 320, 420) et le système de rétroaction physique, le système comprenant : au moins une unité de rétroaction physique (240, 340, 340a, 340b, 440) au-dessous de l'écran tactile flexible (220, 320, 420) ; dans lequel l'unité de rétroaction physique (240, 340, 340a, 340b, 440) comprend une partie d'armature (242, 343, 346) et une partie de bobinage (244, 342, 345) connectées par un ressort (344, 347), au moins l'une de la partie d'armature (242, 343, 346) et de la partie de bobinage (244, 342, 345) est dans un état actif, et une distance initiale relative entre la partie d'armature (242, 343, 346) et la partie de bobinage (244, 342, 345) est une valeur prédéterminée, **caractérisé en ce que** le procédé comprend :

détecter (502, 602) si un graphique d'affichage sur l'écran tactile flexible (220, 320, 420) est un graphique prédéterminé, le graphique prédéterminé comprenant l'un quelconque ou une combinaison d'un bouton, d'un cadre, d'une étiquette, d'un menu, d'un hyperlien et d'une icône ; et si le résultat de la détection est que le graphique d'affichage est le graphique prédéterminé, exciter (504) une unité de rétroaction physique

(240, 340, 340a, 340b, 440) au-dessous de la position du graphique d'affichage, de telle sorte qu'une distance relative entre la partie d'armature et la partie de bobinage dans l'unité de rétroaction physique (240, 340, 340a, 340b, 440) est changée par une action électromagnétique et une saillie ou un renfoncement est formé à une position correspondante de l'écran tactile flexible (220, 320, 420),
et **en ce que** avant d'exciter (504) l'unité de rétroaction physique (240, 340, 340a, 340b, 440) au-dessous de la position du graphique d'affichage, le procédé comprend en outre :

consulter (604) un attribut de courant correspondant au graphique d'affichage d'une relation correspondante pré-stockée entre le graphique prédéterminé et l'attribut de courant conformément au graphique d'affichage, l'attribut de courant comprenant une direction de courant et une valeur de courant ; et
exciter (504) l'unité de rétroaction physique (240, 340, 340a, 340b, 440) au-dessous de la position du graphique d'affichage comprend :
exciter (606) l'unité de rétroaction physique (240, 340, 340a, 340b, 440) au-dessous de la position du graphique d'affichage conformément à l'attribut de courant consulté correspondant au graphique d'affichage.

2. Procédé selon la revendication 1, **caractérisé en ce que**, après l'excitation (504) de l'unité de rétroaction physique (240, 340, 340a, 340b, 440) au-dessous de la position du graphique d'affichage, le procédé comprend en outre :

détecter (608) si le courant est changé ; et
si le résultat de la détection est que le courant est changé, changer (610) le graphique d'affichage sur l'écran tactile flexible (220, 320, 420) conformément à la valeur de changement du courant ; ou bien
si le résultat de la détection est que le courant est changé, ajuster (610) le courant conformément à la valeur de changement du courant.

3. Procédé selon la revendication 2, **caractérisé en ce que**, avant l'ajustement (610) du courant conformément à la valeur de changement du courant, le procédé comprend en outre :

consulter un attribut de courant (604) correspondant à la valeur de changement du courant d'une relation correspondante pré-stockée entre la valeur de changement et l'attribut de courant conformément à la valeur de changement, l'attribut de courant comprenant la direction de courant et la valeur de courant ; et
l'ajustement (610) du courant conformément à la valeur de changement du courant comprend :
ajuster le courant conformément à l'attribut de courant consulté correspondant à la valeur de changement du courant.

4. Appareil de commande d'un système de rétroaction physique, qui est appliqué à un dispositif électronique comprenant un écran tactile flexible (220, 320, 420) et le système de rétroaction physique, le système comprenant : au moins une unité de rétroaction physique (240, 340, 340a, 340b, 440) au-dessous de l'écran tactile flexible (220, 320, 420) ; dans lequel l'unité de rétroaction physique (240, 340, 340a, 340b, 440) comprend une partie d'armature (242, 343, 346) et une partie de bobinage (244, 342, 345) connectées par un ressort (344, 347), au moins l'une de la partie d'armature (242, 343, 346) et de la partie de bobinage (244, 342, 345) est dans un état actif, et une distance initiale relative entre la partie d'armature (242, 343, 346) et la partie de bobinage (244, 342, 345) est une valeur prédéterminée, **caractérisé en ce que** l'appareil comprend en outre :

un module de détection de graphique (820) configuré pour détecter si un graphique d'affichage sur l'écran tactile flexible (220, 320, 420) est un graphique prédéterminé, le graphique prédéterminé comprenant l'un quelconque ou une combinaison d'un bouton, d'un cadre, d'une étiquette, d'un menu, d'un hyperlien et d'une icône ;
un module de commande d'unité (840) configuré pour, si le résultat de la détection du module de détection de graphique (820) est que le graphique d'affichage est le graphique prédéterminé, exciter une unité de rétroaction physique (240, 340, 340a, 340b, 440) au-dessous de la position du graphique d'affichage, de telle sorte qu'une distance relative entre la partie d'armature (242, 343, 346) et la partie de bobinage (244, 342, 345) dans l'unité de rétroaction physique (240, 340, 340a, 340b, 440) est changée par une action électromagnétique et une saillie ou un renfoncement est formé à une position correspondante de l'écran tactile flexible (220, 320, 420),
un module de consultation de graphique (830) configuré pour consulter un attribut de courant correspondant au graphique d'affichage détecté par le module de détection de graphique (820) d'une relation correspondante pré-stockée entre le graphique prédéterminé et l'attribut de courant conformément au graphique d'affichage, l'attribut de courant comprenant une direction de courant et une valeur de courant ; et
un module de commande d'unité (840) configu-

ré pour exciter l'unité de rétroaction physique (240, 340, 340a, 340b, 440) au-dessous de la position du graphique d'affichage conformément à l'attribut de courant correspondant au graphique d'affichage consulté par le module de consultation de graphique (830).

5. Appareil selon la revendication 4, **caractérisé en ce que** l'appareil comprend en outre :

un module de détection de courant (860) et un module d'ajustement d'affichage (870) ;
le module de détection de courant (860) est configuré pour détecter si un courant sorti par le module de commande d'unité (840) est changé ; et
le module d'ajustement d'affichage (870) est configuré pour, si le résultat de la détection du module de détection de courant (860) est que le courant est changé, changer le graphique d'affichage sur l'écran tactile flexible (220, 320, 420) conformément à la valeur de changement de courant ; ou bien
l'appareil comprend en outre :

un module de détection de courant (860) et un module d'ajustement de courant (890) ;
le module de détection de courant (860) est configuré pour détecter si un courant sorti par le module de commande d'unité (840) est changé ; et
le module d'ajustement de courant (890) est configuré pour, si le résultat de la détection du module de détection de courant (860) est que le courant est changé, ajuster le courant conformément à la valeur de changement du courant.

6. Appareil selon la revendication 5, **caractérisé en ce que** l'appareil comprend en outre :

un module de consultation de changement (880) configuré pour consulter un attribut de courant correspondant à la valeur de changement du courant détectée par le module de détection de courant (860) d'une relation correspondante pré-stockée entre la valeur de changement et l'attribut de courant conformément à la valeur de changement, l'attribut de courant comprenant une direction de courant et une valeur de courant : et
le module d'ajustement de courant (890) est configuré pour ajuster le courant conformément à l'attribut de courant correspondant à la valeur de changement du courant consulté par le module de consultation de changement (880).

7. Dispositif électronique, **caractérisé en ce que** le dispositif comprend un écran tactile flexible (220, 320, 420) et un système de rétroaction physique, le système comprenant : au moins une unité de rétroaction physique (240, 340, 340a, 340b, 440) au-dessous de l'écran tactile flexible (220, 320, 420) ; dans lequel l'unité de rétroaction physique (240, 340, 340a, 340b, 440) comprend une partie d'armature (242, 343, 346) et une partie de bobinage (244, 342, 345) connectées par un ressort (344, 347), au moins l'une de la partie d'armature (242, 343, 346) et de la partie de bobinage (244, 342, 345) est dans un état actif, et une distance initiale relative entre la partie d'armature (242, 343, 346) et la partie de bobinage (244, 342, 345) est une valeur prédéterminée et l'appareil de commande d'un système de rétroaction physique selon l'une quelconque des revendications 4 à 6.

8. Programme informatique, qui lorsque exécuté sur un processeur d'un dispositif électronique comprenant un écran tactile flexible (220, 320, 420) et un système de rétroaction physique, le système comprenant : au moins une unité de rétroaction physique (240, 340, 340a, 340b, 440) au-dessous de l'écran tactile flexible (220, 320, 420) ; dans lequel l'unité de rétroaction physique (240, 340, 340a, 340b, 440) comprend une partie d'armature (242, 343, 346) et une partie de bobinage (244, 342, 345) connectées par un ressort (344, 347), au moins l'une de la partie d'armature (242, 343, 346) et de la partie de bobinage (244, 342, 345) est dans un état actif, et une distance initiale relative entre la partie d'armature (242, 343, 346) et la partie de bobinage (244, 342, 345) est une valeur prédéterminée, met en œuvre un procédé selon l'une quelconque des revendications 1 à 3.

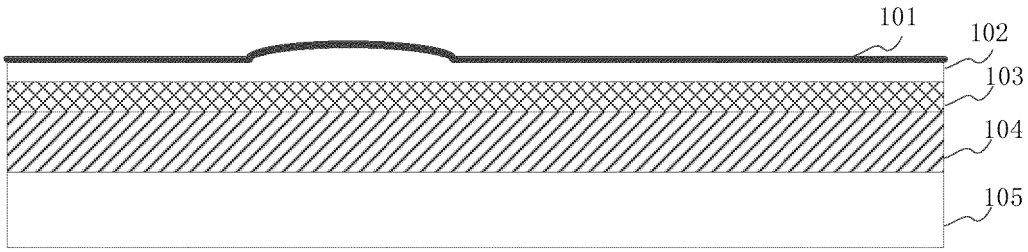

Fig. 1

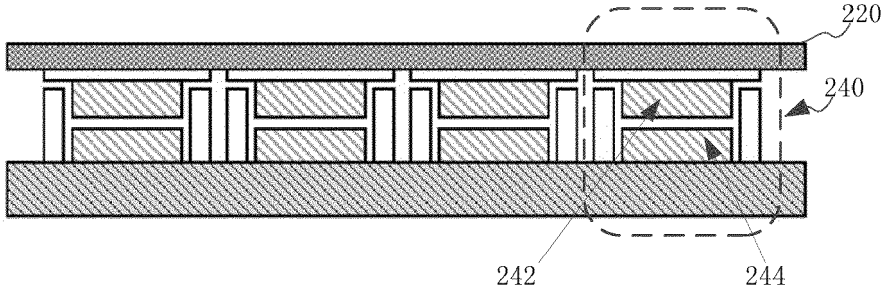

Fig. 2A

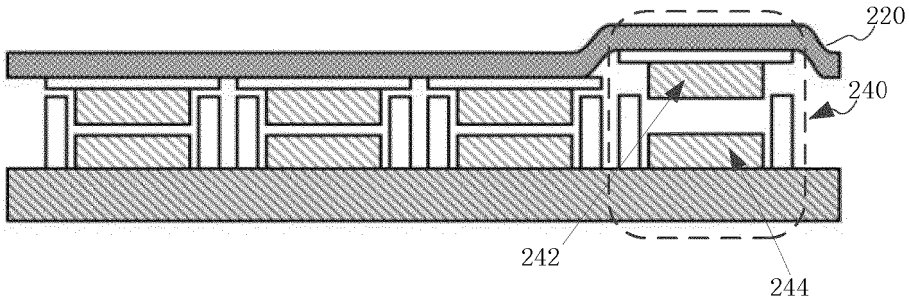

Fig. 2B

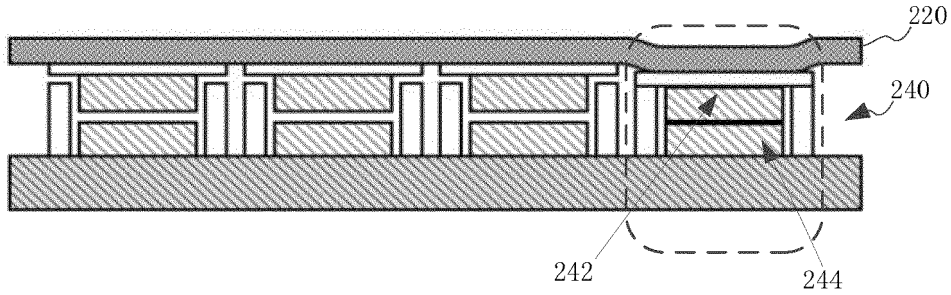

Fig. 2C

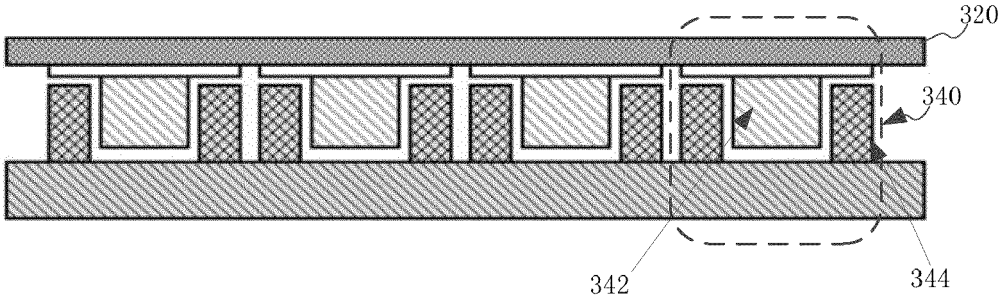

Fig. 3A

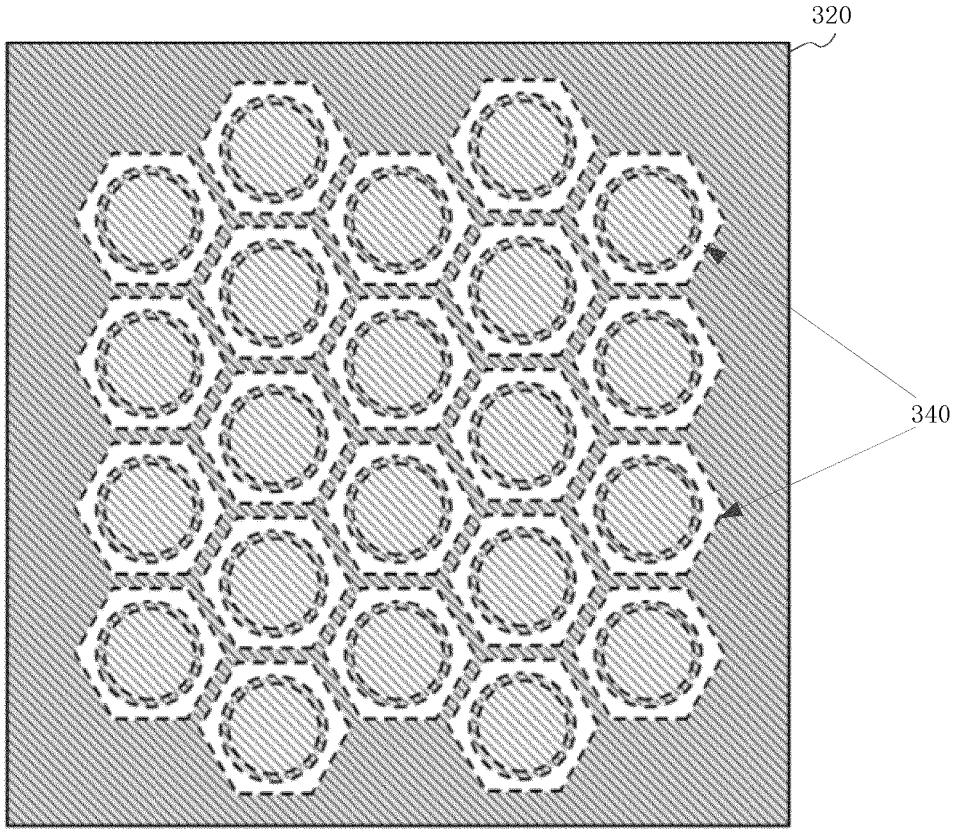

Fig. 3B

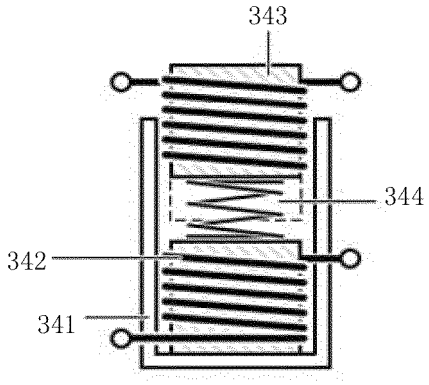

Fig. 3C

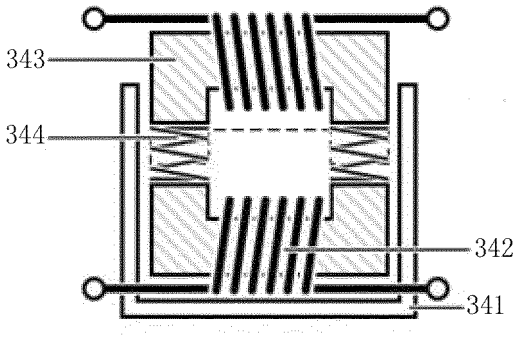

Fig. 3D

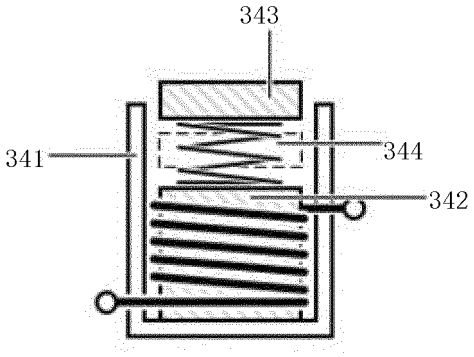

Fig. 3E

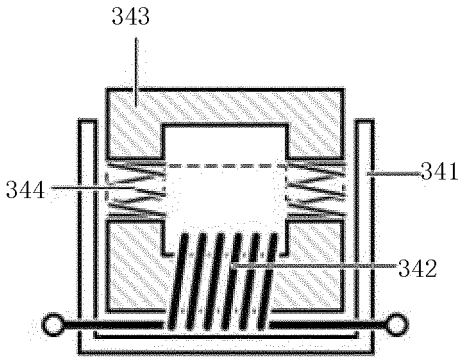

Fig. 3F

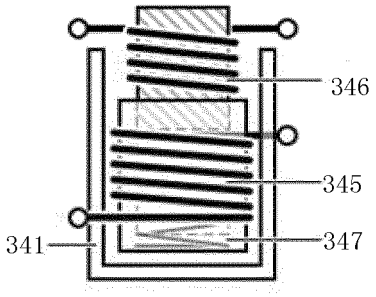

Fig. 3G

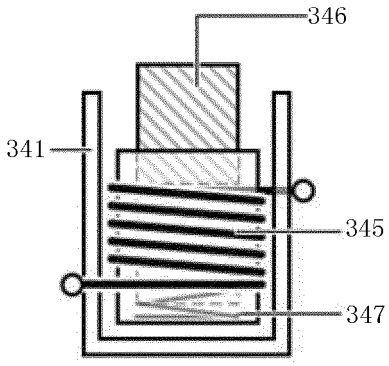

Fig. 3H

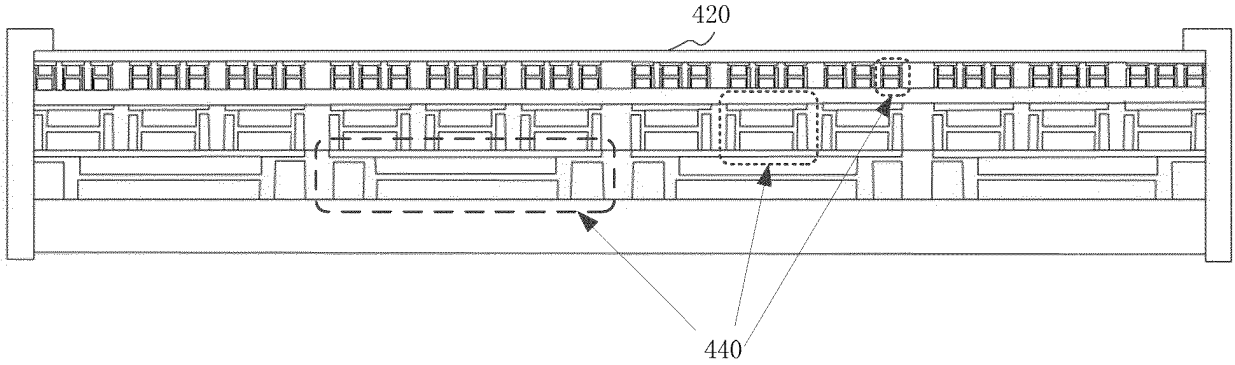

Fig. 4A

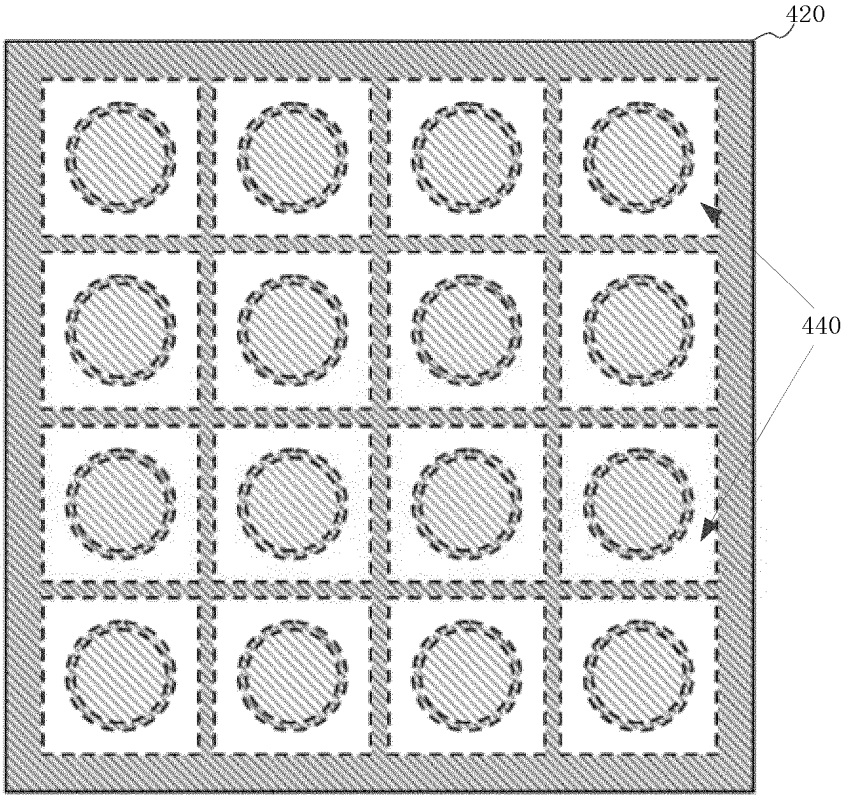

Fig. 4B

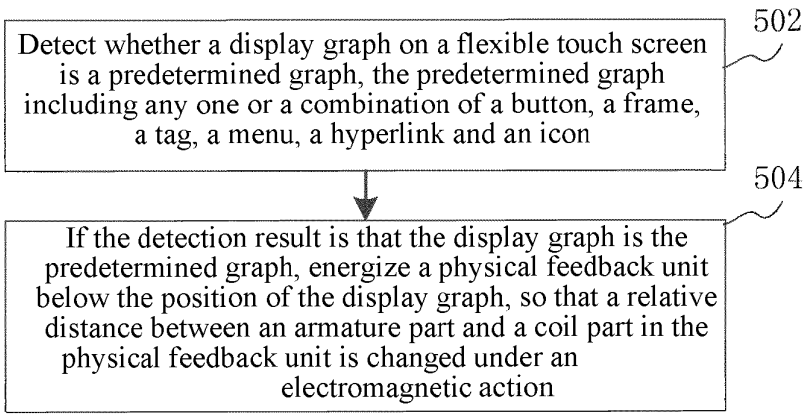
Detect whether a display graph on a flexible touch screen is a predetermined graph, the predetermined graph including any one or a combination of a button, a frame, a tag, a menu, a hyperlink and an icon
502
If the detection result is that the display graph is the predetermined graph, energize a physical feedback unit below the position of the display graph, so that a relative distance between an armature part and a coil part in the physical feedback unit is changed under an electromagnetic action
504

Fig. 5

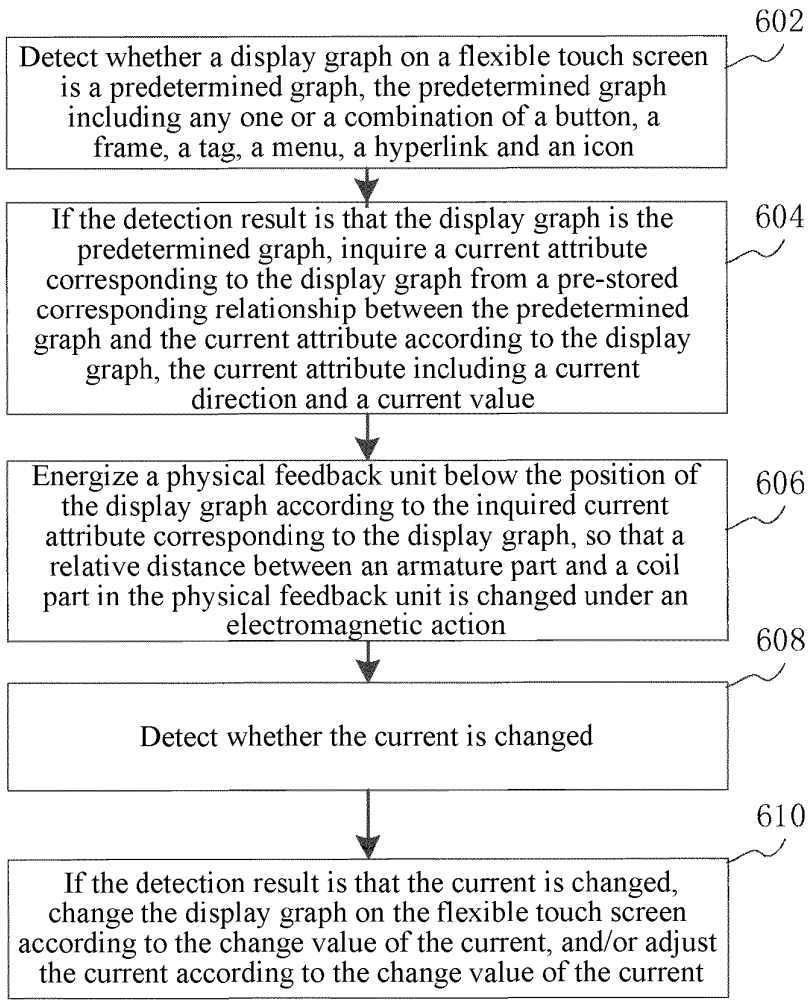
Detect whether a display graph on a flexible touch screen is a predetermined graph, the predetermined graph including any one or a combination of a button, a frame, a tag, a menu, a hyperlink and an icon
602
If the detection result is that the display graph is the predetermined graph, inquire a current attribute corresponding to the display graph from a pre-stored corresponding relationship between the predetermined graph and the current attribute according to the display graph, the current attribute including a current direction and a current value
604
Energize a physical feedback unit below the position of the display graph according to the inquired current attribute corresponding to the display graph, so that a relative distance between an armature part and a coil part in the physical feedback unit is changed under an electromagnetic action
606
Detect whether the current is changed
608
If the detection result is that the current is changed, change the display graph on the flexible touch screen according to the change value of the current, and/or adjust the current according to the change value of the current
610

Fig. 6

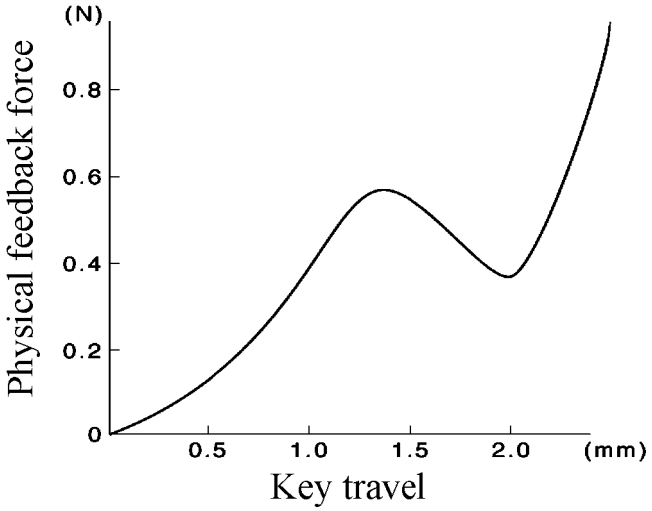
(N)
0.8
0.6
0.4
0.2
0
Physical feedback force
0.5
1.0
1.5
2.0
(mm)
Key travel

Fig. 7

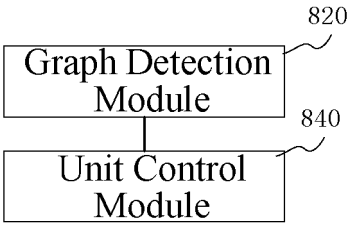
820
Graph Detection Module
840
Unit Control Module

Fig. 8

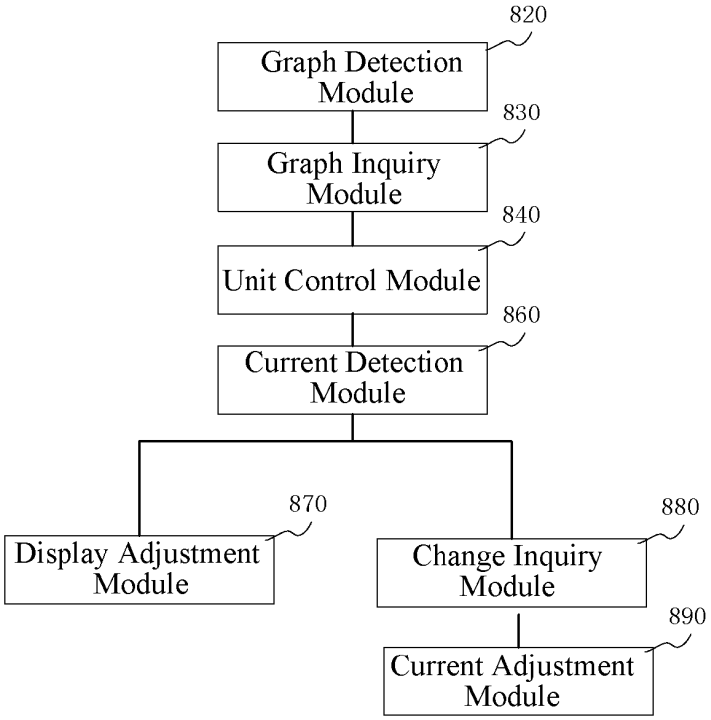

Fig. 9

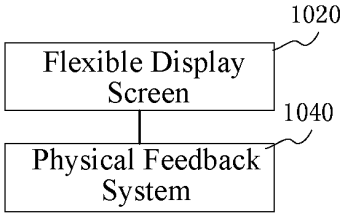

Fig. 10

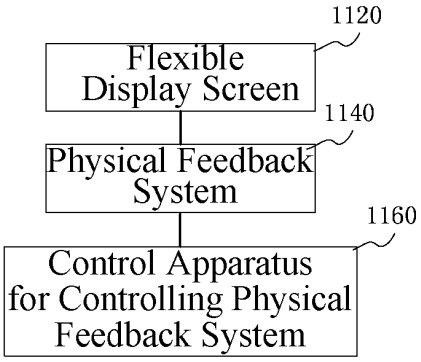

Fig. 11

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20100162109 A1 **[0006]**
- US 20110304550 A1 **[0006]**
- US 20120105333 A1 **[0006]**