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(54) **DISPLAY DEVICE HAVING REDUCED POWER CONSUMPTION AND DRIVING METHOD THEREFOR**

ANZEIGEVORRICHTUNG MIT REDUZIERTEM LEISTUNGSVERBRAUCH UND ANSTEUERUNGSVERFAHREN DAFÜR

DISPOSITIF D'AFFICHAGE À CONSOMMATION D'ÉNERGIE RÉDUITE ET SON PROCÉDÉ DE COMMANDE

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Description

BACKGROUND

1. Field

[0001] Embodiments of the invention relate generally to display devices.

2. Description of the Related Art

[0002] Display devices today are employed in widely used computer monitors, televisions, mobile phones or the like. Such display devices may include a cathode-ray tube, liquid crystal, plasma, organic light emitting display devices, or the like.

[0003] These display devices typically include a display panel and a signal controller. The signal controller generates a control signal to drive the display panel along with an image signal received from an external source, and transmits them to the display panel.

[0004] High-frequency driving techniques have been developed in order to eliminate motion blur, afterimage, and flicker, causes for a decline in picture quality. Accordingly, breaking from the traditional 60Hz driving technology, high frequency driving technologies such as 120Hz, 240Hz, 480Hz, etc. are being developed to realize high picture quality.

[0005] However, unlike TV which uses commercial electricity, mobile devices such as mobile phones and information technology products are sensitive to power consumption because they are supplied with power through a battery.

[0006] If driving frequency is reduced to reduce power consumption, problems that can arise include motion blur, afterimage and flicker, all of which result in a decline in picture quality.

[0007] Whilst different to the subject-matter of the present disclosure, background art includes: US2015062100; EP2876636; US2013111377; US2009128487; US2008309652; and EP2284826.

[0008] US2015062100 describes a display device having a first mode (video image driving) in which driving is performed at a first frame frequency and a second mode (still image driving) in which the driving is performed at a second frame frequency lower than the first frame frequency. When the first mode is switched to the second mode, the display device first performs the driving at a frame frequency higher than the second frame frequency for at least one frame and then, the driving is switched to be performed at the second frame frequency. EP2876636 describes a method of driving a display panel including generating a first driving period having a first driving frequency, generating a second driving period having a second driving frequency, and inserting a compensating frame between the first driving period and the second driving period. EP2876636 also describes a display apparatus includes a display panel configured to display an image, and a display panel driver configured to generate a first driving period having a first driving frequency, to generate a second driving period having a second driving frequency, and to insert a compensating frame between the first driving period and the second driving period.

[0009] US2013111377 describes a portable electronic device with first and second modes, the first mode, associated with allowing for the availability of one or more of a first level of power consumption and processor activity for the portable electronic device, and allowing general unlocked user interaction with the user interface of the portable electronic device; the second mode, associated with allowing for the availability of one or more of a second level of power consumption or processor activity, and allowing locked user interaction with the user interface; and the locked user interaction allowing for the provision of one or more specific limited user inputs using the user interface, to directly interact with associated second mode output provided using the user interface in the second mode, the one or more specific limited user inputs not being associated with general unlocking of portable electronic device to enter the first mode of operation.

[0010] US2009128487 describes a wearable electronic device such as a wrist watch which is supplied with a conventional clock with two pointers. The device displays a parameter indicative of how "cool" the wearer has been over the past period as a function of time, using the time axis of one of the pointers. "Coolness" can be based on the measurement of related physiological parameters like heart-rate, body temperature, movement, skin resistance or muscle activity. "Coolness" of a person is understood as being the ability to cope with stress. Therefore, the stability of physiological parameters can be used to derive a signal for the subjective trait called "coolness". All physiological parameters can be measured by sensors in the watch or in the strap. The wearable electronic device is used as a gadget for self-expression and emotional feedback.

[0011] US2008309652 describes a device including a display capable of providing variable refresh rates, and a display controller that determines a refresh rate and outputs an image to the display based on the determined refresh rate.

[0012] EP2284826 describes an organic light emitting display capable of reducing power consumption in a standby mode to increase the use time of a battery and a method of driving the same. The organic light emitting display includes a pixel unit for displaying an image by utilizing a plurality of frames and in accordance with data signals and scan signals; a data driver for outputting the data signals; a scan driver for outputting the scan signals; and a controller for controlling the data driver and the scan driver so that, in at least one frame of the plurality of frames, the scan signals are not transmitted to the pixel unit. US2015082446 A1 describes a display device displaying slow changing visual content, such as "heartbeat" indications or battery status in a sleep mode by

using a low-power processor.

SUMMARY

[0013] Embodiments of the invention seek to provide a display device that reduces power consumption and avoids picture quality problems, as well as a method for driving the same. The present invention is defined by the independent claims 1 and 5.

[0014] In accordance with an embodiment of the invention, there is provided a display device according to claim 1.

[0015] Also, the low frequency may comprise repeating cycles, where the timing controller may change the luminance from a first luminance value to a second luminance value in continuous manner during each cycle of the low frequency.

[0016] In an embodiment, the timing controller, if the first image comprises at least any one of a text or an included image, may change a size or a color of the text or the included image every said cycle.

[0017] In an example not forming an embodiment, the certain information may include at least any one of present time, date, weather, location of user, biological information or an alarm message.

[0018] In an embodiment, the normal frequency may be 60Hz, and the low frequency may be 0Hz or greater and 3Hz or less.

[0019] In an example not forming an embodiment, if the low frequency is 0Hz, the timing controller may lower the luminance from a first luminance value to a second luminance value in continuous manner when the first image is displayed on the display panel and thereafter maintain the second luminance value.

[0020] In an example not forming an embodiment, the display device may further include a touch sensor for generating a touch input signal, and the timing controller may increase the luminance to the first luminance value in response to the touch input signal.

[0021] In accordance with another embodiment of the invention, there is provided a method of driving a display device according to claim 5.

[0022] Also, the displaying the image may further include gradually changing the luminance from the first luminance value to the second luminance value during the cycles if the image is the first image.

[0023] In an example not forming an embodiment, the displaying the image may further comprise changing at least any one of a size or a color of a text or a graphical image included in the first image from one cycle to the next cycle if the image is the first image.

[0024] In an embodiment of the invention, power consumption may be reduced by driving the first image at a low frequency.

[0025] Also, the problem of flicker due to low frequency operation may be resolved, or utilized to advantage.

At least some of the above and other features of the invention are set out in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] Example embodiments of the invention will now be described more fully hereinafter with reference to the accompanying drawings; however, they may be embodied in different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the example embodiments to those skilled in the art.

[0027] In the drawing figures, dimensions may be exaggerated for clarity of illustration. The various figures are thus not necessarily to scale. It will be understood that when an element is referred to as being "between" two elements, it can be the only element between the two elements, or one or more intervening elements may also be present. Like reference numerals refer to like elements throughout.

FIG. 1 illustrates a display panel, a display driver, and a frequency selector in accordance with an embodiment of the invention.

FIG. 2 is a block diagram schematically illustrating an internal configuration of a display device in accordance with an embodiment of the invention.

FIG. 3 illustrates changes in the luminance of a first image displayed on a display panel in accordance with an embodiment of the invention.

FIG. 4 illustrates changes in the luminance of a first image displayed on a display panel in accordance with another embodiment of the invention.

FIG. 5 illustrates the appearance of electronic equipment with a display device in accordance with an embodiment of the invention.

FIG. 6 illustrates a first image in accordance with an embodiment being displayed on the electronic equipment shown in FIG. 5 as an example.

FIG. 7 illustrates the appearance of another electronic equipment in accordance with an embodiment of the invention.

FIG. 8 illustrates a first image in accordance with an embodiment being displayed on the electronic equipment shown in FIG. 7 as an example.

DETAILED DESCRIPTION

[0028] In the following detailed description, only certain embodiments of the present invention have been shown and described, simply by way of illustration. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the scope of the present invention. Accordingly, the drawings and description are to be regarded as illustrative in nature and not restrictive. In addition, it will be understood that when an element or layer is referred to as being "on", "connected to" or "coupled to" another element or layer, it can be directly on, connected or coupled to the other element or layer or inter-

vening elements or layers may be present. In contrast, when an element is referred to as being "directly on," "directly connected to" or "directly coupled to" another element or layer, there are no intervening elements or layers present. Like numbers refer to like elements throughout. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

[0029] It will be understood that, although the terms first, second, etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another region, layer or section. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section, a second element, component, region, layer or section could be termed a first element, component, region, layer or section, and so forth, without departing from the teachings of the present invention.

[0030] Spatially relative terms, such as "beneath", "below", "lower", "above", "upper" and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "below" or "beneath" other elements or features would then be oriented "above" the other elements or features. Thus, the exemplary term "below" can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

[0031] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms, "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "includes" and/or "including", when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0032] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein. All numerical values are approximate, and may vary. All examples of specific materials and compositions are to be taken as nonlimiting and exemplary only. Other suitable materials and compositions may be used instead.

[0033] FIG. 1 illustrates a display panel 110, a display driver 120, and a frequency selector 130 in accordance with an embodiment of the invention.

[0034] A display device in accordance with an embodiment of the invention, as shown in FIG. 1, may include a display panel 110 for displaying image, a data driver 122 and a scan driver 121 for driving the display panel 110. The display may also include a timing controller 125, and a frequency selector 130 for controlling the data driver 122 and the scan driver 121.

[0035] Referring to FIG. 1, the display panel 110 may include multiple data lines D1 to Dm, multiple scan lines S1 to Sn, and multiple pixels P.

[0036] The multiple scan lines S1 to Sn may extend in a horizontal direction, and the multiple data lines D1 to Dm may extend in a vertical direction, crossing the multiple scan lines S1 to Sn.

[0037] The pixels P may be coupled to the data lines D1 to Dm and the scan lines S1 to Sn. For example, the pixels P may be arranged in matrix form at the intersections of the data lines D1 to Dm and the scan lines S1 to Sn.

[0038] Also, each pixel P may receive a data signal and a scan signal through the data lines D1 to Dm and the scan lines S1 to Sn.

[0039] Embodiments may be applied to various display panels, such as liquid crystal display panels, organic light emitting display panels, electrophoretic display panels, plasma display panels, or the like.

[0040] The display driver 120 may include the scan driver 121, the data driver 122, and the timing controller 125. In addition, a driving signal generated by the display driver 120 may include a scan signal and a data signal.

[0041] The scan driver 121 may supply scan signals to the scan lines S1 to Sn in response to timing control signals SCS. For example, the scan driver 121 may sequentially supply scan signals to the scan lines S1 to Sn.

[0042] The scan driver 121 may be electrically coupled to the scan lines S1 to Sn located on the display panel 110 through a separate component. Or the scan driver 121 may be mounted directly on the display panel 110.

[0043] The data driver 122 may receive data timing control signals DCS and image data Di1 and Di2 from the timing controller 125, and may generate data signals in response.

[0044] Also, the data driver 122 may supply the generated data signals to the data lines D1 to Dm.

[0045] The data driver 122 may be electrically coupled to the data lines D1 to Dm located on the display panel 110 through a separate component. Or the data driver 122 may be mounted directly on the display panel 110.

[0046] The pixels P is supplied with data signals

through the data lines D1 to Dm and may emit light at a luminance corresponding to the data signals. More specifically, the data driver 122 may display images by supplying data signals corresponding to the image data Di1 and Di2.

[0047] The data driver 122, as shown in FIG. 1, may be located separately from the scan driver 121. However, in another embodiment, the data driver 122 may be integrated into the scan driver 121.

[0048] The timing controller 125 may receive image data Di1 and a control signal Cs from an external source.

[0049] The timing controller 125 may generate timing control signals to control the scan driver 121 and the data driver 122 based on the control signal Cs.

[0050] For example, the timing control signals may include a scan timing control signal SCS to control the scan driver 121 and a data timing control signal DCS to control the data driver 122.

[0051] Therefore, the timing controller 125 may supply a scan timing control signal SCS to the scan driver 121 and a data timing control signal DCS to the data driver 122.

[0052] In addition, the timing controller 125 may receive image data Di2, which includes information regarding a driving frequency (frequency to drive the display panel), from the frequency selector 130.

[0053] For example, the timing controller 125, referring to the image data Di2 transmitted from the frequency selector 130, may operate in such a way that the first image driven at a low frequency may be displayed on the display panel 110, or the second image driven at a normal frequency may be displayed.

[0054] Here, the timing controller 125 may convert the image data Di1 and Di2 such that the image data Di1 and Di2 are suitable for the specifications of the data driver 122, and supply them to the data driver 122.

[0055] FIG. 1 shows the frequency selector 130 as being located separately from the timing controller 125, but it is not so limited, and unlike what is shown in FIG. 1, the frequency selector 130 may be integrated into the timing controller 125.

[0056] FIG. 2 is a block diagram illustrating the internal configuration of a display device in accordance with an embodiment of the invention.

[0057] Referring to FIG. 2, a display device in accordance with an embodiment may include a display panel 110, a display driver 120, a frequency selector 130, a touch sensor 140, a bio-signal sensor 150, and a controller 160.

[0058] First, the touch sensor 140 may detect a touch by a user, and more specifically, a touch by a body part of the user (for example, a finger) or by a stylus or the like.

[0059] Touches by the user may be performed by a direct touching action of a finger, etc. on an electronic device having a display device, and by a hovering action of a finger, etc. in which a finger, etc. may approach but not physically contact the electronic device.

[0060] For example, the touch sensor 140 may be realized with any one or more of a capacitive type touch sensor, a resistive type touch sensor, an optical touch sensor, a surface acoustic wave touch sensor, a pressure touch sensor, or a hybrid touch sensor.

[0061] Here, a hybrid touch sensor may be realized by combining the same type of sensors together, or by combining different types of sensors together.

[0062] However, the touch sensor 140 used in an embodiment is not limited to the types mentioned above; regardless of the type, a sensor capable of detecting touch by a finger or a tool is sufficient.

[0063] The touch sensor 140 may generate and supply a touch signal to a touch controller (not shown) when touch by the user is detected.

[0064] The touch controller may detect the location of touch using a touch signal supplied from the touch sensor 140.

[0065] The touch sensor 140, as shown in FIG. 2, may be located separately from the display panel 110, but is not limited thereto, and the touch sensor 140 may alternatively be integrated into the display panel 110.

[0066] Next, the bio-signal sensor 150 may perform the function of obtaining a user's biometrics information from a biometrics measuring device (not shown).

[0067] Biometrics information may include at least one of blood pressure, blood sugar, heart rate (or pulse), body fat, weight, the presence of diseases such as atopic dermatitis, asthma, etc., stress level, organic compounds in exhalation, or height.

[0068] The biometrics measuring device may measure the user's biometrics, which may include not only a blood pressure measuring device, a blood sugar measuring device, a pulse measuring device, or a weight measuring device, but also a height measuring device, a body temperature measuring device, and the like.

[0069] Also, the biometrics measuring device may include various measuring devices which measure factors affecting the user's health and those attributes of the surrounding environment which may affect the user's health (for example, temperature, humidity, ultraviolet index, cleanliness, etc.).

[0070] Next, the controller 160 may control the flow of data among the touch sensor 140, the bio-signal sensor 150, and the frequency selector 130. In other words, the controller 160 may operate in such a way that the touch sensor 140, the bio-signal sensor 150, and the frequency selector 130 each may perform its unique functions, by controlling the flow of data between components.

[0071] In FIG. 2, the controller 160 is shown to be located separately from each component for ease of illustration, but it is not limited thereto and may instead for example be combined into the frequency selector 130, or into the timing controller 125 along with the frequency selector 130.

[0072] Next, the display panel 110 may display certain images by including multiple pixels P as described in detail with reference to FIG. 1. For example, the display panel 110 may display the first image or the second im-

age in accordance with the control of the display driver 120.

[0073] Also, the display panel 110 may be realized with an organic light emitting display panel, a liquid crystal display panel, a plasma display panel, etc., but is not limited thereto. Any display is contemplated.

[0074] The display driver 120 may control the image display actions of the display panel 110 by supplying certain driving signals to the display panel 110.

[0075] For example, the display driver 120 may generate a driving signal using at least one of the following: the image data Di1 supplied from an external source, the image data Di2 for a driving frequency in accordance with a selection by the frequency selector 130, and the control signal Cs.

[0076] Specifically, the display driver 120 may display the first image or the second image on the display panel 110. When the image displayed on the display panel 110 is the first image, a driving signal may be generated such that the luminance of the display panel on which the first image is displayed may repeatedly change every cycle corresponding to a low frequency selected by the frequency selector 130.

[0077] Next, the frequency selector 130 may select a driving frequency for display of the image. Especially when the image displayed on the display panel 110 is the first image, the frequency selector 130 may select a low frequency, and when the image displayed on the display panel 110 is the second image, the frequency selector 130 may select a normal frequency that is higher than the low frequency.

[0078] An image displayed on the display panel 110 which is not a first image shall be referred to as a second image.

[0079] The first image may be an Always On Display (AOD) image to display certain information on the display panel 110 at all times, even when an input signal to activate the display panel 110 is not detected. This is in contrast to images which appear when the display panel 110 is activated in accordance with the user's need.

[0080] Here, the certain information displayed in the first image may include at least one of the following: the present time, the date, the weather, the user's location, the user's biometrics, or notification messages. For example, the first image may include a clock screen or the like.

[0081] An input signal to activate the display panel 110 may be a touch input signal, or a signal by an input button of an electronic device equipped with a display device in accordance with an embodiment.

[0082] When displaying the first image, that is, an AOD image, it may be advantageous to be able to check certain information at all times, and this may be especially useful for wearable display devices, smart phones, etc. which must display fixed screens for long periods of time.

[0083] However, because the first image is always on, there may be a problem of power consumption, but such a problem may be solved by driving the first image at a low frequency. This will be described subsequently.

[0084] Generally the display panel 110 displays several frames per second. For example, when the driving frequency of the display panel 110 is 60Hz, it may display 60 frames per second, and when the driving frequency is 1Hz, it may display one frame per second.

[0085] When the image data of each frame is the same, a still image may be displayed, and when the image data of each frame is different, video or moving images may be displayed.

[0086] As each pixel P on the display panel 110 emits light, voltage charged in a capacitor (not shown) in each pixel P may decrease over time, and especially when driven at a low frequency, the amount of time it takes for the voltage to leak may increase, leading to an increased voltage difference of a pixel electrode.

[0087] Therefore, in this case, the phenomenon of flicker may be perceived. Conventionally, the phenomenon of flicker may be controlled by driving at a high frequency even when a still image is displayed, such that the problem of flicker may not be perceived.

[0088] Therefore, in an embodiment of the invention, when the image displayed on the display panel 110 is the first image, power consumption may be reduced by operating at a low frequency and may solve any user inconveniences arising from flicker.

[0089] The frequency selector 130 may select a low frequency as a driving frequency of the display panel 110 when the image displayed on the display panel 110 is the first image. Specifically, it may select a frequency corresponding to either for example a second (i.e. 1 sec) or according to the embodiment the heart rate of the user.

[0090] The timing controller 125 may control the display panel 110 based on a driving frequency selected by the frequency selector 130, such that the luminance of the first image is changed repeatedly every cycle corresponding to the driving frequency when the image displayed on the display panel 110 is the first image.

[0091] This will be described subsequently with reference to FIG. 3.

[0092] FIG. 3 illustrates changes in the luminance of a first image displayed on a display panel in accordance with an embodiment of the invention.

[0093] As shown in FIG. 3, the luminance of the first image may be changed repeatedly every certain cycle T1 by a driving frequency selected by a frequency selector 130 and a control signal of a timing controller 125.

[0094] In other words, when the first image starts, during one cycle T1, the luminance of the first image may increase to the value of a first luminance value L1 and then continuously decay from the first luminance value L1 to a second luminance value L2 in an analog manner. After one cycle, when a new cycle begins, the luminance of the first image may increase to the first luminance value L1 again, and then once again decay from the first luminance value L1 to the second luminance value L2 in an analog manner.

[0095] For example, when the frequency selector 130

selects 1Hz corresponding to 1 second, which is the unit with which the frequency selector 130 measures time as a driving frequency, the luminance of the first image may be changed every second.

[0096] As described above, the first image in accordance with an embodiment may be AOD, which, unlike a simple still image, contains information regarding time, date, location, biometrics, etc. that may continuously change, e.g. a clock screen.

[0097] In other words, in accordance with an embodiment of the invention, in displaying the first image including a clock screen, the phenomenon of flicker due to low frequency driving may be utilized as a new function (for example, a stopwatch) by causing flickering by changing the luminance every second.

[0098] Meanwhile, as described above, the frequency selector 130 according to the embodiment is configured to select, as a driving frequency, a low frequency value corresponding to a heart rate of the user.

[0099] In this case, the frequency selector 130 may obtain the user's heart rate (number of heartbeats per minute) from the bio-signal sensor 150. For example, when the user's heart rate is 80, the luminance of the first image may be changed every 0.75 seconds (or value proportional to 0.75).

[0100] In an embodiment of the invention, as the user's heart rate goes up, the cycle TImay shorten. Therefore, the user may estimate his/her own heart rate based on the rate at which the display panel 110 flickers.

[0101] In other words, in an embodiment of the invention, driving the first image at a low frequency may lead to lower power consumption, and the phenomenon of flicker may be solved by using the problem of voltage leakage due to low frequency operation to convey useful information to the user.

[0102] In an embodiment of the invention, when the first image is displayed, low frequency values which the frequency selector 130 selects may be 0Hz or greater and 3Hz or less, such that a driving frequency of the display panel 110 may correspond to a unit of time (especially the second) or the heart rate of the user. Also, when the second image is displayed, the display panel may be driven at 60Hz, which is a conventional driving frequency. It should be noted that 60Hz is described herein as a normal or conventional frequency, but the driving frequency is not limited thereto, and the value of a normal frequency which displays the second image may vary depending on the specification of the display device.

[0103] In FIG. 3, it is assumed that the value of the first luminance L1 is greater than the value of the second luminance L2 and gradually decreases over one cycle, but it is not limited thereto.

[0104] It is also possible to set the value of the first luminance L1 to be smaller than the value of the second luminance L2, such that luminance may increase over one cycle.

[0105] Detailed explanations will follow regarding, in displaying the first image, changes in the luminance of the first image when a low frequency selected by the frequency selector 130 is 0Hz.

[0106] FIG. 4 illustrates changes in the luminance of a first image displayed on a display panel 110 in accordance with another embodiment of the invention.

[0107] Unlike an embodiment in which the luminance of the first image is changed or refreshed repeatedly from the first luminance value L1 to the second luminance value L2 in an analog manner, referring to FIG. 4, the luminance of the first image may continuously decrease from the first luminance value L1 in an analog manner, without being refreshed at predetermined time intervals.

[0108] In this case, when the value of the luminance reaches the second luminance value L2, the luminance of the first image may still maintain the second luminance value L2 even after time has expired. In other words, it may be saturated at the second luminance value.

[0109] As shown in FIG. 4, when the luminance of the first image is decreasing from the first luminance value, or when a certain amount of time has passed and the luminance of the first image is saturated at the second luminance value L2, the luminance of the first image may increase back to the first luminance value L1 every time a touch input signal is detected. That is, the luminance of the first image may be refreshed to first luminance value L1 upon a touch, not at any particular time or time interval.

[0110] Referring to FIGS. 5 to 8, examples shall be given hereunder of display devices in accordance with embodiments of the invention and as used in various electronic devices.

[0111] FIG. 5 illustrates an electronic device including a display device in accordance with an embodiment of the invention.

[0112] Referring to FIG. 5, an electronic device 800 in accordance with an embodiment of the invention may include a display device 850 for displaying images, a main body 810 to which the display device is stably placed and locked of affixed, an additional device formed on the main body 810 for performing certain functions, etc.

[0113] The additional device may include a physical button 840, an audio part 820, a front camera module 830, or the like.

[0114] FIG. 6 illustrates an example of a first image in accordance with an embodiment of the invention, being displayed on the electronic device shown in FIG. 5.

[0115] As shown in FIG. 5 and FIG. 6, a display device 850 in accordance with an embodiment of the invention may be flat and display a first image on certain areas of the display device 850.

[0116] Text indicating the present time, day, and date and an image indicating the weather may be displayed together in the first image.

[0117] As described above, the luminance of the first image shown in FIG. 6 may be changed according to the low frequency. Also, not only the luminance of the first image, but also the sizes or colors of the text and the

image displayed in the first image may be changed as well.

[0118] For example, at least one of either the size or the color of the text and the image may be changed every time T1 passes, or every time the first image is refreshed.

[0119] When the first image is displayed on the display device 850 in accordance with an embodiment, the remaining display panel area other than the area on which the first image is displayed may be set not to emit light, in order to reduce power consumption.

[0120] In FIG. 5, the electronic device 800 is shown to be a smart phone for ease in illustration, but it is not limited thereto, and a smart watch, display for automobiles, etc. may also be adopted to be the electronic device 800 in accordance with an embodiment. That is, the electronic device 800 may be any device capable of displaying an image.

[0121] FIG. 7 illustrates the appearance of an electronic device including a flexible display device in accordance with an embodiment of the invention.

[0122] Referring to FIG. 7, an electronic device 900 in accordance with an embodiment of the invention may include a flexible display device 940, a main body 910 to which the flexible display device 940 is stably placed and locked, an additional device formed on the main body 910 and for performing certain functions, or the like.

[0123] The additional device may include a speaker 920, a microphone (not shown), a front camera module 930, a physical button (not shown), or the like.

[0124] The flexible display device 940 may refer to a display device which can bend, and may bend or be rolled due to its paper-like thin and flexible substrate.

[0125] Since a flexible display device 940 like this uses a plastic substrate, not a glass substrate as generally used, it may be formed using a low-temperature manufacturing process instead of a conventional manufacturing process, in order to prevent damage to the substrate.

[0126] In a flexible display device 940, the glass substrate surrounding the liquid crystals in a liquid crystal display LCD, light emitting diodes LED, organic LED OLED, active matrix OLED AMOLED, etc. may be replaced by plastic film, making it flexible enough to be folded and unfolded.

[0127] The flexible display device 940 may not only be thin and light but also strong against shock, may bend or be folded, and may be manufactured in various forms or shapes.

[0128] As shown in FIG. 7, the flexible display device 940 may extend to and over at least one side (for example, at least one side among left, right, upper, and bottom) of the electronic device 900, folded enough to clear out of the operable radius of curvature of the flexible display device 940, and locked on or attached to a side of the main body 910.

[0129] Hereunder, the display area on the front side of the flexible display device 940 may be referred to as a main display area 941, and the display area extending from the main display area 941, curving to at least one side of the main body 910, and appearing on the side of the main body 910 may be referred to as an auxiliary display area 943.

[0130] In an embodiment of the invention, as described with reference to FIGS. 5 and 6, the first image may be displayed on the front side of the display area, that is, on the main display area 941, but when a flexible display device 940 as shown in FIG. 7 is equipped, the first image may also (or alternatively) be displayed on the auxiliary display area 943.

[0131] FIG. 8 illustrates examples of a first image in accordance with an embodiment of the invention, being displayed in the auxiliary display area 943 of the electronic device 900 shown in FIG. 7.

[0132] In an embodiment of the invention, the first image may be displayed using the auxiliary display area 943. In this case, even when the electronic device 900 is put into a separate case (not shown) covering the main display area 941, certain information may still be provided through the auxiliary display area 943. This information may, if desired, be displayed at any or all times.

[0133] As shown in FIG. 8, a text and a certain image indicating present time, day, date, and alarms may be displayed together in the first image, although any information capable of display is contemplated.

[0134] The first video shown in FIG. 8 may be changed every certain cycle, and not only the luminance of the first video, but also the size or the color of the text and the image displayed in the first video may be changed together. Example embodiments of the invention have been disclosed herein, and although specific terms are employed, they are used and are to be interpreted in a generic and descriptive sense only and not for purpose of limitation. In some instances, as would be apparent to one of ordinary skill in the art as of the filing of the present application, features, characteristics, and/or elements described in connection with a particular embodiment may be used singly or in combination with features, characteristics, and/or elements described in connection with other embodiments unless otherwise specifically indicated. Accordingly, it will be understood by those of skill in the art that various changes in form and details may be made without departing from the scope of the present invention as set forth in the following claims. Various features of the above described and other embodiments can be mixed and matched in any manner, to produce further embodiments consistent with the invention.

Claims

1. A display device comprising:

a display panel (110) comprising a plurality of pixels (P) coupled to scan lines (S1-Sn) and data lines (D1-Dm);
a data driver (122) coupled to the data lines (D1-Dm) and configured to transmit a data signal;

a scan driver (121) coupled to the scan lines (S1-Sn) and configured to sequentially transmit a scan signal;
a frequency selector (130) configured to select a driving frequency for displaying an image, the frequency selector (130) further configured to select a low frequency as the driving frequency if it is determined by the display device that the image to be displayed on the display panel (110) is a first image and to select a normal frequency as the driving frequency if it is determined by the display device that the image to be displayed on the display panel (110) is not the first image, wherein the normal frequency being higher than the low frequency; and
a timing controller (125) configured to control the data driver (122) and the scan driver (121) based on the driving frequency selected by the frequency selector (130),
wherein the timing controller (125) controls the data driver (122) and the scan driver (121) such that luminance of the display panel (110) on which the first image is displayed is periodically changed according to the low frequency selected as the driving frequency if the image displayed on the display panel (110) is the first image,
the display device further comprising a bio-signal sensor (150) arranged to obtain a user's heart rate from a heart-rate measuring device;
the display device further comprising a biological information receiving unit (160) configured to receive the heart rate of a user obtained by the bio-signal sensor (150),
wherein the frequency selector (130) is configured to select a value of the low frequency to correspond to the received heart rate of the user, wherein the driving frequency is the selected low frequency value, and
wherein the first image is an always on display image for displaying the received heart rate of the user on the display panel (110) at all times even though an input signal for activating the display panel (110) is not detected.

2. A display device as claimed in claim 1, wherein the low frequency comprises repeating cycles, and wherein the timing controller is configured to change the luminance from a first luminance value to a second luminance value in continuous manner during each cycle of the low frequency.

3. A display device as claimed in claim 1 or 2, wherein, if the first image comprises at least one of a text or an included image, the timing controller (125) is configured to change a size or a color of the text or the included image according to the low frequency.

4. A display device as claimed in claim 1, wherein the normal frequency is 60Hz, and wherein the low frequency is from 0Hz to 3Hz.

5. A method of driving a display device, the method performed by the display device and comprising steps of:

determining a type of an image to be displayed on a display panel (110);
selecting a driving frequency for driving display of the image, the selecting comprising selecting a low frequency as the driving frequency if determining that the image to be displayed on the display panel is a first image and selecting a normal frequency as the driving frequency if determining that the image to be displayed on the display panel is not the first image, wherein the normal frequency being higher than the lower frequency;
displaying the image on the display panel (110) based on the selected driving frequency, the displaying further comprising periodically changing a luminance of the first image according to the low frequency selected as the driving frequency if the image is the first image and receiving information comprising a heart rate of a user from a terminal (150) of the display device measuring biological information of the user,
wherein, if the image is the first image, a low frequency value corresponding to the received heart rate of the user is selected as the driving frequency, wherein the first image is an always on display image for displaying the heart rate of the user on the display panel (110) at all times even though an input signal for activating the display panel (110) is not detected.

6. A method as claimed in claim 5, wherein the low frequency comprises repeating cycles and the displaying the image further comprises gradually changing the luminance from the first luminance value (L1) to the second luminance value (L2) during the cycles if the image is the first image.

7. A method as claimed in claim 5 or 6, wherein the displaying the image further comprises changing at least any one of a size or a color of a text or a graphical image included in the first image in accordance with the low frequency, if the image is the first image.

Patentansprüche

1. Anzeigevorrichtung, umfassend:

eine Anzeigetafel (110), umfassend eine Vielzahl von Bildpunkten (P), gekoppelt an Abtast-

leitungen (S1-Sn) und Datenleitungen (D1-Dm);
einen Datentreiber (122), gekoppelt an die Datenleitungen (D1-Dm) und konfiguriert zum Übertragen eines Datensignals;
einen Abtasttreiber (121), gekoppelt an die Abtastleitungen (S1-Sn) und konfiguriert zum aufeinanderfolgenden Übertragen eines Abtastsignals;
einen Frequenzwähler (130), konfiguriert zum Auswählen einer Ansteuerungsfrequenz zum Anzeigen eines Bilds, wobei der Frequenzwähler (130) ferner konfiguriert ist zum Auswählen einer Niederfrequenz als die Ansteuerungsfrequenz, wenn durch die Anzeigevorrichtung bestimmt wird, dass das Bild, das auf der Anzeigetafel (110) anzuzeigen ist, ein erstes Bild ist, und zum Auswählen einer Normalfrequenz als die Ansteuerungsfrequenz, wenn durch die Anzeigevorrichtung bestimmt wird, dass das Bild, das auf der Anzeigetafel (110) anzuzeigen ist, nicht das erste Bild ist, wobei die Normalfrequenz höher als die Niederfrequenz ist; und
eine Taktsteuerung (125), konfiguriert zum Steuern des Datentreibers (122) und des Abtasttreibers (121) basierend auf der durch den Frequenzwähler (130) ausgewählten Ansteuerungsfrequenz,
wobei die Taktsteuerung (125) den Datentreiber (122) und den Abtasttreiber (121) derart steuert, dass die Luminanz der Anzeigetafel (110), auf der das erste Bild angezeigt wird, periodisch gemäß der als die Ansteuerungsfrequenz ausgewählten Niederfrequenz verändert wird, wenn das auf der Anzeigetafel (110) angezeigte Bild das erste Bild ist,
die Anzeigevorrichtung ferner umfassend einen Biosignalsensor (150), angeordnet zum Erlangen der Herzschlagrate eines Benutzers von einer die Herzschlagrate messenden Vorrichtung;
die Anzeigevorrichtung ferner umfassend eine biologische Informationen empfangende Einheit (160), konfiguriert zum Empfangen der durch den Biosignalsensor (150) erlangten Herzschlagrate eines Benutzers,
wobei der Frequenzwähler (130) konfiguriert ist zum Auswählen eines Werts der Niederfrequenz zum Korrespondieren mit der empfangenen Herzschlagrate des Benutzers, wobei die Ansteuerungsfrequenz der ausgewählte Niederfrequenzwert ist, und
wobei das erste Bild ein immer auf der Anzeige befindliches Bild zum Anzeigen der empfangenen Herzschlagrate des Benutzers auf der Anzeigetafel (110) zu allen Zeiten ist, selbst wenn ein Eingabesignal zum Aktivieren der Anzeigetafel (110) nicht detektiert wird.

2. Anzeigevorrichtung nach Anspruch 1, wobei die Niederfrequenz sich wiederholende Zyklen umfasst und wobei die Taktsteuerung konfiguriert ist zum Verändern der Luminanz von einem ersten Luminanzwert zu einem zweiten Luminanzwert in einer fortlaufenden Weise während jedes Zyklus der Niederfrequenz.

3. Anzeigevorrichtung nach Anspruch 1 oder 2, wobei, wenn das erste Bild mindestens eines eines Texts oder eines enthaltenen Bilds umfasst, die Taktsteuerung (125) konfiguriert ist zum Verändern einer Größe oder einer Farbe des Texts oder des enthaltenen Bilds gemäß der Niederfrequenz.

4. Anzeigevorrichtung nach Anspruch 1, wobei die Normalfrequenz 60 Hz beträgt und wobei die Niederfrequenz 0 Hz bis 3 Hz beträgt.

5. Verfahren zum Ansteuern einer Anzeigevorrichtung, wobei das Verfahren durch die Anzeigevorrichtung durchgeführt wird und die folgenden Schritte umfasst:

Bestimmen eines Typs eines Bilds, das auf einer Anzeigetafel (110) anzuzeigen ist;
Auswählen einer Ansteuerungsfrequenz zum Ansteuern der Anzeige des Bilds, wobei das Auswählen umfasst, eine Niederfrequenz als die Ansteuerungsfrequenz auszuwählen, wenn bestimmt wird, dass das auf der Anzeigetafel anzuzeigende Bild ein erstes Bild ist, und eine Normalfrequenz als die Ansteuerungsfrequenz auszuwählen, wenn bestimmt wird, dass das auf der Anzeigetafel anzuzeigende Bild nicht das erste Bild ist, wobei die Normalfrequenz höher als die Niederfrequenz ist;
Anzeigen des Bilds auf der Anzeigetafel (110) basierend auf der ausgewählten Ansteuerungsfrequenz, wobei das Anzeigen ferner umfasst, eine Luminanz des ersten Bilds gemäß der als die Ansteuerungsfrequenz ausgewählten Niederfrequenz periodisch zu verändern, wenn das Bild das erste Bild ist, und Informationen, die eine Herzschlagrate eines Benutzers umfassen, von einem Endgerät (150) der Anzeigevorrichtung, das biologische Informationen des Benutzers misst, zu empfangen,
wobei, wenn das Bild das erste Bild ist, ein Niederfrequenzwert korrespondierend mit der empfangenen Herzschlagrate des Benutzers als die Ansteuerungsfrequenz ausgewählt wird,
wobei das erste Bild ein immer auf der Anzeige befindliches Bild zum Anzeigen der Herzschlagrate des Benutzers auf der Anzeigetafel (110) zu allen Zeiten ist, selbst wenn ein Eingabesignal zum Aktivieren der Anzeigetafel (110) nicht detektiert wird.

6. Verfahren nach Anspruch 5, wobei die Niederfrequenz sich wiederholende Zyklen umfasst und das Anzeigen des Bilds ferner umfasst, die Luminanz von dem ersten Luminanzwert (L1) zu dem zweiten Luminanzwert (L2) während der Zyklen graduell zu verändern, wenn das Bild das erste Bild ist.

7. Verfahren nach Anspruch 5 oder 6, wobei das Anzeigen des Bilds ferner umfasst, mindestens eines einer Größe oder einer Farbe eines Texts oder eines in dem ersten Bild enthaltenen grafischen Bilds gemäß der Niederfrequenz zu verändern, wenn das Bild das erste Bild ist.

Revendications

1. Dispositif d'affichage comprenant :

un panneau d'affichage (110) comprenant une pluralité de pixels (P) couplés à des lignes de balayage (S1 à Sn) et à des lignes de données (D1 à Dm) ;
un dispositif de commande de données (122) couplé aux lignes de données (D1 à Dm) et configuré pour transmettre un signal de données ;
un dispositif de commande de balayage (121) couplé aux lignes de balayage (S1 à Sn) et configuré pour transmettre séquentiellement un signal de balayage ;
un sélecteur de fréquence (130) configuré pour sélectionner une fréquence de commande pour afficher une image, le sélecteur de fréquence (130) étant en outre configuré pour sélectionner une fréquence basse en tant que fréquence de commande s'il est déterminé par le dispositif d'affichage que l'image à afficher sur le panneau d'affichage (110) est une première image et pour sélectionner une fréquence normale en tant que fréquence de commande s'il est déterminé par le dispositif d'affichage que l'image à afficher sur le panneau d'affichage (110) n'est pas la première image, dans lequel la fréquence normale est supérieure à la fréquence basse ; et
un contrôleur de synchronisation (125) configuré pour commander le dispositif de commande de données (122) et le dispositif de commande de balayage (121) sur la base de la fréquence de commande sélectionnée par le sélecteur de fréquence (130),
dans lequel le contrôleur de synchronisation (125) commande le dispositif de commande de données (122) et le dispositif de commande de balayage (121) de sorte que la luminance du panneau d'affichage (110) sur lequel la première image est affichée soit changée périodiquement conformément à la fréquence basse sélectionnée en tant que fréquence de commande si l'image affichée sur le panneau d'affichage (110) est la première image,
le dispositif d'affichage comprenant en outre un capteur de biosignal (150) agencé pour obtenir le rythme cardiaque d'un utilisateur à partir d'un dispositif de mesure de rythme cardiaque ;
le dispositif d'affichage comprenant en outre une unité de réception d'informations biologiques (160) configurée pour recevoir le rythme cardiaque d'un utilisateur obtenu par le capteur de biosignal (150),
dans lequel le sélecteur de fréquence (130) est configuré pour sélectionner une valeur de la fréquence basse pour qu'elle corresponde au rythme cardiaque reçu de l'utilisateur, dans lequel la fréquence de commande est la valeur de fréquence basse sélectionnée, et
dans lequel la première image est une image toujours à l'affichage pour afficher le rythme cardiaque reçu de l'utilisateur sur le panneau d'affichage (110) à tous moments même si un signal d'entrée pour activer le panneau d'affichage (110) n'est pas détecté.

2. Dispositif d'affichage selon la revendication 1, dans lequel la fréquence basse comprend des cycles répétitifs, et dans lequel le contrôleur de synchronisation est configuré pour changer la luminance d'une première valeur de luminance à une deuxième valeur de luminance d'une manière continue pendant chaque cycle de la fréquence basse.

3. Dispositif d'affichage selon la revendication 1 ou 2, dans lequel, si la première image comprend au moins l'un d'un texte ou d'une image incluse, le contrôleur de synchronisation (125) est configuré pour changer une taille ou une couleur du texte ou de l'image incluse conformément à la fréquence basse.

4. Dispositif d'affichage selon la revendication 1, dans lequel la fréquence normale est de 60 Hz, et dans lequel la fréquence basse est de 0 Hz à 3 Hz.

5. Procédé de commande d'un dispositif d'affichage, le procédé étant effectué par le dispositif d'affichage et comprenant les étapes :

de détermination d'un type d'une image à afficher sur un panneau d'affichage (110)
de sélection d'une fréquence de commande pour commander l'affichage de l'image, la sélection comprenant la sélection d'une fréquence basse en tant que fréquence de commande s'il est déterminé que l'image à afficher sur le panneau d'affichage est une première image et la sélection d'une fréquence normale en tant que fréquence de commande s'il est déterminé que l'image à afficher sur le panneau d'affichage

n'est pas la première image, dans lequel la fréquence normale est supérieure à la fréquence basse ;

d'affichage de l'image sur le panneau d'affichage (110) sur la base de la fréquence de commande sélectionnée, l'affichage comprenant en outre le changement périodique d'une luminance de la première image conformément à la fréquence basse sélectionnée en tant que fréquence de commande si l'image est la première image et la réception d'informations comprenant un rythme cardiaque d'un utilisateur en provenance d'un terminal (150) du dispositif d'affichage mesurant les informations biologiques de l'utilisateur,

dans lequel, si l'image est la première image, une valeur de fréquence basse correspondant au rythme cardiaque reçu de l'utilisateur est sélectionnée en tant que fréquence de commande,

dans lequel la première image est une image toujours à l'affichage pour afficher le rythme cardiaque de l'utilisateur sur le panneau d'affichage (110) à tous moments même si un signal d'entrée pour activer le panneau d'affichage (110) n'est pas détecté.

6. Procédé selon la revendication 5, dans lequel la fréquence basse comprend des cycles répétitifs et l'affichage de l'image comprend en outre le changement graduel de la luminance de la première valeur de luminance (L1) à la deuxième valeur de luminance (L2) pendant les cycles si l'image est la première image.

7. Procédé selon la revendication 5 ou 6, dans lequel l'affichage de l'image comprend en outre le changement d'au moins l'une quelconque d'une taille ou d'une couleur d'un texte ou d'une image graphique incluse dans la première image conformément à la fréquence basse, si l'image est la première image.

FIG. 1

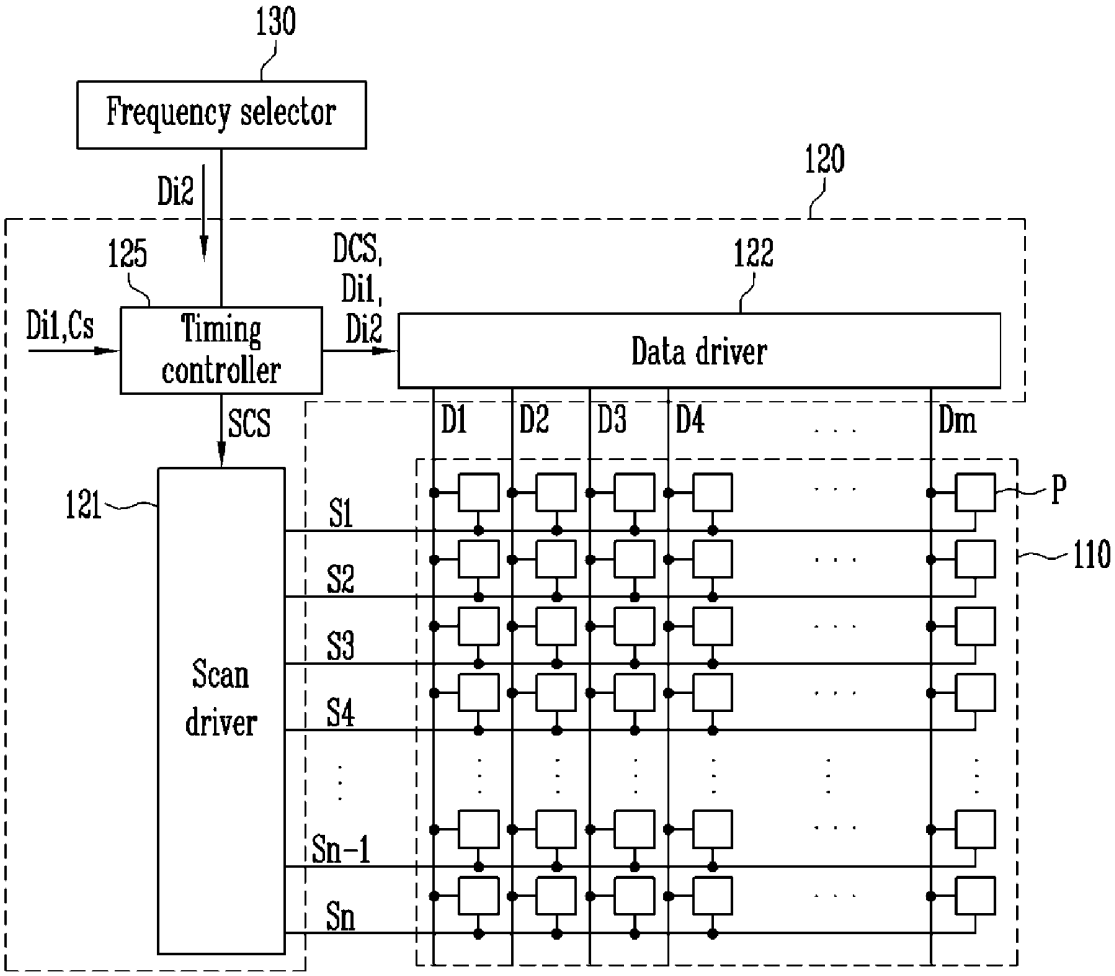
130
Frequency selector
Di2
120
125
DCS,
Di1,
Di2
122
Di1,Cs
Timing controller
Data driver
SCS
D1
D2
D3
D4
Dm
121
S1
S2
S3
S4
Sn-1
Sn
Scan driver
P
110

FIG. 2

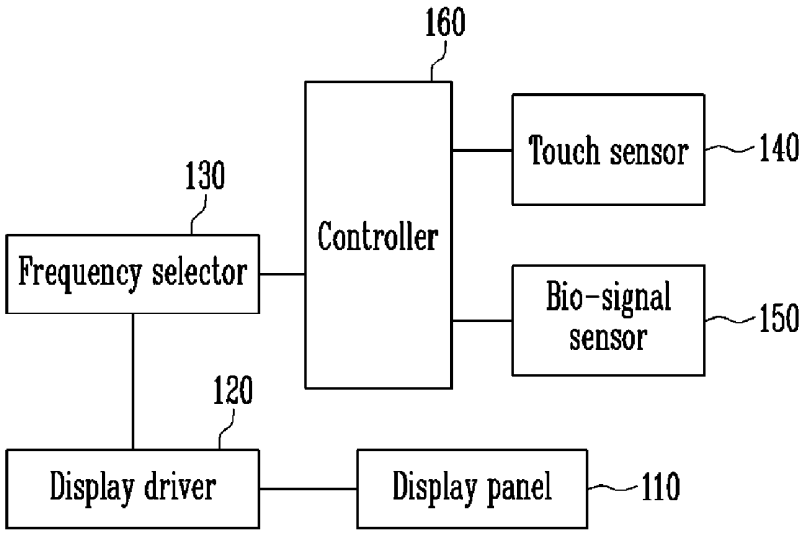
160
Touch sensor
140
130
Controller
Frequency selector
Bio-signal sensor
150
120
Display driver
Display panel
110

FIG. 3

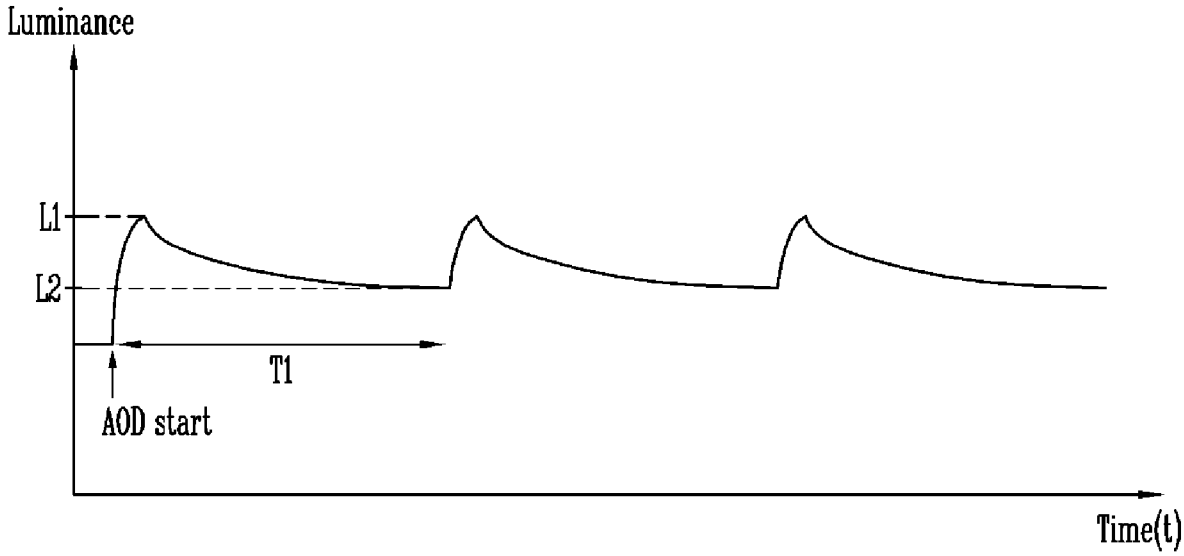
Luminance
L1
L2
T1
AOD start
Time(t)

FIG. 4

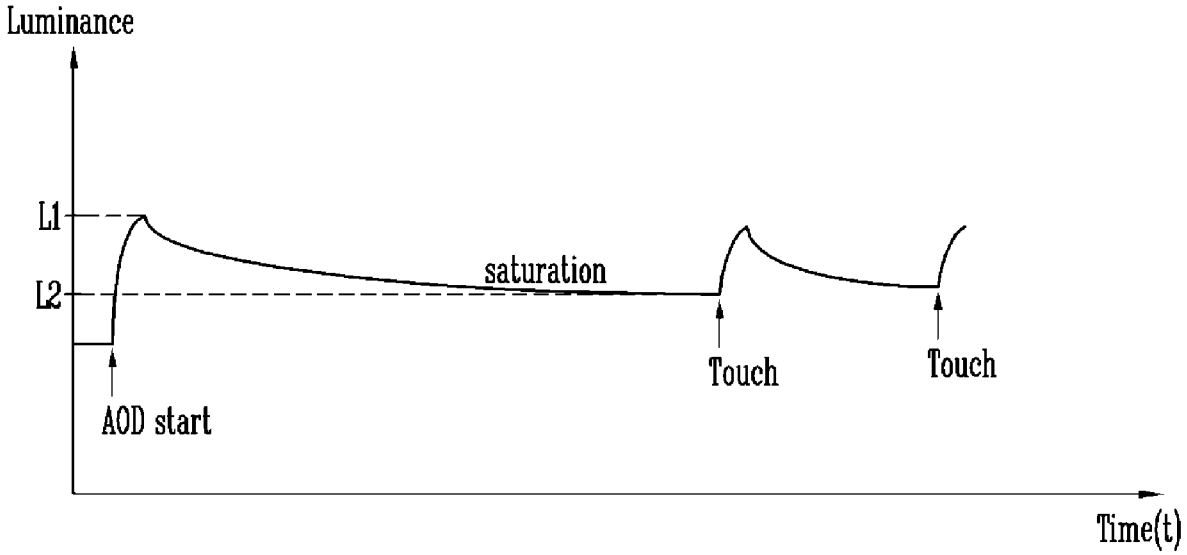
Luminance
L1
L2
saturation
Touch
Touch
AOD start
Time(t)

FIG. 5

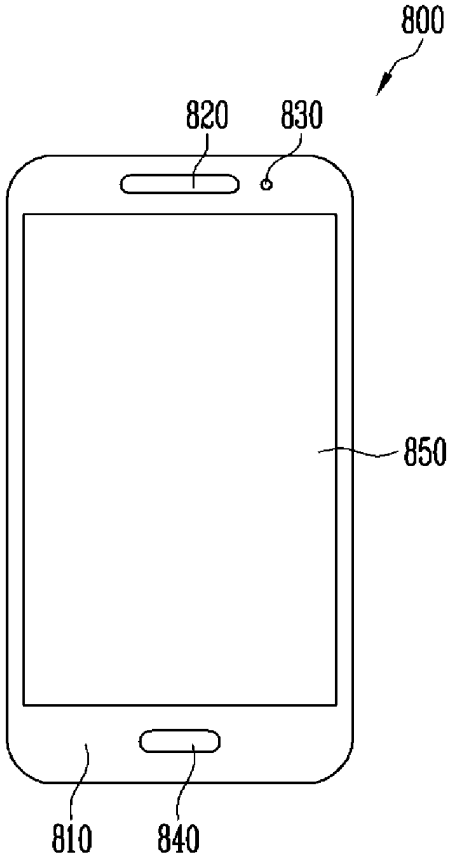

FIG. 6

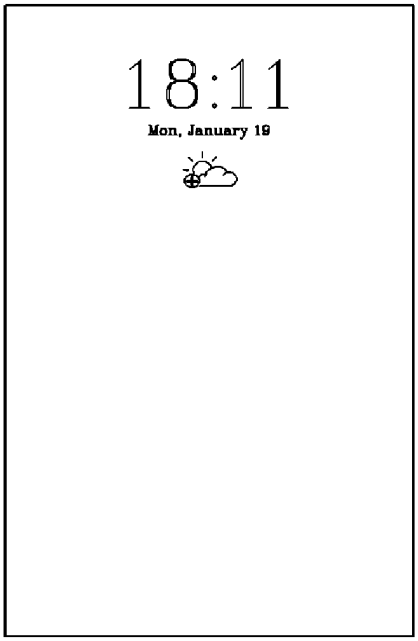

FIG. 7

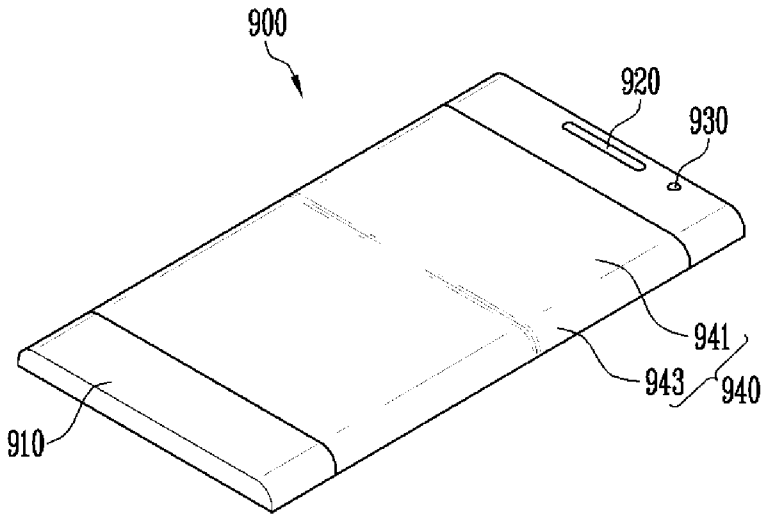

FIG. 8

Mon, 10 March	12:45 PM	06:30 AM

REFERENCES CITED IN THE DESCRIPTION

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专利名称(译)	降低了功耗的显示装置及其控制方法		
公开(公告)号	EP3133585B1	公开(公告)日	2020-01-01
申请号	EP2016185001	申请日	2016-08-19
[标]申请(专利权)人(译)	三星显示有限公司		
申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
当前申请(专利权)人(译)	三星DISPLAY CO.，LTD.		
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发明人	SHIN, WON JU PYO, SI BEAK		
IPC分类号	G09G3/20 A61B5/01 A61B5/00 A61B5/024 G09G5/10 A61B5/145 A61B5/107		
CPC分类号	G06F3/0416 G09G2330/021 A61B5/01 A61B5/02438 A61B5/1072 A61B5/14532 A61B5/742 A61B5/024 G09G3/20 G09G3/2003 G09G5/10 G09G2320/0247 G09G2320/062 G09G2320/103 G09G2330/022 G09G2340/0435 G09G2340/045 G09G2340/14 G09G2354/00 G09G2380/08 G06F3/011 G09G3/3225 G09G3/3648 G09G2310/08 G09G2320/0626		
优先权	1020150118200 2015-08-21 KR		
其他公开文献	EP3133585A3 EP3133585A2		
外部链接	Espacenet		

摘要(译)

显示装置可以包括显示面板，发送数据信号的数据驱动器，顺序发送扫描信号的扫描驱动器，用于选择图像显示的驱动频率的频率选择器，如果在显示面板上显示的图像则选择低频。 是第一图像，如果显示面板上显示的图像不是第一图像，则选择正常频率，该正常频率高于低频。 该显示设备还包括用于基于所选择的驱动频率来控制数据驱动器和扫描驱动器的时序控制器。 定时控制器可以控制数据驱动器和扫描驱动器，使得如果在显示面板上显示的图像是第一图像，则根据低频周期性地改变在其上显示第一图像的显示面板的亮度。

FIG. 1

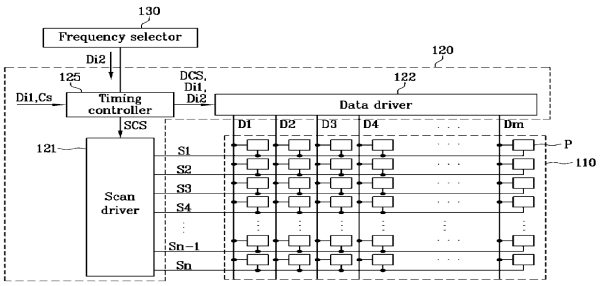

FIG. 2