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Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

[Continued on next page]

(54) Title: DYNAMIC ADJUSTMENT OF TOUCH RESOLUTIONS ON AN AMOLED DISPLAY

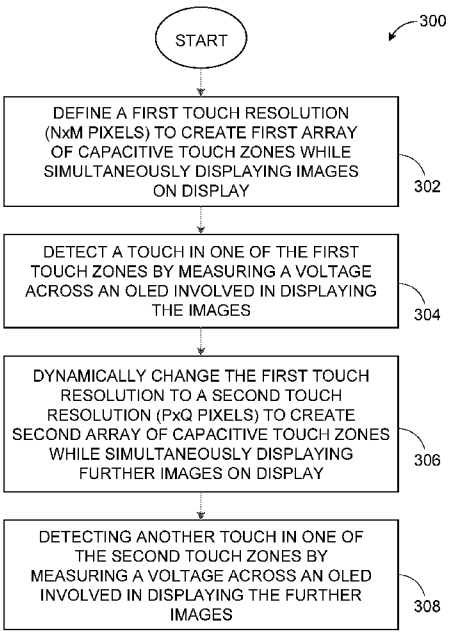

FIG. 3

(57) Abstract: Dynamically adjusting a touch resolution of a display having pixel circuits each including an OLED driven by a driving transistor according to programming information representing a desired brightness for each OLED. A first touch resolution of the display is defined to create first touch zones relative to the display as images are being displayed thereon. A first touch in one of the first touch zones is detected by measuring a voltage across an anode and a cathode of each of a first set of OLEDs in the first touch zone. The first touch resolution is dynamically changed to a different second touch resolution to create second touch zones as further images are being displayed. A second touch in one of the second touch zones is detected by measuring a voltage across an anode and a cathode of each of a second set of OLEDs in the second touch zone.

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— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

— *with international search report (Art. 21(3))*

DYNAMIC ADJUSTMENT OF TOUCH RESOLUTIONS ON AN AMOLED DISPLAY

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FIELD OF THE PRESENT DISCLOSURE

[0002] The present disclosure generally relates to touch-sensitive displays, and more particularly, to methods of dynamically adjusting a touch resolution of an active-matrix organic light-emitting diode display where the light emitting device is used for touch detection.

BACKGROUND

[0003] Touch resolutions on AMOLED displays are generally fixed, and the number of touch zones is defined by how the touch monitoring circuit that monitors the touch substrate is subdivided in a predetermined and fixed manner.

BRIEF SUMMARY

[0004] According to an aspect of the present disclosure, a method is disclosed of dynamically adjusting a touch resolution of a video display having a plurality of pixel circuits each including a light emitting device driven by a driving transistor according to a programming current or voltage representing a desired brightness produced by the light emitting device. The method comprises: defining, by a controller, a first touch resolution of the video display to create a first plurality of capacitive touch zones relative to a transparent substrate of the video display as images are being displayed on the video display; detecting a first touch on the transparent substrate in one of the first touch zones by measuring a voltage across an anode and a cathode of each of a first set of light emitting devices of the video display in the first touch zone; dynamically changing, by the controller, the first touch resolution to a second touch resolution different from the first touch resolution to create a second plurality of capacitive touch zones relative to the video display as further images are

being displayed on the video display; and detecting a second touch in one of the second touch zones by measuring a voltage across an anode and a cathode of each of a second set of light emitting devices of the video display in the second touch zone.

[0005] The measuring corresponding changes in the voltage across each of the first set of light emitting devices can include: activating each of a first set of read transistors connected to corresponding ones of the first set of light emitting devices thereby connecting each of the first set of read transistors to a readout circuit; comparing the measured voltage from each of the first set of activated read transistors with a criterion indicative of a touch; and responsive to the comparing indicating that the criterion is satisfied, the controller indicating a coordinate of the first touch relative to the video display in the one of the first touch zones.

[0006] A gate of each of the first set of read transistors can be connected to a corresponding readout select line. A first terminal of each of the first set of read transistors can be connected to a corresponding monitor line that is connected to the readout circuit. The activating can include activating each of the gates of the first set of read transistors simultaneously with activating the corresponding monitor line connected to readout circuit.

[0007] The method can further comprise: simultaneously with the detecting, determining from the measured voltage an aging characteristic of the driving transistor or of the light emitting device of a selected pixel circuit in the one of the first touch zones; adjusting the programming current or voltage for the selected pixel circuit to compensate for the determined aging characteristic; and driving the light emitting device in the selected pixel circuit according to the adjusted programming current or voltage.

[0008] The detecting can be carried out simultaneously with programming each of the pixel circuits in the one of the first touch zones with a desired brightness. The first touch resolution can correspond to a surface area of a tip of an average human finger, and the second touch resolution can correspond to a surface area of a point of a capacitive stylus, or vice versa.

[0009] The maximum number of touch zones can correspond exactly to the number of pixels in the video display such that each of the pixels in the video display corresponds to a discrete touch point.

[0010] A size of the first touch resolution can be NxM such that N is an integer multiple of the total number of rows of pixel circuits forming the video display and M is an

integer multiple of the total number of columns of pixel circuits forming the video display. A size of the second touch resolution can be PxQ such that P is an integer multiple of the total number of rows of pixel circuits forming the video display and Q is an integer multiple of the total number of columns of pixel circuits forming the video display. NxM is distinct from PxQ.

[0011] The foregoing and additional aspects and embodiments of the present disclosure will be apparent to those of ordinary skill in the art in view of the detailed description of various embodiments and/or aspects, which is made with reference to the drawings, a brief description of which is provided next.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The foregoing and other advantages of the present disclosure will become apparent upon reading the following detailed description and upon reference to the drawings.

[0013] FIG. 1 is functional block diagram of an example pixel circuit showing a light emitting device that is used for touch detection;

[0014] FIG. 2 is a functional block diagram of part of an active matrix display having monitor lines on the columns of the display and readout select lines on the rows of the display for dynamically defining differently sized touch zones relative to the display; and

[0015] FIG. 3 is a flowchart diagram of an exemplary algorithm for dynamically adjusting the touch resolution of a display while displaying images on the display.

[0016] While the present disclosure is susceptible to various modifications and alternative forms, specific embodiments and implementations have been shown by way of example in the drawings and will be described in detail herein. It should be understood, however, that the present disclosure is not intended to be limited to the particular forms disclosed. Rather, the present disclosure is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the inventions as defined by the appended claims.

DETAILED DESCRIPTION

[0017] FIG. 2 is an electronic video display system or panel 200 having an active matrix area or pixel array in which an array of pixel circuits 100 (shown in FIG. 1) are arranged in a row and column configuration. For ease of illustration, only some rows and columns are

shown. Peripheral circuitry external to an active matrix area on the display includes a conventional gate or address driver circuit (not shown), a source or data driver circuit (not shown), a controller 210, and a readout circuit 220 connected to the controller 210 (these are illustrated as functional modules, so the readout circuit 220 can be part of the controller 210). The controller 210 conventionally controls the gate and source drivers (not shown). The gate driver, under control of the controller 210, operates on address or select lines SEL, one for each row of pixels 104 in the display 200. The source driver circuit, under control of the controller 210, operates on voltage data lines VDATA 110, one for each column of pixels 104 in the display 200. The voltage data lines VDATA 110 carry voltage or current programming information to each pixel circuit 100 indicative of a luminance (or brightness as subjectively perceived by an observer) of each light emitting device 104. A conventional storage element, such as a capacitor, in each pixel circuit 100 (see FIG. 1) stores the programming information until an emission or driving cycle turns on the light emitting device 104, such as an organic light emitting device (OLED). During the driving cycle, the programming information preserved in the storage element in each pixel circuit is transferred by a drive transistor T1 to illuminate each light emitting device 104 at the programmed luminance.

[0018] As is known, each pixel circuit (FIG. 1) in the display 200 needs to be programmed with information indicating the luminance of the light emitting device 104. This information can be supplied by the controller 210 to each light emitting device 104 in the form of a stored voltage or a current. A frame defines the time period that includes a programming cycle or phase during which each and every pixel circuit (FIG. 1) in the display system 200 is programmed with a programming voltage (or current) indicative of a luminance and a driving or emission cycle or phase during which each light emitting device 104 in each pixel circuit 100 is turned on to emit light at a luminance commensurate with or indicative of the programming voltage stored in a storage element or a programming current. A frame is thus one of many still images that compose a complete moving picture displayed on the display system 200. There are different schemes for programming and driving the pixels, including row-by-row and frame-by-frame. In row-by-row programming, a row of pixels is programmed and then driven before the next row of pixels is programmed and driven. In frame-by-frame programming, all rows of pixels in the display system 100 are programmed first, and all of the pixels are driven row-by-row. Either scheme can employ a

brief vertical blanking time at the beginning or end of each frame during which the pixels are neither programmed nor driven.

[0019] Turning now to the example pixel circuit 100 shown in FIG. 1, each pixel circuit 100 includes conventional a switching network and one or more capacitors (102). The switching network conventionally includes one or more switching transistors for conveying the programming information from the VDATA line 110 to the one or more storage devices and storing that information in the storage devices until the driving or emission cycle. The details of the switching network are not pertinent here. Each pixel circuit 100 includes a driving transistor T1, which turns on to transfer the programming information stored in the one more storage devices in the switching network 102 in the form of a drive current to the light emitting device 104, which in this example is an organic light-emitting diode (OLED). The OLED has an anode 106 and a cathode 108, which form a capacitor whose varying voltage can be used to detect a touch. When a human finger or a stylus grasped by a human hand is brought sufficiently near the surface of the anode 106, a voltage across the OLED changes, and this change in voltage can be used by the controller 210 to detect a touch. To read the OLED voltage across the anode and cathode 106, 108, each pixel circuit 100 includes a read transistor T2 having a gate terminal connected to a readout select line 114 (RD), a drain terminal connected to a monitor line 112, and a source terminal connected to the anode 106 of the OLED 104. When the read transistor T2 is activated, the voltage across the OLED 104 is transferred to the monitor line 112, which is read by the readout circuit 220. Because each pixel circuit 100 can detect a touch, the touch resolution for the entire display 200 is equal to the pixel resolution.

[0020] FIG. 2 shows two touch zones 202, 204. For ease of illustration, the first touch zone 202 is shown as having an array size of NxM pixels (2x2), whereas the second touch zone 204 is shown as having an array size of PxQ pixels (3x3). Of course, the present disclosure contemplates any touch resolutions of any size or shape (array, circular, irregular), where N, M, P, and Q can be any positive integers but no greater than the overall pixel resolution (N_RxN_C pixels 100) of the display 200. Moreover, each of the touch zones can be different on the display 200. For example, in one area of the display 200, the touch zones can be relatively small, such as to detect the tip of a capacitive stylus grasped by a human finger, but another area of the same display 200 can have relatively large touch zones, such as sufficiently sized to detect the tip of an average-sized human finger. Thus, the various touch

zones can be uniform or non-uniform relative to the entire surface of the display 200. In the illustrated example, the touch zones are uniform, but this is merely for ease of illustration. Because each OLED 104 is capable of detecting a discrete touch, the smallest achievable touch resolution is 1x1 pixel. Some aspects of the present disclosure are directed to dynamically changing the touch resolution by exploiting the fact that each OLED 104 itself can be used to detect a touch, and by selectively reading the voltage across different groupings of OLEDs in the display 200, different touch resolutions are achievable on-the-fly in real time as the display 200 is displaying images.

[0021] As disclosed herein, the controller 210 can dynamically adjust the touch resolution of the display 200 as the display 200 is displaying images, by selectively activating combinations of the monitor lines 112 and the readout select lines 114 to dynamically define different touch resolutions as images are being displayed on the display 200. During the programming cycles, for example, the readout circuit 220 or controller 200 can selectively activate selected ones of the readout select lines 114 (rows) while selectively activating selected ones of the monitor lines 112 (columns) to define a touch electrode or a touch zone. In FIG. 2, the first touch zone 202 is selected by successively activating the RD1 and RD2 lines and simultaneously activating monitor switches 212-1 and 212-2, thereby allowing the voltage from the OLEDs 104 in the four pixel circuits 100 that comprise the first touch zone 202 to be read by the readout circuit 220 via the respective monitor lines 112-1 and 112-2. For example, the first two pixel circuits 100 in the first row can be selected by activating the RD1 line and simultaneously activating the monitor switches 212-1 and 212-2, and reading the OLED voltage that is presented at the drain of T2. Then, while keeping the monitor switches 212-1 and 212-2 activated, the RD1 line is deactivated while the RD2 line is activated, thereby reading the OLED voltages for the two pixels in the second row. This readout can occur, for example, simultaneously while programming each of the pixel circuits 100 with programming information on the respective VDATA lines 110 (omitted from FIG. 2 for clarity and ease of discussion).

[0022] In the next frame, for example, before the next image is displayed on the display 200, the controller 200 can dynamically change the touch resolution from 2x2 as defined by the touch zone 202, to a larger touch resolution of 3x3 as defined by the second touch zone 204, which comprises an array of 3x3 pixel circuits 100 in the illustrated example. Each of the readout select lines RD1, RD2, RD3 are successively activated while the monitor

switches 212-1 to 212-3 remain activated, and the corresponding OLED voltages from each of the rows are read by the readout circuit 220 to determine whether a touch is detected in the second touch zone 204. The programming information for the next image to be displayed can be simultaneously imparted to the storage device(s) in the switching network 102 via the VDATA lines 110.

[0023] FIG. 3 is a flow chart diagram of an example method or algorithm 300 for carrying out an aspect of the present disclosure. The algorithm 300 is directed to dynamically adjustment of a touch resolution of a video display 200 having a pixel circuits 100 such as shown in FIG. 1. Each pixel circuit 100 includes a light emitting device 104 driven by a driving transistor T1 according to a programming current or voltage representing a desired brightness produced by the light emitting device 104. The algorithm 300 defines, by a controller 200, a first touch resolution of the video display 200 to create first capacitive touch zones 202 relative to a transparent substrate of the display 200 as images are being displayed on the display 200 (302). The controller 200 detects a first touch (e.g., by a capacitive stylus grasped by a human hand) relative to the display 200 in one of the first touch zones by measuring a voltage across an anode 106 and a cathode 108 of each of a first set of light emitting devices 104 of the display 200 in the first touch zone 202 (304). The controller dynamically changes the first touch resolution to a second touch resolution different from the first touch resolution to create second capacitive touch zones 204 relative to the display 200 as further images are being displayed on the display 200 (306). The controller 200 detects a second touch (e.g., by a tip of an average-size human finger) in one of the second touch zones 204 by measuring a voltage across an anode 106 and a cathode 108 of each of a second set of light emitting devices 104 of the display 200 in the second touch zone 204 (308).

[0024] Changes in the voltage across the light emitting devices 104 can be measured as follows. Each of a first set of read transistors T2 connected to corresponding ones of the first set of light emitting devices 104 is activated, thereby connecting each of the first set of read transistors T2 to a readout circuit 220. The algorithm 300 compares the measured voltage from each of the first set of activated read transistors T2 with a criterion indicative of a touch. The criterion can include a threshold value such that if the voltage changes by more than the threshold value, a touch is detected. If the criterion is satisfied such that a touch is detected, the controller 200 indicates a coordinate of the first touch relative to the display 200 in the one of the first touch zones 202.

[0025] A gate of each of the first set of read transistors T2 is connected to a corresponding readout select line RD. A first terminal (e.g., a drain) of each of the first set of read transistors T2 is connected to a corresponding monitor line 112 that is connected to the readout circuit 220. Each of the gates of the first set of read transistors T2 in one of the rows, e.g., the row defined by RD1, are activated simultaneously with activating the corresponding monitor line 112 connected to readout circuit 220 by activating respective ones of the monitor switches 212. As touches are being detected, the readout circuit 220 can also determine from the measured voltage an aging or non-uniformity (caused by process non-uniformities in the fabrication of the display 200) characteristic of the driving transistor T1 or of the light emitting device 104 of a selected pixel circuit 100 in the one of the first touch zones 202. The algorithm 300 can adjust the programming current or voltage for the selected pixel circuit 100 to compensate for the determined aging or non-uniformity characteristic or both, and drive the light emitting device 104 in the selected pixel circuit 100 according to the adjusted programming current or voltage to compensate for the aging or non-uniformity characteristic or both.

[0026] The touch detection can be carried out simultaneously with programming each of the pixel circuits 100 in the one of the first touch zones 202 with a desired brightness. The first touch resolution can, for example, correspond to a surface area of a tip of an average human finger, and the second touch resolution can, for example, correspond to a surface area of a point of a capacitive stylus, or vice versa. As mentioned above, different regions on the display 200 can have different touch resolutions simultaneously, such that part of the display 200 is used for detecting stylus inputs, for example, while another part of the same display 200 is used for detecting inputs from a human finger (which requires a bigger touch resolution).

[0027] A maximum number of touch zones definable relative to the display 200 corresponds exactly to the number of pixels 100 in the display 200 such that each of the pixels 100 in the display 200 corresponds to a discrete touch point. In other words, the smallest possible touch resolution has a size of one pixel circuit 100. A size of the first touch resolution is NxM such that N is an integer multiple of the total number of rows of pixel circuits 100 forming the display 200, and M is an integer multiple of the total number of columns of pixel circuits 100 forming the display 200. N can be identical to or distinct from M. A size of the second touch resolution is PxQ such that P is an integer multiple of the total

number of rows of pixel circuits 100 forming the display 200, and Q is an integer multiple of the total number of columns of pixel circuits 100 forming the display 200. P can be identical to or distinct from Q. NxM is distinct from PxQ. As mentioned above, the form factor of the touch zones is not limited to an array, but can be any regular or irregular shape.

[0028] Any of the circuits disclosed herein can be fabricated according to many different fabrication technologies, including for example, poly-silicon, amorphous silicon, organic semiconductor, metal oxide, and conventional CMOS. Any of the circuits disclosed herein can be modified by their complementary circuit architecture counterpart (e.g., n-type circuits can be converted to p-type circuits and vice versa).

[0029] While particular embodiments and applications of the present disclosure have been illustrated and described, it is to be understood that the present disclosure is not limited to the precise construction and compositions disclosed herein and that various modifications, changes, and variations can be apparent from the foregoing descriptions without departing from the scope of the invention as defined in the appended claims.

WHAT IS CLAIMED IS:

1. A method of dynamically adjusting a touch resolution of a video display having a plurality of pixel circuits each including a light emitting device driven by a driving transistor according to a programming current or voltage representing a desired brightness produced by the light emitting device, comprising:

defining, by a controller, a first touch resolution of the video display to create a first plurality of capacitive touch zones relative to a transparent substrate of the video display as images are being displayed on the video display;

detecting a first touch on the transparent substrate in one of the first touch zones by measuring a voltage across an anode and a cathode of each of a first set of light emitting devices of the video display in the first touch zone;

dynamically changing, by the controller, the first touch resolution to a second touch resolution different from the first touch resolution to create a second plurality of capacitive touch zones relative to the video display as further images are being displayed on the video display; and

detecting a second touch in one of the second touch zones by measuring a voltage across an anode and a cathode of each of a second set of light emitting devices of the video display in the second touch zone.

2. The method of claim 1, wherein the measuring corresponding changes in the voltage across each of the first set of light emitting devices includes:

activating each of a first set of read transistors connected to corresponding ones of the first set of light emitting devices thereby connecting each of the first set of read transistors to a readout circuit;

comparing the measured voltage from each of the first set of activated read transistors with a criterion indicative of a touch; and

responsive to the comparing indicating that the criterion is satisfied, the controller indicating a coordinate of the first touch relative to the video display in the one of the first touch zones.

3. The method of claim 2, wherein a gate of each of the first set of read transistors is connected to a corresponding readout select line, and wherein a first terminal of each of the

first set of read transistors is connected to a corresponding monitor line that is connected to the readout circuit, wherein the activating includes activating each of the gates of the first set of read transistors simultaneously with activating the corresponding monitor line connected to readout circuit.

4. The method of claim 3, further comprising:

simultaneously with the detecting, determining from the measured voltage an aging characteristic of the driving transistor or of the light emitting device of a selected pixel circuit in the one of the first touch zones;

adjusting the programming current or voltage for the selected pixel circuit to compensate for the determined aging characteristic; and

driving the light emitting device in the selected pixel circuit according to the adjusted programming current or voltage.

5. The method of claim 1, wherein the detecting is carried out simultaneously with programming each of the pixel circuits in the one of the first touch zones with a desired brightness.

6. The method of claim 1, wherein the first touch resolution corresponds to a surface area of a tip of an average human finger, and wherein the second touch resolution corresponds to a surface area of a point of a capacitive stylus, or vice versa.

7. The method of claim 1, wherein a maximum number of touch zones definable relative to the video display corresponds exactly to the number of pixels in the video display such that each of the pixels in the video display corresponds to a discrete touch point.

8. The method of claim 1, wherein a size of the first touch resolution is NxM such that N is an integer multiple of the total number of rows of pixel circuits forming the video display and M is an integer multiple of the total number of columns of pixel circuits forming the video display, and wherein a size of the second touch resolution is PxQ such that P is an integer multiple of the total number of rows of pixel circuits forming the video display and Q is an integer multiple of the total number of columns of pixel circuits forming the video display, where NxM is distinct from PxQ.

9. The method of claim 1, wherein the video display is an active matrix organic light-emitting organic device (AMOLED) display, and each of the light emitting devices is an organic light emitting device (OLED).

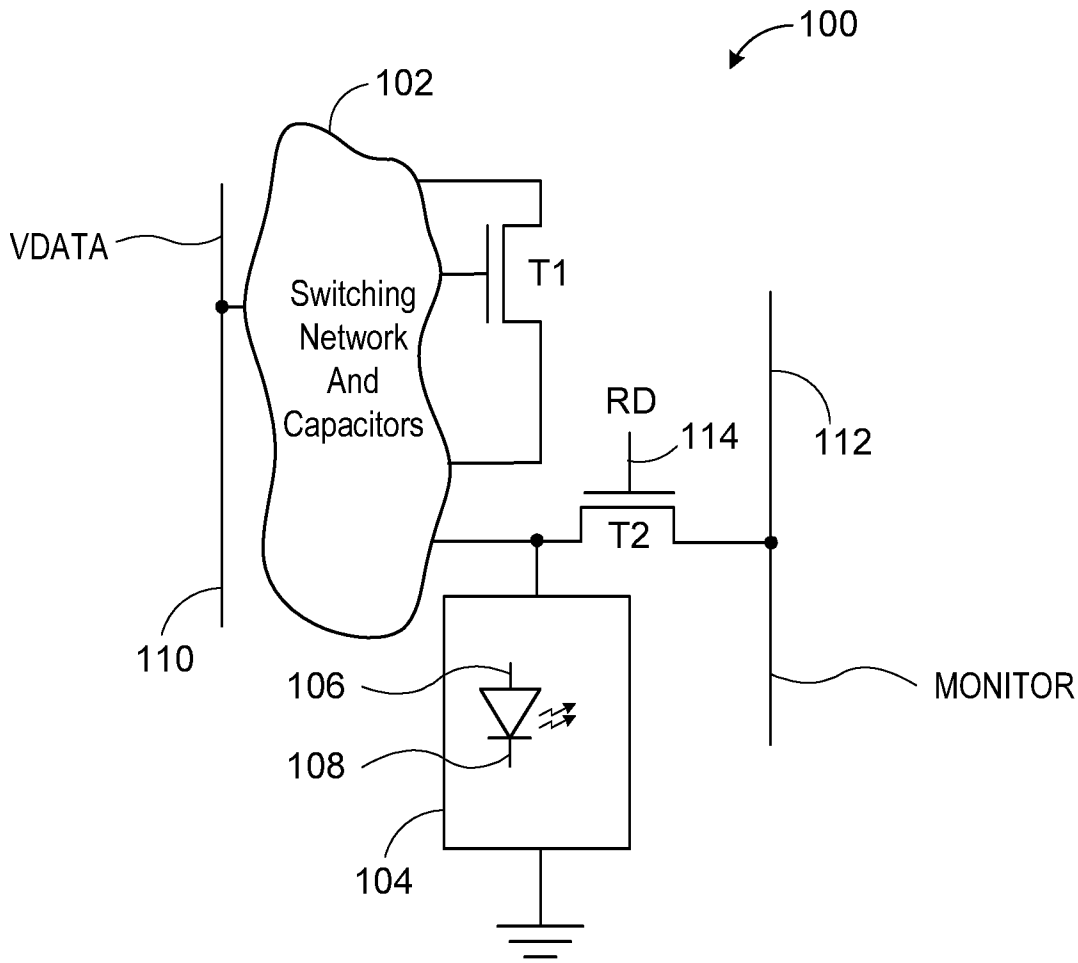
100
102
VDATA
Switching
Network
And
Capacitors
T1
RD
114
112
T2
110
106
108
104
MONITOR

FIG. 1

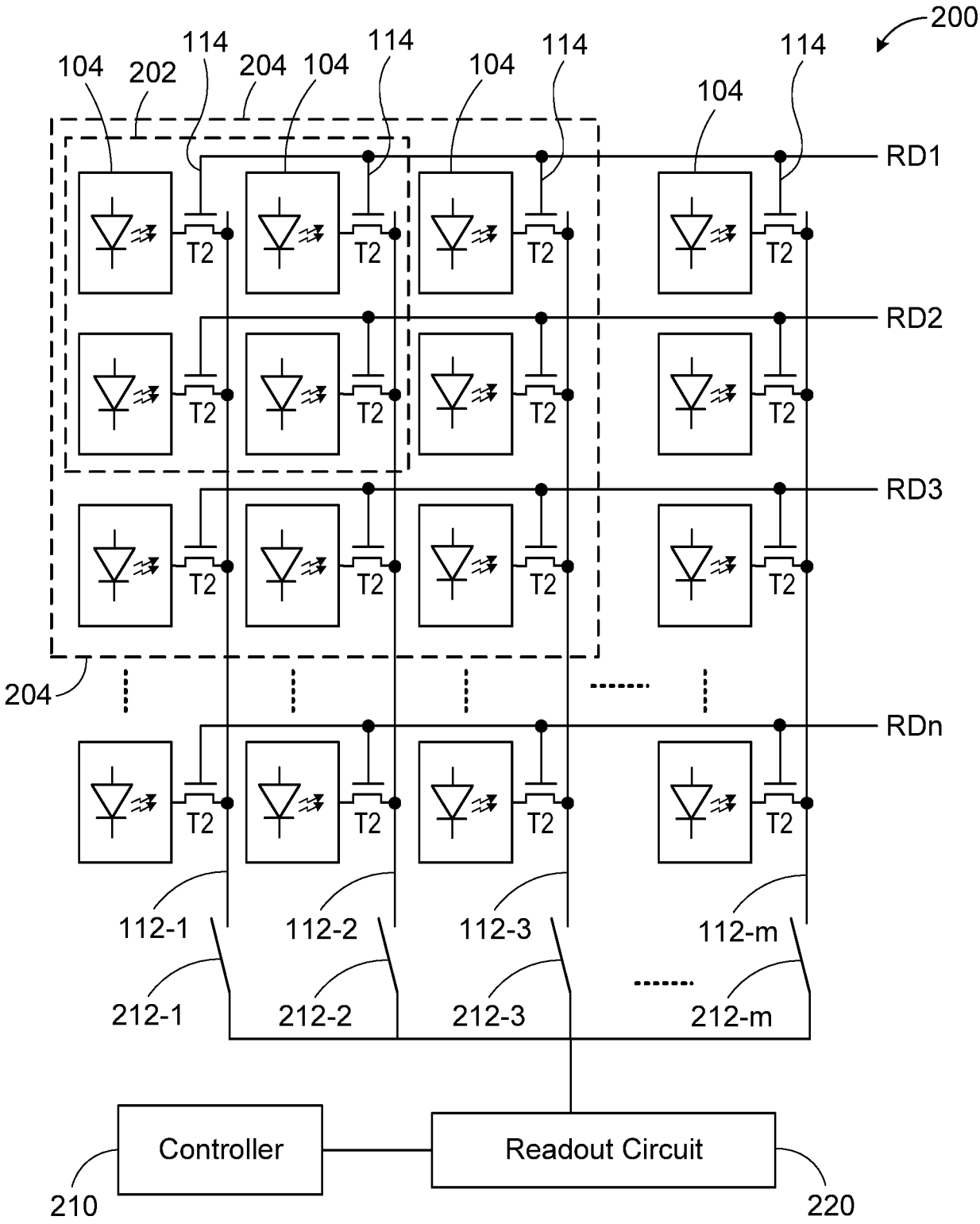
200
104
202
114
204
104
114
104
114
104
114
RD1
RD2
RD3
RDn
T2
204
112-1
112-2
112-3
112-m
212-1
212-2
212-3
212-m
Controller
Readout Circuit
210
220

FIG. 2

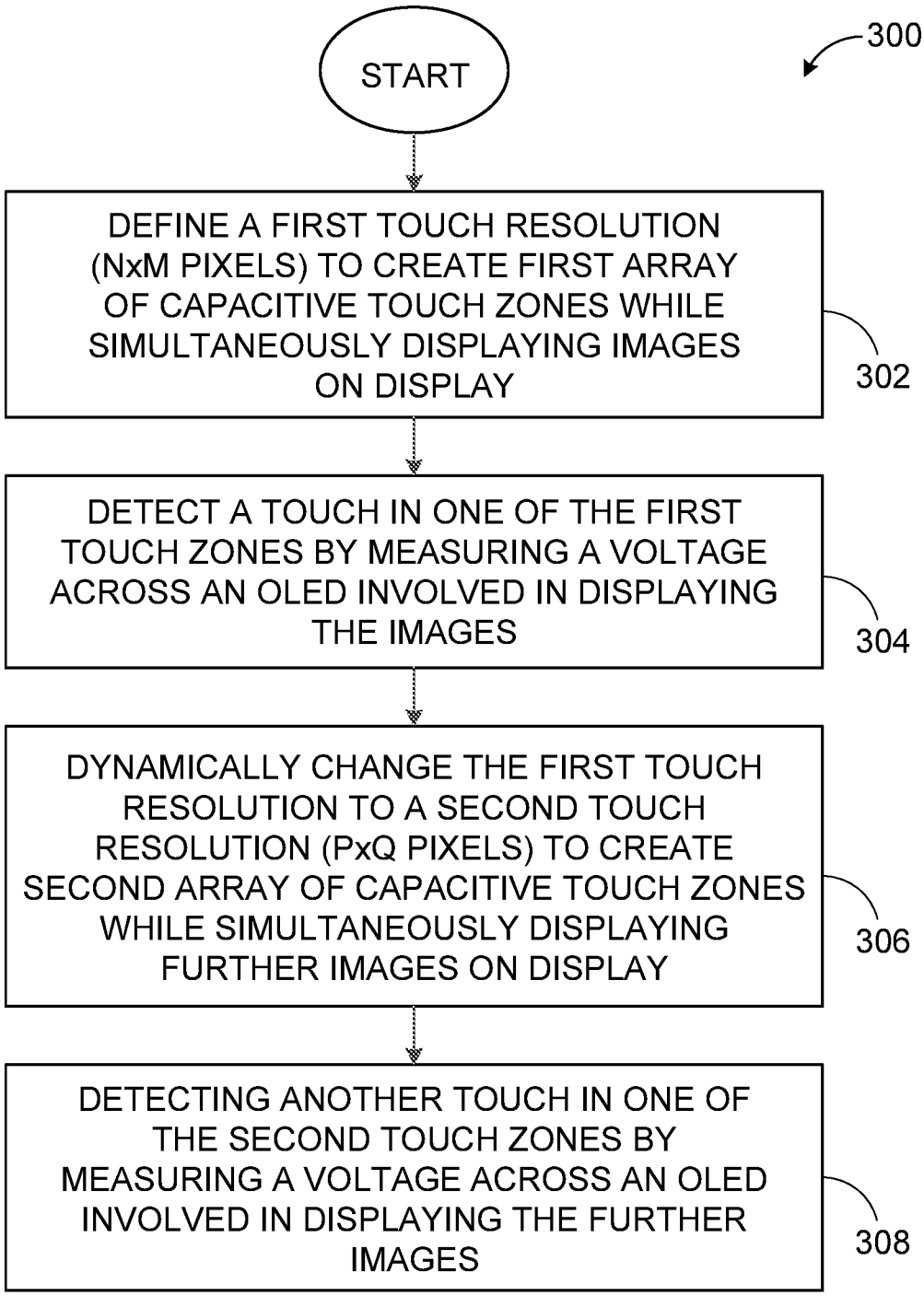
START
300
DEFINE A FIRST TOUCH RESOLUTION (NxM PIXELS) TO CREATE FIRST ARRAY OF CAPACITIVE TOUCH ZONES WHILE SIMULTANEOUSLY DISPLAYING IMAGES ON DISPLAY
302
DETECT A TOUCH IN ONE OF THE FIRST TOUCH ZONES BY MEASURING A VOLTAGE ACROSS AN OLED INVOLVED IN DISPLAYING THE IMAGES
304
DYNAMICALLY CHANGE THE FIRST TOUCH RESOLUTION TO A SECOND TOUCH RESOLUTION (PxQ PIXELS) TO CREATE SECOND ARRAY OF CAPACITIVE TOUCH ZONES WHILE SIMULTANEOUSLY DISPLAYING FURTHER IMAGES ON DISPLAY
306
DETECTING ANOTHER TOUCH IN ONE OF THE SECOND TOUCH ZONES BY MEASURING A VOLTAGE ACROSS AN OLED INVOLVED IN DISPLAYING THE FURTHER IMAGES
308

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2014/059409

A. CLASSIFICATION OF SUBJECT MATTER
IPC: ***G06F 3/044*** (2006.01), ***G06F 3/0354*** (2013.01), ***G09G 3/32*** (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: ***All*** (2006.01)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
TotalPatent™ (US, EP, WO, GB, CA fulltext) & keywords: adjust/change/modify; resolution/"touch resolution"; screen/display/panel; capacitive/capacitance; amoled/oled/"organic led"/led; touch/contact/sense; group/combine/merge/couple/bin/plural/several/multiple; sensor/pixel/detector/capacitor; brightness; aging

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2010/0097335 A1 (Jung et al.) – 22 April 2010 (22-04-2010) * Abstract; [0005]; [0013]; [0034]; [0040]; [0043]; Fig. 3 *	1-9
Y	US 2013/0009930 A1 (Cho et al.) – 10 January 2013 (10-01-2013) * [0007]; [0010]; [0013]; [0057]; [0060]; [0075]-[0077]; [0086]; [0096]; [0098]; [0164] Figs. 1-4 *	1-9
Y	US 2012/0212468 A1 (Govil) – 23 August 2012 (23-08-2012) * [0007]; [0071]; [0074]; [0076]; [0086] *	4-5

☐ Further documents are listed in the continuation of Box C.

☑ See patent family annex.

*	Special categories of cited documents:
"A"	document defining the general state of the art which is not considered to be of particular relevance
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"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Patent Document Cited in Search Report	Publication Date	Patent Family Member(s)	Publication Date
US2010097335A1	22 April 2010 (22-04-2010)	US2010097335A1	22 April 2010 (22-04-2010)
		CN101727237A	09 June 2010 (09-06-2010)
		EP2177981A1	21 April 2010 (21-04-2010)
		KR20100043437A	29 April 2010 (29-04-2010)
US2013009930A1	10 January 2013 (10-01-2013)	US2013009930A1	10 January 2013 (10-01-2013)
		KR20130006081A	16 January 2013 (16-01-2013)
US2012212468A1	23 August 2012 (23-08-2012)	US2012212468A1	23 August 2012 (23-08-2012)
		CA2715274A1	20 August 2009 (20-08-2009)
		CA2715280A1	20 August 2009 (20-08-2009)
		CA2715283A1	20 August 2009 (20-08-2009)
		CN101971239A	09 February 2011 (09-02-2011)
		CN101946277A	12 January 2011 (12-01-2011)
		CN101946278A	12 January 2011 (12-01-2011)
		EP2252990A1	24 November 2010 (24-11-2010)
		EP2255355A1	01 December 2010 (01-12-2010)
		EP2252991A1	24 November 2010 (24-11-2010)
		JP2011515704A	19 May 2011 (19-05-2011)
		JP2011516903A	26 May 2011 (26-05-2011)
		JP2011516904A	26 May 2011 (26-05-2011)
		KR20100124263A	26 November 2010 (26-11-2010)
		KR20100121498A	17 November 2010 (17-11-2010)
		KR20100118131A	04 November 2010 (04-11-2010)
		RU2010133663A	20 March 2012 (20-03-2012)
		RU2010133953A	20 March 2012 (20-03-2012)
		RU2010133954A	20 March 2012 (20-03-2012)
		TW200949793A	01 December 2009 (01-12-2009)
		TW200949794A	01 December 2009 (01-12-2009)
		TW200949795A	01 December 2009 (01-12-2009)
		US2009207159A1	20 August 2009 (20-08-2009)
		US2009213107A1	27 August 2009 (27-08-2009)
		US2010039409A1	18 February 2010 (18-02-2010)
		US8169426B2	01 May 2012 (01-05-2012)
		WO2009102637A1	20 August 2009 (20-08-2009)
		WO2009102639A1	20 August 2009 (20-08-2009)
		WO2009102641A1	20 August 2009 (20-08-2009)