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(54) **DISPLAY PANEL AND OPERATING METHOD THEREFOR**

Publication Classification

(75) Inventor: **Wein-Town Sun**, Kaohsiung City 811 (TW)

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Correspondence Address:
THOMAS, KAYDEN, HORSTEMEYER & RISLEY, LLP
100 GALLERIA PARKWAY, NW
STE 1750
ATLANTA, GA 30339-5948 (US)

(57) **ABSTRACT**

A display panel for OLED device having a display mode and an input mode. The display panel comprises a driving unit, a capacitor, a light-emitting diode, a light-detecting unit, and a detecting unit. The driving unit has a control electrode coupled to a first node, a first electrode coupled to a first voltage source, and a second electrode. The capacitor and the light-detecting unit are coupled between the first node and the first voltage source. The light-emitting diode is coupled between the control electrode of the driving unit and a second voltage source. In the input mode, the detecting unit detects a voltage at the first node.

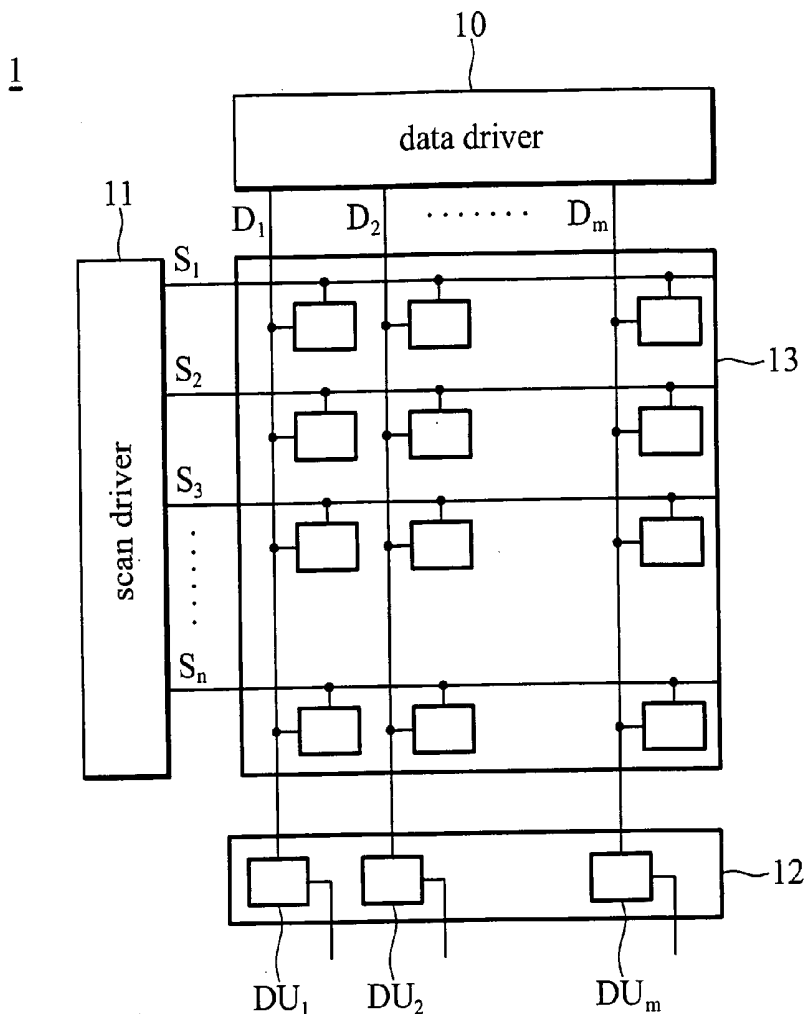
(73) Assignee: **AU Optronics Corp.**

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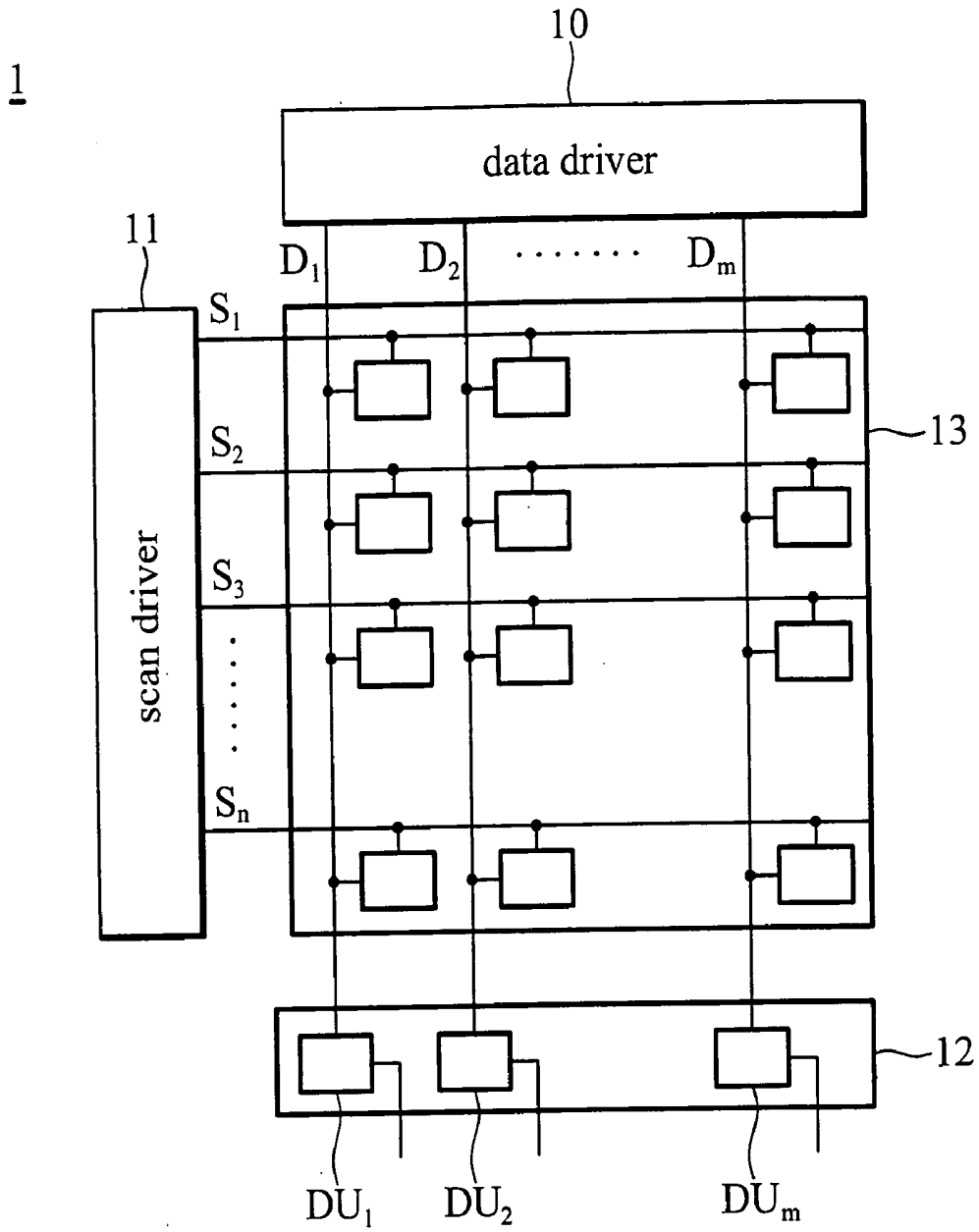


FIG. 1

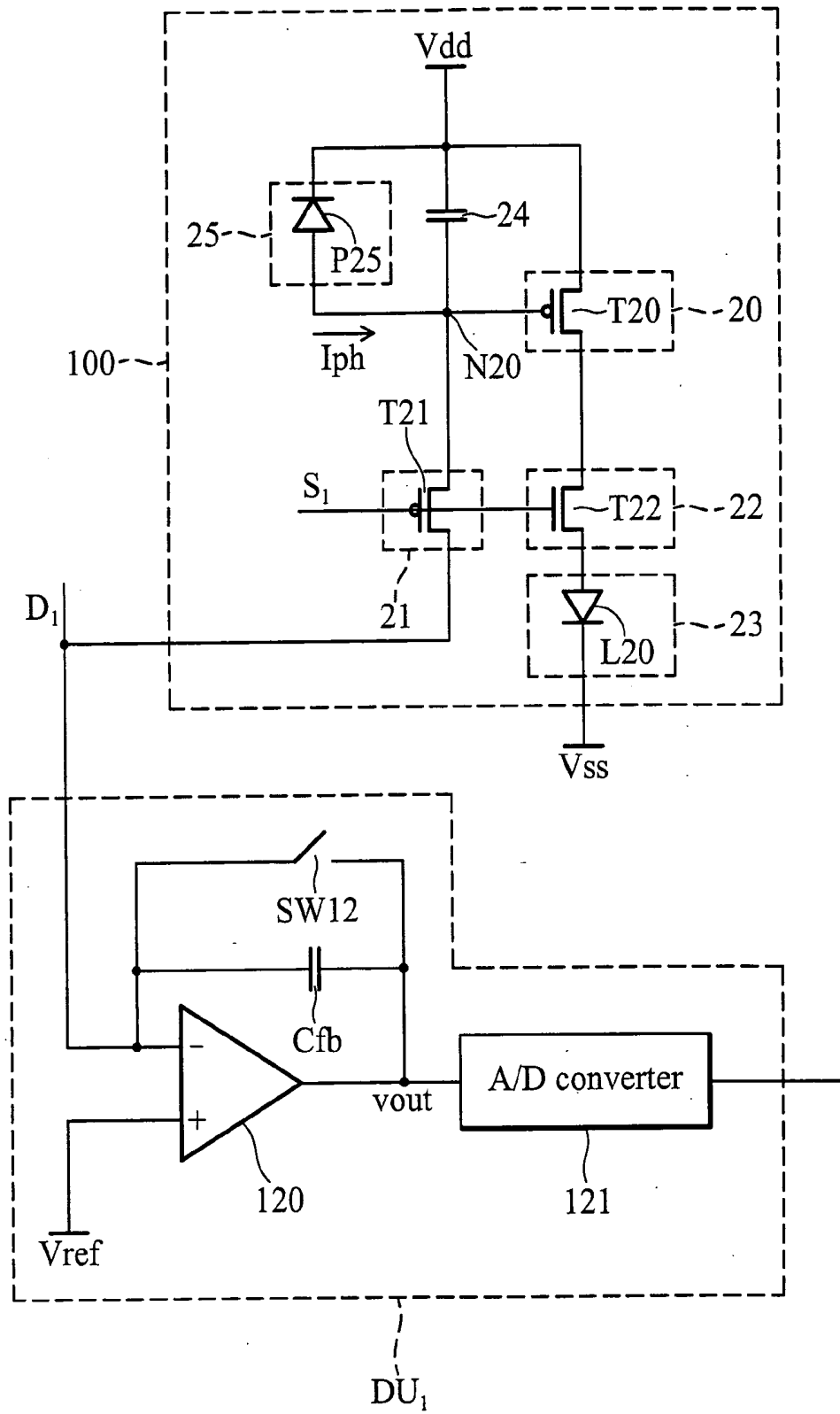


FIG. 2

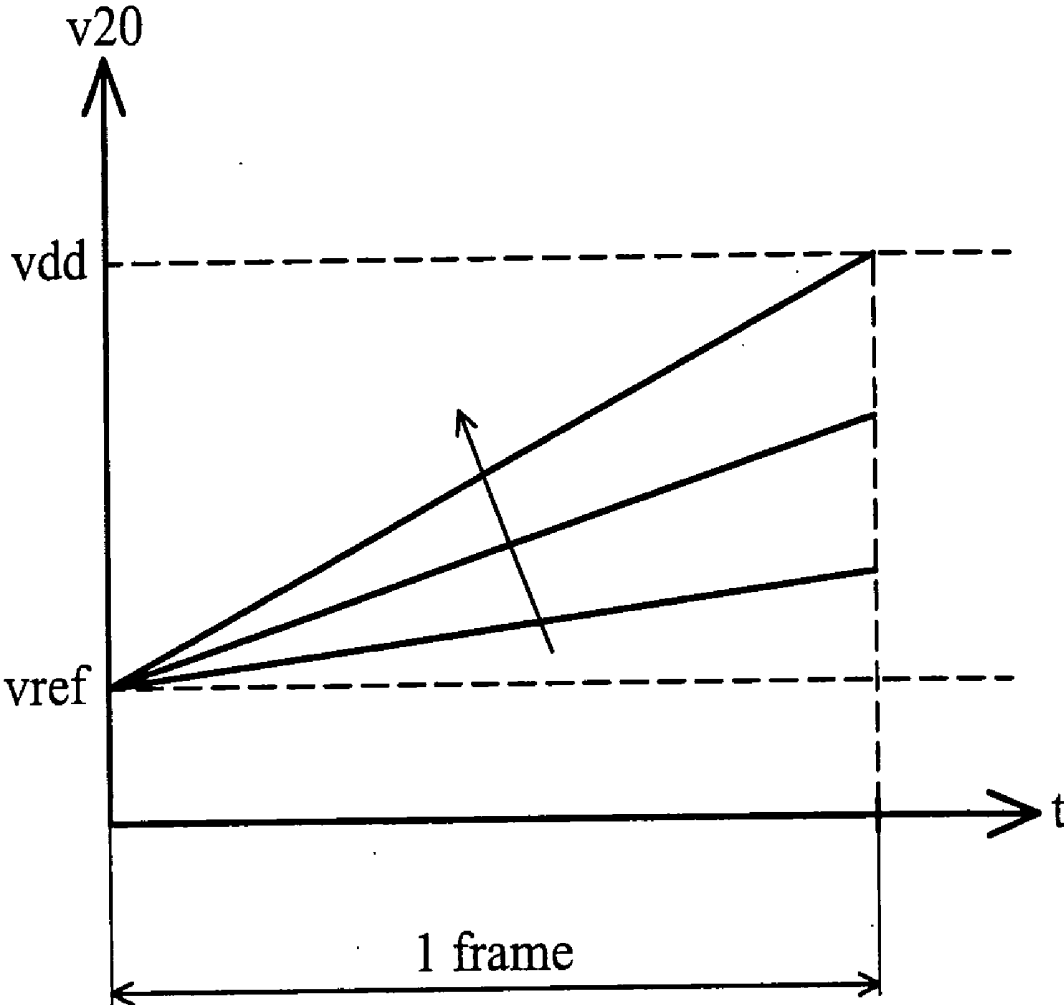


FIG. 3

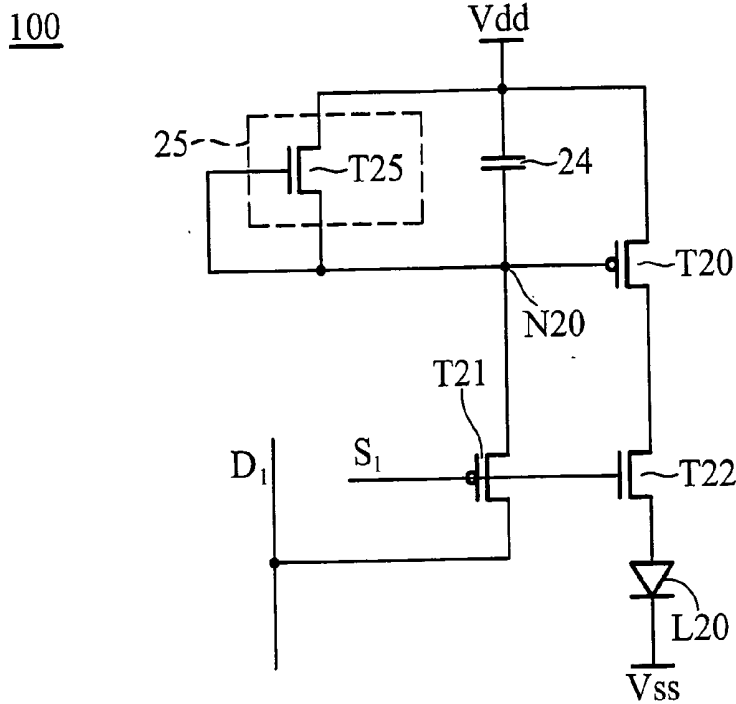


FIG. 4

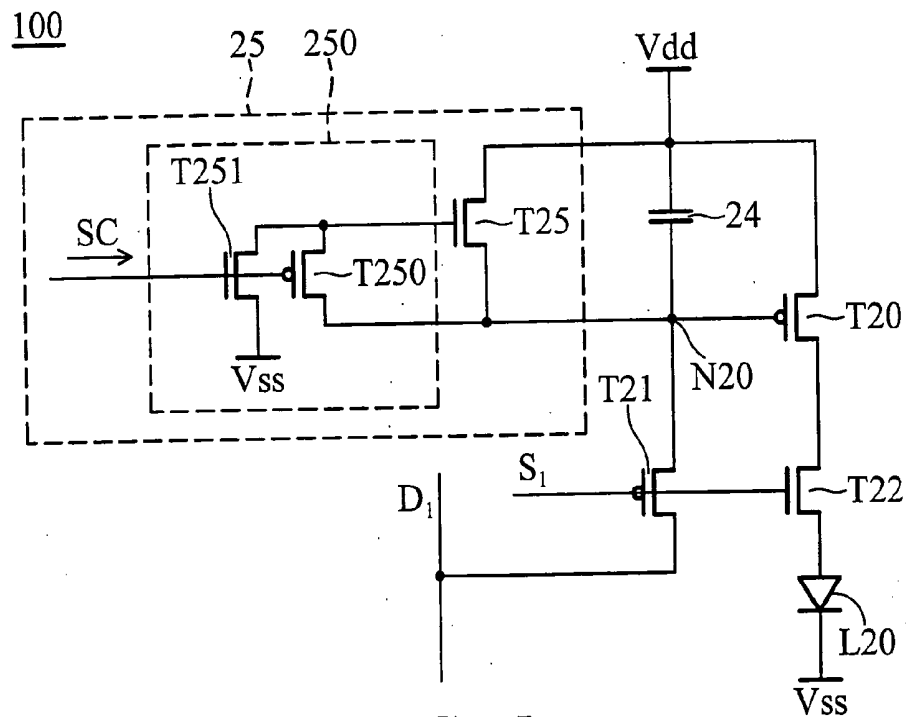


FIG. 5

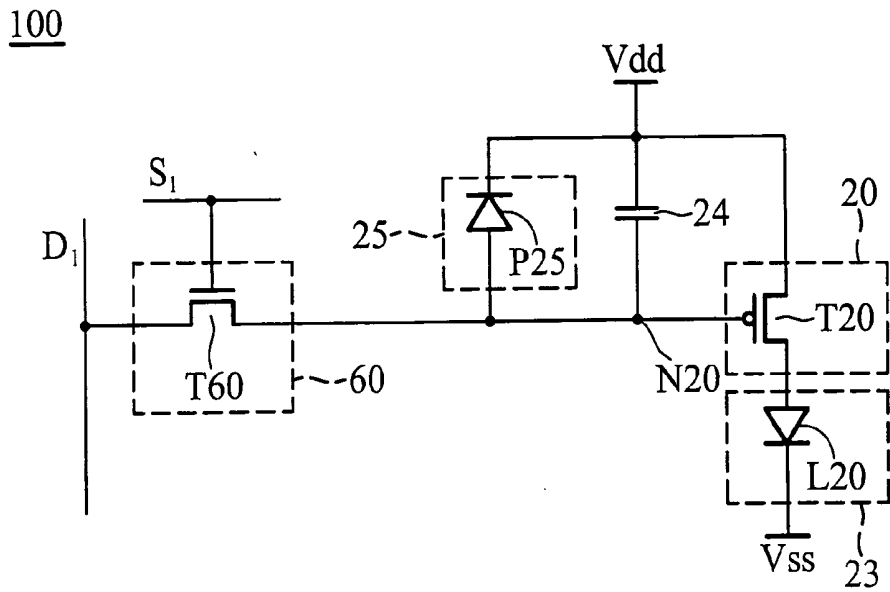


FIG. 6

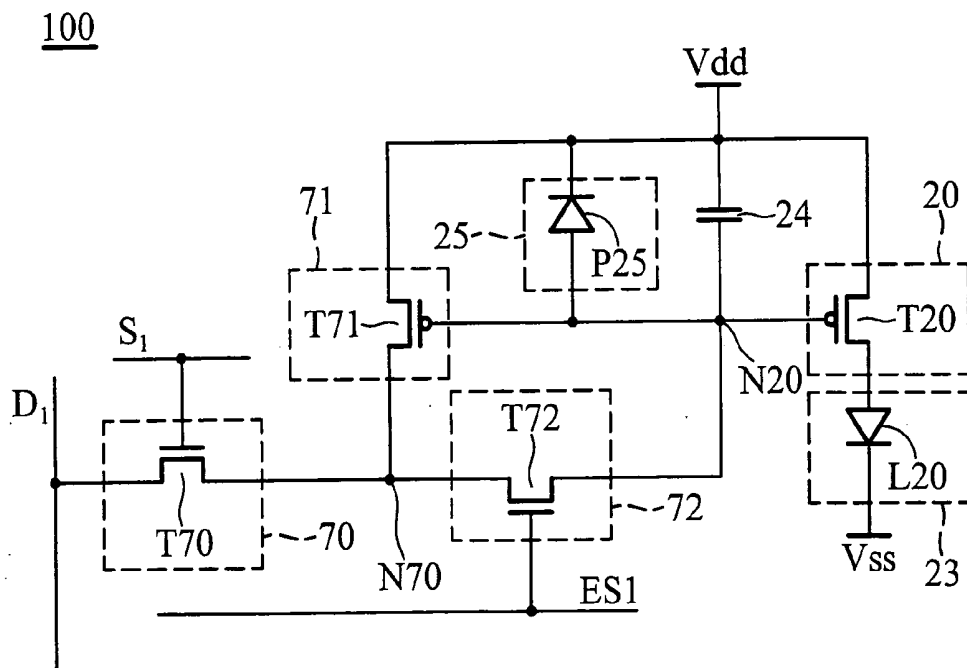


FIG. 7

DISPLAY PANEL AND OPERATING METHOD THEREFOR

BACKGROUND

[0001] The invention relates to a display device, and in particular to a display panel having a display mode and an input mode employed in a display device.

[0002] As electronic commerce has created and the transmission rate of information exchange has increased, conventional input interfaces, such as keyboards and mice, cannot adequately satisfy the requirement for rapid data transmission. Thus, new modes of inputting information, such as vocal voice and handwritten input, may replace conventional input interfaces. An alternative input interface is the touch panel developed.

[0003] In the prior art of touch panels, since leakage current of amorphous silicon thin film transistors (a-Si TFTs) is sensitive to light, a-Si TFTs are used to form photodiodes serving as image sensors. Jeong Hyun Kim of LG. Philips LCD Co. discloses a fingerprint scanner, in which a photodiode formed by an a-Si TFT senses the light reflected by a finger, and then a readout amplifier determines a fingerprint.

[0004] Moreover, T.Nakamura of Toshiba Matsushita Display discloses a TFT-LCD with image capture function using LTPS technology, in which a low temperature polysilicon (LTPS) TFT serves as a light sensor. In the TFT-LCD of T.Nakamura, light from a backlight source is transmitted to an object through a pixel unit, and an LTPS TFT senses the light reflected from the object, resulting in the discharge of a storage capacitor within the pixel unit. Finally the image of the object is determined according to the charges in the storage capacitor.

SUMMARY

[0005] Display panels are provided. An exemplary embodiment of a display panel is employed in an organic light emitting display (OLED) device having a display mode and an input mode and comprises a driving unit, a capacitor, a light-emitting diode, a light-detecting unit, and a detecting unit. The driving unit has a control electrode coupled to a first node, a first electrode coupled to a first voltage source, and a second electrode. The capacitor is coupled between the first node and the first voltage source. The light-emitting diode is coupled between the control electrode of the driving unit and a second voltage source. The light-detecting unit is coupled between the first node and the first voltage source. The detecting unit is coupled to the first node. In the input mode, the detecting unit detects a voltage at the first node.

DESCRIPTION OF THE DRAWINGS

[0006] The invention will become more fully understood from the detailed description given hereinbelow and the accompanying drawings, given by way of illustration only and thus not intended to be limitative of the invention.

[0007] FIG. 1 depicts an embodiment of a panel of an OLED device.

[0008] FIG. 2 depicts an embodiment of a display unit and a detecting unit in FIG. 1.

[0009] FIG. 3 depicts the relationship between the voltage v_{20} in FIG. 2 and the brightness.

[0010] FIG. 4 depicts an embodiment of a light-detecting unit.

[0011] FIG. 5 depicts an embodiment of a light-detecting unit.

[0012] FIGS. 6 and 7 depict embodiments of a display unit.

DETAILED DESCRIPTION

[0013] Display panels are provided. In some embodiments, as shown in FIG. 1, a panel 1 of an organic light emitting display (OLED) device has a display mode and an input mode, comprising a data driver 10, a scan driver 11, a detecting circuit 12, and a display array 13. The data driver 10 controls a plurality of data lines D_1 to D_m , and the scan driver 11 controls a plurality of scan lines S_1 to S_n . The detecting circuit 12 comprises a plurality of detecting units DU_1 to DU_m . The display array 13 comprises a plurality of display units. Each set of interlacing data line and scan line corresponds one display unit, such as the interlacing data line D_1 and scan line S_1 correspond to the display unit 100. In this embodiment, each data line is coupled to one detecting unit, for example, the data line D_1 is coupled to the detecting unit DU_1 .

[0014] FIG. 2 shows an embodiment of the display unit 100 and the detecting unit DU_1 in FIG. 1. As with any other display unit, the display unit 100 comprises a driving unit 20, switch units 21 and 22, a light-emitting unit 23, a storage capacitor 24, and a light-detecting unit 25. In FIG. 2, the driving unit 20 comprises a P-type transistor T20, the switch units 21 and 22 are a P-type transistor T21 and an N-type transistor T22 respectively, the light-emitting unit 23 comprises a light-emitting diode (LED) L20, and the light-detecting unit 25 comprises a photodiode P25.

[0015] A gate (control electrode) of the transistor T20 is coupled to a node N20, a drain (first electrode) thereof is coupled to a drain of the transistor T22, and a source (second electrode) thereof is coupled a voltage source Vdd. A gate of the transistor T21 is coupled to the scan line S_1 , a drain thereof is coupled to the data line D_1 , and a source thereof is coupled to the node N20. A gate of the transistor T22 is coupled to the scan line S_1 , and a source thereof is coupled to the LED L20. The photodiode P25 and the storage capacitor 24 are coupled between the voltage source Vdd and the node N20. The LED L20 is coupled between the source of the transistor T22 and a voltage source Vss. The voltage sources Vdd and Vss respectively provide high level voltage vdd and low level voltage vss.

[0016] The detecting unit DU_1 comprises a charge amplifier 120 and an analog/digital (A/D) converter 121. A noninverting input terminal (-) of the charge amplifier 120 is coupled to the data line D_1 , and an inverting input terminal (+) thereof is coupled to a reference voltage source Vref. A switch SW12 and a capacitor Cfb are coupled in parallel between the noninverting input terminal (-) and the inverting input terminal (+) of the charge amplifier 120. The A/D converter 121 is coupled to an output terminal of the charge amplifier 120.

[0017] When the OLED device operates in the display mode, the transistors T21 and T22 are respectively turned on and off according to a scan signal on the scan line S_1 , and the data line D_1 transmits a data signal to the display unit

100, so that voltage **v20** at the node **N20** is equal to voltage **vdata** of the data signal. At this time, the voltage stored in the storage capacitor **24** is equal to (**vdd-vdata**). The transistors **T21** and **T22** are then respectively turned off and on. The transistor **T20** is turned on according to the data voltage **vdata** at the node **N20** and thus generates a driving current to drive the LED **L20** to emit light.

[0018] When the OLED device operates in the input mode, the transistors **T21** and **T22** are respectively turned on and off. First, the reference voltage source **Vref** of the charge amplifier **120** provides a reference voltage **vref** to the node **N20** through the data line **D₁**, so that the voltage **v20** at the node **N20** is set to the reference voltage **vref**. At this time, saturation charge stored in the storage capacitor **24** is given by:

$$Q_{\text{sat}} = cs * (vdd - vref)$$

wherein, Q_{sat} represents the saturation charge, and cs represents the value of the storage capacitor **24**.

[0019] The transistors **T21** and **T22** are then respectively turned off and on, and the transistor **T20** drives the LED **L20** to emit light according to the voltage **v20** (equal to voltage **vref**) at the node **N20**. An object serving as an input tool is irradiated by the LED **L20**. The object reflects different degrees of light to the display unit **100** according the gray levels of the surface of the object. The photodiode **P25** senses the reflected light and generates photo current **Iph**, resulting in leakage voltage of the node **N20**. Thus, the voltage **v20** at the node **N20** is increased from the voltage **vref** toward the voltage **vdd** due to the leakage current of the photodiode **P25**. When brightness of the reflected light is higher, the leakage current of the photodiode **P25** is greater, and the largest voltage **v20** is equal to the voltage **vdd**. **FIG. 3** depicts the relationship between the voltage **v20** and the brightness, wherein the direction of an arrow **A** represents that the brightness of the reflected light is from high to low in a frame. The charge amplifier **120** of the detecting unit **DU₁** reads out and amplifies the value of the voltage **v20**, and then outputs readout voltage **vout**:

$$v_{\text{out}} = \frac{\int_{t_0}^{t_0+Tf} iph(t) dt}{cfb}$$

wherein, $iph(t)$ represents the value of the photo current **Iph**, t_0 represents the time when the value of the voltage **v20** is read out, Tf represents a frame, and cfb represents the value of the capacitor **Cfb**.

[0020] According to the saturation charge, the largest readout voltage **voutmax** is thus given by:

$$v_{\text{out max}} = \frac{cs * (vdd - vref)}{cfb}$$

[0021] After the readout voltage **vout** output by the charge amplifier **120** is converted by the A/D converter **121**, the A/D converter **121** outputs a corresponding digital input signal to back-end devices for processing or storing. The

switch **SW12** of the charge amplifier **120** is then turned on to reset the voltage **v20** to be the reference voltage **vref**.

[0022] The photodiode **P25** of this embodiment can be implemented by a transistor **T25**, referring to **FIG. 4**. A source of the transistor **T25** is coupled to the voltage source **Vdd**, and a gate and a drain thereof are both coupled to the node **N20**. It is noted that the light-detecting unit **25** is used to sense light only when the OLED device operates in the input mode. Thus, the light-detecting unit **25** is enabled according to a control signal **SC** in the input mode to reduce power consumption. Referring to **FIG. 5**, the light-detecting unit **25** further comprises a control unit **250**. The control unit **250** comprises transistors **T250** and **T251**. In this embodiment, the transistors **T250** and **T251** are respectively P-type and N-type. A gate of the transistor **T250** receives the control signal **SC**, a source thereof is coupled to the gate of the transistor **T25**, and a drain thereof is coupled to the node **N20**. A gate of the transistor **T251** receives the control signal **SC**, a drain thereof is coupled to the gate of the transistor **T25**, and a source thereof is coupled to the voltage source **Vss**.

[0023] Referring to **FIG. 5**, when the OLED device operates in the display mode, the light-detecting unit **25** is not used to sense light. The transistors **T250** and **T251** are respectively turned off and on by the control signal **SC** with a high voltage level. The gate of the transistor **T25** is coupled to the low level voltage source **Vss** through the transistor-**T251**. The transistor **T25** is thus turned off and does not sense light. When the OLED device operates in the input mode, the light-detecting unit **25** is used to sense light. The transistors **T250** and **T251** are respectively turned on and off by the control signal **SC** with a low voltage level. The gate and drain of the transistor **T25** are coupled together to form a photodiode.

[0024] In some embodiments, as shown in **FIG. 6**, the display unit **100** comprises driving unit **20**, switch unit **60**, a light-emitting unit **23**, a storage capacitor **24**, and a light-detecting unit **25**. In **FIGS. 2 and 6**, like reference numbers are used to designate like parts, and the descriptions of the like parts are omitted here. In this embodiment of **FIG. 6**, the switch unit **60** is an N-type transistor **T60**.

[0025] A gate of the transistor **T60** is coupled to the scan **S₁**, and a drain thereof is coupled to the data line **D₁**, and a drain thereof is coupled to the node **N20**. The light-detecting unit **25** can comprise the circuitry in **FIG. 4** or **FIG. 5**.

[0026] In some embodiments, as shown in **FIG. 7**, the display unit **10.0** comprises driving unit **20**, switch units **70** to **72**, a light-emitting unit **23**, a storage capacitor **24**, and a light-detecting unit **25**. In **FIGS. 2 and 7**, like reference numbers are used to designate like parts, and the descriptions of the like parts are omitted here. In this embodiment of **FIG. 7**, the switch units **70** and **72** are N-type transistors **T70** and **T72**, and the switch unit **71** is a P-type transistor.

[0027] A gate of the transistor **T70** is coupled to the scan line **S₁**, a drain thereof is coupled to the data line **D₁**, and a source thereof is coupled to a node **N70**. A gate of the transistor **T71** is coupled to the node **N20**, a source thereof is coupled to the node **N70**, and a drain thereof is coupled to the voltage source **Vdd**. A gate of the transistor **T72** is coupled to an erase scan line **ES₁**, a drain thereof is coupled to the node **N70**, and a source thereof is coupled to the node

N20. In one frame, the timing of an erase signal on the erase scan line ES_1 is different from that of the scan signal on the scan line S_1 . Moreover, the pulse of the erase signal appears following that of the scan signal. The light-detecting unit 25 can comprise the circuitry in FIG. 4 or FIG. 5.

[0028] According to the described embodiments, an OLED device has a display mode and an input mode. When the OLED operates in the display mode, a display panel displays images. When the OLED operates in the input mode, a light-detecting unit within each display unit senses the light reflected by an object, and a detecting circuit determines the input signal according to the reflected light. Moreover, the light-detecting unit can be implemented by an LTPS TFT.

[0029] While the invention has been described in terms of preferred embodiment, it is to be understood that the invention is not limited thereto. On the contrary, it is intended to cover various modifications and similar arrangements as would be apparent to those skilled in the art. Therefore, the scope of the appended claims should be accorded the broadest interpretation so as to encompass all such modifications and similar arrangements.

What is claimed is:

1. A display panel for an organic light emitting display (OLED) device having a display mode and an input mode, the display panel comprising:

a driving unit having a control electrode coupled to a first node, a first electrode coupled to a first voltage source, and a second electrode;

a capacitor coupled between the first node and the first voltage source;

a light-emitting diode coupled between the second electrode of the driving unit and a second voltage source;

a light-detecting unit coupled between the first node and the first voltage source; and

a detecting unit coupled to the first node and detecting a voltage at the first node in the input mode.

2. The display panel as claimed in claim 1, wherein the detecting unit comprises:

a charge amplifier, coupled to the first node, for receiving a reference voltage and detecting the voltage at the first node to generate a readout voltage; and

an analog/digital converter for generating the input signal according to the readout voltage.

3. The display panel as claimed in claim 1 further comprising:

a first switch unit having a control electrode coupled to a scan line, a first electrode coupled to the first node, and a second electrode coupled to a data line; and

a second switch unit having a control electrode, a first electrode coupled to the first electrode of the driving unit, and a second electrode coupled to the light-emitting diode.

4. The display panel as claimed in claim 3, wherein the first switch unit is a first-type transistor, and the second switch unit is a second-type transistor.

5. The display panel as claimed in claim 1 further comprising a switch unit having a control electrode coupled to a

scan line, a first electrode coupled to a data line, and a second electrode coupled to the first node.

6. The display panel as claimed in claim 1 further comprising:

a first switch unit having a control electrode coupled to a scan line, a first electrode coupled to a data line, and a second electrode coupled to a second node;

a second switch having a control electrode coupled to the first node, a first electrode coupled to the second node, and a second electrode coupled to the first voltage source; and

a third switch having a control electrode coupled to an erase scan line, a first electrode coupled to the second electrode, and a second electrode coupled to the first node.

7. The display panel as claimed in claim 6, wherein the second switch unit is a P-type transistor, and the first and third switch units are N-type transistors.

8. The display panel as claimed in claim 6, wherein the second switch unit is an N-type transistor, and the first and third switch units are P-type transistors.

9. The display panel as claimed in claim 6, wherein the signal timing of the erase scan line is different from that of the scan line.

10. The display panel as claimed in claim 9, wherein a pulse on the erase scan line appears following that of the scan line.

11. The display panel as claimed in claim 1, wherein the light-detecting unit comprises a first transistor having a control electrode and a first electrode coupled together, and a second electrode coupled to the first voltage source.

12. The display panel as claimed in claim 11, wherein the first transistor is a low temperature poly-silicon thin film transistor.

13. The display panel as claimed in claim 1, wherein the light-detecting unit comprises:

a first transistor having a control electrode, a first electrode coupled to the first node, and a second electrode coupled to the first voltage source; and

a control unit determining whether the control electrode and first electrode of the first transistor coupled together according to the display and input modes.

14. The display panel as claimed in claim 13, wherein the control unit comprises:

a second transistor having a control electrode receiving a control signal, a first electrode coupled to the first node, and a second electrode coupled to the control electrode of the first transistor; and

a third transistor having a control electrode receiving the control signal, a first electrode is coupled to the control electrode of the first transistor, and a second electrode coupled to the second voltage source;

wherein when the OLED device operates in the display mode, the third transistor is turned on according to the control signal, coupling the control electrode of the first transistor to the second voltage source; and

wherein when the OLED device operates in the input mode, the second transistor is turned on according to the control signal, coupling the control electrode and first electrode.

15. The display panel as claimed in claim 14, wherein the second transistor is a first-type transistor, and the third transistor is a second-type transistor.

16. The display panel as claimed in claim 15, wherein the first transistor is a second-type transistor.

17. The display panel as claimed in claim 13, wherein the first transistor is a low temperature poly-silicon thin film transistor.

18. An operating method for a display panel, and the display panel comprising a driving unit having a control electrode coupled to a first node, a first electrode coupled to a first voltage source, and a second electrode, a capacitor coupled between the first node and the first voltage source, a light-emitting diode coupled between the second electrode of the driving unit and a second voltage source, a light-

detecting unit coupled between the first node and the first voltage source, and detecting unit coupled to the first node, the operating method comprising:

emitting light by the light-emitting diode to a object;

sensing the light reflected by the object;

changing a voltage at the first node according the light reflected by the object; and

detecting the voltage at the first node.

19. The operating method as claimed in claim 18, wherein the steps are performed in an input mode of the display panel.

* * * * *

专利名称(译)	显示面板及其操作方法		
公开(公告)号	US20060267508A1	公开(公告)日	2006-11-30
申请号	US11/243835	申请日	2005-10-05
[标]申请(专利权)人(译)	友达光电股份有限公司		
申请(专利权)人(译)	友达光电.		
当前申请(专利权)人(译)	友达光电.		
[标]发明人	SUN WEIN TOWN		
发明人	SUN, WEIN-TOWN		
IPC分类号	G09G3/10		
CPC分类号	G09G3/3233 G09G3/3241 G09G2300/0842 G09G2360/142 G09G2320/029 G09G2320/043 G09G2300/0861		
优先权	094117790 2005-05-31 TW		
其他公开文献	US7652663		
外部链接	Espacenet USPTO		

摘要(译)

一种用于OLED器件的显示面板，具有显示模式和输入模式。显示面板包括驱动单元，电容器，发光二极管，光检测单元和检测单元。驱动单元具有耦合到第一节点的控制电极，耦合到第一电压源的第一电极和第二电极。电容器和光检测单元耦合在第一节点和第一电压源之间。发光二极管耦合在驱动单元的控制电极和第二电压源之间。在输入模式中，检测单元检测第一节点处的电压。

