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(54) **LIQUID CRYSTAL PANEL AND DRIVER DEVICE THEREOF**

Publication Classification

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(57) **ABSTRACT**

The invention provides a liquid crystal display panel, comprising a plurality of scan lines fabricated along a first axis, a plurality of data lines fabricated along a second axis, a first pixel and a second pixel. Each of the first and second pixels is surrounded by two adjacent scan lines and two adjacent data lines. The first pixel comprises a first thin film transistor (TFT). The second pixel comprises a second and a third TFT. The gates of the second and third TFT are electrically connected to the two adjacent scan lines surrounding the second pixel, respectively. The third TFT further comprises a source electrically connected to a photo-sensor, and a drain electrically connected to an access line fabricated along the second axis. One end of the access line is electrically connected to a signal processor via a switch.

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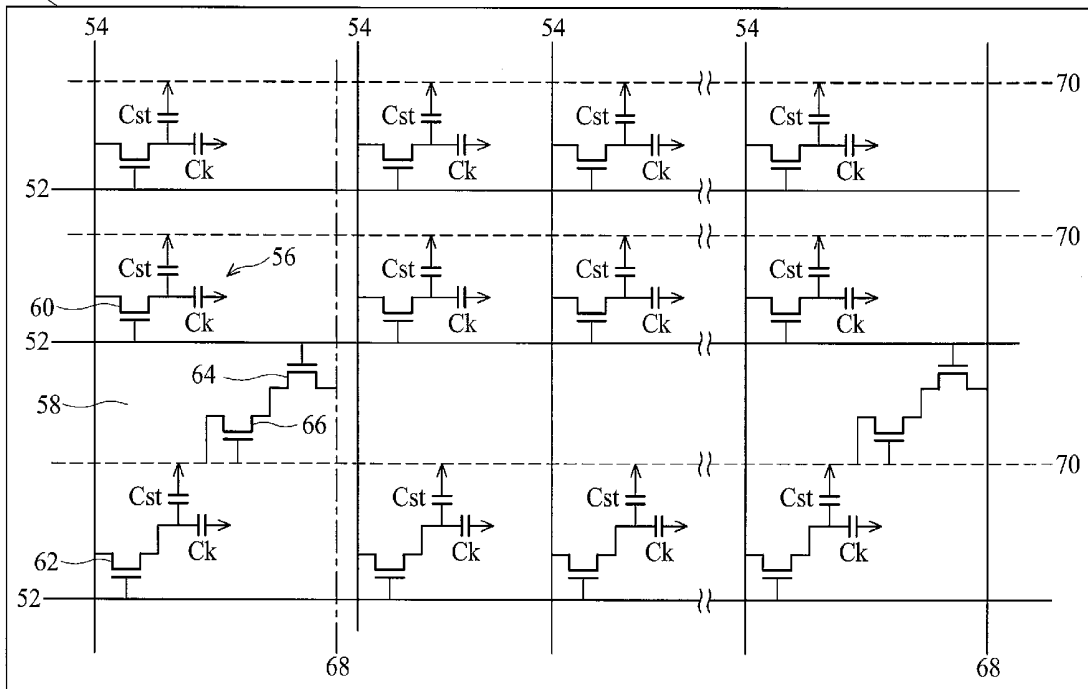
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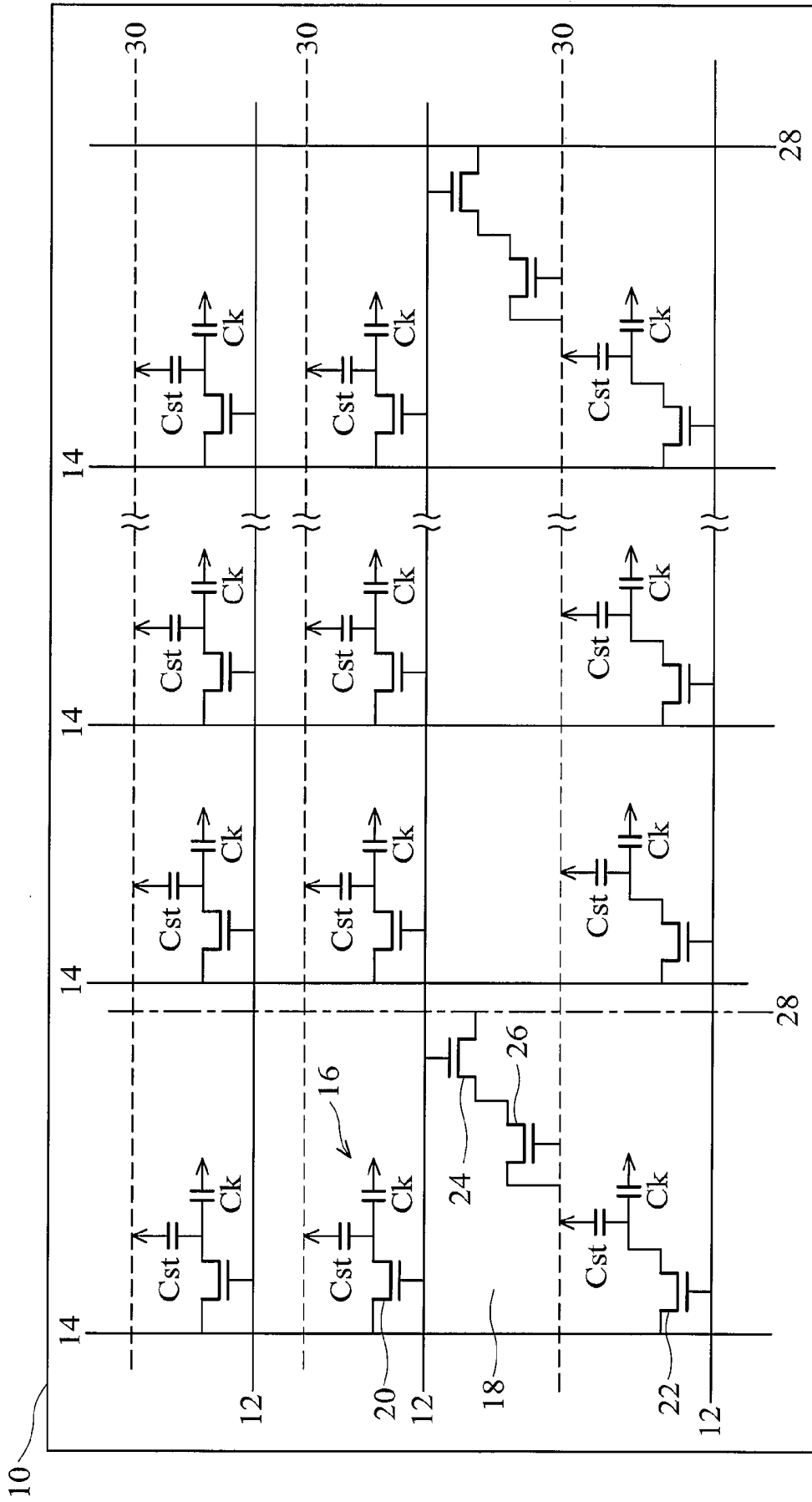


FIG. 1 (PRIOR ART)

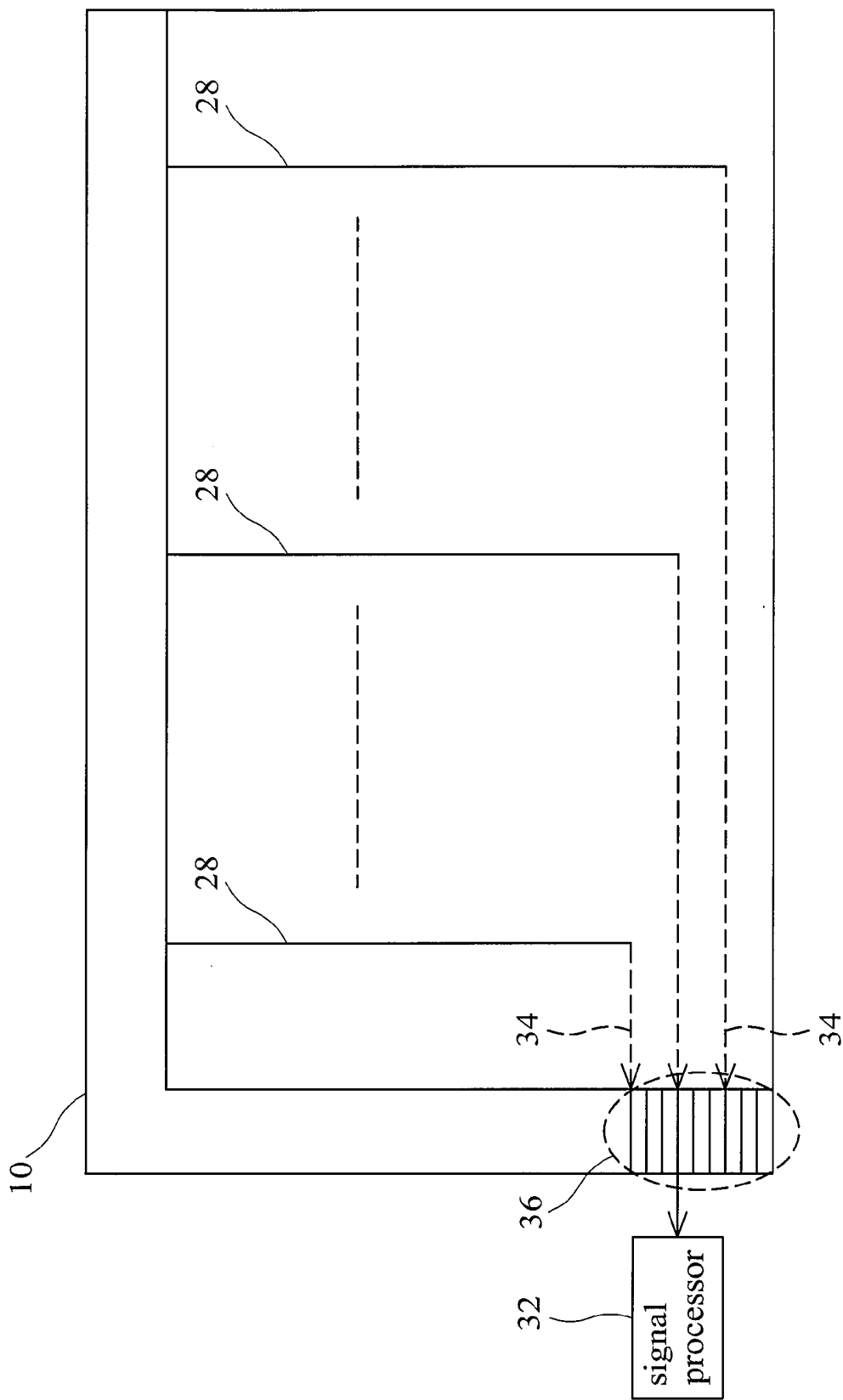


FIG. 2 (PRIOR ART)

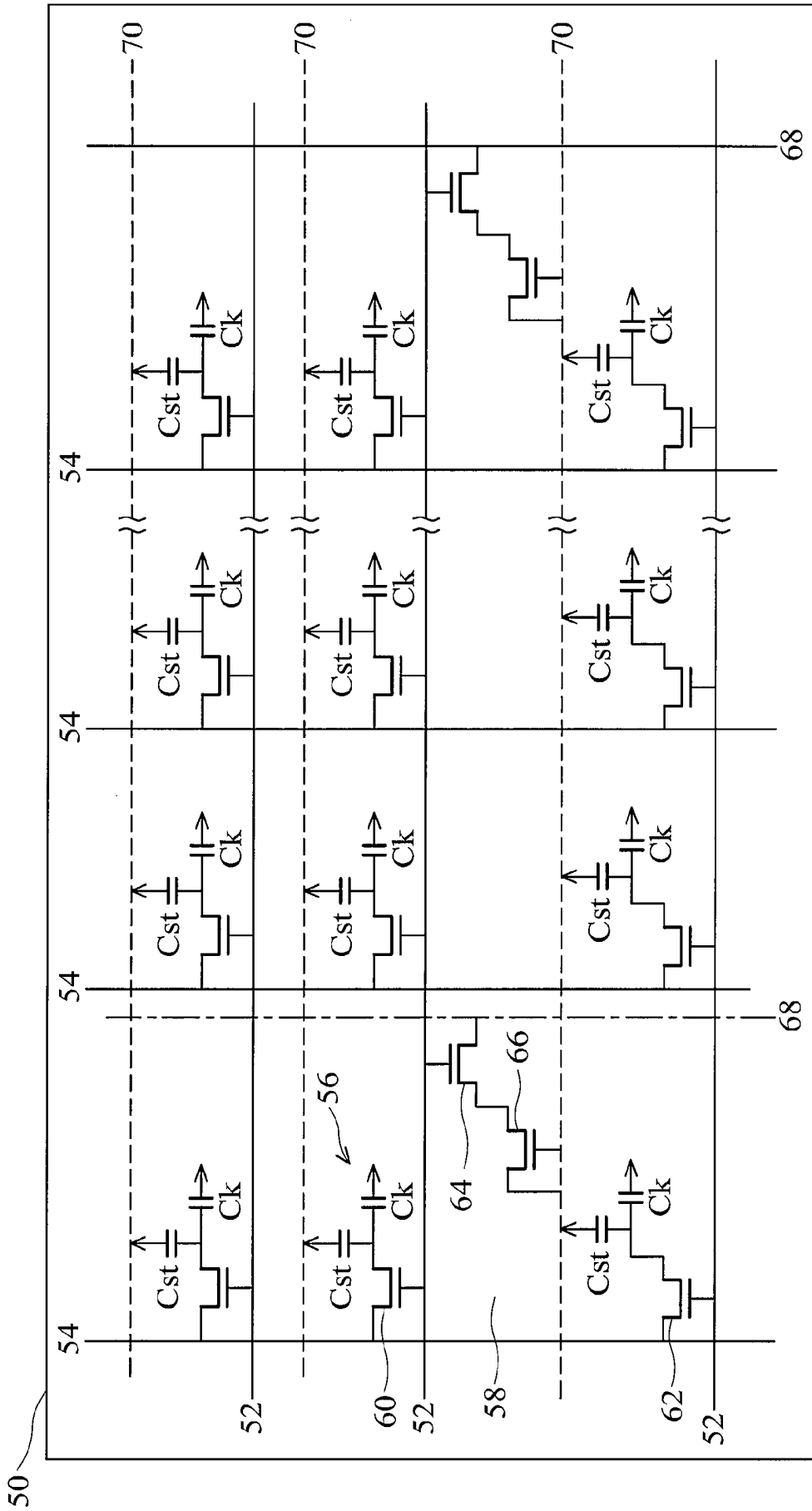


FIG. 3

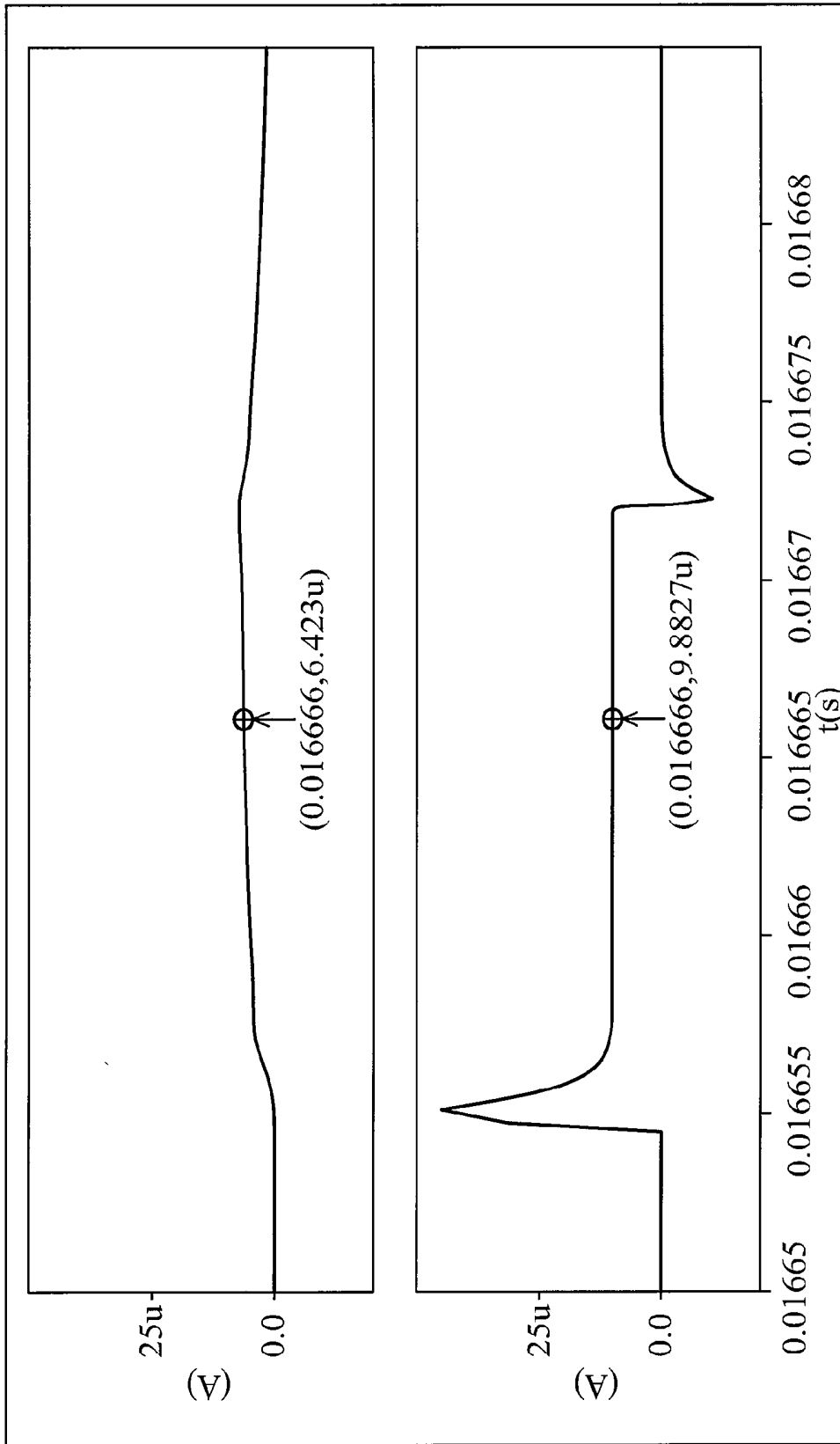


FIG. 4 (PRIOR ART)

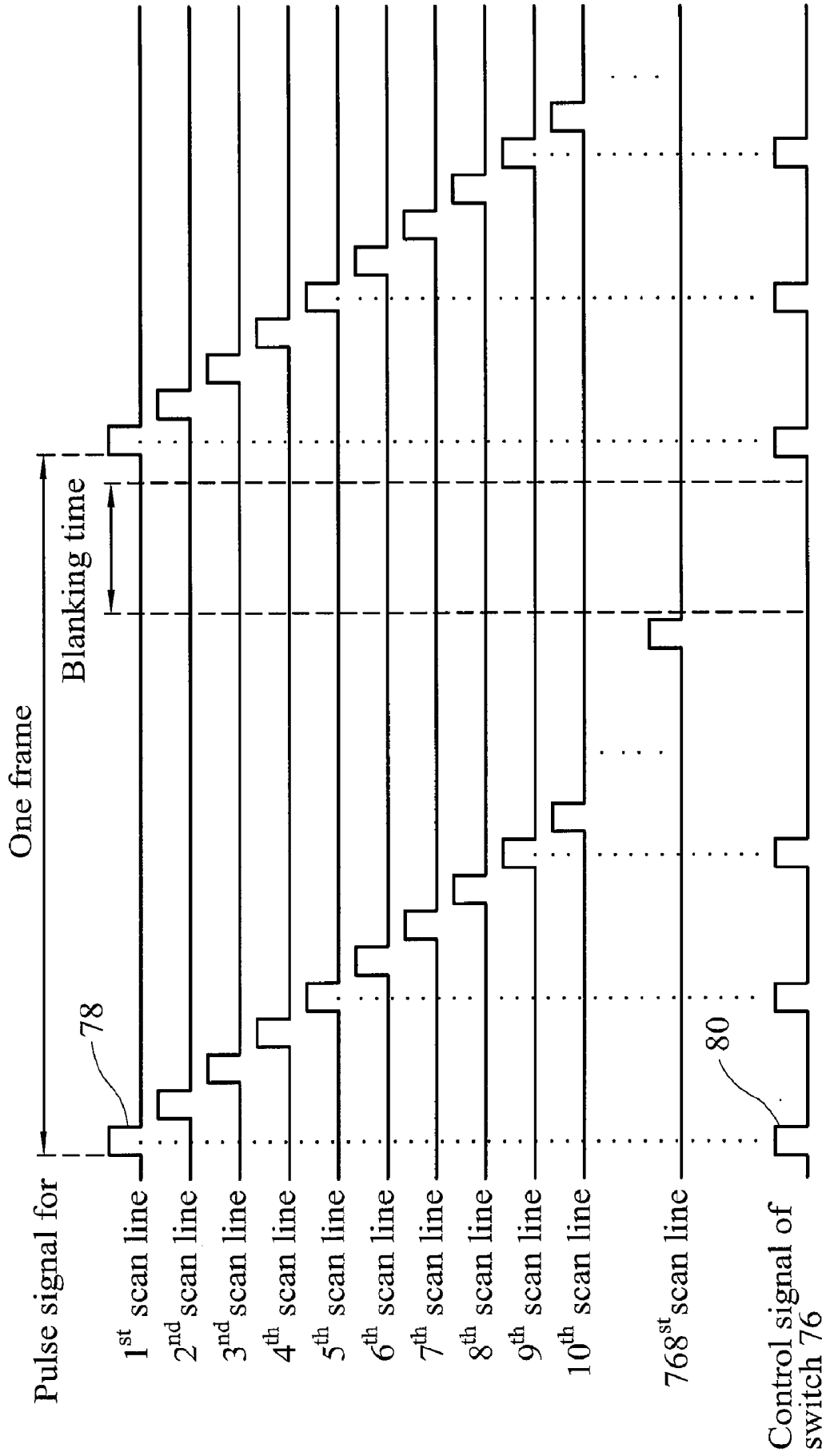


FIG. 6

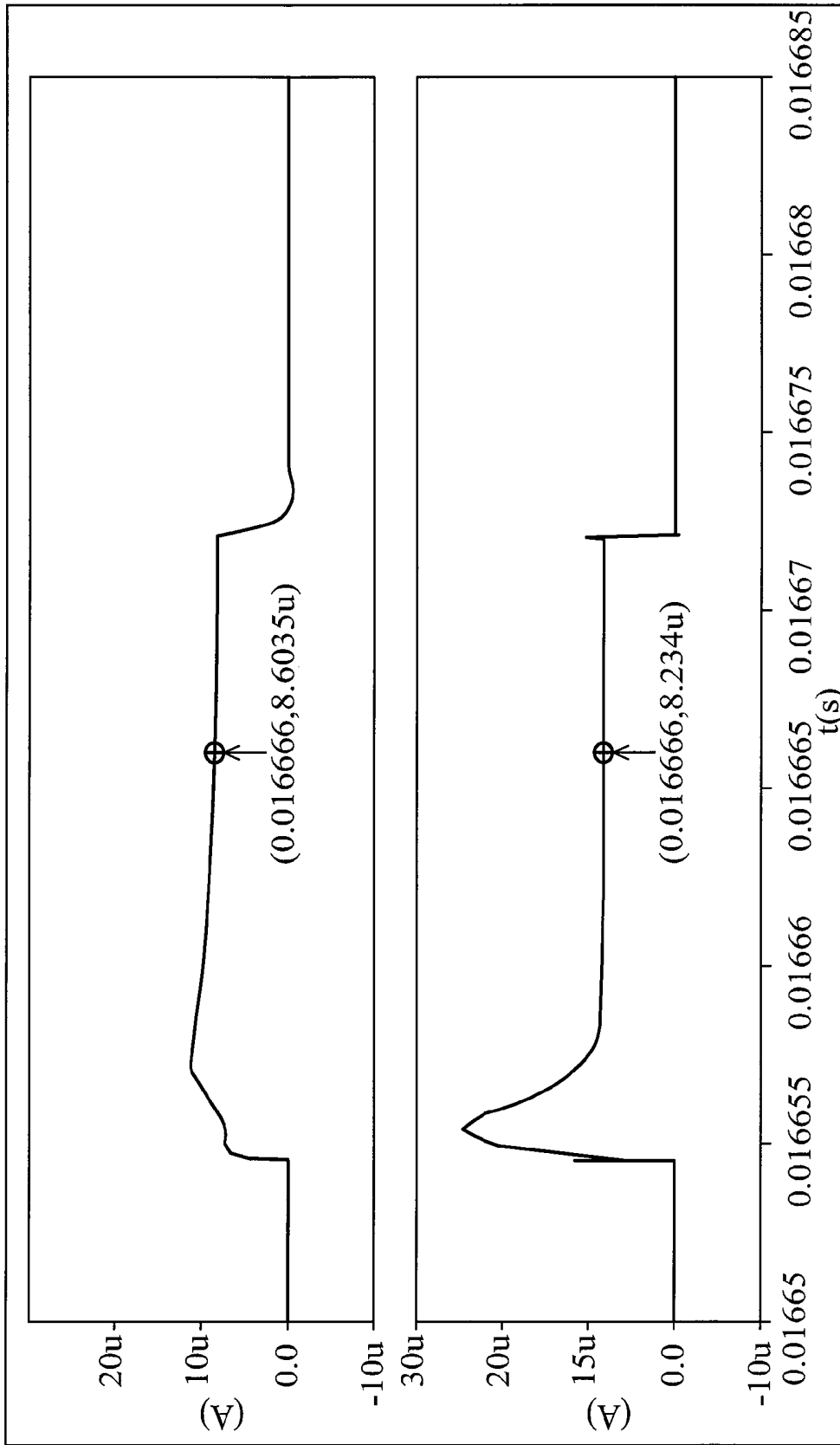


FIG. 7

LIQUID CRYSTAL PANEL AND DRIVER DEVICE THEREOF

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The invention relates to liquid crystal panels, and particularly relates to the driver devices thereof.

[0003] 2. Description of the Related Art

[0004] There are three types of touch panel: resistive, surface wave, and capacitive. Resistive touch panels are usually limited to small size. Surface wave touch panels register contact by electromagnetic response or by electromagnetic transmission. Capacitive touch panels register contact by capacitive response, with coordinates of the contact point evaluated according to variations in capacitance generated.

[0005] Conventionally, touch panels and liquid crystal display panels are manufactured separately and combined into a finished product. The separately manufactured liquid crystal display panel and touch panel result in a heavy and expensive finished product with low transparency. To deal with the above drawbacks, a liquid crystal touch panel, which integrally fabricates the touch panel and the liquid crystal display panel in the same panel, is in development.

[0006] FIG. 1 illustrates a conventional liquid crystal touch panel. As shown in FIG. 1, the liquid crystal display panel 10 comprises a plurality of scan lines 12 fabricated along a first axis, a plurality of data lines 14 fabricated along a second axis, a plurality of first pixels 16, and a plurality of second pixels 18. As shown in FIG. 1, each of the first and second pixels (16 and 18) is surrounded by two adjacent scan lines 12 and two adjacent data lines 14. The first pixel 16 comprises a first thin film transistor 20. The first thin film transistor 20 has a gate electrically connected to one of the two adjacent scan lines surrounding the first pixel, a source electrically connected to one of the two adjacent data lines surrounding the first pixel, and a drain electrically connected to a pixel electrode (not shown in FIG. 1). The second pixel 18 comprises a second thin film transistor 22 and a third thin film transistor 24. The gates of the second and third thin film transistors 22 and 24 are electrically connected to the two adjacent scan lines surrounding the second pixel, respectively. The second pixel 22 further comprises a source electrically connected to one of the two adjacent data lines surrounding the second pixel, and a drain electrically connected to a pixel electrode (not shown in FIG. 1). The third thin film transistor 24 further comprises a source electrically connected to a photo-sensor, and a drain electrically connected to an access line 28. The photo-sensor may be implemented by a fourth thin film transistor 26, as the FIG. 1 shows. The fourth thin film transistor 26 has a gate and a source both electrically connected to a bias voltage line 30, and a drain electrically connected to the drain of the third thin film transistor 24. In response to external light, the fourth thin film transistor 26 generates a current as a photo-sensed signal. The photo-sensed signal is passed to the access line 28 via the third thin film transistor 24 and then transmitted to a signal processor (shown in FIG. 2). After the signal processing, contact is available.

[0007] FIG. 2 illustrates the peripheral circuit of the liquid crystal display panel 10. As shown in FIG. 2, between an access line 28 and the signal processor 32, a fan-out line 34 couples the access line 28 to a connection pad 36 of the liquid crystal display panel 10. The length of fan-out line 34 is dependent on the access line 28 coupling to the fan-out line 34. The resistance of fan-out line 34 is dependent on the

length of the fan-out line 24. The transmission of the photo-sensed signal is affected by the different resistance of fan-out lines 34. Therefore, the signal processor 32 cannot deal correctly with the received photo-sensed signal.

[0008] FIG. 4 shows a simulated result of the liquid crystal display panel 10. As shown in the lower waveform of FIG. 4, in the gate-in terminal of an access line 28, the photo-sensed signal measures 9.8827 μA . As shown in the top waveform of FIG. 4, in the gate-end terminal of the connection pad 36, the photo-sensed signal measures 6.423 μA . There is an error between the measurements. Therefore, a solution for the asynchronous gate-in/gate-end signals is called for.

BRIEF SUMMARY OF THE INVENTION

[0009] The invention provides liquid crystal touch panels. The invention comprises a switch fabricated between a fan-out line of an access line of the invention and a signal processor. The switch allows a photo-sensed signal to be transmitted from the access line to the signal processor via a fan-out line. The switch provides a solution for the asynchronous gate-in and gate-end terminals.

[0010] In an embodiment of the invention, a liquid crystal touch panel comprises a plurality of scan lines fabricated along a first axis, a plurality of data lines fabricated along a second axis, a first pixel, and a second pixel. Each of the first and second pixels is surrounded by two adjacent scan lines and two adjacent data lines. The first pixel comprises a first thin film transistor. The second pixel comprises a second thin film transistor and a third thin film transistor. The gates of the second and third pixels are electrically connected to the two adjacent scan lines surrounding the second pixel, respectively. The source of the third thin film transistor is electrically connected to a photo-sensor. The drain of the third thin film transistor is electrically connected to an access line. The access line is fabricated along the second axis. One terminal of the access line is electrically connected to a signal processor via a switch.

[0011] The above and other advantages will become more apparent with reference to the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS The invention can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

[0012] FIG. 1 illustrates a portion of a conventional liquid crystal touch panel;

[0013] FIG. 2 illustrates another portion of the conventional liquid crystal touch panel;

[0014] FIG. 3 illustrates a portion of a liquid crystal touch panel of the invention;

[0015] FIG. 4 shows a simulated result of the conventional liquid crystal touch panel;

[0016] FIG. 5 illustrates another portion of the liquid crystal touch panel of the invention;

[0017] FIG. 6 shows pulse signals driving the scan lines and a control signal of the switch of the invention; and

[0018] FIG. 7 shows a simulated result of the liquid crystal touch panel of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0019] The following description is of the best-contemplated mode of carrying out the invention. This description is made for the purpose of illustrating the general principles of the invention and should not be taken in a limiting sense. The scope of the invention is best determined by reference to the appended claims.

[0020] FIG. 3 illustrates an exemplary embodiment of the invention, a liquid crystal touch panel. As shown, a liquid crystal display panel comprises a plurality of scan lines 52 fabricated along a first axis, a plurality of data lines 54 fabricated along a second axis, a plurality of first pixels 56, and a plurality of second pixels 58. As shown in FIG. 3, each of the first pixels 56 is surrounded by two adjacent scan lines 52 and two adjacent data lines 54. The first pixel 56 comprises a first thin film transistor 60 having a gate electrically connected to one of the two adjacent scan lines, a source electrically connected to one of the data lines, and a drain electrically connected to a pixel electrode (not shown). When the first thin film transistor 60 is turned on, data transmitted in the data line 54 is passed to the pixel electrode to display images. As shown in FIG. 3, each of the second pixels 58 is surrounded by two adjacent scan lines 52 and two adjacent data lines 54. The second pixel 58 comprises a second thin film transistor 62 and a third thin film transistor 64. The gates of the second and third thin film transistors 62 and 64 are electrically connected to the two adjacent scan lines surrounding the second pixel 58, respectively. The second thin film transistor 62 comprises a source electrically connected to one of the two adjacent data lines, and a drain electrically connected to a pixel electrode (not shown). Operation of the second thin film transistor 62 is similar to the first thin film transistor 60. When the second thin film transistor 62 is turned on, the data transmitted by the data line 54 is passed to the pixel to display images. The third thin film transistor 64 comprises a source electrically connected to a photo-sensor, and a drain electrically connected to an access line 68 fabricated along the second axis. The photo-sensor is generally implemented by a thin film transistor named as fourth thin film transistor 66, as shown in FIG. 3. But it should be known that the photo-sensor in the exemplary embodiment can also be implemented by a photo-sensitive diode, a photo-sensitive resistor, and so on. The fourth thin film transistor 66 comprises a gate and a source both electrically connected to a bias voltage line 70 at a constant voltage level, and a drain electrically connected to the source of the third thin film transistor 64. When the fourth thin film transistor 66 is triggered by external light, a photo-current is generated by the fourth thin film transistor 66 as a photo-sensed signal, and passed to the access line 68 via the third thin film transistor 64. The access line 68 transmits the photo-sensed signal to a signal processor 72 (shown in FIG. 5). After processing by the signal processor 72, the coordinates of contact on the panel 50 are available.

[0021] FIG. 5 illustrates the difference between the invention and conventional technique. As shown, each access line 68 is electrically connected to a signal processor 72 via a conductive line comprising a fan-out line 74 and a switch 76. The switch 76 may be implemented as a component of metal oxide semiconductor or any like elements, utilized to control conduction between the fan-out line 74 and the signal processor 72 to transmit the photo-sensed signal from the access line

68 to the signal processor 72. The switch 76 is controlled by a control signal dependent on the status of the third thin film transistor 64. When a pulse signal is applied to the gate of the third thin film transistor 64 to turn on the third thin film transistor 64, the switch 76 is turned on by the control signal simultaneously. Consequently, when the third thin film transistor 64 is turned on to transmit the photo-sensed signal generated by the fourth thin film transistor 66 to the access line 68, the switch 66 is turned on to allow the transmission from the access line 68 to the signal processor 72 via the fan-out line 74. When no pulse signal is applied to the third thin film transistor 64, the third thin film transistor 64 and the switch 76 remain off, and access line 68 floats. The switches 76 further prevent leakage current generated by unused photo-sensors 66.

[0022] In some embodiments, to overcome resistance mismatch of the conductive lines (each comprising an access line 68 and a fan-out line 74), the switches 76 are designed to have on-resistance much larger than the resistance of the corresponding conductive lines. Because the resistance of the transmission paths (each comprising an access line 68, a fan-out line 74, and a switch 76) are similar to each other, data can synchronously transmit on the transmission paths.

[0023] Compared with the first pixel 56, the second pixel 58 further comprises third thin film transistor 64 and the fourth thin film transistor 66 which affect image quality. For this reason, in an embodiment of the invention, the second pixels 58 of a panel are sparsely distributed in the liquid crystal display panel 50 and spaced by the first pixels 56 to ensure image quality. In an embodiment, the second pixel 58 is implemented to display blue, blue not being sensitive to the naked eye. In an embodiment of the invention, the second pixels 58 are spaced every four scan lines 52, that is to say, only the 1st, 5th, 9th . . . scan lines (52) are electrically connected to the third thin film transistors 64. FIG. 6 shows the pulse signals (marked as 78) for scan lines 52, and the control signal (marked as 80) of switch 76. To display one image frame, a gate driver (not shown in FIG. 6) generates pulse signals 78 to sequentially drive the scan lines (from the 1st scan line to the 768th scan line). As shown in the lowest waveform of FIG. 6, the control signal is in a high state to turn on the switch 76 when any of the 1st, 5th, 9th . . . scan lines is activated to turn on the third thin film transistor 64 thereof. Therefore, the photo-sensed signal transmitted to the access line 68 can be transmitted to the signal processor 72 by way of the corresponding fan-out line 74. When any of the 2nd, 4th, 6th-8th, 10th-12th . . . scan lines are activated, the control signal is in a low state to turn off the switch 76. At this time, all of the third film transistors 64 of the panel and the corresponding switches 76 are turned off, and the access lines 68 float. As shown in the lowest waveform of FIG. 6, the control signal is in the low state during a blanking time.

[0024] The liquid crystal touch panel comprises a switch 76, fabricated between the corresponding fan-out line 74 and the signal processor 72, allowing the photo-sensed signal to be transmitted from the access line 68 to the signal processor 72 by the way of the fan-out line 74. When the switch 76 is turned off, the access line 68 floats to avoid transmission of leakage current from the access line 68 to the signal processor 72. The switch 76 further provides a solution for erroneous judgment caused by different impedance of the fan-out lines 74.

[0025] FIG. 7 shows a simulated result of the invention. FIG. 4 shows a simulated result of a conventional liquid

crystal touch panel. Comparing the lower waveforms of FIG. 4 and FIG. 7, the photo-sensed signal generated by the photo-sensor of the invention is similar to that of the conventional liquid crystal display panel. With reference to the lower waveform of FIG. 7, the photo-sensed signal at the gate-in terminal of the access line 68 measures 8.234 μA . With reference to the upper waveform of FIG. 7, the photo-sensed signal at the gate-end terminal of the connection pad of the invention measures 8.6035 μA . With reference to the lower waveform of FIG. 4, the photo-sensed signal at the gate-in terminal of the access line 26 measures 9.8827 μA . With reference to the upper waveform of FIG. 4, the photo-sensed signal at the gate-end terminal of the connection pad 36 of the conventional liquid crystal touch panel measures 6.423 μA . It can be seen that the invention overcomes the drawbacks of the conventional technique. In the invention, the photo-sensed signal is unaffected by transmission distance.

[0026] While the invention has been described by way of example and in terms of preferred embodiment, it is to be understood that the invention is not limited thereto. To the contrary, it is intended to cover various modifications and similar arrangements (as would be apparent to those skilled in the art). For example, the invention can not only be employed in the panel with input function (such as touch panel, light-sensor panel and so on), but also can be utilized in TN mode, STN mode, OCB (Optically compensated bend) mode, VA (Vertical Alignment) mode, IPS (In-plane switch) mode, FFS (Fringe field switch) mode, FLC (Ferroelectric Liquid Crystal) mode and so on. Therefore, the scope of the appended claims should be accorded to the broadest interpretation so as to encompass all such modifications and similar arrangements.

What is claimed is:

1. A liquid crystal display panel, comprising:
 - a plurality of scan lines, fabricated along a first axis;
 - a plurality of data lines, fabricated along a second axis, perpendicular to the scan lines;
 - at least one first pixel, surrounded by two adjacent scan lines and two adjacent data lines, and coupled to a conductive line; and
 - a switch, connected between the conductive line and a signal processor.
2. The liquid crystal display panel as claimed in claim 1, further comprising:
 - a plurality of second pixels, each surrounded by two adjacent scan lines and two adjacent data lines and comprising a first thin film transistor having a gate electrically connected to one of the two adjacent scan lines, a source electrically connected to one of the two adjacent data lines, and a drain electrically connected to a first pixel electrode.
3. The liquid crystal display panel as claimed in claim 2, wherein the first pixel comprises:
 - a second thin film transistor and a third thin film transistor, wherein gates of the second and third thin film transistors are electrically connected to the two adjacent scan lines surrounding the first pixel, respectively,
 - wherein the second thin film transistor further has a source electrically connected to one of the two adjacent data lines surrounding the first pixel, and a drain electrically connected to a second pixel electrode,
 - wherein the third thin film transistor further has a source electrically connected to a photo-sensor, and a drain electrically connected to the conductive line.

4. The liquid crystal display panel as claimed in claim 3, wherein the photo-sensor is implemented by a fourth thin film transistor having a gate and a source both electrically connected to a bias voltage line, and a drain electrically connected to the source of the third thin film transistor.

5. The liquid crystal display panel as claimed in claim 4, wherein the bias voltage line is biased in a constant voltage level.

6. The liquid crystal display panel as claimed in claim 1, wherein the conductive line comprises an access line and a fan-out line.

7. The liquid crystal display panel as claimed in claim 1, wherein the switch is implemented via metal oxide semiconductor.

8. The liquid crystal display panel as claimed in claim 3, wherein when the third thin film transistor is turned on by a pulse signal transmitted by the scan line connected to the gate of the third thin film transistor, a photo-sensed signal generated by the photo-sensor is transmitted to the conductive line via the third thin film transistor, and the switch is turned on to transmit the photo-sensed signal to the signal processor.

9. The liquid crystal display panel as claimed in claim 8, wherein when no pulse signal is in the scan line connected to the gate of the third thin film transistor and the second thin film transistor is turned off, the switch is turned off and the conductive line floats.

10. The liquid crystal display panel as claimed in claim 3, wherein the scan line connected to the gate of the third thin film transistor is connected to the gate of the first thin film transistor.

11. The liquid crystal display panel as claimed in claim 10, wherein when the third thin film transistor is turned on by a pulse signal transmitted by the scan line connected to the gate of the third thin film transistor, the first thin film transistor is turned on to transmit a data signal to the first pixel electrode.

12. The liquid crystal display panel as claimed in claim 3, wherein the switch is controlled by a control signal.

13. The liquid crystal display panel as claimed in claim 12, wherein when the scan line connected to the gate of the third thin film transistor transmits a pulse signal, the control signal is simultaneously transmitted to the switch to turn on the switch.

14. A liquid crystal display panel, comprising:

- a plurality of scan lines fabricated along a first axis;
- a plurality of data lines fabricated along a second axis;
- a first pixel, surrounded by two adjacent scan lines and two adjacent data lines;
- a second pixel, surrounded by two adjacent scan lines and two adjacent data lines;
- a conductive line, fabricated along the second axis; and
- a switch, connected between the conductive line and a signal processor.

15. The liquid crystal display panel as claimed in claim 14, wherein the first pixel comprises a first thin film transistor.

16. The liquid crystal display panel as claimed in claim 15, wherein the first thin film transistor comprises a gate electrically connected to one of the two adjacent scan lines surrounding the first pixel, and a source electrically connected to one of the two adjacent data lines surrounding the first pixel.

17. The liquid crystal display panel as claimed in claim 16, wherein the first thin film transistor further comprises a drain electrically connected to a first pixel electrode.

18. The liquid crystal display panel as claimed in claim **14**, wherein the second pixel comprises second thin film transistor and a third thin film transistor.

19. The liquid crystal display panel as claimed in claim **18**, wherein the gates of the second and third thin film transistor are electrically connected to the two adjacent scan lines surrounding the second pixel, respectively.

20. The liquid crystal display panel as claimed in claim **19**, wherein the second thin film transistor further comprises a

source electrically connected to one of the two adjacent data lines surrounding the second pixel, and a drain electrically connected to a second pixel electrode.

21. The liquid crystal display panel as claimed in claim **20**, wherein the third thin film transistor further comprises a source electrically connected to a photo-sensor, and a drain electrically connected to the access line.

* * * * *

专利名称(译)	液晶面板及其驱动装置		
公开(公告)号	US20080129912A1	公开(公告)日	2008-06-05
申请号	US11/695109	申请日	2007-04-02
[标]申请(专利权)人(译)	瀚宇彩晶股份有限公司		
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当前申请(专利权)人(译)	瀚宇彩晶股份有限公司.		
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摘要(译)

本发明提供一种液晶显示面板，包括沿第一轴制作的多条扫描线，沿第二轴制作的多条数据线，第一像素和第二像素。第一和第二像素中的每一个被两条相邻的扫描线和两条相邻的数据线包围。第一像素包括第一薄膜晶体管 (TFT)。第二像素包括第二和第三TFT。第二和第三TFT的栅极分别电连接到围绕第二像素的两条相邻扫描线。第三TFT还包括电连接到光传感器的源极，以及电连接到沿第二轴制造的存取线的漏极。接入线的一端通过开关电连接到信号处理器。

