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Trend of LCD Touch Sensor Technology

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Abstract: Touch Screen Panel(TSP) is widely used for mobile devices as a most intuitive and user-friendly input device, various kinds of TSP technology are studied in the past few years. This paper reviews the features of conventional (external) technology and internal touch technology, the technology trend of TSP is also discussed.

Key words: LCD; touch screen panel; external; internal; trend

LCD 触控感应技术发展趋势

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摘 要:作为直接和界面友好的输入装置,触摸屏被广泛地应用于移动显示产品。在过去几年中,触控技术的发展也是多种多样的。文章主要介绍了传统式触控技术及内嵌式触控技术的特点,并讨论了触控技术的发展趋势。

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1 Introduction

Touch screens are becoming increasingly critical in more and more embedded applications, such as mobile phone, PDA, Point of Sales (POS) terminal, etc. Touch technology has penetrated into our life and keeps growing dramatically and rapidly on LCD.

The conventional touch sensor attaches to the upper layer of LCD and is called "External Touch Panel". However, external TSP causes problems of the thickness of the module, the deterioration of optical performance and higher price.

Touch panel embedded in LCD is proposed as a solution to these problems. The structure is called "Internal Touch Panel"[1-3]. Compared with external TSP, internal TSP has 10 ~ 50 times higher reflective contrast ratio, 10% ~ 15% brighter display image and 25% thinner and 30% lighter LCD module.

2 External Touch Screen Panel

2.1 Resistive type TSP

In resistive TSP, top electrode layer and bottom electrode layer separate with air gap. Electrode layers form a resistive network when two electrode layers are forced to connect, and cause a change in the electrical current which

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will be sent to controller for processing in the meantime. Resistive type TSP is the most common type of touch screens, the advantages of resistive TSP is that it is suitable for application of almost every size, finger and stylus can be both detected, and lower cost. Fig. 1 gives the basic structure of resistive type TSP.

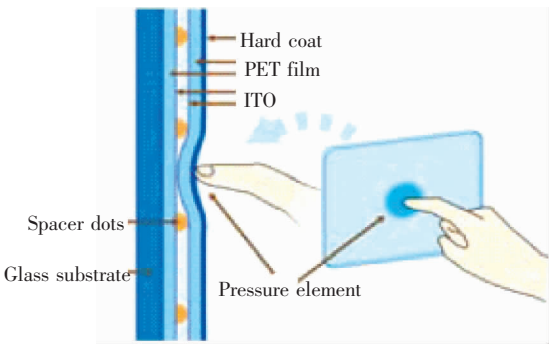

Fig. 1　Resistive type TSP

2.2　Capacitive type TSP

Capacitive touch screens (Fig. 2) are an all-glass touch screen with a transparent metallic conductive coating. An electrode pattern is printed along the edges which distributes a low voltage field over the conductive layer. When a finger touches the screen, a minute amount of current is induced to the point of contact, creating a voltage drop. The current flow from each corner is proportional to the distance to the touch point. The X/Y location of the point of contact is calculated by the controller and transmitted to the computer.

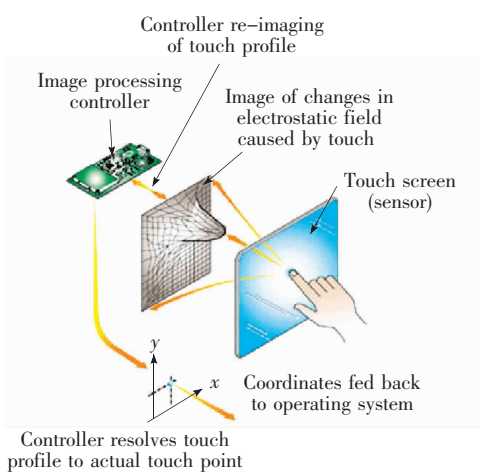

Fig. 2　Capacitive type TSP

2.3　IR type TSP

An array of vertical and horizontal sensors is used to detect an interruption of the IR rays above the surface of the screen. This solution is very durable but requires a very flat surface and is subject to frequent maintenance. It's used for large size screen.

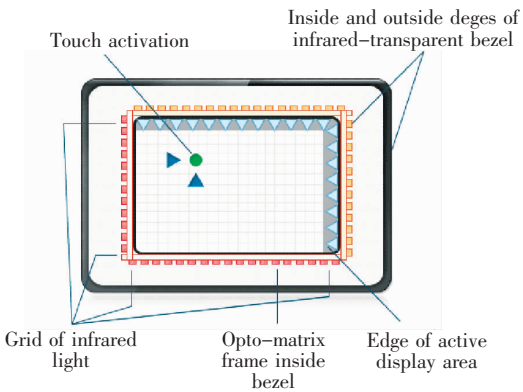

Fig. 3　IR type TSP

2.4　Surface acoustic wave type TSP

Ultrasonic waves pass over the touch sensor, so that when the screen is touched, a portion of the acoustic energy is absorbed. The position of the touch is then sent to the controller for processing. It is used on large screen panel.

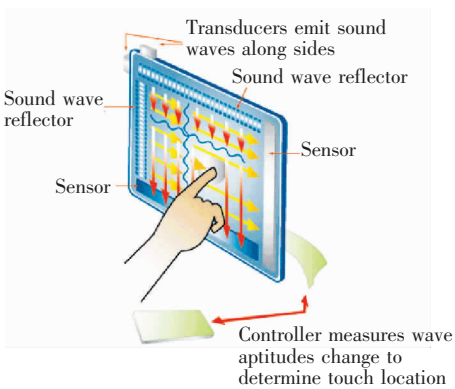

Fig. 4　Surface acoustic wave type TSP

2.5　Comparison of external type TSP

Comparison with external type TSP, projective-capacitive TSP technology is the most suitable for portable devices because of its multi-touch and durability. Resistive type touch panel technology are widely used because of its low cost, mature technology; SAW, IR will continue develop in

special area, especially for large size LCD panel.

3 Internal Type TSP

Touch panel embedded in LCD is called "Internal Touch Panel", the integration of TSP function enables devices to have better optical and mechanical performances since the upper TSP layers are removed and replaced by integrated sensor arrays. The various integration technologies for touch function have been introduced using optical[4], capacitive or resistive sensor arrays.

3.1 Optical sensor TSP

The photo sensor is integrated in the LCD panel based on the LTPS technology, and LCD panel could sense the luminance of outside. This type of TSP works by detecting the difference of current due to light intensity between touch and no-touch states [5]. The advantage of this sensor is that the sensitivity is prefect if the ambient light is kept in the appropriate level. However, its touch function is limited under a certain ambient light condition, and its aperture ratio for display drops significantly so as to need more power consumption. The simple concept diagram is shown in Fig. 5.

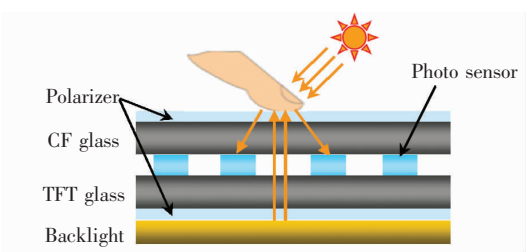

Fig. 5 Optical sensor type TSP

3.2 Capacitive sensor TSP [6]

The capacitive sensor (Fig. 6) is located between CF glass and CF polarizer as show in Fig. 6. If the finger is approached to the sensor pattern, the change of capacitance is generated, and the readout circuit of the sensor recognizes the changes. The patterning should be done on both side of CF glass. However, application is limited to small

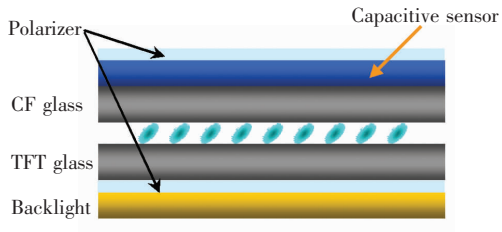

Fig. 6 Capacitive sensor TSP

size because of the small readout voltage.

3.3 Switch sensor TSP

In this method (Fig. 7), internal electrodes in the upper and lower glass are shorted by touch events, and the touch signal is sent to a readout IC. That method is very effective for sensing pen writing, however, sensitivity for finger touch events is not good enough.

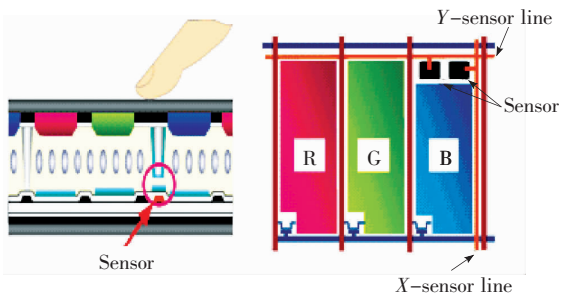

Fig. 7 Switch Sensor TSP

3.4 Hybrid TSP

In order to increase the sensing margin of conventional in-cell type TSPs, Samsung developed a new hybrid-type TSP [7], which can detect the change of both CLC and photo current at the same time. Fig. 8 shows the view of the proposed hybrid-type TSP.

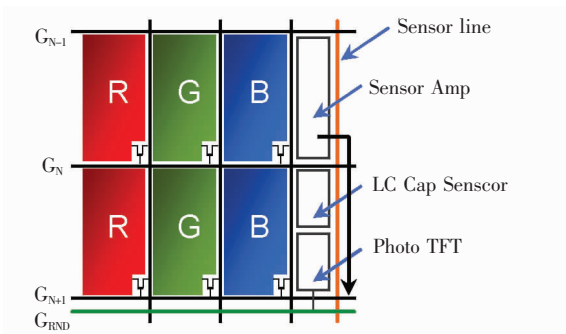

Fig. 8 Hybrid TSP

3.5 Resistive sensor TSP

In this technology the ITO layer is patterned on the backside of CF glass, and the other ITO film is faced to this CF glass. This technology can eliminate one glass, comparing to the external type resistive TSP.

4 Conclusion

Touch screens are used in various display and applications. External touch screen technology employs resistive, capacitive, surface acoustic wave and infrared methods. Resistive type external sensor was used extensively in the past. Recently, capacitive type touch sensor is popularly used. However, external type TSP requires an extra assembly with additional components, which causes higher cost, thicker size and a heavier module and reduces display brightness and result in the degradation of image quality.

Internal touch panel is proposed as a solution to these problems and would be the next generation of touch sensor because of its good mechanical and optical features. Within a few years, the integrated type touch technology will be the mainstream of the touch screen technology.

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作者更正

在《液晶与显示》2010 年第 3 期发表的《基于 PCI 总线的 COMS 图像传感器 OV6620 的驱动设计》一文，作者及单位信息应为：

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特此更正。

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