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(54) **LIQUID CRYSTAL DISPLAY PANEL AND LIQUID CRYSTAL DISPLAY APPARATUS AND 3D IMAGE SYSTEM**

(75) Inventors: **Chia-Chiang Hsiao**, Shenzhen (CN); **Chih-Wen Chen**, Shenzhen (CN)

(73) Assignee: **Shenzhen China Star Optoelectronics Technology Co., Ltd.**, Guangdong (CN)

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G02B 27/26 (2006.01)

(52) **U.S. Cl.**
CPC ***G02B 27/26*** (2013.01); ***G02F 1/133512*** (2013.01)

(58) **Field of Classification Search**
CPC G02B 27/26
USPC 349/15
See application file for complete search history.

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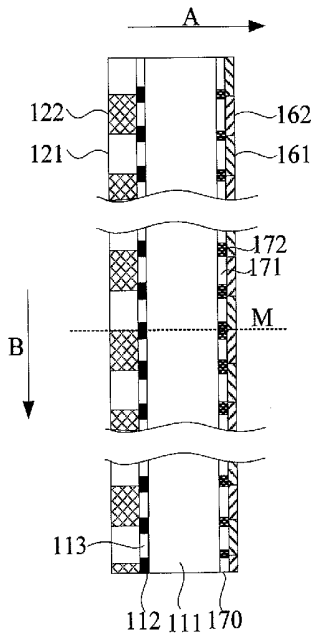
Primary Examiner — Michael Caley
Assistant Examiner — Edmond Lau
(74) *Attorney, Agent, or Firm* — Muncy, Geissler, Olds & Lowe, P.C.

(57) **ABSTRACT**

The present invention provides a liquid crystal display panel, a liquid crystal display apparatus and a 3D image system. The liquid crystal display panel comprises a patterned retarder and a shading film. The shading film includes a plurality of transparent units and a plurality of shading units arranged in an alternating manner, and the shading units are positioned between the first phase retarders and the second phase retarders, respectively. When the offset of the first phase retarders or the second phase retarders occurs, the shading unit can shade the deviated light rays.

11 Claims, 5 Drawing Sheets



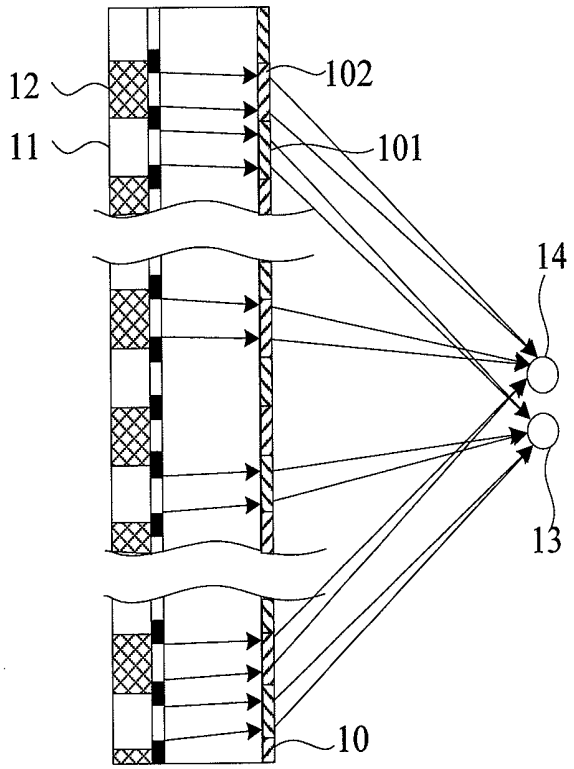


Fig.1

Prior Art

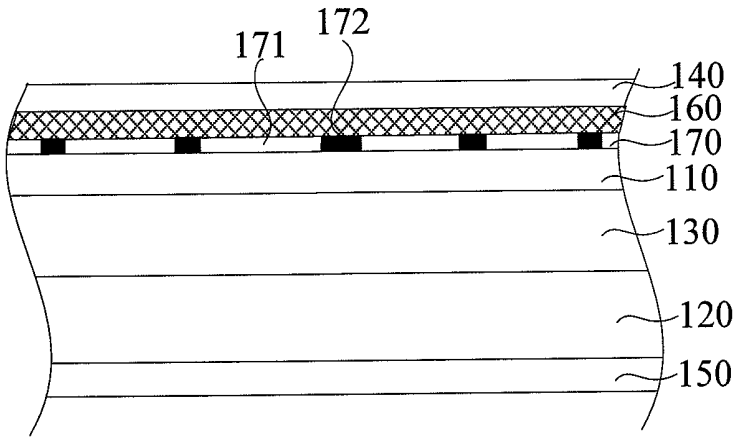


Fig.2

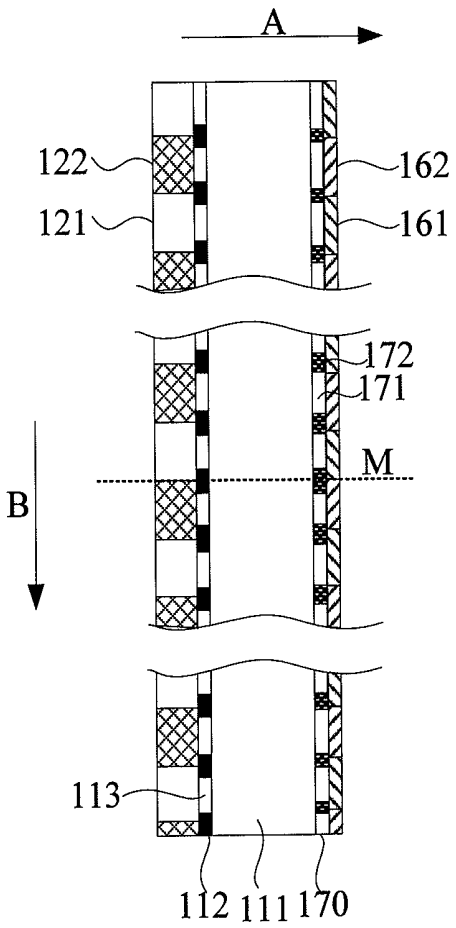


Fig.3

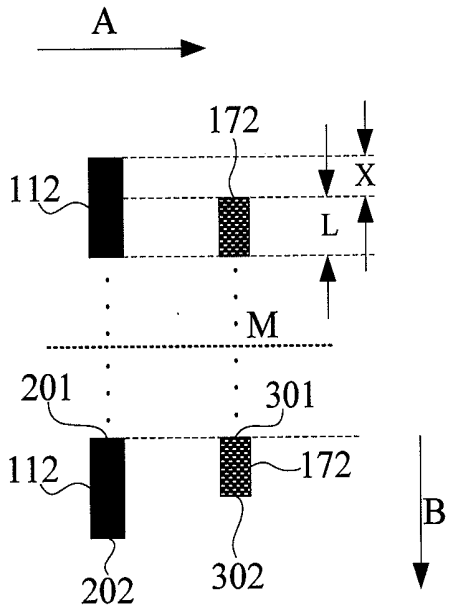


Fig.4

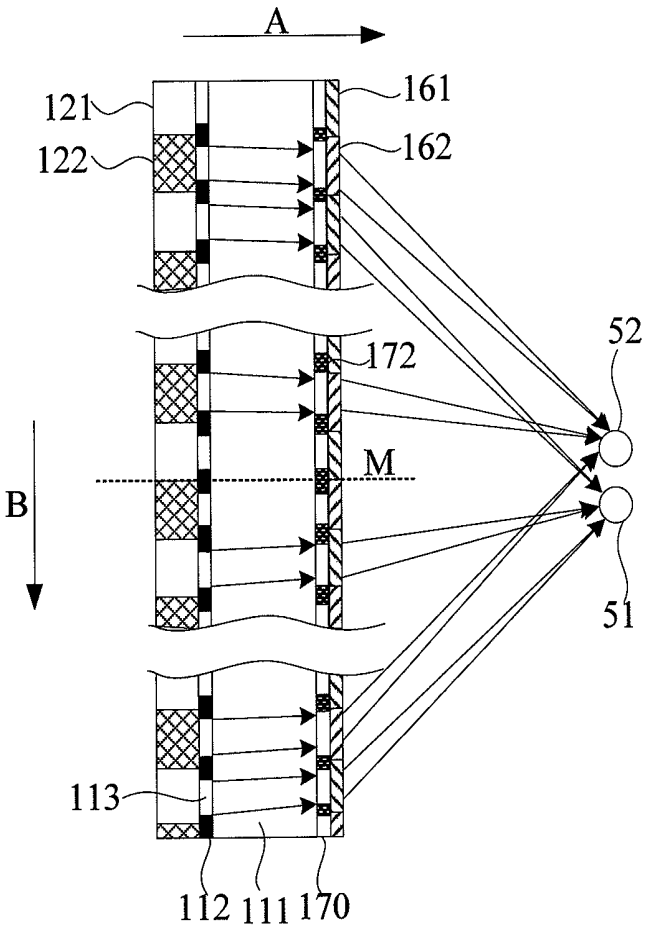


Fig.5

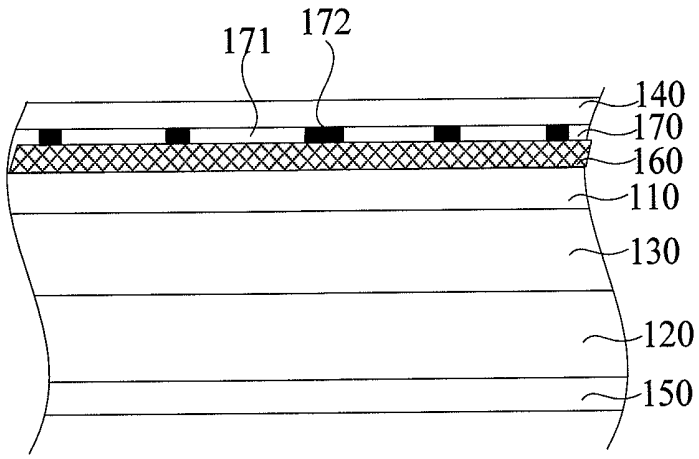

171
172
140
170
160
110
130
120
150

Fig.6

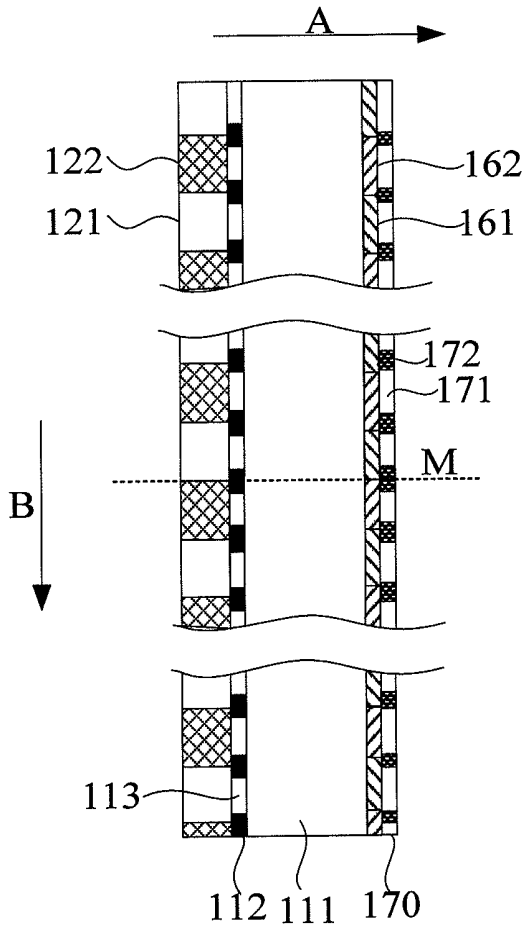

A
122
121
162
161
172
171
M
B
113
112
111
170

Fig.7

LIQUID CRYSTAL DISPLAY PANEL AND LIQUID CRYSTAL DISPLAY APPARATUS AND 3D IMAGE SYSTEM

FIELD OF THE INVENTION

The present invention relates to a field of a liquid crystal display technology, and more particularly to a liquid crystal display (LCD) panel, a liquid crystal display apparatus and a three-dimensional (3D) image system.

BACKGROUND OF THE INVENTION

Referring to FIG. **1**, pixel regions of a 3D LCD include left eye pixels **11** and right eye pixels **12**. A phase retarder **10** is bonded to an outer side of the 3D LCD, and the phase retarder **10** includes left eye phase retarders **101** and right eye phase retarders **102** corresponding to the left eye pixels **11** and the right eye pixels **12**, respectively. When boding the phase retarder **10**, a machine for bonding may have an allowable tolerance of about ±20 um. When the allowable tolerance occurs, for example, the right eye phase retarders **102** are shifted 20 um with respect to the right eye pixels **12**, and thus some light rays which passed through the right eye pixels **12** will be emitted to the left eye phase retarders **101**. As a result, a user's left eye **13** will view the images which correspond to the right eye **14**, resulting in an image crosstalk.

As a result, it is necessary to provide an LCD panel, an LCD apparatus and a 3D image system to solve the problems existing in the conventional technologies, as described above.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an LCD panel, so as to solve the image crosstalk problem resulting from the offset of the phase retarders.

For solving the above-mentioned problem, the present invention provides a liquid crystal display panel, and the liquid crystal display panel comprises: a first substrate including a black matrix and a plurality of color filters, wherein the color filters are arranged in the black matrix at intervals; a second substrate including a plurality of pixel regions corresponding to the color filters, wherein each of the pixel regions includes a left eye pixel region and a right eye pixel region; a liquid crystal layer disposed between the first substrate and the second substrate; a patterned retarder bonded to an outer side of the first substrate and including a plurality of first phase retarders corresponding to the left eye pixel regions and a plurality of second phase retarders corresponding to the right eye pixel regions, wherein the black matrix is positioned between the first phase retarders and the second phase retarders; a shading film disposed at the outer side of the first substrate and corresponding to the black matrix, wherein the shading film includes a plurality of transparent units and a plurality of shading units arranged in an alternating manner, and the shading units are positioned between the first phase retarders and the second phase retarders, respectively; wherein light rays are emitted along a light emitting direction and vertical to the second substrate, and a vertical direction is vertical to the light emitting direction and parallel to a longitudinal direction of the black matrix, and the first substrate has a midline parallel to the light emitting direction and passing through a center of the first substrate, and each of the shading units has a shading length along the vertical direction, and along the vertical direction, the shading length increases in accordance with an increase of a distance between each of the shading units and the midline; wherein, along the vertical direction, a length of the first phase retarders and the second phase retarders is less than a length of the left eye pixel regions and the right eye pixel regions corresponding thereto.

In one embodiment of the present invention, the shading film is disposed between the first substrate and the patterned retarder.

In one embodiment of the present invention, the shading film is disposed at an outer side of the patterned retarder.

In one embodiment of the present invention, each of black units of the black matrix has one first end close to the midline and another first end far away the midline, and each of the shading units has one second end close to the midline and another second end far away the midline, and along the light emitting direction, the first end of the black matrix and the second end of the corresponding shading unit are positioned on the same level.

In one embodiment of the present invention, along the vertical direction, there is an image distance between the another second end of the shading unit and the another first end of the black matrix.

Another object of the present invention is to provide an LCD panel, so as to solve the image crosstalk problem resulting from the offset of the phase retarders.

For solving the above-mentioned problem, the present invention provides a liquid crystal display panel, and the liquid crystal display panel comprises: a first substrate including a black matrix and a plurality of color filters, wherein the color filters are arranged in the black matrix at intervals; a second substrate including a plurality of pixel regions corresponding to the color filters, wherein each of the pixel regions includes a left eye pixel region and a right eye pixel region; a liquid crystal layer disposed between the first substrate and the second substrate; a patterned retarder bonded to an outer side of the first substrate and including a plurality of first phase retarders corresponding to the left eye pixel regions and a plurality of second phase retarders corresponding to the right eye pixel regions, wherein the black matrix is positioned between the first phase retarders and the second phase retarders; and a shading film disposed at the outer side of the first substrate and corresponding to the black matrix, wherein the shading film includes a plurality of transparent units and a plurality of shading units arranged in an alternating manner, and the shading units are positioned between the first phase retarders and the second phase retarders, respectively.

In one embodiment of the present invention, the shading film is disposed between the first substrate and the patterned retarder.

In one embodiment of the present invention, the shading film is disposed at an outer side of the patterned retarder.

In one embodiment of the present invention, light rays are emitted along a light emitting direction and vertical to the second substrate, and the first substrate has a midline parallel to the light emitting direction and passing through a center of the first substrate, and each of black units of the black matrix has one first end close to the midline and another first end far away the midline, and each of the shading units has one second end close to the midline and another second end far away the midline, and along the light emitting direction, the first end of the black matrix and the second end of the corresponding shading unit are positioned on the same level.

In one embodiment of the present invention, a vertical direction is vertical to the light emitting direction and parallel to a longitudinal direction of the black matrix, and along the vertical direction, there is an image distance between the another second end of the shading unit and the another first end of the black matrix.

In one embodiment of the present invention, each of the shading units has a shading length along the vertical direction, and along the vertical direction, the shading length increases in accordance with an increase of a distance between each of the shading units and the midline.

In one embodiment of the present invention, along the vertical direction, a length of the first phase retarders and the second phase retarders is less than a length of the left eye pixel regions and the right eye pixel regions corresponding thereto.

Still another object of the present invention is to provide an LCD apparatus, so as to solve the image crosstalk problem resulting from the offset of the phase retarders.

For solving the above-mentioned problem, the present invention provides a liquid crystal display apparatus comprising a backlight module and a liquid crystal display panel, wherein the liquid crystal display panel comprises: a first substrate including a black matrix and a plurality of color filters, wherein the color filters are arranged in the black matrix at intervals; a second substrate including a plurality of pixel regions corresponding to the color filters, wherein each of the pixel regions includes a left eye pixel region and a right eye pixel region; a liquid crystal layer disposed between the first substrate and the second substrate; a patterned retarder bonded to an outer side of the first substrate and including a plurality of first phase retarders corresponding to the left eye pixel regions and a plurality of second phase retarders corresponding to the right eye pixel regions, wherein the black matrix is positioned between the first phase retarders and the second phase retarders; and a shading film disposed at the outer side of the first substrate and corresponding to the black matrix, wherein the shading film includes a plurality of transparent units and a plurality of shading units arranged in an alternating manner, and the shading units are positioned between the first phase retarders and the second phase retarders, respectively.

In one embodiment of the present invention, the shading film is disposed between the first substrate and the patterned retarder.

In one embodiment of the present invention, the shading film is disposed at an outer side of the patterned retarder.

In one embodiment of the present invention, light rays are emitted along a light emitting direction and vertical to the second substrate, and the first substrate has a midline parallel to the light emitting direction and passing through a center of the first substrate, and each of black units of the black matrix has one first end close to the midline and another first end far away the midline, and each of the shading units has one second end close to the midline and another second end far away the midline, and along the light emitting direction, the first end of the black matrix and the second end of the corresponding shading unit are positioned on the same level.

In one embodiment of the present invention, a vertical direction is vertical to the light emitting direction and parallel to a longitudinal direction of the black matrix, and along the vertical direction, there is an image distance between the another second end of the shading unit and the another first end of the black matrix.

In one embodiment of the present invention, each of the shading units has a shading length along the vertical direction, and along the vertical direction, the shading length increases in accordance with an increase of a distance between each of the shading units and the midline.

In one embodiment of the present invention, along the vertical direction, a length of the first phase retarders and the second phase retarders is less than a length of the left eye pixel regions and the right eye pixel regions corresponding thereto.

Still another object of the present invention is to provide 3D image system, so as to solve the image crosstalk problem resulting from the offset of the phase retarders.

For solving the above-mentioned problem, the present invention provides a 3D image system comprising 3D glasses and a liquid crystal display apparatus, wherein the liquid crystal display apparatus comprises a backlight module and a liquid crystal display panel, and the liquid crystal display panel comprises: a first substrate including a black matrix and a plurality of color filters, wherein the color filters are arranged in the black matrix at intervals; a second substrate including a plurality of pixel regions corresponding to the color filters, wherein each of the pixel regions includes a left eye pixel region and a right eye pixel region; a liquid crystal layer disposed between the first substrate and the second substrate; a patterned retarder bonded to an outer side of the first substrate and including a plurality of first phase retarders corresponding to the left eye pixel regions and a plurality of second phase retarders corresponding to the right eye pixel regions, wherein the black matrix is positioned between the first phase retarders and the second phase retarders; and a shading film disposed at the outer side of the first substrate and corresponding to the black matrix, wherein the shading film includes a plurality of transparent units and a plurality of shading units arranged in an alternating manner, and the shading units are positioned between the first phase retarders and the second phase retarders, respectively.

By using the shading film disposed at the outer side of the first substrate, when the offset of the first phase retarders or the second phase retarders occurs, the shading unit of the shading film can shade the deviated light rays, thereby preventing the image crosstalk problem.

The structure and the technical means adopted by the present invention to achieve the above and other objects can be best understood by referring to the following detailed description of the preferred embodiments and the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view showing a conventional 3D image system;

FIG. **2** is a cross-sectional view showing a liquid crystal display panel according to a first preferred embodiment of the present invention;

FIG. **3** is a partially side view shown in FIG. **2**;

FIG. **4** illustrates a position relation between the black matrix and the shading units shown in FIG. **3**;

FIG. **5** is a schematic diagram showing an effect in FIG. **4**;

FIG. **6** is a cross-sectional view showing a liquid crystal display panel according to a second preferred embodiment of the present invention; and

FIG. **7** is a partially side view shown in FIG. **6**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following embodiments are referring to the accompanying drawings for exemplifying specific implementable embodiments of the present invention. Furthermore, directional terms described by the present invention, such as upper, lower, front, back, left, right, inner, outer, side and etc., are only directions by referring to the accompanying drawings, and thus the used directional terms are used to describe and understand the present invention, but the present invention is not limited thereto. In the drawings, structure-like elements are labeled with like reference numerals.

FIG. **2** is a cross-sectional view showing a liquid crystal display (LCD) panel according to a first preferred embodiment of the present invention.

Referring to FIG. **2** again, a cross-sectional view showing the LCD panel according to the first preferred embodiment of the present invention is illustrated. The LCD apparatus of the present embodiment can comprises the liquid crystal display panel **100** and a backlight module (not shown). The liquid crystal display panel **100** is disposed opposite to the backlight module, and the backlight module may be realized as a side lighting backlight module or a bottom lighting backlight module to provide the liquid crystal display panel **100** with the back-light.

Referring to FIG. **2** again, the liquid crystal display panel **100** may comprise a first substrate **110**, a second substrate **120**, a liquid crystal layer **130**, a first polarizer **140** and a second polarizer **150**, a patterned retarder **160** and a shading film **170**. The liquid crystal layer **130** is formed between the first substrate **110** and the second substrate **120**. That is, the liquid crystal layer **130** is positioned at inner sides of the first substrate **110** and the second substrate **120**. The first polarizer **140** is disposed at an outer side of the first substrate **110**, and the second polarizer **150** is disposed at an outer side of the second substrate **120**. In the present invention, the patterned retarder **160** is bonded to the outer side of the first substrate **110**, and the shading film **170** can be disposed between the patterned retarder **160** and the first substrate **110**.

Referring to FIG. **2**, the first substrate **110** and the second substrate **120** may be realized as glass substrates or flexible plastic substrates. The first substrate **110** may be a glass substrate or other material substrate with color filters (CF), and the second substrate **120** may be a glass substrate or other material substrate with a thin film transistor (TFT) array. It notes that the CF and the TFT array may also be disposed on the same substrate in other embodiments.

Referring to FIG. **3**, FIG. **3** is a partially side view of the liquid crystal display panel shown in FIG. **2**.

The second substrate **120** includes a plurality of signal lines (not shown), such as gate lines and data lines, which are arranged in a crisscross pattern, thereby forming a plurality of pixel regions. Each of the pixel regions includes a left eye pixel region **121** and right eye pixel region **122** shown in FIG. **3** for displaying different images corresponding to user's left and right eyes in a 3D display state.

The first substrate **110** includes a glass substrate **111**, a black matrix (BM) **112** and a plurality of color filters **113**, and the black matrix **112** and the color filters **113** are positioned on the same layer. The color filters **113** may be red filters (R), green filters (G) or blue filters (B). The color filters **113** are arranged in the black matrix **112** at intervals, and the color filters R, G, B correspond to the pixel regions of the second substrate **120**.

The patterned retarder **160** is bonded to the outer side of the first substrate **110**. More specifically, the patterned retarder **160** is bonded to an outer surface of the glass substrate **111** and includes a plurality of first phase retarders **161** and a plurality of second phase retarders **162**. The first phase retarders **161** correspond to the left eye pixel regions **121**, and the second phase retarders **162** correspond to the right eye pixel regions **122**. The black matrix **112** is positioned between the first phase retarders **161** and the second phase retarders **162**.

Referring to FIG. **2** and FIG. **3** again, the shading film **170** is disposed at the outer side of the first substrate **110**. More specifically, the shading film **170** is disposed between the first substrate **110** and the patterned retarder **160** and corresponding to the black matrix **112**. In this case, the shading film **170** includes a plurality of transparent units **171** and a plurality of shading units **172** arranged in an alternating manner. The shading units **172** are positioned between the first phase retarders **161** and the second phase retarders **162**, respectively. The material of the shading units **172** is preferably similar to the material of the black matrix **112**.

Referring to FIG. **3**, light rays are emitted along a light emitting direction A and vertical to the first substrate **110**. The first substrate **110** has a midline M parallel to the light emitting direction A and passing through a center of the first substrate **110**.

Referring to FIG. **4**, FIG. **4** illustrates a position relation between the black matrix **112** and the corresponding shading units **172**. Each of black units of the black matrix has one first end **201** close to the midline M and another first end **202** far away the midline M. Each of the shading units **172** has one second end **301** close to the midline M and another second end **302** far away the midline M. Along the light emitting direction A, the first end **201** of the black matrix **112** and the second end **301** of the corresponding shading unit **172** are positioned on the same level.

Referring to FIG. **3** and FIG. **4** again, a vertical direction B is vertical to the light emitting direction A and parallel to a longitudinal direction of the black matrix **112**. Along the vertical direction B, there is an image distance X between the second end **302** of the shading unit **172** and the corresponding first end **202** of the black matrix **112**, so as to allow the light rays to pass through.

Referring to FIG. **3** again, along the vertical direction B, the first phase retarders **161** and the second phase retarders **162** are shorter then the corresponding left eye pixel regions **121** and the corresponding right eye pixel regions **122**. A width of the first phase retarders **161** and the second phase retarders **162** is less then a width of the corresponding left eye pixel regions **121** and the corresponding right eye pixel regions **122**. For example, along the vertical direction B, the first phase retarder **161** may be shorter then the corresponding left eye pixel region **121** by 0.5 um.

Referring to FIG. **5**, a schematic diagram showing a process of using the liquid crystal display panel according to the first preferred embodiment shown in FIG. **2** to FIG. **4** is illustrated.

The light rays from the left eye pixel regions **121** can pass through the first phase retarders **161** and are emitted to a left eye **51**. The light rays from the right eye pixel regions **122** can pass through the second phase retarders **162** and are emitted to a right eye **52**. An offset may occur between the first phase retarders **161** and the second phase retarders **162**. For example, the second phase retarders **162** may be shifted to the first phase retarders **161**, and some light rays passed through the second phase retarders **162** may be emitted to the left eye **51**. At this time, the shading unit **172** can shade the deviated light rays, thereby preventing user's left eye **51** from viewing right eye images, i.e. preventing the image crosstalk problem.

FIG. **6** is a cross-sectional view showing a liquid crystal display panel according to a second preferred embodiment of the present invention. FIG. **7** is a partially side view of the liquid crystal display panel shown in FIG. **6**.

The difference between this embodiment and the first embodiment shown in FIG. **2** is that the shading film **170** shown in FIG. **6** is disposed at an outer side of the patterned retarder **160**. More specifically, the shading film **170** is disposed between the patterned retarder **160** and the first polarizer **140**. The shading film **170** includes the transparent units **171** and the shading units **172**, and the material of the shading units **172** is preferably similar to the material of the black matrix **112**.

The process of using the liquid crystal display panel according to the second preferred embodiment shown in FIG. **6** and FIG. **7** is similar to the first preferred embodiment shown in FIG. **2** to FIG. **4**, and is not mentioned for simplification.

The present invention further provides an LCD apparatus. The LCD apparatus comprises the LCD panel provided by the present invention. The present invention further provides a 3D image system comprising 3D glasses and the above-mentioned LCD panel, and is not mentioned for simplification.

By using the shading film disposed at the outer side of the first substrate, when the offset of the first phase retarders or the second phase retarders occurs, the shading unit can shade the deviated light rays, thereby preventing the image crosstalk problem.

The present invention has been described with a preferred embodiment thereof and it is understood that many changes and modifications to the described embodiment can be carried out without departing from the scope and the spirit of the invention that is intended to be limited only by the appended claims.

The inventiom claimed is:

1. A liquid crystal display panel, comprising:

a first substrate including a black matrix and a plurality of color filters, wherein the color filters are arranged in the black matrix at intervals;

a second substrate including a plurality of pixel regions corresponding to the color filters, wherein each of the pixel regions includes a left eye pixel region and a right eye pixel region;

a liquid crystal layer disposed between the first substrate and the second substrate;

a patterned retarder bonded to an outer side of the first substrate and including a plurality of first phase retarders corresponding to the left eye pixel regions and a plurality of second phase retarders corresponding to the right eye pixel regions, wherein the black matrix is positioned between the first phase retarders and the second phase retarders; and

a shading film disposed at the outer side of the first substrate and corresponding to the black matrix, wherein the shading film includes a plurality of transparent units and a plurality of shading units arranged in an alternating manner, and the shading units are positioned between the first phase retarders and the second phase retarders, respectively;

wherein a length of the first phase retarders and the second phase retarders is less than a length of the left eye pixel regions and the right eye pixel regions corresponding thereto.

2. The liquid crystal display panel according to claim **1**, wherein the shading film is disposed between the first substrate and the patterned retarder.

3. The liquid crystal display panel according to claim **1**, wherein the shading film is disposed at an outer side of the patterned retarder.

4. The liquid crystal display panel according to claim **1**, wherein light rays are emitted along a light emitting direction and vertical to the second substrate, and the first substrate has a midline parallel to the light emitting direction and passing through a center of the first substrate, and each of black units of the black matrix has one first end close to the midline and another first end far away the midline, and each of the shading units has one second end close to the midline and another second end far away the midline, and along the light emitting direction, the first end of the black matrix and the second end of the corresponding shading unit are positioned on the same level.

5. The liquid crystal display panel according to claim **4**, wherein a vertical direction is vertical to the light emitting direction and parallel to a longitudinal direction of the black matrix, and along the vertical direction, there is an image distance between the another second end of the shading unit and the another first end of the black matrix.

6. A liquid crystal display apparatus comprising a backlight module and a liquid crystal display panel, wherein the liquid crystal display panel comprises:

a first substrate including a black matrix and a plurality of color filters, wherein the color filters are arranged in the black matrix at intervals;

a second substrate including a plurality of pixel regions corresponding to the color filters, wherein each of the pixel regions includes a left eye pixel region and a right eye pixel region;

a liquid crystal layer disposed between the first substrate and the second substrate;

a patterned retarder bonded to an outer side of the first substrate and including a plurality of first phase retarders corresponding to the left eye pixel regions and a plurality of second phase retarders corresponding to the right eye pixel regions, wherein the black matrix is positioned between the first phase retarders and the second phase retarders; and

a shading film disposed at the outer side of the first substrate and corresponding to the black matrix, wherein the shading film includes a plurality of transparent units and a plurality of shading units arranged in an alternating manner, and the shading units are positioned between the first phase retarders and the second phase retarders, respectively;

wherein a length of the first phase retarders and the second phase retarders is less than a length of the left eye pixel regions and the right eye pixel regions corresponding thereto.

7. The liquid crystal display apparatus according to claim **6**, wherein the shading film is disposed between the first substrate and the patterned retarder.

8. The liquid crystal display apparatus according to claim **6**, wherein the shading film is disposed at an outer side of the patterned retarder.

9. The liquid crystal display apparatus according to claim **6**, wherein light rays are emitted along a light emitting direction and vertical to the second substrate, and the first substrate has a midline parallel to the light emitting direction and passing through a center of the first substrate, and each of black units of the black matrix has one first end close to the midline and another first end far away the midline, and each of the shading units has one second end close to the midline and another second end far away the midline, and along the light emitting direction, the first end of the black matrix and the second end of the corresponding shading unit are positioned on the same level.

10. The liquid crystal display apparatus according to claim **6**, wherein a vertical direction is vertical to the light emitting direction and parallel to a longitudinal direction of the black matrix, and along the vertical direction, there is an image distance between the another second end of the shading unit and the another first end of the black matrix.

11. A 3D image system comprising 3D glasses and a liquid crystal display apparatus, wherein the liquid crystal display apparatus comprises a backlight module and a liquid crystal display panel, and the liquid crystal display panel comprises:

a first substrate including a black matrix and a plurality of color filters, wherein the color filters are arranged in the black matrix at intervals;

a second substrate including a plurality of pixel regions corresponding to the color filters, wherein each of the pixel regions includes a left eye pixel region and a right eye pixel region;

a liquid crystal layer disposed between the first substrate and the second substrate;

a patterned retarder bonded to an outer side of the first substrate and including a plurality of first phase retarders corresponding to the left eye pixel regions and a plurality of second phase retarders corresponding to the right eye pixel regions, wherein the black matrix is positioned between the first phase retarders and the second phase retarders; and

a shading film disposed at the outer side of the first substrate and corresponding to the black matrix, wherein the shading film includes a plurality of transparent units and a plurality of shading units arranged in an alternating manner, and the shading units are positioned between the first phase retarders and the second phase retarders, respectively;

wherein a length of the first phase retarders and the second phase retarders is less than a length of the left eye pixel regions and the right eye pixel regions corresponding thereto.

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专利名称(译)	液晶显示面板和液晶显示装置以及3D图像系统		
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[标]申请(专利权)人(译)	萧嘉CHIANG 陈致文		
申请(专利权)人(译)	萧嘉CHIANG CHEN，CHIH-WEN		
当前申请(专利权)人(译)	深圳市中国星光电科技有限公司.		
[标]发明人	HSIAO CHIA CHIANG CHEN CHIH WEN		
发明人	HSIAO, CHIA-CHIANG CHEN, CHIH-WEN		
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摘要(译)

本发明提供一种液晶显示面板，液晶显示装置和3D图像系统。液晶显示面板包括图案化延迟器和遮光膜。遮光膜包括多个透明单元和多个以交替方式布置的遮光单元，遮光单元分别位于第一相位延迟器和第二相位延迟器之间。当第一相位延迟器或第二相位延迟器的偏移发生时，阴影单元可以遮蔽偏离的光线。