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(54) **DRIVING METHOD FOR A LIQUID CRYSTAL DISPLAY WITH TRI-GATE DRIVING ARCHITECTURE**

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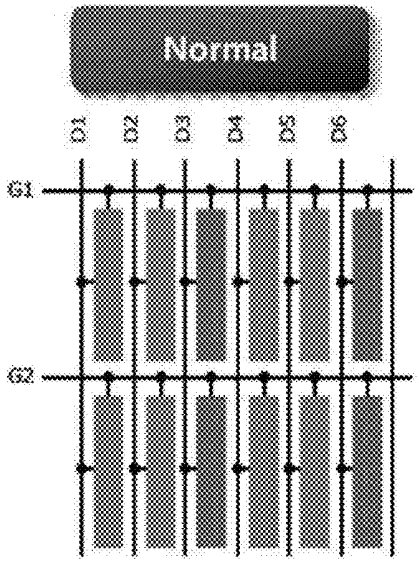
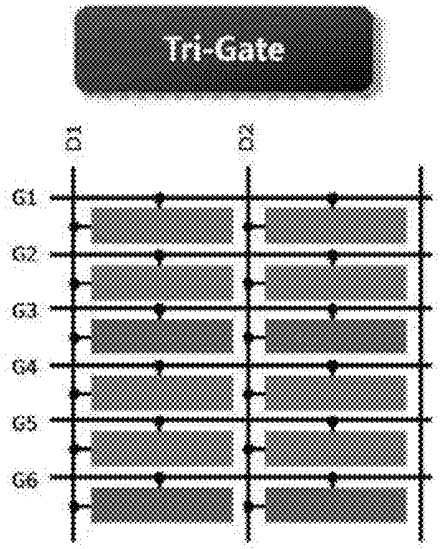
(57) **ABSTRACT**

The present invention provides a driving method for a liquid crystal display with Tri-gate driving architecture. The liquid crystal display with Tri-gate driving architecture comprises a plurality of sub-pixels in an array arrangement. The sub-pixels comprise red sub-pixels, green sub-pixels and blue sub-pixels. Each sub-pixel is electrically connected to a scanning line and a data line. The sub-pixels of each column are arranged from top to bottom according to a preset sub-pixel-color order. Color of the sub-pixels in each row is the same. The driving is orderly carried out with interval of **3**N columns, and N is a natural number larger than 1. When driving each **3**N columns interval, from top to bottom, the sub-pixels of the N rows with a first color are continuously driven first, then the sub-pixels of the N rows with a second color are continuously driven, and finally the sub-pixels of the N rows with a third color are continuously driven. The driving method for a liquid crystal display with Tri-gate driving architecture of the present invention can enhance the charging rate of the single-colored images and eliminate the color shift and display unevenness caused by insufficient pixel charging.





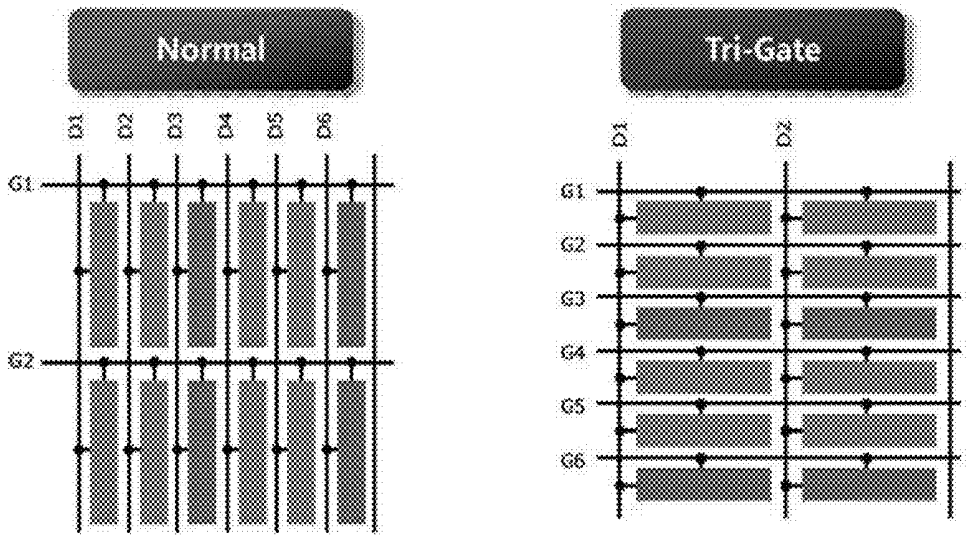

Normal
Tri-Gate
D1
D2
D3
D4
D5
D6
G1
G2
G3
G4
G5
G6

FIG. 1

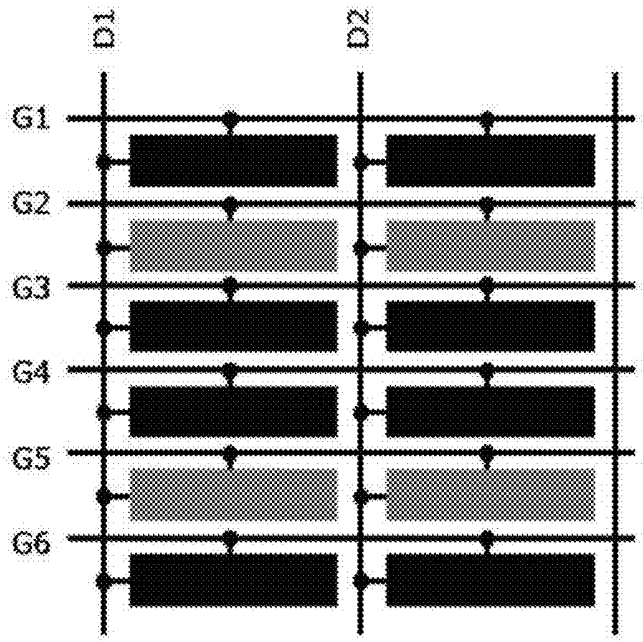

D1
D2
G1
G2
G3
G4
G5
G6

FIG. 2

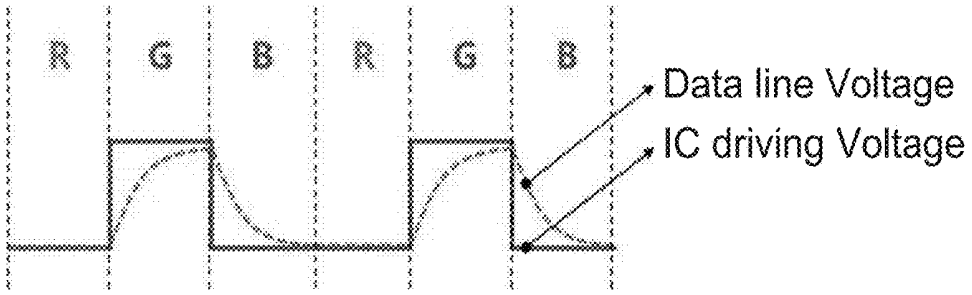

R
G
B
R
G
B
Data line Voltage
IC driving Voltage

FIG. 3

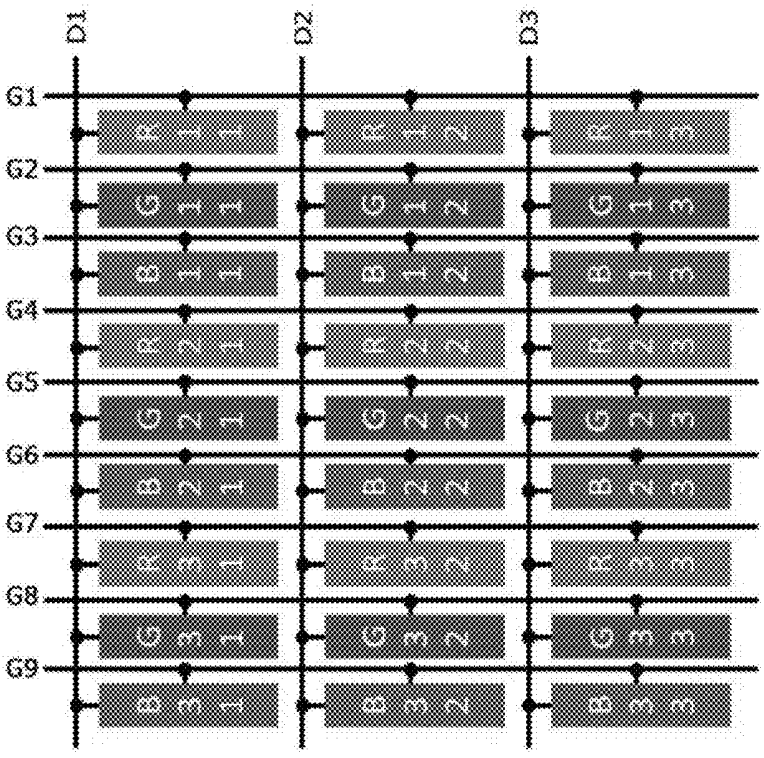

D1
D2
D3
G1
G2
G3
G4
G5
G6
G7
G8
G9

FIG. 4

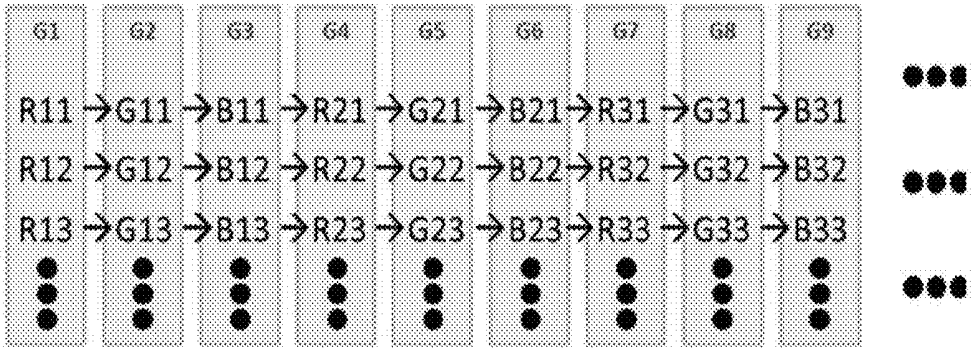


FIG. 5

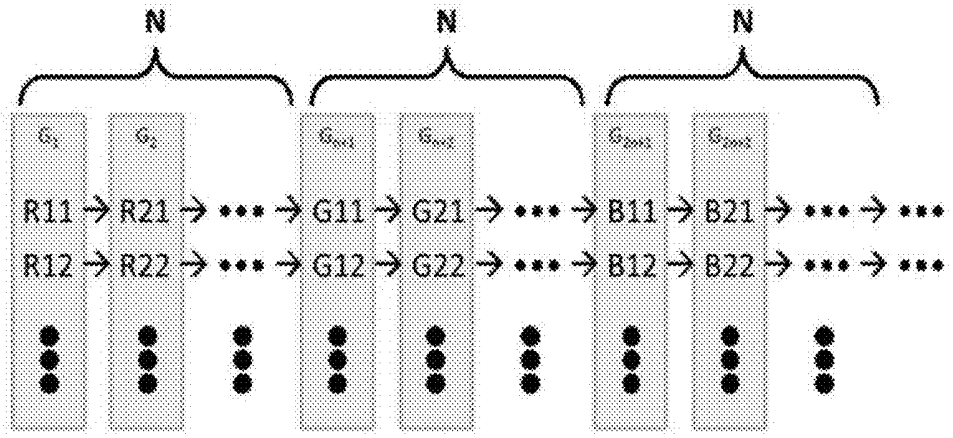


FIG. 6

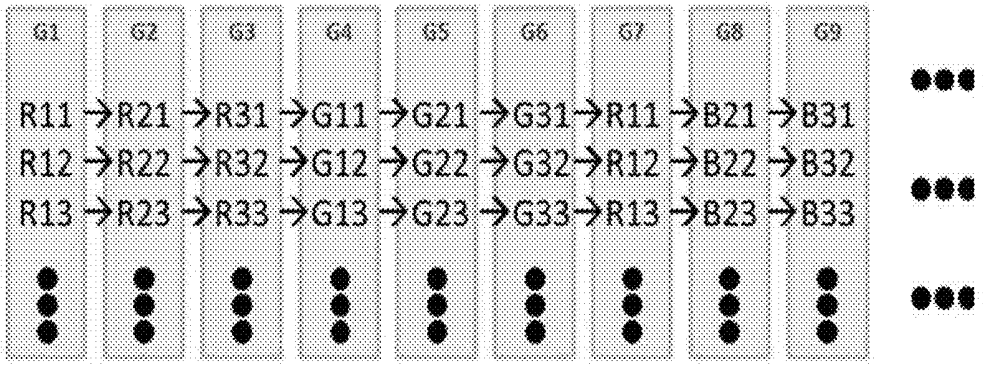


FIG. 7

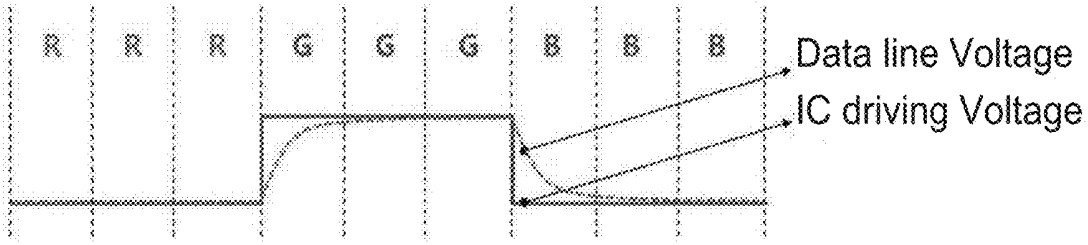

R
R
R
G
G
G
B
B
B
Data line Voltage
IC driving Voltage

FIG. 8

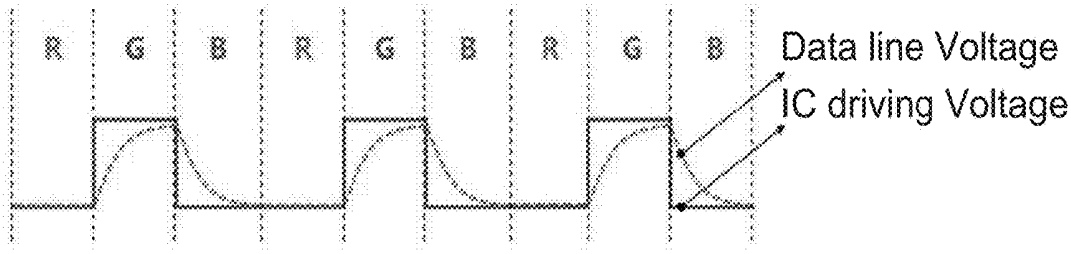

R
G
B
R
G
B
R
G
B
Data line Voltage
IC driving Voltage

FIG. 9

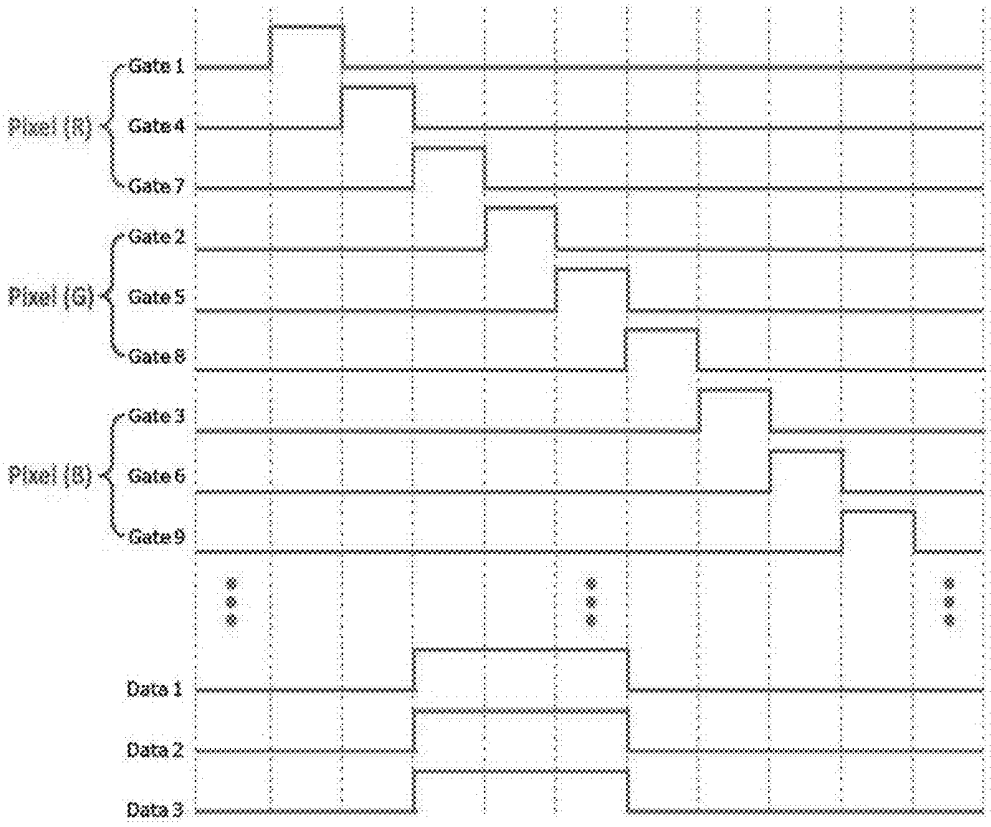

Pixel (R)
Gate 1
Gate 4
Gate 7
Pixel (G)
Gate 2
Gate 5
Gate 8
Pixel (B)
Gate 3
Gate 6
Gate 9
Data 1
Data 2
Data 3

FIG. 10

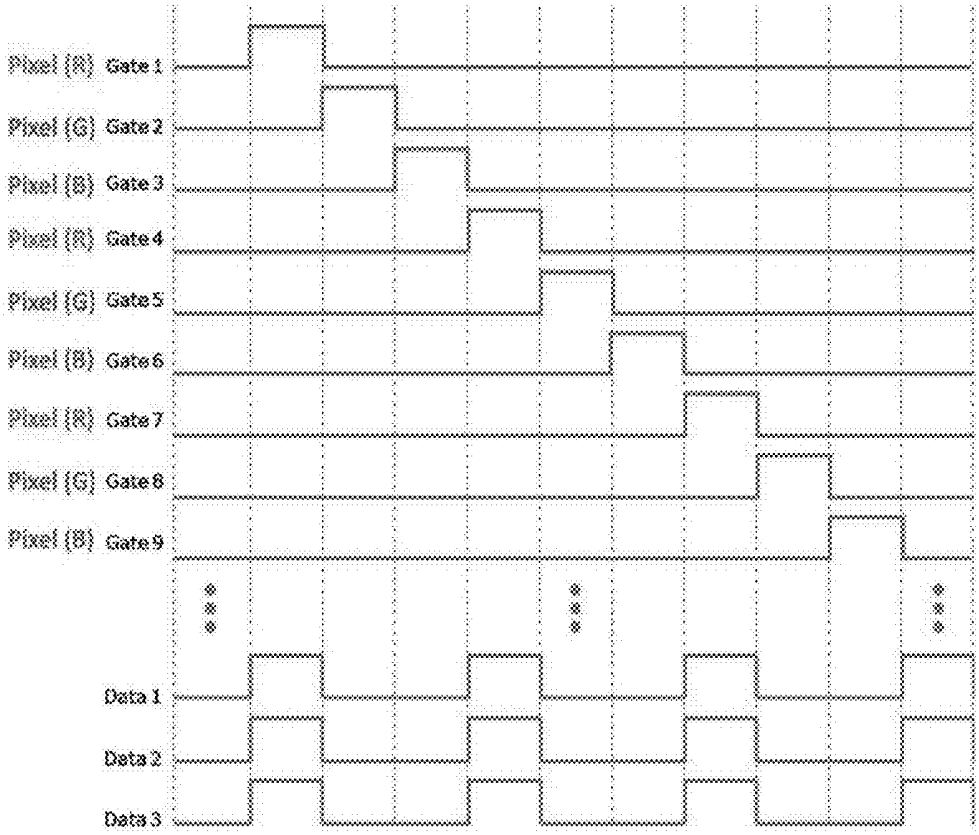

Pixel (R) Gate 1
Pixel (G) Gate 2
Pixel (B) Gate 3
Pixel (R) Gate 4
Pixel (G) Gate 5
Pixel (B) Gate 6
Pixel (R) Gate 7
Pixel (G) Gate 8
Pixel (B) Gate 9
Data 1
Data 2
Data 3

FIG. 11

DRIVING METHOD FOR A LIQUID CRYSTAL DISPLAY WITH TRI-GATE DRIVING ARCHITECTURE

BACKGROUND OF THE INVENTION

Field of Invention

[0001] The present invention relates to the field of liquid crystal display, and more particularly to a driving method for a liquid crystal display with Tri-gate driving architecture.

Description of Prior Art

[0002] LCDs are currently the most widely used flat panel displays, has gradually become a variety of electronic devices such as mobile phones, personal digital assistants (PDA), digital camera, computer screen or laptop screen is widely used with high-resolution color screen monitor. Currently liquid crystal displays commonly used, usually the upper and lower liquid crystal substrate and the intermediate layer, the substrate has a composition of glass and the electrode. If the upper and lower substrates both have display electrodes may be formed of the longitudinal electric field mode, such as Twist Nematic (TN) mode, Vertical Alignment (VA) mode, and Multi-domain Vertical Alignment (MVA) mode developed for solving an over-narrow viewing angle. Another type different from said display device, the electrode only on one side of the substrate, a transverse electric field mode display, such as IPS (In-plane switching, in-plane switching) mode, Fringe Field Switching (FFS) mode.

[0003] FIG. **1** shows two driving architecture diagrams commonly used in the conventional LCD display, the left side is a normal driving architecture; the right side is a Tri-gate driving architecture. The schematic diagrams of the two driving architecture contains the same number of RGB sub-pixels, the scanning lines G**1**, G**2** . . . are on the horizontal direction, the data lines D**1**, D**2** . . . are on the vertical direction. In the Tri-gate driving architecture, the number of data lines is reduced to ⅓ of the normal driving architecture, and the number of Gate lines increases by three times to the normal driving architecture, then, the data chip on film (Data-COF) of the Tri-gate driving architecture is reduced to ⅓ of the Normal driving architecture, and the width and charge time of each gate pulse are reduced to ⅓ of the Normal driving architecture.

[0004] FIG. **2** shows a schematic drawing of a single-colored image of the Tri-gate driving architecture, only the green (G) sub-pixels are driven, the green single-colored image is displayed.

[0005] When the single-colored image is shown in FIG. **2**, the driving waveform of the Tri-gate driving architecture is shown in FIG. **3**. Since the voltage of the Data line is always in variation status between high and low, the single-colored image is a re-loading image for the Tri-gate driving architecture, the charge capacity of pixels is very poor, in other words, the pixels are easy to charge insufficient, resulting in poor image display and reducing the display quality.

[0006] FIG. **4** is a schematic drawing showing a connection pattern of the pixels of the conventional liquid crystal display. According to the connection method shown in FIG. **4**, a plurality of sub-pixels are arranged in an array including red sub-pixel R, green sub-pixel G, and blue sub-pixel B Each sub-pixel electrically connecting a scanning line and a data line. The red sub-pixel R, the green sub-pixel and the blue sub-pixel B in each column of the sub-pixel are alternately arranged in a repeating order. Each column of the sub-pixel is the sub-pixels with the same color. Each complete pixel includes one red sub-pixel R, one green sub-pixel G and one blue sub-pixel B, such as the sub-pixels R**11**, G**11** and B**11** form one complete pixel.

[0007] FIG. **5** is an illustrative diagram of the liquid crystal display shown in FIG. **4** with applying a conventional driving method, the driving method from top to bottom is (RGB)→(RGB)→(RGB) . . . , that is, the scanning lines G**1**, G**2**, G**3** are opened orderly, being driven with this cycle. The pixels of the same raw are driven with the same way. When the single-colored image is displayed, the driving waveform is shown as FIG. **3**. The data lines are driven by the IC driving voltage provided by the data driver IC. Since the voltage on the data lines are always in the variation status between high and low, the single-colored image is a re-loading image for the Tri-gate driving architecture, the charge capacity of pixels is very poor, and in other words, the pixels are easy to charge insufficient, resulting in poor image display and reducing the display quality.

SUMMARY OF THE INVENTION

[0008] Hence, the objective of the present invention is to provide a driving method for a liquid crystal display with Tri-gate driving architecture, to enhance the charging rate of single-colored images.

[0009] In order to achieve the objective, the present invention provides a driving method for a liquid crystal display with Tri-gate driving architecture. The liquid crystal display with Tri-gate driving architecture comprises a plurality of sub-pixels in an array arrangement. The sub-pixels comprise red sub-pixels, green sub-pixels and blue sub-pixels. Each sub-pixel is electrically connected to a scanning line and a data line. The sub-pixels of each column are arranged from top to bottom according to a preset sub-pixel-color order. Color of the sub-pixels in each row is the same. The driving is orderly carried out with interval of 3N columns, and N is a natural number larger than 1. When driving each 3N columns interval, from top to bottom, the sub-pixels of the N rows with a first color are continuously driven first, then the sub-pixels of the N rows with a second color are continuously driven, and finally the sub-pixels of the N rows with a third color are continuously driven.

[0010] Wherein the preset sub-pixel-color order is the red sub-pixel, the green sub-pixel and the blue sub-pixel, from top to bottom.

[0011] Wherein the preset sub-pixel-color order is the red sub-pixel, the blue sub-pixel and the green sub-pixel, from top to bottom.

[0012] Wherein the preset sub-pixel-color order is the green sub-pixel, the red sub-pixel and the blue sub-pixel, from top to bottom.

[0013] Wherein the preset sub-pixel-color order is the green sub-pixel, the blue sub-pixel and the red sub-pixel, from top to bottom.

[0014] Wherein the preset sub-pixel-color order is the blue sub-pixel, the green sub-pixel and the red sub-pixel, from top to bottom.

[0015] Wherein the preset sub-pixel-color order is the blue sub-pixel, the red sub-pixel and the green sub-pixel, from top to bottom.

[0016] Wherein the N is equal to 2.

[0017] Wherein the N is equal to 3.

[0018] Wherein the N is equal to 4.

[0019] In order to achieve the objective, the present invention provides a driving method for a liquid crystal display with Tri-gate driving architecture. The liquid crystal display with Tri-gate driving architecture comprises a plurality of sub-pixels in an array arrangement. The sub-pixels comprise red sub-pixels, green sub-pixels and blue sub-pixels. Each sub-pixel is electrically connected to a scanning line and a data line. The sub-pixels of each column are arranged from top to bottom according to a preset sub-pixel-color order. Color of the sub-pixels in each row is the same. The driving is orderly carried out with interval of 3N columns, and N is a natural number larger than 1. When driving each 3N columns interval, from top to bottom, the sub-pixels of the N rows with a first color are continuously driven first, then the sub-pixels of the N rows with a second color are continuously driven, and finally the sub-pixels of the N rows with a third color are continuously driven.

[0020] Wherein the preset sub-pixel-color order is the red sub-pixel, the green sub-pixel and the blue sub-pixel, from top to bottom.

[0021] Wherein the N is equal to 3.

[0022] Summary, the driving method for a liquid crystal display with Tri-gate driving architecture of the present invention can enhance the charging rate of the single-colored images and eliminate the color shift and display unevenness caused by insufficient pixel charging.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] For better understanding the technical proposals and other beneficial effects of the present invention, please refer the following detailed description of the present invention with the accompanying drawings.

[0024] FIG. **1** shows two driving architecture diagrams commonly used in the conventional LCD display.

[0025] FIG. **2** shows a schematic drawing of a single-colored image of the Tri-gate driving architecture.

[0026] FIG. **3** shows an illustrative diagram of the driving waveform when the Tri-gate driving architecture displays the single-colored images.

[0027] FIG. **4** is a schematic drawing showing a connection pattern of the pixels of the conventional liquid crystal display.

[0028] FIG. **5** is an illustrative diagram of the liquid crystal display shown in FIG. **4** with applying a conventional driving method.

[0029] FIG. **6** is an illustrative diagram of the liquid crystal display shown in FIG. **4** with applying a driving method according to the present invention.

[0030] FIG. **7** is an illustrative diagram of one preferred embodiment according to a driving method for a liquid crystal display with Tri-gate driving architecture of the present invention.

[0031] FIG. **8** shows an illustrative diagram of the driving waveform of the single-colored images according to the embodiment of FIG. **7**.

[0032] FIG. **9** shows an illustrative diagram of the driving waveform of the single-colored images while applying the conventional driving method.

[0033] FIG. **10** is a driving time-domain diagram of the single-colored image according to the embodiment of FIG. **7**.

[0034] FIG. **11** is a driving time-domain diagram of the single-colored image while applying the conventional driving method.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0035] The same as the conventional art, the connection method of the pixels of the liquid crystal display of the present invention is also shown in FIG. **4**, and the inventive point of the present invention is a driving method for the liquid crystal display.

[0036] FIG. **6** is an illustrative diagram of the liquid crystal display shown in FIG. **4** with applying a driving method according to the present invention. From top to bottom, the driving method is (RR . . .)→(GG . . .)→(BB . . .)→ . . . . The N scanning lines corresponding to the red sub-pixels R are opened, the N scanning lines corresponding to the green sub-pixel G are opened and the N scanning lines of corresponding to the blue sub-pixel B are opened. The driving method for the pixels of the same column is the same with this cycle. The present invention provides a driving method for a liquid crystal display with Tri-gate driving architecture in which N red sub-pixels R, N green sub-pixels G and N blue sub-pixels B are successively driven, when the single-colored image is displayed, to enhance the charging rate of the single-colored images and to eliminate the color shift and display unevenness caused by insufficient pixel charging.

[0037] The liquid crystal display of the driving method for a liquid crystal display with Tri-gate driving architecture comprises a plurality of sub-pixels in an array arrangement. The sub-pixels comprise red sub-pixels R, green sub-pixels G and blue sub-pixels B. Each sub-pixel is electrically connected to a scanning line and a data line. The sub-pixels of each column are arranged from top to bottom according to a preset sub-pixel-color order. The order is random, such as R, B, R, B . . . or R, B, R, B, G . . . , color of the sub-pixels in each row are the same. The driving is orderly carried out with interval of 3N columns, and N is a natural number larger than 1. When driving each 3N columns interval, from top to bottom, the sub-pixels of the N rows with a first color are continuously driven first, then the sub-pixels of the N rows with a second color are continuously driven, and finally the sub-pixels of the N rows with a third color are continuously driven, to open the scanning lines at the corresponding columns. According to the quest, the N can be selected as 2, 3, 4, 5 . . . etc.

[0038] FIG. **7** is an illustrative diagram of one preferred embodiment according to a driving method for a liquid crystal display with Tri-gate driving architecture of the present invention. From top to bottom, the driving method is (RRR)→(GGG)→(BBB)→ . . . . That is, the N is equal to three, the driving method is performed according to an interval of 3×3 columns, the three scanning lines corresponding to the red sub-pixels R are opened, the three scanning lines corresponding to the green sub-pixel G are opened and the three scanning lines of corresponding to the blue sub-pixel B are opened, the corresponding scanning lines are opened. The driving method for the pixels of the same column of the array arrangement is the same with this cycle. The present invention provides a driving method for a liquid crystal display with Tri-gate driving architecture in which three red sub-pixels R, three green sub-pixels G and

three blue sub-pixels B are successively driven, when the single-colored image is displayed.

[0039] FIG. **8** shows an illustrative diagram of the driving waveform of the single-colored images according to the embodiment of FIG. **7**. FIG. **9** shows an illustrative diagram of the driving waveform of the single-colored images while applying the conventional driving method. Compared the FIG. **8** and the FIG. **9**, when applying the driving method of the present invention to a single-colored image, three pixels G can be continuously driven, and the charging rate of the latter two pixels G pixels is greatly improved, and the charging rate of the latter two pixels B pixels is greatly improved. It can reduce the IC load, enhance the charging rate of the single-colored images and eliminate the color shift and display unevenness caused by insufficient pixel charging.

[0040] FIG. **10** is a driving time-domain diagram of the single-colored image according to the embodiment of FIG. **7**. As a comparison, FIG. **11** is a driving time-domain diagram of the single-colored image while applying the conventional driving method. In the conventional driving method, the scanning lines G**1**, G**2**, G**3**, . . . are sequentially opened in the order according to the original scanning lines, and in the driving method of the present invention, in order to continuously drive the single-colored pixels, the connection pattern corresponding to the liquid crystal display pixels, the scanning lines are opened in the order of G**1**, G**4**, G**7**, G**2**, G**5**, G**8**, G**3**, G**6**, G**9**, so that the data lines can continuously charge the three single-colored pixels of the same color to enhance the charging rate of the single-colored image.

[0041] In summary, the driving method for a liquid crystal display with Tri-gate driving architecture of the present invention can enhance the charging rate of the single-colored images and to eliminate the color shift and display unevenness caused by insufficient pixel charging.

[0042] As mentioned above, those of ordinary skill in the art, without departing from the spirit and scope of the present disclosure, can make various kinds of modifications and variations to the present disclosure. Therefore, all such modifications and variations are intended to be included in the protection scope of the appended claims of the present invention.

What is claimed is:

1. A driving method for a liquid crystal display with Tri-gate driving architecture, the liquid crystal display with Tri-gate driving architecture comprising a plurality of sub-pixels in an array arrangement, the sub-pixels comprising red sub-pixels, green sub-pixels and blue sub-pixels, each sub-pixel being electrically connected to a scanning line and a data line, the sub-pixels of each column are arranged from top to bottom according to a preset sub-pixel-color order, color of the sub-pixels in each row being the same; the driving is orderly carried out with interval of 3N columns, and N being a natural number larger than 1, when driving each 3N columns interval, from top to bottom, the sub-pixels of the N rows with a first color being continuously driven first, then the sub-pixels of the N rows with a second color being continuously driven, and finally the sub-pixels of the N rows with a third color being continuously driven.

2. The driving method for a liquid crystal display with Tri-gate driving architecture according to claim **1**, wherein the preset sub-pixel-color order is the red sub-pixel, the green sub-pixel and the blue sub-pixel, from top to bottom.

3. The driving method for a liquid crystal display with Tri-gate driving architecture according to claim **1**, wherein the preset sub-pixel-color order is the red sub-pixel, the blue sub-pixel and the green sub-pixel, from top to bottom.

4. The driving method for a liquid crystal display with Tri-gate driving architecture according to claim **1**, wherein the preset sub-pixel-color order is the green sub-pixel, the red sub-pixel and the blue sub-pixel, from top to bottom.

5. The driving method for a liquid crystal display with Tri-gate driving architecture according to claim **1**, wherein the preset sub-pixel-color order is the green sub-pixel, the blue sub-pixel and the red sub-pixel, from top to bottom.

6. The driving method for a liquid crystal display with Tri-gate driving architecture according to claim **1**, wherein the preset sub-pixel-color order is the blue sub-pixel, the green sub-pixel and the red sub-pixel, from top to bottom.

7. The driving method for a liquid crystal display with Tri-gate driving architecture according to claim **1**, wherein the preset sub-pixel-color order is the blue sub-pixel, the red sub-pixel and the green sub-pixel, from top to bottom.

8. The driving method for a liquid crystal display with Tri-gate driving architecture according to claim **1**, wherein the N is equal to 2.

9. The driving method for a liquid crystal display with Tri-gate driving architecture according to claim **1**, wherein the N is equal to 3.

10. The driving method for a liquid crystal display with Tri-gate driving architecture according to claim **1**, wherein the N is equal to 4.

11. A driving method for a liquid crystal display with Tri-gate driving architecture, the liquid crystal display with Tri-gate driving architecture comprising a plurality of sub-pixels in an array arrangement, the sub-pixels comprising red sub-pixels, green sub-pixels and blue sub-pixels, each sub-pixel being electrically connected to a scanning line and a data line, the sub-pixels of each column are arranged from top to bottom according to a preset sub-pixel-color order, color of the sub-pixels in each row being the same; the driving is orderly carried out with interval of 3N columns, and a N being a natural number larger than 1, when driving each 3N columns interval, from top to bottom, the sub-pixels of the N rows with a first color being continuously driven first, then the sub-pixels of the N rows with a second color being continuously driven, and finally the sub-pixels of the N rows with a third color being continuously driven;

wherein the preset sub-pixel-color order is the red sub-pixel, the green sub-pixel and the blue sub-pixel, from top to bottom;

wherein the N is equal to 3.

* * * * *

专利名称(译)	具有三栅极驱动结构的液晶显示器的驱动方法		
公开(公告)号	US20180308437A1	公开(公告)日	2018-10-25
申请号	US15/539691	申请日	2017-05-18
[标]申请(专利权)人(译)	深圳市华星光电技术有限公司		
申请(专利权)人(译)	深圳市中国星光电科技有限公司.		
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	HAO SIKUN		
发明人	HAO, SIKUN		
IPC分类号	G09G3/36 G02F1/133		
CPC分类号	G09G3/3607 G02F1/13306 G09G3/3648		
优先权	201710249940.8 2017-04-17 CN		
外部链接	Espacenet USPTO		

摘要(译)

本发明提供一种具有三栅极驱动结构的液晶显示器的驱动方法。具有三栅极驱动架构的液晶显示器包括阵列布置的多个子像素。子像素包括红色子像素，绿色子像素和蓝色子像素。每个子像素电连接到扫描线和数据线。每列的子像素根据预设的子像素颜色顺序从上到下排列。每行中的子像素的颜色是相同的。以 3 N列的间隔有序地进行驱动，并且N是大于1的自然数。当从上到下驱动每个 3 N列的间隔时，首先连续驱动具有第一颜色的N行的子像素，然后连续驱动具有第二颜色的N行的子像素，最后连续驱动具有第三颜色的N行的子像素驱动。本发明的具有三栅极驱动结构的液晶显示器的驱动方法可以提高单色图像的充电率，并消除由像素充电不足引起的色移和显示不均匀。