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(54) **LIQUID CRYSTAL DISPLAY AND METHOD OF CONTROLLING THE SAME**

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See application file for complete search history.

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Primary Examiner — Lun-Yi Lao

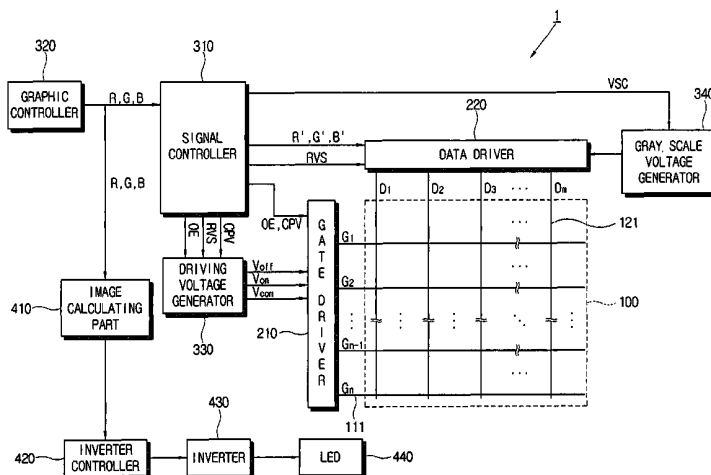
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(57) **ABSTRACT**

A liquid crystal display and control method thereof, having a liquid crystal display panel, a light emitting diode device which is disposed on the rear of the liquid crystal display panel and which is divided into a plurality of partitioned areas that are capable of being driven independently, a light guide part disposed for each of the partitioned areas, an image calculating part for dividing the liquid crystal display panel into a plurality of regions and calculating the brightness of each region by using image data, and an inverter and an inverter controller to provide differentiated power to the partitioned areas based on the calculated brightness.

28 Claims, 12 Drawing Sheets



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FIG. 1

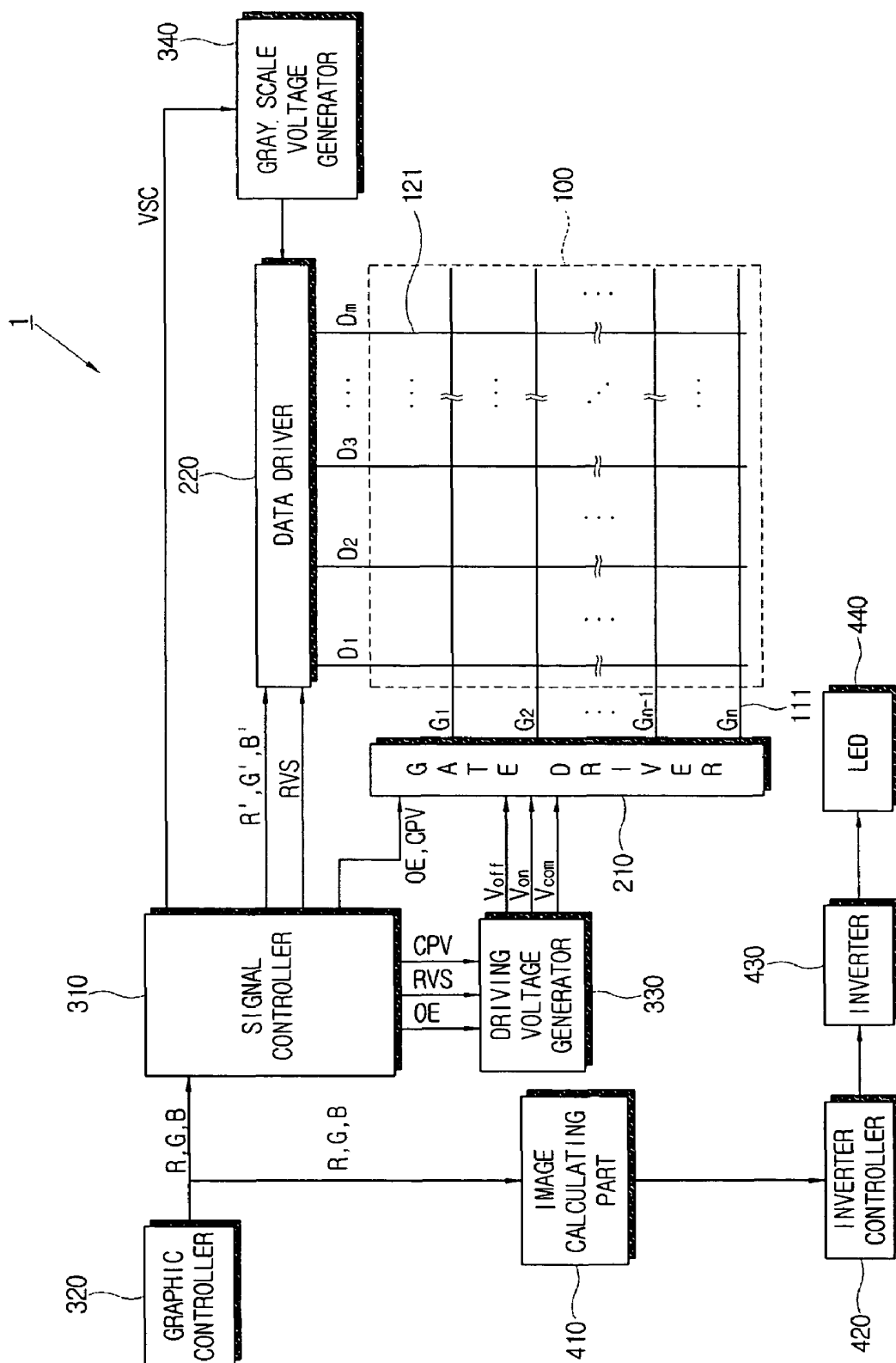


FIG. 2

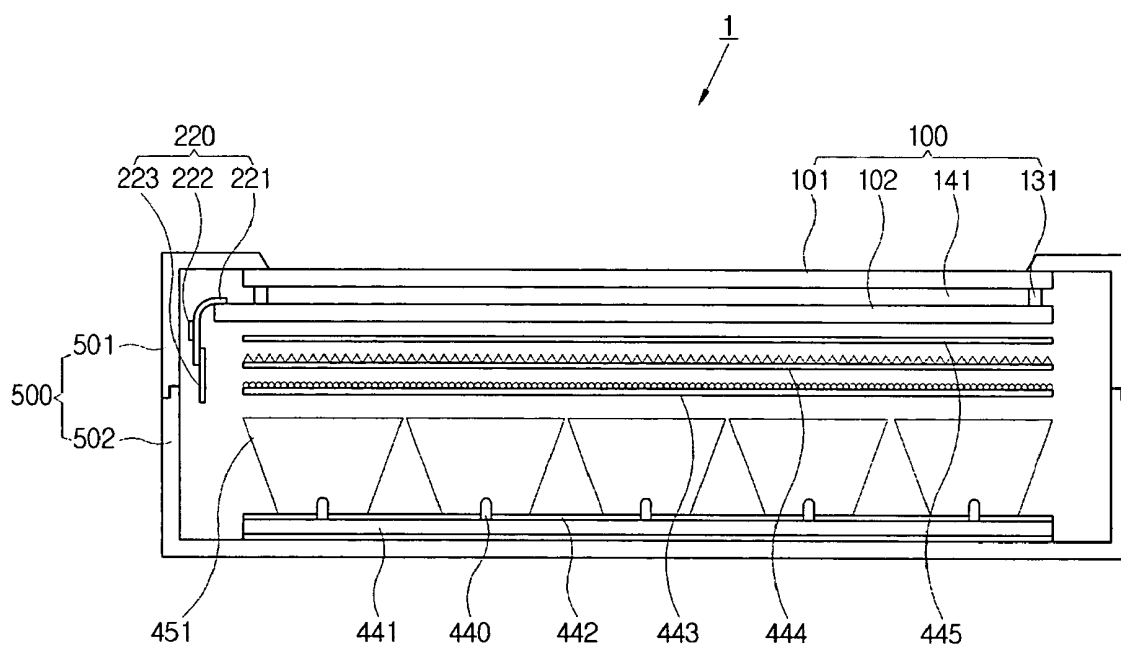


FIG. 3

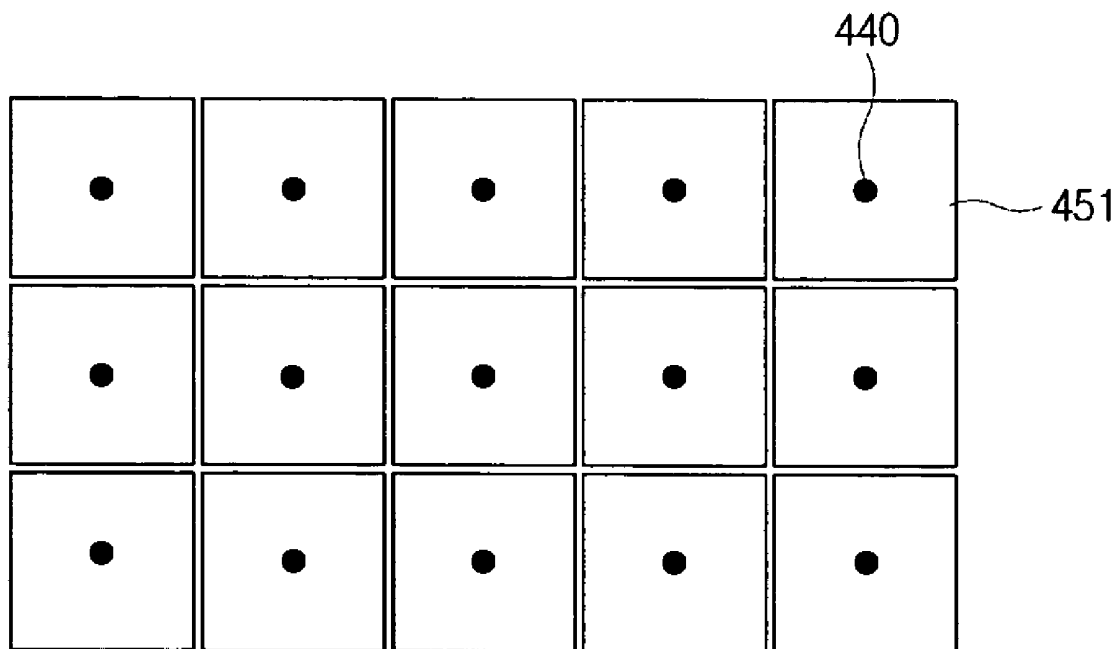


FIG. 4

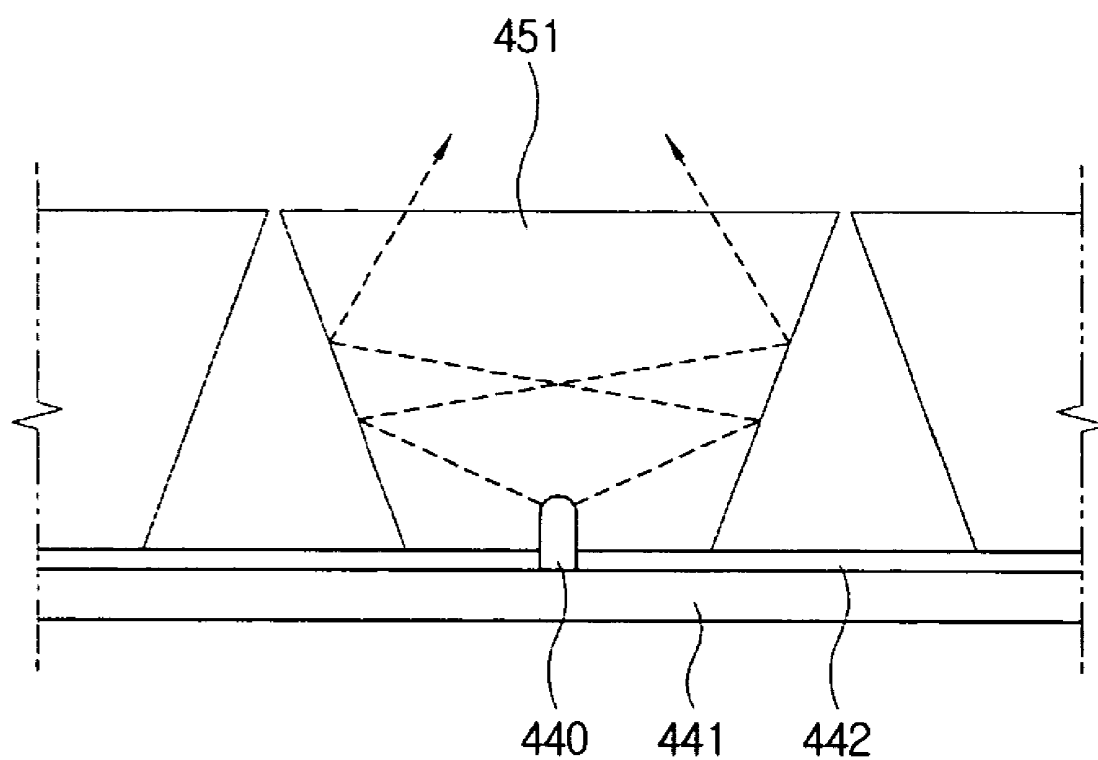


FIG. 5

PARTITION AREA,
REGION

BRIGHTNESS

1 10	2 60	3 55	4 70	5 20
6 70	7 100	8 35	9 45	10 90
11 80	12 90	13 50	14 40	15 30

FIG. 6

PARTITION AREA,
REGION

1 10 R20 G50 B30	2 60 R10 G40 B50	3 55 R15 G50 B35	4 70 R70 G10 B20	5 20 R80 G10 B10
6 70 R15 G30 B55	7 100 R80 G20 B 0	8 35 R70 G10 B20	9 45 R50 G 0 B50	10 90 R 0 G10 B90
11 80 R30 G35 B35	12 90 R40 G45 B15	13 50 R40 G10 B50	14 40 R50 G40 B10	15 30 R10 G10 B80

BRIGHTNESS

COLOR

FIG. 7

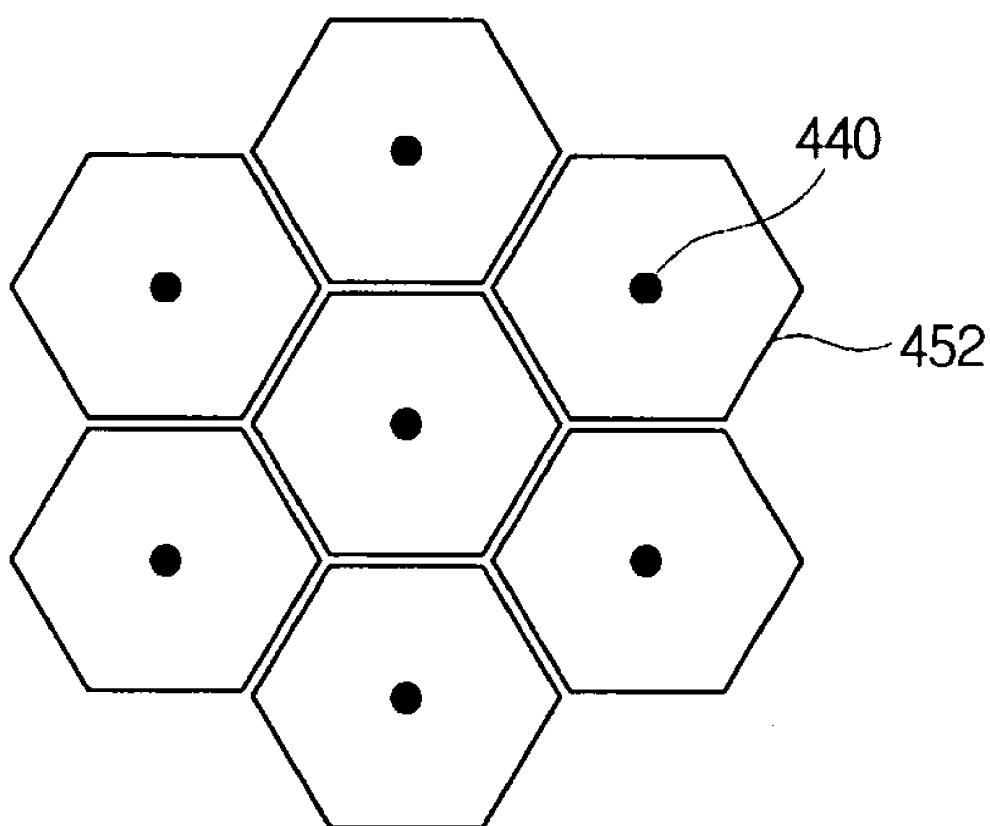


FIG. 8

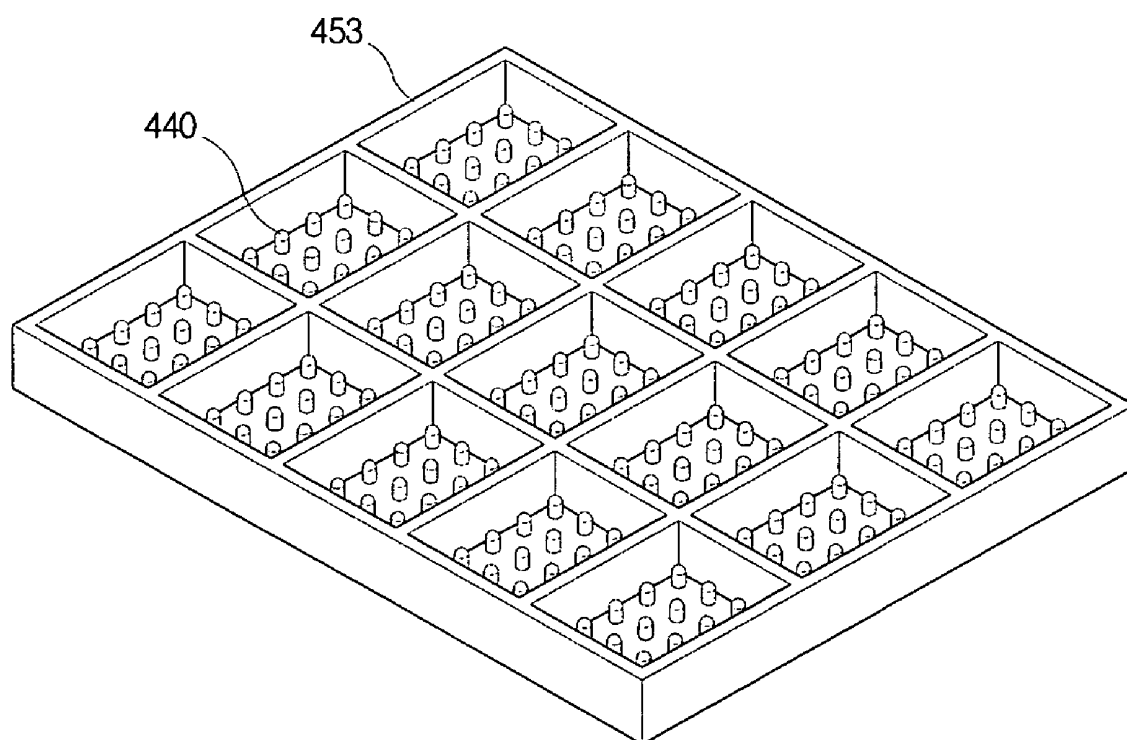


FIG. 9

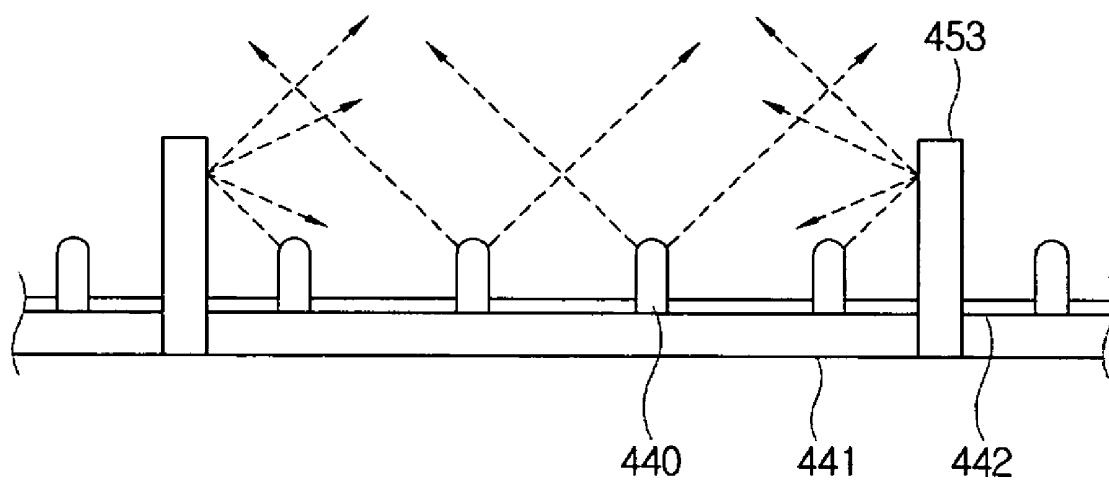


FIG. 10

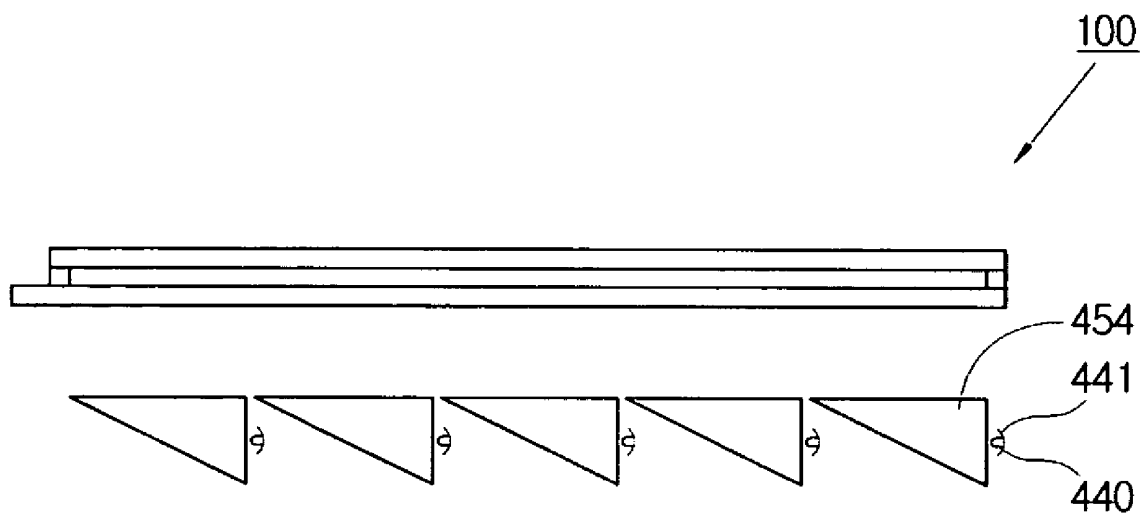


FIG. 11

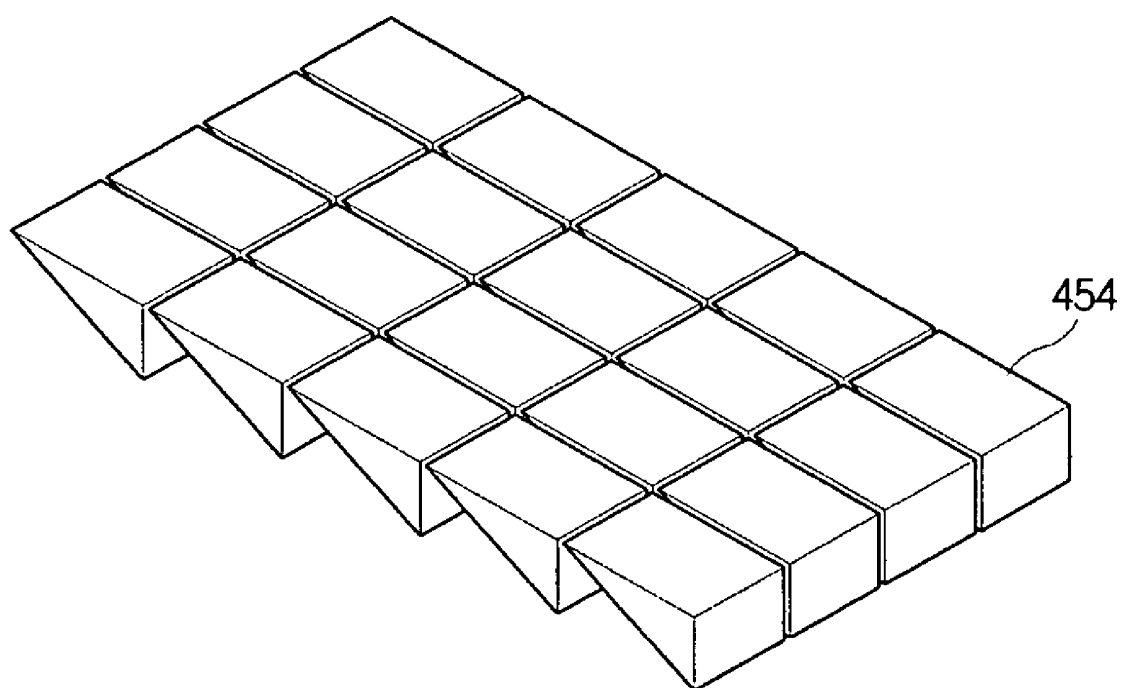
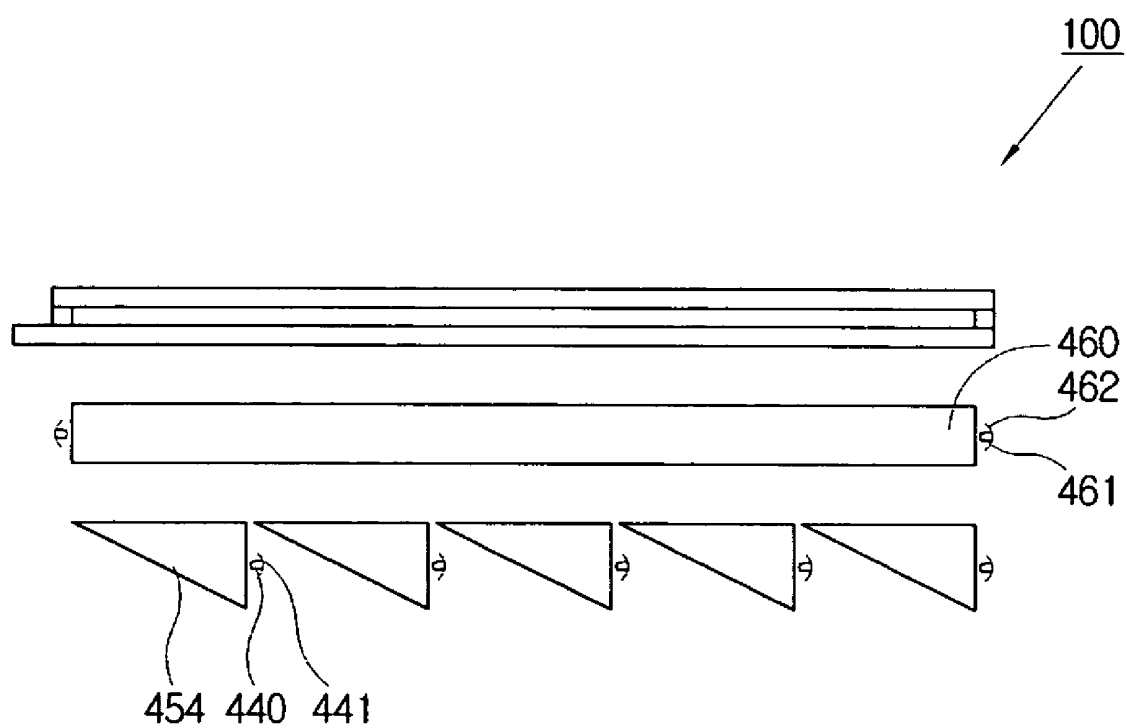


FIG. 12



LIQUID CRYSTAL DISPLAY AND METHOD OF CONTROLLING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit under 35 U.S.C. §119 (a) of Korean Patent Application No. 10-2005-0082194, filed in the Korean Intellectual Property Office on Sep. 5, 2005, the entire disclosure of which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a liquid crystal display. More particularly, the present invention relates to a liquid crystal display in which brightness of a light emitting diode is changed according to regions of a screen.

2. Description of the Related Art

A liquid crystal display (LCD) comprises an LCD panel having a thin film transistor (TFT) substrate on which the TFTs are formed and a color filter substrate on which the color filters are formed, and a liquid crystal layer disposed therebetween. Since the LCD panel does not emit light by itself, the LCD may further comprise a backlight unit in the rear of the TFT substrate as a light source for providing light. The transmittance of the light generated from the backlight unit is adjusted according to an alignment of the liquid crystal in the liquid crystal layer.

The light source of the backlight unit may be a cold cathode fluorescent lamp (CCFL), an external electrode fluorescent lamp (EEFL), organic light emitting diode (OLED), and the like. Recently, a light emitting diode (LED) having a good color reproducibility and brightness has become popular.

In general, the LED provides light having a constant strength for the LCD panel, without relation to an image displayed on the screen. Hence, if a dark image is displayed on the screen, the light of the LED leaks. Thus, the contrast ratio is poor and consumption power is used wastefully.

Recently, a method has been developed in which the screen is divided into a plurality of regions and thus, the LED can have different brightness according to the region. If such a method is used, the bright screen is brighter and the dark screen is darker. Accordingly, the display quality can be improved. However, control of the brightness is difficult since the light of the LED influences other adjacent regions.

Accordingly, a need exists for a system and method in which brightness of a light emitting diode is changed according to the regions of a divided screen.

SUMMARY OF THE INVENTION

Accordingly, it is an object of embodiments of the present invention to substantially solve the above and other problems, and to provide a liquid crystal display in which brightness of a light emitting diode is changed according to the regions of a divided screen and the brightness of each region is controlled without difficulty.

Additional features of embodiments of the present invention will be set forth in the description which follows, and in part will be apparent from the description, or may be learned by practice of the present invention.

The foregoing and/or other aspects of embodiments of the present invention can be achieved by providing a liquid crystal display, comprising a liquid crystal display panel, a light emitting diode device which is disposed on the rear of the

liquid crystal display panel and which is divided into a plurality of partitioned areas capable of being driven independently, a light guide part disposed for each of the partitioned areas and thus guiding light generated from the light emitting diode device in a direction of the liquid crystal display panel, an image calculating part for dividing the liquid crystal display panel into a plurality of regions and calculating the brightness of each region by using image data, an inverter for providing power for the light emitting diode device as divided by the partitioned areas, and an inverter controller for controlling the inverter to provide respective power to the partitioned areas based on the calculated brightness provided by the image calculating part.

According to an aspect of embodiments of the present invention, the light emitting diode device is disposed on substantially the entire rear surface of the liquid crystal display panel.

According to another aspect of embodiments of the present invention, the light guide part comprises a transparent pillar disposed between the light emitting diode device and the liquid crystal display panel.

According to another aspect of embodiments of the present invention, the transparent pillar substantially encloses the light emitting diode device.

According to another aspect of embodiments of the present invention, a section of the transparent pillar facing the liquid crystal display panel is a rectangular shape.

According to another aspect of embodiments of the present invention, a section of the transparent pillar facing the liquid crystal display panel is a regular hexagonal shape.

According to another aspect of embodiments of the present invention, a section of the transparent pillar is increasingly wider toward the liquid crystal display panel.

According to another aspect of embodiments of the present invention, the light guide part comprises a partition dividing the partitioned areas.

According to another aspect of embodiments of the present invention, the partition is higher than the light emitting diode device.

According to another aspect of embodiments of the present invention, the partition is formed using a white color film.

According to another aspect of embodiments of the present invention, the partition comprises polyethylene terephthalate (PET) or polycarbonate (PC) materials.

According to another aspect of embodiments of the present invention, the light guide part comprises a plurality of sub light guide plates disposed on the rear of the liquid crystal display panel, and the light emitting diode device is provided on a light incident plane of each sub light guide plate.

According to another aspect of embodiments of the present invention, the sub light guide plates are disposed on the same plane.

According to another aspect of embodiments of the present invention, the sub light guide plate is a wedge shape.

According to another aspect of embodiments of the present invention, a light exiting plane of the sub light guide plate is substantially parallel to the liquid crystal display panel.

According to another aspect of embodiments of the present invention, the liquid crystal display further comprises a main light guide plate disposed between the plurality of sub light guide plates and the liquid crystal display panel, and a light source provided on a light incident plane of the main light guide plate.

According to another aspect of embodiments of the present invention, the image calculating part further calculates a color value of each region, and the inverter controller controls the

inverter to provide power for the light emitting diode device based on the calculated color value provided by the image calculating part.

According to another aspect of embodiments of the present invention, the partitioned area for the light emitting diode device and the region correspond to each other.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory, and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and/or other aspects and advantages of embodiments of the present invention will become apparent and more readily appreciated from the following description of the exemplary embodiments, taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a block diagram of an exemplary LCD according to a first embodiment of the present invention;

FIG. 2 is a sectional view of the LCD according to the first embodiment of the present invention;

FIG. 3 is a view for illustrating an exemplary arrangement relation of an LED and a light guide part according to the first embodiment of the present invention;

FIG. 4 is a drawing for illustrating a light path in the LCD according to the first embodiment of the present invention;

FIG. 5 is a drawing for illustrating the brightness according to the partitioned areas in the LCD according to the first embodiment of the present invention;

FIG. 6 is a drawing for illustrating the brightness and color according to the partitioned areas in the LCD according to the first embodiment of the present invention;

FIG. 7 is a drawing for illustrating an exemplary arrangement between an LED and a light guide part according to a second embodiment of the present invention;

FIG. 8 is a perspective view for illustrating an exemplary arrangement between an LED and a light guide part according to a third embodiment of the present invention;

FIG. 9 is a drawing for illustrating a light path in the LCD according to the third embodiment of the present invention;

FIG. 10 is a sectional view of an exemplary LCD according to a fourth embodiment of the present invention;

FIG. 11 is a perspective view of a light guide part in the LCD according to the fourth embodiment of the present invention; and

FIG. 12 is a sectional view of an exemplary LCD according to a fifth embodiment of the present invention.

Throughout the drawings, like reference numerals will be understood to refer to like parts, components and structures.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

Reference will now be made in detail to embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The embodiments are described below so as to explain embodiments of the present invention by referring to the figures.

An exemplary LCD according to a first embodiment of the present invention will be described with reference to the FIGS. 1 through 3.

FIG. 1 is a block diagram of an LCD according to the first embodiment of the present invention, and FIG. 2 is a sectional view of the LCD according to the first embodiment of the present invention. FIG. 3 is a view for illustrating an arrange-

ment of an LED and a light guide part according to the first embodiment of the present invention.

An LCD 1 of embodiments of the present invention comprises an LCD panel 100, a gate driver 210 and a data driver 220 connected to the LCD panel 100, a driving voltage generator 330 connected to the gate driver 210 and a gray scale voltage generator 340 connected to the data driver 220, and a signal controller 310 which controls the above components and receives image data from a graphic controller 320. The image data from the graphic controller 320 is also provided to an image calculating part 410. The image calculating part 410 provides the brightness of an individual region to an inverter controller 420 controlling an inverter 430. The inverter 430 supplies power for an LED 440.

The LCD panel 100 comprises a color filter substrate 101 on which color filters are formed and a TFT substrate 102 on which TFTs are formed. A liquid crystal layer 141 is arranged in a space, e.g., a cell gap, formed by the two substrates 101 and 102 and a sealant 131 is arranged along the edges of the two substrates 101 and 102.

The driving voltage generator 330 generates a gate on voltage Von for turning on the TFTs, a gate off voltage Voff for turning off the TFTs, a common electrode voltage Vcom applied to a common electrode, and the like, and provides them to the gate driver 210.

The gray scale voltage generator 340 generates a plurality of gray scale voltages related to the brightness of the LCD 1 and then provides them to the data driver 220.

The gate driver 210, which is also referred to as a scan driver, is connected to a gate line 111 and applies a gate signal comprising a combination of the gate on voltage Von and the gate off voltage Voff from the driving voltage generator 330 to the gate line 111.

A gray scale voltage from the gray scale voltage generator 340 is applied to the data driver 220, which is also referred to as a source driver. The data driver 220 selects the gray scale voltage for the data line 121 according to the control of the signal controller 310, and applies the gray scale voltage as a data signal to the data line 121. The data driver 220 comprises a flexible printed circuit (FPC) 221 of which a first side is connected to the TFT substrate 102, a driving chip 222 mounted on the FPC 221, and a printed circuit board (PCB) 223 connected on a second side of the FPC 221. Here, the data driver 220 shown in FIG. 2 is a chip on film (COF) type. However, other types of data drivers can be used, such as tape carrier package (TCP) or chip on glass (COG) type. The gate driver 210 can be provided in substantially the same manner as the data driver 220, and can be formed on the TFT substrate 121.

The signal controller 310 generates a control signal for controlling operations of the gate driver 210, the data driver 220, the driving voltage generator 330, the gray scale voltage generator 340, and the like, and thus provides a control signal for each of the gate driver 210, the data driver 220 and the driving voltage generator 330.

The image calculating part 410 receives the image data from the graphic controller 320 and divides the LCD panel 100, e.g., the screen, into a plurality of regions and calculates the brightness of each region. The inverter controller 420 controls the inverter 430 such that power is supplied to the LED 440 based on the calculated value provided by the image calculating part 410.

The LEDs 440, mounted on the LED circuit board 441, are disposed on substantially the entire rear surface of the LCD panel 100. The LEDs 440 are provided as three lines in width and five lines in length and thus, a sum of the LEDs 440 is fifteen. This is presented as one example only, and other

embodiments of the present invention can comprise any number of LEDs as required. Each of the LEDs **440** shown in FIG. **3** provides white light. For this purpose, each LED **440** can comprise an RGB multi unit, but are not limited thereto.

The reflecting plate **442** reflects the light generated from the LEDs **440** and directs the reflected light toward the LCD panel **100**. The reflecting plate **442** is disposed on substantially the entire surface of the LED circuit board **441**. Portions of the reflecting plate **442** corresponding to where the LEDs **440** are arranged are removed.

A diffusion sheet **443** comprises a base plate and a coating layer having beads formed on the base plate. If the light generated from the LEDs **440** is directly supplied to the LCD panel **100**, a user recognizes an arrangement type of the LEDs **440**. Accordingly, the LCD **1** doesn't have uniform brightness. To avoid this result, the diffusion sheet **443** is provided and evenly diffuses the light generated from the LEDs **440**, and then provides the diffused light to the LCD panel **100** via a prism film **444** and a protection film **445**.

A plurality of triangular prisms are placed on the prism film **444** in a predetermined alignment. The prism film **444** concentrates the light diffused from the diffusion plate **443** in a direction perpendicular to a surface of the LCD panel **100**. Preferably, two prism films **444** are used, and the micro prisms formed on the prism films **444** form a predetermined angle with each other. The light passing through the prism films **444** mainly progresses upward, thereby forming a uniform brightness distribution.

The protection film **445**, positioned at the top of a light regulating part, protects the prism film **444** which can be vulnerable to scratching.

A plurality of transparent pillars **451** are formed between the LEDs **440** and the diffusion plate **443** as a light guide part. The number of the transparent pillars **451** in this example is fifteen, which corresponds to the number of LEDs **440**, but embodiments of the present invention are not limited thereto. Each transparent pillar **451** has a square pillar shape which encloses the corresponding LED **440** and gets wider toward an upper part, e.g., toward the LCD panel **100**. The upper sides of the adjacent transparent pillars **451** are disposed closely to each other. Each transparent pillar **451** may be made of acrylic resin or polycarbonate (PC) materials. Further, each transparent pillar **451** may be a plate shape of which the width is larger than the height unlike the exemplary embodiment shown.

A chassis **500** is provided and comprises an upper chassis **501** and a lower chassis **502**, and accommodates the LCD panel **100** and the LEDs **440**.

An exemplary operation of the LCD **1** will now be explained in greater detail.

The signal controller **310** is provided with red, green and blue (RGB) image data R, G, and B, and an input control signal for controlling a display of the image data from the graphic controller **320**. For example, the input control signal can comprise a vertical synchronizing signal Vsync, a horizontal synchronizing signal Hsync, a main clock CLK, a data enable signal DE, and the like. The signal controller **310** generates a gate control signal, a data control signal and a voltage selection control signal VSC based on the input control signal, and converts the RGB image data R, G, and B to correspond to an operational condition of the LCD panel **100**. Thereafter, the gate control signal is transferred to the gate driver **210** and the driving voltage generator **330**, and the data control signal and the processed RGB image data R', G', and B' are transferred to the data driver **220**. Also, the voltage selection control signal VSC is transferred to the gray scale voltage generator **340**.

The gate control signal comprises a vertical synchronization start signal STV for ordering a start time of the output of a gate on pulse (a high region of the gate signal), a gate clock signal CPV for controlling the output time of the gate on pulse, a gate on enable signal OE for limiting the width of the gate on pulse, and the like. The gate on enable signal OE and the gate clock signal CPV among those are provided to the driving voltage generator **330**. The data control signal comprises a horizontal synchronization start signal STH for ordering the input of a gray scale signal, a load signal LOAD or TP for ordering the applying of the corresponding data voltage to the data line **121**, a control reversion signal RVS for reversing a polarity of the data voltage, a data clock signal HCLK, and the like.

First, the gray scale voltage generator **340** provides a gray scale voltage having a voltage value determined by the voltage selection control signal VSC to the data driver **220**.

The gate driver **210** applies the gate on voltage Von to the gate line **111** in order according to the gate control signal from the signal controller **310**. The TFT connected to the gate line **111** is then turned on. At substantially the same time, the data driver **220** provides an analog data voltage as the data signal from the gray scale voltage generator **340** corresponding to an image data R', G' and B' about a pixel comprising the turned-on switching device to the corresponding data line **121** according to the data control signal from the signal controller **310**.

The data signal provided via the data line **121** is applied to the corresponding pixel through the turned-on TFT. In this manner, the gate on voltage Von is applied to all the gate lines **111** during one frame in turn and thus, the data signal is applied to all of the pixels. After the one frame, the control reversion signal RVS is provided to the driving voltage generator **330** and the data driver **220** and thus, the polarities of all of the data signals in next frame are changed.

In a first embodiment of the present invention, control of the brightness is executed according to the LEDs **440** and thus, brightness interference is decreased between the adjacent LEDs **440** by the transparent pillars **451**. An exemplary embodiment will now be described in greater detail by referring to FIG. **4**.

FIG. **4** is a drawing for illustrating a light path in the LCD according to the first embodiment of the present invention. The light from the LED **440** enters the transparent pillar **451** which encloses the LED **440**. A portion of the light from the LED **440** is radiated toward the upper part, e.g., the LCD panel **100**, and another portion of the light from the LED **440** is reflected by a side wall of the transparent pillar **451** and is then directed to the LCD panel **100**.

The light radiated from the side wall of the transparent pillar **451** is restricted due to a difference of a refractive index between the transparent pillar **451** and the surrounding air. As the transparent pillar **451** goes toward the upper part, the sectional area of the transparent pillar **451** is increasingly larger. Accordingly, an incident angle that the light from the LED **440** enters into the side wall of the transparent pillar **451** is larger and thus, a substantially total reflection occurs. Accordingly, the control of the brightness becomes easier since the amount of the light from the side wall of the transparent pillar **451** which affects other adjacent transparent pillars **451** is decreased.

Additionally, the LEDs **440** of embodiments of the present invention can be divided into a plurality of partitioned areas. Also, the LCD panel can be divided into a plurality of regions and thus, the brightness thereof can be calculated. Therefore, the power provided to each LED **440** can be controlled on a

basis of the calculated brightness. An exemplary embodiment will now be described in greater detail by referring to FIGS. 5 and 6.

FIG. 5 is a drawing for illustrating the brightness according to the partitioned area in the LCD according to the first embodiment of the present invention. FIG. 6 is a drawing for illustrating both the brightness and color according to the partitioned area in the LCD according to the first embodiment of the present invention.

In the first embodiment of the present invention, the LCD panel 100, e.g., a region of the screen, is the same as the partition area of the LEDs 440. One of the LEDs 440 and one of the transparent pillars 451 are disposed in each partitioned area.

The RGB image data R, G, and B from the graphic controller 320 is input to the image calculating part 410. The image calculating part 410 divides the LCD panel 100, e.g., the screen into the plurality of regions and calculates the brightness in each region. The plurality of regions are provided respectively as having the same size. The number of regions can be increased such that the contrast ratio is improved. However, the control of the regions becomes more complicated. The regions can have a lattice shape that is divided into a transverse direction and a longitudinal direction of the screen.

Preferably, the brightness of each region is calculated as the mean brightness of each region. However, the image calculating part 410 can remember the image of the previous frame such that the image calculating part 410 can provide a difference value of the brightness between the frames to the inverter controller 420. Preferably, the vertical synchronizing signal Vsync, the horizontal synchronizing signal Hsync, and the main clock CLK, as well as image data from the graphic controller 320, are further provided to the image calculating part 410.

The inverter controller 420 controls the inverter 430 on a basis of the calculated brightness from the image calculating part 410 for each the region. That is, the LED 440 corresponding to the region having a high brightness provides the light of the high brightness, and the LED 440 corresponding to the region having a low brightness provides the light of the low brightness. In this manner, the inverter controller 420 controls the inverter 430. To achieve this, the inverter 430 supplies power which can be different for the respective regions to the LED 440 corresponding to the brightness of each region. Accordingly, the brightness of the LEDs 440 provided to the screen is changed according to each of the regions as shown by the brightness values (e.g., 10, 60, 55) in FIG. 5. In the next frame, the brightness of the LED 440 is also changed according to the image data.

The image calculating part 410 and the inverter controller 420 can be provided separately, or included in the signal controller 310.

According to the first embodiment of the present invention, the brightness of the LEDs 440 may be adjusted by the regions of the screen. Accordingly, a bright region may be brighter and a dark region may be darker. In doing so, for example, an explosion scene or a scene expressing an instant flash may be displayed more effectively.

Accordingly, the contrast ratio of the screen can be improved and the power used in driving the LEDs 440 can be distributed effectively. Further, the brightness in one of the partitioned areas of the LED 440 does not substantially influence the brightness of the adjacent partitioned areas by the use of the transparent pillars 451.

As described above, the driving of the LEDs 440 is controlled in consideration of the brightness of each region. How-

ever, the driving of the LEDs 440 can also be controlled in consideration of the color of each region.

FIG. 6 illustrates the brightness and relative intensity between a red R, green G, and blue B color based on the light which the LED 440 provides to each region. In this embodiment of the present invention, the image calculating part 410 calculates the color as well as the brightness of each region. The inverter controller 420 controls the inverter 430 to supply power to the LED 440 based on the color and the brightness. For example, if the color red R is significantly displayed on a fourth region based on a calculating result of the image calculating part 410, the LED 440 corresponding to the fourth region provides red R to a greater extent. In doing so, much more power is provided to the LED 440 emitting the red R than emitting the blue B or green G colors. Since red color expressed from a red light is more vivid than that from white light, display quality can be enhanced.

The first embodiment of the present invention may have various modifications and variations. For example, a plurality of the partitioned areas can be disposed in one region. Further, a plurality of the light guide parts can be formed in each partitioned area. Also, each light guide part can be used to guide the light from a plurality of LEDs 440.

FIG. 7 is a drawing for illustrating an exemplary arrangement between an LED and a light guide part according to a second embodiment of the present invention.

The light guide part according to the second embodiment of the present invention comprises a transparent pillar 452 substantially the same as the pillars 451 of the first embodiment. However, a section of the transparent pillar 452 is a hexagon shape. The light emitted from the LED 440 exits the LED 440 in a circular shape. Accordingly, the transparent pillar 452 is a hexagonal pillar which is more similar to the circular shape and is filled with more planes and thus, the light efficiency can be increased.

FIG. 8 is a perspective view for illustrating an exemplary arrangement between an LED and a light guide part according to a third embodiment of the present invention. FIG. 9 is a drawing for illustrating a light path in the LCD according to the third embodiment of the present invention.

In the third embodiment of the present invention, a partition 453 is provided as the light guide part. The partition 453 is higher than the LEDs 440. A part surrounded by the partition 453 is referred to as a partitioned area. A plurality of the LEDs 440 are provided in each partitioned area. The LEDs 440 having different colors are disposed in each partitioned area so that white light is provided in it by mixing colors.

As shown in FIG. 9, the light generated from the LEDs 440 is directed to the LCD panel 100 or is reflected by the partition 453 and is then directed to the LCD panel 100. Accordingly, the light from the LEDs 440 has less influence on the brightness of another adjacent partitioned area by the partition 453. In addition, an efficiency of the color mixing can be increased due to a light reflection of the partition 453. The partition 453 can be formed with a white color film having good reflectivity and can comprise polyethylene terephthalate (PET), polycarbonate (PC), and the like.

FIG. 10 is a sectional view of an exemplary LCD according to a fourth embodiment of the present invention. FIG. 11 is a perspective view of a light guide part in the LCD according to the fourth embodiment of the present invention.

As shown in FIG. 10, a plurality of sub light guide plates 454 are provided as the light guide part. Each the sub light guide plates 454 have a wedge shape and are arranged on the same plane. A light exiting plane of each sub light guide plate 454, e.g., a plane facing the LCD panel 100, is substantially

parallel to the LCD panel 100. A light incident plane of each sub light guide plate 454 is provided with the LED 440 and the LED circuit board 441.

The brightness of the LED 440 disposed in each sub light guide plate 454 is differentiated so that light having different brightness can be provided to each region. The light generated from each of the LEDs 440 is mainly provided in the corresponding sub light guide plate 454 and thus, does not influence the adjacent sub light guide plates 454. Although not shown in FIG. 10, it is preferable that a reflecting plate is provided on a reflecting plane, e.g., a lower part of the sub light guide plate 454.

FIG. 12 is a sectional view of an exemplary LCD according to a fifth embodiment of the present invention. In the fifth embodiment of the present invention, the sub light guide plate 454 is provided as the light guide part substantially the same as described in the fourth embodiment.

However, a main light guide plate 460 is disposed between the sub light guide plates 454 and the LCD panel 100. Also, a main LED 461 and a main LED circuit board 462 are provided and are disposed at a lateral side of the main light guide plate 460.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A liquid crystal display, comprising:
 - a liquid crystal display panel;
 - a light emitting diode device comprising a plurality of partitioned areas, each of the partitioned areas being driven independently of adjacent partitioned areas;
 - a plurality of light guide parts, the light guide parts for guiding light generated from corresponding ones of the partitioned areas of the light emitting diode device toward the liquid crystal display panel;
 - an image calculating part for dividing the liquid crystal display panel into a plurality of regions and calculating brightness of each of the regions by using image data, the regions being arranged along a transverse direction and a longitudinal direction of the liquid crystal display panel;
 - an inverter for providing power to each of the partitioned areas of the light emitting diode device; and
 - an inverter controller for controlling the inverter to provide power to each of the partitioned areas of the light emitting diode device according to the calculated brightness of corresponding regions of the liquid crystal display panel;
- wherein the provided power to each of the partitioned areas of the light emitting diode device by the inverter has a different level from each other according to the calculated brightness of each of the regions; and
- wherein the light emitting diode corresponding to the region having a high brightness provides a light of the high brightness, and the light emitting diode corresponding to the region having a low brightness provides a light of the low brightness.
2. The liquid crystal display according to claim 1, wherein the light emitting diode device is disposed on substantially the entire rear surface of the liquid crystal display panel.

3. The liquid crystal display according to claim 2, wherein the light guide part comprises a transparent pillar disposed between the light emitting diode device and the liquid crystal display panel.

4. The liquid crystal display according to claim 3, wherein the transparent pillar substantially encloses the light emitting diode device.

5. The liquid crystal display according to claim 3, wherein a section of the transparent pillar facing the liquid crystal display panel is a rectangular shape.

6. The liquid crystal display according to claim 3, wherein a section of the transparent pillar facing the liquid crystal display panel is a hexagonal shape.

7. The liquid crystal display according to claim 3, wherein a section of the transparent pillar becomes wider toward the liquid crystal display panel.

8. The liquid crystal display according to claim 1, wherein the light guide part comprises a partition that is positioned above the light emitting diode device.

9. The liquid crystal display according to claim 1, wherein the light guide part comprises a partition, wherein the partition comprises a white color film.

10. The liquid crystal display according to claim 1, wherein the light guide part comprises a partition, wherein the partition comprises a polyethylene terephthalate (PET) or polycarbonate (PC) material.

11. The liquid crystal display according to claim 1, wherein the light guide part comprises a plurality of sub light guide plates, and the light emitting diode device is provided on a light incident plane of each sub light guide plate.

12. The liquid crystal display according to claim 11, wherein the sub light guide plates are disposed on the same plane.

13. The liquid crystal display according to claim 11, wherein the sub light guide plates have a wedge shape.

14. The liquid crystal display according to claim 13, wherein the light emitting diode device is disposed at a side of the sub light guide plates.

15. The liquid crystal display according to claim 11, wherein a light exiting plane of the sub light guide plate is substantially parallel to the liquid crystal display panel.

16. The liquid crystal display according to claim 11, further comprising:

- a main light guide plate disposed between the plurality of sub light guide plates and the liquid crystal display panel; and
- a light source provided on a light incident plane of the main light guide plate.

17. The liquid crystal display according to claim 1, wherein:

- the image calculating part is configured to calculate a color value of each region; and
- the inverter controller is configured to control the inverter to provide respective power to the light emitting diode device based on the calculated color value.

18. The liquid crystal display according to claim 1, wherein the partitioned areas for the light emitting diode device and the regions correspond to each other.

19. A method of controlling a liquid crystal display, comprising:

- dividing a light emitting diode device into a plurality of partitioned areas, wherein each of the partitioned areas is driven independently of adjacent partitioned areas;
- providing a liquid crystal display panel;
- providing a plurality of light guide parts, the light guide parts for guiding light generated from corresponding

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light emitting diodes of the light emitting diode device toward the liquid crystal display panel;
dividing the liquid crystal display panel into a plurality of regions and calculating brightness of each of the regions by using image data, the regions being arranged along a transverse direction and a longitudinal direction of the liquid crystal display panel; and
providing power to each of the partitioned areas of the light emitting diode device based on the calculated brightness of corresponding regions of the liquid crystal display panel;
wherein the provided power to each of the partitioned areas of the light emitting diode device by an inverter has a different level from each other according to the calculated brightness of each of the regions;
wherein the light emitting diode corresponding to the region having a high brightness provides a light of the high brightness, and the light emitting diode corresponding to the region having a low brightness provides a light of the low brightness.

20. The method according to claim 19, further comprising: calculating a color value of each region; and providing respective power to the light emitting diode device based on the calculated color value.

21. A liquid crystal display, comprising:
a liquid crystal display panel;
a light emitting diode device comprising a plurality of partitioned areas, each of the partitioned areas being driven independently of adjacent partitioned areas;
a plurality of light guide parts, the light guide parts for guiding light generated from corresponding ones of the partitioned areas of the light emitting diode device toward the liquid crystal display panel;
an image calculating part for dividing the liquid crystal display panel into a plurality of regions and calculating brightness of each of the regions by using image data, the regions being arranged along a transverse direction and a longitudinal direction of the liquid crystal display panel;
an inverter for providing power to each of the partitioned areas of the light emitting diode device; and
an inverter controller for controlling the inverter to provide power to each of the partitioned areas of the light emitting diode device according to the calculated brightness of corresponding regions of the liquid crystal display panel;
wherein each of the light guide parts comprises a transparent pillar disposed between the light emitting diode device and the liquid crystal display panel;
wherein the provided power to each of the partitioned areas of the light emitting diode device by the inverter has a different level from each other according to the calculated brightness of each of the regions; and
wherein the light emitting diode corresponding to the region having a high brightness provides a light of the

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high brightness, and the light emitting diode corresponding to the region having a low brightness provides a light of the low brightness.

22. The liquid crystal display according to claim 21, wherein each of the light guide parts comprises a plurality of sub light guide plates, and the light emitting diode device is provided on a light incident plane of each sub light guide plate.

23. The liquid crystal display according to claim 22, wherein the sub light guide plates are disposed on the same plane.

24. The liquid crystal display according to claim 22, wherein the sub light guide plates comprise a wedge shape.

25. The liquid crystal display according to claim 24, wherein the light emitting diode device is disposed at a side of the sub light guide plates.

26. The liquid crystal display according to claim 22, wherein a light exiting plane of the sub light guide plate is substantially parallel to the liquid crystal display panel.

27. The liquid crystal display according to claim 22, further comprising:
a main light guide plate disposed between the plurality of sub light guide plates and the liquid crystal display panel; and
a light source provided on a light incident plane of the main light guide plate.

28. A liquid crystal display, comprising:
a liquid crystal display panel;
a light emitting diode device comprising a plurality of partitioned areas, each of the partitioned areas being driven independently of adjacent partitioned areas;
a plurality of light guide parts, the light guide parts for guiding light generated from corresponding ones of the partitioned areas of the light emitting diode device toward the liquid crystal display panel;
an image calculating part for dividing the liquid crystal display panel into a plurality of regions and calculating brightness of each of the regions by using image data, the regions being arranged along a transverse direction and a longitudinal direction of the liquid crystal display panel;
an inverter for providing power to each of the partitioned areas of the light emitting diode device; and
an inverter controller for controlling the inverter to provide power to each of the partitioned areas of the light emitting diode device according to the calculated brightness and the relative intensity among the plurality of colors of corresponding regions of the liquid crystal display panel;
wherein the provided power to each of the partitioned areas of the light emitting diode device by the inverter has a different level from each other according to the calculated brightness and the relative intensity among the plurality of colors of each of the regions.

* * * * *

专利名称(译)	液晶显示器及其控制方法		
公开(公告)号	US8164564	公开(公告)日	2012-04-24
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外部链接	Espacenet USPTO		

摘要(译)

一种液晶显示器及其控制方法，具有液晶显示面板，发光二极管装置，设置在液晶显示面板的后部，并且被分成多个能够独立驱动的分隔区域，为每个分区设置的导光部分，用于将液晶显示板分成多个区域并通过使用图像数据计算每个区域的亮度的图像计算部分，以及提供的逆变器 and 逆变器控制器基于计算的亮度将分化的功率区分到分区区域。

