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(54) **LIQUID CRYSTAL DISPLAY DRIVING SYSTEM HAVING LIGHT EMITTING DIODES**

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(57) **ABSTRACT**

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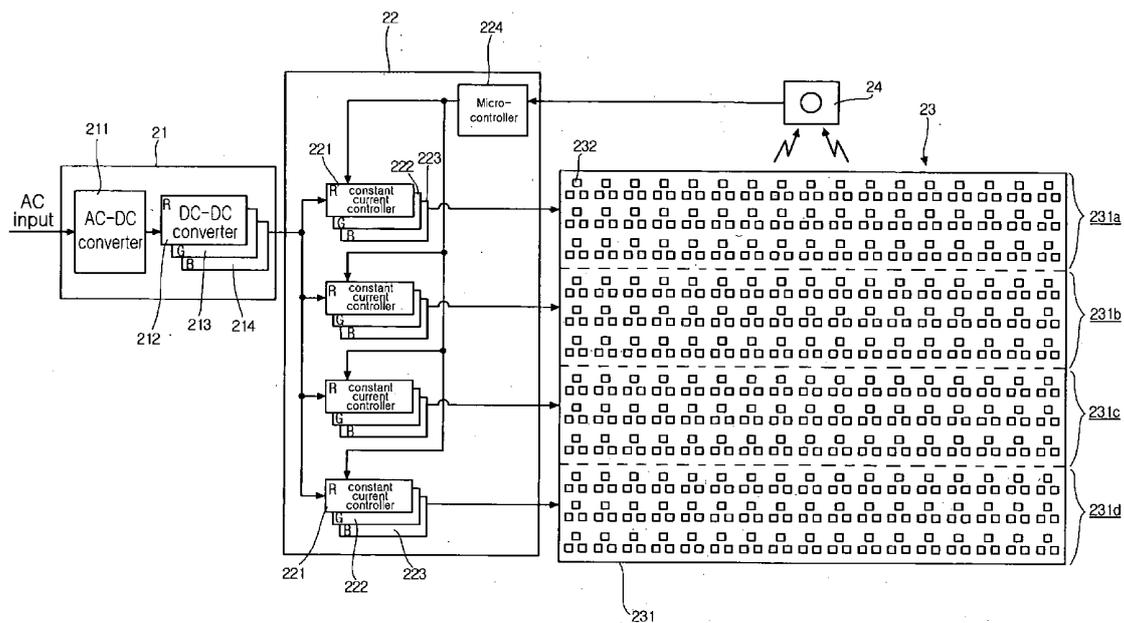
An LCD backlight driving system includes a light source, which is composed of at least one of each of red, green and blue LED arrays each with a plurality of corresponding color LEDs connected in series, and a substrate on which the red, green and blue LED arrays are disposed to emit white light. The system also includes an SMPS having an AC-DC converter for converting an externally inputted AC voltage to a DC voltage and red, green and blue LED DC-DC converters each converting the DC voltage to a predetermined magnitude of DC voltage suitable for driving the corresponding color LED arrays, respectively. The system further includes a control board having at least one of each of red, green and blue LED constant current controllers for regulating current running through the red, green and blue LED arrays, to maintain predetermined outputs of the red, green and blue LEDs.

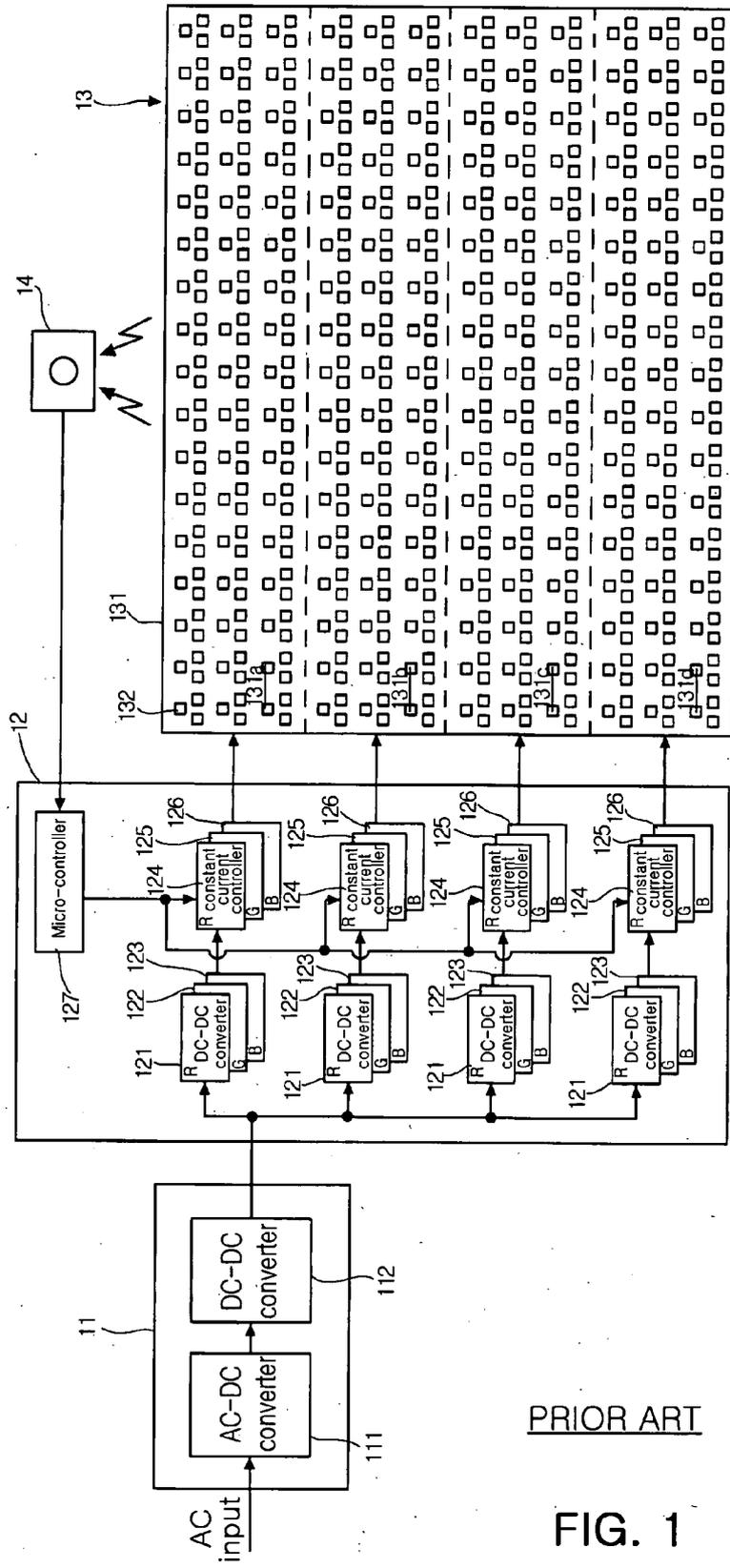
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PRIOR ART

FIG. 1

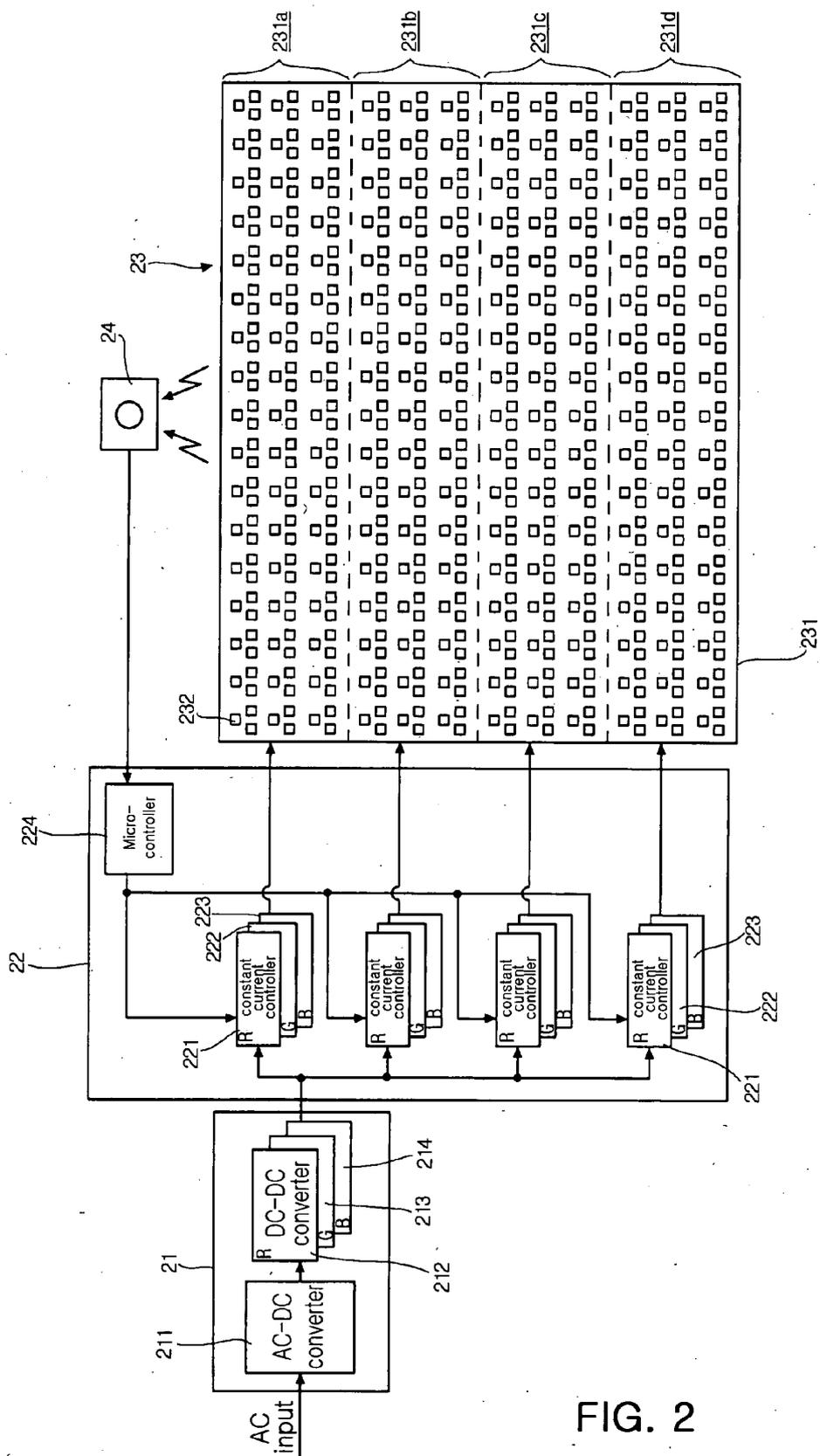


FIG. 2

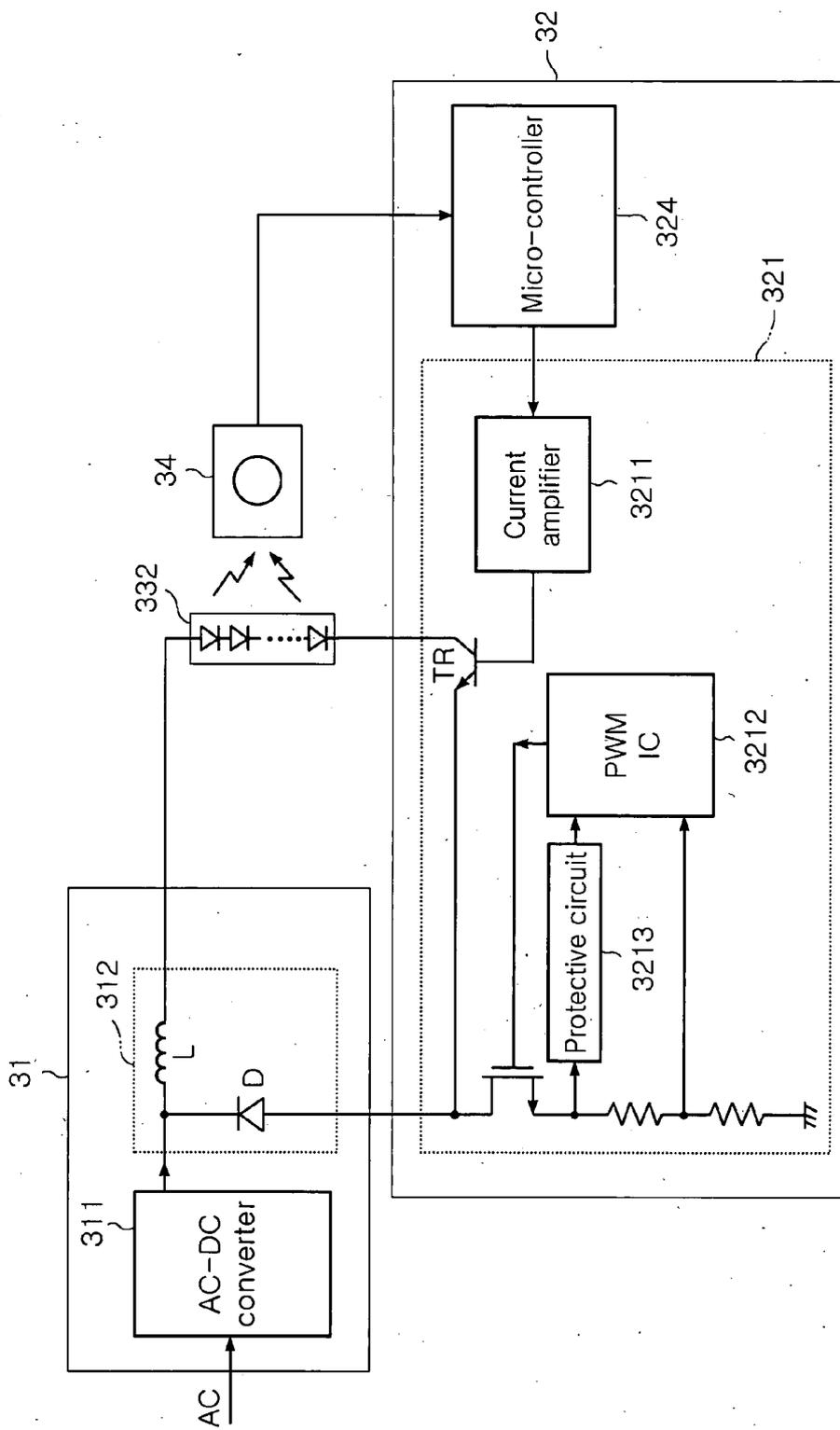


FIG. 3

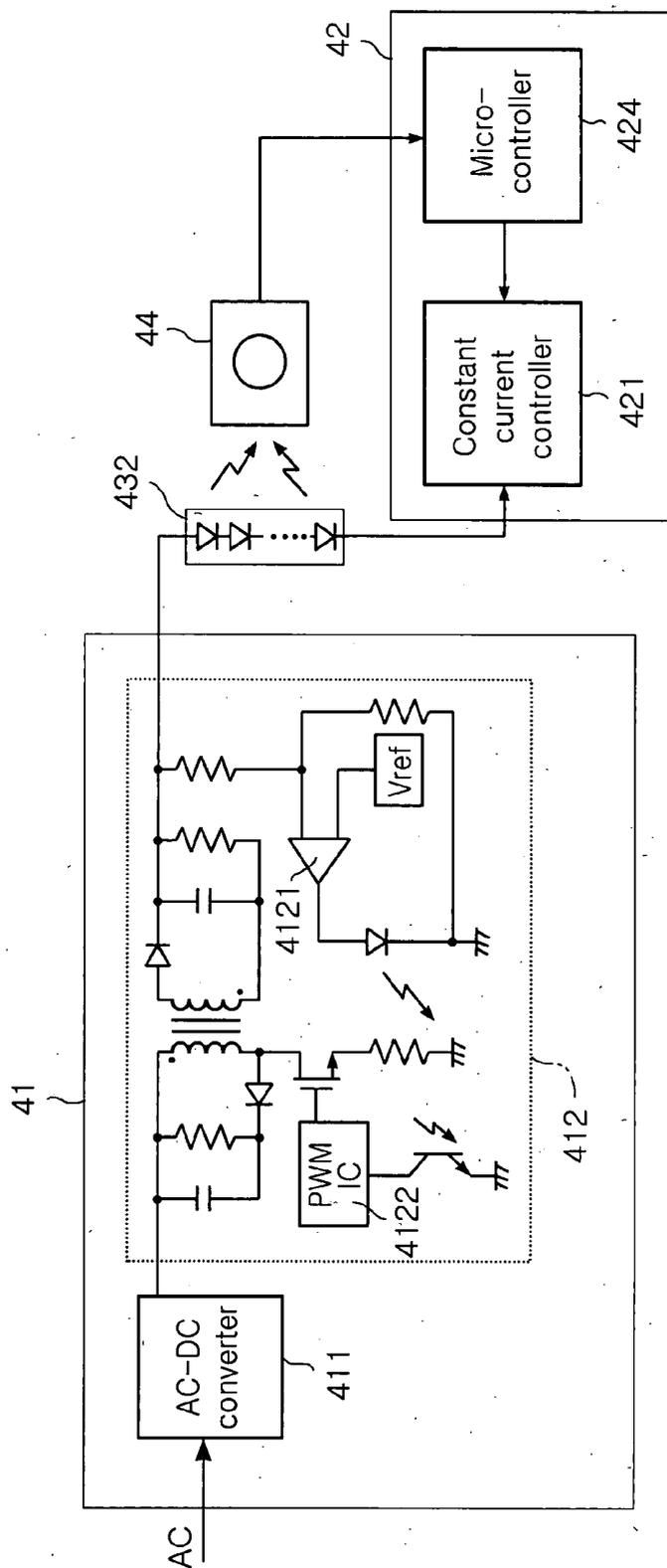


FIG. 4

## LIQUID CRYSTAL DISPLAY DRIVING SYSTEM HAVING LIGHT EMITTING DIODES

### CLAIM OF PRIORITY

[0001] This application claims the benefit of Korean Patent Application No. 2006-0059100 filed on Jun. 29, 2006, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

### BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] The present invention relates to a Liquid Crystal Display (LCD) driving system having Light Emitting Diodes (LEDs) and, more particularly, to an LCD driving system having LEDs, which drives a backlight of an LCD using a plurality of LEDs as a light source.

[0004] 2. Description of the Related Art

[0005] Cold Cathode Fluorescent Lamps (CCFLs), which have been used as a light source for the existing LCD backlight unit, are prone to environmental pollution with use of mercury gas, slow in response rate, have low color reproducibility and are inappropriate for miniaturization of LCD panels.

[0006] On the other hand, LEDs are environmentally friendly, possible in high speed response in nanoseconds, which is effective for a video signal stream, and possible in impulsive driving. In addition, it has color reproducibility of over 100% and can be varied in luminance, color temperature, etc. by adjusting the light amounts of red, green and blue LEDs. Moreover, LED light sources are suitable for miniaturization of LCD panels. Due to these merits, LEDs have been actively adopted as a light source for backlight for LCD panels, etc.

[0007] When LED arrays with a plurality of LEDs connected in series are used in an LCD backlight, a driving system is required to provide a predetermined constant current to the LED arrays. FIG. 1 is a configuration view illustrating a conventional LCD backlight driving system having LEDs.

[0008] Referring to FIG. 1, the conventional LCD backlight driving system includes a Switch Mode Power Supply (SMPS) 11, a drive board 12, and a light source 13. The SMPS converts an externally supplied AC voltage to a DC voltage. The drive board 12 includes a plurality of red, green and blue LED DC-DC converters 121, 122 and 123 for converting the DC voltage, converted by the SMPS 11, to a DC voltage suitable for driving respective color LED arrays, and includes red, green and blue constant current controllers 124, 125 and 126 for regulating the DC voltage converted by the DC-DC converters 121, 122 and 123 to maintain a regulated current supplied to the respective color LED arrays. The light source 13 includes a substrate 131 and the respective color LED arrays suitably arranged on the substrate 131, thereby producing white light from the mixture of the light beams from the LED arrays. The conventional LCD backlight driving system further includes a sensor 14 for detecting the luminance and/or color of the light emitted from the light source 13 and a micro-controller 127 provided in the drive board 12 for determining the outputs of the red, green and blue LEDs so as to conform the luminance and/or color of the light detected from the sensor 14 with predetermined luminance and/or color of light.

[0009] In such a conventional LCD backlight driving system, after the SMPS 11 converts the AC voltage to the DC voltage at an AC-DC converter 111, the converted DC voltage is converted again to a predetermined value of DC voltage at the DC-DC converter 112. Then, the DC voltage outputted from the DC-DC converter 112 of the SMPS 11 is step-up or down transformed to a voltage suitable for driving the corresponding color LED array in the respective LED DC-DC converters 121, 122 and 123. Therefore, in the conventional LCD driving system, similar operations of converting a DC voltage to a DC voltage are redundantly executed, resulting in inefficiency of the system and an increased number of components for the operations. Furthermore, each color LED array requires one DC-DC converter in the drive board 12, increasing the number of required components and the space for forming the circuit, which is not suitable for miniaturization of the LCD backlight.

### SUMMARY OF THE INVENTION

[0010] The present invention has been made to solve the foregoing problems of the prior art and therefore an aspect of the present invention is to provide an LCD backlight driving system having LEDs, which requires a fewer number of components to improve circuit efficiency, thereby enabling low costs and miniaturization.

[0011] According to an aspect of the invention, the invention provides a liquid crystal display backlight driving system, which includes a light source including at least one red Light Emitting Diode (LED) array with a plurality of red LEDs emitting red light connected in series, at least one green LED array with a plurality of green LEDs emitting green light connected in series, and at least one blue LED array with a plurality of blue LEDs emitting blue light connected in series, and a substrate on which the red, green and blue LED arrays are disposed in such an arrangement that light beams from the LEDs are mixed into white light; a Switch Mode Power Supply (SMPS) having an AC-DC converter for converting an externally inputted AC voltage to a DC voltage, a red LED DC-DC converter for converting the DC voltage, converted from the AC-DC converter, to a predetermined magnitude of DC voltage suitable for driving the red LED array, a green LED DC-DC converter for converting the DC voltage, converted from the AC-DC converter, to a predetermined magnitude of DC voltage suitable for driving the green LED array, and a blue LED DC-DC converter for converting the DC voltage, converted from the AC-DC converter, to a predetermined magnitude of DC voltage suitable for driving the blue LED array; and a control board including at least one red LED constant current controller for regulating current running through the red LED array, at least one green LED constant current controller for regulating current running through the green LED array, and at least one blue LED constant current controller for regulating current running through the blue LED array to maintain predetermined outputs of the red, green and blue LEDs.

[0012] In an exemplary embodiment of the present invention, the liquid crystal backlight driving system may further include a sensor for detecting at least one of luminance and color of light emitted from the light source, and at the same time, the control board may further include a micro-controller for determining the outputs of the red, green and blue LEDs so as to conform the at least one of luminance and

color of the light detected by the sensor with predetermined luminance and color of light. In this embodiment, the at least one of each of red, green and blue LED constant current controllers regulates the current running through the red, green and blue LED arrays, respectively, so as to maintain the outputs of the red, green and blue LEDs determined by the micro-controller, thereby maintaining a predetermined magnitude of current to each of the red, green and blue LED arrays.

[0013] In an exemplary embodiment of the present invention, the substrate has a plurality of divided regions, and one red LED array, one green LED array and one blue LED array are disposed in each of the divided regions. Also, the red LED constant current controller is provided for the one red LED array, the green LED constant current controller is provided for the one green LED array, and the blue LED constant current controller is provided for the one blue LED array, thereby providing constant current to the red, green and blue LED arrays, respectively.

[0014] In addition, as one red LED DC-DC converter, one green DC-DC converter, and one blue LED DC-DC converter are provided in the SMPS, the drive voltage outputted from each of the DC-DC converters is applied in the same fashion to each of all LED arrays. In this respect, each of the plurality of red LED arrays should have an equal number of the red LEDs, each of the plurality of green LED arrays should have an equal number of the green LEDs, and each of the plurality of blue LED arrays should have an equal number of the blue LEDs.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The above and other aspects, features and other advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

[0016] FIG. 1 is a configuration view illustrating a conventional LCD backlight driving system having LEDs;

[0017] FIG. 2 is a configuration view illustrating an LCD backlight driving system having LEDs according to the present invention;

[0018] FIG. 3 is a configuration view illustrating a circuit of an LCD backlight driving system according to another embodiment of the present invention; and

[0019] FIG. 4 is a configuration view illustrating a circuit of an LCD backlight driving system according to further another embodiment of the present invention.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0020] Exemplary embodiments of the present invention will now be described in detail with reference to the accompanying drawings. The invention may however be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, the shapes and dimensions may be exaggerated for clarity, and the same reference numerals will be used throughout to designate the same or like components.

[0021] FIG. 2 is a configuration view illustrating an LCD backlight driving system having LEDs according to an embodiment of the present invention.

[0022] Referring to FIG. 2, the LCD backlight driving system having LEDs according to an embodiment of the present invention broadly includes an SMPS 21, a control board 22, and a light source 23, and additionally a sensor 24.

[0023] The SMPS 21 includes an AC-DC converter 211 for receiving an externally supplied AC voltage to a predetermined magnitude of DC voltage; a red LED DC-DC converter 212 for converting the DC voltage converted from the AC-DC converter 211 to a predetermined magnitude of DC voltage suitable for driving at least one red LED array with a plurality of red LEDs emitting red light connected in series; a green LED DC-DC converter 213 for converting the DC voltage converted by the AC-DC converter 211 to a predetermined magnitude of DC voltage suitable for driving at least one green LED array with a plurality of green LEDs emitting green light connected in series; and a blue LED DC-DC converter 214 for converting the DC voltage converted by the AC-DC converter 211 to a predetermined magnitude of DC voltage suitable for driving at least one blue LED array with a plurality of LEDs emitting blue light connected in series. Each of the red, green and blue LED DC-DC converters 212, 213 and 214 may adopt a Pulse Width Modulation (PWM) boost or buck DC-DC converter, in which an on-off duty of a switching device is regulated to convert an input DC voltage to a desired magnitude of DC voltage.

[0024] The control board 22 includes at least one of each of red, green and blue LED constant current controllers 221, 222 and 223, each of which regulates the output voltage from each of the red, green and blue LED DC-DC converter 212, 213 and 214, respectively, to maintain a predetermined output of current supplied to the red, green and blue LED arrays, respectively. In addition, in the case where the LCD backlight driving system according to the present invention further includes a sensor 24 for detecting luminance and/or color of the light emitted from the light source, the control board 22 further includes a micro-controller 224 for determining the outputs of the red, green and blue LEDs so that the luminance and color of the light detected by the sensor 24 is conformed to predetermined luminance and color of light.

[0025] The light source 23 includes at least one red LED array, at least one green LED array and at least one blue LED array, and a substrate 231 on which the red, green and blue LED arrays are disposed in such an arrangement that light beams from the LEDs are mixed into white light. The red, green and blue LED arrays are disposed in an arrangement that allows mixing of the light beams therefrom to produce white light. In FIG. 2, the reference numeral '232' denotes the LED, and the LED array is not shown in detail for the simplicity of the drawings.

[0026] Preferably, the substrate 231 of the light source 23 has a plurality of divided regions 231a to 231d, and one red LED array, one green LED array and one blue LED array are disposed in each of the divided regions 231a to 231d. One red LED constant current controller 233 is disposed in the control board 22 corresponding to one red LED array. In the same manner, one green LED constant current controller 234 is disposed in the control board 22 corresponding to one green LED array, and one blue LED constant current controller 235 is disposed in the control board 22 corresponding to one blue LED array. That is, the number of divided regions 231a to 231d, the number of each of the red, green

and blue LED arrays, and the number of each of the red, green and blue LED constant current controllers **221**, **222** and **223** are all equal.

[0027] In FIG. 2, the substrate **231** is illustrated to have four divided regions **231a** to **231d**, but the number of divided regions can be variously modified according to the size or application form of the LCD panel.

[0028] The sensor **24** detects luminance and/or color of the light outputted from the light source **23**. The sensor **24** can be composed of one sensor detecting the luminance and/or color of the light outputted from the entire light source **23**, or can be composed of multiple sensors for detecting the luminance and/or color of the light emitted from the respective divided regions **231a** to **231d** of the substrate **231**.

[0029] Now, the operations and effects of the invention will be explained in detail with reference to the accompanying drawings.

[0030] As shown in FIG. 2, the backlight driving system according to the present invention receives an externally supplied AC voltage as a power source for driving the LEDs of the light source **23**. The externally supplied AC voltage is converted to a DC voltage in a suitable form by the SMPS **21**.

[0031] First, the externally supplied AC voltage is converted to a DC voltage of a predetermined magnitude by the AC-DC converter **211**. The AC-DC converter **211** may include an EMI filter, a rectifier, a power factor corrector, etc. as known to those skilled in the art.

[0032] Then, each of the red LED DC-DC converter **212**, the green LED DC-DC converter **213** and blue LED DC-DC converter **214** converts the predetermined magnitude of DC voltage outputted from the AC-DC converter **211** to a predetermined magnitude of voltage suitable for driving each of the red, green and blue LED arrays.

[0033] For example, supposing that the magnitude of the output DC voltage from the AC-DC converter **211** is 380V, the red LED array is made up of 30 red LEDs, and the driving voltage required for one red LED is 3.3V, the red LED DC-DC converter **212** converts the DC voltage of 380V to a voltage necessary for driving the 30 red LEDs connected in series, which is 100V in this case. Each of the green and blue LED DC-DC converters **213** and **214** converts the voltage of 380V to a magnitude of voltage necessary to drive all of the LEDs included in the corresponding color LED array. The drive voltage converted by each of the red, green and blue LED DC-DC converters **212**, **213** and **214** is applied to each of the plurality of LED arrays in the same manner, and thus each color LED array should be composed of an equal number of LEDs connected in series in order for uniform luminance.

[0034] In the present invention, rather than the single DC-DC converter included in the conventional SMPS, a plurality of DC-DC converters are included in the SMPS to drive the respective colors of LED arrays. This improves the efficiency of the driving system with omission of the unnecessary DC-DC conversion processes and reduces the number of components. In addition, the respective colors of LED DC-DC converters, which are included in the drive board according to the prior art, are included in the SMPS according to the present invention to reduce the area occupied by the drive board. Moreover, according to the present invention, the same color LEDs are operated commonly by only one DC-DC converter to significantly reduce the number of components.

[0035] The drive voltage, provided from each of the red, green and blue LED DC-DC converters **212**, **213** and **214** in the SMPS **21**, is regulated by each of the red, green and blue LED constant current controllers **221**, **222** and **223** and provided to each of the red, green and blue LED arrays in the form of a predetermined magnitude of current. Therefore, the number of each of the red, green and blue LED constant current controllers **231**, **232** and **233** equals to the number of each of the red, green and blue LED arrays, and one of each of the red, green and blue LED constant current controllers **221**, **222** and **223** is connected to one of each of the red, green and blue LED arrays to drive the same.

[0036] In addition, when the luminance and/or color of the mixed light from the respective color LEDs is detected by the sensor **14**, the information on the luminance and/or color of the light detected by the sensor **24** is transmitted to the micro-controller **25** in the control board **22**. The micro-controller **25** determines the outputs of the red, green and blue LEDs to conform to predetermined luminance and color of light, and regulates the drive voltage received from the each of the red, green and blue LED constant current controllers **221**, **222** and **223** to provide a predetermined magnitude of current to respective color LED arrays.

[0037] In the meantime, the substrate **231** of the light source **23** is divided into a plurality of regions **231a** to **231d**. In each of the divided regions, one red LED array, one green LED array and one blue LED array can be provided. These divided regions **231a** to **231d** serve the purpose of distinguishing one set of the LED arrays controlled by one set of the constant current controllers **221**, **222**, **223** from other set of the LED arrays, and serve the purpose of local dimming in which the luminance and/or color is individually controlled for each of the divided regions, in the case where a plurality of sensors are provided to detect the luminance and/or color from the respective divided regions.

[0038] Now, various embodiments of the present invention will be explained in detail with reference to the accompanying drawings.

[0039] FIG. 3 is a configuration view illustrating a circuit of the LCD backlight driving system having LEDs according to another embodiment of the present invention. FIG. 3 illustrates an embodiment in which the current running through the LED array **331** of the light source **33** is fed back to control the output voltage of the LED DC-DC converter **312** in the SMPS **31**. In this embodiment, the output of one single LED DC-DC converter **312** in the SMPS **31** is controlled according to the current of the LED array **331**. Thus, this embodiment can be applied only to a light source having one of each of the red, green and blue LED arrays. For the sake of convenience in explanation, FIG. 3 illustrates only one color LED array. Therefore, the same configurations of the LED array, the constant current controller and the DC-DC converter can be provided for each color.

[0040] As shown in FIG. 3, this embodiment adopts a buck type DC-DC converter **312** with a diode **D** and an inductor **L** connected. The light outputted from the LED array **331** is detected by the sensor **34**, and the detection result is transmitted to the micro-controller **35**. The micro-controller **35** transmits a suitable control current to a current amplifier **3321** in the constant current controller **332** in the light source **33** so as to maintain a preset output according to the light output detected. The current amplifier **3321** amplifies the control current of the micro-controller **35** and provides the amplified control current to a base end of a

transistor TR having a collector connected to an output end of the LED array and an emitter connected to an anode of the diode D of the DC-DC converter 312, thereby regulating the output of the DC-DC converter 312. This allows regulation of the constant current for the LED array 331.

[0041] In addition, the constant current controller 332 may further include various detection resistors R1 and R2; a PWM IC 3322 which outputs a pulse signal with a duty controlled such that the on/off time of a switch S1 is controlled in accordance with the voltage value detected from the detection resistors R1 and R2; and a protection circuit 3323 which drives the PWM IC 3322 so as to block over voltage from voltage values detected by the detection resistors R1 and R2.

[0042] FIG. 4 is a configuration view of a circuit of a LCD backlight driving system having LEDs according to further another embodiment of the present invention. FIG. 4 illustrates an embodiment with a flyback type DC-DC converter 412 applied, in which the current outputted from the LED array 431 is directly controlled by the constant current controller 432 in the light source 43. In the embodiment shown in FIG. 4, the constant current controller can be provided for each LED array, and thus the embodiment can be applied to a light source having a plurality of LED arrays for each of the different colors. In the meantime, FIG. 4 illustrates one LED array for the sake of convenience in explanation, but there can be provided the same configuration of constant current controller for each of the plurality of LED arrays.

[0043] As shown in FIG. 4, this embodiment adopts a flyback type DC-DC converter 412 with a coil transformer applied thereto. The light output from the LED array 431 is detected by the sensor 44, and the detection result is transmitted to the micro-controller 45. The micro-controller 45 determines a magnitude of current that maintains a predetermined output, in accordance with the detected light output. Then, the constant current controller 432 regulates the current running through the LED array 431 to maintain the magnitude of current determined by the micro-controller 45.

[0044] In the meantime, the flyback type DC-DC converter 412 may include a comparator 4121 for comparing the output voltage with a reference voltage Vref, and a PWM IC 4122 for regulating the voltage at a primary coil by PWM method according to the comparison result.

[0045] According to the present invention set forth above, DC-DC converters for driving respective color LEDs are provided in an SMPS, omitting unnecessary DC-DC conversion processes taken place in the conventional SMPS, thereby improving circuit efficiency. In addition, the plurality of DC-DC converters for respective color LEDs provided in the conventional drive board are provided in the SMPS, thereby significantly reducing the number of components, power consumption and the size of the drive board.

[0046] While the present invention has been shown and described in connection with the exemplary embodiments, it will be apparent to those skilled in the art that modifications and variations can be made without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A liquid crystal display backlight driving system comprising:

a light source including at least one red Light Emitting Diode (LED) array with a plurality of red LEDs emitting

red light connected in series, at least one green LED array with a plurality of green LEDs emitting green light connected in series, and at least one blue LED array with a plurality of blue LEDs emitting blue light connected in series, and a substrate on which the red, green and blue LED arrays are disposed in such an arrangement that light beams from the LEDs are mixed into white light;

a Switch Mode Power Supply (SMPS) having an AC-DC converter for converting an externally inputted AC voltage to a DC voltage, a red LED DC-DC converter for converting the DC voltage, converted from the AC-DC converter, to a predetermined magnitude of DC voltage suitable for driving the red LED array, a green LED DC-DC converter for converting the DC voltage, converted from the AC-DC converter, to a predetermined magnitude of DC voltage suitable for driving the green LED array, and a blue LED DC-DC converter for converting the DC voltage, converted from the AC-DC converter, to a predetermined magnitude of DC voltage suitable for driving the blue LED array; and

a control board including at least one red LED constant current controller for regulating current running through the red LED array, at least one green LED constant current controller for regulating current running through the green LED array, and at least one blue LED constant current controller for regulating current running through the blue LED array to maintain predetermined outputs of the red, green and blue LEDs.

2. The liquid crystal backlight driving system according to claim 1, further comprising a sensor for detecting at least one of luminance and color of light emitted from the light source,

wherein the control board further includes a micro-controller for determining the outputs of the red, green and blue LEDs so as to conform the at least one of luminance and color of the light detected by the sensor with predetermined luminance and color of light, and

wherein the at least one of each of red, green and blue LED constant current controllers regulate the current running through the red, green and blue LED arrays, respectively, so as to maintain the outputs of the red, green and blue LEDs determined by the micro-controller.

3. The liquid crystal display backlight driving system according to claim 1, wherein the substrate has a plurality of divided regions, and one red LED array, one green LED array and one blue LED array are disposed in each of the divided regions, and

wherein the red LED constant current controller is provided for the one red LED array, the green LED constant current controller is provided for the one green LED array, and the blue LED constant current controller is provided for the one blue LED array.

4. The liquid crystal display backlight driving system according to claim 1, wherein the red LED array comprises a plurality of red LED arrays, the green LED array comprises a plurality of green LED arrays and the blue LED array comprises a plurality of blue LED arrays, and

wherein each of the plurality of red LED arrays has an equal number of the red LEDs, each of the plurality of green LED arrays has an equal number of the green LEDs, and each of the plurality of blue LED arrays has an equal number of the blue LEDs.

\* \* \* \* \*

专利名称(译)	具有发光二极管的液晶显示器驱动系统		
公开(公告)号	<a href="#">US20080002103A1</a>	公开(公告)日	2008-01-03
申请号	US11/806309	申请日	2007-05-31
[标]申请(专利权)人(译)	李相云		
申请(专利权)人(译)	李相云		
当前申请(专利权)人(译)	李相云		
[标]发明人	LEE SANG YUN		
发明人	LEE, SANG YUN		
IPC分类号	G02F1/13357 F21V23/04 F21S2/00 F21V23/00 F21Y101/02 G02F1/133 H01L33/00 H05B37/02		
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优先权	1020060059100 2006-06-29 KR		
外部链接	<a href="#">Espacenet</a> <a href="#">USPTO</a>		

摘要(译)

一种LCD背光驱动系统，包括光源，所述光源由红色，绿色和蓝色LED阵列中的每一个中的至少一个组成，每个LED阵列具有串联连接的多个对应的彩色LED，以及其上具有红色，绿色和蓝色的基板。设置LED阵列以发射白光。该系统还包括SMPS，其具有用于将外部输入的AC电压转换为DC电压的AC-DC转换器以及红色，绿色和蓝色LED DC-DC转换器，每个转换器将DC电压转换为适合于驱动该DC电压的预定幅度的DC电压。分别对应的彩色LED阵列。该系统还包括控制板，该控制板具有红色，绿色和蓝色LED恒定电流控制器中的每一个中的至少一个，用于调节流过红色，绿色和蓝色LED阵列的电流，以维持红色，绿色和蓝色LED的预定输出。

