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(74) Agent: **HAW, Yong Noke**; 8th Fl. Songchon Bldg.,
642-15, Yoksam-dong, Kangnam-ku, Seoul 135-080 (KR).

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(71) Applicant (*for all designated States except US*): **LG INNOTEK CO., LTD** [KR/KR]; 14th Fl. Hansol Bldg., 736-1, Yoksam-dong, Kangnam-gu, Seoul 135-983 (KR).

(72) Inventors; and

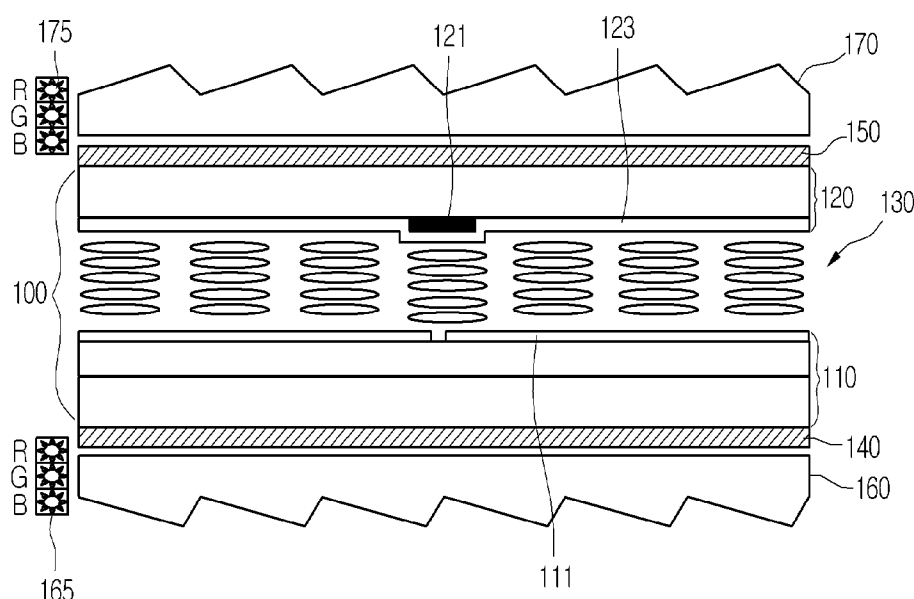
(75) Inventors/Applicants (*for US only*): **HWANG, Hyun Ha** [KR/KR]; 303, Sumoktwinvill, 36-2, Samsung-dong, Kangnam-gu, Seoul 135-090 (KR). **KIM, Sung Ho** [KR/KR]; 164-506, Lg Apt., Hwaseo2-dong, Jangan-gu, Suwon-shi, Kyoungki-do 442-150 (KR).

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(54) Title: LIQUID CRYSTAL DISPLAY DEVICE, DRIVING METHOD THEREOF AND MOBILE STATION HAVING THE SAME



(57) Abstract: A liquid crystal display device includes a transmissive liquid crystal panel having no color filter, a first front light unit disposed on front side of the transmissive liquid crystal panel to sequentially irradiate red, green, and blue light, and a second front light unit disposed on rear side of the transmissive liquid crystal panel to sequentially irradiate red, green, and blue light.

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Description

LIQUID CRYSTAL DISPLAY DEVICE, DRIVING METHOD THEREOF AND MOBILE STATION HAVING THE SAME

Technical Field

- [1] The present invention relates to a liquid crystal display device capable of displaying an image on both front and rear surfaces of a liquid crystal panel using one transmissive liquid crystal panel, a driving method thereof, and a mobile station having the same.

Background Art

- [2] Among display devices for displaying an image on a screen, a Braun tube display device (or, cathode ray tube (CRT)) has been most popularly used. However, the CRT has several disadvantages that it is bulky and heavy in comparison with its display area.
- [3] Accordingly, a thin film type flat panel display device, which can be easily used anywhere because of its slimness, has been developed, and is gradually substituting the Braun tube display device. In particular, a liquid crystal display device has an excellent resolution in comparison with other flat panel display devices, and the response time of the LCD device has become almost as fast as the Braun tube display device, when displaying moving pictures.
- [4] The principles of the optical anisotropy and polarization of liquid crystals are employed in driving such an LCD device. The liquid crystal has an elongate structure, and it has a direction and a polarizability of a molecule array. Accordingly, the direction of the molecule array can be controlled by artificially applying an electric field to the liquid crystal. When the alignment direction is controlled by such an electric field, a light is transmitted or blocked according to the alignment direction of the liquid crystal molecules due to the optical anisotropy of the liquid crystal, thereby displaying colors and images.
- [5] In an active matrix LCD, an active device with a nonlinear characteristic is added into each of pixels arranged in a shape of matrix. Thus, an operation of each pixel is controlled using a switching characteristic of this active device.
- [6] Meanwhile, in recent years, various researches for a dual display have been undertaken, which is capable of displaying an image on both front and rear surface thereof.
- [7]

Disclosure of Invention

Technical Problem

[8] The present invention is to provide an LCD capable of displaying an image on both front and rear surfaces of a liquid crystal panel using one transmissive liquid crystal panel and a driving method thereof.

[9] And the present invention is to provide a slim type mobile station capable of displaying an image on both front and rear surfaces of an LCD using the LCD having one transmissive liquid crystal panel.

[10]

Technical Solution

[11] The present invention provides an LCD including: a transmissive liquid crystal panel having no color filter; a first front light unit disposed on a front side of the transmissive liquid crystal panel to irradiate red, green, and blue light; and a second front light unit disposed on a rear side of the transmissive liquid crystal panel to irradiate red, green, and blue light.

[12] The present invention provides a driving method of a liquid crystal display device, which includes a transmissive liquid crystal panel having no color filter, a first front light unit disposed on a front side of the transmissive liquid crystal panel to supply red, green, and blue light, and a second front light unit disposed on a rear side of the transmissive liquid crystal panel to supply red, green, and blue light. the driving method includes driving the liquid crystal display device in a first display mode displaying an image corresponding to one frame on the rear surface of the transmissive liquid crystal panel using irradiated red, green, and blue light from the first front light unit and a second display mode displaying an image corresponding to one frame on the front surface of the transmissive liquid crystal panel using irradiated red, green, and blue light from the second front light unit.

[13] The present invention provides a mobile station including: an LCD having a transmissive liquid crystal panel having no color filter, a first front light unit disposed on front side of the transmissive liquid crystal panel to irradiate red, green, and blue light, and a second front light unit disposed on rear side of the transmissive liquid crystal panel to irradiate red, green, and blue light; a communication unit for communicating with the exterior; and a control unit controlling the communication unit and an image display of the LCD.

[14]

Advantageous Effects

[15] According to the present invention, there is provided the LCD capable of displaying an image on both front and rear surfaces of a liquid crystal panel using one transmissive liquid crystal panel and a driving method thereof.

[16] And according to the present invention, there is provided a slim type mobile station

capable of displaying an image on both front and rear surfaces of an LCD using the LCD having one transmissive liquid crystal panel.

[17]

Brief Description of the Drawings

[18] Fig. 1 is a schematic view illustrating a constitution of an LCD according to the present invention.

[19] Fig. 2 is a view illustrating an image display using a light supplied from a second front light unit, in the LCD according to the present invention.

[20] Fig. 3 is a view illustrating an image display using a light supplied from a first front light unit, in the LCD according to the present invention.

[21] Fig. 4 is a view illustrating a driving signal of a front light unit and a data signal applied to the LCD according to the present invention.

[22] Figs. 5 and 6 are views illustrating an opening ratio difference between a related art LCD and the LCD according to the present invention.

[23]

Mode for the Invention

[24] Hereinafter, embodiments of the present invention will be described in detail with reference to accompanying drawings.

[25] Fig. 1 is a schematic view illustrating a constitution of an LCD according to the present invention.

[26] The LCD according to the present invention, as illustrated in Fig. 1, includes a transmissive liquid crystal panel 100, and a first front light unit 170 and a second front light unit 160 supplying a light for an image display.

[27] The LCD according to the present invention can display an image on rear surface of the transmissive liquid crystal panel 100 by driving the first front light unit 170 disposed in front of the transmissive liquid crystal panel 100. Also, the LCD according to the present invention can display an image on front surface of the transmissive liquid crystal panel 100 by driving the second front light unit 160 disposed in rear side of the transmissive liquid crystal panel 100. Accordingly, an image can be displayed on both and rear surfaces of the transmissive liquid crystal panel 100.

[28] More specifically, as illustrated in Fig. 2, the LCD according to the present invention can be driven in a first display mode displaying an image on rear surface of the transmissive liquid crystal panel 100 using sequentially irradiated red, green light, and blue light from the first front light unit 170. Also, as illustrated in Fig. 3, the LCD according to the present invention can be driven in a second display mode displaying an image on front surface of the transmissive liquid crystal panel 100 using sequentially irradiated red, green, and blue light from the second front light unit 160.

- [29] The present invention employs the transmissive liquid crystal panel 100 having no color filter. A first light source 175 and a second light source 165 are provided respectively in the first front light unit 170 and the second front light unit 160. The first light source 175 and the second light source 165 are formed so as to supply red, green, and blue light. For example, the first light source 175 and the second light source 165 may include a red light emitting diode (LED), a green LED, and a blue LED, or include a red cold cathode fluorescent lamp (CCFL), a green CCFL, and a blue CCFL.
- [30] As described above, red, green, and blue light is supplied from the first front light unit 170 and the second front light unit 160, such that the LCD according to the present invention can display a color image without a color filter. That is, a desired color image can be displayed by irradiating sequentially supplied red, green, and blue light from the first front light unit 170 and the second front light unit 160 at certain intervals. A driving method of the LCD will be described more specifically later.
- [31] Meanwhile, the LCD is configured with a first substrate 110, a second substrate 120, a liquid crystal layer 130, a first polarizer 140, and a second polarizer 150. Since detail illustrations for these elements are well known already, explanations will be schematically described herein.
- [32] The first substrate 110 is configured with an array device having a thin film transistor, and a pixel electrode 111 formed on the array device to display an image by transmitting an incident light.
- [33] The array device includes a plurality of gate lines formed in a first direction, a plurality of data lines formed perpendicular to the gate lines, a pixel region defined by the gate line and the data line, and a thin film transistor formed at a region where the gate line and the data line are intersected with each other. Herein, a semiconductor layer constituting the thin film transistor may be formed of an amorphous silicon layer or a poly-silicon layer. Since a number of studies have been performed about processes of manufacturing a thin film transistor using an amorphous silicon layer or a poly-silicon layer, explanations for the method will be omitted.
- [34] In addition, the second substrate 120 is disposed opposite to the first substrate 110. The second substrate 120 includes a black matrix 121 formed opposite to a portion between the pixel electrodes 111 of the first substrate 110, and a common electrode 123 formed under the black matrix 121 and/or the second substrate 120.
- [35] The liquid crystal layer 130 is filled between the first and second substrates 110 and 120. The first polarizer 140 and the second polarizer 150 are disposed respectively under the first substrate 110 and on the second substrate 120.
- [36] Herein, the polarizers 140 and 150 may include a quarter-wave plate.
- [37] A driving method of the LCD having the above structure will be set forth with reference to FIG. 4. Fig. 4 is a view illustrating a driving signal of the front light unit

and a data signal applied to the LCD according to the present invention.

- [38] In Fig. 4, turn-on times of red/green/blue light sources of the front light unit for displaying a color image is illustrated considering a response time of the liquid crystal panel. When applying such a field sequential driving, a time, for which red, green, and blue light sources are turned on, need to be made longer in order to increase the brightness. In this case, it is advantageous that an address time and a response time of the liquid crystal are short.
- [39] However, there are limits to decrease of the address time, which is defined by a driving circuit and a resolution. Accordingly, when applying the field sequential driving, in general, it tends to make a response time of the liquid crystal as high as possible. Accordingly, the response time of the liquid crystal should be higher than 5.55 ms assigned to a sub frame in driving at 180 Hz so as to display an image by a normal field sequential driving.
- [40] When applying such a field sequential driving type, red, green, blue light sources provided in the front light unit are sequentially driven. The incident red, green, and blue light by sequential driving of each light sources are transmitted through an opening portion (pixel region), such that red, green, and blue colors are sequentially displayed. The red, green, and blue colors are displayed in the pixel region at a time interval, and the time interval is called 'a field'. The field sequential driving type means that colors are displayed by driving sequentially red, green, and blue light sources.
- [41] In the field sequential driving type LCD, a frame applied to a related art LCD is divided into three fields, and red, green, and blue light is irradiated to the liquid crystal panel from the front light unit during each fields. Generally, a time interval of one frame of the LCD driving at 60 Hz is 16.7 ms(1/60 s). Accordingly, a field of the field sequential driving type has a time interval of 5.55 ms(1/180 s). This time interval is so short, that human's eye can not feel the change in the field of such a short time interval. Therefore, human's eye recognizes the field changes as a combined time of 16.7 ms, such that a combined color of red, green, and blue can be recognized.
- [42] As described above, since the LCD according to the present invention includes light sources respectively emitting red, green, and blue light, the LCD can display a color image without a color filter. Accordingly, since an image is displayed using the liquid crystal panel without a color filter, light absorption by a color filter is not generated, thereby displaying an image with a high brightness.
- [43] Also, according to the present invention, because a unit pixel is not divided into subpixels of R, G and B, an opening ratio increases, and an image with a high resolution is displayed. This will be described with reference to Figs. 5 and 6. Figs. 5 and 6 are views illustrating an opening ratio difference between a related art LCD and the LCD according to the present invention.

- [44] In the related art LCD having a color filter, as illustrated in Fig. 5, three subpixels 201R, 201G and 201B displaying red, green, and blue color configure one unit pixel. In addition, a black matrix 203 is formed between the subpixels 201R, 201G and 201B. However, in the LCD according to the present invention, as illustrated in Fig. 6, a unit pixel 210 of a single structure can be formed without the subpixels of red, green, and blue color and the black matrix. Therefore, in the LCD according to the present invention, an opening ratio increases, and size of the unit pixel decreases, and thus it becomes easier to design the LCD with a high resolution.
- [45] Also, according to the present invention, the number of driving devices can decrease by driving the unit pixel corresponding to the related R, G and B subpixel, without driving each subpixels of R, G and B.
- [46] Meanwhile, the LCD having the above structure may be utilized as a dual display device. Accordingly, if applying the inventive LCD to the mobile station such as a mobile communication terminal, a personal digital assistant (PDA) or the like, the image can be displayed on both front and rear surfaces of the liquid crystal panel. Therefore, it is possible to implement various image display functions in the mobile station.
- [47] The mobile station includes the LCD described above, a communication unit communicating with the exterior, and a control unit controlling the communication unit and an image display of the LCD. Elements of the mobile station and functions thereof are well known, descriptions about this in detail will be omitted.

[48]

Industrial Applicability

- [49] According to the LCD of the present invention and a driving method thereof, there is an advantage of displaying an image on both front and rear surfaces of a liquid crystal panel using one liquid crystal panel.
- [50] Also, according to the present invention, there is another advantage of generating no light absorption by a color filter and displaying an image with a high brightness by using a liquid crystal panel without a color filter.
- [51] Also, according to the present invention, there is another advantage of increasing an opening ratio and displaying an image with a high resolution because a unit pixel is not divided into each subpixels of R, G and B.
- [52] Also, according to the present invention, there is another advantage of decreasing the number of driving devices of a data line to 1/3 by driving a unit pixel corresponding to related art subpixelss of R, G and B without driving each subpixels of R, G, and B.
- [53] Also, according to the mobile station of the present invention, there is another

advantage of providing a slim type mobile station capable of displaying an image on both surfaces of an LCD, using the LCD having one liquid crystal panel.

[54]

Claims

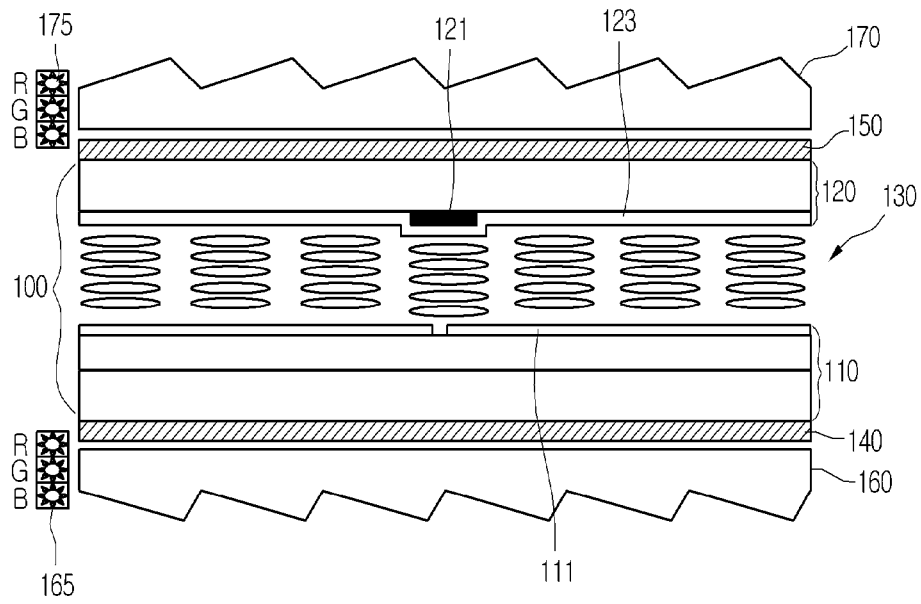
- [1] A liquid crystal display device comprising:
a transmissive liquid crystal panel having no color filter;
a first front light unit disposed on a front side of the transmissive liquid crystal panel to irradiate red, green, and blue light;
a second front light unit disposed on a rear side of the transmissive liquid crystal panel to irradiate red, green, and blue light.
- [2] The liquid crystal display device according to claim 1, wherein an image is displayed on both surfaces in a first display mode displaying an image on the rear surface of the transmissive liquid crystal panel using the sequentially irradiated red, green, and blue light from the first front light unit and a second display mode displaying an image on the front surface of the transmissive liquid crystal panel using the sequentially irradiated red, green, and blue light from the second front light unit.
- [3] The liquid crystal display device according to claim 1, wherein the first front light unit and the second front light unit include red, green, and blue light sources.
- [4] The liquid crystal display device according to claim 1, wherein the first front light unit and the second front light unit include red, green, and blue light emitting diodes.
- [5] The liquid crystal display device according to claim 1, wherein the first front light unit and the second front light unit include green, and blue cold cathode fluorescent lamps (CCFLs).
- [6] The liquid crystal display device according to claim 1, wherein the transmissive liquid crystal panel comprises:
a first substrate including an array device having a thin film transistor and a pixel electrode formed on the array device to display an image by transitting an incident light;
a second substrate formed opposite to the first substrate to include a black matrix formed opposite to a portion between the pixel electrodes of the first substrate;
and
a liquid crystal layer filled between the first substrate and the second substrate.
- [7] The liquid crystal display device according to claim 6, wherein the array device comprises:
a plurality of gate lines formed in a first direction;
a plurality of data lines formed perpendicular to the gate lines;
a pixel region defined by the gate line and the data line; and

a thin film transistor formed at a region where the gate line and the data line are intersected with each other.

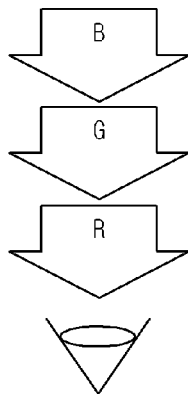
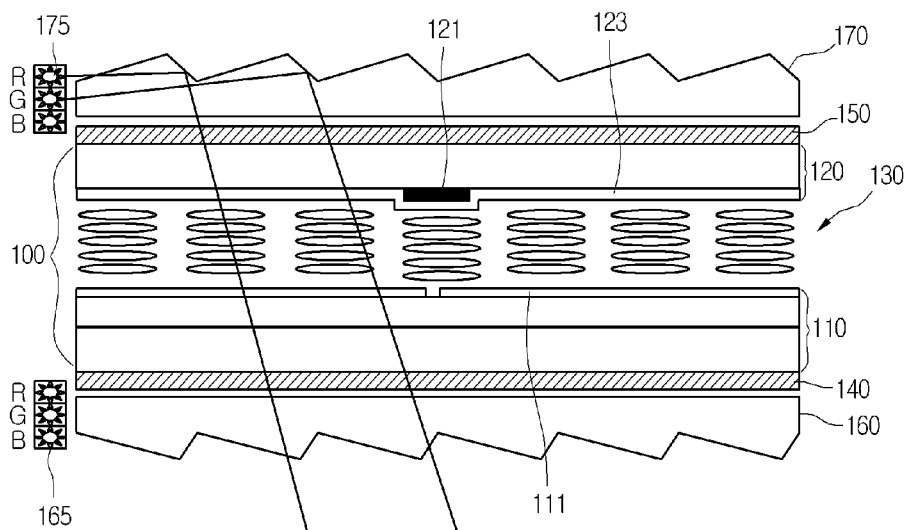
- [8] The liquid crystal display device according to claim 1, wherein the transmissive liquid crystal panel has a higher response time than 5.55 ms.
- [9] The liquid crystal display device according to claim 1, wherein a semiconductor layer formed on the transmissive liquid crystal panel is formed of an amorphous silicon layer or poly-silicon layer.
- [10] The liquid crystal display device according to claim 1, wherein polarizers are respectively formed on the front and rear surfaces of the transmissive liquid crystal panel.
- [11] A driving method of a liquid crystal display device, the liquid crystal display device including a transmissive liquid crystal panel having no color filter, a first front light unit disposed on a front side of the transmissive liquid crystal panel to supply red, green, and blue light, and a second front light unit disposed on a rear side of the transmissive liquid crystal panel to supply red, green, and blue light, the method comprising:
driving the liquid crystal display device in a first display mode displaying an image corresponding to one frame on the rear surface of the transmissive liquid crystal panel using irradiated red, green, and blue light from the first front light unit and a second display mode displaying an image corresponding to one frame on the front surface of the transmissive liquid crystal panel using irradiated red, green, and blue light from the second front light unit.
- [12] The method according to claim 11, wherein the first front light unit and the second front light unit include red, green, and blue light sources.
- [13] The method according to claim 11, wherein the transmissive liquid crystal panel has a higher response time than 5.55 ms.
- [14] The method according to claim 11, wherein red, green, and blue light supplied from the first front light unit and the second front light unit is sequentially irradiated at a time interval from each other to implement one image frame.
- [15] A mobile station comprising:
a liquid crystal display device including a transmissive liquid crystal panel having no color filter, a first front light unit disposed on a front side of the transmissive liquid crystal panel to irradiate red, green, and blue light, and a second front light unit disposed on rear side of the transmissive liquid crystal panel to irradiate red, green, and blue light;
a communication unit communicating with the exterior; and
a control unit controlling the communication unit and an image display of the liquid crystal display device.

- [16] The mobile station according to claim 15, wherein an image is displayed in a first display mode displaying an image on the rear surface of the liquid crystal display device using the sequentially irradiated red, green, and blue light from the first front light unit and a second display mode displaying an image on the front surface of the liquid crystal display device using the sequentially irradiated red, green, and blue light from the second front light unit.
- [17] The mobile station according to claim 15, wherein the transmissive liquid crystal panel has a higher response time than 5.55 ms.
- [18] The mobile station according to claim 15, wherein polarizers are respectively formed on the front and rear surfaces of the transmissive liquid crystal panel.

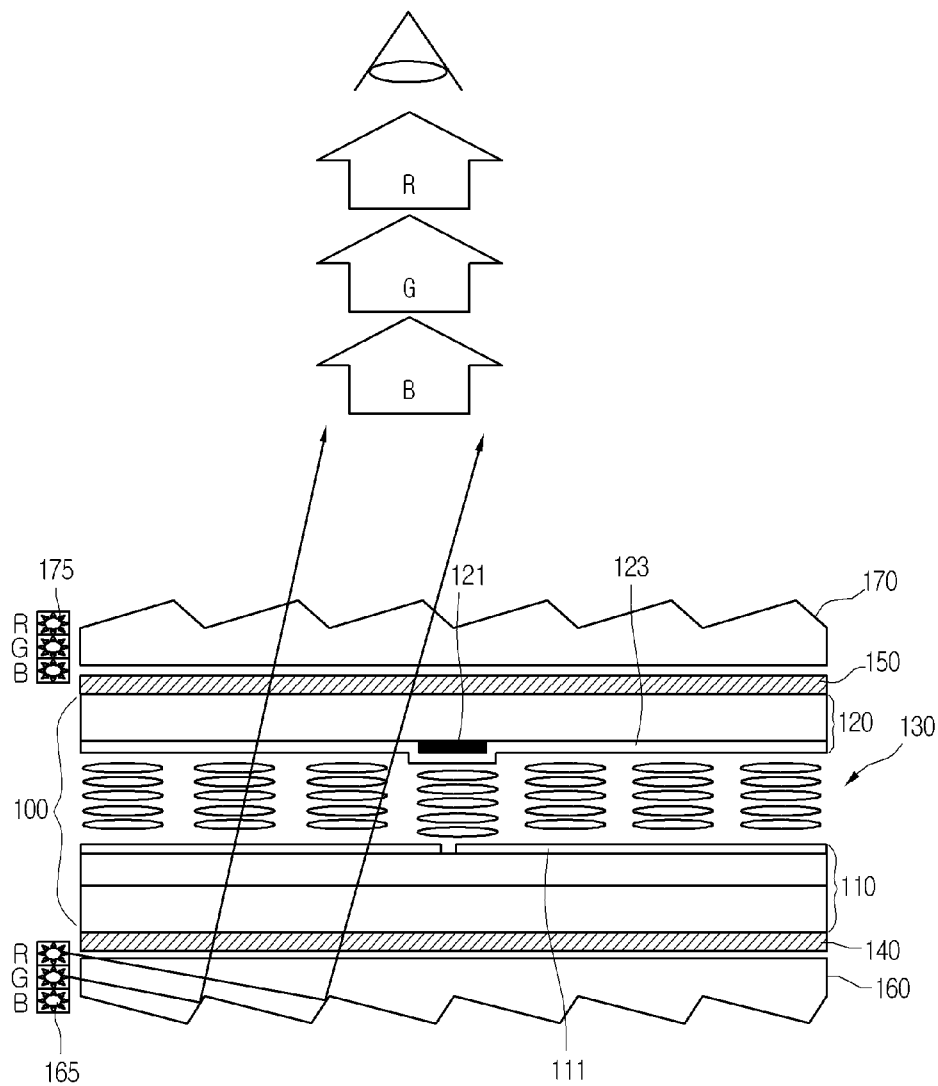
[Fig. 1]



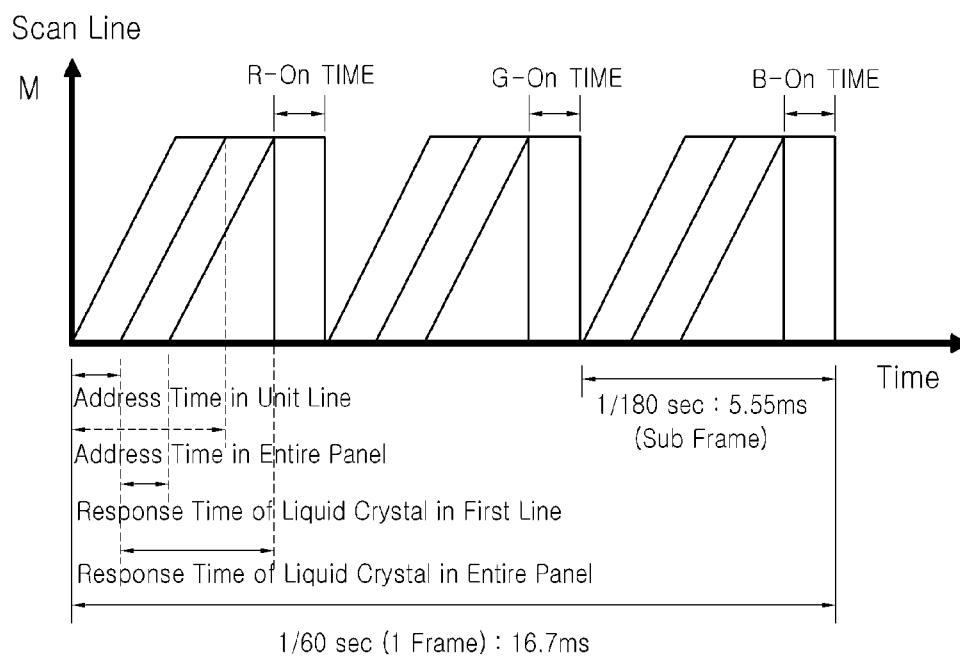
[Fig. 2]



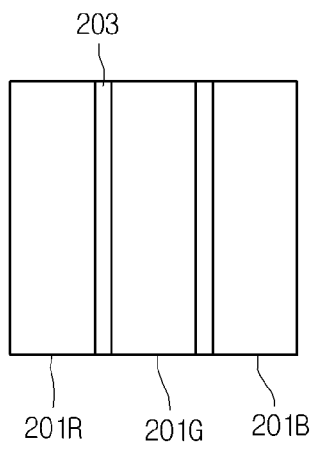
[Fig. 3]



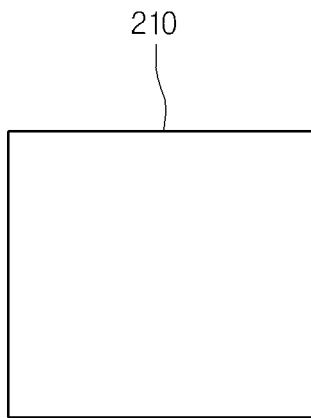
[Fig. 4]



[Fig. 5]



[Fig. 6]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2006/000540**A. CLASSIFICATION OF SUBJECT MATTER****G02F 1/13357(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC8 G02F 1/13

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applications for inventions since 1975

Korean Utility Models and applications for Utility Models since 1975

Japanese Utility Models and applications for Utility Models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP16104545 A (NEC ACCESS TECHNICA LTD) 04.02.2004 see the whole document	1-18
A	JP08211361 A (CASIO ELECTRON MFG CO LTD) 20.08.1996 see the whole document	1-18
A	KR 1020030049943 A (LG.PHILIPS LCD CO., LTD.) 25.06.2003 see the whole document	1-18
A	KR 1020030049944 A (LG.PHILIPS LCD CO., LTD.) 25.06.2003 see the whole document	1-18
A	KR 1020040098492 A (LG.PHILIPS LCD CO., LTD.) 20.11.2004 see the whole document	1-18



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

24 MAY 2006 (24.05.2006)

Date of mailing of the international search report

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Name and mailing address of the ISA/KR

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Facsimile No. 82-42-472-7140

Authorized officer

CHANG, Kyung Tae

Telephone No. 82-42-481-5769



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2006/000540

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		JP16348126A1	09.12.2004
		US20040246412A1	09.12.2004
		US2004183960A1	23.09.2004

专利名称(译)	液晶显示装置及其驱动方法和具有该液晶显示装置的移动台		
公开(公告)号	EP1851586A1	公开(公告)日	2007-11-07
申请号	EP2006715991	申请日	2006-02-17
[标]申请(专利权)人(译)	印诺泰克公司		
申请(专利权)人(译)	LG INNOTEK CO. , LTD.		
当前申请(专利权)人(译)	LG DISPLAY CO. , LTD.		
[标]发明人	HWANG HYUN HA KIM SUNG HO		
发明人	HWANG, HYUN HA KIM, SUNG HO		
IPC分类号	G02F1/13357		
CPC分类号	G02F1/133615 G02F1/133621 G02F2001/133342 G02F2001/133616 G02F2001/133622 G02F2203/01		
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优先权	1020050015737 2005-02-25 KR		
其他公开文献	EP1851586A4		
外部链接	Espacenet		

摘要(译)

一种液晶显示装置，包括不具有滤色器的透射式液晶面板，设置在透射式液晶面板的前侧以对红色，绿色和蓝色光进行瞬时照射的第一前光单元，以及设置的第二前光单元在透射型液晶面板的后侧，依次照射红色，绿色和蓝色光。