US007466301B2

(12) United States Patent
Sohn et al.

(10) Patent No.: US 7,466,301 B2
(45) Date of Patent: Dec. 16, 2008

(54) METHOD OF DRIVING A DISPLAY ADAPTIVE FOR MAKING A STABLE BRIGHTNESS OF A BACK LIGHT UNIT

(75) Inventors: **Min Ho Sohn**, Gwangmyung-shi (KR); **Seong Ho Baik**, Gwancheon-shi (KR)

(73) Assignee: **LG Display Co., Ltd.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 918 days.

(21) Appl. No.: **10/880,218**

(22) Filed: **Jun. 28, 2004**

(65) **Prior Publication Data**

US 2005/0104840 A1 May 19, 2005

(30) **Foreign Application Priority Data**

Nov. 17, 2003 (KR) 10-2003-0081174

(51) **Int. Cl.**
G09G 3/36 (2006.01)

(52) **U.S. Cl.** **345/102**; 345/84

(58) **Field of Classification Search** 345/87, 345/88, 89, 98, 99, 102, 55, 76, 84
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,756,954 B2 * 6/2004 Yamamoto et al. 345/87
7,113,163 B2 * 9/2006 Nitta et al. 345/102
2003/0222841 A1 * 12/2003 Hirosue 345/89
2004/0246275 A1 * 12/2004 Yoshihara et al. 345/690
2006/0050047 A1 * 3/2006 Jin et al. 345/102

FOREIGN PATENT DOCUMENTS

JP 2001-027890 1/2001
JP 2002-031846 1/2002
JP 2002-202767 7/2002
JP 2003-036063 2/2003
JP 2003-345315 12/2003

OTHER PUBLICATIONS

Preliminary Notice of Reasons for Rejection for corresponding Japanese Patent Application Serial No. 2004-192074, dated Nov. 27, 2007.

* cited by examiner

Primary Examiner—Chanh Nguyen
Assistant Examiner—Pegeman Karimi
(74) *Attorney, Agent, or Firm*—Brinks Hofer Gilson & Lione

(57) **ABSTRACT**

A driving method and apparatus for a liquid crystal display stabilizing variations in the brightness of a back light dependent upon brightness components extracted from data to be displayed are disclosed. In the method, the brightness components of each frame are arranged into a histogram, which is divided into a plurality of brightness areas. The most-frequent value of the brightness components or the average value of the brightness components is extracted. The brightness of a back light is controlled to correspond to the brightness areas to which the extracted most-frequent value or the average value belongs. One or more particular areas within the brightness areas are selected such that if the extracted most-frequent value or the average value belongs to the particular areas, the brightness of the back light may not be changed in successive frames.

26 Claims, 10 Drawing Sheets

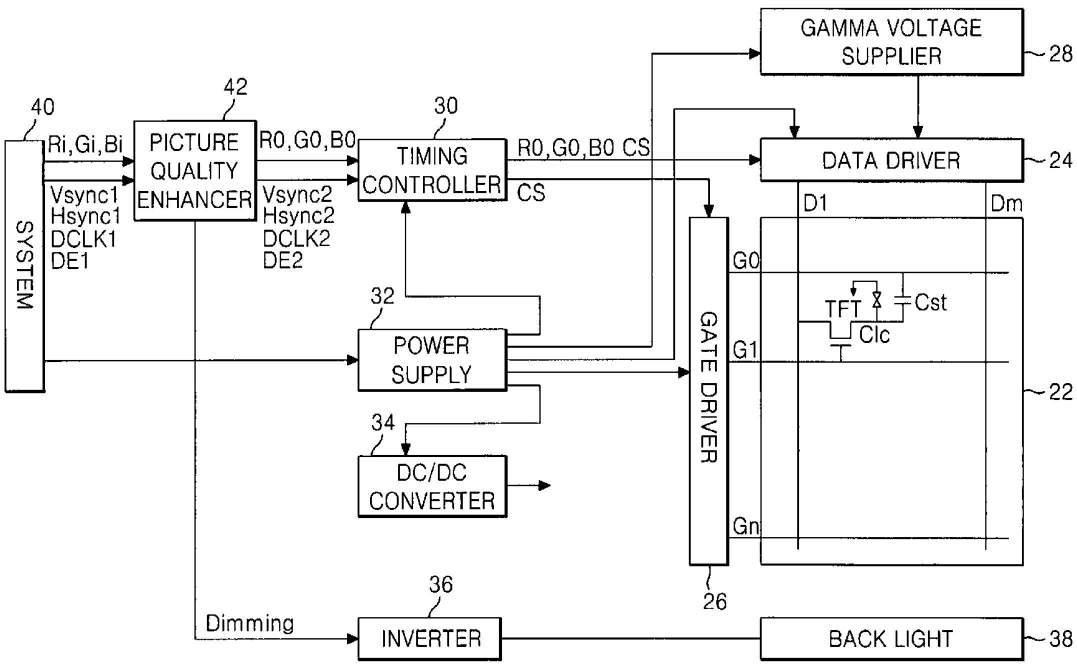


FIG. 1
RELATED ART

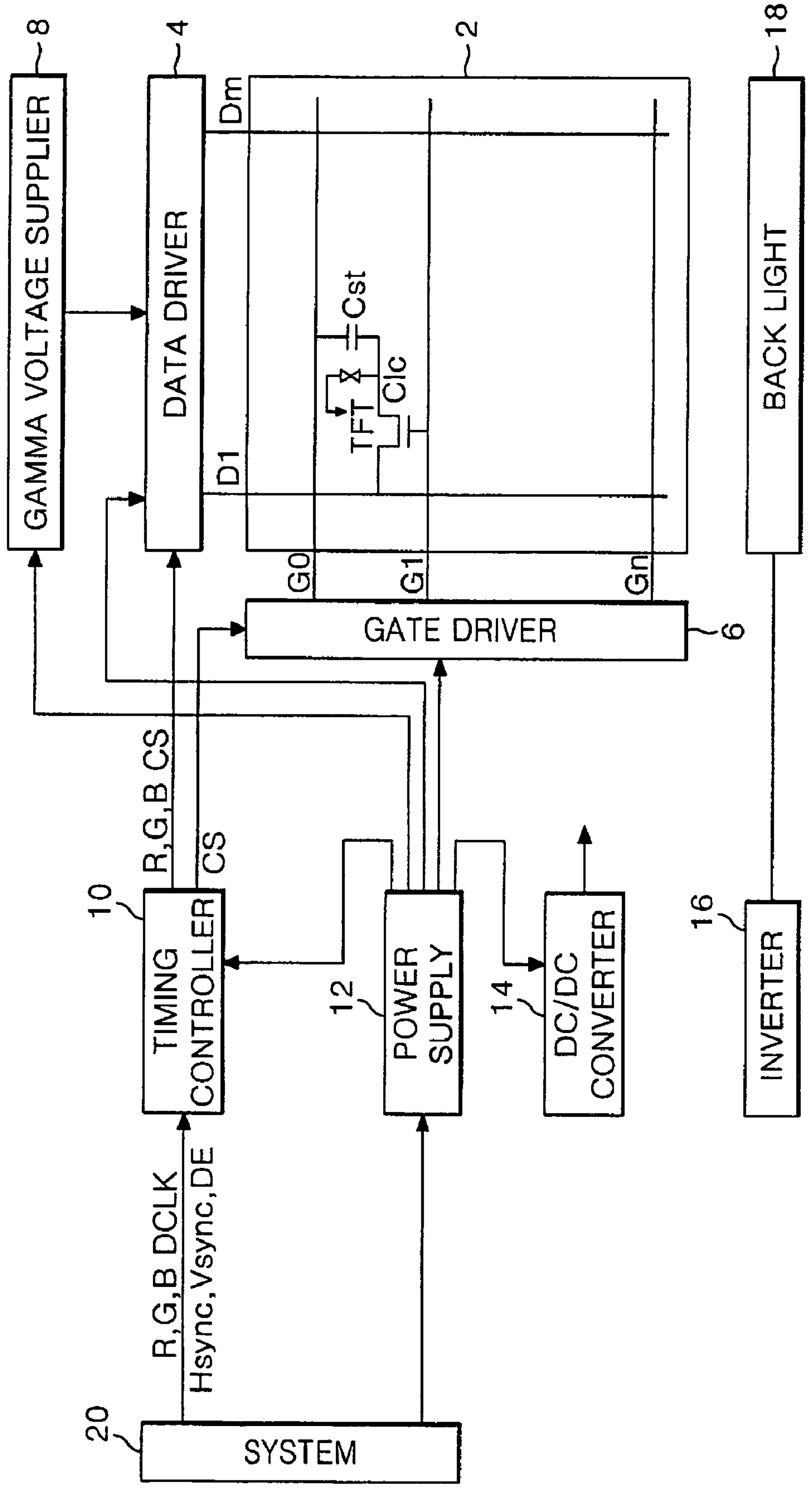


FIG. 2

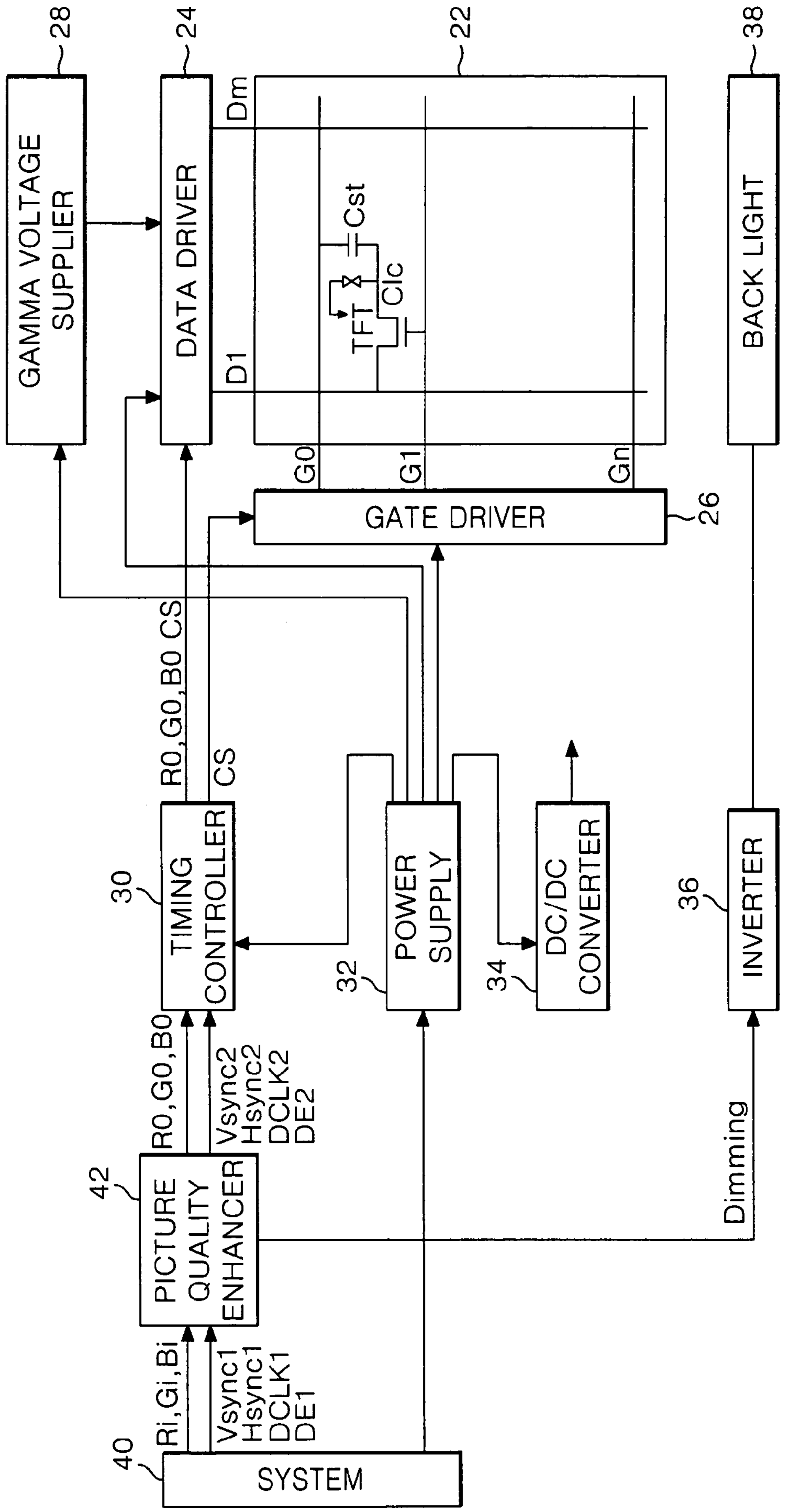

28
GAMMA VOLTAGE SUPPLIER
24
DATA DRIVER
22
Dm
D1
Cst
Clc
TFT
38
BACK LIGHT
G0
G1
Gn
GATE DRIVER
26
R0,G0,B0 CS
R0,G0,B0
CS
30
TIMING CONTROLLER
32
POWER SUPPLY
34
DC/DC CONVERTER
36
INVERTER
Vsync2
Hsync2
DCLK2
DE2
42
PICTURE QUALITY ENHANCER
Dimming
Ri,Gi,Bi
Vsync1
Hsync1
DCLK1
DE1
40
SYSTEM

FIG.3

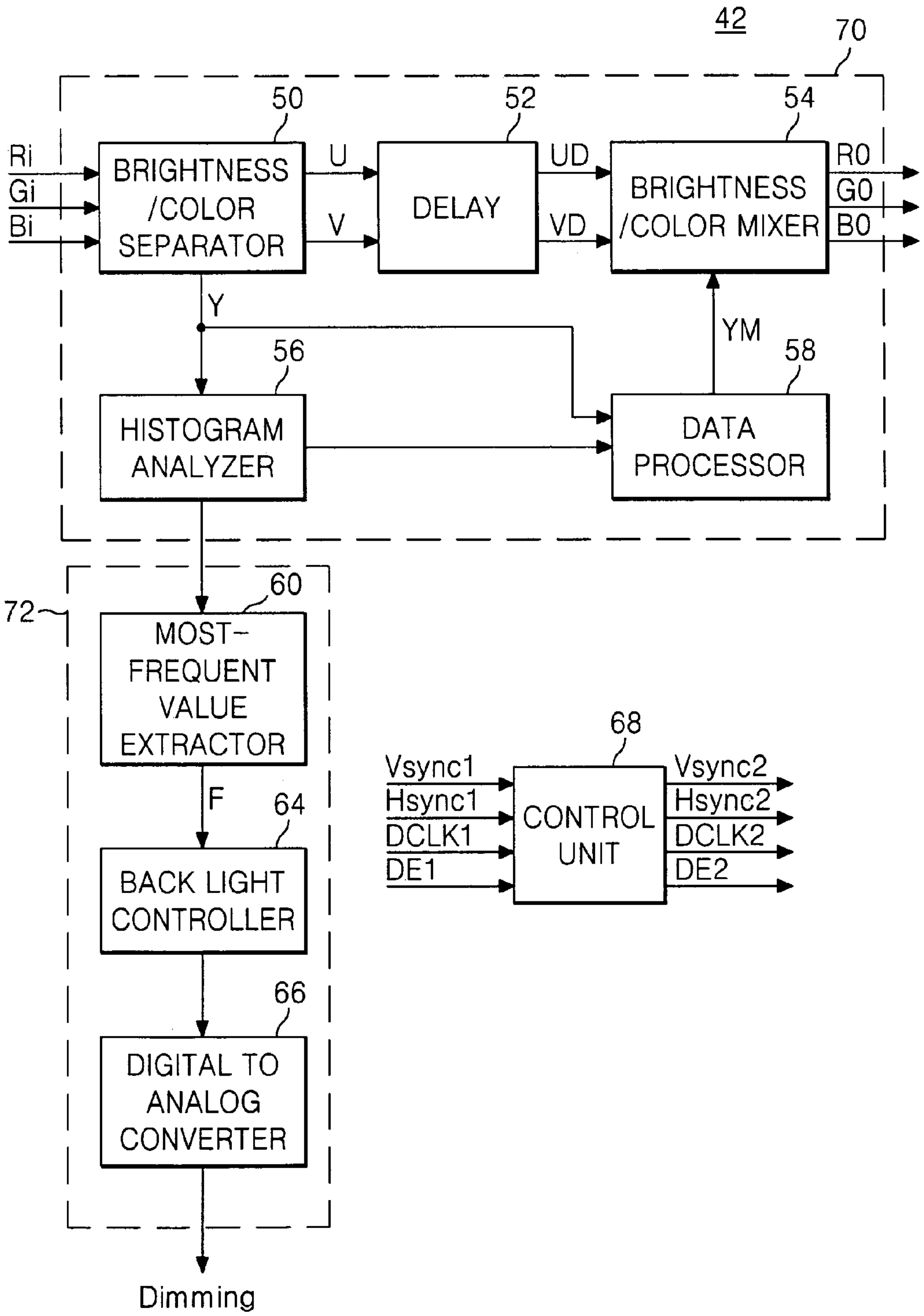

42
70
50
52
54
Ri
Gi
Bi
BRIGHTNESS /COLOR SEPARATOR
U
V
DELAY
UD
VD
BRIGHTNESS /COLOR MIXER
R0
G0
B0
Y
YM
56
58
HISTOGRAM ANALYZER
DATA PROCESSOR
72
60
MOST-FREQUENT VALUE EXTRACTOR
F
64
BACK LIGHT CONTROLLER
66
DIGITAL TO ANALOG CONVERTER
Dimming
68
Vsync1
Hsync1
DCLK1
DE1
CONTROL UNIT
Vsync2
Hsync2
DCLK2
DE2

FIG.4

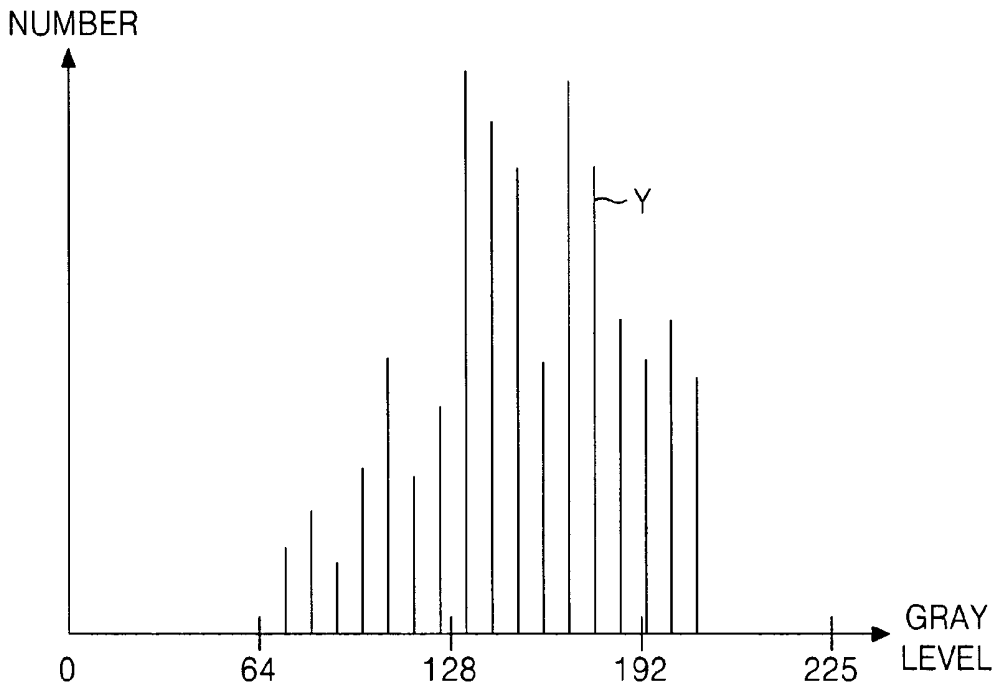


FIG.5

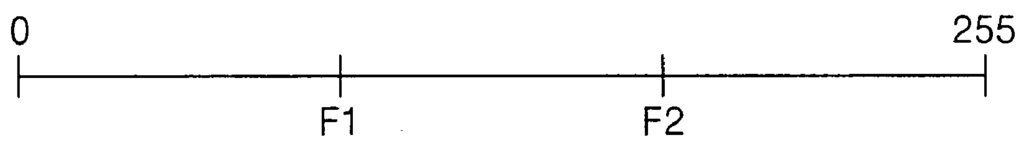


FIG.6

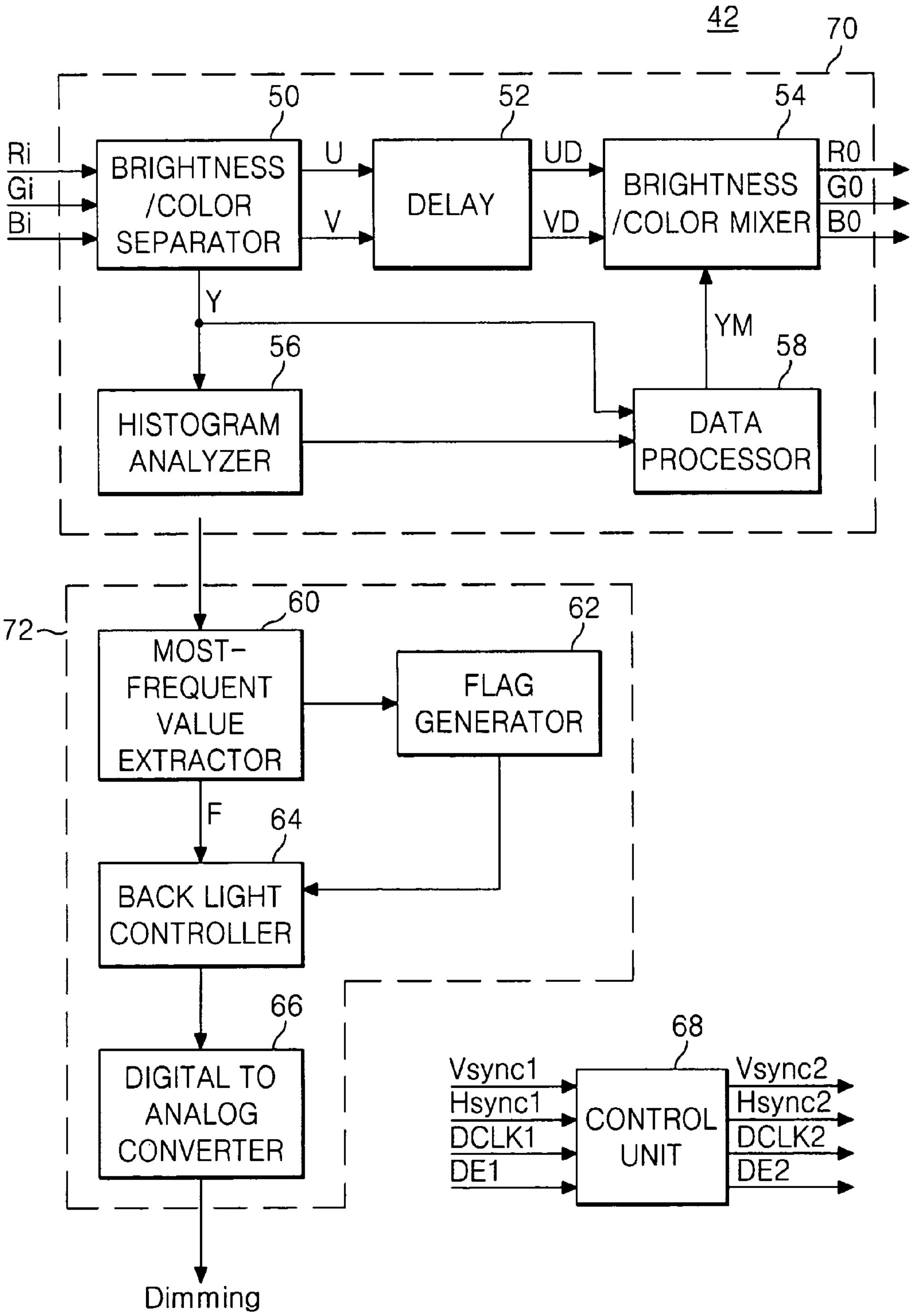

42
70
50
52
54
Ri
Gi
Bi
BRIGHTNESS /COLOR SEPARATOR
U
V
DELAY
UD
VD
BRIGHTNESS /COLOR MIXER
R0
G0
B0
Y
YM
56
58
HISTOGRAM ANALYZER
DATA PROCESSOR
72
60
62
MOST-FREQUENT VALUE EXTRACTOR
FLAG GENERATOR
F
64
BACK LIGHT CONTROLLER
66
DIGITAL TO ANALOG CONVERTER
68
Vsync1
Hsync1
DCLK1
DE1
CONTROL UNIT
Vsync2
Hsync2
DCLK2
DE2
Dimming

FIG.7

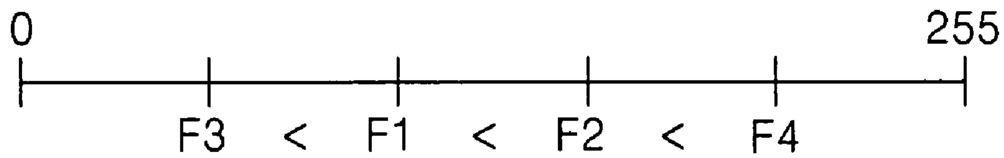


FIG. 8

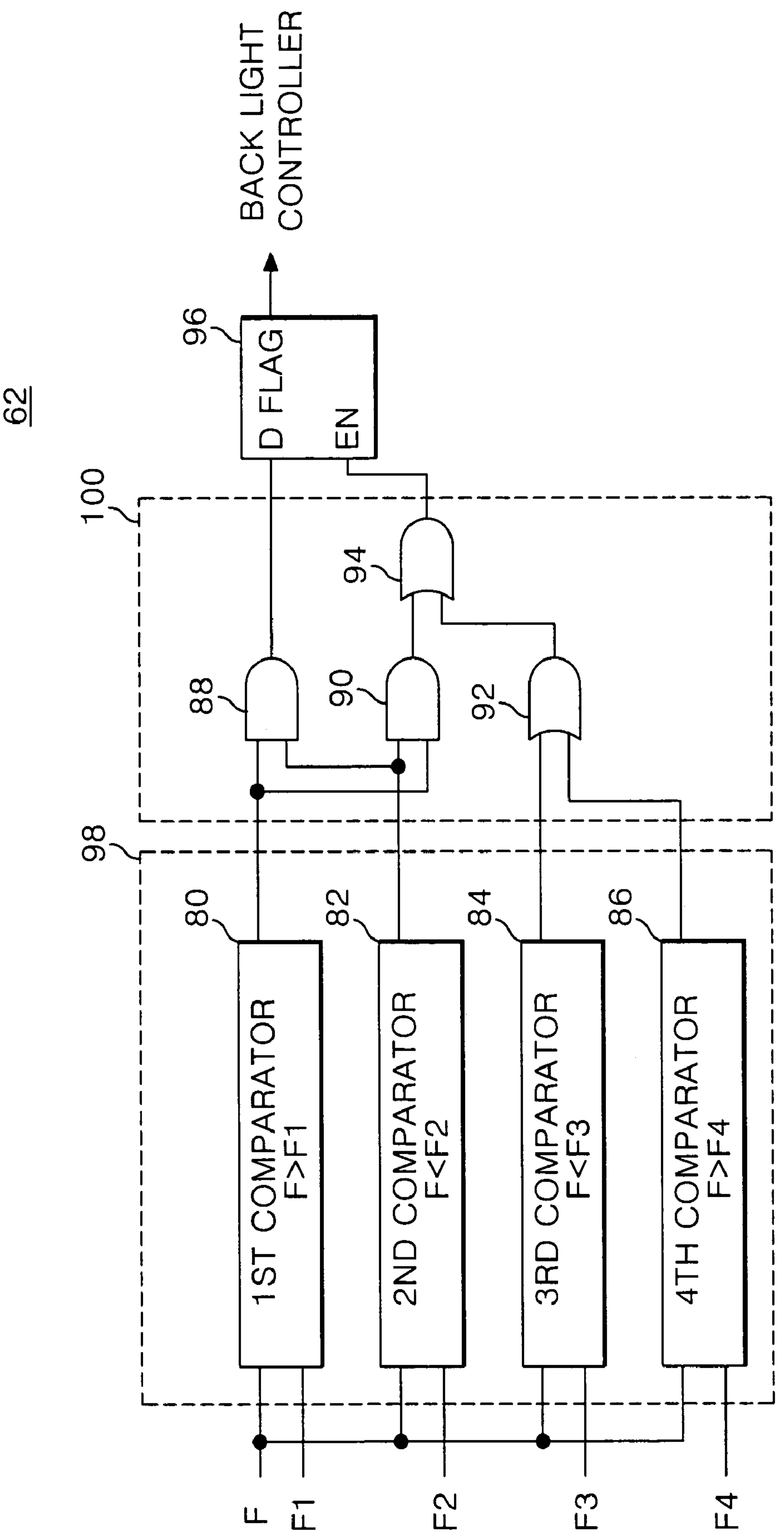

62
BACK LIGHT CONTROLLER
D FLAG
EN
96
100
94
88
90
92
98
80
82
84
86
1ST COMPARATOR F>F1
2ND COMPARATOR F<F2
3RD COMPARATOR F<F3
4TH COMPARATOR F>F4
F
F1
F2
F3
F4

FIG. 9

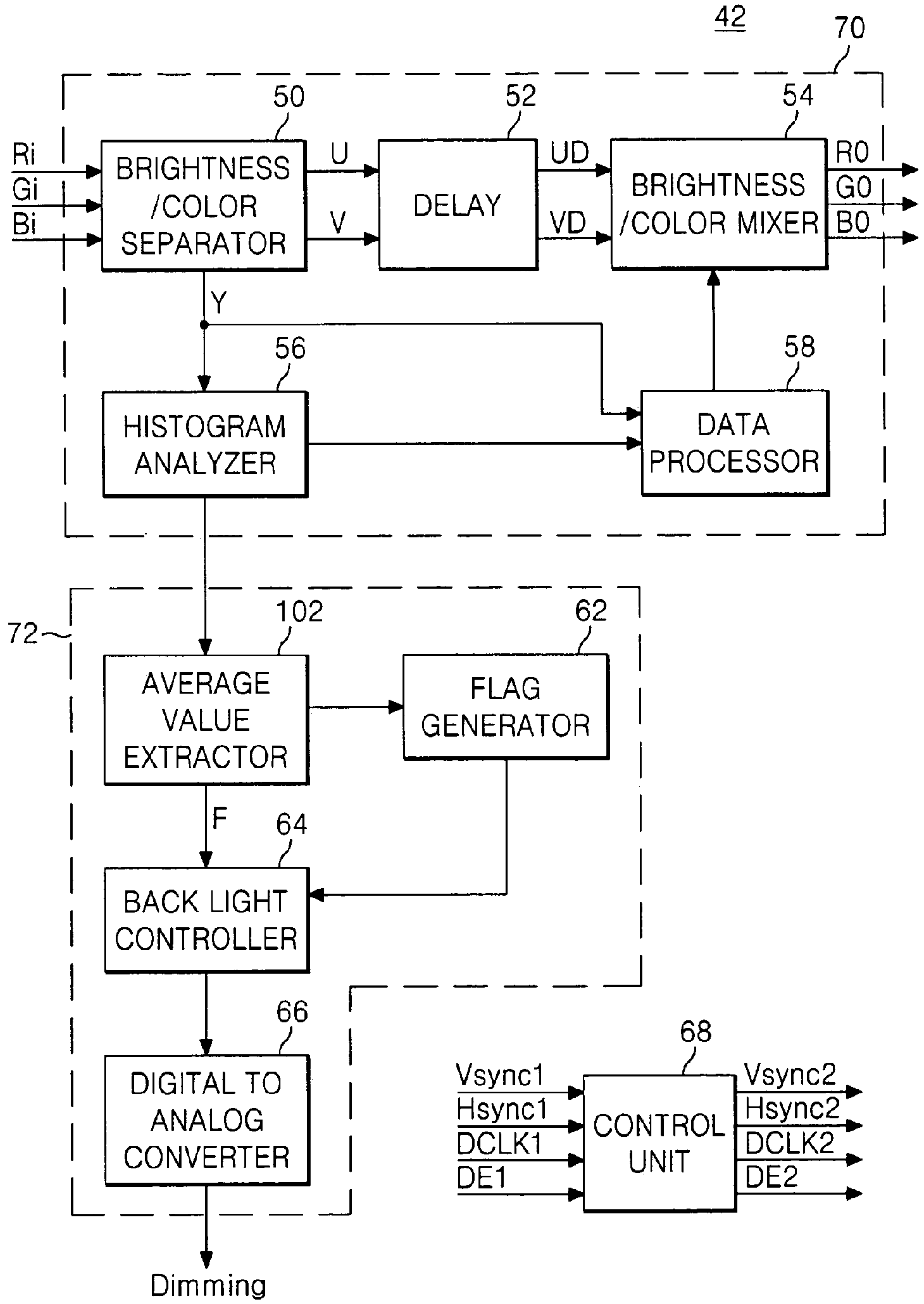
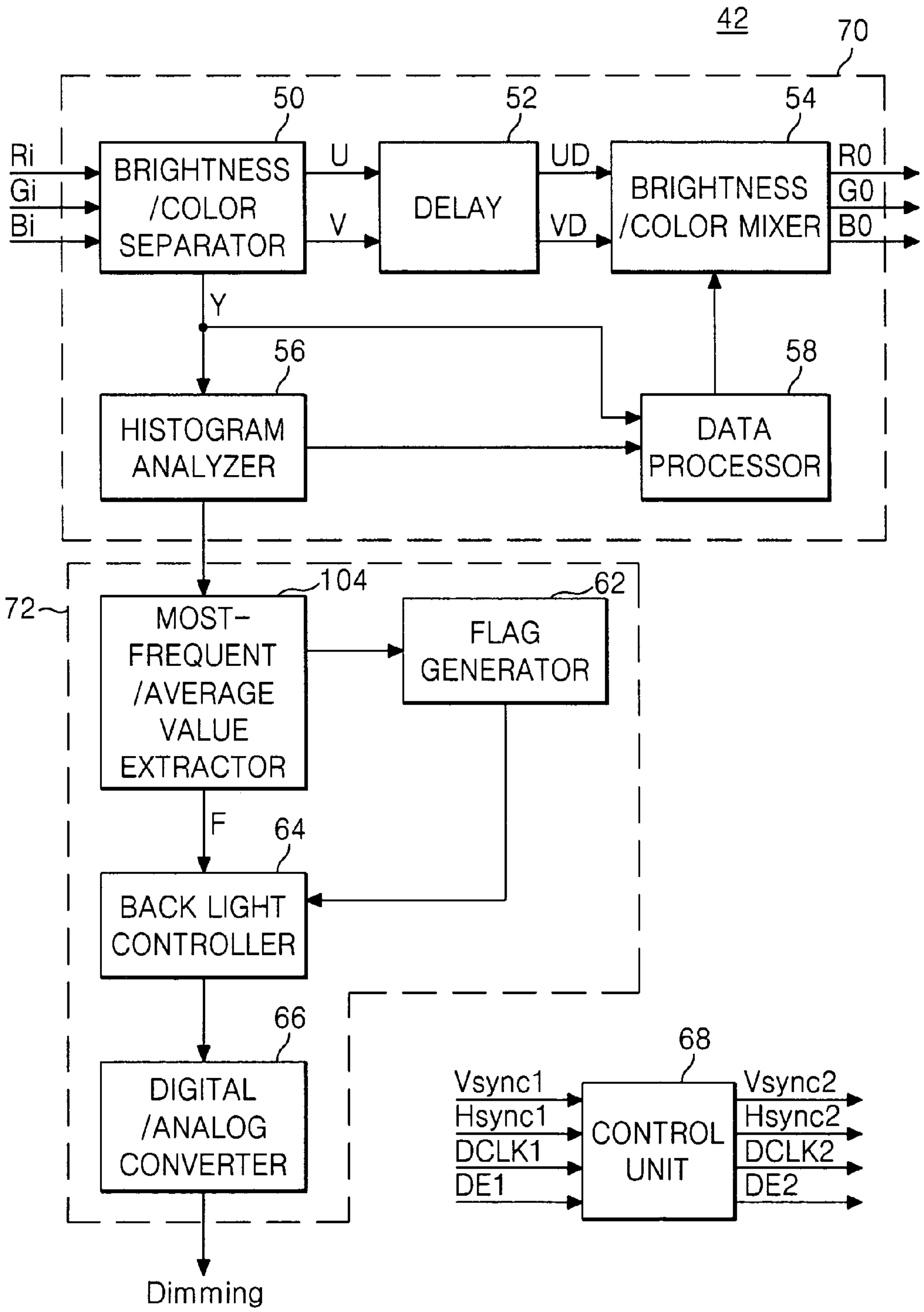

42
70
50
52
54
Ri
Gi
Bi
BRIGHTNESS /COLOR SEPARATOR
U
V
DELAY
UD
VD
BRIGHTNESS /COLOR MIXER
R0
G0
B0
Y
56
58
HISTOGRAM ANALYZER
DATA PROCESSOR
72
102
62
AVERAGE VALUE EXTRACTOR
FLAG GENERATOR
F
64
BACK LIGHT CONTROLLER
66
DIGITAL TO ANALOG CONVERTER
Dimming
68
Vsync1
Hsync1
DCLK1
DE1
CONTROL UNIT
Vsync2
Hsync2
DCLK2
DE2

FIG.10


42
70
50
52
54
Ri
Gi
Bi
BRIGHTNESS /COLOR SEPARATOR
U
V
DELAY
UD
VD
BRIGHTNESS /COLOR MIXER
R0
G0
B0
Y
56
58
HISTOGRAM ANALYZER
DATA PROCESSOR
72
104
62
MOST-FREQUENT /AVERAGE VALUE EXTRACTOR
FLAG GENERATOR
F
64
BACK LIGHT CONTROLLER
66
DIGITAL /ANALOG CONVERTER
Dimming
68
Vsync1
Hsync1
DCLK1
DE1
CONTROL UNIT
Vsync2
Hsync2
DCLK2
DE2

METHOD OF DRIVING A DISPLAY ADAPTIVE FOR MAKING A STABLE BRIGHTNESS OF A BACK LIGHT UNIT

This application claims the benefit of Korean Patent Application No. P2003-81174 filed in Korea on Nov. 17, 2003, which is hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a liquid crystal display, and more particularly to a driving method and apparatus for a liquid crystal display that is adaptive for making a stable brightness variation of a back light in correspondence with a gray level value of data.

2. Description of the Related Art

Generally, a liquid crystal display (LCD) controls light transmittance of liquid crystal cells in accordance with video signals to thereby display a picture. Such an LCD has been implemented by an active matrix type having a switching device for each cell, and applied to a display device such as a monitor for a computer, office equipments, a cellular phone and the like. The switching device for the active matrix LCD mainly employs a thin film transistor (TFT).

FIG. **1** schematically shows a conventional LCD driving apparatus.

Referring to FIG. **1**, the conventional LCD driving apparatus includes a liquid crystal display panel **2** having m×n liquid crystal cells Clc arranged in a matrix type, m data lines D**1** to Dm and n gate lines G**1** to Gn intersecting each other and thin film transistors TFT provided at the intersections, a data driver **4** for applying data signals to the data lines D**1** to Dm of the liquid crystal display panel **2**, a gate driver **6** for applying scanning signals to the gate lines G**1** to Gn, a gamma voltage supplier **8** for supplying the data driver **4** with gamma voltages, a timing controller **10** for controlling the data driver **4** and the gate driver **6** using synchronizing signals from a system **20**, a direct current to direct current converter **14**, hereinafter referred to as "DC/DC converter", for generating voltages supplied to the liquid crystal display panel **2** using a voltage from a power supply **12**, and an inverter **16** for driving a back light **18**.

The system **20** applies vertical/horizontal signals Vsync and Hsync, clock signals DCLK, a data enable signal DE and data R, G and B to the timing controller **10**.

The liquid crystal display panel **2** includes a plurality of liquid crystal cells Clc arranged, in a matrix type, at the intersections between the data lines D**1** to Dm and the gate lines G**1** to Gn. The thin film transistor TFT provided at each liquid crystal cell Clc applies a data signal from each data line D**1** to Dm to the liquid crystal cell Clc in response to a scanning signal from the gate line G. Further, each liquid crystal cell Clc is provided with a storage capacitor Cst. The storage capacitor Cst is provided between a pixel electrode of the liquid crystal cell Clc and a pre-stage gate line or between the pixel electrode of the liquid crystal cell Clc and a common electrode line, to thereby constantly keep a voltage of the liquid crystal cell Clc.

The gamma voltage supplier **8** applies a plurality of gamma voltages to the data driver **4**.

The data driver **4** converts digital video data R, G and B into analog gamma voltages (i.e., data signals) corresponding to gray level values in response to a control signal CS from the timing controller **10**, and applies the analog gamma voltages to the data lines D**1** to Dm.

The gate driver **6** sequentially applies a scanning pulse to the gate lines G**1** to Gn in response to a control signal CS from the timing controller **10** to thereby select horizontal lines of the liquid crystal display panel **2** supplied with the data signals.

The timing controller **10** generates the control signals CS for controlling the gate driver **6** and the data driver **4** using the vertical/horizontal synchronizing signals Vsync and Hsync and the clock signal DCLK inputted from the system **20**. Herein, the control signal CS for controlling the gate driver **6** is comprised of a gate start pulse GSP, a gate shift clock GSC and a gate output enable signal GOE, etc. Further, the control signal CS for controlling the data driver **4** is comprised of a source start pulse SSP, a source shift clock SSC, a source output enable signal SOE and a polarity signal POL, etc. The timing controller **10** re-aligns the data R, G and B from the system **20** to apply them to the data driver **4**.

The DC/DC converter **14** boosts or drops a voltage of 3.3V. inputted from the power supply **12** to generate a voltage supplied to the liquid crystal display panel **2**. Such a DC/DC converter **14** generates a gamma reference voltage, a gate high voltage VGH, a gate low voltage VGL and a common voltage Vcom.

The inverter **16** applies a driving voltage (or driving current) for driving the back light **18** to the back light **18**. The back light **18** generates light corresponding to the driving voltage (or driving current) from the inverter **16** to apply it to the liquid crystal display panel **2**.

In order to display a vivid image at the liquid crystal display panel **2** driven in this manner, a distinct contrast between brightness and darkness is made in correspondence with the input data. However, since the conventional back light **18** always produces a constant degree of brightness irrespectively of the data, it is difficult to display a dynamic and fresh image.

SUMMARY OF THE INVENTION

The present invention provides a driving method and apparatus for a liquid crystal display that is adaptive stabilizing the brightness variation of a back light in correspondence with a gray level value of input data.

A method of driving a liquid crystal display according to one aspect of the present invention includes dividing gray levels in a frame into a plurality of brightness areas, converting input data into brightness components, extracting a most-frequent value and/or an average value after arranging the brightness components into a histogram of the gray levels, and controlling brightness of a back light to correspond to the brightness areas to which the extracted most-frequent value or the average value belongs.

In the method, the brightness of the back light is controlled such that a different brightness of light can be produced for each of the plurality of brightness areas.

The most-frequent value is the gray level that is occupied by the greatest number of brightness components.

The most-frequent value and/or the average value is extracted from the histogram, and the brightness of the back light is controlled to correspond to the brightness area to which the extracted value belongs.

The most-frequent value may be selected when the most-frequent value is occupied by 40% or more of the total number of brightness components and the average value extracted otherwise.

The brightness of the back light increases with an increase in the brightness area to which the extracted value belongs.

At least one of the brightness areas is an area in which a previous brightness value of the back light is maintained.

A method of driving a liquid crystal display according to another aspect of the present invention includes dividing gray levels in a frame into a plurality of brightness areas, converting input data into brightness components, extracting a most-frequent value and/or an average value after arranging the brightness components into a histogram, generating a flag signal to correspond to the brightness area to which the extracted most-frequent value or average value belongs, and controlling brightness of a back light using the extracted most-frequent value or average value and the flag signal.

In the method, the flag signal maintains a previous flag signal when the most-frequent value or the average value belongs to a particular brightness area while permitting the flag signal to change when not in the particular brightness area.

When the flag signal keeps the previous flag signal, the brightness of the back light is not changed irrespective of the area to which the most-frequent value or the average value belongs.

The particular brightness area is an area in which the brightness value of the back light is not changed.

Otherwise, when the flag signal is changed, the brightness of the back light is changed to correspond to an area at which the most-frequent value or the average value belongs.

The most-frequent value is extracted from the histogram when the most-frequent value is occupied by 40% or more of the total brightness components in the frame while the average value is extracted from the histogram otherwise.

A driving apparatus for driving a liquid crystal display according to another aspect of the present invention includes a brightness/color separator for converting data into brightness components; a histogram analyzer for arranging the brightness components into a histogram for each frame; and back light control for extracting a most-frequent value and/or an average value of the brightness components from the histogram and for controlling brightness of a back light using the extracted value. The back light control divides the brightness components into a plurality of areas and controls the brightness of the back light in correspondence with an area to which the extracted most-frequent value or average value belongs.

In the driving apparatus, the back light control includes a most-frequent and/or average value extractor for extracting the most-frequent and/or average value; a back light controller for controlling the brightness of the back light to correspond to the area at which the extracted value belongs; and a digital to analog converter for converting a digital output signal of the back light controller into an analog output signal to apply it to an inverter.

The most-frequent value may be selected when the most-frequent value is occupied by 40% or more of the total number of brightness components and the average value extracted otherwise.

The back light controller controls the back light such that a different brightness of light can be supplied for each area.

The back light control includes a most-frequent value extractor for extracting the most-frequent and/or average value; a flag generator for generating a flag signal to correspond to the area to which the extracted value belongs to; a back light controller, being supplied with the extracted value and the flag signal, for controlling the brightness of the back light to correspond to the area at which the extracted value belongs when the flag signal has been changed in comparison with the previous flag signal; and a digital to analog converter for converting a digital output signal of the back light controller into an analog output signal to apply it to an inverter.

As above, the most-frequent value may be selected when the most-frequent value is occupied by 40% or more of the total number of brightness components and the average value extracted otherwise.

The back light controller does not control the brightness of the back light when the flag signal has the same value as the previous flag signal.

The flag generator generates a flag signal identical to the previous flag signal in at least one area of the plurality of areas.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will be apparent from the following detailed description of the embodiments of the present invention with reference to the accompanying drawings, in which:

FIG. **1** is a schematic block diagram showing a configuration of a conventional driving apparatus for a liquid crystal display;

FIG. **2** is a schematic block diagram showing a configuration of a driving apparatus for a liquid crystal display according to an embodiment of the present invention;

FIG. **3** is a block diagram showing a configuration of a first embodiment of the picture quality enhancer shown in FIG. **2**;

FIG. **4** illustrates a histogram analyzed by the histogram analyzer shown in FIG. **3**;

FIG. **5** illustrates an area for controlling brightness in the back light controller shown in FIG. **3**;

FIG. **6** is a block diagram showing a configuration of a second embodiment of the picture quality enhancer shown in FIG. **2**;

FIG. **7** illustrates an area for controlling brightness in the back light controller shown in FIG. **6**;

FIG. **8** is a block diagram showing a configuration of a third embodiment of the picture quality enhancer shown in FIG. **2**;

FIG. **9** is a block diagram showing a configuration of a fourth embodiment of the picture quality enhancer shown in FIG. **2**; and

FIG. **10** is a black diagram showing a back light control that includes a most-frequent/average value extractor.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. **2** schematically shows a driving apparatus for a liquid crystal display (LCD) according to an embodiment of the present invention.

Referring to FIG. **2**, the LCD driving apparatus according to the embodiment of the present invention includes a liquid crystal display panel **22** having m×n liquid crystal cells Clc arranged in a matrix type, m data lines D**1** to Dm and n gate lines G**1** to Gn intersecting each other and thin film transistors TFT provided at the intersections, a data driver **24** for applying data signals to the data lines D**1** to Dm of the liquid crystal display panel **22**, a gate driver **26** for applying scanning signals to the gate lines G**1** to Gn, a gamma voltage supplier **28** for supplying the data driver **24** with gamma voltages, a timing controller **30** for controlling the data driver **24** and the gate driver **26** using a second synchronizing signal from a picture quality enhancer **42**, a DC/DC converter **34** for generating voltages supplied to the liquid crystal display panel **22** using a voltage from a power supply **32**, an inverter **36** for driving a back light unit **38**, and a picture quality enhancer **42** for selectively emphasizing a contrast of an input data and for applying a brightness control signal Dimming corresponding to the input data to the inverter **36**.

The system **40** applies first vertical/horizontal signals Vsync**1** and Hsync**1**, a first clock signal DCLK**1**, a first data enable signal DE**1** and first data Ri, Gi and Bi to the picture quality enhancer **42**.

The liquid crystal display panel **22** includes a plurality of liquid crystal cells Clc arranged, in a matrix type, at the intersections between the data lines D**1** to Dm and the gate lines G**1** to Gn. The thin film transistor TFT provided at each liquid crystal cell Clc applies a data signal from each data line D**1** to Dm to the liquid crystal, cell Clc in response to a scanning signal from the gate line G. Further, each liquid crystal cell Clc is provided with a storage capacitor Cst. The storage capacitor Cst is provided between a pixel electrode of the liquid crystal cell Clc and a pre-stage gate line or between the pixel electrode of the liquid crystal cell Clc and a common electrode line, to thereby constantly keep a voltage of the liquid crystal cell Clc.

The gamma voltage supplier **28** applies a plurality of gamma voltages to the data driver **24**.

The data driver **24** converts digital video data Ro, Go and Bo into analog gamma voltages (i.e., data signals) corresponding to gray level values in response to a control signal CS from the timing controller **30**, and applies the analog gamma voltages to the data lines D**1** to Dm.

The gate driver **26** sequentially applies a scanning pulse to the gate lines G**1** to Gn in response to a control signal CS from the timing controller **30** to thereby select horizontal lines of the liquid crystal display panel **22** supplied with the data signals.

The timing controller **30** generates the control signals CS for controlling the gate driver **26** and the data driver **24** using second vertical/horizontal synchronizing signals Vsync**2** and Hsync**2** and a second clock signal DCLK**2** inputted from the picture quality enhancer **42**. Herein, the control signal CS for controlling the gate driver **26** is comprised of a gate start pulse GSP, a gate shift clock GSC and a gate output enable signal GOE, etc. Further, the control signal CS for controlling the data driver **24** is comprised of a source start pulse SSP, a source shift clock SSC, a source output enable signal SOE and a polarity signal POL, etc. The timing controller **30** re-aligns second data Ro, Go and Bo from the picture quality enhancer **42** to apply them to the data driver **24**.

The DC/DC converter **34** boosts or drops a voltage of 3.3V inputted from the power supply **32** to generate a voltage supplied to the liquid crystal display panel **22**. Such a DC/DC converter **34** generates a gamma reference voltage, a gate high voltage VGH, a gate low voltage VGL and a common voltage Vcom.

The inverter **36** applies a driving voltage (or driving current) corresponding to the brightness control signal Dimming from the picture quality enhancer **42** to the back light **38**. In other words, a driving voltage (or driving current) applied from the inverter **36** to the back light **38** is determined by the brightness control signal Dimming from the picture quality enhancer **42**. The back light **38** applies light corresponding to the driving voltage (or driving current) from the inverter **36** to the liquid crystal display panel **22**.

The picture quality enhancer **42** extracts brightness components using the first data Ri, Gi and Bi from the system **40**, and generates second data Ro, Go and. Bo obtained by a change in gray level values of the first data Ri, Gi and Bi in correspondence with the extracted brightness components. In this case, the picture quality enhancer **42** generates the second data Ro, Go and Bo such that the contrast is selectively expanded with respect to the input data Ri, Gi and Bi.

Further, the picture quality enhancer **42** generates a brightness control signal Dimming corresponding to the brightness components to apply it to the inverter **36**. For instance, the picture quality enhancer **42** extracts the most frequent value (i.e., the gray level value in the frame having the maximum number of brightness components) and/or an average value (i.e., an average value of the gray levels in the frame) from the brightness components, and generates the brightness control signal Dimming using the extracted most frequent value and/or average value. The picture quality enhancer **42** divides the brightness of the back light corresponding to gray levels of the brightness components into at least two regions, and generates the brightness control signal Dimming such that regions of the brightness are selected in correspondence with the control value.

Moreover, the picture quality enhancer **42** generates second vertical/horizontal synchronizing signals Vsync**2** and Hsync**2**, a second clock signal DCLK**2** and a second data enable signal DE**2** synchronized with the second data Ro, Go and Bo with the aid of the first vertical/horizontal synchronizing signals Vsync**1** and Hsync**1**, the first clock signal DCLK**1** and the first data enable signal DE**1** inputted from the system **40**.

To this, end, as shown in FIG. **3**, the picture quality enhancer **42** includes an image signal modulator **70** for generating the second data Ro, Go and Bo using the first data Ri, Gi and Bi, a back light control **72** for generating the brightness control signal Dimming under control of the image signal modulator **70**, and a control unit **68** for generating the second vertical/horizontal synchronizing signals Vsync**2** and Hsync**2**, the second clock signal DCLK**2** and the second enable signal DE**2**.

The image signal modulator **70** extracts the brightness components Y from the first data Ri, Gi and Bi, and generates the second data Ro, Go and Bo in which a contrast is partially emphasized with the aid of the extracted brightness components Y. To this end, the image signal modulator **70** includes a brightness/color separator **50**, a delay **52**, a brightness/color mixer **54**, a histogram analyzer **56** and a data processor **58**.

The brightness/color separator **50** separates the first data Ri, Gi and Bi into brightness components Y and chrominance components U and V. Herein, the brightness components Y and the chrominance components U and V are obtained by the following equations:

$$Y=0.229\times Ri+0.587\times Gi+0.114\times Bi \quad (1)$$

$$U=0.493\times(Bi-Y) \quad (2)$$

$$V=0.887\times(Ri-Y) \quad (3)$$

The histogram analyzer **56** divides the brightness components Y into gray levels for each frame. In other words, the histogram analyzer **56** arranges the brightness components Y for each frame to correspond to the gray levels, thereby obtaining a histogram as shown in FIG. **4**. The shape of the histogram thus depends on the brightness components of the first data Ri, Gi and Bi.

The data processor **58** generates modulated brightness components YM having a selectively emphasized contrast using the analyzed histogram from the histogram analyzer **56** by various methods. Such methods are disclosed in Korean Patent Applications Nos. 2003-036289, 2003-040127 and 2003-041127, etc. previously filed by the applicants and which are incorporated by reference herein.

The delay **52** delays chrominance components U and V until the brightness components YM modulated by the data processor **58** are produced. Further, the delay **52** applies the delayed chrominance components VD and UD to the brightness/color mixer **54** to be synchronized with the modulated brightness components YM.

The brightness/color mixer **54** generates second data Ro, Go and Bo with the aid of the modulated brightness components YM and the delayed chrominance components UD and VD. Herein, the second data Ro, Go and Bo is obtained by the following equations:

$$Ro=YM+0.000\times UD+1.140\times VD \tag{4}$$

$$Go=YM-0.396\times UD-0.581\times VD^{-} \tag{5}$$

$$Bo=YM+2.029\times UD+0.000\times VD \tag{6}$$

Since the second data Ro, Go and Bo obtained by the brightness/color mixer **54** has been produced from the modulated brightness components YM having an expanded contrast, they have more expanded contrast than the first data Ri, Gi and Bi. The second data Ro, Go and Bo produced such that the contrast can be expanded as mentioned above is applied to the timing controller **30**.

The control unit **68** receives the first vertical/horizontal synchronizing signals Vsync**1** and Hsync**1**, the first clock signal DCLK**1** and the first data enable signal DE**1** from the system **40**. Further, the controller **68** generates the second vertical/horizontal synchronizing signals Vsync**2** and Hsync**2**, the second clock signal DCLK**2** and the second data enable signal DE**2** in such a manner to be synchronized with the second data Ro, Go and Bo, and applies them to the timing controller **30**.

The back light control **72** extracts the most-frequent value F from the histogram analyzer **56**, and generates a brightness control signal Dimming using the extracted most-frequent value F.

To this end, the back light control **72** includes a most-frequent value extractor **60**, a back light controller **64** and a digital to analog converter **66**.

As shown in FIG. **5**, the back light controller **64** divides gray levels of the brightness components Y into a plurality of areas (e.g., three areas in FIG. **5**), and controls the back light **38** such that a different brightness of light can be supplied for each area. In other words, the back light controller **64** generates a brightness control signal Dimming such that light of a low brightness is generated when the most-frequent value F is in less than a first value F**1**. The back light controller **64** generates a brightness control signal Dimming such that light of a middle brightness is generated when the most-frequent value F is between the first value F**1** and a second value F**2**. The back light controller **64** generates a brightness control signal Dimming such that light of a high brightness is generated when the most-frequent value F is beyond the second value F**2**.

The most-frequent value extractor **60** extracts the most-frequent value F from the histogram analyzer **56** to apply it to the back light controller **64**.

The digital to analog converter **66** converts a digital control signal into an analog control signal (i.e., a brightness control signal) Dimming to apply it to the inverter **36**.

An operation procedure of the back light control **72** will be described in detail below.

First, the most-frequent value extractor **60** extracts a most-frequent value F from a histogram analyzed by the histogram analyzer **56** to apply it to the back light controller **64**. The back light controller **64** having received the most-frequent value F checks the area (i.e., gray level value) to which the most-frequent value F applied thereto belongs. In other words, the back light controller **64** checks the area to which the most-frequent value F inputted thereto belongs, of areas in FIG. **5**, and generates a brightness control signal Dimming corresponding thereto.

The brightness control signal Dimming from the back light controller **64** is applied to the digital to analog converter **66**. The digital to analog converter **66** converts a brightness control signal Dimming applied thereto into an analog signal to apply it to the inverter **36**. The inverter **36** controls the back light **38** such that light is applied to the liquid crystal display panel **22** in correspondence with the brightness control signal Dimming. In other words, the present back light control **72** divides gray levels into a plurality of areas and applies the brightness control signal Dimming such that light having a different brightness for each area is generated in correspondence with the most-frequent value F, thereby displaying a vivid image. That is to say, brightness of a light is controlled in accordance with the area to which the most-frequent value F belongs, thereby displaying a picture having a distinct contrast on the liquid crystal display panel **22**.

However, in such an embodiment, the brightness of the back light **38** is sensitive to the most-frequent value F, which may cause sparkling. For instance, if the most-frequent value F moves between an area of middle brightness (F**1**<F<F**2**) and an area of low brightness (F<F**1**) and back again in adjacent frames, then the brightness of the back light **38** is changed dramatically in the adjacent frames. This is problematic if there is only a slight change in the brightness between frames but the most-frequent value F happens to fall close to the border between areas so that this slight change in the brightness is intensified by the change in the brightness of the back light **38** being supplied. Changing back and forth between two adjacent areas in successive frames causes sparkling in the liquid crystal display panel **22**.

In order to overcome such a problem, a picture quality enhancer according another embodiment of the present invention is shown in FIG. **6**. Since configurations and functions of an image signal modulator **70** and a control unit **68** except for a back light control **72** in the embodiment of the present invention shown in FIG. **6** are identical to those of the embodiment of the present invention shown in FIG. **3**, a detailed explanation as to these elements will be omitted.

Referring to FIG. **6**, the back light control **72** according to another embodiment of the present invention extracts a most-frequent value F from the histogram analyzer **56**, and generates a brightness control signal Dimming using the extracted most-frequent value F. Further, the back light control **72** according to this embodiment divides the gray levels into a plurality of areas (e.g., five areas in FIG. **7**) as shown in FIG. **7**, and controls brightness of a back light **38** in correspondence with an area to which the most-frequent value F belongs. Also, the back light control **72** according to this embodiment maintains a previous brightness value (the value supplied to the back light **38** in the preceding frame) in at least one area to prevent the brightness of the back light **38** from being suddenly changed in correspondence with the most-frequent value F.

To this end, the back light control **72** includes a most-frequent value extractor **60**, a flag generator **62**, a back light controller **64** and a digital to analog converter **66**.

The most-frequent value extractor **60** extracts a most-frequent value F from the histogram analyzer **56** to apply it to the back light controller **64** and the flag generator **62**.

The flag generator **62** applies a control signal of '0' or '1' to the back light controller **64** in correspondence with the most-frequent value F inputted thereto. An operation procedure of the flag generator **62** will be described in detail with reference to FIG. **7** and FIG. **8**.

The flag generator **62** includes a comparator array **98** for comparing gray levels of boundary values F**1** to F**4** dividing the areas of the brightness components Y with that of the most-frequent value F, a logical sum operation array **100** logically summing the output values of the comparator array **98**, and an output part **96** for generating a control signal using the output value of the logical sum operation array **100**.

The comparator array **98** includes a first comparator **80** for comparing the most-frequent value F with the first boundary value F**1**, a second comparator **82** for comparing the most-frequent value F with the second boundary value F**2**, a third comparator **84** for comparing the most-frequent value F with the third boundary value F**3**, and a fourth comparator **86** for comparing the most-frequent value F with the fourth boundary value F**2**.

The first to fourth boundary values F**1** to F**4** are value established so as to divide gray level values into a plurality of areas. Herein, each boundary value F**1** to F**4** are experimentally set such that a vivid image can be displayed. For instance, the third boundary value F**3** is set to a gray level value of 64; the first boundary value F**1** is set to a gray level value of 96; the second boundary value F**2** is set to a gray level value of 160; and the fourth boundary value F**4** is set to a gray level value of 190.

Firstly, the first comparator **80** compares the most-frequent value F and the first boundary value F**1** to thereby output '1' when the most-frequent value F is larger than the first boundary value F**1** while outputting '0' otherwise. The second comparator **82** compares the most-frequent value F and the second boundary value F**2** to thereby output '1' when the most-frequent value F is smaller than the second boundary value F**2** while outputting '0' otherwise. The third comparator **84** compares the most-frequent value F and the third boundary value F**3** to thereby output '1' when the most-frequent value F is smaller than the third boundary value F**3** while outputting '0' otherwise. The fourth comparator **86** compares the most-frequent value F and the fourth boundary value F**4** to thereby output '1' when the most-frequent value F is larger than the fourth boundary value F**4** while outputting '0' otherwise.

The logical sum operation array **100** logically sums the output values to apply it to the output part **96**. Herein, the logical sum operation array **100** outputs values to be applied to a clock EN and an input D of the output part **96**. To this end, the logical sum operation array **100** includes first and second AND gates **88** and **90** that logically sum the output values of the first and second comparators **80** and **82**, a first OR gate **92** that logically sum the output values of the third and fourth comparators **84** and **86**, and a second OR gate **94** that logically sums the output values of the second AND gate **90** and the first OR gate **92**. An output signal of the first AND gate **88** is applied to the input D of the output part **96**. An output signal of the second OR gate **94** is applied to the clock EN of the output part **96**.

The output part **96** applies a control signal (i.e., a flag signal) of '1' or '0' to the back light controller **64** in correspondence with a value from the logical sum operation array **100**. To this end, the output part **96** consists of a D flip-flop. The input D of the D flip-flop receives the output signal of the first AND gate **88** while the clock EN thereof receives the output signal of the second OR gate **94**.

An operation procedure of the flag generator **62** will be described assuming that the most-frequency value F is positioned between the first boundary value F**1** and the second boundary value F**2**. If the most-frequency value F is positioned between the first boundary value F**1** and the second boundary value F**2**, then the first and second comparators **80** and **82** output signals of '1' while the third and fourth comparators **84** and **86** output signals of '0'.

If the first and second comparators **80** and **82** output signals of '1', then the first and second AND gates **88** and **90** output signals of '0'. Herein, the signal of '1' outputted from the first AND gate **88** is applied to the input D of the output part **96**. If the second AND gate **90** outputs a signal of '1', then the second OR gate **94** outputs a signal of '1' irrespectively of an output of the first OR gate **92**. Herein, the signal of '1' outputted from the second OR gate **94** is applied to the clock EN of the output part **96**. Thus, if the most-frequency value F is positioned between the first boundary value F**1** and the second boundary value F**2**, then the flag generator **62** applies a flag signal of '1' to the back light controller **64**.

If the most-frequent value F has a gray level less than the third boundary value F**3**, then the first and fourth comparators **80** and **86** output signals of '0' while the second and third comparators **82** and **84** output signals of '1'.

If the first comparator **80** outputs a signal of '0', then the first and second AND gates **88** and **90** output signals of '0' irrespectively of an output of the second comparator **82**. Herein, the signal of '0' outputted from the first AND gate **88** is applied to the input D of the output part **96**. If the third comparator **80** outputs a signal of '1', then the first OR gate **92** outputs a signal of '1'. On the other hand, if the first OR gate **92** outputs a signal of '1', then the second OR gate **94** also outputs a signal of '1'. Herein, the signal of '1' outputted from the second OR gate **94** is applied to the clock EN of the output part **96**. Thus, the most-frequent value F has a gray level less than the third boundary value F**3**, then the flag generator **62** applies a flag signal of '0' to the back light controller **64**.

On the other hand, if the most-frequent value F has a gray level more than the fourth boundary value F**4**, then the first and fourth comparators **80** and **86** output signals of '1' while the second and third comparators **82** and **84** output signals of '0'. Herein, the signal of '0' outputted from the first AND gate **88** is applied to the input D of the output part **96**. If the fourth comparator **86** outputs a signal of '1', then the first OR gate **92** outputs a signal of '1'. On the other hand, if the first OR gate **92** outputs a signal of '1', then the second OR gate **94** also outputs a signal of '1'. Herein, the signal of '1' outputted from the second OR gate **94** is applied to the clock EN of the output part **96**. Thus, the most-frequent value F has a gray level more than the fourth boundary value F**4**, then the flag generator **62** applies a flag signal of '0' to the back light controller **64**.

If the most-frequent value F has a gray level between the third boundary value F**3** and the first boundary value F**1**, then the second comparator **82** outputs a signal of '1' while the remaining comparators **80**, **84** and **86** other than the second comparator **82** output signals of '0'.

If the first comparator **80** outputs a signal of '0', then the first and second AND gates **88** and **90** output signals of '0' irrespectively of an output of the second comparator **82**. Herein, the signal of '0' outputted from the first AND gate **88** is applied to the input D of the output part **96**. If the third and fourth comparators **84** and **86** output signals of '0', then the first and second OR gates **92** and **94** output signals of '0'. The signal of '0' outputted from the second OR gate **94** is applied to the clock EN of the output part **96**. Herein, as the signal of '0' is inputted to the clock EN of the output part **96**, the output part **96** does not generate an output. In other words, if the most-frequent value F has a gray level between the third boundary value F**3** and the first boundary value F**1**, then the flag generator **62** maintains a previous flag signal (of '0' or '1')

On the other hand, if the most-frequent value F has a gray level between the second boundary value F**2** and the fourth boundary value F**4**, then the first comparator **80** outputs a signal of '1' while the remaining comparators **82**, **84** and **86** other than the first comparator **80** output signals of '0'.

If the second comparator **82** outputs a signal of '0', then the first and second AND gates **88** and **90** output signals of '0' irrespectively of an output of the first comparator **80**. Herein, the signal of '0' outputted from the first AND gate **88** is applied to the input D of the output part **96**. If the third and fourth comparators **84** and **86** output signals of '0', then the first and second OR gates **92** and **94** output signals of '0'. The signal of '0' outputted from the second OR gate **94** is applied to the clock EN of the output part **96**. Herein, as the signal of '0' is inputted to the clock EN of the output part **96**, the output part **96** does not generate an output. In other words, if the most-frequent value F has a gray level between the second boundary value F**2** and the fourth boundary value F**4**, then the flag generator **62** maintains a previous flag signal (of '0' or '1').

In other words, the present flag generator **62** applies a flag signal of '1' to the back light controller **64** when the most-frequent value F is positioned between the first boundary value F**1** and the second boundary value F**2** while applying a flag signal of '0' to the back light controller **64** when the most-frequent value F has a value less than the third boundary value F**3** or a value more than the fourth boundary value F**4**. On the other hand, the flag generator **62** maintains the previous flag signal when the most-frequent value F is positioned between the third boundary value F**3** and the first boundary value F**1** or between the second boundary value F**2** and the fourth boundary value F**4**.

The back light controller **64** divides gray levels into a plurality of areas as shown in FIG. **7**, and controls the back light **38** such that light having a brightness corresponding to each area can be supplied. Herein, the back slight controller **64** compares a flag value from the flag generator **62** with the previous flag value to thereby generate a brightness control signal Dimming such that light having a brightness corresponding to an area to which the most-frequent value F belongs is produced only when the flag value is changed while generating the brightness control signal Dimming such that light having the previous brightness is kept otherwise. In other words, the back light controller **64** generates a brightness control signal Dimming such that, when the most-frequent value has a value between the first boundary value F**1** and the second boundary value F**2**, a value less than the third boundary value or a value more than the fourth boundary value F**4**, light corresponding thereto can be produced. On the other hand, the back light controller **64** generates a brightness control signal Dimming such that light having the previous brightness is kept when the most-frequent value F is positioned between the third boundary value F**3** and the first boundary value F**1** or between the second boundary value F**2** and the fourth boundary value F**4**.

The digital to analog converter **66** converts a digital control signal into an analog control signal (i.e., a brightness control signal) Dimming to apply it to the inverter **36**.

An operation procedure of the back light control **72** will be described in detail below.

First, the most-frequent value extractor **60** extracts a most-frequent value F from a histogram analyzed by the histogram analyzer **56** to apply it to the back light controller **64** and the flag generator **62**. The flag generator **62** applies a flag signal corresponding to a gray level value having the most-frequent value applied thereto to the back light controller **64**. Herein, the flag generator **62** sets at least one of gray level area maintaining the previous flag value, and maintains the previous flag value when the most-frequent value F is included in this area.

The back light controller **64** receives a flag signal from the flag generator **62**. The back light controller **64** having received the flag signal checks whether or not the flag signal has been changed, and generates a brightness control signal to correspond to the most-frequent value F when the flag signal has been changed. On the other hand, the back light controller **64** generates a brightness control signal such that light having the previous brightness is kept irrespective of the most-frequent value F when the flag signal has not been changed (i.e., when the current flag signal is identical to the previous, flag signal).

The brightness control signal Dimming from the back light controller **64** is applied to the digital to analog converter **66**. The digital to analog converter **66** converts a brightness control signal Dimming applied thereto into an analog signal to apply it to the inverter **36**. Then, the inverter **36** controls the back light **38** in response to the brightness control signal Dimming, thereby applying light corresponding to the brightness control signal Dimming to the liquid crystal display panel **22**.

In other words, the back light control **72** according to another embodiment of the present invention sets a plurality of gray level areas having changed brightness and applies the brightness control signal Dimming such that light having a different brightness for each area can be generated in correspondence with the most-frequent value F, thereby displaying a vivid image. That is to say, the brightness is controlled in accordance with the gray level area to which the most-frequent value F belongs, thereby displaying a picture having a distinct contrast on the liquid crystal display panel **22**.

Furthermore, the back light controller according to another embodiment of the present invention generates a brightness control signal such that a gray level having the previous brightness can be displayed in at least one area of the plurality of gray level areas having changed brightness. Accordingly, brightness of the back light **38** is relatively insensitive to small changes in the most-frequent value F between frames, thereby displaying an image with a stable brightness on the liquid crystal display panel **22**.

For instance, since the flag signal keeps the same value even though a gray level value having the most-frequent value F is alternates around the third boundary value F**3** in FIG. **7**, the back light **38** has the same brightness. In other words, in another embodiment of the present invention, a brightness control signal is generated such that a gray level having the previous brightness can be displayed in at least one area of the plurality of areas set by a division of gray levels, thereby displaying an image whose brightness is stable on the liquid crystal display panel **22**.

Alternatively, in the present invention, an average value extractor **102** may be included in the back light control **72** as shown in FIG. **9**. The average value extractor **102** extracts an average value of the analyzed brightness components Y from the histogram analyzer **56**. In other words, the average value extractor **102** extracts an average value of the brightness components Y from the histogram analyzer **56** to apply it to the flag generator **62** and the back light controller **64**. Thereafter, the flag generator **62** and the back light controller **64** generate a brightness control signal using an average value rather than the most-frequent value F. Herein, since an operation procedure of the flag generated generator **62** and the back light controller **64** has been described in detail through an explanation in FIG. **6**, a detailed explanation as to these elements will be omitted. As mentioned above, the embodiment shown in FIG. **9** extracts an average value rather than the most-frequent value F from a histogram to determine brightness components Y of the data more accurately, so that it can control the brightness of the back light **38** to accurately correspond to the brightness components Y of the data.

Otherwise, the present-back light control **72** may include a most-frequent/average value extractor **104** as shown in FIG. **10**. The most-frequent/average extractor **104** extracts a most-frequent value F and an average value of the analyzed brightness components Y from the histogram analyzer **56**. The most-frequent/average extractor **104** having extracted the most-frequent value F calculates a ratio at which a gray level having the most-frequent value F occupies the histogram (i.e., a frequency number of the most-frequent value). Further, the most-frequent/average value extractor **104** applies the most-frequent value F to the flag generator **62** and the back light controller **64** when the ratio that the most-frequent value F occupies is 40% or more of the gray levels of the histogram while applying the average value to the flag generator **62** and the back light controller **64** otherwise.

As mentioned above, the embodiment of the present invention shown in FIG. **10** controls the brightness of the back light **38** using the most-frequent value F when the most-frequent value F is 40% or more of the gray levels of the histogram, thereby displaying a vivid image. On the other hand, the embodiment of the present invention shown in FIG. **10** controls the brightness of the back light **38** using an average value when the most-frequent value F is less than 40% of the histogram, thereby controlling brightness of the back light **38** to correspond to the brightness components Y.

The flag generator **62** and the back light controller **64** generate a brightness control signal using an average value or the most-frequent value F applied thereto. Since a detailed operation procedure of the flag generator **62** and the back light controller **64** has been described with reference to FIG. **6**, an explanation as to these elements will be omitted.

As described above, according to the present invention, data is changed into brightness components to be arranged into a histogram for each frame and brightness of the back light is controlled with the aid of a most-frequent value and/or an average value extracted from the histogram, thereby displaying a vivid image. Furthermore, according to the present invention, a plurality of gray level areas having changed brightness components of the back light are established and control is preformed such that the previous brightness is kept at at least one area of these gray level areas, thereby displaying a stable brightness of image.

Although the present invention has been explained by the embodiments shown in the drawings described above, it should be understood to the ordinary skilled person in the art that the invention is not limited to the embodiments, but rather that various changes or modifications thereof are possible without departing from the spirit of the invention. Accordingly, the scope of the invention shall be determined only by the appended claims and their equivalents.

What is claimed is:

1. A method of driving a display adaptive for making a stable brightness of a back light unit, comprising:

(A) dividing gray levels in a frame to be displayed into a plurality of brightness areas;

(B) converting data of the frame into brightness components;

(C) arranging the brightness components into a histogram of the gray levels;

(D) extracting at least one of a most-frequent value of the gray levels in the histogram and an average value of the gray levels in the histogram;

(E) controlling brightness of a back light to correspond to the brightness areas to which the extracted belongs, wherein the brightness of the back light is controlled such that a different brightness can be produced for each of the brightness areas; and

(D) selecting the brightness area to which the most-frequent value belongs to control the brightness of the back light when the number of brightness components occupying the most-frequent value is at least a predetermined percentage of the total brightness components of the frame and selecting the brightness area to which the average value belongs to control the brightness of the back light when the most-frequent value is less than the predetermined percentage.

2. The method of claim **1**, wherein the most-frequent value is extracted from the histogram, and the brightness of the back light is controlled to correspond to the brightness area to which the most-frequent value belongs.

3. The method of claim **1**, wherein the average value is extracted from the histogram, and the brightness of the back light is controlled to correspond to the brightness area to which the average value belongs.

4. The method of claim **1**, wherein the brightness of the back light is controlled such that the brightness supplied increases with an increase in gray level of the extracted value.

5. The method of claim **1**, further comprising maintaining the brightness of the back light from the brightness of the back light in a previous frame when the brightness area in which the extracted value belongs is at least one brightness area of the plurality of brightness areas.

6. The method of claim **5**, wherein a brightness area of the at least one brightness area separates brightness areas in which the brightness of the back light is allowed to change.

7. A method of driving a display adaptive for making a stable brightness of a back light unit, comprising:

(A) dividing gray levels in a frame to be displayed into a plurality of brightness areas;

(B) converting data of the frame into brightness components;

(C) arranging the brightness components into a histogram of the gray levels;

(D) extracting at least one of a most-frequent value of the gray levels of the histogram and an average value of the gray levels of the histogram;

(E) generating a flag signal to correspond to a brightness area to which the extracted belongs;

(F) controlling brightness of a back fight using the extracted value and the flag signal; and

(G) selecting the brightness area to which the most-frequent value belongs to control the brightness of the back light when the number of brightness components occupying the most-frequent value is at least a predetermined percentage of the total brightness components of the frame and selecting the brightness area to which the average value belongs to control the brightness of the back light when the most-frequent value is less than the predetermined percentage.

8. The method of claim **7**, further comprising maintaining the flag signal from a previous flag signal when the most-frequent value or the average value belongs to at least one brightness area of the brightness areas and otherwise permitting the flag signal to be able to be changed from the previous flag signal when the most-frequent value or the average value does not belong to the at least one brightness area.

9. The method of claim **8**, further comprising maintaining the brightness of the back light from a previous brightness of the back light when the flag signal is maintained irrespective of the brightness area to which the most-frequent value or the average value belongs.

10. The method of claim **8**, wherein the at least one brightness area is an area in which a brightness value of the back light is not changed.

11. The method of claim 8, further comprising changing the brightness of the back light to correspond to an area to which the most-frequent value or the average value belongs when the flag signal is changed.

12. A driving apparatus for driving a display adaptive for making a stable brightness of a back light unit, comprising:

a brightness/color separator for converting data of a frame into brightness components;

a histogram analyzer for arranging the brightness components into a histogram of gray levels; and

a back light control for extracting a most-frequent value or an average value of the gray levels from the histogram and for controlling brightness of a back light using the extracted value, the back light control dividing the gray levels into a plurality of areas and controlling the brightness of the back light in correspondence with an area to which the extracted value belongs;

wherein the back light control includes:

a most-frequent/average value extractor for extracting the most-frequent value when the number of brightness components occupying the most-frequent value is at least a predetermined percentage of the total brightness components of the frame while extracting the average value when the most-frequent value is less than the predetermined percentage;

a back light controller for controlling the brightness of the back light to correspond to the area to which the extracted value belongs; and

a digital to analog converter for converting a digital output signal of the back light controller into an analog output signal to apply the analog output signal to an inverter.

13. The driving apparatus of claims 12, wherein the back light controller controls the back light such that a different brightness of light can be supplied for each area.

14. A driving apparatus for driving a display adaptive for making a stable brightness of a back light unit, comprising:

a brightness/color separator for converting data of a frame into brightness components;

a histogram analyzer for arranging the brightness components into a histogram of gray levels; and

a back light control for extracting a most-frequent value or an average value of the gray levels from the histogram and for controlling brightness of a back light using the extracted value, the back light control dividing the gray levels into a plurality of areas and controlling the brightness of the back light in correspondence with an area to which the extracted value belongs;

wherein the back light control includes:

a most-frequent value extractor for extracting the most-frequent value;

a flag generator for generating a flag signal to correspond to the area to which the most-frequent value belongs;

a back light controller that is supplied with the most-frequent value and the flag signal, the back light controller for controlling the brightness of the back light to correspond to the area to which the most-frequent value belongs when the flag signal has been changed in comparison with a previous flag signal; and

a digital to analog converter for converting a digital output signal of the back light controller into an analog output signal to apply the analog output signal to an inverter;

wherein the flag generator comprises:

a comparator that compares the most-frequent value with a plurality of gray levels of the histogram and outputs compared results;

a logic array that logically combines the compared results into a plurality of combined results; and

a generator that generates the flag signal from the combined results.

15. A driving apparatus for driving a display adaptive for making a stable brightness of a back light unit, comprising:

a brightness/color separator for converting data of a frame into brightness components;

a histogram analyzer for arranging the brightness components into a histogram of gray levels; and

a back light control for extracting a most-frequent value or an average value of the gray levels from the histogram and for controlling brightness of a back light using the extracted value, the back light control dividing the gray levels into a plurality of areas and controlling the brightness of the back light in correspondence with an area to which the extracted value belongs;

wherein the back light control includes:

an average value extractor for extracting the average value;

a flag generator for generating a flag signal to correspond to the area to which the average value belongs;

a back light controller that is supplied with the average value and the flag signal, the back light controller for controlling the brightness of the back light to correspond to the area to which the average value belongs when the flag signal has been changed in comparison with a previous flag signal; and

a digital to analog converter for converting a digital output signal of the back light controller into an analog output signal to apply the analog output signal to an inverter;

wherein the flag generator comprises:

a comparator that compares the average value with a plurality of gray levels of the histogram and outputs compared results;

a logic array that logically combines the compared results into a plurality of combined results; and

a generator that generates the flag signal from the combined results.

16. A driving apparatus for driving a display adaptive for making a stable brightness of a back light unit, comprising:

a brightness/color separator for converting data of a frame into brightness components;

a histogram analyzer for arranging the brightness components into a histogram of gray levels; and

a back light control for extracting a most-frequent value or an average value of the gray levels from the histogram and for controlling brightness of a back light using the extracted value, the back light control dividing the gray levels into a plurality of areas and controlling the brightness of the back light in correspondence with an area to which the extracted value belongs;

wherein the back light control includes:

a most-frequent/average value extractor for extracting the most-frequent value when the number of brightness components occupying the most-frequent value is at least a predetermined percentage of the total brightness components of the frame while extracting the average value when the most-frequent value is less than the predetermined percentage;

a flag generator for generating a flag signal to correspond to the area to which the extracted value belongs;

a back light controller that is supplied with the extracted value and the flag signal, the back light controller for controlling the brightness of the back light to correspond to the area to which the extracted value belongs when the flag signal has been changed in comparison with a previous flag signal; and a digital to analog converter for converting a digital output signal of the back light controller into an analog output signal to apply the analog output signal to an inverter.

17. The driving apparatus of claim **14**, wherein the back light controller does not change the brightness of the back light when the flag signal has the same value as the previous flag signal.

18. The driving apparatus of claim **15**, wherein the back light controller does not change the brightness of the back light when the flag signal has the same value as the previous flag signal.

19. The driving apparatus of claim **16**, wherein the back light controller does not change the brightness of the back light when the flag signal has the same value as the previous flag signal.

20. The driving apparatus of claim **14**, wherein the flag generator is required to generate a flag signal identical to the previous flag signal when the area to which the most-frequent value belongs is a particular area selected from the plurality of areas.

21. The driving apparatus of claim **15**, wherein the flag generator is required to generate a flag signal identical to the previous flag signal when the area to which the average value belongs is a particular area selected from the plurality of areas.

22. The driving apparatus of claim **16**, wherein the flag generator is required to generate a flag signal identical to the previous flag signal when the area to which the extracted value belongs is a particular area selected from the plurality of areas.

23. The driving apparatus of claim **20**, wherein the particular area lies between areas in which the flag generator is not required to generate a flag signal identical to the previous flag signal.

24. The driving apparatus of claim **21**, wherein the particular area lies between areas in which the flag generator is not required to generate a flag signal identical to the previous flag signal.

25. The driving apparatus of claim **22**, wherein the particular area lies between areas in which the flag generator is not required to generate a flag signal identical to the previous flag signal.

26. The driving apparatus of claim **16**, wherein the flag generator comprises:

a comparator that compares the extracted average value with a plurality of gray levels of the histogram and outputs compared results;

a logic array that logically combines the compared results into a plurality of combined results; and

a generator that generates the flag signal from the combined results.

* * * * *

patsnap

专利名称(译)	驱动显示器的方法，其适于使背光单元的亮度稳定		
公开(公告)号	[US7466301](US7466301)	公开(公告)日	2008-12-16
申请号	US10/880218	申请日	2004-06-28
[标]申请(专利权)人(译)	乐金显示有限公司		
申请(专利权)人(译)	LG飞利浦LCD CO.，LTD.		
当前申请(专利权)人(译)	LG DISPLAY CO.，LTD.		
[标]发明人	SOHN MIN HO BAIK SEONG HO		
发明人	SOHN, MIN HO BAIK, SEONG HO		
IPC分类号	G09G3/36 G02F1/133 G09G3/20 G09G3/34		
CPC分类号	G09G3/3406 G09G3/3611 G09G3/2077 G09G2320/0626 G09G2320/0646 G09G2360/16		
代理机构(译)	BRINKS霍费尔GILSON＆LIONE		
审查员(译)	阮筝		
优先权	1020030081174 2003-11-17 KR		
其他公开文献	US20050104840A1		
外部链接	Espacenet USPTO		

摘要(译)

公开了一种用于液晶显示器的驱动方法和装置，其稳定了依赖于从要显示的数据提取的亮度分量的背光亮度的变化。在该方法中，每帧的亮度分量被排列成直方图，该直方图被分成多个亮度区域。提取亮度分量的最频繁值或亮度分量的平均值。控制背光的亮度以对应于提取的最频繁值或平均值所属的亮度区域。选择亮度区域内的一个或多个特定区域，使得如果提取的最频繁值或平均值属于特定区域，则背光的亮度可以不在连续帧中改变。