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Amended claims in accordance with Rule 86 (2)
EPC.

(54) **Driving circuit of a liquid crystal display and driving method thereof**

(57) A driving method of a liquid crystal display (LCD) (30) includes (a) measuring reaction curves of LCD panel pixels (36) switching from any gray scale value to others within a frame period and generating a standard table (60) according to the results, (b) measuring adjustment gray scale values of any gray scale value for different gammas, (c) generating a plurality of tables (52) according to the adjustment gray scale values and the standard table (60), (d) applying scan voltages

to the scan lines (32), (e) receiving image data from an image signal terminal (42), (f) delaying the image data for a frame period to generate delayed image data, (g) selecting a table (70) from the standard table (60) and the tables (52) according to gamma, and (h) selecting an image data value from the selected table (70) according to the current and delayed image data to generate a data line voltage to be applied on a corresponding data line (34).

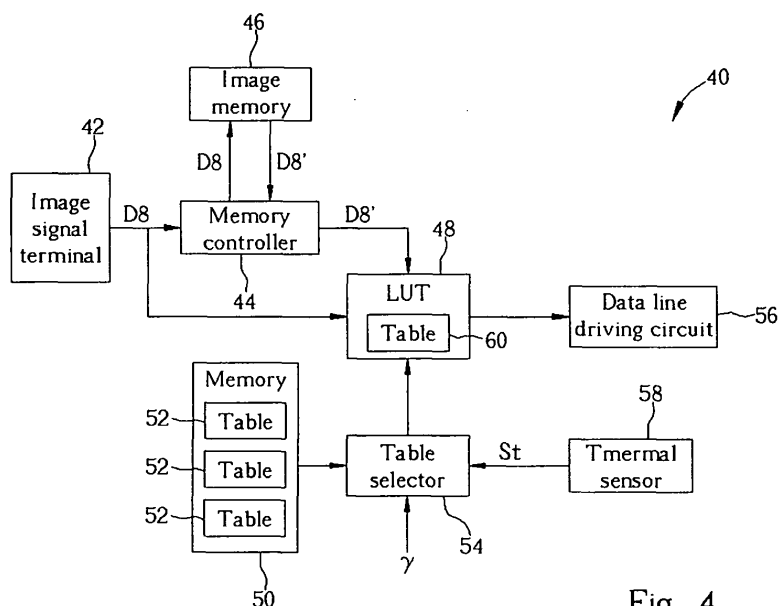


Fig. 4

Description

[0001] The invention relates to a driving circuit of a liquid crystal display and its relating driving method according to the pre-characterizing clause of claim 1.

[0002] A liquid crystal display (LCD) has advantages of light weight, low power consumption, and low divergence and is applied to various portable equipment such as notebook computers and personal digital assistants (PDAs). In addition, LCD monitors and LCD televisions are gaining in popularity as a substitute for traditional cathode ray tube (CRT) monitors and televisions. However, an LCD does have some disadvantages. Because of the limitations of physical characteristics, the liquid crystal molecules need to be twisted and rearranged when changing input data, which can cause the images to be delayed. For satisfying the rapid switching requirements of multimedia equipment, improving the response speed of liquid crystal is desired.

[0003] With these problems in mind, the present invention aims at providing a driving circuit with an adjustable gamma and an LUT of an LCD along with the relating driving method to solve the problem mentioned above.

[0004] This is achieved by the present invention as claimed in claim 1 that the present invention provides a driving method of an LCD. The LCD includes an LCD panel; the LCD panel includes a plurality of scan lines, a plurality of data lines, and a plurality of pixels. Each pixel is connected to a corresponding scan line and a corresponding data line, and each pixel comprises a switching device connected to the corresponding scan line and the corresponding data line. The method includes (a) measuring reaction curves of a pixel of the LCD panel switched from any gray scale value to other gray scale values within a frame period and generating a standard table according to the reaction curves measured, (b) measuring adjustment gray scale values of any gray scale value for different gammas, (c) generating a plurality of tables according to the adjustment gray scale values and the standard table, (d) applying scan voltages to the scan lines, (e) receiving image data from an image signal terminal, (f) delaying the image data for a frame period in order to generate delayed image data, (g) selecting a table from the standard table and the tables according to the gamma, and (h) selecting an image data value from the selected table according to the current image data and the delayed image data and generating a data line voltage according to the image data value, applying the generated data line voltage on a corresponding data line.

[0005] The invention is illustrated by way of example with reference to the accompanying drawings, in which

Fig.1 is a timing diagram of pixel voltage and transmission rate according to prior art,

Fig.2 is a timing diagram of pixel voltage and transmission rate according to prior art using an over-

driving method,

Fig.3 is a circuit diagram of a typical LCD,

Fig.4 is a block diagram of a driving circuit according to the present invention,

Fig.5 illustrates a table used by the LUT in Fig. 4,

Fig.6 illustrates the measured reaction curves of the LCD panel,

Fig.7 illustrates the method to determine overdrive image data in the table, and

Fig.8 illustrates a table in Fig.5 whose gamma is adjusted.

[0006] The prior art is disclosed in U.S. published application No. 2002/0050965. The U.S. published application No. 2002/0050965 discloses an over-driving method using a brief table to store the over-driving image data. The brief table only includes part of the over-driving image data for driving the pixels switched from one gray scale to another. When the driving circuit receives the image data from the input terminal, a processor is used to perform an interpolation operation to expand the brief table. Hence, an extra algorithm is needed in the conventional over-driving method. The effect of using an extra algorithm is that it will slow down the response speed.

[0007] Please refer to Fig.1, which is a timing diagram of the pixel voltage and the transmission rate V1 according to a prior art LCD. In Fig.1, the pixel voltage is shown with the straight lines, and the transmission rate V1 is shown with a dotted line. In Fig.1, frame N means a frame period, and frame N+1, N+2... mean the following frame periods. Due to the physical characteristics of liquid crystal molecules, when the pixel voltage is switched from a data voltage C1 to a data voltage C2, the liquid crystal molecules cannot be twisted to a predetermined angle within a single frame period, resulting in failure to perform at a predetermined transmission rate. As the curve of the transmission rate V1 shows, the transmission rate V1 cannot reach a predetermined transmission rate until the frame period of frame N+2. The delayed response-time will cause blurring on the LCD.

[0008] An over-driving method is utilized to improve the response-time. Please refer to Fig.2, which is a timing diagram of the pixel voltage and the transmission rate V2 according to a prior art LCD using an over-driving method. When the pixel voltage is switched from the data voltage C1 to the data voltage C2, an over-driving data voltage C3 is added to accelerate the response speed of the liquid crystal molecules. Since a higher data voltage can obtain a faster response speed of the liquid crystal molecules, a data voltage C3 that is higher than the data voltage C2 can improve the response-time enough to reach the predetermined transmission rate in a single frame period. As Fig.2 shows, the curve of the transmission rate V2 reaches the predetermined transmission rate in frame N.

[0009] In addition, there is no description relating to the adjustment of gamma of an LCD. In the prior art, the

overdrive and adjustment of gamma depend respectively on two different circuits, which complicates the whole circuit.

[0010] Hereby the operation of an LCD is described in advance. Please refer to Fig.3, which is a circuit diagram of a typical LCD 30. The LCD 30 comprises an LCD panel 31, and the LCD panel 31 includes a plurality of scan lines 32, a plurality of data lines 34, and a plurality of pixels 36. Each pixel 36 is connected to a corresponding scan line 32 and a corresponding data line 34, and each pixel 36 has a switching device 38 and a pixel electrode 39. The switching device 38 is connected to the corresponding scan line 32 and the corresponding data line 34. To drive the LCD 30, scan voltages are applied to the scan lines 32 to turn on the switching devices 38, and data voltages are applied to the data lines 34 and transmitted to the pixel electrodes 39 through the switching devices 38. Therefore, when the scan voltages are applied to the scan lines 32 to turn on the switching devices 38, the data voltages on the data lines 34 will charge the pixel electrodes 39 through the switch devices 38 thereby, twisting the liquid crystal molecules. When the scan voltages on the scan lines 32 are removed to turn off the switching devices 38, the data lines 34 and the pixels 36 will disconnect, and the pixel electrodes 39 will remain charged. The scan lines 32 turn the switching devices 38 on and off repeatedly so that the pixel electrodes 39 can be repeatedly charged. Different data voltages cause different twisting angles and show different transmission rates. Hence, the LCD 30 displays various images.

[0011] Please refer to Fig.4, which is a block diagram of a driving circuit according to the present invention. The driving circuit 40 is for driving the LCD 30 in Fig.3. The driving circuit 40 includes an image signal terminal 42, a memory controller 44, an image memory 46, an LUT 48, a memory 50, a table selector 54, a data line driving circuit 56, and a thermal sensor 58. In the present embodiment, the image signal terminal 42 respectively transmits 8-bit image data of red, green and blue (RGB) to the memory controller 44 and the LUT 48. Each group of image data is for controlling the gray scale value of the pixel 30 in red, green or blue. Each color has 256 (2^8) gray scales, so that 24 (8×3) bits of image data are required to determine the properties of each pixel 30.

[0012] In the present embodiment, one (image data D8) of the 3 groups of image data is used for a further description. First, the image signal terminal 42 transmits the 8-bit image data D8 to the memory controller 44 and the LUT 48. Continuously, the memory controller 44 transmits the image data D8 to the image memory 46 to store, delays the image data D8 for a frame period, and then reads the image data D8 out from the image memory 46 and transmits them to the LUT 48. The image data D8 delayed for a frame period is hereby defined as delayed image data D8'. Therefore, the delayed image data D8' and the image data D8 belong to two different frames, and these two image data D8' and D8 are input

from the image signal terminal 42 in sequence at an interval of a frame period.

[0013] The memory 50 stores a plurality of parameter tables 52. Each table 52 corresponds to different gammas. The driving circuit 40 can select the proper table 52 to use as the LUT 48 to drive the LCD panel 31 according to the gamma. For this reason, a table selector 54 is used to select a table 60 from the plurality of tables 52 according to the gamma and send it to the LUT 48.

[0014] Please refer to Fig.5 showing a table 60 used by the LUT 48 in Fig.4. The table 60 stores ($2^8 \times 2^8$) pieces of 8-bit overdrive image data 62. Each piece of image data 62 corresponds to different combinations of the current image data D8 and the delayed image data D8'. The LUT 48 selects an image data value 62 from the table 60, selected by the table selector 54, according to the current image data D8 and the delayed image data D8' and then sends it to the data line driving circuit 56. Continuously, the data line driving circuit 56 generates a data line voltage according to the image data value 62 output from the LUT 48 and applies it to a corresponding data line 34. Take for instance the situation where the delayed image data D8' is 128 and the current image data D8 is 180, i.e. the corresponding pixel 36 is switched from gray scale 128 to gray scale 180. In this case the LUT 48 selects the image data value 62 with a value of 210 from the table 60 according to the current image data D8 and the delayed image data D8'. In response, the data line driving circuit 56 generates a data line voltage corresponding to the image data value 62 with a value of 210 and applies it to the corresponding data line 34. In addition, please notice that the selected image data value 62 is larger than the value of the current image data D8 (i.e. $210 > 180$), which means the driving circuit 40 overdrives the pixel 36.

[0015] Additionally, in contrast to the prior art, which uses a processor to extract values in a table by interpolation, the image data values in the tables 52 according to the present invention are previously stored in the memory 50. Therefore, the driving circuit 40 according to the present invention does not require the processor for extraction as in the prior art. The image data values in the tables 52 are obtained by measuring the LCD panel 31 so that the driving circuit 40 can overdrive the LCD panel 31 correctly without an operation such as interpolation as in the prior art. Please refer to Fig.6 showing the measurement of reaction curves of the LCD panel 31. Before determining the overdrive image data in the table 52, reaction curves representing a pixel 36 switching from any gray scale value to other gray scale values in a frame period t can be measured. Fig.6 shows the reaction curves C0~C255 representing the pixel 36 switching from a gray scale value 128 to any other gray scale values (0~255). In the case of measuring the LCD panel 31 used in the above examples, since the pixel 36 is switched among 256 gray scales, there are 256 reaction curve diagrams like Fig. 6 shown respectively for the pixel 36 switching from one gray scale value

(0~225) to other gray scale values within a frame period t.

[0016] Please refer to Fig.7 showing the method used to determine overdrive image data in the table 52. Take a pixel 36 switched from gray scale value 128 to gray scale value 180 for an example. As shown in Fig.7, if the pixel electrode 39 of the pixel 36 is subject to a data voltage corresponding to gray scale 180, the gray scale is not able to reach 180 in a frame period t. Thus, an overdrive voltage is required to be applied to the pixel electrode 39 of the pixel 36. Therefore, the data voltage required to have the pixel electrode 39 of the pixel 36 switch from the gray scale value 128 to 180 in a frame period can be known by using the reaction curves C0~C225 in Fig.6. The method to determine overdrive image data is as follows:

- (1) Find an intersection A (as shown in Fig.7) between a vertical line of frame period t and a horizontal line of the gray scale value 180 in Fig.6; and
- (2) Determine which one of the reaction curves C0~C225 is closer to A. Image data (or gray scale value) corresponding to the reaction curve closer to A is the required overdrive image data.

[0017] In the said example, since the reaction curve corresponding to image data 210 passes A, the required overdrive image data for the pixel 36 switched from gray scale value 128 to 180 is 210. Moreover, each table 50 stores ($2^8 \times 2^8$) 8-bit overdrive image data, and each piece of the image data is obtained by measuring the LCD panel 31. In addition, please notice that during the gray scale switching of the pixel 36, if the difference between two neighboring gray scales is too large (e.g. 128 to 255) so that the switching cannot be completed in a frame period t, the overdrive data value will be 0 or 255, wherein 0 is for a high gray scale value to a low gray scale value, and 255 is for a low gray scale value to a high gray scale value.

[0018] In addition, the table 60 in Fig.5 obtained by measurement is defined as a standard table. The overdrive image data 62 in the column along a diagonal line 64 from the upper-left to the lower-right equals to the corresponding delayed image data D8' and the corresponding image data D8. That means the gamma of the table 60 has not been adjusted, i.e. the gamma corresponding to the table 60 is 1. Compared with the table 60 in Fig.6, Fig.8 shows a table 70 whose gamma has been adjusted. Being the same as the standard table 60, the table 70 is selected from the plurality of tables 52 in the memory 50, and it stores a plurality of overdrive image data 72 for the LUT 48. The difference is that in the table 70, the gamma is adjusted so that all the overdrive image data 72 in the columns along the diagonal line 74 do not necessarily equal to the corresponding delayed image data D8' and the corresponding image data D8. Moreover, the overdrive image data 72 in the table 70 is relative to the overdrive image data 62 in the

table 60 because the overdrive image data 72 is obtained through the following steps:

- (1) Measure an adjustment gray scale value of every gray scale value of the pixel 36 for a specific gamma. Take the table 70 for example. Now measure all the overdrive image data 72 in the columns along the diagonal line 74; and
- (2) Solve other overdrive image data 72 to fill in the rest of the table (i.e. the spaces not along the diagonal) by using the adjustment gray scale value and the standard table 60. To solve for an image data value 72 on the table 70, find the diagonal image data 72 located on the same row i.e. D8' as the image data 72 that needs to be solved. Replace the D8' coordinate with the diagonal image data 72 value and look up the value using the new coordinates on the standard table 60. The image data value 62 located at the new coordinates is the value of the image data 72 to be solved. Take the overdrive image data 72 located at (D8', D8) = (2, 1) in the table 70 for example. The overdrive image data 72 in the column along the diagonal line 74 and on the same line as (2,1) has an the image data value of 3. Replacing the old D8' coordinate (2) with the image data value of 3, the new coordinates become (3,1) after adjustment. Using the new coordinates on table 60, it is found that the image data 62 has a value of 1. By this way, it can be known that the overdrive image data 72 (D8', D8) = (2, 1) in the table 70 is equal to the overdrive image data 62 (D8', D8) = (3, 1) in the table 60, the overdrive image data being equal to 1.

[0019] Moreover, tables 50 corresponding to other gammas can be generated according to the method mentioned above. Measure overdrive image data in columns along a diagonal line of each table 50, and then solve other overdrive image data according to the standard table 60 and the overdrive data in the columns along the diagonal line.

[0020] Additionally, when the liquid crystal molecules are twisted according to data voltage change, the response time of the twisting differs according to the temperature of the LCD panel 31. For better performance under various temperature, the driving circuit 40 selects the table according to the temperature of the LCD panel 31 by generates temperature compensation signals St sending them to the table selector 54 so that the table selector 54 selects a table from the plurality of tables 52 stored in the memory 50, according to both gamma and the temperature compensation signals St, and transmits the selected table to the LUT 48.

[0021] In contrast to the prior art, the tables according to the present invention are built by actually measuring the over-driving voltages needed for properly driving the liquid crystal panel within a frame period. The tables include all the over-driving image data that drives the pix-

els from any gray scale to another so that the processor used to extract the brief table is no longer required. Additionally, the driving circuit and the driving method of the present invention is capable of selecting different tables according to gamma and temperature of the LCD panel for the LUT.

[0022] Those skilled in the art will readily observe that numerous modifications and alterations of the device and method may be made while retaining the teachings of the invention. Accordingly, the above disclosure should be construed as limited only by the metes and bounds of the appended claims.

Claims

1. A driving method of a liquid crystal display (LCD) (30), the LCD (30) comprising:

an LCD panel (31), the LCD panel (31) comprising:

a plurality of scan lines (32);
a plurality of data lines (34); and
a plurality of pixels (36), each pixel (36) being connected to a corresponding scan line (32) and a corresponding data line (34), and each pixel (36) comprising a switching device (38) connected to the corresponding scan line (32) and the corresponding data line (34); and

characterized in that:

the driving method comprises:

(a) measuring reaction curves of the pixels (36) of the LCD panel (31) switched from any gray scale value to other gray scale values in a frame period, and generating a standard table (60) according to the reaction curves measured;
(b) measuring adjustment gray scale values of any gray scale value for different gammas;
(c) generating a plurality of tables (52) according to the adjustment gray scale values and the standard table (60);
(d) applying scan voltages to the scan lines (32);
(e) receiving image data from an image signal terminal (42);
(f) delaying the image data for a frame period in order to generate delayed image data;
(g) selecting a table (70) from the standard table (60) and the tables (52) according to gamma; and

(h) selecting an image data value from the selected table (70) according to the current image data and the delayed image data and generating a data line voltage according to the image data value, applying the generated data line voltage on a corresponding data line (34).

2. The driving method of claim 1 **characterized in that** the driving method further comprises:

(i) generating temperature compensation signals according to temperature of the LCD panel (31); and
(j) selecting the table (70) from the standard table (60) and the tables (52) according to the gamma and the temperature compensation signals in step (g).

3. A driving method of a liquid crystal display (LCD) (30), the LCD (30) comprising:

an LCD panel (31), the LCD panel (31) comprising:

a plurality of scan lines (32);
a plurality of data lines (34); and
a plurality of pixels (36), each pixel (36) being connected to a corresponding scan line (32) and a corresponding data line (34), and each pixel (36) comprising a switching device (38) connected to the corresponding scan line (32) and the corresponding data line (34);

characterized in that:

the driving method comprises:

(a) applying scan voltages to the scan lines (32);
(b) receiving image data from an image signal terminal (42);
(c) delaying the image data for a frame period in order to generate delayed image data;
(d) selecting a table (70) from the standard table (60) and the tables (52) according to gamma; and
(e) selecting an image data value from the selected table (70) according to the current image data and the delayed image data, and generating a data line voltage according to the image data value, applying the generated data line voltage on a corresponding data line (34).

4. The driving method of claim 3 **characterized in that**

the driving method further comprises:

(f) measuring reaction curves of the pixels (36) of the LCD panel (31) switched from any gray scale value to other gray scale values in a frame period, and generating a standard table (60) according to the reaction curves measured. 5

5. The driving method of claim 4 **characterized in that** the driving method further comprises: 10

(g) measuring adjustment gray scale values of any gray scale value for different gammas; (h) generating a plurality of tables (52) except the standard table (60) according to the adjustment gray scale values and the standard table (60); 15

6. The driving method of claim 3 **characterized in that** the driving method further comprises: 20

(i) generating temperature compensation signals according to temperature of the LCD panel (31); and (j) selecting the table (70) from the standard table (60) and the tables (52) according to the gamma and the temperature compensation signals in step (d). 25

7. A driving circuit for driving an LCD (30), the LCD (30) comprising: 30

an LCD panel (31), the liquid crystal panel (31) comprising: 35

a plurality of scan lines (32); a plurality of data lines (34); and a plurality of pixels (36), each pixel (36) being connected to a corresponding scan line (32) and a corresponding data line (34), and each pixel (36) having a switching device (38) connected to the corresponding scan line (32) and the corresponding data line (34); 40

characterized in that: 45

the driving circuit (40) comprises:

a scan line driving circuit for applying scan voltages to the scan lines (32); an image signal terminal (42) for receiving image data; an image memory (46) for storing the image data and delaying the image data for a frame period; a memory (50) for storing a plurality of tables (52); 50

a selector (54) for selecting a table (70) from the plurality of tables (52) according to gamma;

a look up table (48) for selecting an image data value from the selected table (70) according to the current image data and the delayed image data; and

a data line driving circuit (56) for generating a data voltage according to the image data value and applying the data voltage to a corresponding data line (34).

8. The driving circuit of claim 7 **characterized in that** the driving circuit (40) further comprises a thermal sensor (58) for sensing temperature of the LCD panel (31) and generating temperature compensation signals according to the temperature, and the selector (54) selecting the table (70) from the plurality of tables (52) stored in the memory (50) according to gamma and the temperature compensation signals.

Amended claims in accordance with Rule 86(2) EPC.

1. A driving method of a liquid crystal display (LCD) (30), the LCD (30) comprising:

an LCD panel (31), the LCD panel (31) comprising:

a plurality of scan lines (32); a plurality of data lines (34); and a plurality of pixels (36), each pixel (36) being connected to a corresponding scan line (32) and a corresponding data line (34), and each pixel (36) comprising a switching device (38) connected to the corresponding scan line (32) and the corresponding data line (34);

wherein the driving method comprises:

- (a) applying scan voltages to the scan lines (32); (b) receiving image data from an image signal terminal (42); (c) delaying the image data for a frame period in order to generate delayed image data;

characterized by:

- (d) selecting a table (70) from a standard table (60), which stores overdrive image data (62) corresponding to different combinations of current image data (D8) and delayed image data (D8') and which reflects a gamma of 1, and a plurality of tables (52), which reflect overdrive image data adjusted to a specific gamma, respectively, according to a specific gamma; and

(e) selecting an overdrive image data value from the selected table (70) according to the current image data actually received at the image signal image data actually received at the image signal terminal (42) and the delayed image data received one frame period earlier at the image signal terminal (42), and generating a data line voltage according to the overdrive image data value, applying the generated data line voltage on a corresponding data line (34).

2. The driving method of claim 1 characterized in that the driving method further comprises:

(f) measuring reaction curves representing the switching of the pixels (36) of the LCD panel (31) from any gray scale value to other gray scale values in a frame period to generate the standard table (60) according to the reaction curves measured.

3. The driving method of claim 4 characterized in that the driving method further comprises:

(g) measuring adjustment gray scale values of every gray scale value of the pixels (36) for different specific gammas; and
(h) generating the plurality of tables (52) according to the adjustment gray scale values and the standard table (60);

4. The driving method of claim 1 characterized in that the driving method further comprises:

(i) generating temperature compensation signals according to temperature of the LCD panel (31), which compensate the differing of the response time of the twisting of the liquid crystal molecules according to the temperature of the LCD panel (31); and
(j) selecting the table (70) from the standard table (60) and the tables (52) according to the specific gamma and the temperature compensation signals, in step (d).

5. A driving circuit for driving an LCD (30), the LCD (30) comprising:

an LCD panel (31), the liquid crystal panel (31) comprising:

a plurality of scan lines (32);
a plurality of data lines (34); and
a plurality of pixels (36), each pixel (36) being connected to a corresponding scan line (32) and a corresponding data line (34), and each pixel (36) having a switching device (38) connected to the corresponding

scan line (32) and the corresponding data line (34);

wherein the driving circuit (40) comprises:

a scan line driving circuit for applying scan voltages to the scan lines (32);
an image signal terminal (42) for receiving image data; an image memory (46) for storing the image data and delaying the image data for a frame period;
a memory (50) for storing a plurality of tables (52);

characterized by:

a selector (54) for selecting a table (70) from the plurality of tables (52) according to a specific gamma;
a look up table (48) for selecting an overdrive image data value from the selected table (70) according to current image data actually received at the image signal terminal (42) and delayed image data received one frame earlier at the image signal terminal (42); and
a data line driving circuit (56) for generating a data voltage according to the overdrive image data value and applying the data voltage to a corresponding data line (34).

6. The driving circuit of claim 5 characterized in that the driving circuit (40) further comprises a thermal sensor (58) for sensing temperature of the LCD panel (31) and generating temperature compensation signals according to the temperature, and the selector (54) selecting the table (70) from the plurality of tables (52) stored in the memory (50) according to gamma and the temperature compensation signals, which compensate the differing of the response time of the twisting of the liquid crystal molecules according to the temperature of the LCD panel (31).

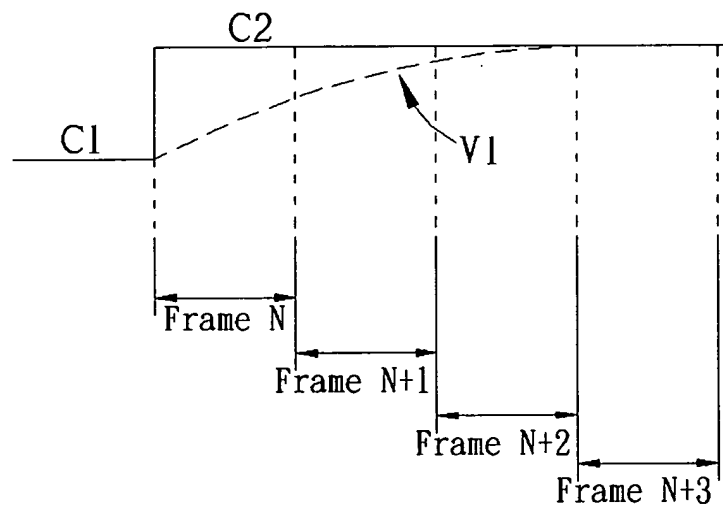


Fig. 1 Prior art

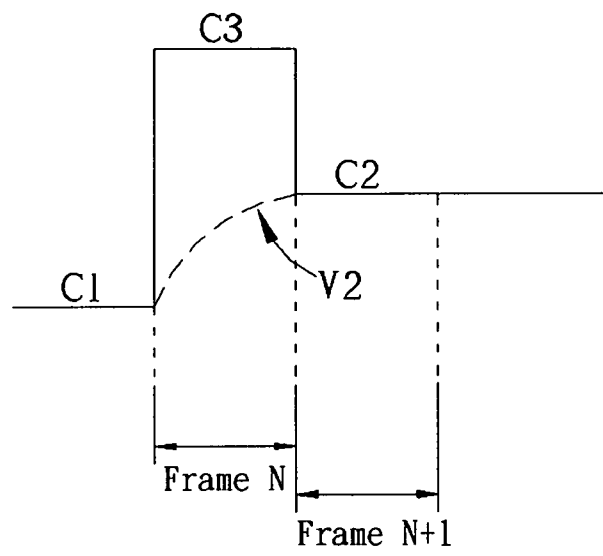


Fig. 2 Prior art

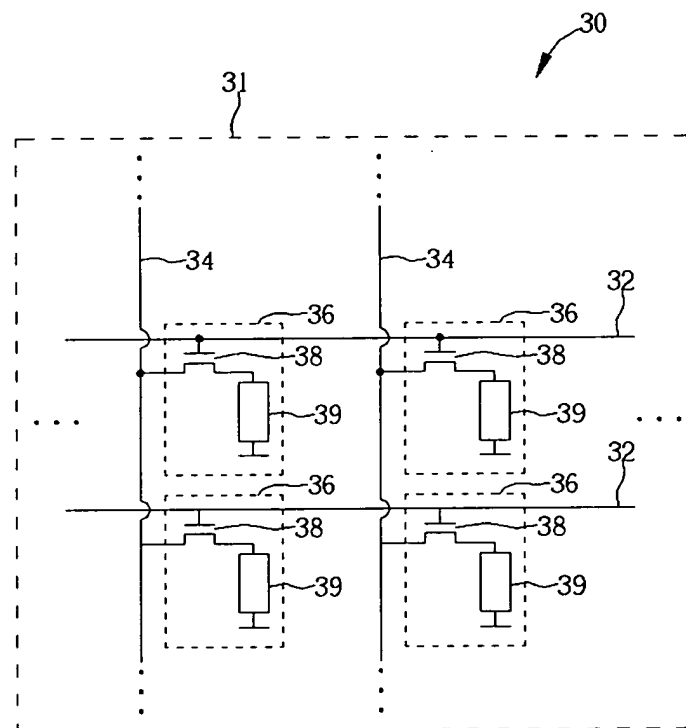


Fig. 3

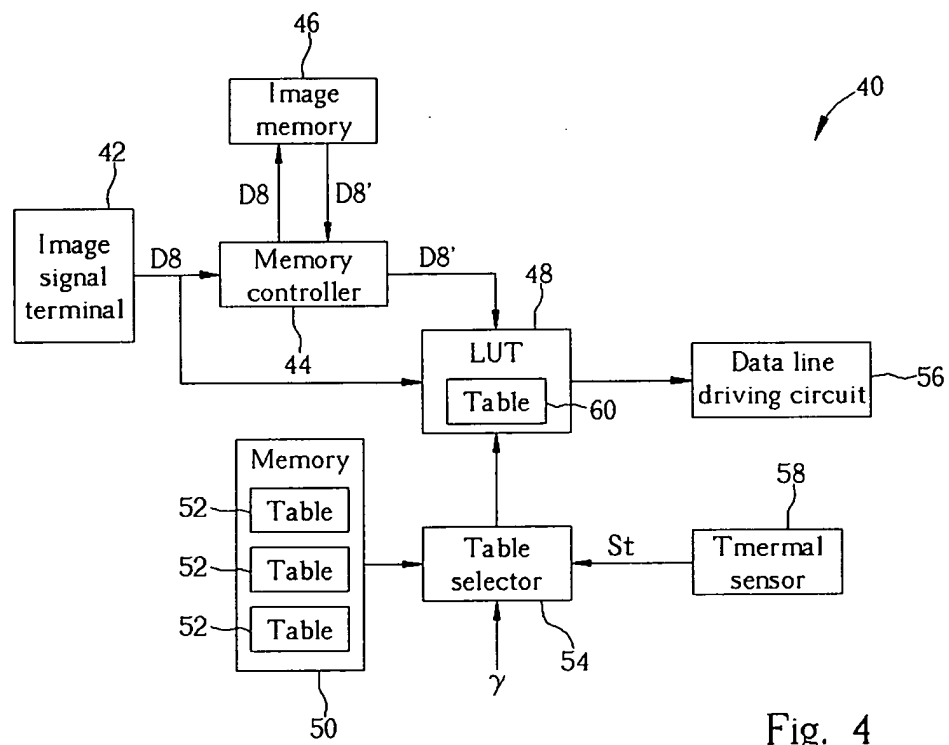


Fig. 4

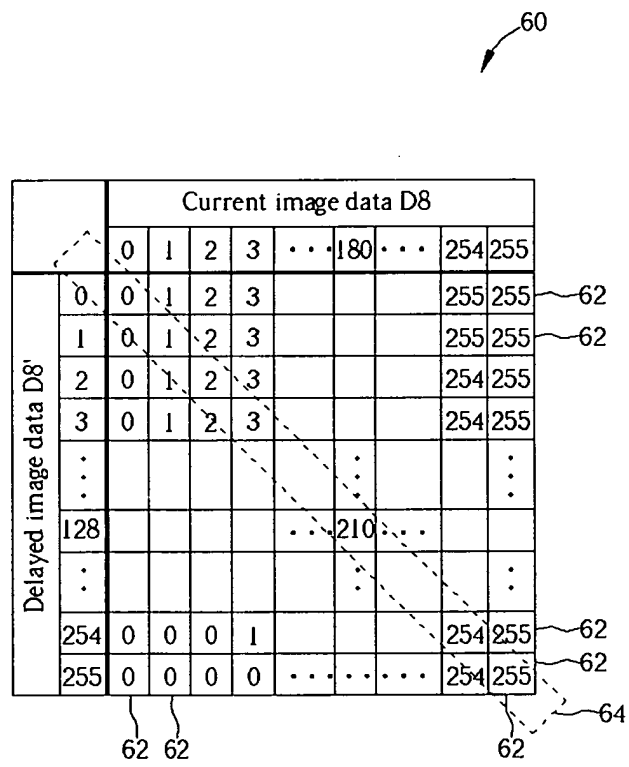


Fig. 5

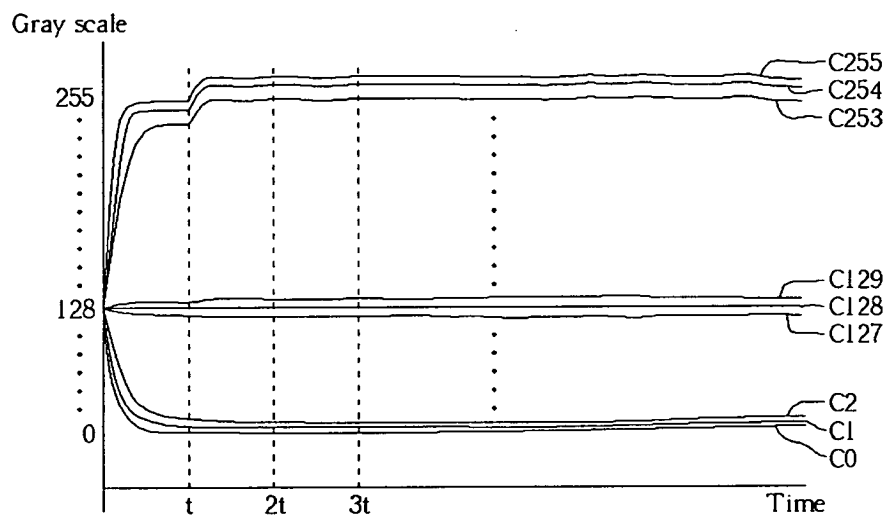


Fig. 6

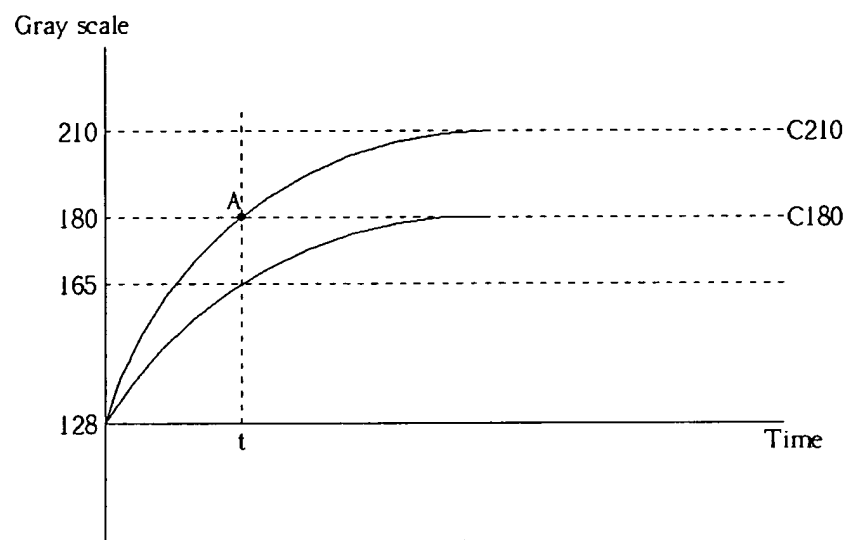


Fig. 7

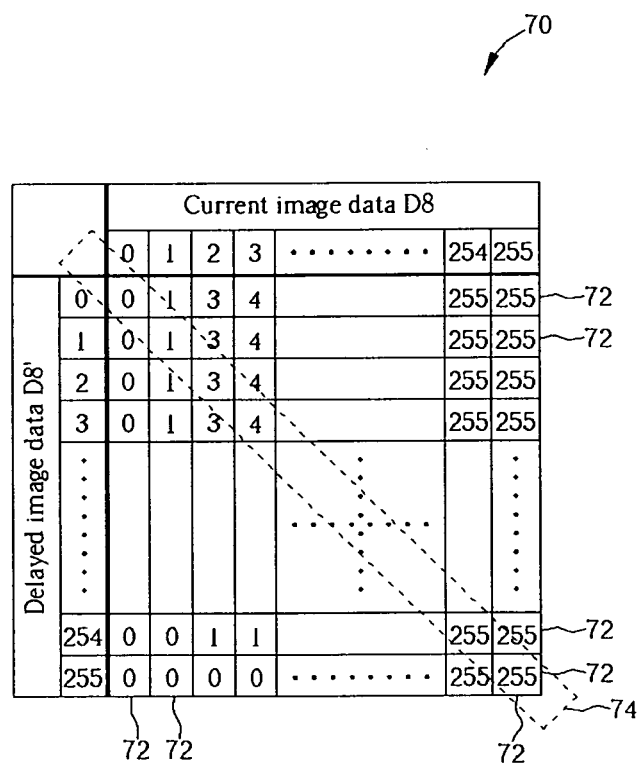


Fig. 8



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 02 7582

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 2003/098839 A1 (LEE BAEK-WOON) 29 May 2003 (2003-05-29)	7,8	G09G3/36
Y	* the whole document * ---	1-6	
X	US 2003/095090 A1 (HAM YONG SUNG) 22 May 2003 (2003-05-22)	7	
Y	* the whole document * ---	1-6,8	
Y	WO 99 05567 A (KONINKL PHILIPS ELECTRONICS NV ; PHILIPS SVENSKA AB (SE)) 4 February 1999 (1999-02-04)	2,6,8	
Y	* the whole document * ---		
Y	US 2002/063666 A1 (EU JUNG TAECK ET AL) 30 May 2002 (2002-05-30)	1-6	
Y	* the whole document * ---		
Y	US 6 100 879 A (DA COSTA VICTOR M) 8 August 2000 (2000-08-08)	1-6	
Y	* the whole document * ---		
Y	US 6 611 249 B1 (EVANICKY DANIEL E ET AL) 26 August 2003 (2003-08-26)	1-6	
	* the whole document * -----		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7) G09G
Place of search MUNICH		Date of completion of the search 26 March 2004	Examiner Harke, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 03 02 7582

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

26-03-2004

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
US 2003098839	A1	29-05-2003	KR	2003042976 A	02-06-2003
			JP	2003208142 A	25-07-2003
			WO	03046881 A1	05-06-2003
			TW	548616 B	21-08-2003

US 2003095090	A1	22-05-2003	KR	2003023203 A	19-03-2003
			CN	1407528 A	02-04-2003
			JP	2003108103 A	11-04-2003

WO 9905567	A	04-02-1999	EP	0927416 A1	07-07-1999
			WO	9905567 A1	04-02-1999
			JP	2001500994 T	23-01-2001
			US	6304254 B1	16-10-2001

US 2002063666	A1	30-05-2002	KR	2002001466 A	09-01-2002
			KR	2002055991 A	10-07-2002
			JP	2002123232 A	26-04-2002

US 6100879	A	08-08-2000	AU	4167097 A	19-03-1998
			CA	2264786 A1	05-03-1998
			DE	69711095 D1	18-04-2002
			DE	69711095 T2	02-10-2002
			DK	978115 T3	01-07-2002
			EP	0978115 A1	09-02-2000
			JP	2002509621 T	26-03-2002
			WO	9809269 A1	05-03-1998

US 6611249	B1	26-08-2003	WO	0005706 A2	03-02-2000
			US	2004036708 A1	26-02-2004
