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(54) **Method for controlling a display comprising a group of pixels, and system, and display controller**

(57) The frame frequency necessary for known liquid cristal displays to get a good image quality without flickering can be reduced for saving memory capacity by splitting up a group of pixels into at least two subgroups of pixels comprising a first number of pixels located in rows and columns, by establishing per subgroup a second number of pixels which should be activated per time frame, by establishing per subgroup an order for pixels located in said subgroup, and by activating during subsequent time frames subsequent second numbers of pixels in accordance with said order. Said subsequent second numbers of pixels for example depend upon the grey level or colour level wanted for that subgroup. These two-dimensional subgroups allow the spreading of activations, which for example will reduce the flickering.
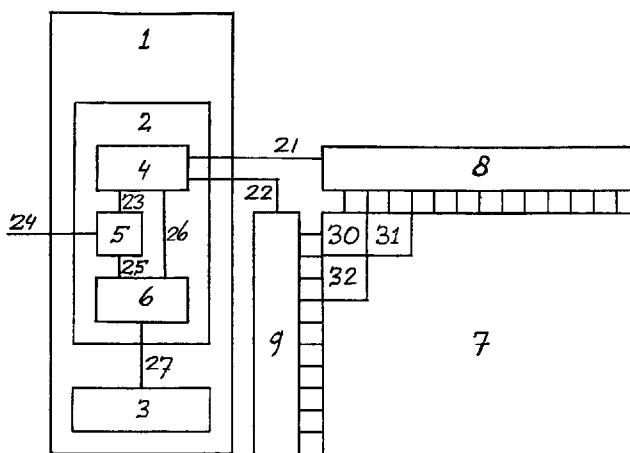
Fig. 1

EP 0 910 060 A1

Description

[0001] The invention relates to a method for controlling a display comprising a group of pixels which need to be refreshed.

[0002] Such a method is of common general knowledge and for example based on refreshing pixels line by line.

[0003] This method is disadvantageous, inter alia, because of needing a high frame frequency like for example 200 Hz to get a sufficient image quality, for example because of avoiding flickering of the display.

[0004] It is an object of the invention, inter alia, to provide a method as defined in the preamble which does not need the high frame frequency to get a sufficient or even better image quality.

[0005] Thereto, the method according to the invention is characterised in that the method comprises the steps of

- splitting up said group of pixels into at least two subgroups of pixels, at least one of said subgroups comprising a first number of pixels located in rows and columns,
- establishing per subgroup a second number of pixels which should be activated per time frame,
- establishing per subgroup an order for pixels located in said subgroup, and
- activating during subsequent time frames subsequent second numbers of pixels in accordance with said order.

[0006] By making for example two-dimensional subgroups and activating in accordance with said order, starting with the first second number of pixels in the first time frame, and then the second second number of pixels in the second time frame, and then the third second number of pixels in the third time frame, etc., whereby these first, second and third second number of pixels are subsequent and in accordance with said order, which first, second and third second number of pixels for example depend upon a grey level and/or colour level, the method according to the invention does not need the high frame frequency to get a sufficient or even better image quality.

[0007] The invention is based on the insight, inter alia, that at least two-dimensional subgroups allow the spreading of activations, which for example will reduce the flickering.

[0008] The invention solves the problem, inter alia, of improving the image quality and/or allowing the frame frequency to be lower by introducing said at least two-dimensional subgroups and said order.

[0009] A first embodiment of the method according to the invention is characterised in that at least one subgroup comprises at least three rows and three columns, with said first number of pixels comprising at least nine pixels, whereby said order is such that two subsequent pixels are located in different rows and columns.

[0010] By locating subsequent pixels in different rows and columns, said spreading is increased.

[0011] A second embodiment of the method according to the invention is characterised in that each subgroup comprises four rows (0,1,2,3) and four columns (0,1,2,3), with said first number of pixels being equal to sixteen, whereby said order is (0,0), (1,2), (3,3), (2,1), (0,2), (1,0), (3,1), (2,3), (0,1), (1,3), (3,2), (2,0), (0,3), (1,1), (3,0), (2,2).

[0012] This subgroup has an ideal size, in particular in case of the liquid cristal display being a blck-and-white or grey level lcd, with said order resulting in an ideal spreading, whereby in (x,y) of said order x is a row number and y is a column number or vice versa. In case of the liquid cristal display being a colour lcd, comprising red, green and blue pixels instead of grey pixels, said size could for example be four rows and twelve columns, or twelve rows and four columns.

[0013] The invention further relates to a system comprising a display comprising a group of pixels which need to be refreshed and comprising a display controller coupled to said display.

[0014] The system according to the invention is characterised in that the display controller comprises a processor for

- splitting up said group of pixels into at least two subgroups of pixels, at least one of said subgroups comprising a first number of pixels located in rows and columns,
- establishing per subgroup a second number of pixels which should be activated per timeframe,
- establishing per subgroup an order for pixels located in said subgroup, and
- activating during subsequent timeframes subsequent second numbers of pixels in accordance with said order.

[0015] A first embodiment of the system according to the invention is characterised in that at least one subgroup comprises at least three rows and three columns, with said first number of pixels comprising at least nine pixels, whereby said order is such that two subsequent pixels are located in different rows and columns.

[0016] A second embodiment of the system according to the invention is characterised in that each subgroup comprises four rows (0,1,2,3) and four columns (0,1,2,3), with said first number of pixels being equal to sixteen, whereby said order is (0,0), (1,2), (3,3), (2,1), (0,2), (1,0), (3,1), (2,3), (0,1), (1,3), (3,2), (2,0), (1,1), (3,0), (2,2).

[0017] The invention yet further relates to a display controller for controlling a display comprising a group of pixels which need to be refreshed.

[0018] The display controller according to the invention is characterised in that the display controller comprises a processor for

- splitting up said group of pixels into at least two subgroups of pixels, at least one of said subgroups comprising a first number of pixels located in rows and columns,
- establishing per subgroup a second number of pixels which should be activated per timeframe,
- establishing per subgroup an order for pixels located in said subgroup, and
- activating during subsequent timeframes subsequent second numbers of pixels in accordance with said order.

[0019] A first embodiment of the display controller according to the invention is characterised in that at least one subgroup comprises at least three rows and three columns, with said first number of pixels comprising at least nine pixels, whereby said order is such that two subsequent pixels are located in different rows and columns.

[0020] A second embodiment of the display controller according to the invention is characterised in that each subgroup comprises four rows (0,1,2,3) and four columns (0,1,2,3), with said first number of pixels being equal to sixteen, whereby said order is (0,0), (1,2), (3,3), (2,1), (0,2), (1,0), (3,1), (2,3), (0,1), (1,3), (3,2), (2,0), (0,3), (1,1), (3,0), (2,2).

[0021] All references including further references cited with respect to and/or inside said references are considered to be incorporated in this patent application.

[0022] The invention will be explained in greater detail at the hand of embodiments disclosed in the drawings, whereby

figure 1 discloses a system according to the invention comprising a display and a display controller according to the invention, and
figure 2 discloses a part of a display comprising a subgroup of pixels which in accordance with an order are to be activated.

[0023] The system according to the invention as disclosed in figure 1 comprises a display controller 1, which is provided with a processor 2 and a memory 3. Processor 2 comprises splitting means 4 for splitting up a group of pixels of display 7 into at least two subgroups of pixels, at least one of said subgroups comprising a first number of pixels located in rows and columns. Splitting means 4 are coupled via a connection 23 with establishing means 5 for establishing per subgroup a second number of pixels which should be activated per time frame, which is done at the hand of information arriving via connection 24. Establishing means 5 are coupled via a connection 25 to a mastering means 6, which are coupled via a connection 27 to memory 3. Mastering means 6 and memory 3 together form establishing means for establishing an order per subgroup for pixels located in said subgroup. Mastering means 6 are coupled via a connection 26 to splitting means 4, which

are coupled via a connection 21 to a column-interface 8 and via a connection 22 to a row-interface 9, with column-interface 8 and row-interface 9 being coupled to column-inputs and row-inputs of said display 7. Inside display 7 three subgroups 30, 31 and 32 are shown, of which subgroup 30 is shown in greater detail in figure 2, for indicating an order a, b, c, d, e, f, g, h, i, j, k, l, m, n, o and p.

[0024] Display 7, column-interface 8 and row-interface 9 are of common general knowledge and function for example as follows. By supplying a certain column-number via connection 21 to column-interface 8, which translates this column-number into a signal destined for one of said column-inputs, and supplying a certain row-number via connection 22 to row-interface 9, which translates this row-number into a signal destined for one of said row-inputs, a pixel located on said column and row is activated, either during said supplying of column-number and row-number, or during a predefined interval, which might be dependent upon a duration of said supplying or not. Due to the fact that pixels of for example an LCD-display need to be refreshed, according to common general knowledge a known display controller is used for, for example, line by line refreshing said pixels. Thereto, said known display controller generates a first row-number to be supplied to row-interface 8, and, while this first row-number is continuously offered, then generates either all column-numbers one after the other or groups of column-numbers at approximately at the same time, with the groups being generated one after the other or approximately at the same time. In case of said line by line refreshing, a frame frequency of for example 200 Hz is necessary to get sufficient image quality, for example to avoid flickering of the display. Such a high sample frequency asks for too much memory capacity, which is disadvantageous.

[0025] With the system disclosed in figure 2 the same or even a better image quality is got, without any flickering of the display, for a frame frequency of for example 70 Hz. It functions as follows.

[0026] Splitting means split up all pixels, for example 640 columns and 480 rows, into subgroups, of for example 4 columns and 4 rows. This is done by generating, instead of 0,1,2,3,...,639, only 0,1,2,3, and adding 4,8,12,16,...,636 (one after the other or approximately at the same time) with respect to the column-numbers, and by generating, instead of 0,1,2,3,...479, only 0,1,2,3, and adding 4,8,12,16,...,476 (one after the other or approximately at the same time) with respect to the row-numbers. This corresponds with splitting one group of pixels into 19200 subgroups, of which three are shown in figure 1 as subgroup 30, 31 and 32. In figure 2 subgroup 30 is shown in greater detail, thereby disclosing an order a, b, c,..., p which has proven to be a good one. This order a, b, c,..., p corresponds with (0,0), (1,2), (3,3), (2,1), (0,2), (1,0), (3,1), (2,3), (0,1), (1,3), (3,2), (2,0), (0,3), (1,1), (3,0), (2,2) whereby in (x,y) of said order x is a row number and y is a column number or

vice versa. Due to such a subgroup having an ideal size, and said order resulting in an ideal spreading, a good quality is achieved for a relatively low sample frequency. Said order is established by mastering means 6 and memory 3. Of course, the number of pixels in a subgroup to be refreshed per time frame (the second number of pixels) depends upon for example the grey level, which is calculated by establishing means 5 in response to information arriving via connection 24. For a grey level 0, per time frame no pixels should be activated. For a grey level 1, per time frame 1 pixel should be activated following said order, in other words during the first time frame pixel a, during the second time frame pixel b, etc. For a grey level 2, per time frame two pixels should be activated following said order, in other words during the first time frame pixels a, b, during the second time frame pixels c, d, etc. And for a grey level 15, for example all pixels a-p will be activated during each time frame (which implies that according to this embodiment for grey level 15, due to 16 pixels being activated, the formulae is not used). The above (which is based on a 16 frames refresh rate) is realised/calculated by establishing means 5 which, via connection 25 inform mastering means 6, and/or via connection 23 inform splittting means 4.

[0027] This subgroup has an ideal size, in particular in case of the liquid cristal display being a blck-and-white or grey level lcd, with said order resulting in an ideal spreading. In case of the liquid cristal display being a colour lcd, comprising red, green and blue pixels instead of grey pixels, said size could for example be four rows and twelve columns, or twelve rows and four columns.

[0028] In general, due to splitting up the entire group of pixels of the display into subgroups (comprising a first number of pixels) having rows and columns and therefore being two-dimensional, whereby per time frame in each subgroup the second number of pixels is activated for refreshing, with this second number of pixels being dependent upon the grey level per subgroup, and whereby during subsequent time frames subsequent second numbers are activated in accordance with one predefined order, a good image quality without flickering is got for a low sample frequency.

[0029] Inside processor 2, said splitting means 4, establishing means 5 and mastering means 6 can be realised by using either hardware only, or software only, or a combination of both.

Claims

1. Method for controlling a display comprising a group of pixels which need to be refreshed, characterised in that the method comprises the steps of

    - splitting up said group of pixels into at least two subgroups of pixels, at least one of said subgroups comprising a first number of pixels located in rows and columns,
    - establishing per subgroup a second number of pixels which should be activated per time frame,
    - establishing per subgroup an order for pixels located in said subgroup, and
    - activating during subsequent time frames subsequent second numbers of pixels in accordance with said order.

2. Method according to claim 1, characterised in that at least one subgroup comprises at least three rows and three columns, with said first number of pixels comprising at least nine pixels, whereby said order is such that two subsequent pixels are located in different rows and columns.

3. Method according to claim 2, characterised in that each subgroup comprises four rows (0,1,2,3) and four columns (0,1,2,3), with said first number of pixels being equal to sixteen, whereby said order is (0,0), (1,2), (3,3), (2,1), (0,2), (1,0), (3,1), (2,3), (0,1), (1,3), (3,2), (2,0), (0,3), (1,1), (3,0), (2,2).

4. System comprising a display comprising a group of pixels which need to be refreshed and comprising a display controller coupled to said display, characterised in that the display controller comprises a processor for

    - splitting up said group of pixels into at least two subgroups of pixels, at least one of said subgroups comprising a first number of pixels located in rows and columns,
    - establishing per subgroup a second number of pixels which should be activated per time frame,
    - establishing per subgroup an order for pixels located in said subgroup, and
    - activating during subsequent time frames subsequent second numbers of pixels in accordance with said order.

5. System according to claim 4, characterised in that at least one subgroup comprises at least three rows and three columns, with said first number of pixels comprising at least nine pixels, whereby said order is such that two subsequent pixels are located in different rows and columns.

6. System according to claim 5, characterised in that each subgroup comprises four rows (0,1,2,3) and four columns (0,1,2,3), with said first number of pixels being equal to sixteen, whereby said order is (0,0), (1,2), (3,3), (2,1), (0,2), (1,0), (3,1), (2,3), (0,1), (1,3), (3,2), (2,0), (0,3), (1,1), (3,0), (2,2).

7. Display controller for controlling a display compris-

ing a group of pixels which need to be refreshed, characterised in that the display controller comprises a processor for

- splitting up said group of pixels into at least two subgroups of pixels, at least one of said subgroups comprising a first number of pixels located in rows and columns,
- establishing per subgroup a second number of pixels which should be activated per time frame,
- establishing per subgroup an order for pixels located in said subgroup, and
- activating during subsequent time frames subsequent second numbers of pixels in accordance with said order.

8. Display controller according to claim 7, characterised in that at least one subgroup comprises at least three rows and three columns, with said first number of pixels comprising at least nine pixels, whereby said order is such that two subsequent pixels are located in different rows and columns.

9. Display controller according to claim 8, characterised in that each subgroup comprises four rows (0,1,2,3) and four columns (0,1,2,3), with said first number of pixels being equal to sixteen, whereby said order is (0,0), (1,2), (3,3), (2,1), (0,2), (1,0), (3,1), (2,3), (0,1), (1,3), (3,2), (2,0), (0,3), (1,1), (3,0), (2,2).
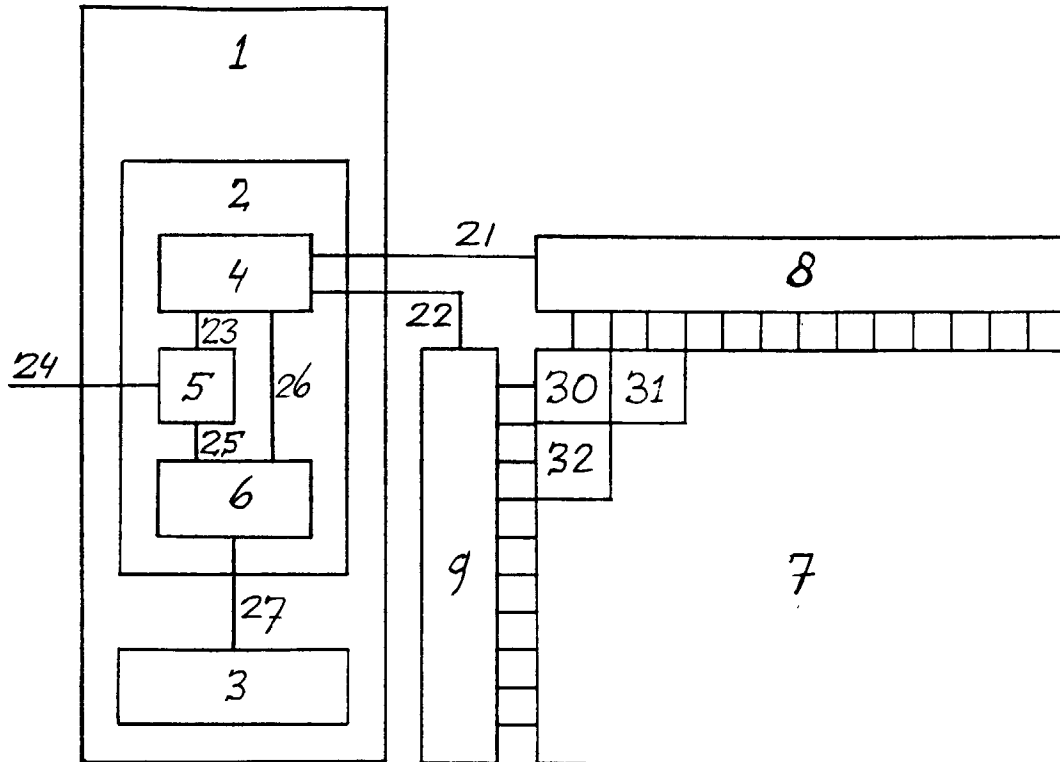
Fig. 1

Fig. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 97 44 0099

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.6)
X	EP 0 623 912 A (PHILIPS ELECTRONICS NV ;PHILIPS ELECTRONICS NV (NL)) * abstract * * column 1, line 1 - line 35 * * column 2, line 1 - line 33 * * column 4, line 25 - column 7, line 36 * * figures 1-5 * ---	1-9	G09G3/20 G09G3/36
X	WO 93 13513 A (ACUMOS INC) * abstract * * page 7, line 10 - page 11, line 25 * * figures 2-4 * ---	1-9	
X	US 5 266 940 A (SHIRAISHI TAI) * abstract * * column 2, line 23 - line 36 * * column 7, line 24 - column 8, line 46 * * claims 1,2 * * figures 3-17 * -----	1-9	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) G09G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 March 1998	Cochonneau, O

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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P : intermediate document

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E : earlier patent document, but published on, or after the filing date
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L : document cited for other reasons

& : member of the same patent family, corresponding document