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(71) Applicant (for all designated States except US): KONINKLIJKE PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(72) Inventors; and
(75) Inventors/Applicants (for US only): KUIJPERS, Henricus J., C. [NL/NL]; c/o High Tech Campus Building 44, NL-5656 AE Eindhoven (NL). VAN DER HORST, Jan [NL/NL]; c/o High Tech Campus Building 44, NL-5656 AE Eindhoven (NL).

(74) Agents: KROEZE, John et al.; High Tech Campus Building 44, NL-5656 AE Eindhoven (NL).

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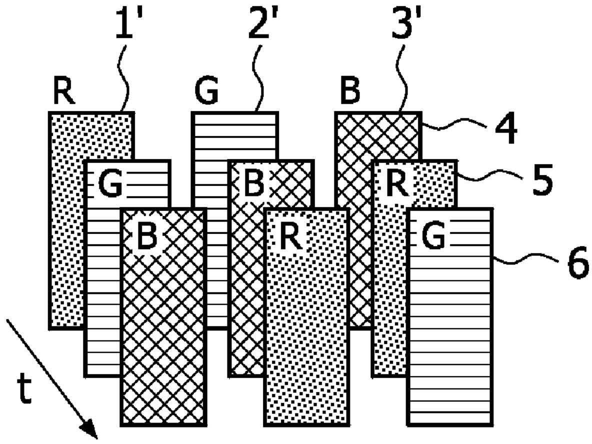

FIG. 1B

(57) Abstract: A method of driving a display uses first (4) and second (5) illumination cycles of the display. In each cycle, a first set of pixels (1') is illuminated with a first color (R, G) and a second set of pixels (2') is illuminated with a second color (G, B). The first and second colors of the two cycles together include at least three colors (R, G, B) for forming an image. This method provides a sequential drive scheme, in that at least two cycles are used with different color properties. However, each cycle uses at least two different colors, so that each cycle is not a single color across the whole display area. In this way, the color sequence is alternated spatially as well as temporally.

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METHODS OF DRIVING COLOUR SEQUENTIAL DISPLAYS

FIELD OF THE INVENTION

This invention relates to pixellated displays with sequential drive schemes, for example active matrix liquid crystal displays which use a sequential drive scheme to provide a color output.

BACKGROUND OF THE INVENTION

Active matrix liquid crystal displays (AMLCDs) typically generate colored images by providing pixels which consist of three separate dots, each of which has a color filter transmitting one primary color. These dots usually cover an area of one third of a full pixel and are generally referred to as sub-pixels of the full pixel. As a result of limitations in process and design of the dots, the aperture for transmitted light is reduced in AMLCD displays resulting either in low brightness or high power in the backlight.

An alternative method for generating colored images is to have just one dot per pixel space, and sequentially flash the backlight within one image buildup period with the three color primaries, where the image build up period is the time in which all image information is output by the display such that a viewer is able to observe a full color image. This creates what is known as a color sequential display. The liquid crystal pixel can then sequentially control the amount of each primary color transmitted. Because the sequential flashing occurs quickly, the eye will integrate the light of one image buildup period such as to perceive a full color image.

A similar display technology is known as spectrum sequential display, and this technology only requires that the backlight is flashed twice per image buildup period. Color is then generated by each backlight flash in the form of two primaries (for example blue and yellow in the first sub-frame and cyan and red in the second sub-frame). Each pixel is divided into two dots and each dot has a color filter which transmits one primary from each flash of the backlight (for example blue and cyan for the first dot and yellow and red for the second dot). This approach thus provides a compromise between the time available for each flash of the backlight and the size of each pixel dot.

The two approaches above each rely upon flashing of the backlight, and the desired color for each pixel is built up as a sequence of color outputs. These two approaches can both be described as a “sequential drive scheme”.

One advantage of a sequential drive scheme is that the resolution can be increased compared to a standard display, because there need only be one or two sub-pixels per pixel.

This increase in resolution is of general interest for LCD displays, but is of particular interest for autostereoscopic display devices, in which a display panel has an array of display pixels for producing a display, and a plurality of imaging means, such as lenticular elements or semi-transparent barriers, arranged over the display panel and through which the display pixels are viewed. Taking a display having lenticulars as an example for explaining the working principle of such view directing means, the lenticular elements are typically provided as a sheet of lenticular elements (lenticulars), each of which comprises an elongate lens element that may have a desired lens shape such as elliptical or semi-cylindrical. The lenticular elements extend in the column direction of the display panel (or slanted with respect to the column direction), with each lenticular element overlying a respective group of two or more adjacent columns of display pixels or sub-pixels.

In an arrangement in which, for example, each lenticule is associated with two columns of display pixels (no slant angle), the display pixels in each column provide a vertical slice of a respective two dimensional sub-image, i.e. multiple views are directed into multiple directions. The lenticular sheet directs these two slices and corresponding slices from the display pixel columns associated with the other lenticules, to the left and right eye of a user positioned in front of the sheet, so that the user observes a single stereoscopic image. The sheet of lenticular elements (and each lenticular element) thus provides a light output directing function such that light output intended for the left and right eye is directed into two different views or view directions.

In other arrangements, each lenticule is associated with a group of more than two adjacent display pixels in the row direction. Corresponding columns of display pixels in each group are arranged appropriately to provide a vertical slice from a respective two dimensional sub-image. As a user's head is moved from left to right across a display a series of successive, different, stereoscopic views are perceived creating, for example, a look-around impression. A detailed explanation of the working principle including slanting of the lens to achieve certain improvements is provided hereinafter and for example in US6069650.

The above described device provides an effective three dimensional display. However, it will be appreciated that, in order to provide stereoscopic views, there is a necessary sacrifice in the resolution of the device, as different sets of display pixels are associated with different views. This sacrifice in resolution is unacceptable for certain applications, such as the display of small text characters for viewing from short distances. For this reason, it has been proposed to provide a display device that is switchable between a two-dimensional mode and a three-dimensional (stereoscopic) mode. However, this fails to address the problem of the loss of resolution in the 3D mode.

It will be seen that the use of a sequential drive scheme can restore some of the loss of resolution. In addition, by reducing the amount of filtering, the efficiency is improved. When color filtered pixels are used, the efficiency is reduced by roughly 67 %.

Although sequential drive schemes can improve resolution and efficiency, a problem is the occurrence of color break-up, also known as the "rainbow effect". This is the effect that the color visibility at different moments becomes visible by high motion of the displayed image and/or by high motion of the viewer (eyes). In most cases this artefact is perceived as very disturbing.

SUMMARY OF THE INVENTION

According to the invention, there is provided a method of driving a display having output pixels each of which is capable of providing a light output of at least a first and a second color different from the first color, the first and second colors being selected from a group of three different colors, the method comprising:

performing first and second illumination cycles of the display in sequence, wherein each illumination cycle comprises illuminating the pixels (45) of the display with at least a first set of pixels being illuminated with a first color and a second set of pixels illuminated with a second color, wherein the first and second colors of the two cycles together include all three colors of the group for forming an image.

This method provides a sequential drive scheme, in that at least two cycles are used with color properties. However, each cycle uses at least two different colors, so that each cycle is not a single color across the whole display area. In this way, the color sequence is alternated spatially as well as temporally. The spatial alternation period can be within individual pixels (i.e. different sub-pixels have different colors) or it can be on a larger scale (i.e. groups of adjacent pixels have the same color in a given cycle).

Preferably, all pixels are illuminated in each illumination cycle, although this is not essential.

The method can be for driving a liquid crystal display, wherein each display cycle comprises illuminating the display using a backlight. In this case the liquid crystal cells function as individually addressable shutters that are sequentially illuminated with the required colors.

In one arrangement, both (or all if there are more than 2) cycles can have all colors, but at a fraction of the resolution (e.g. 1/3). All cycles when combined reconstruct the total resolution. In this way, when high motion exists in the displayed image or the viewer's eyes are moving, a lower resolution of the image is perceived (i.e. resolution break-up) instead of the annoying color break-up.

In one arrangement, the first and second colors of the first cycle comprise two of red, green and blue, and the first and second colors of the second cycle comprise two of red, green and blue. There can then be only two cycles, which together provide the three required colors (one color provided twice). This represents an increase in resolution of 150% (each pixel has two sub-pixels instead of three), and the two sub-frames are required.

The first and second colors of one cycle can comprise red and green and the first and second colors of the other cycle 1. This corresponds to a 4:2:2 color resolution.

In another arrangement, there are at least three illumination cycles, wherein during the first, second and third illumination cycles, the pixels are illuminated with a first set of pixels being illuminated with a respective first color, a second set of pixels illuminated with a respective second color and a third set of pixels illuminated with a respective third color.

This arrangement provides all three colors during each cycle, and requires (at least) three cycles. This can increase the resolution to 300% with the area corresponding to a sub-pixel of a conventional display functioning as a color pixel. The first to at least third cycles comprise a group of cycles corresponding to a frame period of the display, and in each group of cycles, each pixel is illuminated at least once with red, green and blue.

Providing different color illumination to different pixels can comprise using a colored light source to illuminate a directing arrangement which directs light to a predetermined set of pixels. This requires a patterned directing arrangement rather than a patterned backlight.

Alternatively, providing different color illumination to different pixels can comprise using discrete light sources behind the display to illuminate respective predetermined sets of pixels of the display.

In one arrangement, the pixels have a 3:1 height to width aspect ratio. The color pattern in each cycle can then be arranged as a repeating pattern in the row direction. The method is of particular interest for driving an autostereoscopic display. Such a display may be a liquid crystal display.

The invention also provides a display drive circuit for driving each pixel of a display in cycles, wherein the display has output pixels each of which is capable of providing a light output of at least a first and a second color different from the first color, the first and second colors being selected from a group of three different colors, wherein the circuit comprises means for controlling the display such that:

during each of at least first and second illumination cycles, the pixels are illuminated with at least a first set of pixels being illuminated with a respective first color and a second set of pixels being illuminated with a respective second color, wherein the first and second colors of the two cycles together include all three colors of the group for forming an image.

In one example, drive signals are provided to the pixels in synchronism with a backlight control, such that each pixel is addressed by a group of illumination cycles.

The invention also provides a display comprising: an array (43) of pixels, and a drive circuit according to the invention.

The pixels of the display according to the invention may comprise an array of liquid crystal pixels, and the display can further comprise a backlight arrangement (for illuminating the liquid crystal pixels, and wherein the means for controlling the display is for controlling the backlight, wherein each illumination cycle comprises illuminating the display using the backlight.

The display may be an autostereoscopic display for providing autostereoscopic images. The display, for this purpose may further comprise a view directing arrangement overlaying at least part of the pixels for directing the output of the pixels it overlays into different directions such that a viewer experiences a stereoscopic image.

In one example of such an autostereoscopic display the view directing arrangement comprises a parallax barrier which may be (but need not necessarily be) shaped such that it has non-transparent stripes and transparent slits that are elongate with their elongate axis parallel or slanted with a slant angle with respect to the pixel column direction.

Further structural features are defined in the detailed description here below referring to specific disclosures of such displays.

In another and preferred embodiment, the view directing arrangement takes the form of lenticular elements that overly the pixels. The lenticular elements may be semi-curved (cylindrical elements) having a long optical axis parallel or slanted with some specific slant angel to the pixel column direction. Each lenticular element then overlies a respective group (set) of two or more adjacent columns of display pixels.

BRIEF DESCRIPTION OF THE DRAWINGS

Examples of the invention will now be described in detail with reference to the accompanying drawings, in which:

Fig. 1 shows schematically the known sequential drive scheme and a first example of sequential drive scheme of the invention;

Fig. 2 shows one example of how to implement the backlight to enable the drive scheme of the invention;

Fig. 3 shows a second example of drive scheme using a second example of backlight arrangement;

Fig. 4 is used to explain the operation of an autostereoscopic display device to which the invention can be applied; and

Fig. 5 shows a display arrangement of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS

The invention provides amongst others a sequential drive scheme comprising multiple drive cycles performed sequentially in time, in which multiple colors are provided in each drive cycle such that different colors are provided to different pixels within different cycles. Over the full number of cycles making up an addressing period, each pixel is illuminated by all three required colors. There can be a single pixel element per pixel - illuminated three times in three different colors, or there can be two sub-pixel elements per pixel - illuminated twice so that the three different colors are represented in the two sub-pixels. In this way, the color sequence is alternated spatially as well as temporally.

Fig. 1 illustrates schematically one example of approach of the invention (Fig. 1B) in comparison with a standard color sequential LCD drive scheme (Fig. 1A). Fig. 1A shows three sub-pixels 1, 2 and 3 of a pixel illuminated in drive cycles 4 5 and 6 sequentially in time and thus in turn with red (R), green (G) and blue (B) as represented by the rectangles along the time axis (t). Each of the drive cycles 4, 5 and 6 uses a single color, i.e. results in illumination of all sub-pixels 1, 2 and 3 with one color simultaneously in one cycle. This is the conventional arrangement, in which the display resolution is maximized, with one sub-pixel element (one rectangle in the image) being driven as a single pixel, but over three sequential cycles. Fig. 1B shows three sub-pixels 1', 2' and 3' of a pixel illuminated again like in Fig1A in turn with red (R), green (G) and blue (B). However, now the colors are spatially interleaved. Thus, each cycle 4, 5 and 6 uses each color for different pixels (or set of pixels if applicable). Again, the display resolution is maximized, with one sub-pixel element (one rectangle in the image) being driven as a single pixel, but over three sequential cycles. Thus, within one cycle multiple colors are output instead of only one as in Fig. 1A. One advantage is that in response to rapid movement (of the image or the viewer), the loss in image quality is seen as resolution break up rather than color break up, and this has been found to be significantly less distracting to the viewer.

This approach is particularly suitable for standard 3:1 pixel dimensions. The spatial pattern in each illumination cycle comprises alternation with a period of three sub-pixels in the row direction. This looks like a standard LCD panel where a pixel triplet alternates between RGB, GBR and BRG configurations over time.

This is illustrated in Fig. 1C, which shows the three cycles (T=1 to 3) corresponding to the arrangement of Fig. 1B.

There are however numerous other possible implementations of the method of interleaving.

A partial color sequential display can also be implemented, for example with only red and blue interleaved in time and position, with only two cycles. In this way, a balance is created between color break-up and resolution break-up and the resolution gain is limited to 150 % instead of 300%. A form of inverted spatial positioning can then be used, for example RGB in one cycle and BGR in the other cycle.

The invention requires the backlight output to be patterned, with different colors applied to different pixels.

One way to implement this is shown in Fig. 2, in which the pixels do not have color filters themselves. The display has a backlight arrangement that can generate three colors. There are three pixel patterns, and a light directing arrangement 20,22,24 is associated with each pixel pattern. In a first cycle (T=1), green light (G) is provided to the first light directing arrangement 20, blue light (B) is provided to the second light directing arrangement 22 and red light (R) is provided to the third light directing arrangement 24. In a second cycle

(T=2), red light (R) is provided to the first light directing arrangement 20, green light (G) is provided to the second light directing arrangement 22 and blue light (B) is provided to the third light directing arrangement 24. In a third cycle (T=3), blue light (B) is provided to the first light directing arrangement 20, red light (R) is provided to the second light directing arrangement 22 and green light (G) is provided to the third light directing arrangement 24.

The light directing arrangements can comprise lightguides which direct collimated light to the LCD panel.

One example of arrangement for providing light to the lightguides is a set of RGB LED systems. One such RGB LED system is provided for each cycle, so that for the example of Fig. 2, there are three separate RGB LED light systems. Each of these is controllable to output red, green or blue light as desired. Each LED light system is coupled to a respective lightguide arrangement at the side of the display.

The lightguide arrangement can comprise optical fiber bundles which together terminate in an array corresponding to the pixel array. As can be seen from Fig. 2, each optical fiber bundle terminates in a set of positions corresponding to a sub-array of pixels, namely a sub-array of pixels which will always be illuminated with the same color at any given time.

Fig. 3 shows an arrangement in which an array of small RGB LEDs is placed behind the LCD panel. These RGB LEDs are turned on in a time-sequential manner. Different groups of LEDs are used in each cycle, so that there is spatial separation. The spatial separation occurs at a larger scale, for example every five pixels.

The rectangles in Fig. 3 represent the pixels and the circles represent the LEDs, with filled circles representing LEDs that are turned on, and the letter R,G,B indicating the color.

A four-cycle scheme is shown (T=1 to T=4). Each LED will illuminate a ring of pixels, with decreasing intensity further from the LED centre. Processing can cope with the exact light distribution of the LED-light projected on the LCD. Thus, the set of illuminated light sources can be considered to illuminate all (sub) pixels. During each cycle, the same number of LEDs are illuminated (for each pair of alternate rows, one row is not illuminated and half of the LEDs of the other row are illuminated, giving 1/4 of the LEDs per cycle).

Fig. 3 is a Delta-Nabla LED distribution behind the LCD. Simpler configurations are possible, but this particular configuration, has a circular spatial frequency response achieving good compatibility with the round form of the LED backlights and also providing optimal homogeneity of the formed low resolution color grid. Each LED is illuminated only once in the four cycles, but during each cycle, all pixels are illuminated, albeit with different intensities.

The invention is of particular interest for autostereoscopic displays. Fig. 4 is a schematic perspective view of a known direct view autostereoscopic display device 41. The known device 41 comprises a liquid crystal display panel 43 of the active matrix type that acts as a spatial light modulator to produce the display.

The display panel 43 has an orthogonal array of the display pixels 45 arranged in rows and columns. For the sake of clarity, only a small number of display pixels 45 are shown in the Fig 4. In practice, the display panel 43 might comprise about one thousand rows and several thousand columns of display pixels 45.

The structure of the liquid crystal display panel 43 is entirely conventional. In particular, the panel 43 comprises a pair of spaced transparent glass substrates, between which an aligned twisted nematic or other liquid crystal material is provided. The substrates carry patterns of transparent indium tin oxide (ITO) electrodes on their facing surfaces. Polarizing layers are also provided on the outer surfaces of the substrates.

In one example, each display pixel 45 comprises opposing electrodes on the substrates, with the intervening liquid crystal material therebetween. The shape and layout of the display pixels 45 are determined by the shape and layout of the electrodes. The display pixels 45 are regularly spaced from one another by gaps.

Each display pixel 45 is associated with a switching element, such as a thin film transistor (TFT) or thin film diode (TFD). The display pixels are operated to produce the display by providing addressing signals to the switching elements, and suitable addressing schemes will be known to those skilled in the art.

The display panel 43 is illuminated by a light source 47. In a conventional arrangement, this comprises a planar backlight extending over the area of the display pixel array. Light from the light source 47 is directed through the display panel 43, with the individual display pixels 45 being driven to modulate the light and produce the display.

The display device 41 also comprises a lenticular sheet 49, arranged over the display side of the display panel 43, which performs a view forming function. The lenticular sheet 49 comprises a row of lenticular elements 51 extending parallel to one another, of which only one is shown with exaggerated dimensions for the sake of clarity.

The lenticular elements 51 are in the form of convex cylindrical lenses (but other shapes such as elliptical etc may equally well be used without loss of the effect of the invention), and they act as a light output directing means to provide different images, or views, from the display panel 43 to the eyes of a user positioned in front of the display device 41.

The autostereoscopic display device 41 shown in Fig. 4 is capable of providing several different perspective views in different directions. In particular, each lenticular element 51 overlies a small group of display pixels 45 in each row. The lenticular element 51 projects each display pixel 45 of a group in a different direction, so as to form the several different views. As the user's head moves from left to right, his/her eyes will receive different ones of the several views, in turn.

In the present example, the application of the invention has been described in relation to an autosteoscopic display that uses a lenticular sheet as the view directing means. Although that is a preferred option with respect to for example display brightness, the invention is equally well applicable to autostereoscopic displays that have parallax barriers as the view directing means, or even other autostereoscopic displays that direct the parallactic output of different pixels into different views that when perceived by a viewer result in the viewer to experience stereoscopic or even look around display of images video etc. In the parallax barrier based autostereoscopic displays the view directing means takes the form of a parallax barrier instead of a lenticular, which, in essence, is a sheet having in alternating fashion transparent and non-transparent parallel stripes. In the display, the sheet is oriented such that the stripes extend, just like the lenticulars of a lenticular autostereoscopic display, in the pixel column direction. In this way output of pixels may pass through the transparent stripes between the non-transparent stripes while they are blocked by the non-transparent stripes (barriers). In this manner, output of certain pixels is directed into certain directions representing the view directions (views). The exact directions in which output is provided by a display depends on amongst others the pitch of the alternating stripes with respect to the pixel pitch as well as the distance of the sheet to the pixel plane and the lateral position of transparent parts of the sheet with respect to pixels. More detailed description of the operation of and general construction of a parallax barrier autostereoscopic display is given in for example US715463 (incorporated by reference), which by description of Figs 1 to 3 therein provide the construction of an example of such a display. Another example is provided in the description of US6859256 or WO2007/024118 (both incorporated by reference). Many more examples of such displays have been described to which the current invention may be applied with its advantageous effects as described here before.

The conventional arrangement of Fig. 4 can be amended in accordance with the invention by modifying the backlight and the control of the pixel outputs in the manner explained above.

For an autostereoscopic display, the invention enables higher 3D resolutions and depth perception. This is due to the fact that the different colors of a particular view can be sent out to the viewer sequentially, thus not requiring spatially different pixels. Hence less spatially distributed pixels are used for defining one image point of a view. At the same time the advantages as described here before are achieved. For 2D displays, the invention improves efficiency and enables improved brightness and color gamut.

Fig. 5 shows a display device of the invention. A display drive circuit 60 is provided for driving each pixel of the pixel array 43 display in the cycles as explained above, and also controls the backlight 47.

The pixel array 43 can be part of a 2D LCD system or a 3D autostereoscopic display. The drive circuit implements the conventional LCD drive functions, but additionally synchronizes the pixel drive with the backlight illumination. The implementation of the LCD drive circuit will be completely routine to those skilled in the art. Thus, the drive circuit may be built according to conventional electronics and preferably from microelectronics or semiconductor electronic chips such that it in effect is a computer. The software for steering such driving devices may be contained within an internal memory of such a driving circuit or may be contained on separate appropriate software carriers such as electronic memory (magnetic harddisc, solid state memory) or optical memory like DC-ROM DVD or others that may be connected to or inserted in the drive circuit.

The examples above use a liquid crystal display. The described embodiment serves to exemplify the operation of the invention. However, the advantages of the invention can be obtained when other illuminated display technologies are employed. It will be appreciated that the improvements or advantages of the invention are provided to all displays that have the pixels with the defined requirements. These need not be LCD defined/ based pixels. Thus, a display that has pixels capable of emitting multiple distinct colors or color spectra sequentially may be used. Furthermore, the invention applies to any display arrangement which uses an illumination source and a shutter-type pixellated display. An LCD may be seen as an example of a shutter type pixellated display.

Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measured cannot be used to advantage. A computer program may be stored/distributed on a suitable medium, such as an optical storage medium or a solid-state medium supplied together with or as part of other hardware, but may also be distributed in other forms, such as via the Internet or other wired or wireless telecommunication systems. Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

1. A method of driving a display having output pixels each of which is capable of providing a light output of at least a first and a second color different from the first color, the first and second colors being selected from a group of three different colors, the method comprising:

performing first and second illumination cycles of the display in sequence, wherein each illumination cycle comprises illuminating the pixels (45) of the display with at least a first set of pixels being illuminated with a first color and a second set of pixels illuminated with a second color, wherein the first and second colors of the two cycles together include all three colors of the group for forming an image.

2. A method as claimed in claim 1 for driving a liquid crystal display, wherein each illumination cycle comprises illuminating the display using a backlight (47).

3. A method as claimed in claim 1, wherein the first and second colors of the first cycle comprise two of red, green and blue, and the first and second colors of the second cycle comprise two of red, green and blue.

4. A method as claimed in claim 3, wherein the first and second colors of one cycle comprise red and green and the first and second colors of the other cycle comprise blue and green.

5. A method as claimed in claim 1, wherein a color pixel output is generated in two display cycles, with a color pixel defined by two sub-pixels.

6. A method as claimed in claim 1, wherein there are at least three illumination cycles,

wherein during the first, second and third illumination cycles, the pixels are illuminated with a first set of pixels being illuminated with a respective first color, a second set of pixels illuminated with a respective second color and a third set of pixels illuminated with a respective third color.

7. A method as claimed in claim 6, wherein the first to at least third illumination cycles comprise a group of cycles corresponding to an image buildup period of the display, wherein in each group of cycles, each pixel is illuminated at least once with red, green and blue.

8. A method as claimed in claim 2, wherein providing different color illumination to different pixels comprises:

using a colored light source to illuminate a directing arrangement which directs light to a predetermined set of pixels, or

using discrete light sources behind the display to illuminate respective predetermined sets of pixels of the display.

9. A method as claimed in claim 1, for driving an autostereoscopic display.

10. A computer program comprising computer program code means adapted to perform all the steps of claim 1 when said program is run on a computer.

11. A display drive circuit (60) for driving each pixel of a display in sequential cycles, wherein the display has output pixels each of which is capable of providing a light output of at least a first and a second color different from the first color, the first and second colors being selected from a group of three different colors, wherein the drive circuit comprises means for controlling the display such that:

during each of at least first and second illumination cycles, the pixels are illuminated with at least a first set of pixels being illuminated with a respective first color and a second set of pixels being illuminated with a respective second color, wherein the first and second colors of the two cycles together include all three colors of the group for forming an image.

12. A drive circuit (60) as claimed in claim 11 for a liquid crystal display, wherein the means for controlling the display is for controlling a backlight (47), wherein each illumination cycle comprises illuminating the display using the backlight (47).

13. A drive circuit as claimed in claim 12, further comprising means for providing drive signals to the pixels in synchronism with the backlight control, such that each pixel is addressed by a group of illumination cycles.

14. A display comprising:
- an array (43) of pixels, and
- a drive circuit as claimed in claim 11.

15. A display according to claim 14 wherein the array of pixels comprises an array (43) of liquid crystal pixels, and the display further comprises a backlight arrangement (47) for illuminating the liquid crystal pixels, and wherein the means for controlling the display is for controlling the backlight (47), wherein each illumination cycle comprises illuminating the display using the backlight (47).

16. A display as claimed in claim 14 or 15 for providing autostereoscopic images, the display further comprising a view directing arrangement (49) overlaying at least part of the display pixels for directing the output of the pixels it overlays into different directions such that a viewer experiences a stereoscopic image.

17 A display as claimed in claim 16 wherein the view directing arrangement comprises a parallax barrier or lenticular elements.

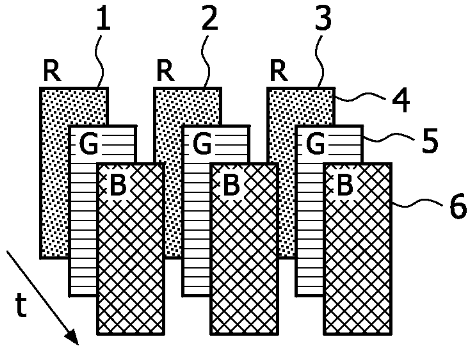


FIG. 1A

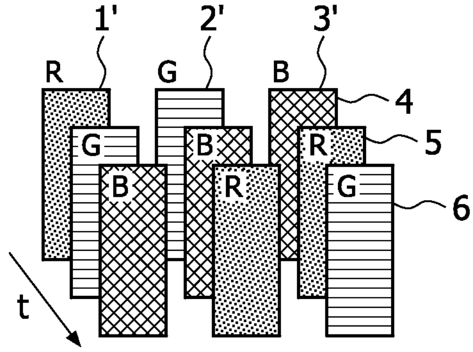


FIG. 1B

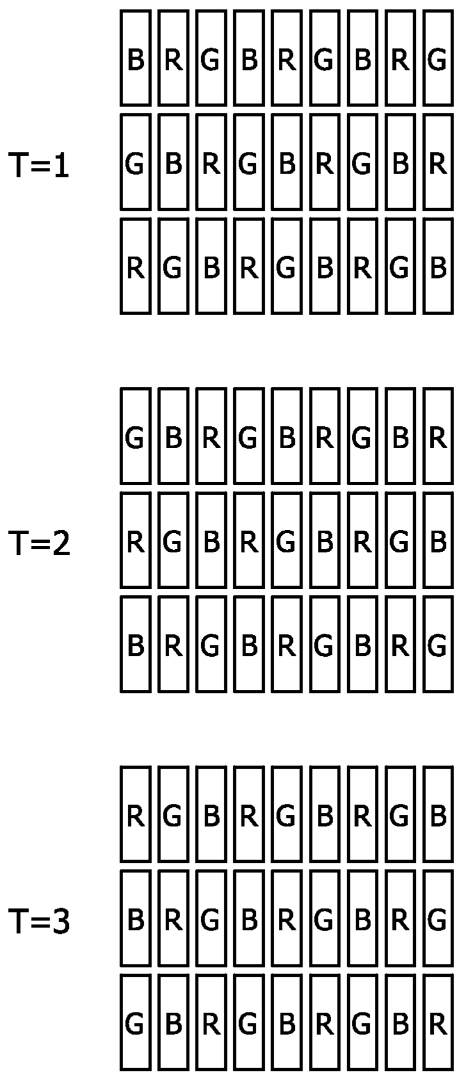


FIG. 1C

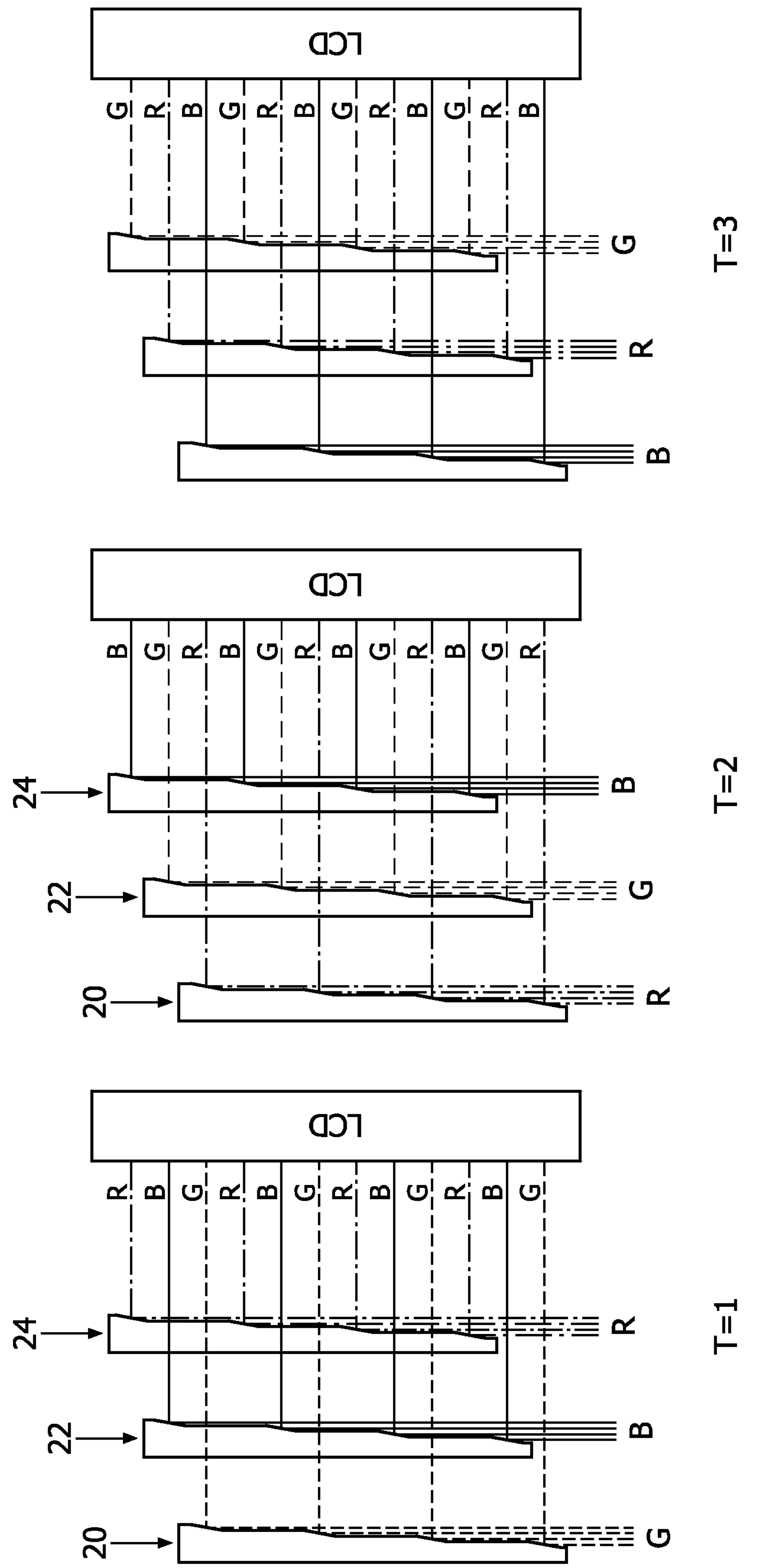
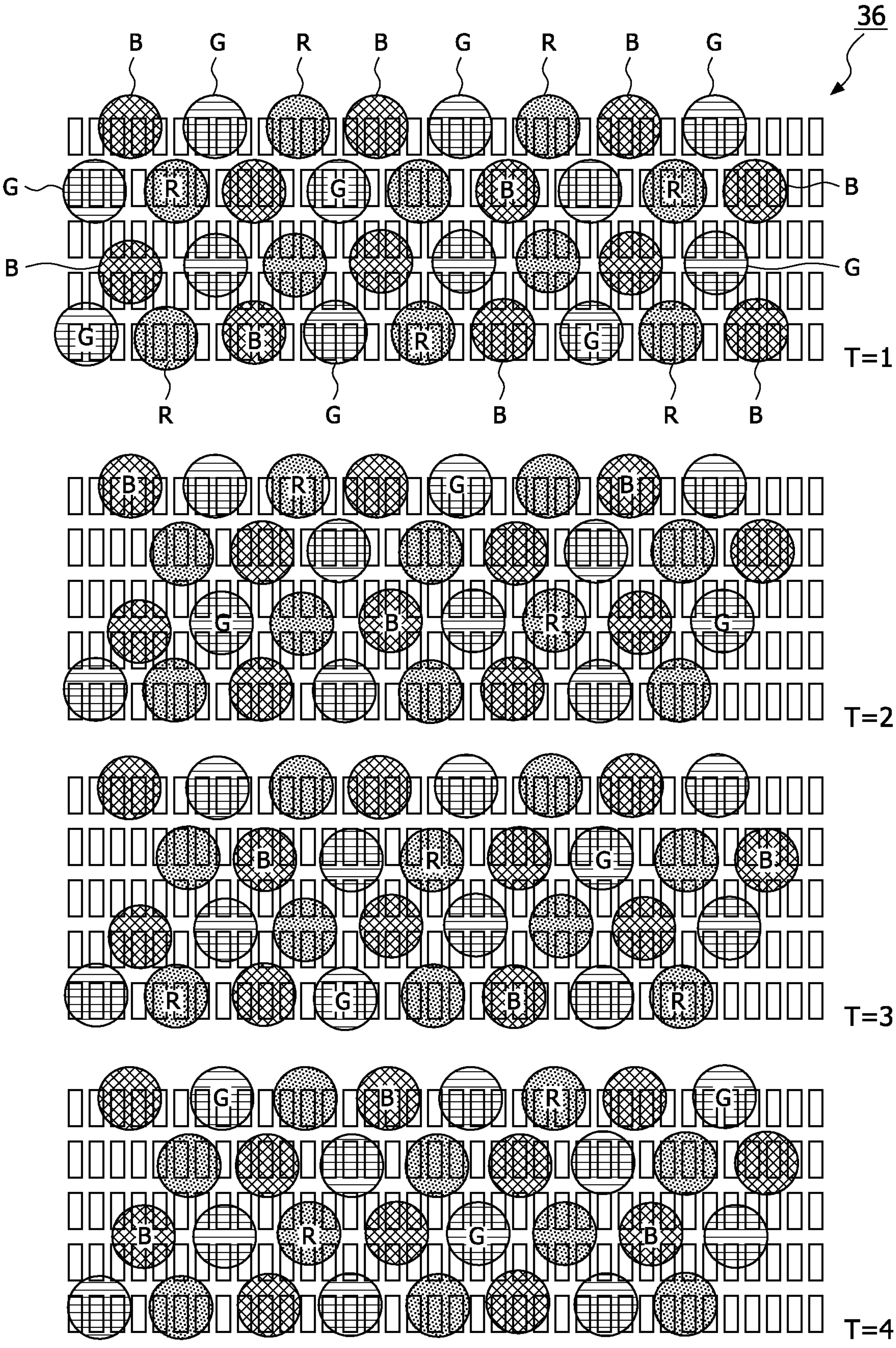

LCD
G R B G R B G R B G R B
G
R
B
T=3
LCD
B G R B G R B G R B G R
24
22
20
B
G
R
T=2
LCD
R B G R B G R B G R B G
24
22
20
R
B
G
T=1

FIG. 2


36
B G R B G R B G
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B G
G B R G
R G B R B
T=1
B R G B
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T=2
B R G B
R G B R
T=3
G B R G
B R G B
T=4

FIG. 3

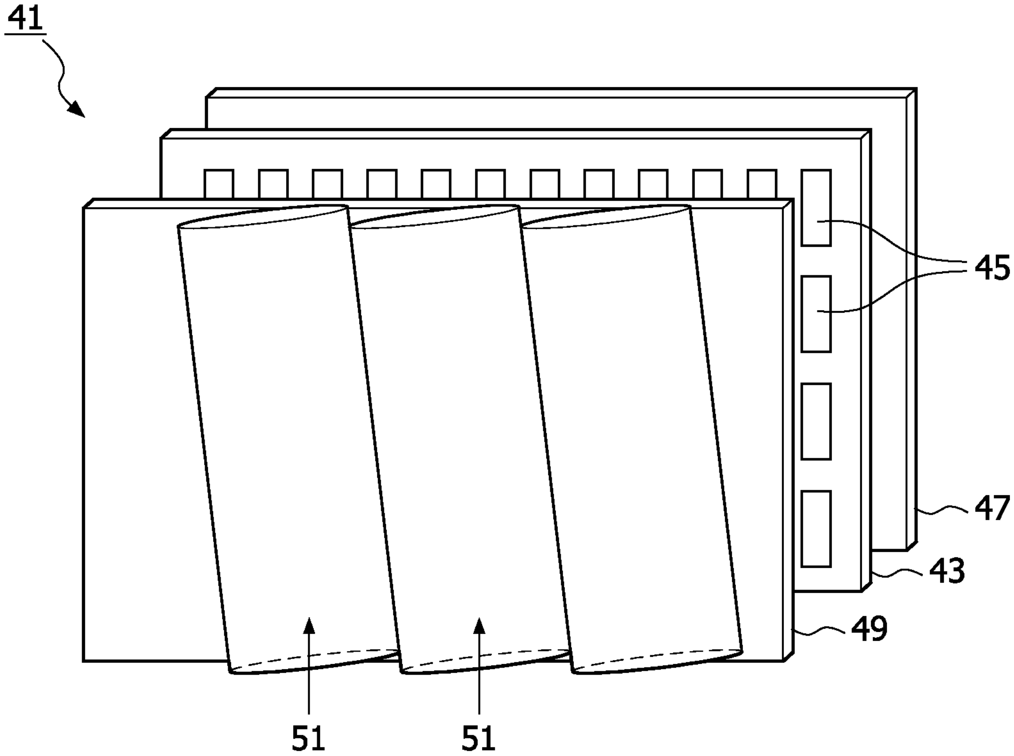

FIG. 4

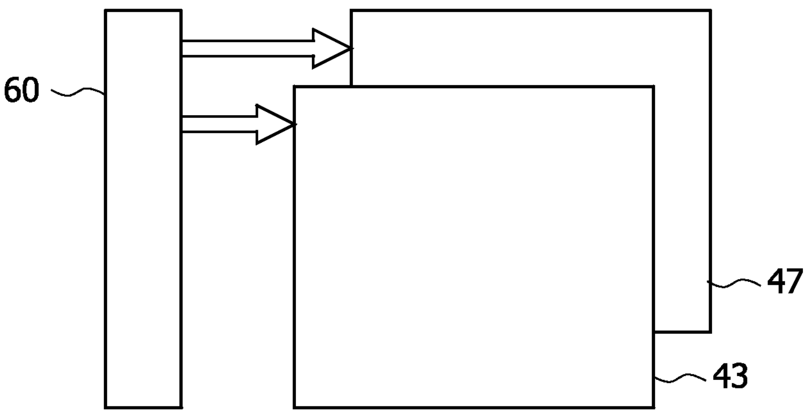

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2010/051004

A. CLASSIFICATION OF SUBJECT MATTER
INV. G09G3/36 G09G3/34 H05B33/08 G09G3/20
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G09G H05B

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/259099 A1 (ARAI YOSHIO [JP] ET AL) 23 October 2008 (2008-10-23)	1-4,6-17
Y	paragraphs [0155] - [0166]; figures 21-23 paragraphs [0001], [0004]	5
X	US 2008/273005 A1 (CHEN KE-HORNG [TW] ET AL) 6 November 2008 (2008-11-06)	1-4,6-17
Y	paragraphs [0036] - [0041]; figures 5A-7B paragraph [0003]	5
Y	US 2009/059581 A1 (HAYASHI KEIJI [JP] ET AL) 5 March 2009 (2009-03-05) paragraphs [0080] - [0098]; figures 1-4	5

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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

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

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

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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 June 2010	18/06/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2, NL - 2280 HV Rijswijk, Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Demin, Stefan

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2010/051004

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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