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(54) **Method and apparatus for preventing pixel burn-in**

(57) A method and apparatus for preventing pixel burn-in on a display screen (1) is disclosed. It is determined whether a static image has been displayed on the screen (1) for longer than a certain period. The smallest region (2) on the screen (1) within which said static image fits is found. The brightness level of pixels within said region (2) within which the static image fits are reduced.

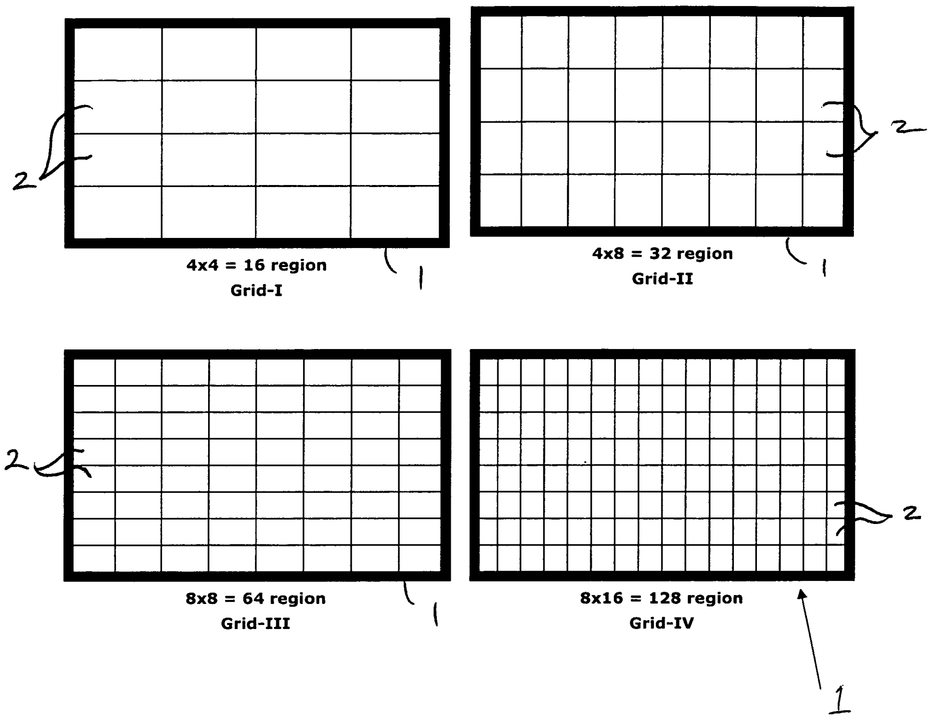


Figure 1

EP 1 772 849 A1

Description

[0001] The present invention relates to a method of and apparatus for preventing pixel burn-in.

[0002] Display devices are used in many applications, including for example television receivers, computer monitors, public display panels (at airports, railway stations, conference centres and the like), etc. Display devices can be classified broadly into two types. The first is a passive type, a typical example of which is a liquid crystal display (LCD). A passive display device does not emit the light that forms the image as such. On the contrary, a passive display device selectively filters a backlight in order to produce the required image. Active display devices on the other hand emit the light that forms the image. Examples of active display devices include cathode ray tube (CRT) displays, light emitting diode (LED) displays, vacuum fluorescent displays (VFD) and plasma display panels (PDP). Active display devices use phosphors to generate the visible light. The phosphors are excited by electrons (in for example a CRT), by ultraviolet light (for example in a plasma display panel), or another fast charged carrier (in for example an electroluminescent display). When excited, the phosphors emit light. Typically a pixel of such a display device has three sub-pixels which respectively emit red, green and blue light so that any pixel can emit any colour by appropriate driving of the three sub-pixels.

[0003] A particular problem with active displays that use phosphors to generate the visible light is the problem of pixel burn-in. More specifically, when a static image is displayed on (a part of) a display device, a ghost image of the static image can remain such that when the image is changed, there is nevertheless a remnant of the previously displayed static image. In for example a CRT display or a PDP, the display of a static image on the screen prematurely ages the phosphors such that those phosphors do not shine as brightly as the others on the screen. This therefore manifests itself as a dimmed ghost image on the screen. Where for example the static image was of a certain colour only, such as blue for example, this means that the sub-pixels of that colour will age more prematurely, such that the ghost image will have the complementary colour (in this example yellow, being a mixture of the red and green phosphors which shine more brightly relative to the aged blue phosphors). This is a particular problem in PDPs, though it also affects CRTs and other active displays. (For completeness, it is mentioned that PDPs also suffer from a short term burn-in problem in which the ghost image is a brighter image because the "burned" pixels shine more brightly. This short term burn-in tends to disappear a short time after the static image is removed.)

[0004] Users of active displays are warned to avoid pixel burn-in, typically by taking steps to ensure that a static image is not displayed on the display device for any extended period. However, it is often the case that users forget this and in any event it is often not a practical solution. For example, active displays are often used in public venues to display a static image for a long period (for example for promotional or advertising material). As another example, many television channels are transmitted with the channel logo at a fixed position on the screen, the logo being present at all times. It is in such cases simply not possible to avoid having the static image on the screen.

[0005] There are a number of technical proposals for avoiding pixel burn-in. For example, if a static image is detected, it is known to shift the whole image around the screen by a few pixels so as to try to prevent any particular pixel being on for any length of time. However, the number of pixels by which the image can be moved is limited by the size of the screen, given that ideally an image will fill the screen, and by the fact that too large a movement will disturb the viewer. Moreover, if the static image is larger than the number of pixels over which the whole image is moved, there will be pixels (towards the centre of the static image) that are always on and which will therefore suffer from burn-in. As an alternative, parts of the static image may be distorted in shape so as to mix up the pixels that are on, see for example EP-A-1503360. As another example, the colours and/or the contrast level of the static image can be inverted, which can be carried out periodically, but this can also be disturbing to the viewer. In WO-A-2003/034718, all of the pixels in a vertical line are switched off for a short period, and then all of the pixels in another vertical line are switched off for a short period, etc., across the whole screen. Thus, all pixels across the whole vertical extent of the screen are switched off sequentially. However, it is possible for this to be perceptible to the viewer and in any event switches off pixels unnecessarily. Another example of avoiding burn-in is to use a screen saver, but these are not generally acceptable on television receivers or display devices used in public venues and the like.

[0006] A number of techniques for so-called "healing" of the burn-in problem are also known, including for example increasing the brightness level of damaged pixels to compensate for the loss of brightness. However, plainly, these do not prevent the burn-in in the first place and simply operate to hide the worst effects.

[0007] According to a first aspect of the present invention, there is provided a method of preventing pixel burn-in on a display screen, the method comprising: determining whether a static image has been displayed on the screen for longer than a certain period; finding the smallest region on the screen within which said static image fits; and, reducing the brightness level of pixels within said region within which the static image fits.

[0008] According to a second aspect of the present invention, there is provided a method of preventing pixel burn-in on a display screen, the method comprising: (a) determining whether a static image has been displayed on the screen for longer than a certain period; (b) notionally dividing the screen into a plurality of regions; (c) determining whether said static image fits within one of the regions; and, (d) if said static image does not fit within one of said regions, notionally dividing the screen into a plurality of regions larger than the previous regions and returning to step (c) using the larger regions, else proceeding to step (e); (e) when said static image does fit within one of the regions, reducing the brightness level of pixels within the region within which the static image fits.

[0009] Thus, in either aspect, it can be quickly detected whether a static image is being displayed. In the preferred embodiments, the smallest (reasonable) region in which the static image fits is identified. Then it is determined whether the static image has been on for a period of time that might lead to pixel burn-in. Such period may be set depending on a number of factors, including for example the known burn-in period of the screen (which depends in part on the type and quality of the screen), the brightness level of the pixels concerned, etc. If that period of time has elapsed, then a burn-in protection method can be carried out to protect the pixels in that region. In this way, there is for example no shifting around of the entire image. The smallest possible part of the screen is treated to avoid burn-in, which therefore minimises the possibility that the viewer might detect the operation of any burn-in protection.

[0010] In an embodiment, the brightness level of said pixels is temporarily reduced. The brightness level of said pixels may for example be reduced for a random period of time, which may be randomly set at different periods, or the brightness level of said pixels may be reduced for a fixed period of time.

[0011] The brightness level may be reduced to zero.

[0012] Said pixels may be selected randomly.

[0013] In an alternative arrangement, said pixels form a line, said line being swept across said region by temporarily reducing the brightness levels of pixels in a line in sequence across said region.

[0014] Said line of pixels may extend fully across said region in a direction transverse to the direction of sweeping of the line.

[0015] Alternatively, said line of pixels may extend partly across said region in a direction transverse to the direction of sweeping of the line, the method comprising sweeping said line in a first direction across said region by temporarily reducing the brightness levels of pixels in a line in sequence across said region, displacing the line in a direction transverse to the direction of sweeping of the line, and sweeping the displaced line back in a second direction across said region by temporarily reducing the brightness levels of pixels in a line in sequence across said region. This helps to reduce the possibility of the viewer noticing that the brightness of pixels is being reduced.

[0016] According to a third aspect of the present invention, there is provided apparatus for preventing pixel burn-in on a display screen, the apparatus comprising: one or more processors arranged: to determine whether a static image has been displayed on the screen for longer than a certain period; to find the smallest region on the screen within which said static image fits; and, to reduce the brightness level of pixels within said region within which the static image fits.

[0017] According to a fourth aspect of the present invention, there is provided apparatus for preventing pixel burn-in on a display screen, the apparatus comprising: one or more processors arranged: (a) to determine whether a static image has been displayed on a display screen for longer than a certain period; (b) to notionally divide the screen into a plurality of regions; (c) to determine whether said static image fits within one of the regions; and, (d) if said static image does not fit within one of said regions, to notionally divide the screen into a plurality of regions larger than the previous regions and return to (c) using the larger regions, else to proceed to (e); and (e) when said static image does fit within one of the regions, to reduce the brightness level of pixels within the region within which the static image fits.

[0018] In an embodiment, the one or more processors are arranged such that the brightness level of said pixels is temporarily reduced.

[0019] The one or more processors may be arranged such that the brightness level is reduced to zero.

[0020] The one or more processors may be arranged such that said pixels are selected randomly.

[0021] The one or more processors may be arranged such that said pixels form a line, and such that said line is swept across said region by temporarily reducing the brightness levels of pixels in a line in sequence across said region. The one or more processors are preferably arranged such that said line of pixels extends fully across said region in a direction transverse to the direction of sweeping of the line.

[0022] Embodiments of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

Fig. 1 shows schematically the division of a display screen into a plurality of regions of different size;

Fig. 2 shows schematically the selection of pixels within one of the regions;

Fig. 3 shows schematically an example of line sweeping;

Figs. 4 and 5 show schematically another example of line sweeping; and,

Fig. 6 shows in summary the steps of an example of a method according to the present invention.

[0023] Referring first to Figure 1, there is shown a screen 1 of a display device of the type that suffers from pixel burn-in. For example, the screen 1 may be the screen of a plasma display panel or a cathode ray tube display. For present purposes, the screen 1 is notionally divided into a plurality of regions 2. As will be understood from the following, the screen 1 may be notionally divided into regions 2 of different sizes during different points in the method. Thus, the division of the screen 1 can be by virtue of a first grid, grid-I, having 16 regions 2; a second grid, grid-II, having 32 regions 2 all smaller than the regions 2 of grid-I; a third grid, grid-III, having 64 regions 2 all smaller than the regions 2 of grid-II; and a fourth grid, grid-IV, having 128 regions 2 all smaller than the regions 2 of grid-III.

[0024] As will be understood, more or less grids may be provided. The grids may have more or less regions 2 than in the examples shown. Also, in each of the grids shown in Figure 1, all regions 2 are of the same size and shape and are rectangular. In general, however, the regions 2 within a grid may be of different shapes and need not be the same size. For example, it may be desirable to have regions 2 of a different size at the top right hand or top left hand corner of the screen 1 as that is the area where a channel logo is often displayed, or the regions 2 may be of a different size and shape at the lower part of the screen 1 where often a scrolling text (for example displaying latest news, share prices and the like) is displayed within a static border.

[0025] It should be understood that the division of the screen 1 into regions 2 is notional. The size, shape and number of regions 2 within each grid can be predefined by the manufacturer of the display device or can be determined by a software-implemented algorithm according to the size and position of any static image.

[0026] The screen 1 is monitored so that it can be detected when a static image has been displayed on a part of the screen for a predetermined period of time. The particular period of time that should be set depends on a number of factors, including for example the quality of the screen 1 and the brightness and contrast levels of the pixels in the screen 1. A number of methods already exist for monitoring for display of a static image on a screen 1. For example, the drive signals to the individual pixels can be appropriately monitored by a controller or processor.

[0027] When it is detected that a static image has been displayed on the screen 1 for the certain period of time, it is determined whether the static image fits entirely within the smallest regions 2 of the grids, i.e. the regions 2 of grid-IV in this particular example. Again, a number of techniques exist for determining whether an image fits entirely within a particular region on a screen 1, including for example monitoring the drive signals to the pixels that make up the static image.

[0028] If it is determined that the static image does not fit entirely within the smallest regions 2 formed by grid-IV, then grid-III having its larger regions 2 is used instead. Similarly, if the static image does not fit entirely within the larger regions 2 of grid-III, then grid-II with its even larger regions 2 is used. Then, grid-I can be used if the static image does not fit within the regions 2 of grid-II.

[0029] At some point then, a grid is found in which the static image fits entirely within one of the regions 2, and this is the grid having the smallest possible regions 2 that can accommodate the whole of the static image.

[0030] It will be understood that other methods may be available for determining the smallest region in which the static image fits.

[0031] A counter is provided for at least the region 2 in which the static image entirely fits. In some embodiments, counters may be provided for all regions 2 in the grids. Moreover, the method may operate to detect plural static images at different positions on the screen 1, possibly with regions 2 of different sizes being selected according to the size of the respective static images, and separate counters may be allocated to those regions.

[0032] If the counter for the region 2 in which the static image is located reaches a predetermined value (indicating that the static image has been on for a particular period of time), then a burn-in protection method is carried out on the pixels in the region 2 in which the static image is located.

[0033] Thus, it is quickly detected whether a static image is being displayed. Then the smallest region 2 in which the static image fits is identified. Then it is determined whether the static image has been on for a predetermined period of time that might lead to pixel burn-in. If that predetermined period of time has elapsed, then a burn-in protection method can be carried out to protect the pixels in that region 2. In this way, there is no shifting around of the entire image. The smallest possible part of the screen 1 is treated to avoid burn-in, which therefore minimises the possibility that the viewer might detect the operation of any burn-in protection.

[0034] Referring now to Figure 2, there is shown one example of a burn-in protection method. The region 2 in which the static image fits is shown schematically in the figure. This region 2 is divided into blocks 10. As shown each block 10 may consist of a single pixel or plural pixels, which may be arranged in square arrays of 2x2, 3x3, 4x4 pixels, etc., or which may in general be of any size and shape However, it is preferred to keep the size of the blocks 10 small so as to minimise the possibility of the viewer noticing operation of the burn-in method.

[0035] The brightness level of the pixel or pixels in the block 10 is then reduced, preferably to zero, by appropriate control of the drive signals sent to the pixels in the block 10. The position of the block 10 for which the brightness level is reduced may be selected randomly. The duration of the reduced brightness level may be set randomly (up to a predetermined maximum period of time for example) or may be a predetermined fixed time period. In general, the period for which the brightness level is reduced may be set depending on the type and quality of the screen, the brightness level being applied to the pixel during display of the static image, etc. After that period of time has expired, the brightness level of the pixel or pixels in the block 10 is returned to its level required to display the static image. Another block 10 is then randomly selected for the brightness level of its pixel or pixels to be reduced. Several blocks 10 in the region 2 can be selected to have the brightness levels of their pixels reduced simultaneously. In general, therefore, over a period of time, the brightness levels of all pixels in the region 2 are reduced, which avoids burn-in of the static image in the region 2.

[0036] In another embodiment, the pixels for which the brightness levels are reduced are selected methodically. For example, referring to Figure 3, there is again shown the region 2 in which the static image fits. In this example, a series of pixels in a line 20, which in this example is vertically orientated with respect to the region 2, are selected to have their brightness level reduced. The brightness level of the pixels in that line 20 is reduced (preferably to zero) for a short period of time and their brightness level then returned to the level necessary to display the static image. Then, pixels in an adjacent line are selected to have their brightness levels reduced temporarily, etc. In this way, the line effectively sweeps across the region 2 so that in turn, all pixels have their brightness level reduced over time.

[0037] In the example shown in Figure 3, the line 20 fits entirely across the region 2. The line 20 in this example sweeps from left to right and then from right to left, etc. In this way, over a short period of time, the brightness levels of all pixels in the region 2 is methodically and temporarily reduced.

[0038] In another example shown schematically in Figures 4 and 5, a short line 30 of pixels is selected that extends only part way across the region 2. As shown in Figure 5, this short line 30 can be swept in one direction across a first row 31 in the region 2. The row 31 contains several rows of pixels. Having reached one edge of the region 2, the line 30 then returns to sweep across a second row 32 of pixels, etc., so that ultimately in a sufficient period of time the line 30 sweeps across the whole of the region 2 such that all pixels in the region 2 have their brightness levels temporarily reduced. Using the short line 30, which is swept back and forth over relatively smaller areas than the long line 20 of the example described above helps to reduce the possibility of the viewer noticing that pixels are being switched off or are having their brightness reduced.

[0039] The line 20 of the example shown in Figure 3, and the line 30 of the example shown in Figures 4 and 5, may have a width of only one pixel or plural pixels. In general, it is preferred that the line 20, 30 be as thin as possible, i.e. only one pixel thick, so as to minimise the possibility of the viewer noticing the operation of a burn-in protection method.

[0040] Figure 6 shows schematically the steps of the preferred embodiment of the present invention. As shown at step 1, the screen of the display device is scanned continually to look for display of a static image of any part of the screen. At step 2, if a static image is detected, the result true leads to step 3 in which the screen is divided into the small regions 2, which is done successively until the smallest region 2 in which the static image fits is identified. In step 4, one or more counters for the region(s) 2 are started. At step 5, if motion in the region 2 or pixels within the region 2 is detected before the counter reaches a predetermined value, the burn-in protection method is not required. Otherwise, a burn-in protection method is activated in step 6. As shown at step 7, it is preferred that monitoring is still carried out to determine whether motion in the region 2 or in particular pixels within the region 2 is detected. If motion is detected, then the burn-in protection method can be switched off, and the process returned to step 1.

[0041] The preferred method can be implemented in one or more processors associated with the display screen. The method may be implemented in software or hardware or a combination of software and hardware. For example, the method may be implemented in software running on a general purpose computer that is used to drive the display screen. By way of another example, where the display screen is part of a television receiver apparatus, the method can be embodied in one or more processors associated with the television receiver apparatus.

[0042] Embodiments of the present invention have been described with particular reference to the examples illustrated. However, it will be appreciated that variations and modifications may be made to the examples described within the scope of the present invention.

Claims

1. A method of preventing pixel burn-in on a display screen, the method comprising:

determining whether a static image has been displayed on the screen for longer than a certain period;
finding the smallest region on the screen within which said static image fits; and,
reducing the brightness level of pixels within said region within which the static image fits.

2. A method of preventing pixel burn-in on a display screen, the method comprising:

(a) determining whether a static image has been displayed on the screen for longer than a certain period;
(b) notionally dividing the screen into a plurality of regions;
(c) determining whether said static image fits within one of the regions; and,
(d) if said static image does not fit within one of said regions, notionally dividing the screen into a plurality of regions larger than the previous regions and returning to step (c) using the larger regions, else proceeding to step (e);
(e) when said static image does fit within one of

the regions, reducing the brightness level of pixels within the region within which the static image fits.

3. A method according to claim 1 or claim 2, wherein the brightness level of said pixels is temporarily reduced.

4. A method according to any of claims 1 to 3, wherein the brightness level is reduced to zero.

5. A method according to any of claims 1 to 4, wherein said pixels are selected randomly.

6. A method according to any of claims 1 to 4, wherein said pixels form a line, said line being swept across said region by temporarily reducing the brightness levels of pixels in a line in sequence across said region.

7. A method according to claim 6, wherein said line of pixels extends fully across said region in a direction transverse to the direction of sweeping of the line.

8. A method according to claim 6, wherein said line of pixels extends partly across said region in a direction transverse to the direction of sweeping of the line, the method comprising sweeping said line in a first direction across said region by temporarily reducing the brightness levels of pixels in a line in sequence across said region, displacing the line in a direction transverse to the direction of sweeping of the line, and sweeping the displaced line back in a second direction across said region by temporarily reducing the brightness levels of pixels in a line in sequence across said region.

9. Apparatus for preventing pixel burn-in on a display screen, the apparatus comprising:

one or more processors arranged: to determine whether a static image has been displayed on the screen for longer than a certain period; to find the smallest region on the screen within which said static image fits; and, to reduce the brightness level of pixels within said region within which the static image fits.

10. Apparatus for preventing pixel burn-in on a display screen, the apparatus comprising:

one or more processors arranged: (a) to determine whether a static image has been displayed on a display screen for longer than a certain period; (b) to notionally divide the screen into a plurality of regions; (c) to determine whether said static image fits within one of the regions; and, (d) if said static image does not fit within one of said regions, to notionally divide the screen into a plurality of regions larger than the previous regions and return to (c) using the larger regions, else to proceed to (e); and (e) when said static image does fit within one of the regions, to reduce the brightness level of pixels within the region within which the static image fits.

11. Apparatus according to claim 9 or claim 10, wherein the one or more processors are arranged such that the brightness level of said pixels is temporarily reduced.

12. Apparatus according to any of claims 9 to 11, wherein the one or more processors are arranged such that the brightness level is reduced to zero.

13. Apparatus according to any of claims 9 to 12, wherein the one or more processors are arranged such that said pixels are selected randomly.

14. Apparatus according to any of claims 9 to 13, wherein the one or more processors are arranged such that said pixels form a line, and such that said line is swept across said region by temporarily reducing the brightness levels of pixels in a line in sequence across said region.

15. Apparatus according to claim 14, wherein the one or more processors are arranged such that said line of pixels extends fully across said region in a direction transverse to the direction of sweeping of the line.

16. Apparatus according to claim 13, wherein the one or more processors are arranged such that said line of pixels extends partly across said region in a direction transverse to the direction of sweeping of the line, and such that said line is swept in a first direction across said region by temporarily reducing the brightness levels of pixels in a line in sequence across said region, the line is displaced in a direction transverse to the direction of sweeping of the line, and the displaced line is swept back in a second direction across said region by temporarily reducing the brightness levels of pixels in a line in sequence across said region.

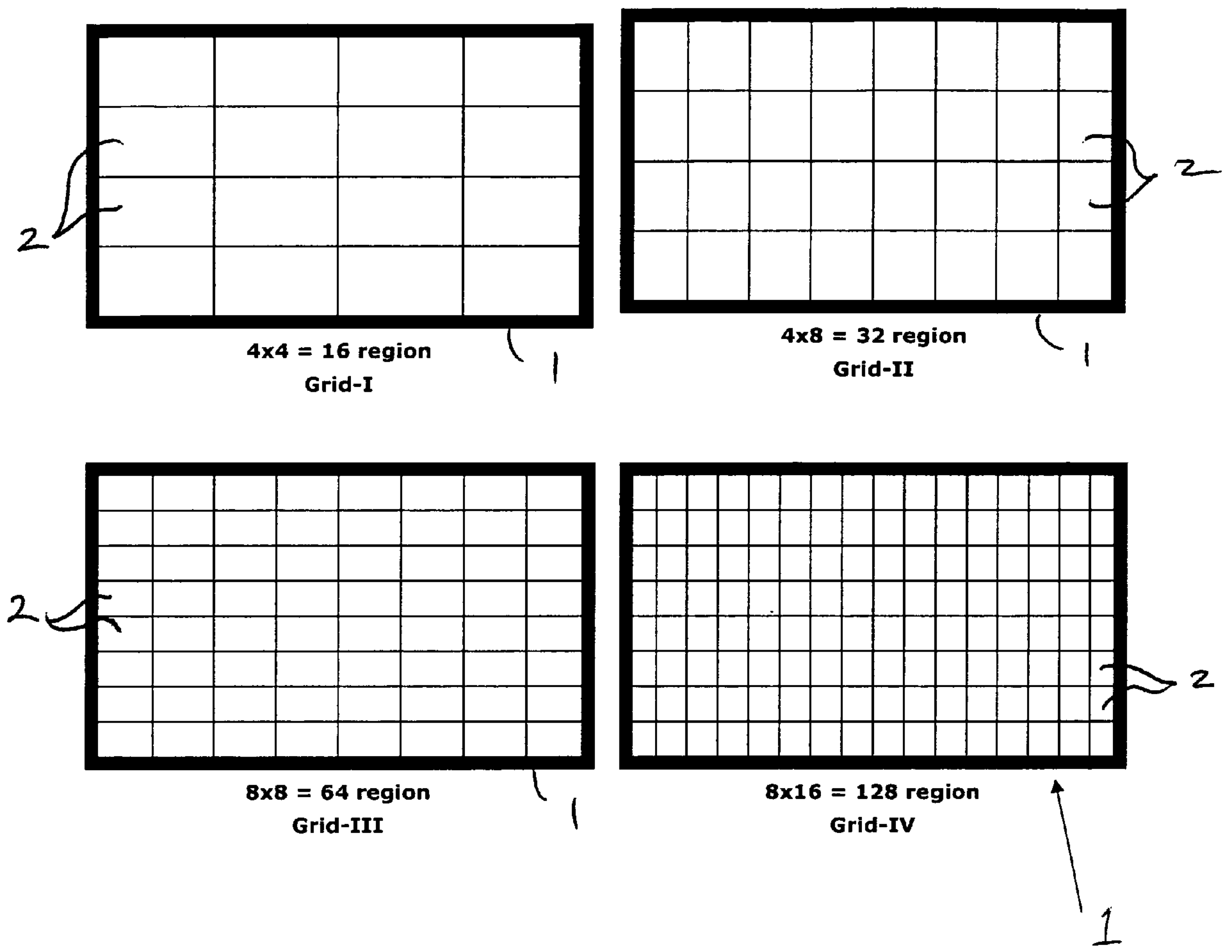

4x4 = 16 region
Grid-I
4x8 = 32 region
Grid-II
8x8 = 64 region
Grid-III
8x16 = 128 region
Grid-IV
1
2

Figure 1

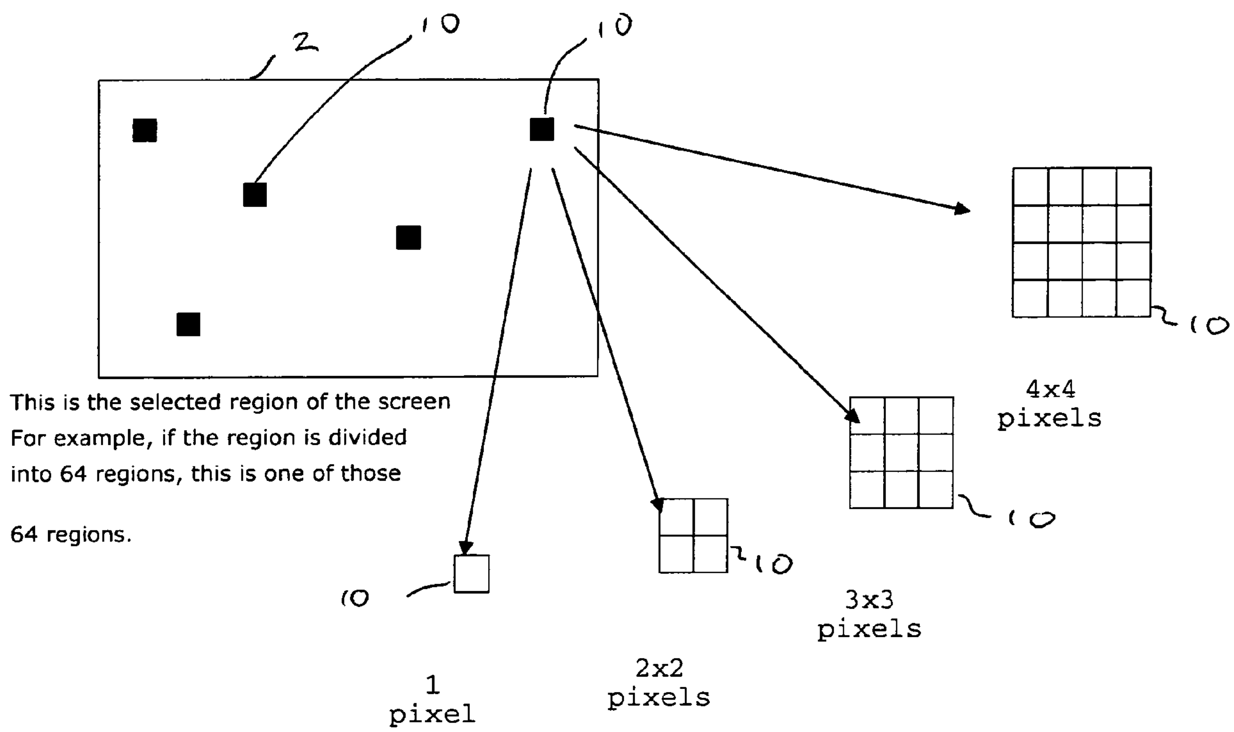
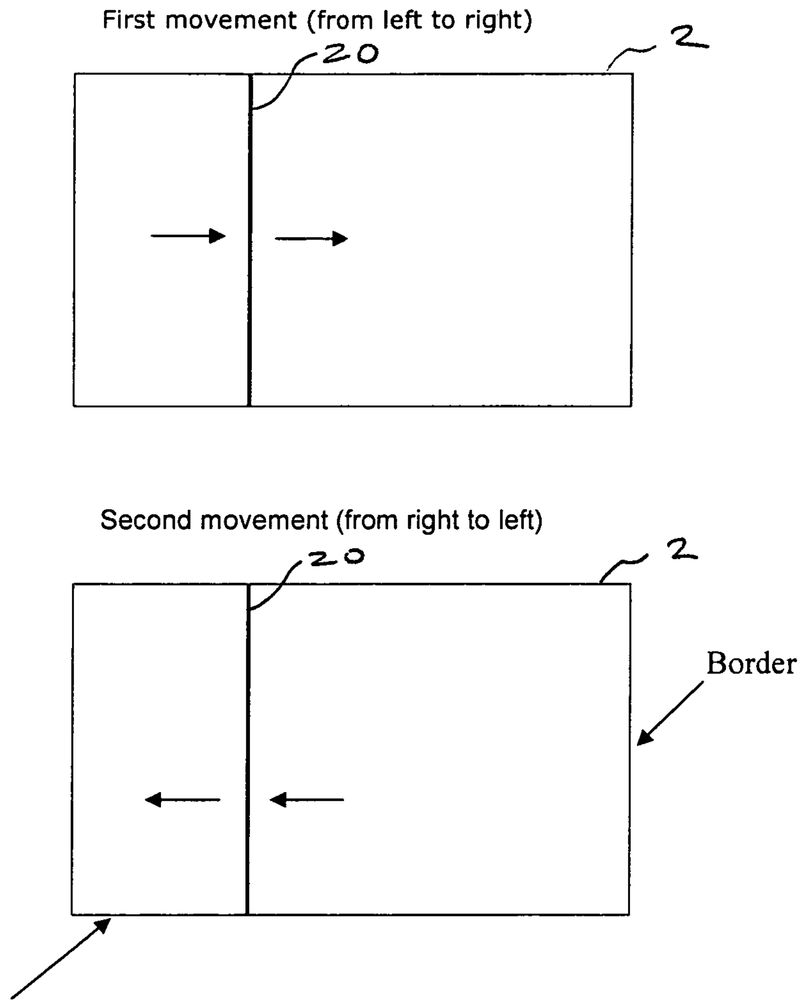

2
10
10
This is the selected region of the screen
For example, if the region is divided
into 64 regions, this is one of those
64 regions.
4x4
pixels
3x3
pixels
2x2
pixels
1
pixel
10

Figure 2



This is the selected region of the screen. For example if the screen is divided into 64 regions, this is one of the 64 regions on the screen.

Figure 3

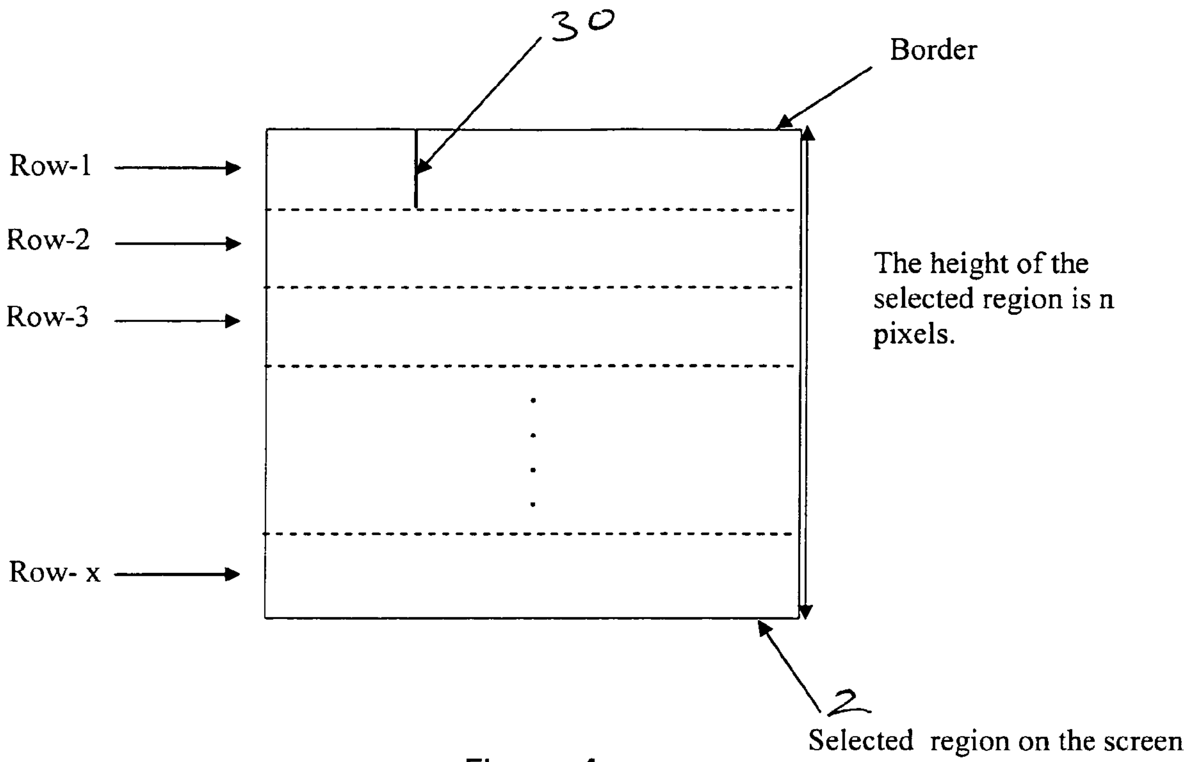

30
Border
Row-1
Row-2
Row-3
Row- x
The height of the selected region is n pixels.
2
Selected region on the screen

Figure 4

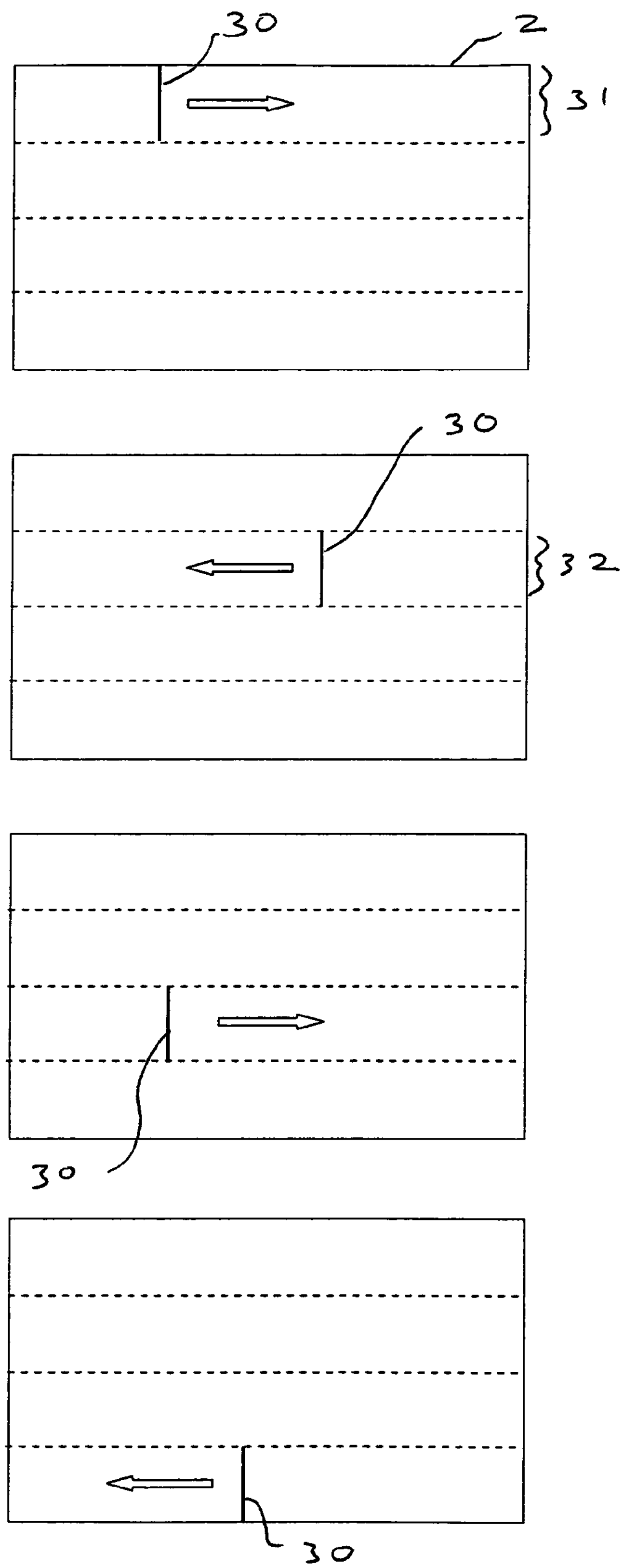


Figure 5

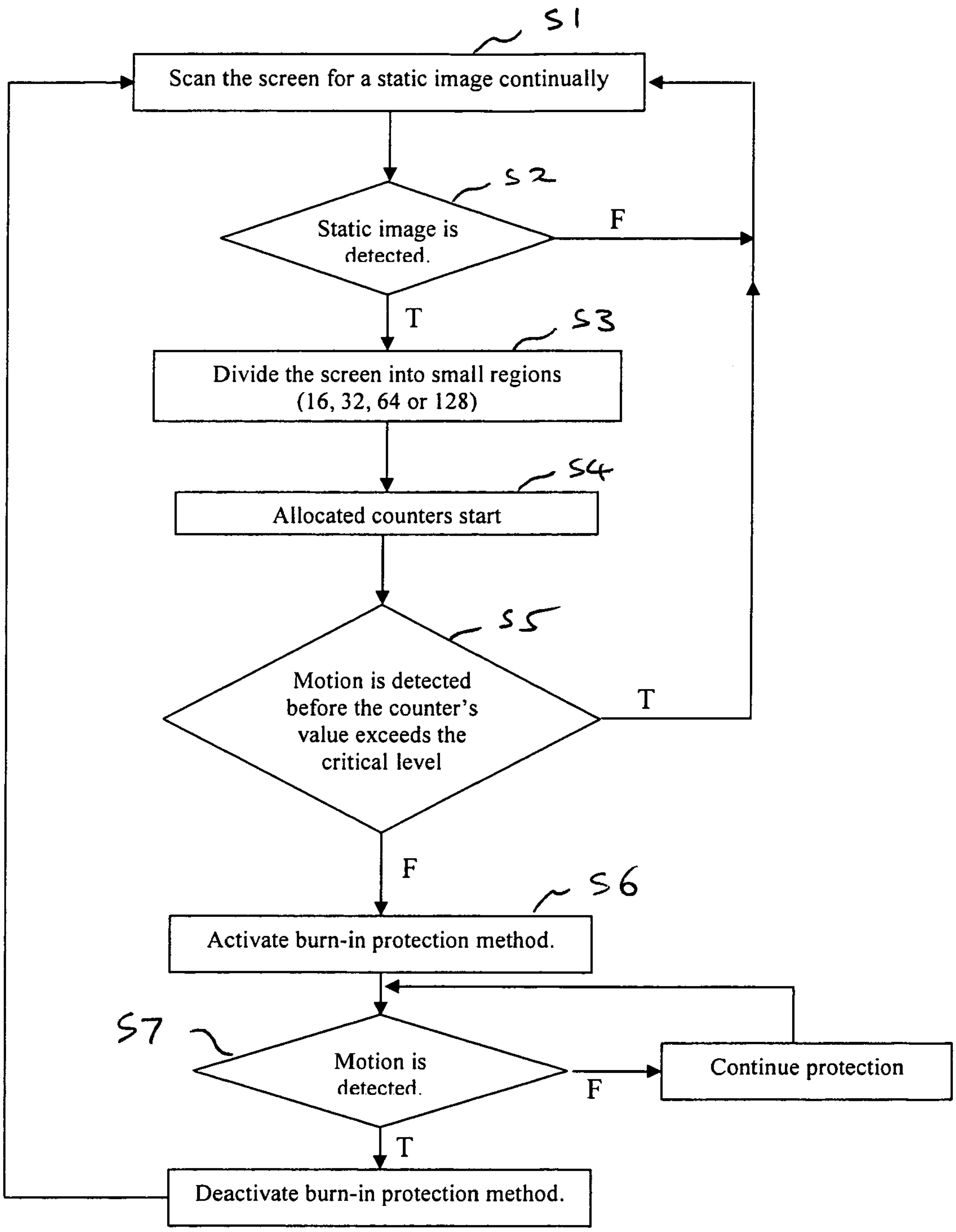

S1
Scan the screen for a static image continually
S2
Static image is detected.
F
T
S3
Divide the screen into small regions (16, 32, 64 or 128)
S4
Allocated counters start
S5
Motion is detected before the counter's value exceeds the critical level
T
F
S6
Activate burn-in protection method.
S7
Motion is detected.
F
Continue protection
T
Deactivate burn-in protection method.

Figure 6

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 25 6255

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 489 589 A (SANYO ELECTRIC CO., LTD) 22 December 2004 (2004-12-22) * abstract * -----	1-16	G09G5/00
			TECHNICAL FIELDS SEARCHED (IPC)
			G09G

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	8 March 2006	Fulcheri, A

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 25 6255

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08-03-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1489589 A	22-12-2004	AU 2003211470 A1	16-09-2003
		CN 1639762 A	13-07-2005
		WO 03075255 A1	12-09-2003

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1503360 A **[0005]**
- WO 2003034718 A **[0005]**