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(71) Applicant: **Vestel Elektronik Sanayi ve Ticaret A.S.**
45030 Manisa (TR)

(72) Inventor: **Yalcin, Yanki**
45030 Manisa (TR)

(74) Representative: **Cayli, Hülya**
Paragon Consultancy Inc.
Koza Sokak No: 63/2
GOP
06540 Ankara (TR)

(54) Personalization of the viewing angle in LED backlight displays

(57) The present invention refers to a backlight module (101) for providing backlight to a display panel for displaying images or video with a single wide viewing angle, said backlight module being divided into a plurality of regions and comprising a backlight controlling device (102). In particular the present invention provides a backlight controlling device which changes the luminance level of said plurality of regions to reduce said single wide viewing angle.

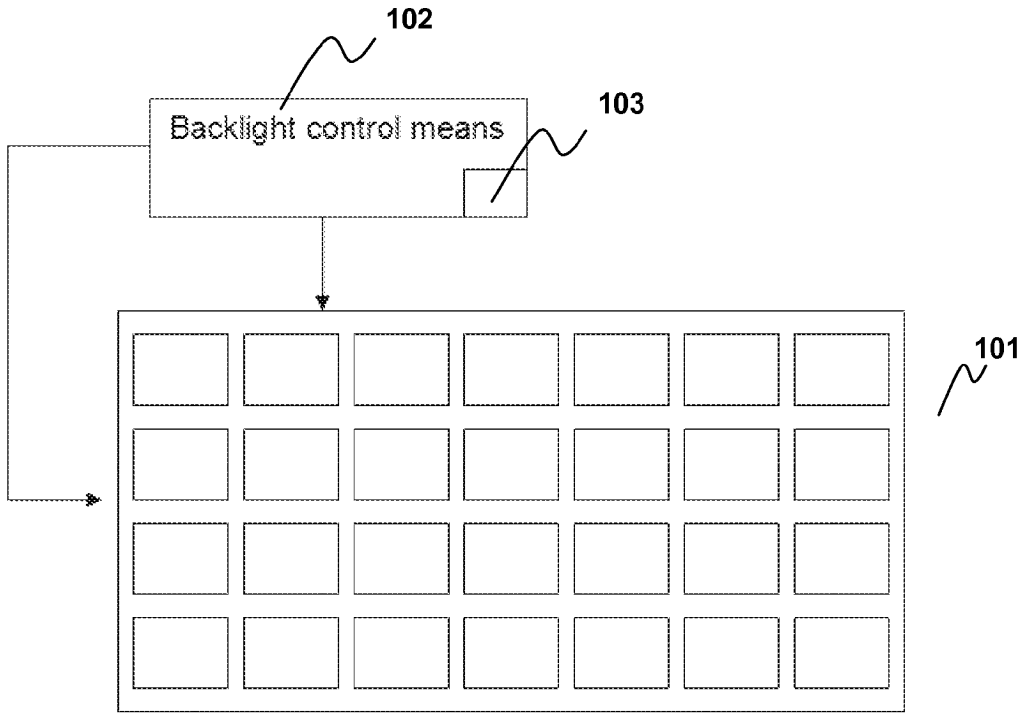

Figure 1

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Description

Field of invention

[0001] This invention relates to increasing the personalization of the TV watching experience and this is essentially realized by adjusting and narrowing the viewing angle of the display.

State of the art

[0002] One of the biggest problems affecting LCD displays, since its early presentation to the market has always been connected to the viewing angle and it is still a problem waiting to be solved, with continuous improvements by various manufacturers. The previous CRT technology was driven by an RGB trigger and as a matter of fact never faced problems associated with the viewing angle and viewpoint.

[0003] At the very beginning LCD displays were conceived as mainly suitable for computer monitors and television sets with small screen sizes. Such systems and application environments did not require much off-axis viewing as the viewer usually sits close enough to the screen so that the viewing angle does not represent a problem. Only when LCDs started to become an integral part of the home theatre entertainment, the narrow viewing angles of older LCD TVs needed to be improved by manufacturers and started to become a main issue. Wide viewing angles make the LCDs suitable for a large room where a large number of viewers can watch the pictures with uniform picture quality. Narrow viewing angles means you have to sit at right in front of the screen and another disadvantage of narrow viewing angles is that they do not allow much audience to watch the TV.

[0004] Various displays, such as flat panel displays, are based on technologies that are very different from CRT technology. For example, flat-panel LCDs for desktops use rod-shaped molecules that bend light to produce an image in contrast to CRTs that use electron guns that light up the phosphors on the viewing area of a glass tube. Flat panel LCDs do not have a CRT's geometric, convergence or focus problems, and their clarity makes it easier to view higher resolutions at smaller screen sizes. Also, the latest flat panel displays are all digital, unlike CRT's. This means that graphics cards with digital outputs do not have to convert the graphics information into analog form as they would with a typical monitor. Theoretically, this makes for more accurate color information and pixel placement.

[0005] CRT's radiate light roughly into a full hemisphere, while flat panel devices radiate light over a smaller solid angle that is highly directional. Consequently, moving the head or tilting the display changes contrast, brightness and colors of the screen in a dramatic way. For example, some conventional flat panel displays have less than 100-degree viewing angles, making it difficult to gather viewers around the screen or even for a viewer to shift his or her head without losing the image. Although some of the latest flat panel displays have 140-degree viewing angles or more on 15-inch panels or 160 or greater degree viewing angles on larger 18-inch displays, it is still desirable to determine the optimal viewing angle of the display. The optimal viewing angle ensures optimal contrast and brightness and consistent color rendering, which are especially important for applications using pictures or graphics, such as presentations, desktop publishing, browser use and so forth.

[0006] Conventional methods for determining the optimal viewing angle are generally rudimentary. For example, common methods include tilting the display until the image looks "good" to a user or viewing the display at an angle normal (i.e. perpendicular) to the display. Such methods may suffice for low level applications dealing mostly with text and saturated colors. However, with respect to pictures, the above limitations, resulting in lost contrast and brightness, become obvious. As the panel is tilted away from the optimum viewing angle, shadows, mid-tones or highlights fail to show contrast and detail, and colors are altered.

[0007] So flat panel displays suffer from viewing angle limitations. With current technologies all LCD panel producers are focused on increasing the viewing angle of the screens. They have several methods to increase the screen size which are briefly mentioned in the referred patents "Viewing angle adjustment for a liquid crystal display (LCD) (United States Patent 6628255)" and "LCD apparatus with improved gray scale at large viewing angles and method and apparatus for driving same (United States Patent 5489917)". There is also a new LCD panel technology, called Optically Compensated Bend (OCB), which enables to see what is on the screen from different viewing angles by changing the pixel structure of the display.

[0008] All the aforementioned technologies can be driven by software or hardware, none of them though mires at increasing the privatization or increasing the personalization of the displays by narrowing the screen size and therefore improving the quality of the image by personalizing it according to the position of the viewer.

Indeed the solutions available on the market try to focus on angle adjustment but this angle adjustment is in reality the mere increase of the viewing angle.

Besides increasing the viewing angle, also change in the quality of the image on the screen up to the viewpoint is a real problem.

Summary of the invention

[0009] So there is certainly a need for decreasing the default viewing angle of the display and in particular to decrease it to a direction where the screen is watched from. Moreover the implementation of this technology as regards LED Backlight displays is still an open issue. It is a purpose of the present invention to provide a solution for solving to all these gaps in the technology and to solve the problem of increasing privatization and personalization of watching a TV display, by adapting the viewing angle to the position of the viewer; this has also the side-effect of increasing the picture quality by personalizing the viewing angle. This problem is solved by employing a backlight display module comprising a backlight controlling device as claimed in claim 1.

[0010] Another aspect of the present invention relates to providing narrow viewing angles also where there is more than one viewer, each angle adapted to each viewer.

[0011] Another aspect of the present invention relates to narrowing the wide viewing angle on the horizontal or vertical plane or at the same time on the horizontal and vertical plane.

[0012] Another aspect of the present invention relates to adapting the viewing angle to the position of the viewer such that the viewing angle of the user is symmetrically divided into two equal angles from the perspective of the viewer.

[0013] Another aspect of the present invention relates to continuously re-arranging the viewing angle by varying the focus point of the backlight module according to the position of the viewer.

[0014] Another aspect of the present invention relates to a display device comprising the aforementioned backlight controlling device for narrowing the viewing angle.

[0015] Another aspect of the present invention relates to a display device comprising means for determining the position of one or more viewers such that the information of the position of the viewer is sent to the backlight controlling device to adapt the narrow-viewing angle.

[0016] Another aspect of the present invention relates to the fact that Infra-Red (IR), or RadioFrequency Identification (RFID) or image acquisition and processing means like a camera are used to determine the position of one or more viewers.

[0017] Another aspect of the present invention relates to the fact that the display has a default operational mode with a wide viewing angle and that the viewing angle is narrowed on the detection of the presence of a viewer, according to the position of this viewer.

[0018] Another aspect of the present invention relates to the fact that the narrow angle operational mode is activated by a user.

Brief description of the drawings

[0019]

Fig. 1 is a backlight module with backlight control means

Fig. 2 is a diagram of viewpoint analysis

Fig. 3 is a diagram of the geometrical problem of the bisection

Fig. 4 is a diagram of the application of the bisection for the calculation of the position of the viewer

Fig. 5 is a diagram of the calculation of the focal point on the panel

Fig. 6 is a diagram of the viewing angle adjustment by the backlight of the display

Fig. 7 is a diagram showing the process of adjustment by adapting the viewing angle

Fig. 8 is a fluorescent backlight display matrix

Fig. 9 is a LED backlight technology

Fig. 10a and 10b show the gradual levelling of the backlight, respectively, on the horizontal axis and in the plane structure

Fig. 11-1-a and 11-1-b shows the diagram of the vintage point calculation from the viewpoint of the viewer if auto adjust is not chosen or not given as default.

Fig. 11-2 shows the diagram of the vintage point calculation from the viewpoint of the viewer if auto adjust is chosen or given as default.

Fig. 12a,12b,12c, show three examples of backlight adaptation for LED and fluorescent displays.

Detailed description of exemplary embodiments

[0020] LCD's produce their image by having a film that when a current runs through the pixel, it turns the shade of color. The problem associated with such LCD film technology is that this color can only be accurately represented when viewed straight on. The further away from a perpendicular viewing angle, the more the color will tend to wash out. LCD monitors are generally rated, on the market, for their visible viewing angle for both horizontal and vertical. This is rated in degrees and is the arc of a semicircle whose center is at the perpendicular to the screen. A theoretical viewing angle of 180 degrees would mean that it is fully visible from any angle in front of the screen. A higher viewing angle is preferred over a lower angle unless you happen to want some security with your screen.

[0021] There is need for adjusting the viewing angle of the display especially for a target user at a specific location for a specific private message which is desired to be seen by him not by anybody else who is not looking from the right angle. This is also a kind of privatization up to the viewpoint of the targeted group of persons. The technical problem to be solved is to determine the position of the user and the viewing angle up to the position of the user. Once obtained the position of the viewer then the limitation of the viewing angle of the display or the shifting of the viewing angle off the display is realized by adequately adapting the backlight technology.

[0022] The present invention uses a viewing angle adjustment methodology that exploits the transformation of bisectional geometry and it arranges the backlight matrix elements according to the viewpoint. The reorganization of the backlight matrix system gradually decreases or increases the backlight intensity of each matrix element following a pattern process defined in the flow chart of Fig. 11-1-a-b and Fig 11-2 with the objective of adjusting the viewing angle of the display. The most important steps of this process are: pointing the focus of the display up to the viewpoint of the user, rearranging the backlight matrix (especially for LED Backlight displays) in one (viewing angle in horizontal or vertical axis), two (viewing angle in horizontal) and vertical axis) or three dimensions (viewing angle in horizontal and vertical axis and distance from the screen) and adjusting the viewing angle up to calculated viewpoint.

[0023] A key step of this process is therefore the calculation of the viewpoint and in particular how a 3D system can be subdivided into a 2D system to be solved by adequately arranging the backlight illumination.

[0024] A first step is related to the identification of the viewpoint in the horizontal axis and the other to the identification of the viewpoint on the vertical axis. In LED backlight displays both vertical and horizontal) axis are needed, though in fluorescent Backlight technology only one axis is enough. The calculation methodology for one axis may be applied also to the other axis, so for the sake of simplicity it will not be repeated for the other axis.

[0025] With reference to Fig. 3, where the geometrical problem is explained, the exploitation of the geometrical properties is used to shape the size of the viewing angle for personalization.

[0026] Specifically it is known that:

$$A\left(\overset{\Delta}{ABC}\right)=\left|BC\right|\cdot h\cdot\frac{1}{2} \tag{1}$$

$$A\left(\overset{\Delta}{ABF}\right)=\left|AB\right|\cdot h_1\cdot\frac{1}{2}=\left|BF\right|\cdot h\cdot\frac{1}{2} \tag{2}$$

$$A\left(\overset{\Delta}{AFC}\right)=\left|AC\right|\cdot h_1\cdot\frac{1}{2}=\left|FC\right|\cdot h\cdot\frac{1}{2} \tag{3}$$

from which it is derived that

$$\frac{A(\overset{\Delta}{ABF})}{A(\overset{\Delta}{AFC})} = \frac{|AB| \cdot h_1 \cdot \frac{1}{2}}{|AC| \cdot h_1 \cdot \frac{1}{2}} = \frac{|BF| \cdot h \cdot \frac{1}{2}}{|FC| \cdot h \cdot \frac{1}{2}} \quad (4)$$

and therefore

$$\frac{|AB|}{|AC|} = \frac{|BF|}{|FC|} \quad (5)$$

[0027] The viewing angle of the user is then symmetrically divided into two equal angles from the perspective of the user. It is assumed to be a bisector from that location and the focus on the screen is calculated in relation with this assumption.

[0028] With reference to Fig. 4 and exploiting the teaching of Eq. 5, we have Eq. 6

$$\frac{c}{a_1} = \frac{b}{a_2} \quad (6)$$

[0029] The distance of the user from the display can be measured with the help of RFID, IR or video and image processing related technologies, so that the values of "b" and "c" are available for the computations. The value of "a", as depicted in Fig. 4, is the length or width of the display and it is known "a priori". So by employing the teaching of Fig. 4 it is possible to find the focus point on the screen up to the viewpoint of the user.

[0030] With reference to Fig. 5, "a" indicates the length or width of the screen and "n" the number of columns, respectively rows of the LED backlight matrix.

[0031] According to the x value which defines the focus matrix element of the display (calculated up to the viewpoint of the user) the back light matrix is then rearranged by employing the following method:

$$\frac{a}{a_1} = \frac{n}{x} \quad (7)$$

- a1 is the distance of the focal point on the panel as in Fig. 4
- x = the column number where the bisector is pointed
- round x to the nearest integer
- if x is at an equal distance from two integers then take both areas
- if $x < \frac{n}{2} \Rightarrow x = n - x$

[0032] After the rearrangement the display backlight matrix will be ready to be used for the backlight intensity adjustment to limit or increase or shift the viewing angle of the display. Fig. 6 shows a 3D LED Backlight Display matrix rearrangement sample.

[0033] With the data representing the viewpoint information, combined with the viewing angle, the backlight is adequately changed by the driver of the display. The backlight driver adapts the specific brightness for each matrix element of the backlight (it can be one row matrix for current fluorescent technology or a matrix for LED Backlight technology or a column for side backlight technology). The value of the intensity of the backlight changes the brightness of that region of the display which is inversely proportional to the contrast ratio. Increasing the backlight intensity of the display means

increasing the brightness of the display which results in decreasing contrast ratio. The viewing angle is assumed to be the angle where the contrast ratio becomes 10:1 or less. So by decreasing the back light intensity of the display it is possible to adjust the contrast ratio.

[0034] Backlight intensity can be adjusted via several methods after the measurement of viewpoint by specifying the matrix structure of the backlight depending on the viewpoint information and on the distance from the screen. The intensity of the backlight will therefore change gradually starting from the located viewpoint on the screen. Gradually adapting algorithms may be adjusted such that the intensity of the backlight may be kept as the default value for the viewpoint on the screen and it will be gradually decreased or increased as the distance increases from the aforementioned point. This is shown in Fig. 7 and also in the flowchart of Fig. 11-1-a-b and Fig 11-2.

[0035] The main advantage of the system over other conventional methods is the adaptability of the quality and the personalization and the technical feature throughout which this is realized. This main advantage consists in the fact that the contrast ratio of the backlight of the display is adjusted up to the location of the viewer by employing data coming from the location sensors. Such location sensors can be RFID tags connected to the user, IR sensors on the remote controller, image processing sensors or else which can define the location of the user.

[0036] With the help of this data and the capability of dividing the screen into smaller pieces and treat it as a matrix of LEDs, it is possible to adapt the viewing angle of the display to customize it for the position and needs of the user.

[0037] Moreover this method, by recognizing the position of the user, allows the display to follow the steps of the user such that he can see different contents depending on the user location. This is an important feature for digital signage technology applications. Since privatization is a very hot topic nowadays this technology will give control for the personalization of the content displayed on the screen.

Claims

1. A backlight module (101) for providing backlight to a display panel for displaying images or video with a single wide viewing angle, said backlight module (101) being divided into a plurality of regions and **characterized in that** it comprises

   - a backlight controlling device (102) which changes the luminance level of said plurality of regions to reduce said single wide viewing angle.

2. The backlight module (101) of claim 1 wherein said backlight controlling device (102) changes the luminance level of said plurality of regions to create two or more viewing angles narrower than said single wide viewing angle.

3. The backlight module (101) of claim 2 wherein said backlight controlling device (102) changes the luminance level of said plurality of regions to reduce said wide viewing angle on the horizontal or vertical plane.

4. The backlight module (101) of claim 2 wherein said backlight controlling device (102) changes the luminance level of said plurality of regions to reduce said wide viewing angle on the horizontal and vertical plane.

5. The backlight module (101) of any preceding claims wherein said backlight controlling device (102) changes the luminance level of said plurality of regions such that the viewing angle of the user is symmetrically divided into two equal angles from the perspective of the viewer.

6. The backlight module (101) of any preceding claims wherein said backlight controlling device (102) comprises receiving means (103) for receiving information representing the position of a viewer.

7. The backlight module (101) of any preceding claims wherein said backlight controlling device (102) continuously re-arranges the luminance level of said plurality of regions by varying the focus point of the backlight module according to the changing position of a viewer.

8. A display device comprising:

   - a display panel
   - a backlight module (101) as claimed in any of the preceding claims

9. The display device of claim 8 further comprising means for determining the presence and the position of one or more viewers with respect to said display.

10. The display of claim 9, wherein said means for determining the presence and the position of one or more viewers with respect to said display are based on RFID or IR technologies.

11. The display of claim 9, wherein said means for determining the presence and the position of one or more viewers with respect to said display comprise a camera and image processing computation means for determining the position of a viewer with respect to said display.

12. The display of claims 8-11 further comprising a default operational mode that is a mode with a wide viewing angle and a narrow viewing angle operational mode automatically activated when said means for determining the position of a viewer detect the presence of a viewer.

13. The display of claims 8-12 wherein the display is an LCD display.

14. A method for providing backlight to a display panel for displaying images or video with a single wide viewing angle, comprising employing a backlight module (101) being divided into a plurality of regions and comprising controlling backlighting, **characterized in that**:

- the luminance level of said plurality of regions is changed to reduce said single wide viewing angle.

15. The method of claim 14 wherein said backlight controlling changes the luminance level of said plurality of regions to create two or more viewing angles narrower than said single wide viewing angle.

16. The method of claim 15 wherein said backlight controlling changes the luminance level of said plurality of regions to reduce wide viewing angle on the horizontal or vertical plane.

17. The method of claim 15 wherein said backlight controlling changes the luminance level of said plurality of regions to reduce wide viewing angle on the horizontal and vertical plane.

18. The method of claims 14-17 wherein said backlight controlling, once provided with information representing the position of the viewer, changes the luminance level of said plurality of regions such that the viewing angle of the user is symmetrically divided into two equal angles from the perspective of the viewer.

19. The method of claims 14-18 wherein said backlight controlling continuously changes the luminance level of said plurality of regions by varying the focus point of the backlight module according to the changing position of the viewer.

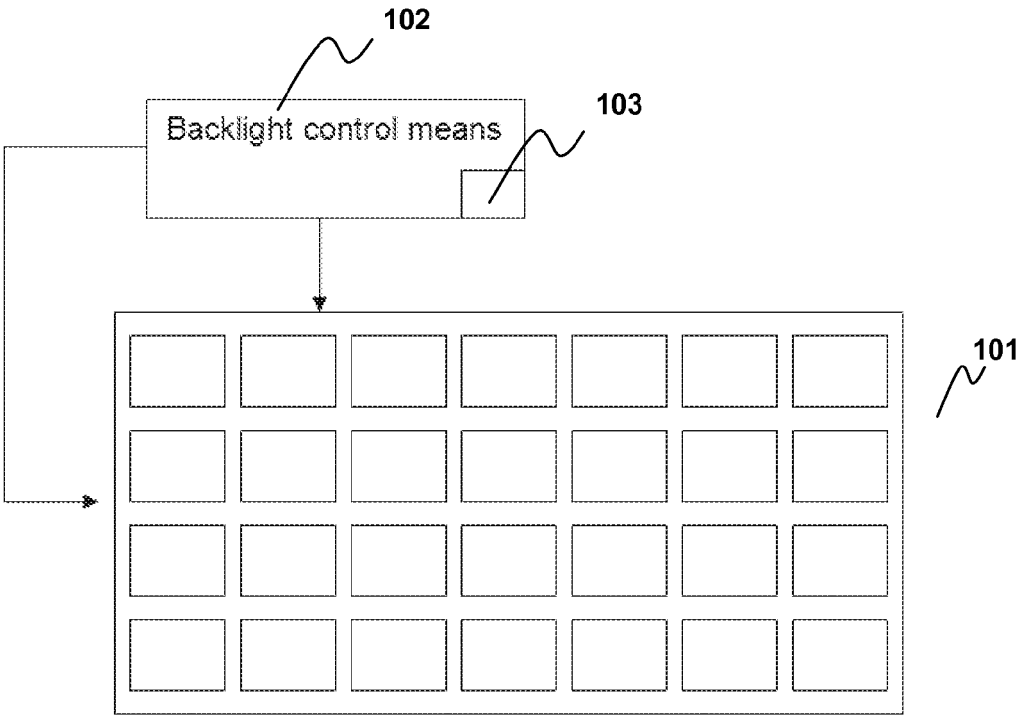

Figure 1

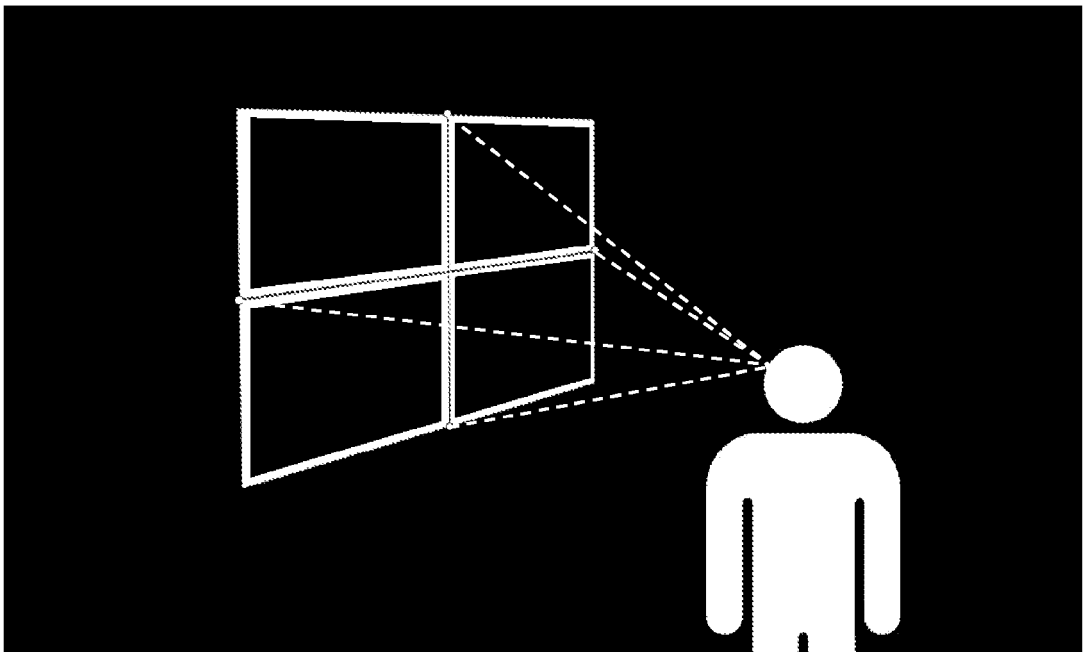

Figure 2

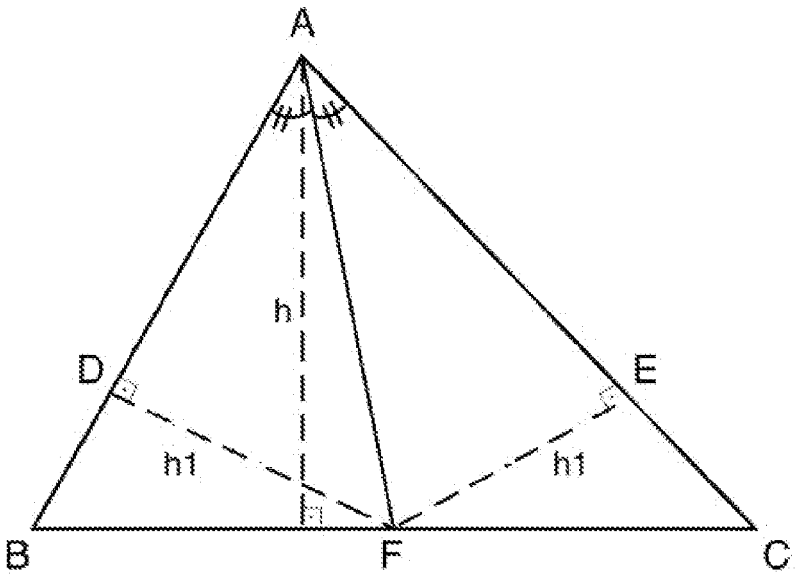

Figure 3

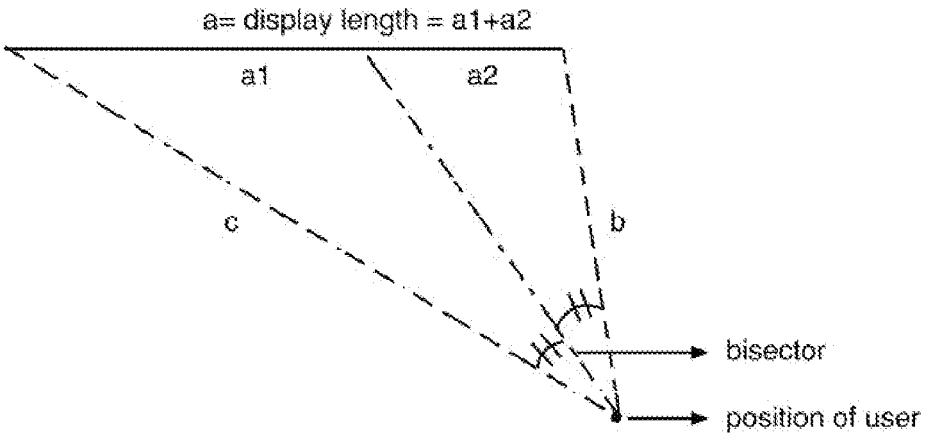

Figure 4

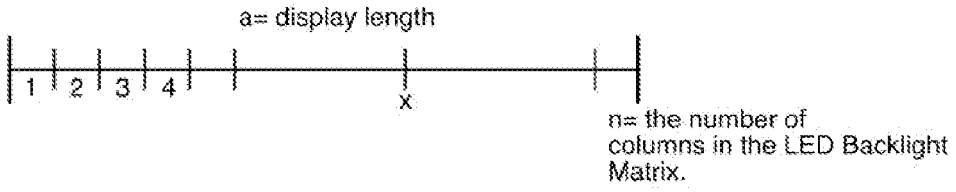

Figure 5

i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[08]	i[08]	i[08]	i[08]	i[08]	i[08]	i[08]	i[01]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[09]	i[09]	i[09]	i[09]	i[09]	i[08]	i[01]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[10]	i[10]	i[10]	i[09]	i[08]	i[01]
i[01]	I[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[11]	i[11]	i[10]	i[09]	i[08]	i[01]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[11]	i[11]	i[10]	i[09]	i[08]	i[01]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[10]	i[10]	i[10]	i[09]	i[08]	i[01]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[09]	i[09]	i[09]	i[09]	i[09]	i[08]	i[01]
i[01]	i[02]	i[03]	I[04]	i[05]	i[06]	i[07]	i[08]	i[08]	i[08]	i[08]	i[08]	i[08]	i[08]	i[08]	i[01]

Figure 6

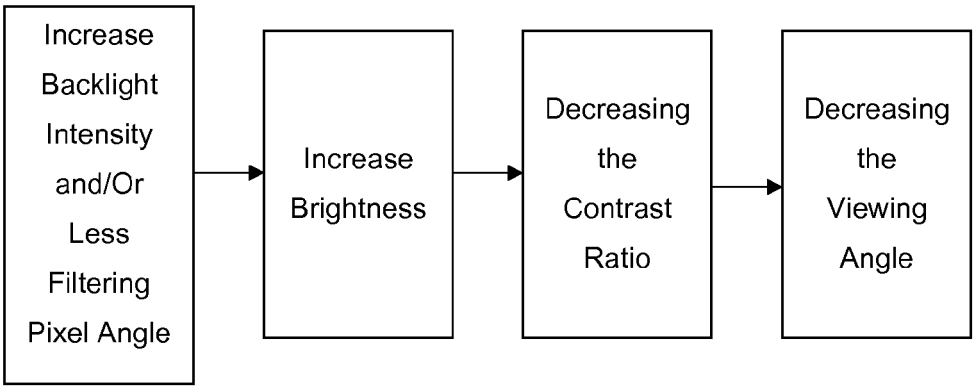

Figure 7

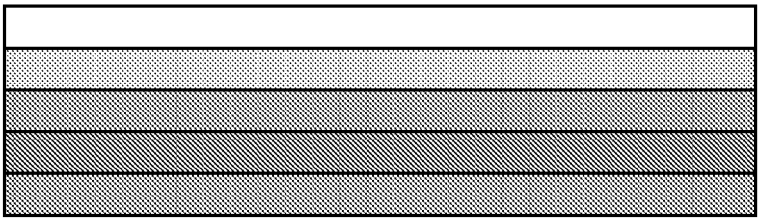

Figure 8

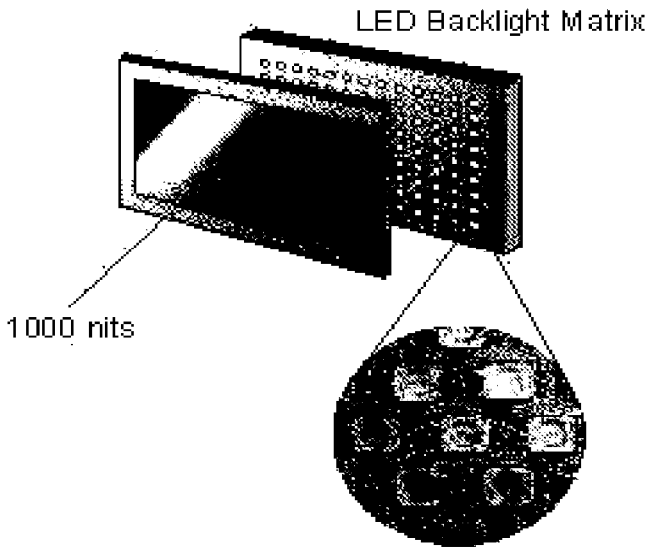

Figure 9

Figure 10.a

Figure 10.b

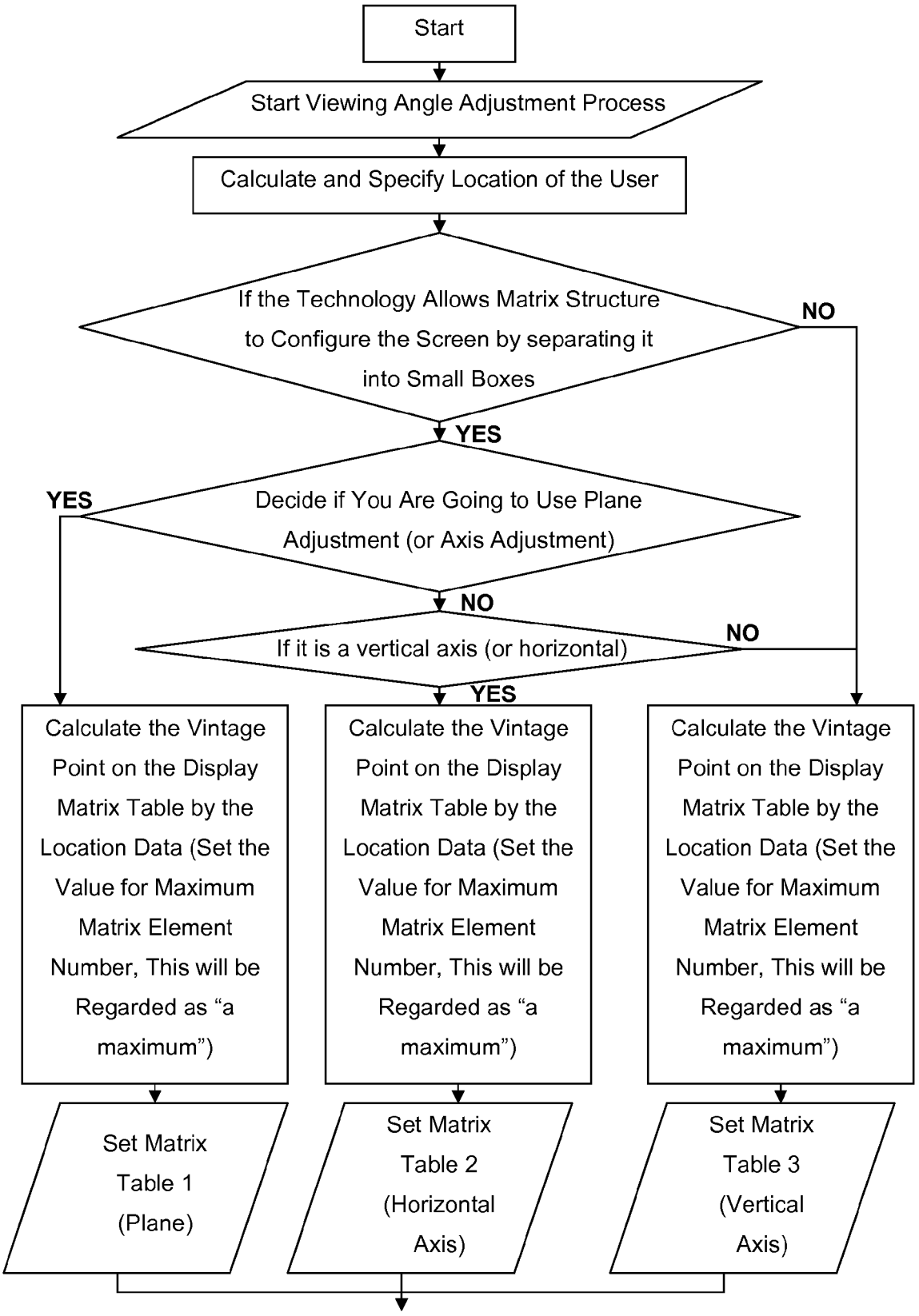
Start
Start Viewing Angle Adjustment Process
Calculate and Specify Location of the User
If the Technology Allows Matrix Structure to Configure the Screen by separating it into Small Boxes
NO
YES
Decide if You Are Going to Use Plane Adjustment (or Axis Adjustment)
YES
NO
If it is a vertical axis (or horizontal)
NO
YES
Calculate the Vintage Point on the Display Matrix Table by the Location Data (Set the Value for Maximum Matrix Element Number, This will be Regarded as “a maximum”)
Calculate the Vintage Point on the Display Matrix Table by the Location Data (Set the Value for Maximum Matrix Element Number, This will be Regarded as “a maximum”)
Calculate the Vintage Point on the Display Matrix Table by the Location Data (Set the Value for Maximum Matrix Element Number, This will be Regarded as “a maximum”)
Set Matrix Table 1 (Plane)
Set Matrix Table 2 (Horizontal Axis)
Set Matrix Table 3 (Vertical Axis)

Figure 11-1-a

Continued from Figure 11-1-a

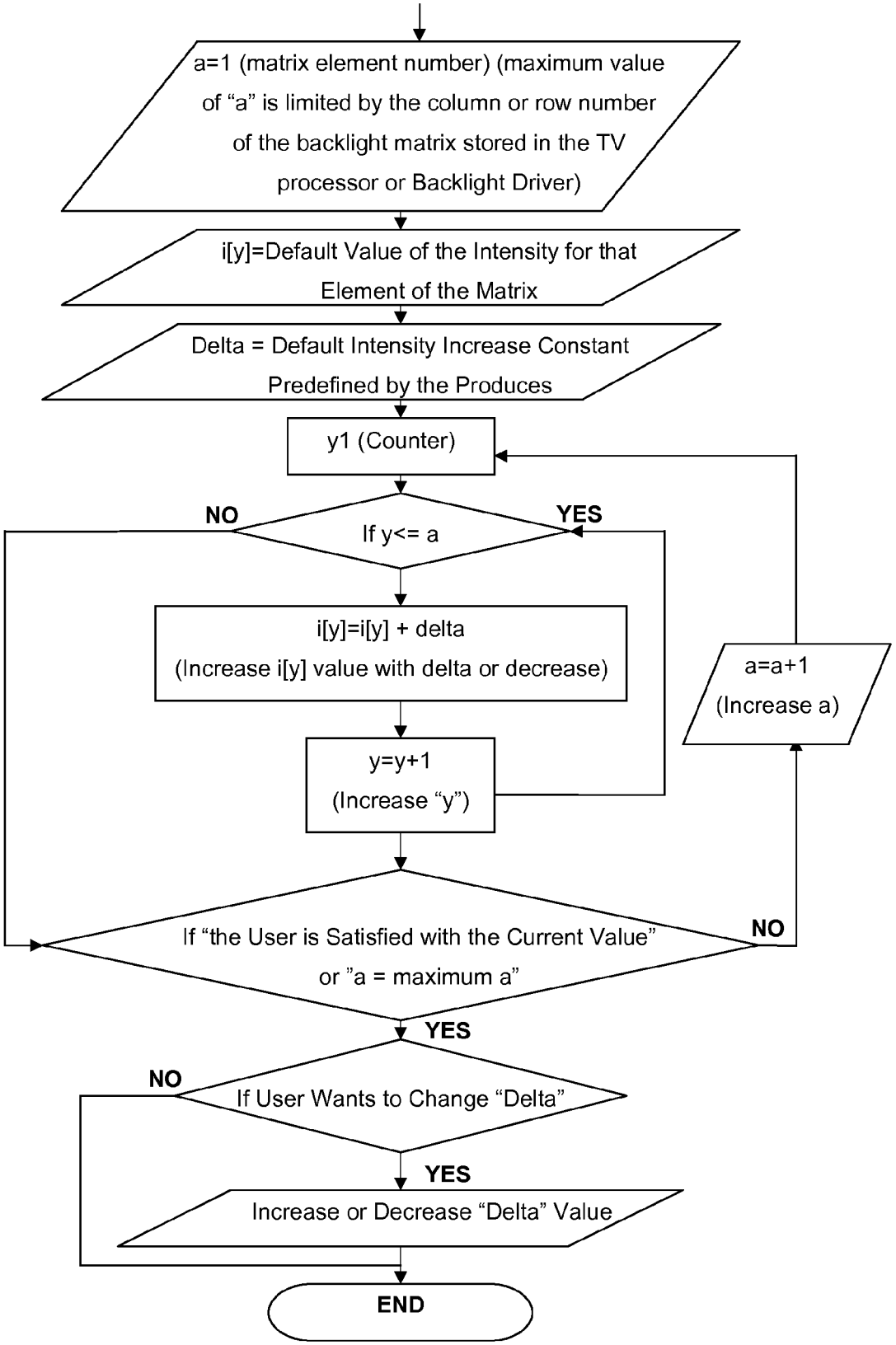

Figure 11-1-b

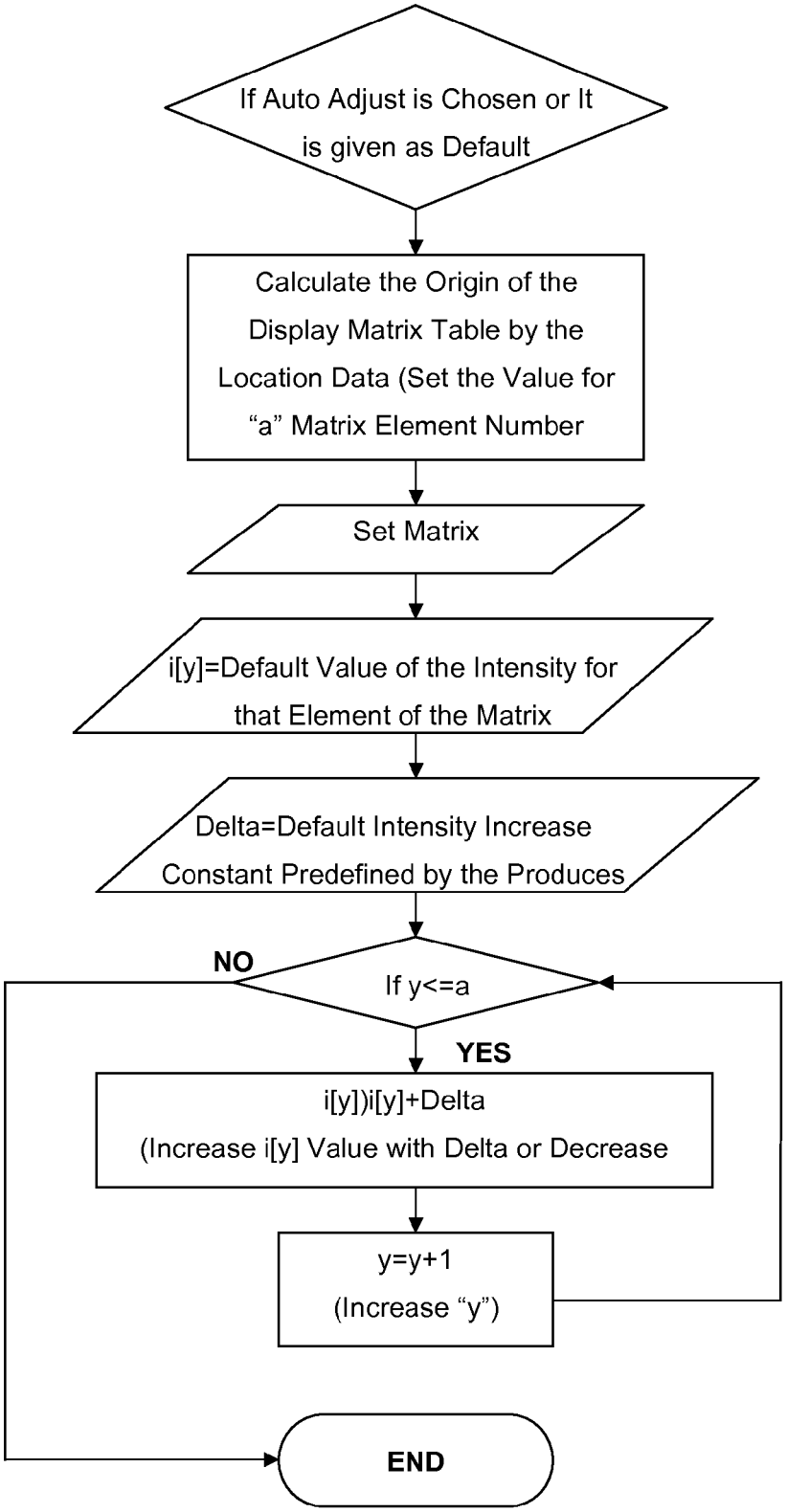
If Auto Adjust is Chosen or It is given as Default
Calculate the Origin of the Display Matrix Table by the Location Data (Set the Value for "a" Matrix Element Number
Set Matrix
i[y]=Default Value of the Intensity for that Element of the Matrix
Delta=Default Intensity Increase Constant Predefined by the Produces
NO
If y<=a
YES
i[y])i[y]+Delta
(Increase i[y] Value with Delta or Decrease
y=y+1
(Increase "y")
END

Figure 11-2

i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[08]	i[08]	i[08]	i[08]	i[08]	i[08]	i[08]	i[01]
i[01]	i[002]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[09]	i[09]	i[09]	i[09]	i[09]	i[08]	i[01]
i[01]	i[002]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[10]	i[10]	i[10]	i[09]	i[08]	i[01]
i[01]	I[002]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[11]	i[11]	i[10]	i[09]	i[08]	i[01]
i[01]	i[002]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[11]	i[11]	i[10]	i[09]	i[08]	i[01]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[10]	i[10]	i[10]	i[09]	i[08]	i[01]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[09]	i[09]	i[09]	i[09]	i[09]	i[08]	i[01]
i[01]	i[02]	i[03]	I[04]	i[05]	i[06]	i[07]	i[08]	i[08]	i[08]	i[08]	i[08]	i[08]	i[08]	i[08]	i[01]

Figure 12.a

i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[11]	i[11]	i[10]	i[09]	i[08]	i[07]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[11]	i[11]	i[10]	i[09]	i[08]	i[07]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[11]	i[11]	i[10]	i[09]	i[08]	i[07]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[11]	i[11]	i[10]	i[09]	i[08]	i[07]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[11]	i[11]	i[10]	i[09]	i[08]	i[07]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[11]	i[11]	i[10]	i[09]	i[08]	i[07]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[11]	i[11]	i[10]	i[09]	i[08]	i[07]
i[01]	i[02]	i[03]	i[04]	i[05]	i[06]	i[07]	i[08]	i[09]	i[10]	i[11]	i[11]	i[10]	i[09]	i[08]	i[07]

Figure 12.b

i[01]	i[01]	i[01]	i[01]	i[01]	i[01]	i[01]	i[01]	i[01]	i[01]	i[01]	i[01]	i[01]	i[01]	i[01]	i[01]
i[02]	i[02]	i[02]	i[02]	i[02]	i[02]	i[02]	i[02]	i[02]	i[02]	i[02]	i[02]	i[02]	i[02]	i[02]	i[02]
i[03]	i[03]	i[03]	i[03]	i[03]	i[03]	i[03]	i[03]	i[03]	i[03]	i[03]	i[03]	i[03]	i[03]	i[03]	i[03]
i[04]	i[04]	i[04]	i[04]	i[04]	i[04]	i[04]	i[04]	i[04]	i[04]	i[04]	i[04]	i[04]	i[04]	i[04]	i[04]
i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]
i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]
i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[06]	i[03]
i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]	i[05]

Figure 12.c

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EUROPEAN SEARCH REPORT

Application Number
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Place of search	Date of completion of the search	Examiner
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