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(54) POWER SAVING DISPLAY MODE FOR ORGANIC ELECTROLUMINESCENT DISPLAYS

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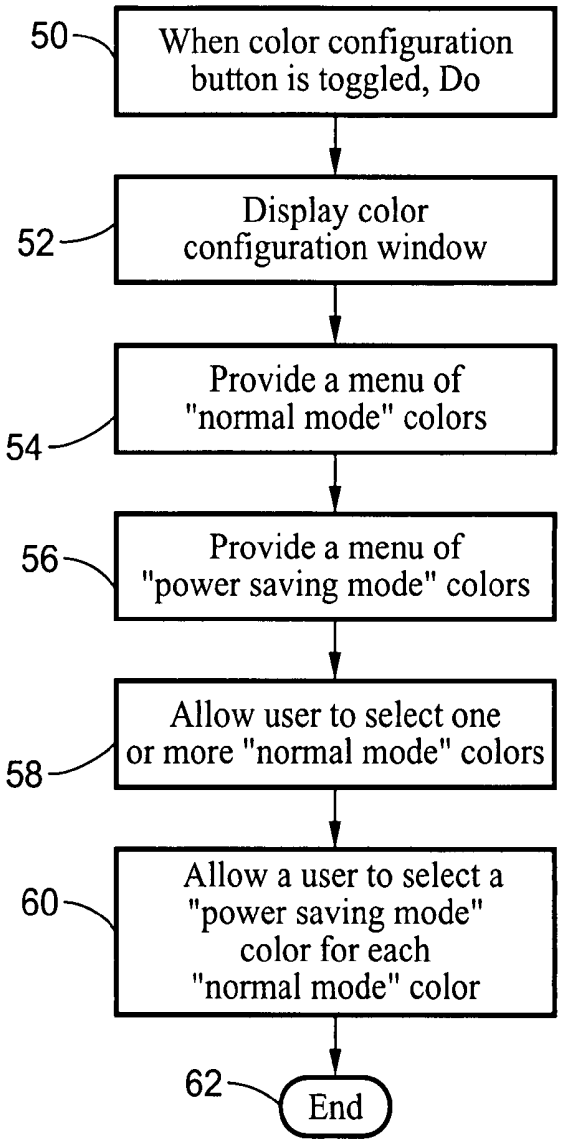
(57) ABSTRACT

An improved organic electroluminescent display includes a plurality of normal mode colors and a plurality of user-selected power saving mode colors. The display is switchable between a normal display mode and a power saving display mode. In the normal display mode, the normal mode colors are displayed by the display. Conversely, in the power saving display mode, the power saving mode colors are displayed by the display.



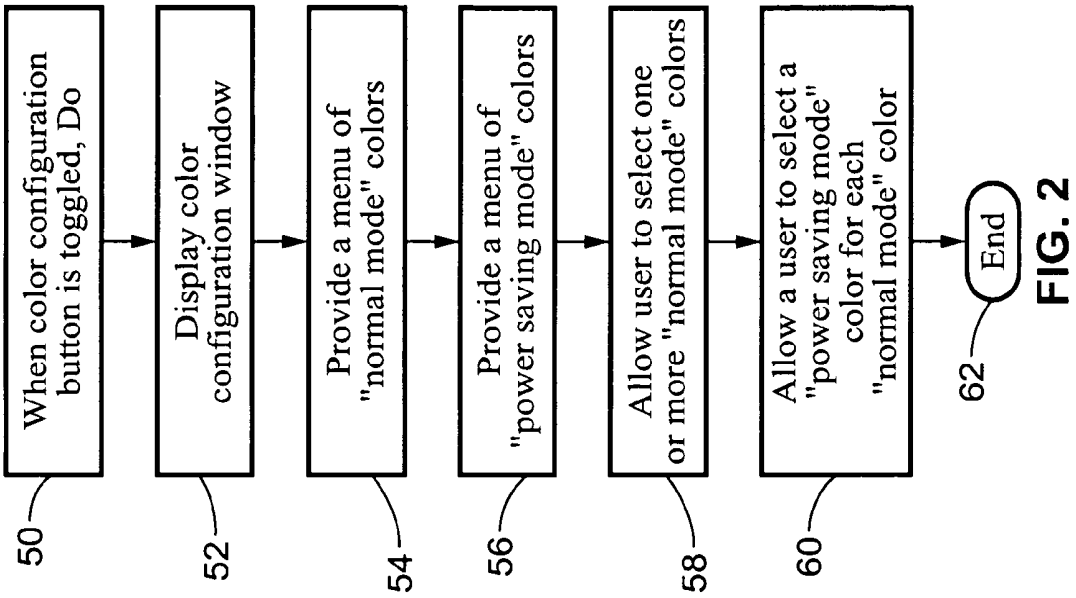

When color configuration button is toggled, Do
Display color configuration window
Provide a menu of "normal mode" colors
Provide a menu of "power saving mode" colors
Allow user to select one or more "normal mode" colors
Allow a user to select a "power saving mode" color for each "normal mode" color
End
50
52
54
56
58
60
62

FIG. 2

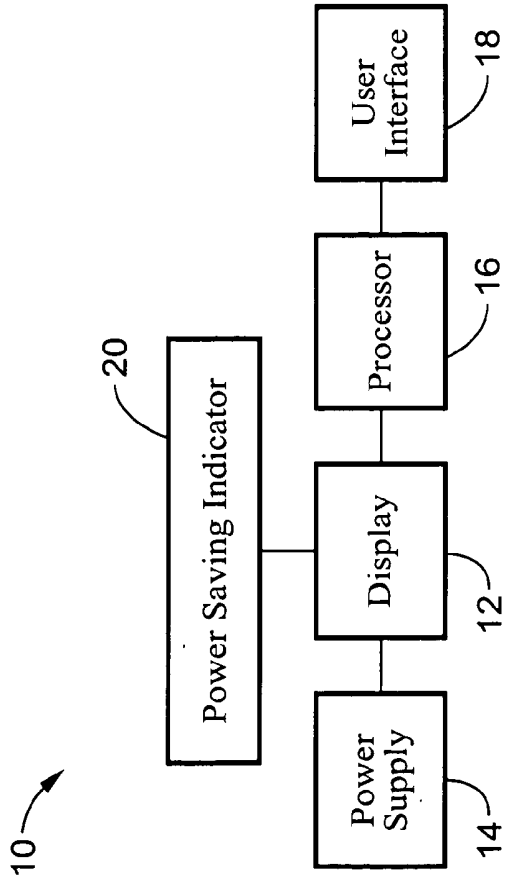

10
Power Supply
14
Display
12
Power Saving Indicator
20
Processor
16
User Interface
18

FIG. 1

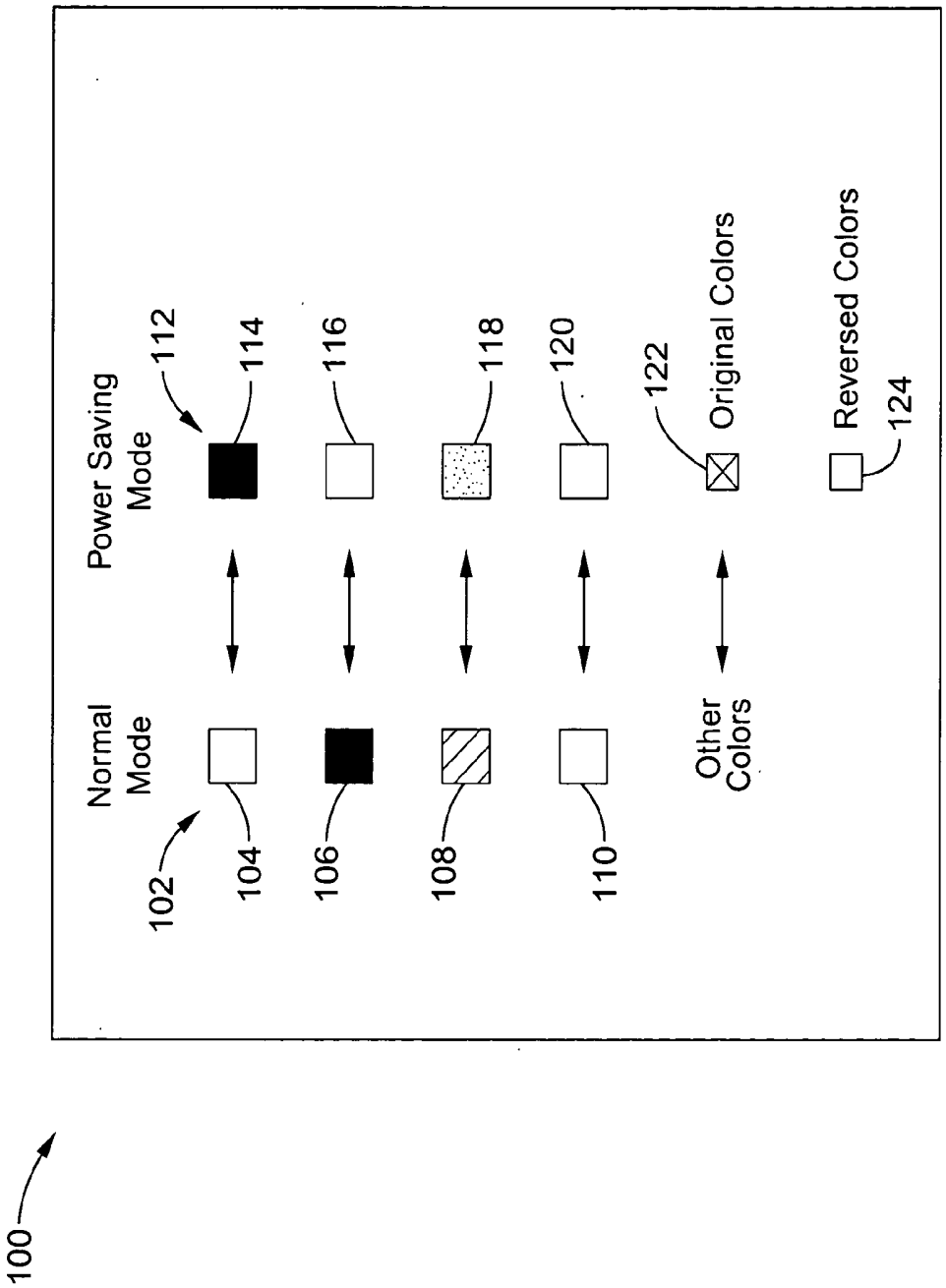

Power Saving Mode
Normal Mode
Original Colors
Other Colors
Reversed Colors
100
102
104
106
108
110
112
114
116
118
120
122
124

FIG. 3

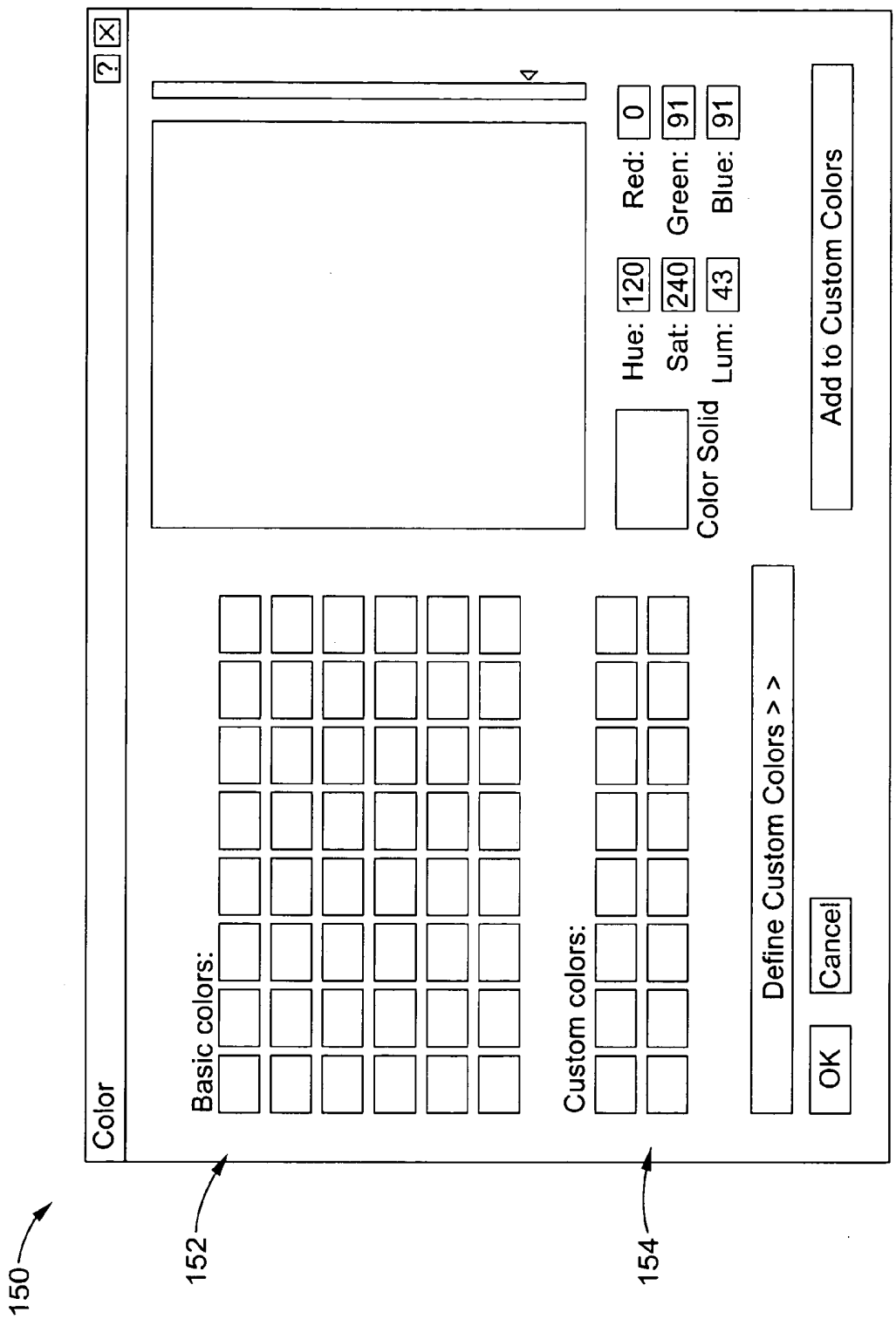

Color
Basic colors:
Custom colors:
Define Custom Colors > >
OK
Cancel
Add to Custom Colors
Hue: 120
Sat: 240
Lum: 43
Red: 0
Green: 91
Blue: 91
Color Solid
150
152
154

FIG. 4

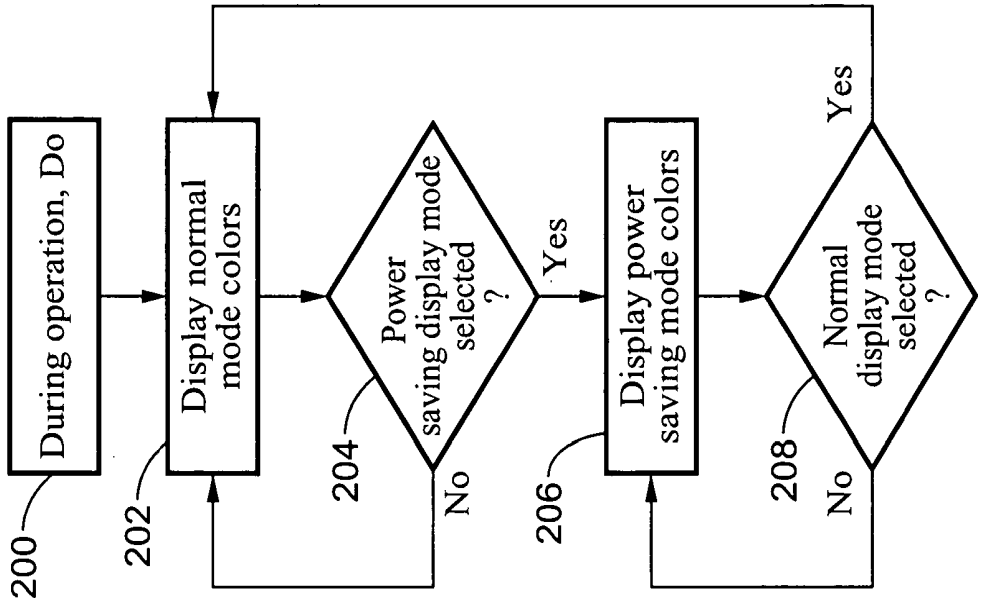

During operation, Do
Display normal mode colors
Power saving display mode selected ?
Yes
No
Display power saving mode colors
Normal display mode selected ?
Yes
No
200
202
204
206
208

FIG. 5

POWER SAVING DISPLAY MODE FOR ORGANIC ELECTROLUMINESCENT DISPLAYS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] Not Applicable

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable

INCORPORATION-BY-REFERENCE OF MATERIAL SUBMITTED ON A COMPACT DISC

[0003] Not Applicable

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BACKGROUND OF THE INVENTION

[0005] 1. Field of the Invention

[0006] This invention pertains generally to organic electroluminescent displays, and more particularly to methods for conserving power consumed by organic electroluminescent displays.

[0007] 2. Description of Related Art

[0008] Liquid crystal displays (LCDS) are widely used for portable computers and other products. One major disadvantage of an LCD is that an LCD emits no light; only the transparency of an LCD changes by adding or not adding a voltage. To obtain a high contrast, an LCD requires a backlight. Unfortunately, a backlight lamp consumes much power, e.g., more than one-half of the total power that a laptop personal computer (PC) consumes. The power consumption of the LCDs is an important matter for battery operated portable products.

[0009] Current state-of-the art displays include organic electroluminescent (OEL) displays. OEL displays are slowly being introduced into the electronics market. Unlike LCDs, each pixel on an OEL display emits light. Therefore, a backlight is not required. Further, OEL displays can be slimmer than LCDs. It is likely that in many applications LCDs will be replaced with OEL displays in the near future.

[0010] As stated above, OEL displays emit light. It happens that darker colors consume less power than brighter colors. As such, darker colors are preferable for power saving. However, white, or other brighter colors, are commonly used as background colors for windows in a PC, and these colors increase the power consumption of OEL displays. Accordingly, if brighter colors occupy most areas of the display screen, a color reverse might be good in order conserve power consumption. Microsoft Windows OS, for example, has such a color reverse feature. A user can change the display mode in a display appearance window. Unfortunately, this feature can only be applied to Windows graphic objects; that is, window background, frames, menus, etc. Many web pages use white as a background color, but this background color remains the same regardless of user Windows settings. Therefore, the Windows color reverse feature is not beneficial for power conservation. In order to maximize power conservation, all brighter colors on the display screen should be changed to darker ones.

[0011] The present invention recognizes the present drawbacks and provides a solution to one or more of the problems associated therewith.

BRIEF SUMMARY OF THE INVENTION

[0012] An aspect of the invention is to provide a self-emitting display such as an organic electroluminescent display that includes a plurality of normal mode colors and a plurality of power saving mode colors. Each power saving mode color is assigned to a normal mode color. During a power saving display mode, each normal mode color having an assigned power saving mode color is switched to the assigned power saving mode color.

[0013] In a preferred embodiment, each normal mode color not having an assigned power saving mode color is reversed during a power saving display mode. Moreover, a user can assign each power saving mode color to a normal mode color. Preferably, the display includes a power saving indicator that shows the reduction in energy consumed by the display when it is in the power saving display mode. The power saving display mode can be entered manually or automatically. In a preferred embodiment, the display is an organic electroluminescent display.

[0014] Another aspect of the invention is a method for conserving power in an organic electroluminescent display. The method includes providing a plurality of normal mode colors and providing a plurality of power saving mode colors. Each power saving mode color is assigned to a normal mode color. In a power saving display mode, each normal mode color having an assigned power saving mode color is switched to the assigned power saving mode color.

[0015] A still further aspect of the invention is an organic electroluminescent display having a plurality of plural normal mode colors and a plurality of power saving mode colors. In this aspect of the present invention, the display is switchable between a normal display mode, in which the normal mode colors are displayed, and a power saving display mode, in which the power saving mode colors are displayed.

[0016] Further aspects of the invention will be brought out in the following portions of the specification, wherein the detailed description is for the purpose of fully disclosing preferred embodiments of the invention without placing limitations thereon.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0017] The invention will be more fully understood by reference to the following drawings which are for illustrative purposes only:

[0018] **FIG. 1** is a block diagram of an organic electroluminescent display system.

[0019] **FIG. 2** is a flow chart of the configuration logic according to the present invention.

[0020] **FIG. 3** is a view of a color configuration window according to the present invention.

[0021] **FIG. 4** is a color selection window according to the present invention.

[0022] **FIG. 5** is a flow chart of the operating logic according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0023] Referring more specifically to the drawings, for illustrative purposes the present invention is embodied in the apparatus generally shown in **FIG. 1** through **FIG. 5**. It will be appreciated that the apparatus may vary as to configuration and as to details of the parts, and that the method may vary as to the specific steps and sequence, without departing from the basic concepts as disclosed herein.

[0024] Referring initially to **FIG. 1**, an organic electroluminescent display system is shown and is generally designated **10**. As shown, the system **10** includes a display **12**, such as an organic electroluminescent (OEL) display, to which a power supply **14** is connected. It can be appreciated that the power supply **14** can be an alternating current (AC) power supply or a direct current (DC) power supply. Moreover, a processor **16** is connected to the display **12**. The processor **16** includes a program, described below, that can be used to conserve the power consumed by the display **12** during operation. **FIG. 1** further shows a user interface **18** that is connected to the processor **16**. The user interface **18** can be, for example, a keyboard, a mouse, an electric pen, etc. In lieu of a user interface **18**, the display **12** can include touch screen functionality that can act as a user interface. **FIG. 1** further shows that the system **10** further includes a power saving indicator **20** that can appear on the display **12** in order to show the reduction in energy consumption of the display **12** when it is in the power saving display mode, described in detail below.

[0025] It is to be understood that the processor **16** includes a program that provides a power saving display mode for the display **12**. The program, described below, increases the energy efficiency of the display **12** while maintaining the clarity of the display. In other words, the easiest way to convert bright colors to dark colors is to automatically reverse the colors. However, this results in a bizarre display scheme, i.e., it looks like a photo negative, that is difficult to see. Additionally, the background color can be user selected and it may be darker in normal mode. Thus, when reversed, the background color is going to be brighter. The program according to the present invention allows a user to freely assign a power saving display mode color to each normal mode color and when the power saving display mode is executed each normal mode color is changed to its corresponding power saving display mode color.

[0026] Referring now to **FIG. 2**, configuration logic according to the present invention is shown and commences at block **50** with a do loop, wherein when a button, e.g., a color configuration button, is toggled, the following steps are performed. At block **52**, a color configuration window is displayed. Thereafter, at block **54**, a menu of normal mode colors is provided, e.g., within the color configuration window. Moving to block **56**, a menu of power saving mode colors is also provided, e.g., within the color configuration window. Proceeding to block **58**, a user is allowed to select one or more normal mode colors for each element displayed on the display **12** (**FIG. 1**). At block **60**, a user is allowed to select a power saving mode color for each normal mode color. The logic then ends at state **62**.

[0027] **FIG. 3** shows a non-limiting, exemplary embodiment of a color configuration window, generally designated **100**. As shown, the color configuration window **100** includes a normal mode column **102** that includes a first color indication square **104**, a second color indication square **106**, a third color indication square **108**, and a fourth color indication square **110**. The color configuration window **112** also includes a power saving mode column **112** that includes a first color indication square **114**, a second color indication square **116**, a third color indication square **118**, and a fourth color indication square **120**.

[0028] It is to be understood that in a non-limiting, exemplary embodiment, user can select a normal mode color for a particular element displayed on the display **12** (**FIG. 1**) by using the user interface **18**, e.g., a mouse, to move a cursor to a particular color area or color element on the display **12**. Then, the user can drag-and-drop that particular color area or color element into a color indication square **104**, **106**, **108**, **110** in the normal mode column **102**, e.g., the first color indication square **104**. After that, the user can toggle or otherwise click on the corresponding first color indication square **114** in the power saving mode column **112** to open a color selection window, e.g., the color selection window shown described below in conjunction with **FIG. 4**. Using the color selection window, the user can select a power saving mode color for the corresponding normal mode color shown in the first color indication square **104**. Similarly, the user can drag-and-drop other colors into the second and third color indication squares **106**, **108** in the normal mode column **102** and choose corresponding power saving mode colors for each normal mode color via the color selection window.

[0029] It can be appreciated that more than four color indication squares **104**, **106**, **108**, **110** can be included in the normal mode column **102** and as such, the power saving mode column **112** can include more than four color indication squares **114**, **116**, **118**, **120**. Moreover, it can be appreciated that the color configuration window **100** can include names of particular graphic objects, e.g., desktop, scrollbar, background, etc., adjacent to corresponding color indication squares **104**, **106**, **108**, **110** in the normal mode column **102**. In such an embodiment, a user does not have to drag-and-drop each object color—he or she can simply select a normal mode color and a power saving mode color for each graphic object listed in the color configuration window **100**.

[0030] Further, it is to be understood that the fourth color indication square **110** in the normal mode column **102** and the corresponding fourth color indication square **120** in the power saving mode column **112** can be a "catch-all" configuration setting for all other remaining colors not given a corresponding power saving mode color. For example, by selecting an original colors square **122** all other normal

mode colors not assigned a power saving mode color can remain their original color during the power saving mode. On the other hand, if a reversed colors square **124** is selected, the other colors not assigned a power saving mode color can be reversed during the power saving mode.

[**0031**] **FIG. 4** shows a color selection window, generally designated **150**. As shown in **FIG. 4**, the color selection window **150** includes a basic colors menu **152** and a custom colors menu **154** from which a user can select power saving mode colors as described above.

[**0032**] Referring to **FIG. 5**, a non-limiting, exemplary embodiment of the operating logic according to the present invention is shown and commences at block **200** with a do loop, wherein during operation, the succeeding steps are performed. At block **202**, the normal mode colors are displayed at the display **12** (**FIG. 1**). Next, at decision diamond **204**, it is determined whether a power saving display mode is selected. The power saving display mode can be selected manually by a user. Alternatively, the power saving display mode can be selected automatically, e.g., when the power supply **14** (**FIG. 1**) is switched from AC to DC or if the power level within the power supply **14** (**FIG. 1**) has fallen below a minimum power threshold.

[**0033**] If the power saving mode is selected, the logic returns to block **202** and the normal mode colors continue to be-displayed by the display **12**. Otherwise, if the power saving mode is selected the logic proceeds to block **206** and the power saving mode colors previously selected by a user are displayed. Additionally, the normal mode colors that are not assigned power saving mode colors, are simply reversed or remain their original colors. Thereafter, moving to decision diamond **208**, it is determined whether a normal display mode has been selected, e.g., threshold or manually. If so, the logic returns to block **202** and the normal mode colors are again displayed. The logic then continues as described above. If the normal display mode is not selected, the logic returns to block **206** and the power saving mode colors continues to be displayed.

[**0034**] It is to be understood that a graphic memory within the processor usually stores three (Red, Green, Blue) 8-bit data per pixel. The screen on the display **12** is drawn based on the graphics data within the graphic memory. With the system and method described above, a user can select a power saving mode color for one or more normal mode colors. During operation, when a power saving mode is entered, the normal mode colors are switched to their corresponding power saving mode colors. Specifically, each of the pixel data is replaced with a new value based on the color conversion information that a user inputs in the color configuration window **100** (**FIG. 3**).

[**0035**] Thereafter, when the normal mode is entered, the power saving mode colors revert back to the normal mode colors. Accordingly, a user can effectively choose which normal mode colors are to be switched during power saving mode in order to effectively conserve power while maintaining screen clarity on the display **12** (**FIG. 1**). It can be appreciated that the power saving display mode can be used in conjunction with displays other than OEL displays. Moreover, the display **12** (**FIG. 1**) can be used in conjunction with a computer, a cellular telephone, a personal data assistant (PDA), or any other energy-sensitive device that includes a display.

[**0036**] Although the description above contains many details, these should not be construed as limiting the scope of the invention but as merely providing illustrations of some of the presently preferred embodiments of this invention. Therefore, it will be appreciated that the scope of the present invention fully encompasses other embodiments which may become obvious to those skilled in the art, and that the scope of the present invention is accordingly to be limited by nothing other than the appended claims, in which reference to an element in the singular is not intended to mean "one and only one" unless explicitly so stated, but rather "one or more." All structural, chemical, and functional equivalents to the elements of the above-described preferred embodiment that are known to those of ordinary skill in the art are expressly incorporated herein by reference and are intended to be encompassed by the present claims. Moreover, it is not necessary for a device or method to address each and every problem sought to be solved by the present invention, for it to be encompassed by the present claims. Furthermore, no element, component, or method step in the present disclosure is intended to be dedicated to the public regardless of whether the element, component, or method step is explicitly recited in the claims. No claim element herein is to be construed under the provisions of 35 U.S.C. 112, sixth paragraph, unless the element is expressly recited using the phrase "means for."

What is claimed is:

1. In an electroluminescent display, the improvement comprising:

providing a plurality of normal mode colors; and

providing a plurality of power saving mode colors;

wherein each power saving mode color is assigned to a normal mode color;

wherein during a power saving display mode, each normal mode color having an assigned power saving mode color is switched to the assigned power saving mode color.

2. An improved electroluminescent display as recited in claim 1, wherein each normal mode color not having an assigned power saving mode color is reversed during a power saving display mode.

3. An improved electroluminescent display as recited in claim 2, wherein a user can assign each power saving mode color to a normal mode color.

4. An improved electroluminescent display as recited in claim 3, further comprising:

a power saving indicator, the power saving indicator showing the reduction in energy consumed by the display when in the power saving display mode.

5. An improved electroluminescent display as recited in claim 1, wherein the power saving display mode is entered manually.

6. An improved electroluminescent display as recited in claim 1, wherein the power saving display mode is entered automatically.

7. An improved electroluminescent display as recited in claim 1, wherein the display comprises an organic electroluminescent display.

8. A method for conserving power in an electroluminescent display, comprising:

providing a plurality of normal mode colors;

providing a plurality of power saving mode colors, each power saving mode color being assigned to a normal mode color; and

in a power saving display mode, switching each normal mode color having an assigned power saving mode color to the assigned power saving mode color.

9. A method as recited in claim 8, further comprising:

allowing a user to assign each power saving mode color to a normal mode color.

10. A method as recited in claim 9, further comprising:

reversing each normal mode color not having an assigned power saving mode color in the power saving display mode.

11. A method as recited in claim 10, further comprising:

indicating the reduction in energy consumed by the display when switched to the power saving display mode.

12. A method as recited in claim 8, wherein the power saving display mode is entered manually.

13. A method as recited in claim 8, wherein the power saving display mode is entered automatically.

14. In an electroluminescent display, the improvement comprising:

providing a plurality of normal mode colors; and

providing a plurality of power saving mode colors;

wherein the display is switchable between a normal display mode in which the normal mode colors are displayed and a power saving display mode in which the power saving mode colors are displayed.

15. An improved electroluminescent display as recited in claim 14, wherein each power saving mode color is assigned to a normal mode color.

16. An improved electroluminescent display as recited in claim 15, wherein a user can assign each power saving mode color to a normal mode color.

17. An improved electroluminescent display as recited in claim 16, wherein each normal mode color not having an assigned power saving mode color is reversed in the power saving display mode.

18. An improved electroluminescent display as recited in claim 17, further comprising:

a power saving indicator, the power saving indicator showing the reduction in energy consumed by the display when in the power saving display mode.

19. An improved electroluminescent display as recited in claim 14, wherein the power saving display mode is entered manually.

20. An improved electroluminescent display as recited in claim 14, wherein the power saving display mode is entered automatically.

21. An improved electroluminescent display as recited in claim 14, wherein the display comprises an organic electroluminescent display.

* * * * *

专利名称(译)	有机电致发光显示器的省电显示模式		
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[标]申请(专利权)人(译)	索尼公司 索尼电子有限公司		
申请(专利权)人(译)	索尼公司 索尼电子INC.		
当前申请(专利权)人(译)	索尼公司 索尼电子INC.		
[标]发明人	IWAMURA RYUICHI		
发明人	IWAMURA, RYUICHI		
IPC分类号	G09G3/30		
CPC分类号	G06F1/3203 G06F1/3265 G09G3/3208 Y02B60/1242 G09G2330/021 Y02B60/32 G09G5/02 Y02D10/153 Y02D50/20		
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外部链接	Espacenet USPTO		

摘要(译)

改进的有机电致发光显示器包括多种正常模式颜色和多种用户选择的省电模式颜色。显示器可在正常显示模式和省电显示模式之间切换。在正常显示模式中，显示器显示正常模式颜色。相反，在省电显示模式中，显示器显示省电模式颜色。