Title: METHOD AND APPARATUS FOR CONTROLLING THE BRIGHTNESS OF A DISPLAY UNIT

Abstract: The invention relates to the field of displays of computers and communication devices, and in particular to a method for controlling the brightness of a display unit (3). Further, the invention relates to an apparatus for controlling the brightness of a display unit (3). In order to minimize energy consumption and enhance the user-friendliness of electronic devices having a display a method is proposed wherein the visual fixation of a user (u) using the display unit (3) is measured and the brightness of the display unit (3) is set depending on the measured visual fixation of the user (u).

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— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(U))

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Method and apparatus for controlling the brightness of a display unit

FIELD OF THE INVENTION

The invention relates to the field of displays of computers and communication devices, and in particular to a method for controlling the brightness of a display unit. Further, the invention relates to an apparatus for controlling the brightness of a display unit.

BACKGROUND OF THE INVENTION

Battery-operated electronic devices, such as mobile computers (laptops) and mobile telephones or PDAs, rely on high-resolution displays with limited size and capable of displaying a large amount of text and/or image information. Although modern liquid crystal displays (LCD) integrated in mobile electronic devices use relatively small amounts of electric power the reduction of energy consumption of a mobile device associated with its display is one of the key issues in the development of innovative devices.

The aforementioned problem basically also applies for mains-operated devices such as computer monitors and displays of other stationary electronic devices such as TV screens or video projectors as these devices tend to become more brilliant and colorful which goes along with an increasing demand of energy. Since the finiteness of fossil fuels is a key matter of a public discussion there is also a demand for intelligent solutions for reducing the energy requirement of those devices.

Several methods for reducing the overall power consumption of a display in a mobile electronic device are known in the art. A straight-forward method for reducing the power requirement of a display is to simply deactivate the display when no user interaction has taken place within a fixed period of time. In case of a personal computer the user interaction may be any keyboard or mouse activity. In many cases this is no problem since many applications, e.g. text processing or spread sheet programs, have extended user interaction via mouse and/or keyboard. In special applications a lack of user interaction may be the normal case, e.g. when a video player is active. Correspondingly, advanced methods already known in the art additionally provide that the deactivation mechanism be disabled when a video-player application is active.
The methods described above only provide an application dependant display deactivation mechanism which means that in case of an application, e.g. word processing, that normally implies extensive user interaction the display will be deactivated although the user may desire to look at the screen content for a longer period, e.g. to interpret the displayed content. In order to prevent the display from being deactivated the user thus has to hit a key or move the mouse at frequent intervals which is largely inconvenient.

SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide a method for controlling the brightness of a display unit that greatly enhances the convenience in using display based electronic devices. It is another object of the invention to reduce the power consumption of such devices. It is yet another object to provide an apparatus for controlling the brightness of a display unit that has a simple design and ensures a user-friendly operation.

These and other objects are solved by a method for controlling the brightness of a display unit, wherein the visual fixation of a user using the display unit is measured and the brightness of the display unit is set depending on the measured visual fixation of the user.

The method according to invention may be carried out on standard electronic devices having a display. These devices only have to be marginally modified for this purpose as they have to be equipped with a means for measuring the user's visual fixation. The main advantage of the method according to the invention is that the brightness of the display is set to a convenient level in a pro-active manner. Since the user's visual fixation is continuously measured or measured in regular intervals the device on which the method is carried out has permanent information about the user's current attention. When the user's attention is drawn off the display and the eye-contact is thus lost the device may reduce the display brightness to a level where power consumption is at a minimum. When the user's visual fixation is redirected to the display which means that the user concentrates his attention to the display content again the display brightness is immediately set to a convenient level without any other user input necessary. In other words: a device on which the method according to the invention is carried out acts pro-active. This largely enhances the user-friendliness of electronic devices and thus reduces energy consumption. As the display brightness in the method according to the invention exclusively depends on the visual fixation or the visual gaze of the user a state of relative high power consumption may be maintained only as long as the user actually gathers information from the display. This allows for an extremely power efficient operation.
According to a first advantageous embodiment of the invention the user's visual fixation is determined by a sensor unit configured to measure the user's eye focus. Sensors for measuring the user's eye focus are commercially available and operate at a high degree of reliability by now. Such sensors have been in use for weapon control, operator training, usability analysis, market research and as an enablement for disabled people.

They are already described in connection with variable applications in patent literature. For example, US 2003/0038754 A1 discloses an eye tracking sensor which is used to detect when a reader's focus shifts outside a text window, indicating that the reader has become inattentive to the displayed text. Thereupon the presentation of text is halted and resumed once the sensor detects that the reader's focus is redirected to the text display.

An eyetracker that determines the direction of gaze over a two dimensional visual field for manipulating scroll bars to change the view displayed to the user is described in EP 0 816 980 A2. The eyetracker is integrated with a computer in such a way that when the eye approaches certain points within the display window scrolling is automatically activated so that the portion of text or graphical material viewed follows the interest of the user, generally with no other action required by the user.

In EP 0 816 985 A2 a gaze-tracking device comprising an infrared LED is described. The gaze-tracking device is mounted below a computer monitor and is connected to a computer thus allowing the computer to remember where a computer user last looked in a document presented on a display device and to restore that document to that position and indicate that position when the user again looks at the document. The gaze-tracker thus helps the user of the display to more quickly recover from a distraction that caused the user to look away from the display.

In the method according to the invention the brightness of the display unit is preferably reduced when the measured visual fixation indicates that the user no longer looks at the display. This ensures a power efficient operation of the display unit without constraining its functionality. The display brightness may then be resumed when the measured visual fixation indicates that the user looks at the display again.

The brightness reduction may be performed immediately after a change of the user's visual fixation that indicates that the user no longer looks at the display is measured. This ensures a maximum degree of energy efficiency. Preferably, the brightness reduction is, however, performed after a delay time. This means that when the user looks away from the display unit for only a very short period of time the brightness level is maintained to ensure
maximum convenience and prevent the display unit from constantly changing the level of
brightness in short intervals which may damage the display unit in the long run.

When the brightness of the display unit is reduced when the measured visual
fixation indicates that the user no longer looks at the display the brightness reduction may be
performed sharply from full brightness to black screen; it may, however, also be gradually
dimmed.

According to the invention the brightness of the display unit is set depending
on the measured visual fixation of the user. According to another advantageous embodiment
the display brightness may be also resumed when an event occurs that requires using the
display. This event may be an incoming email message. Preferably, the user indicates in a
user profile that is stored in the device for which type of events he wants to activate the
display unit.

A second aspect of the invention relates to an apparatus for controlling the
brightness of a display. The apparatus comprises a display unit, a sensor unit configured to
measure the visual fixation of a user using the display unit; and a controlling device
configured to set the brightness of the display unit, wherein the controlling device is
configured to receive signals from the sensor unit and to set the brightness of the display unit
depending on the measured visual fixation of the user. The apparatus according to the
invention has a simple design and makes use of standard components and thus may be
produced in a cost-effective manner. The advantages and benefits mentioned in connection
with the method according to the invention also apply for the apparatus.

A third aspect of the invention relates to a computer program product
comprising a computer readable storage medium having a computer readable code stored
thereon for causing a computer according to claim 12 or 13 or a mobile communication
device according to claim 14 to carry out a method for controlling the brightness of a display
unit according to claim 1.

These and other aspects of the present patent application become apparent
from and will be elucidated with reference to the following Figures. The features of the
present application and of its exemplary embodiments as presented above are understood to
be disclosed also in all possible combinations with each other.

**BRIEF DESCRIPTION OF THE DRAWINGS**

In the Figures show:
Figs. 1a, b a computer comprising an apparatus for controlling the brightness of a display and a user interacting with the computer; and

Fig. 2 a diagram showing the display brightness as a function of the signal of a sensor measuring the user's eye focuses.

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DETAILED DESCRIPTION OF THE DRAWINGS

In the following detailed description of the present invention an exemplary embodiment of the present invention will describe and point out the architecture of the apparatus according to the invention.

Figs. 1a, b each show a computer 1 comprising a processor device 2 and an apparatus for controlling the brightness of a display. Further, Figs. 1a, b show a user U interacting with the computer 1. According to the invention the apparatus comprises a display unit 3, a sensor unit 4 configured to measure the visual fixation of the user U using the display unit 3 and a controlling device 5 configured to set the brightness of the display unit 3. The controlling device 5 is integrated in the processor unit 2 of the computer 1. The computer 1 may comprise further devices for interaction with the user U such as a keyboard or a mouse (not shown).

Computer 1 shown in Figs. 1a and b is a stationary computer. However, it is particularly advantageous to install the apparatus according to the invention in a battery-operated mobile computing device, such as a laptop. Furthermore, the apparatus may be integrated into a mobile communication device such as a mobile telephone or a PDA.

The apparatus is configured to carry out a method for controlling the brightness of a display according to the invention. It thus measures the visual fixation of the user U using the display unit 3 and sets the brightness of the display unit 3 depending on the measured visual fixation of the user U. Presently, the sensor unit 4 is configured to measure the user's eye focus at regular intervals. In Fig. 1a the eyes of user U are focused on the screen content as indicated by arrow V. The User U may study some information on the screen, or may look at a video or slide-show without providing input via mouse movement or use of the keyboard in order to maintain the display brightness on a convenient level. Once the sensor unit 4 measures that the user's eye focus has moved away from the display unit 3 (Fig. 1b, arrow V*) the controlling device 5 reduces the display brightness to a level where power consumption is at a minimum. Preferably, brightness reduction is performed after a certain delay time since a constant change of the level of brightness in short intervals due to a rapid movement of the user's eye focus may damage the display unit 3 in the long run.
In Fig. 2 a diagram showing the display brightness as a function of the signal of a sensor measuring the user's eye focus is shown. Both the sensor signal and the display intensity are plotted against time \( t \) on the x-axis. The sensor unit 4 observes the user's eye focus. When the eye focus is directed to the display (Fig. 1a) the sensor unit 3 outputs signal "b" to the controlling device 5. When the user's eye focus is directed away from the display (Fig. 1b) sensor unit 3 outputs signal "a".

As can be seen in the sensor signal plot the user starts to look at the display at \( T = T_0 \). In the period \( T_0 \rightarrow T_i \) the user primarily looks at the display. However, during short intervals with \( t_i < t_i \) the user is not watching the display. This is detected by the sensor unit 3 and leads to a corresponding signal response. The display brightness is however not changed during the intervals \( t_i \) as they do not exceed the preset delay time \( t_i \). At \( T_i \) the user no longer looks at the display for a period \( > t_i \) (preset delay time). Consequently, the controlling device 5 of the apparatus according to the invention reduces the display brightness in order to save energy. Presently, the display brightness is not reduced sharply but is gradually dimmed during the preset dimming period \( t_2 \). During period \( t_3 \) the display brightness is reduced to zero in order to minimize energy consumption. After time lapse of period \( t_3 \), the user again looks at the display. This is detected by sensor unit 3 which again outputs signal "b" to the controlling device 5. The controlling device then sets the display brightness to the previous level at which the user can study the display content in a convenient manner. Instead of the user's eye focus the display brightness may be reset to the previous level by an event, such as an incoming email message.

Summarizing the method and apparatus for controlling the brightness of a display according to the invention has the advantage that the change of display brightness based on the user's visual fixation, in particular the change from a power save mode to an activated mode, is more direct than in conventional systems where display activation/deactivation depends on input actions such as mouse movement or use of the keyboard. As a result energy can be saved without sacrificing functionality or performance of the device.
CLAIMS:

1. A method for controlling the brightness of a display unit, wherein the visual fixation of a user using the display unit is measured and the brightness of the display unit is set depending on the measured visual fixation of the user.

2. The method according to claim 1, wherein the user's visual fixation is determined by a sensor unit configured to measure the user's eye focus.

3. The method of claim 1, wherein the brightness of the display unit is reduced when the measured visual fixation indicates that the user no longer looks at the display.

4. The method according to claim 1, wherein the display brightness is resumed when the measured visual fixation indicates that the user looks at the display again.

5. The method according to claim 3, wherein the brightness reduction is performed after a delay time.

6. The method according to claim 3, wherein the brightness of the display unit is gradually dimmed.

7. The method according to claim 1, wherein the display brightness is resumed when an event occurs that requires using the display.

8. Apparatus for controlling the brightness of a display comprising,

   - a display unit,

   - a sensor unit configured to measure the visual fixation of a user using the display unit; and

   - a controlling device configured to set the brightness of the display unit

   wherein the controlling device is configured to receive signals from the sensor.
unit and to set the brightness of the display unit depending on the measured visual fixation of the user.

9. The apparatus according to claim 8, wherein the sensor unit is further configured to measure the user's eye focus.

10. The apparatus according to claim 8, wherein the apparatus is further configured to reduce the brightness of the display unit when the measured visual fixation indicates that the user no longer looks at the display.

11. The apparatus according to claim 8, wherein the apparatus is further configured to resume the display brightness when the measured visual fixation indicates that the user looks at the display again.

12. A computer comprising an apparatus according to any one of claims 8 to 11.

13. The computer according to claim 11, wherein the computer is a laptop.

14. A mobile communication device comprising an apparatus according to any one of claims 8 to 11.

15. A computer program product comprising:
   - a computer readable storage medium having a computer readable code stored thereon for causing a computer according to claim 12 or 13 or a mobile communication device according to claim 14 to carry out a method for controlling the brightness of a display unit according to claim 1.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

**INV.** G09G3/34 G06F3/01

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

**B. FIELD(S) SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

G09G G06F

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**

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim</th>
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<td>X</td>
<td>US 6 665 805 B1 (TSIRKEL AARON M [US] ET AL) 16 December 2003 (2003-12-16) column 1, line 63 - column 3, line 40; figures 1-3</td>
<td>1,3-5,7, 8,10-15</td>
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**D**

Further documents are listed in the continuation of Box C

1. 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
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<tr>
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