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(54) **System and method for reducing the cost of electricity consumption in a display device**

(57) A method and system for reducing the cost of electricity consumption in a display device by controlling the illuminance of at least one light source of said display device with respect to the electricity consumption rate information for different time periods is described. The said system comprises; a power consumption status detector for generating the usage status information for the usage time of the display device by detecting the power consumption information for the usage time of said display device; an illuminance controller for controlling the illuminance of at least one light source of said display device with respect to the usage status information, **characterized in that**; said power consumption information contains electricity consumption rate information for different time periods. The said method comprises the steps of; detecting the usage time of the display device; detecting the power consumption information for the usage time of said display device; generating the usage status information with respect to said power consumption information; controlling the illuminance of at least one light source of said display device with respect to said usage status information, **characterized in that**; said power consumption information contains electricity consumption rate information for different time periods.

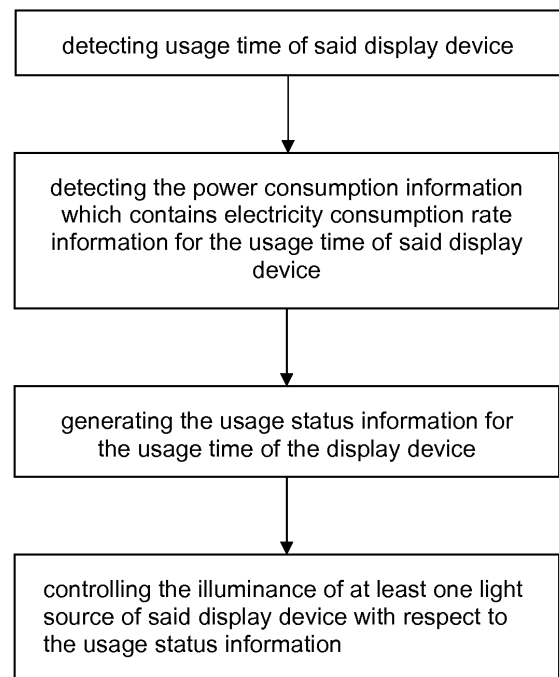


Figure - 4

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## Description

### Technical Field

[0001] This invention is related to a method and system for reducing the cost of electricity consumption in a display device by controlling the illuminance of at least one light source of said display device with respect to the electricity consumption rate information as described in the independent claims of the patent.

### Prior Art

[0002] One of the most important problems in display devices is having a good quality in the displayed picture with less power consumption. That is the main criteria of a common user which should be fulfilled for reducing the cost, caused because of power consumption, without being disturbed by unsatisfactory image quality. It is well known that, the better picture quality in display devices means the more power consumed, so, users believe that not disturbing quality loss in picture quality is tolerable.

[0003] In addition, the most power consuming process in a display device is the display panel or display screen as compared with other processes like video processing, tuning, remote controlling, etc. because of high power consumption of light sources.

[0004] Because of the reasons mentioned above, many systems and methods are used to balance the display quality and power consumption. Common approach and idea of these systems and methods are switching through display modes which have different power consumption and brightness levels.

[0005] In one of the very well known methods, user switches the display modes manually. It is obvious that, although such a method may provide a solution for reducing the cost of power consumption in a display device, it can not be used effectively by a user as it is controlled manually.

[0006] Another common approach is controlling the display mode switching operation automatically according to other criteria. These criteria vary according to the need of the user and the methods used for changing the brightness levels of the display device. Some of the criteria used in these methods are battery power condition, ambient luminance, ambient sound and time information.

[0007] The most effective method used in present systems is defined in Japanese patent application JP2007027930A2 "Content Output Unit" invented by Fukuoka HIDEYOSHI and Koshimizu OSAMU. The main idea of the method is defined as; using time information obtained by a clock or time information included in the broadcasting signal of digital broadcast received by a tuner, and controlling the display image and voice output dependent on that time information according to predetermined conditions.

[0008] It is possible to have a display system which has different display brightness in different times of the

day by using this method. For example; as it is well known that the need of display brightness increases with the ambient luminance, the system can switch to high brightness display mode during the day and low brightness display mode during the night. As the brightness of the display device is controlled by the illuminance of the light source in the display device, power consumed by the light source is reduced by means of low picture quality without disturbing the user.

10 [0009] Although this method solves the problem of automatic switching through display modes and reducing the power consumption of light sources in a display device, it can not reduce the cost of power consumption effectively as the method just works according to the time information and does not concern with electricity consumption rates. So, it is clear that the mentioned patent application can not be an effective solution for reducing the cost of electricity consumption, as the electricity consumption rates changes during usage time of the display device and the time information is not enough to control illuminance of the light sources dynamically and effectively. For that reason a system and method which can control the illuminance of the light source(s) of a display device with respect to electricity consumption rates is needed.

### Object of the Invention

30 [0010] The object of the present invention is to provide a system and method for reducing the cost of electricity consumption in a display device by controlling the illuminance of at least one light source of said display device with respect to the electricity consumption rate information as described in the independent claims.

### Brief Description of the Drawings

#### [0011]

40 Fig. 1: shows a graph of relation between illuminance of the light source in a display device and input signal  
 Fig. 2: shows a graph of relation between illuminance of the light source in a display device and input signal  
 Fig. 3A: shows an example for relation between electricity consumption rate information and time of the day  
 Fig. 3B: shows an example for relation between electricity consumption rate information and day of the week  
 Fig. 3C: shows an example for relation between electricity consumption rate information and month of the year  
 Fig. 3D: shows an example for electricity consumption rate information defined for different time periods  
 Fig. 4: shows the algorithm of a preferred method  
 Fig. 5: shows the block diagram of a preferred system

### **Detailed Description of the Invention**

**[0012]** The main idea and approach of reducing power consumption in a display device is reducing the cost of power consumption of that device. For that reason, a system and method for reducing the cost of power consumption in a display device without having disturbing display quality is needed.

**[0013]** This invention relates to a method and system for reducing the cost of electricity consumption in a display device by controlling the illuminance of at least one light source of said display device with respect to the electricity consumption rate information for different time periods as described in the independent claims.

**[0014]** The main idea of the invention is controlling or limiting the illuminance of the light source(s) with respect to electricity consumption rate defined for the usage time of the device.

**[0015]** It is assumed that the systems, which are used to describe the invention, have one light source. It should be noted that the invention can also be used in the systems with plurality of light sources. The invention can control or limit the illuminance of these light sources, even independently from each other.

**[0016]** The light sources used in display systems vary with the display techniques used. Light sources can be: cold cathode fluorescent lamps (CCFL) or LEDs used as backlights for LCD type display devices; self illuminating pixels or sub-pixels on display panel for plasma type display devices; light bulbs for projection type display devices; OLEDs; and any kind of light source used for creating an image on the display.

**[0017]** The main idea of the invention can easily be understood by analyzing the graphics in Figure 1 and Figure 2.

**[0018]** Figure 1 shows a graph of the relation between the illuminance of the light source (1) of the display device and input signal level (2). In most of the display devices which do not use any method for reducing the power consumption by controlling the illuminance of the light sources, the illuminance of the light source is always kept at a fixed level, mostly at maximum illuminance level, irrespective to the input signal level, just as it is shown by the graphic line 101. Although it is possible to have a good and constant picture quality in such a system, this system has fixed power consumption all the time. As power consumption is fixed, the cost of electricity consumption is also fixed but it is not reduced.

**[0019]** The invention can fix the illuminance of the light source (1) to lower levels as it is shown in the graphic lines 103 and 105. These graphic lines 103 and 105 are defined for different usage times of the display device. It can be assumed that the illuminance of the light source should be reduced as the electricity consumption rate increases. The electricity consumption rate for the usage time of the device defined for the graphic line 103 is higher than the electricity consumption rate for the usage time of the device defined for the graphic line 105.

**[0020]** The invention can also change the relation between the illuminance of the light source (1) of the display device and input signal level (2) as it is shown in graphic lines 102 and 104. These kinds of illuminance and input signal level relations are well known and used in some applications. Such kind of applications are known as dynamic contrast application because the illuminance of the light source increases and decreases as the input signal level increases and decreases to have a better the contrast ratio.

**[0021]** Figure 2 shows another graph of the relation between the illuminance of the light source (1) of the display device and input signal level (2). The graphic line 201 shows a dynamic relation between the illuminance of the light source (1) and input signal level (2) for a usage time when power reducing method is not active. The invention can reduce the cost of power consumption for such a system by controlling the illuminance of the light source as it is shown in graphic lines 202, 203, 204 and 205.

**[0022]** The invention can limit the maximum illuminance of the light source as shown in graphic lines 202 and 204. The invention can also change the relation between the illuminance of the light source (1) of the display device and input signal level (2) as shown in the graphic lines 203 and 205 in different usage times.

**[0023]** It is obvious that different relations for reducing the power consumption for different time periods, other than the ones shown in figure 1 and figure 2, can be defined.

**[0024]** The main criteria for reducing the cost of power consumption is the electricity consumption rate defined for different usage time periods. The electricity consumption rates are determined by governments and these rates are depended on the power generation capacity of the country, power need of citizens in different time periods, power reservation capacity, etc... So, electricity consumption rates vary for different time periods during the day as shown in Figure 3A; for different days of the week as shown in Figure 3B; and for different months of the year as shown in Figure 3C. Generally electricity consumption rates are defined to vary for all of the mentioned time periods as shown in Figure 3D. The electricity consumption rates can be the rates for unit power consumption in different time periods.

**[0025]** As electricity consumption rates are determined by electricity providers or governments, these rates are announced to public by press, broadcasting stations, internet sites, etc... In some countries these rates are uploaded to current meters to calculate the cost of electricity consumption in facilities, manually.

**[0026]** The systems which use the invention can have a memory space to memorise these rates. The electricity consumption rates can be entered manually or gathered from external sources. It is possible to update these rates or re-determine manually.

**[0027]** It is also possible to have systems using the invention without memorising electricity consumption

rates as these rates can be gathered from an external source: like auxiliary data in broadcasting stations like teletext; a dedicated broadcasting signal like MHEG5 channels; internet sites; external devices like current meters, etc...

**[0028]** A method according to the teachings of the invention in a preferred embodiment is described in Figure 4. This method comprises the steps of;

- detecting usage time of said display device,
- detecting the power consumption information which contains electricity consumption rate information for the usage time of said display device,
- generating the usage status information for the usage time of the display device,
- controlling the illuminance of at least one light source of said display device with respect to the usage status information.

**[0029]** First of all, the usage time information of the display device is detected. The usage time of the display device is generally the current time. There are many very well known ways to get the current time information, like: using an internal clock or using the time data in a broadcasting signal. The usage time can also be a scheduled time. For example; user may select a broadcasting station signal to be recorded and the usage time information of that program can be gathered from electronic program guide data.

**[0030]** Secondly, the power consumption information which is used for generating the usage status information for the usage time of the display device should be detected. By using the usage time information, the electricity consumption rate or any other but related data, which can be used instead of the electricity consumption rates for that time period, power consumption information can be detected. As the electricity consumption rates or any other but related data are contained in power consumption information, the system checks the memorized power consumption information in the memory space or gathers power consumption information from external sources.

**[0031]** After detecting power consumption information, the usage status information of the display device is generated. The usage status information can be the power consumption information as it is, or a display mode selection containing the illuminance information of the light source or any kind of information that can be used to control the illuminance of the light source.

**[0032]** Lastly, the usage status information is used for controlling the illuminance of the light source of the display device for reducing the power consumption with respect to the electrical consumption rates defined for the usage time period.

**[0033]** The usage status information can be stored in a memory space if the usage time of the display device is a scheduled time. With such a memorization system, a display device which gathers the power consumption

information from an external source can have the advantage of working without the need of external sources during controlling the light sources.

**[0034]** A block diagram of a preferred embodiment working according to the teachings of the invention is described in Figure 5. The display device defined in the preferred embodiment comprises;

- at least one light source (501),
- a memory space (502) for memorizing power consumption information,
- a power consumption status detector (503) for generating the usage status information for the usage time of the display device by detecting the power consumption information which contains electricity consumption rate information or any other but related data for the usage time of said display device,
- an illuminance controller (504) for controlling the illuminance of the light source with respect to the usage status information.

**[0035]** Preferred embodiment may also comprise;

- an internal clock,
- an interface for user input for re-determining the power consumption information
- connections for updating power consumption information gathered from external sources,
- secondary memory space for memorizing the usage status information
- a microprocessor for controlling power consumption status detector, illuminance controller, internal clock and memory spaces.

**[0036]** The invention can be used in any display device; like televisions, PC monitors, mobile phones, displays of electronic devices, etc...

**[0037]** Embodiments of the invention are not limited to the mentioned systems and methods. Many systems and methods can be developed by using the teachings of the invention.

## Claims

1. A system for reducing the cost of electricity consumption in a display device, the system comprises;

- a power consumption status detector for generating the usage status information for the usage time of the display device by detecting the power consumption information for the usage time of said display device,
- an illuminance controller for controlling the illuminance of at least one light source of said display device with respect to the usage status information,

**characterized in that;**

- said power consumption information contains electricity consumption rate information for different time periods.
- 2. A system according to claim 1 wherein; said electricity consumption rate information includes the rates for unit power consumption in different time periods.
- 3. A system according to claim 1 wherein; the system further comprises; a memory space for storing said power consumption information.
- 4. A system according to claims 1 or 3 wherein; said power consumption information can be re-determined by the user.
- 5. A system according to claims 1 or 3 wherein; said power consumption information is updated automatically.
- 6. A system according to claim 1 wherein; said power consumption information is obtained from an auxiliary data in a broadcasting signal.
- 7. A system according to claim 1 wherein; said power consumption information is obtained from an external device.
- 8. A system according to claim 1 wherein; said illuminance controller limits the maximum illuminance of at least one light source according to the usage status information.
- 9. A system according to claim 1 wherein; said illuminance controller changes the illuminance of at least one light source with respect to at least a predetermined illuminance ratio defined for said usage status information; and said illuminance ratio defines the relation between the illuminance of the light source and the video signal illuminance data.
- 10. A system according to claim 1 wherein; the system further comprises at least one backlight composed of plurality of light sources for illuminating said display screen.
- 11. A system according to claim 1 wherein; the system further comprises a display panel; and said light source is a pixel or sub-pixel on said display panel.
- 12. A system according to claim 1 wherein; said light source is a light bulb.
- 13. A system according to claim 1 wherein; said usage time is the current time.

14. A system according to claim 1 wherein; the system further comprises a second memory space for storing usage status information.

5 15. A system according to claim 14 wherein; usage time is a scheduled time and memorized in said second memory space.

10 16. A method for reducing the cost of electricity consumption in a display device, the method comprising the steps of:

- detecting the usage time of the display device,
- detecting the power consumption information for the usage time of said display device,
- generating the usage status information with respect to said power consumption information,
- controlling the illuminance of at least one light source of said display device with respect to said usage status information,

**characterized in that;**

- said power consumption information contains electricity consumption rate information for different time periods.

17. A method according to claim 16 wherein; said electricity consumption rate information includes the rates for unit power consumption in different time periods.

18. A method according to claim 16 wherein; the method further comprises the step of storing said power consumption information in a memory space.

19. A method according to claims 16 or 18 wherein; said power consumption information can be re-determined by the user.

20. A method according to claims 16 or 18 wherein; said power consumption information is updated automatically.

21. A method according to claim 16 wherein; said method further comprises the step of obtaining said power consumption information from an auxiliary data in a broadcasting signal.

22. A method according to claim 16 wherein; said method further comprises the step of obtaining said power consumption information from an external device.

23. A method according to claim 16 wherein; controlling the illuminance means limiting the maximum illuminance.

24. A method according to claim 16 wherein; controlling

the illuminance means changing the illuminance of at least one light source with respect to at least a predetermined illuminance ratio defined for said usage status information; and said illuminance ratio determines the relation between the illuminance of the light source and the video signal illuminance data. 5

25. A method according to claim 16 wherein; said light source is a backlight composed of plurality of light sources. 10

26. A method according to claim 16 wherein; said light source is a pixel or sub-pixel.

27. A method according to claim 16 wherein; said light source is a light bulb. 15

28. A method according to claim 16 wherein; said usage time is the current time. 20

29. A method according to claim 16 wherein; said method further comprises the step of storing usage status information.

30. A method according to claims 16 and 29 wherein; said usage time is a scheduled time. 25

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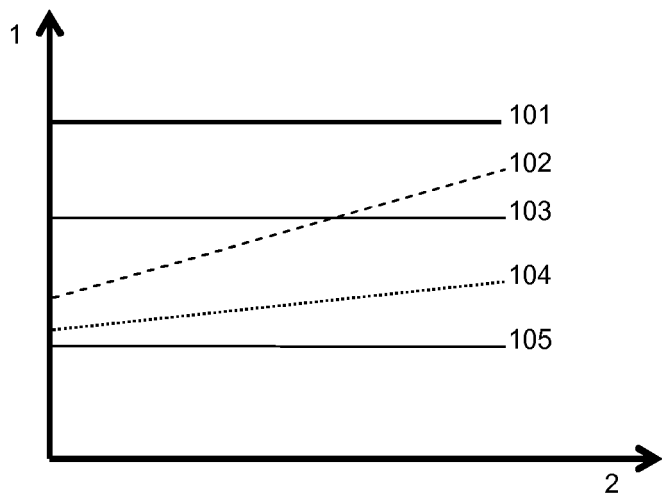


Figure -1

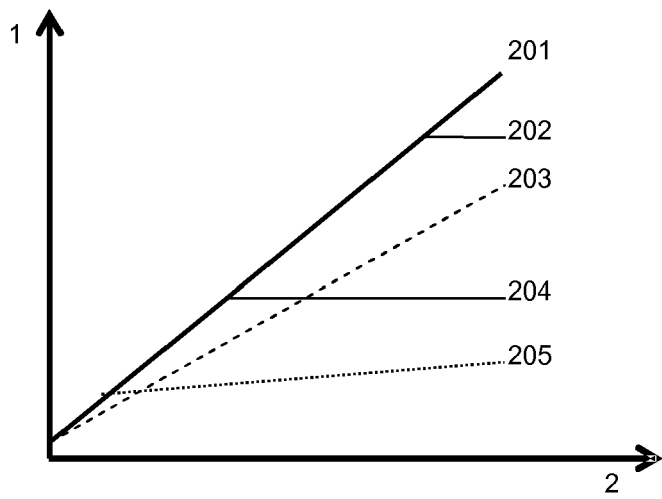


Figure - 2

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| TIME OF DAY   | RATE |
|---------------|------|
| 00:00 – 07:00 | A    |
| 07:00 – 13:00 | B    |
| 13:00 – 18.00 | C    |
| 18:00 – 00:00 | D    |

Figure - 3A

| DAY OF WEEK | RATE |
|-------------|------|
| 1 - 5       | E    |
| 6 - 7       | F    |

Figure - 3B

| MONTH | RATE |
|-------|------|
| 1 - 5 | G    |
| 6 - 7 | H    |
| 8-12  | J    |

Figure - 3C

| MONTH | DAY OF WEEK | TIME OF DAY   | RATE |
|-------|-------------|---------------|------|
| 1-6   | 1 - 5       | 00:00 – 07:00 | A    |
|       |             | 07:00 – 13:00 | B    |
|       |             | 13:00 – 18.00 | C    |
|       |             | 18:00 – 00:00 | D    |
|       | 6-7         | 00:00 – 07:00 | E    |
|       |             | 07:00 – 13:00 | F    |
|       |             | 13:00 – 18.00 | G    |
|       |             | 18:00 – 00:00 | H    |
| 7-12  | 1 - 5       | 00:00 – 07:00 | J    |
|       |             | 07:00 – 13:00 | K    |
|       |             | 13:00 – 18.00 | L    |
|       |             | 18:00 – 00:00 | M    |
|       | 6-7         | 00:00 – 07:00 | N    |
|       |             | 07:00 – 13:00 | P    |
|       |             | 13:00 – 18.00 | R    |
|       |             | 18:00 – 00:00 | S    |

Figure - 3D

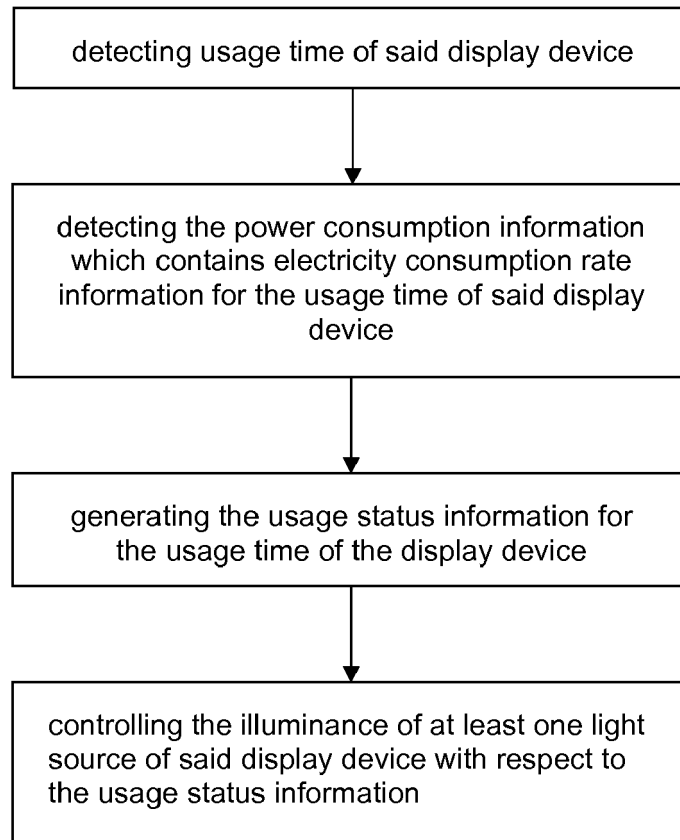


Figure - 4

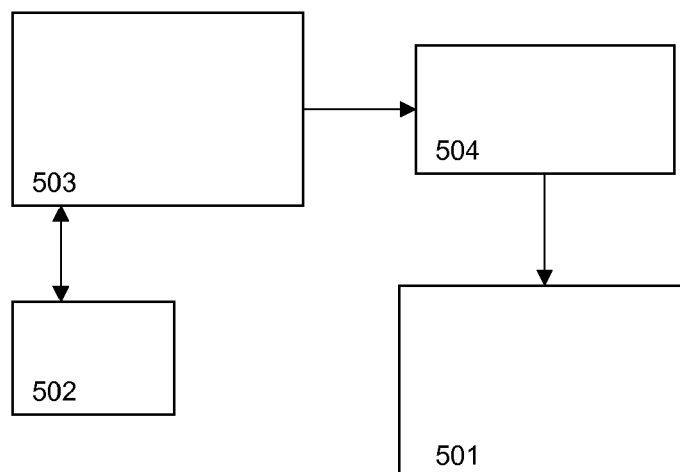


Figure - 5

**REFERENCES CITED IN THE DESCRIPTION**

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