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Choi et al.(10) **Pub. No.: US 2008/0122825 A1**(43) **Pub. Date: May 29, 2008**(54) **DISPLAY SYSTEM THAT REDUCES POWER CONSUMPTION FOR IMAGE PROCESSING APPARATUS HAVING POWER MODES**(75) Inventors: **Jin-wook Choi**, Suwon-si (KR);
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Suwon-si (KR)(21) Appl. No.: **11/867,167**(22) Filed: **Oct. 4, 2007**(30) **Foreign Application Priority Data**

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G09G 5/00 (2006.01)(52) **U.S. Cl.** **345/211**(57) **ABSTRACT**

A display system including an imaging processing apparatus which generates an image based on one power mode of a plurality of power modes and a first display apparatus which receives the image from the image processing apparatus and displays the image. The power mode may include a display power management signaling power mode defined by the Video Electronics Standards Association. Further, the imaging processing apparatus and the first display apparatus may communicate by using a universal serial bus (USB).

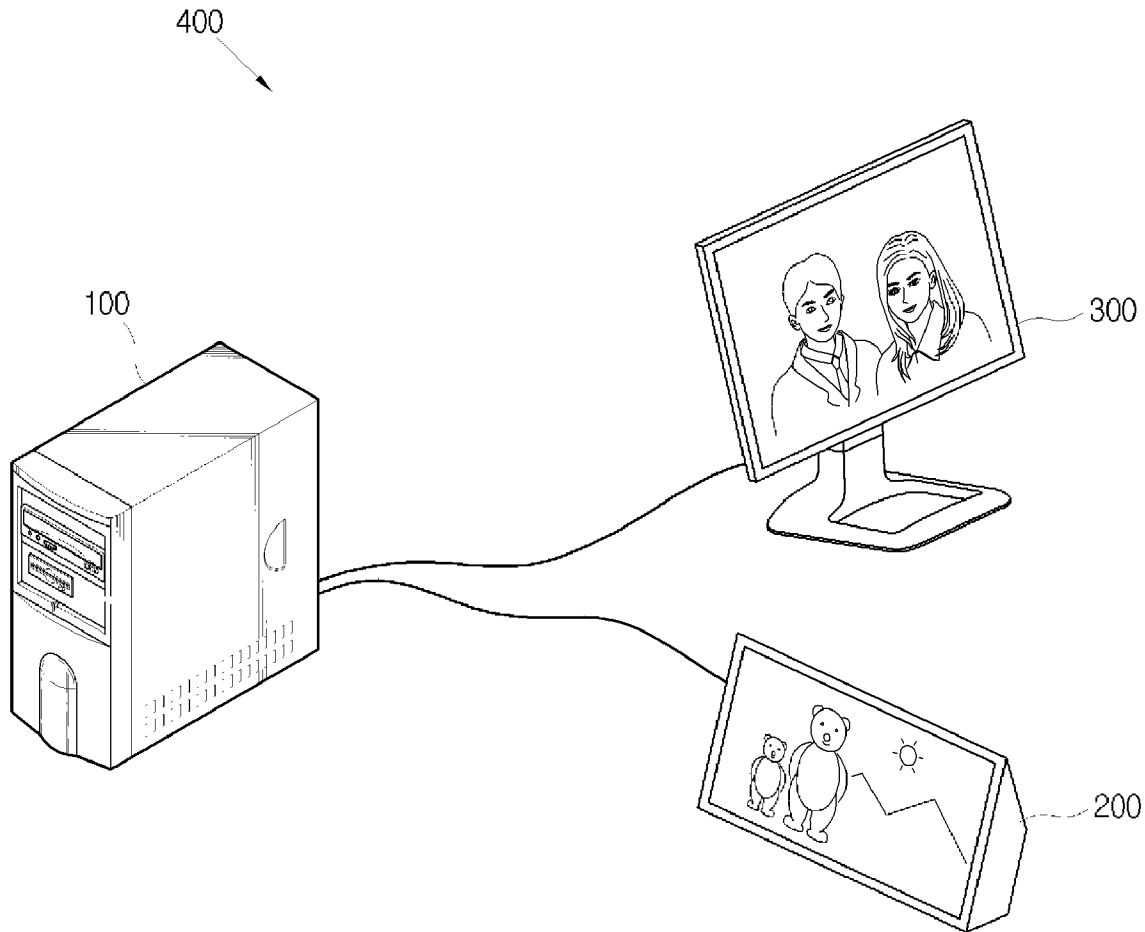


FIG. 1

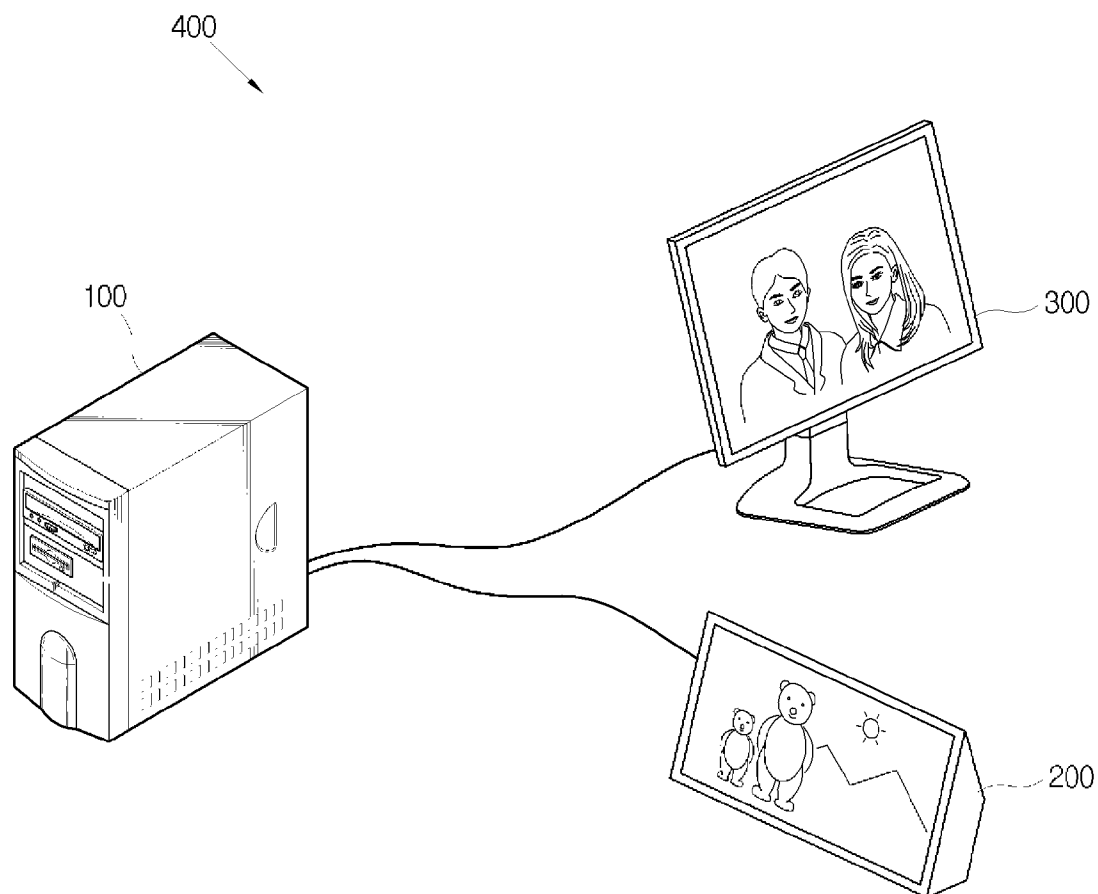


FIG. 2

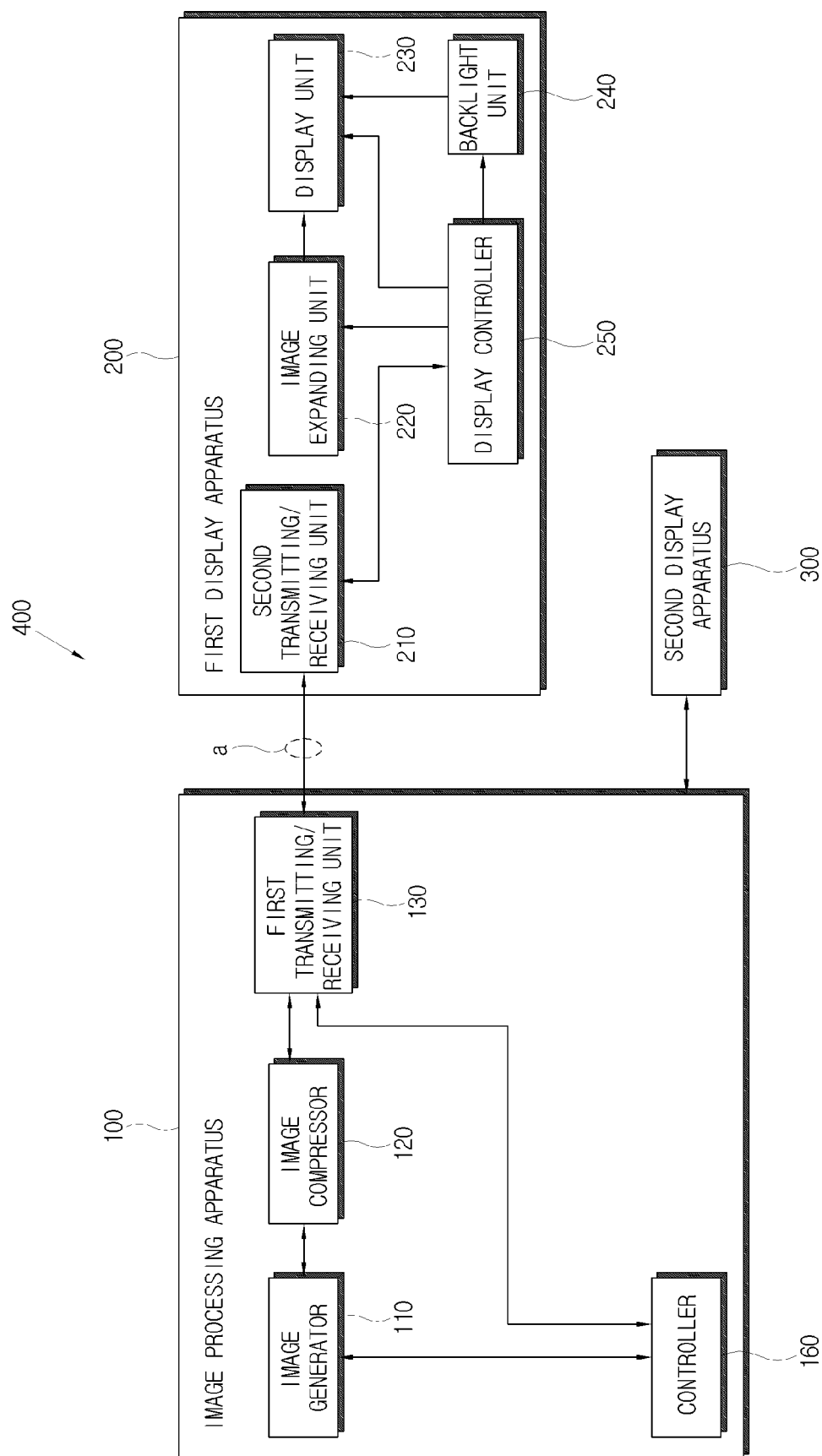


FIG. 3

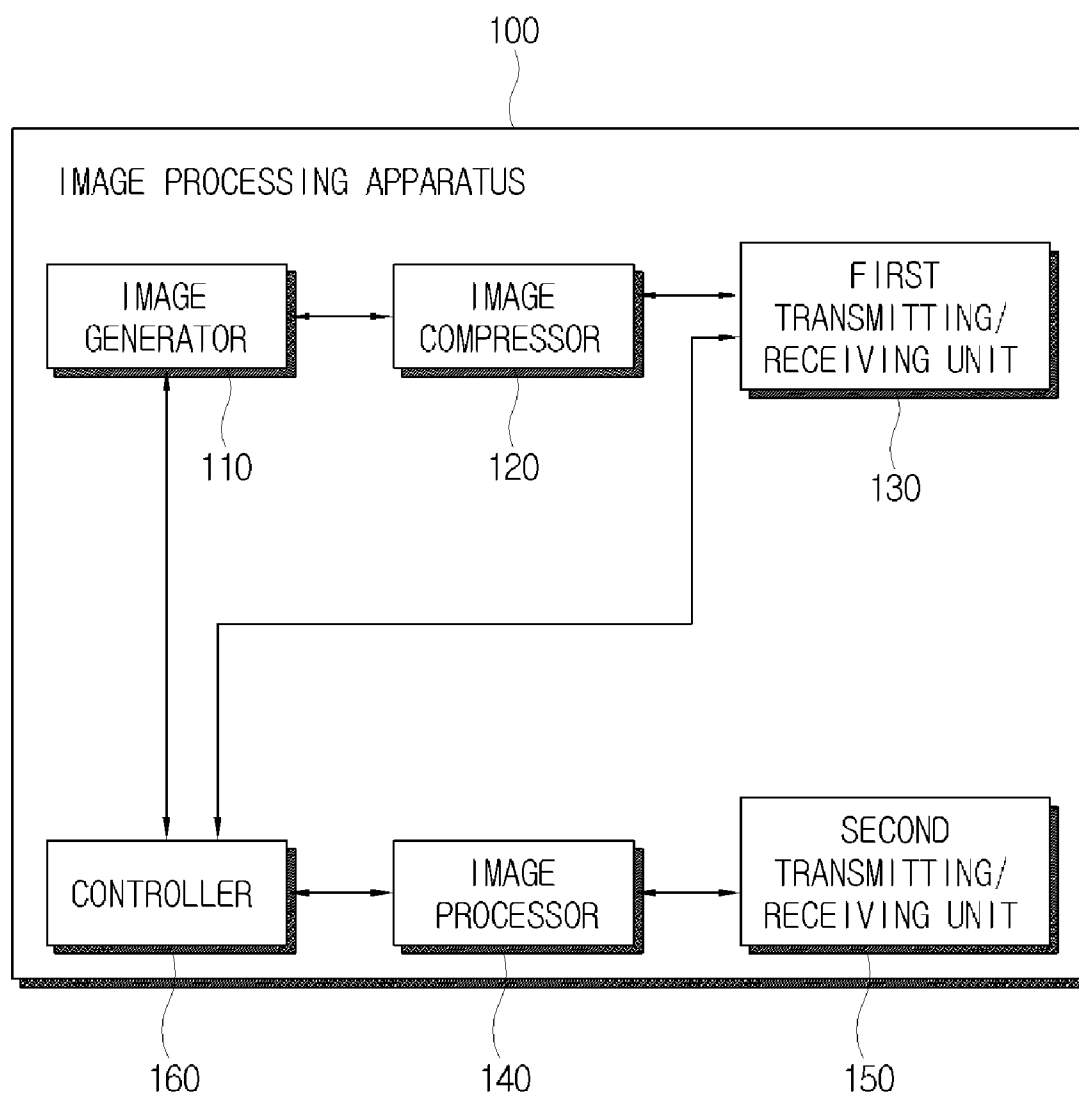


FIG. 4

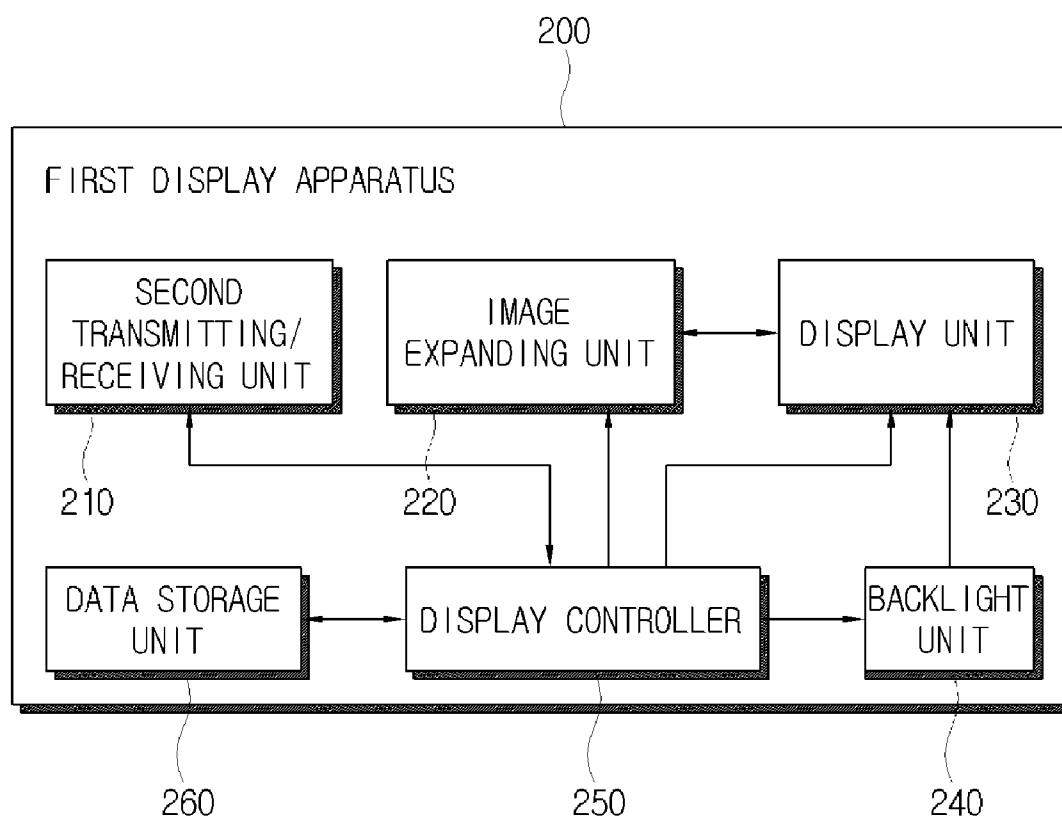


FIG. 5

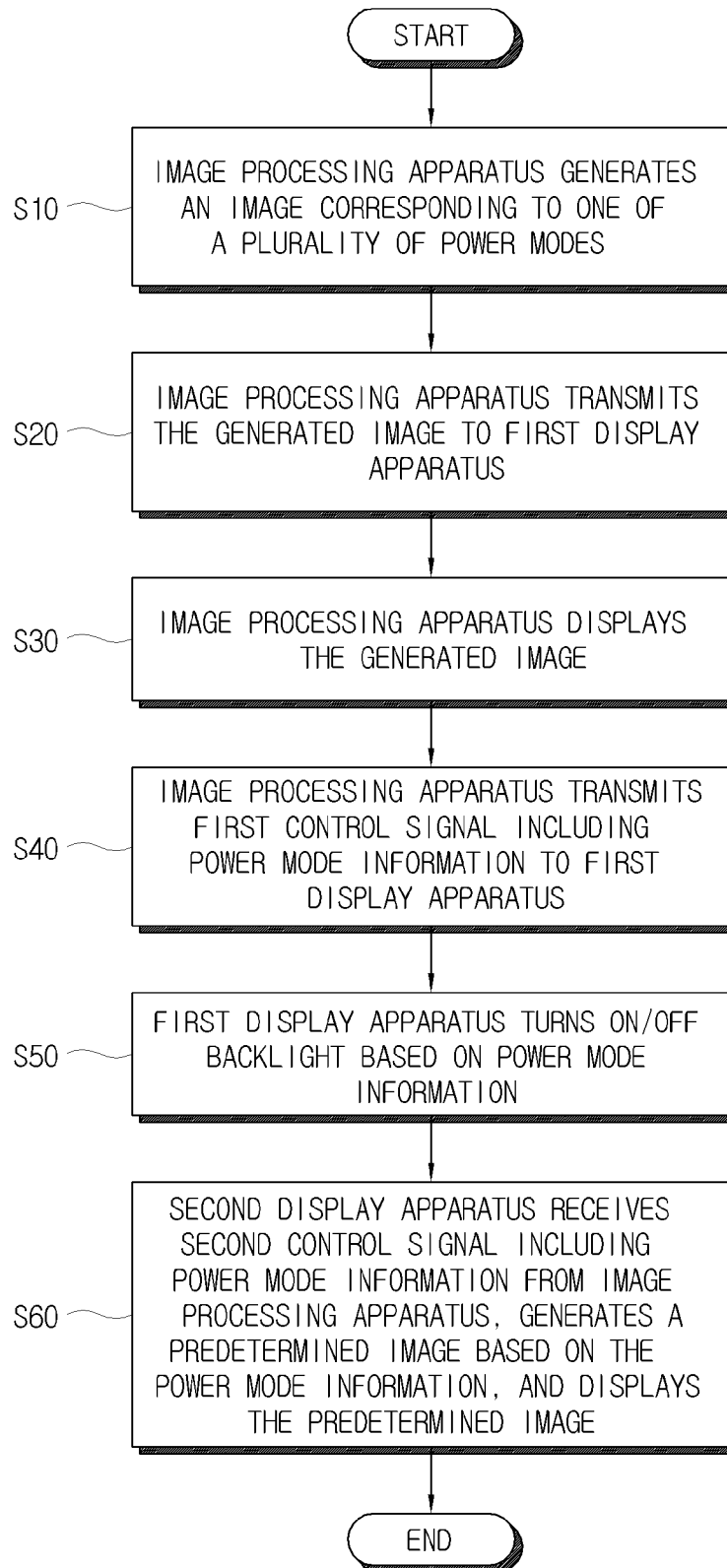


FIG. 6

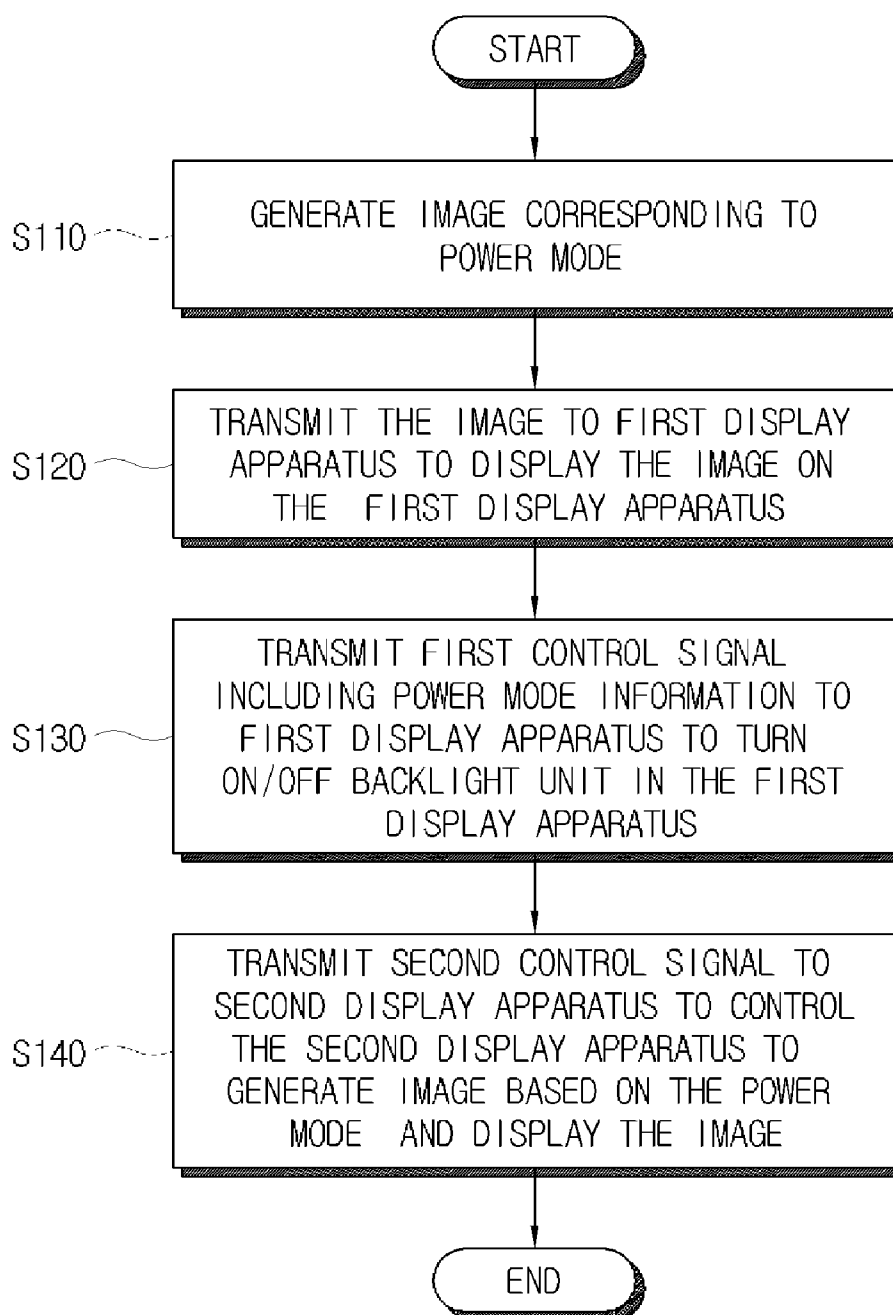
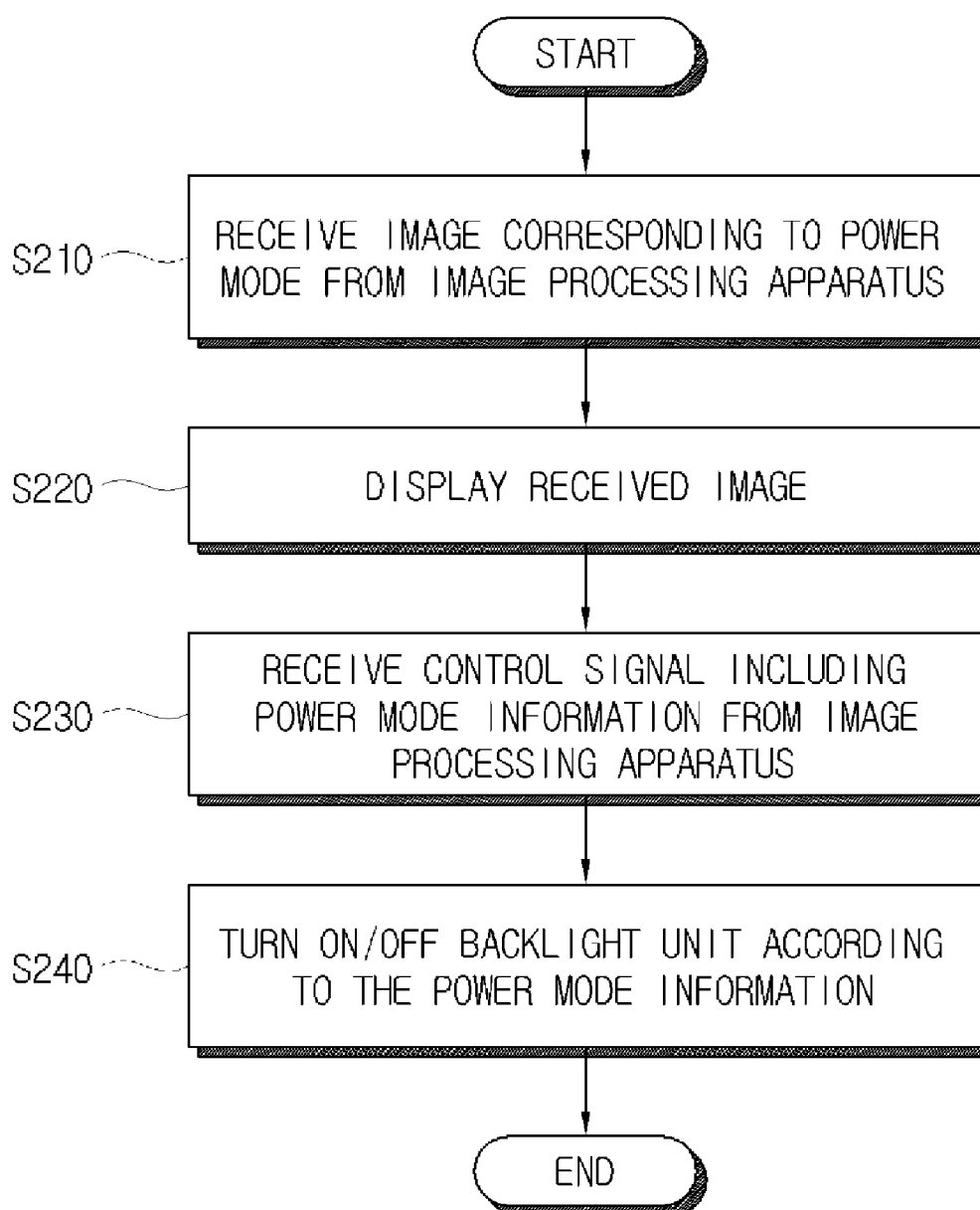


FIG. 7



DISPLAY SYSTEM THAT REDUCES POWER CONSUMPTION FOR IMAGE PROCESSING APPARATUS HAVING POWER MODES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from Korean Patent Application No. 10-2006-0117714, filed on Nov. 27, 2006 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] 1. Technical Field

[0003] Apparatuses consistent with the present invention relate to a display system including an image processing apparatus and a display apparatus, and more particularly, to a display system that reduces power consumption for each power mode of an image processing apparatus having a plurality of power modes.

[0004] 2. Description of the Related Art

[0005] An image processing apparatus generally refers to a computer system. A computer system displays an image on a display apparatus such as a monitor. In order to display the image, the computer system image-processes a video signal through a central processing unit (CPU) and a graphic card provided in the computer system and transmits the image-processed video signal to the monitor. The monitor receives a video signal and modifies the video signal based on vertical synchronization frequency and horizontal synchronization frequency included in the video signal and characteristics of the monitor.

[0006] The computer system controls power consumed by the monitor in accordance with a plurality of power modes. In this case, the power mode is generally set to display power management signaling (DPMS) power mode defined by the Video Electronics Standards Association (VESA).

[0007] The DPMS classifies a power mode of the monitor as one of a normal mode, a standby mode, a suspended mode, and an off mode according to existence of a horizontal synchronization signal and a vertical synchronization signal of a video signal received from the graphic card.

[0008] Recently, a display apparatus such as an electronic frame can access the computer system and display video data stored in the computer system on the electronic frame. However, the computer system and the electronic frame do not communicate with each other using a video graphics array (VGA) method or a digital video/visual interactive (DVI) method, rather the computer system and the electronic frame communicate with each other by using a universal serial bus (USB).

[0009] When the computer system and the electronic frame communicate with each other through the USB, the computer system cannot transmit a video signal to the electronic frame by using a conventional transmission method because the electronic frame only reads video data from a memory provided inside the electronic frame to display the video data.

[0010] That is, the electronic frame cannot receive and process a video signal including image characteristics (e.g. vertical/horizontal synchronization signals) from the computer system. In addition, the electronic frame does not have a module that can perform a power-saving function according

to the power mode depending on existence of the vertical synchronization signal and the horizontal synchronization signal, like the DPMS.

[0011] Therefore, conventional computer systems cannot control power consumption of the electronic frame based on the DPMS-based power mode.

SUMMARY

[0012] The present invention provides a display system and a method of controlling power consumption of a display apparatus such as an electronic frame.

[0013] According to an aspect of the present invention, there is provided a display system comprising: an imaging processing apparatus which generates an image based on one of a plurality of power modes; and a first display apparatus which receives the image from the image processing apparatus and displays the image.

[0014] The power mode may include a display power management signaling (DPMS) power mode defined by the Video Electronics Standards Association (VESA).

[0015] The first display apparatus may include a backlight unit that emits light for displaying the received image, the image processing apparatus transmits a first control signal including information regarding the power mode, and the first display apparatus may further comprise a display controller which controls turning on/off of the backlight unit based on the first control signal received from the image processing apparatus.

[0016] The image processing apparatus may transmit/receive at least one of the image and the first control signal to/from the first display apparatus by using a universal serial bus (USB) transmission method.

[0017] The image processing apparatus may generate a compressed image by compressing the image and transmits the compressed image to the first display apparatus, and the first display apparatus expands the compressed image received from the image processing apparatus and displays the expanded image.

[0018] The display system may further comprise a second display apparatus connected to the image processing apparatus.

[0019] According to another aspect of the present invention, there is provided a display apparatus connected with an image processing apparatus having one power mode among a plurality of power modes, the display apparatus comprising: a transmitting/receiving unit which transmits/receives at least one of an image and a control signal to/from the image processing apparatus by using a universal serial bus (USB) transmission method; a display unit which displays the image received by the transmitting/receiving unit; a backlight unit which emits light to the display unit for displaying the image; and a display controller which turns on/off the backlight unit based on information on the power mode included in the control signal received from the image processing apparatus.

[0020] The power mode may include a display power management signaling (DPMS) power mode defined by the Video Electronics Standards Association (VESA).

[0021] The display apparatus may further comprise an image expanding unit which receives a compressed image through the transmitting/receiving unit and expands the compressed image, wherein the display controller controls the image expanding unit to expand the compressed image and display the expanded image on the display unit.

[0022] The image processing apparatus may be connected with another display apparatus and an image displayed on the display unit includes an image displayed on another display apparatus.

[0023] The display apparatus may further comprise a data storage unit which stores data, wherein the display controller displays image data stored in the data storage on the display unit.

[0024] According to another aspect of the present invention, there is provided a method for controlling a display apparatus which is connected with an image processing apparatus having a plurality of power modes and includes a backlight unit which emits light to display an image received from the image processing apparatus, the method comprising: receiving an image corresponding to the power mode from the image processing apparatus; displaying the received image; receiving a control signal which includes information on a power mode from the image processing apparatus; and turning on/off the backlight unit according to the power mode information.

[0025] The power mode may include a display power management signaling (DPMS) power mode defined by the Video Electronics Standards Association (VESA).

[0026] One of the image and the control signal may be transmitted to and received from the image processing apparatus by using a universal serial bus (USB) transmission method.

[0027] The method may further comprise: determining whether the image received from the image processing apparatus is a compressed image; and expanding the image if the image is a compressed image.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028] The above and/or other aspects of the present invention will become apparent and more readily appreciated from the following description of exemplary embodiments, taken in conjunction with the accompanying drawings, in which:

[0029] FIG. 1 is a perspective view of a display system according to an exemplary embodiment of the present invention;

[0030] FIG. 2 is a block diagram of a display system according to an exemplary embodiment of the present invention;

[0031] FIG. 3 is a block diagram of an image processing apparatus according to an exemplary embodiment of the present invention;

[0032] FIG. 4 is a block diagram of a display apparatus according to an exemplary embodiment of the present invention;

[0033] FIG. 5 is a flowchart of a display method using an image processing apparatus having a plurality of power modes and a first display apparatus connected with the image processing apparatus, according to an exemplary embodiment of the present invention;

[0034] FIG. 6 is a flowchart of a control method of an image processing apparatus connected with a first display apparatus and having one of the plurality of power modes, according to an exemplary embodiment of the present invention; and

[0035] FIG. 7 is a flowchart of a control method of a display apparatus connected with an image processing apparatus having a plurality of power modes and having a backlight unit that emits light for displaying an image received from the

image processing apparatus according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS OF THE PRESENT INVENTION

[0036] Reference will now be made in detail to exemplary embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The exemplary embodiments of the present invention are described below so as to explain the present invention by referring to the figures.

[0037] Hereinafter, an exemplary embodiment of the present invention will be described in detail with reference to the accompanying drawings.

[0038] FIG. 1 is a perspective view of a display system according to an exemplary embodiment of the present invention.

[0039] As shown in FIG. 1, a display system 400 according to an exemplary embodiment of the present invention includes a computer 100, an electronic frame 200, and a monitor 300. The electronic frame 200 and the monitor 300 are connected with the computer 100.

[0040] The monitor 300 is typically a display apparatus, and the electronic frame 200 is a pseudo display apparatus.

[0041] The computer 100 and the monitor 300 communicate an image and a control signal with each other by using a VGA or DVI transmission method, and the computer 100 and the electronic frame 200 communicate an image and a control signal with each other by using a USB transmission method.

[0042] The monitor 300 receives an image signal from the computer 100, modifies the received image signal based on vertical and horizontal synchronization signals and display characteristics of the monitor 300, and displays the corresponding image on a display module (not shown). In addition, a power mode of the monitor 300 is set based on the vertical and horizontal synchronization signals received from the computer 100. The power mode referenced herein corresponds to a DPMS power mode defined by the Video Electronics Standards Association (VESA). The monitor 300 is set to one of a plurality of power modes based on a combination of the vertical and horizontal synchronization signals, and the amount of power consumption can be controlled in accordance with the set power mode of the monitor 300.

[0043] The electronic frame 200 receives an image signal from the computer 100 and displays the received image signal on the electronic frame 200. Whereas the monitor 300 modifies the received image signal in accordance with vertical and horizontal synchronization frequency and characteristics of the monitor 300, the electronic frame 200 displays an image generated by the computer 100.

[0044] The electronic frame 200 receives an image based on a power mode of the computer 100, displays the received image, receives a control signal including power mode information, and controls power consumption based on the power mode information.

[0045] According to this exemplary embodiment, the monitor 300 and the electronic frame 200 may display the same image or may display different images, respectively.

[0046] FIG. 2 is a block diagram of the display system according to an exemplary embodiment of the present invention.

[0047] As shown in FIG. 2, the display system 400 according to an exemplary embodiment of the present invention includes an image processing apparatus 100 that generates an image based on one of the plurality of power modes, and a first display apparatus 200, which receives the image generated by the image processing apparatus 100 and displays the received image.

[0048] According to this exemplary embodiment, the power mode may be classified as at least one of a plurality of power modes according to a predetermined specification, and the power mode includes a DPMS power mode standardized by the VESA.

[0049] In addition, the first display apparatus 200 includes a backlight unit 240 that emits light for displaying the image received from the image processing apparatus 100. The image processing apparatus 100 transmits a first control signal that includes power mode information. Moreover, the first display apparatus 200 further includes a display controller 250 that turns on/off the backlight unit 240 based on the first control signal received from the image processing apparatus 100. Although it is described in the present exemplary embodiment that the first display apparatus 200 includes the backlight unit 240 for displaying an image, this example is not restrictive. For instance, the first display apparatus 200 may include a light emitting diode, or the like, so as to emit light for displaying an image.

[0050] The image processing apparatus 100 and the first display apparatus 200 communicate at least one of an image and a control signal with each other by using a USB transmission method, for example. In addition, the image processing apparatus 100 and the first display apparatus 200 can transmit/receive a voice signal. That is, the image processing apparatus 100 and the first display apparatus 200, respectively, include first transmitting/receiving unit 130 and second transmitting/receiving unit 210, which may include USB ports, for instance. And, a USB cable α may be connected to the respective USB ports of the first and second display apparatuses so that the image, the control signal, and the voice signal can be transmitted/received through the USB cable α . The image processing apparatus 100 and the first display apparatus 200 may use a more improved data transmission method based on a universal data transmission standard as signal transmission technology improves.

[0051] The image processing apparatus 100 generates a compressed image that has been compressed to improve a data transmission rate and transmits the compressed image to the first display apparatus 200. The first display apparatus 200 receives the compressed image from the image processing apparatus 100, expands the image, and displays the expanded image. It is not necessary but preferable that the image processing apparatus 100 compress an image and transmit the compressed image.

[0052] The image processing apparatus 100 may be connected with a second display apparatus 300 in addition to the first display apparatus 200. The second display apparatus 300 may be provided as a computer monitor or a television, for example. In general, the image processing apparatus 100 and the second display apparatus 300 transmit/receive all signals by using a VGA-based transmission method, a DVI-based transmission method, or a high definition multimedia interface (HDMI)-based transmission method.

[0053] FIG. 3 is a block diagram of an image processing apparatus according to an exemplary embodiment of the present invention.

[0054] As shown in FIG. 3, the image processing apparatus 100 according to an exemplary embodiment of the present invention includes an image generator 110 which generates an image, a first transmitting/receiving unit 130 which transmits the image generated by the image generator 110 to the first display apparatus 200, and a controller 160 which controls the image generator 110 to transmit an image based on a power mode among a plurality of power modes through the first transmitting/receiving unit 130. Herein, the power mode can be classified as at least one of a plurality of power modes according to a predetermined specification. The predetermined specification includes, but is not limited to, a DPMS power mode, standardized by the VESA. The DPMS power mode may be classified as a normal mode, a standby mode, a suspended mode, and an off mode according to whether horizontal and/or vertical synchronization signals exist.

[0055] According to the present invention, the controller 160 may reduce the amount of power consumption of the first display apparatus 200 according to a power mode.

[0056] An internal operation mechanism performed by the controller 160 to control the power consumption of the first display apparatus 200 according to the power mode will be described in further detail below.

[0057] In terms of software, the controller 160 comprises an operation system (OS), an application program, and various device drivers. The controller 160 may connect the first display apparatus 200, such as an electronic frame, through a USB port. With respect to a power mode, the controller 160 includes an OS for determining a power mode, a DPMS image generator generating a predetermined image for the respective power modes, and a USB display driver which is a virtual device driver to perceive that the first display apparatus 200 is provided as a monitor like the second display apparatus 300. According to this exemplary embodiment, the DPMS image generator corresponds to the image generator 110 of FIG. 2. The DPMS image generator is a software application, and the USB display driver is a firmware. The USB display driver may include the DPMS image generator and may include the image compressor 120. Therefore, the USB display driver may correspond to the image generator 110.

[0058] The OS determines a current power mode of the image processing apparatus 100, and transmits a power mode signal to the DPMS image generator. The DPMS image generator receives the power mode signal and transmits a signal to a graphic device interface (GDI) module that is a part of the OS for generating a predetermined image. The GDI module then transmits the generated image to the USB display driver. The USB display driver modifies the image received from the GDI module based on a USB protocol and then transmits the image to a USB driver (not shown). The USB driver then transmits the image modified by using the USB protocol to the first display apparatus 200 through the first transmitting/receiving unit 130.

[0059] When receiving the power mode signal from the OS, the DPMS image generator transmits a first control signal to a USB display driver for controlling the backlight unit 240 provided in the first display apparatus 200. According to this exemplary embodiment, the first control signal includes current power mode information. The USB display driver modifies the first control signal by using the USB transmission protocol, and transmits the modified signal to the USB driver

(not shown). The USB driver then transmits the first control signal to the first display **200** through the first transmitting/receiving unit **130**.

[0060] In addition, the USB driver receives a response signal, in USB transmission protocol form, from the first display apparatus **200** responding to the image and the first control signal received by the first display apparatus **200**. The USB driver then transmits the response signal to the USB display driver. Then, the USB display driver changes the protocol of the response signal from the USB transmission protocol to an internal signal protocol of the image processor and transmits the response signal of the changed protocol to the DPMS image generator. The DPMS image processor then passes the received signal to the OS. Consistent with the present invention, a system designer may decide whether the DPMS image generator receives a response signal from a USB display driver and performs the corresponding operation. The OS can determine a status of the first display apparatus **200** by receiving the response signal, and when the OS cannot receive the response signal, the OS may periodically or repeatedly transmit the image and the first control signal to the first display apparatus **200**.

[0061] The first display apparatus **200** includes the backlight unit **240** that emits light so as to display the image received from the image generator **110**. The controller **160** transmits the first control signal to the first display apparatus **200** so as to control the backlight unit **240** to be turned on/off based on the power mode. According to an exemplary embodiment, the first display apparatus **200** may use a light emitting diode (LED) to emit light for displaying an image rather than using the backlight unit **240**.

[0062] At least one of the image and the first control signal is transmitted to and received from the first display apparatus **200** using the USB transmission method.

[0063] The image processing apparatus **100** further includes a first transmitting/receiving unit **130** connected with the first display apparatus **200**. The first display apparatus **200** includes a second transmitting/receiving unit **210** connected with the first transmitting/receiving unit **130**. The image and the first control signal are transmitted to the first display apparatus **200** through the first transmitting/receiving unit **130**. A voice signal and other data signals can also be transmitted through the first transmitting/receiving unit **130**. According to this exemplary embodiment, the first transmitting/receiving unit **130** and the second transmitting/receiving unit **210** can be provided with a USB port and connected through a USB cable 'α'. Consistent with the present invention, as a signal transmission method improves, an improved transmission method based on a universal data transmission standard may be applied, and the first transmitting/receiving unit **130** and the second transmitting/receiving unit **210** may become compatible with a new port or a separate port may be provided according to the improved transmission method.

[0064] The image processing apparatus **100** further includes an image compressor **120** that compresses an image. The image compressor **120** receives an image from the image generator **110**, compresses the received image, and then transmits the compressed image to the first display apparatus **200** through the first transmitting/receiving unit **130**. The image compressor **120** may be included in the image generator **110**.

[0065] The image processing apparatus **100** further includes a second transmitting/receiving unit **150** connected with the second display apparatus **300**, and transmits a second

control signal to the second display apparatus **300** so as to control the second display apparatus **300** to generate an image based on the power mode and display the generated image.

[0066] FIG. 4 is a block diagram of a first display apparatus **200** according to an exemplary embodiment of the present invention.

[0067] As shown in FIG. 4, the display apparatus **200** includes a second transmitting/receiving unit **210**, a display unit **230**, a backlight unit **240**, and a display controller **250**. The second transmitting/receiving unit **210** is connected with an image processing apparatus **100** having at least one of a plurality of power modes. The second transmitting/receiving unit **210** transmits/receives at least one of an image and a control signal to/from the image processing apparatus **100** by using a USB transmission method. The display unit **230** displays the image received through the second transmitting/receiving unit **210**.

[0068] The backlight unit **240** emits light to the display unit **230** so as to display an image, and the display controller **250** turns on/off the backlight unit **240** based on information regarding a power mode of the received control signal. According to this exemplary embodiment, the power mode can be classified as at least one of a plurality of power modes according to a predetermined specification, and the predetermined specification includes, but is not limited to, a DPMS power mode defined by the VESA. The DPMS power mode is divided, for example, into a normal mode, a standby mode, a suspended mode, and an off mode, in accordance with existence of horizontal and vertical signals.

[0069] The display apparatus **200** further includes an image expanding unit **220** that receives the compressed image through the second transmitting/receiving unit **210** and expands the compressed image. The display controller **250** controls the image expanding unit **220** to expand the compressed image and to display the expanded image on the display unit **230**.

[0070] The image processing apparatus **100** may be connected with another display apparatus **300**, and an image displayed on the display unit **230** includes an image displayed on the other display apparatus **300**.

[0071] The display apparatus **200** further includes a data storage unit **260** for storing data, and the display controller **250** displays image data stored in the data storage unit **260** on the display unit **230**.

[0072] A display system according to an exemplary embodiment of the present invention will be described in further detail below.

[0073] As shown in FIG. 1, the image processing apparatus **100** is provided as the computer **100**, the first display apparatus **200** is provided as the electronic frame **200**, and the second display apparatus is provided as the monitor **300**.

[0074] The computer **100** may be operated with a plurality of power modes according to a predetermined specification. The predetermined specification includes, but is not limited to, a DPMS power mode defined by the VESA. In the present exemplary embodiment, the specification is set to the DPMS power mode defined by the VESA.

[0075] The computer **100** enters one of the plurality of power modes. The power mode is classified as a normal mode, a standby mode, a suspended mode and an off mode included in the DPMS power mode defined by the VESA.

[0076] The computer **100** includes a first transmitting/receiving unit **130** connected with the electronic frame **200**. The first transmitting/receiving unit **130** transmits/receives an

image, voice, and a first control signal. The computer **100** further includes an image generator **110** for generating an image and transmitting the generated image to the electronic frame **200** through the first transmitting/receiving unit **130**. Additionally, the computer **100** includes a second transmitting/receiving unit **150** connected with the monitor **300**, an image processor **140** for transmitting an image signal to the monitor **300** through the second transmitting/receiving unit **150**, and a controller **160** controlling the above constituent elements of the computer **100**.

[0077] The first transmitting/receiving unit **130** transmits/receives an image, voice, and a first control signal to/from the electronic frame **200** based on a USB transmission method. Therefore, the first transmitting/receiving unit **130** may be provided as a USB port.

[0078] The first transmitting/receiving unit **130** is connected with a USB cable 'α'.

[0079] When the computer **100** enters one of the plurality of power modes, the controller **160** controls the image generator **110** to generate a predetermined image and transmit/receive one of the image and the first control signal to/from the electronic frame **200** through the USB port of the first transmitting/receiving unit **130**.

[0080] The second transmitting/receiving unit **150** is provided with a port to which a cable is connected for communication with the monitor **300** based on a VGA transmission method or a DVI transmission method, for example. That is, the second transmitting/receiving unit **150** may be provided with a D-SUB port for an analog signal or a DVI port for a digital signal. In the present exemplary embodiment, the second transmitting/receiving unit **150** is provided with a D-SUB port.

[0081] The image processor **140** processes an image signal, and transmits the processed image signal and one of a vertical synchronization signal and a horizontal synchronization signal to the monitor **300** through the D-SUB port by control of the controller **160**.

[0082] The controller **160** corresponds to a central processing unit of a computer. The controller **160** is provided inside the computer **100** and determines a current power mode of the computer **100**. The controller **160** controls the image generator **110** and the image processor **140** in accordance with the current power mode.

[0083] The computer **100** may further include an image compressor **120** that receives the image generated by the image generator **110** and then compresses the received image. The image compressor **120** may be included in the image generator **110**.

[0084] The electronic frame **200** includes a second transmitting/receiving unit **210**, an image expanding unit **220**, a display unit **230**, a backlight unit **240**, a data storage unit **260**, and a display controller **250** for controlling these constituent elements **210**, **220**, **230**, **240**, and **260**.

[0085] The second transmitting/receiving unit **210** is provided with a USB port connected with a USB cable 'α'.

[0086] The image expanding unit **220** expands the compressed image received through the USB port of the first transmitting/receiving unit **130** in the computer **100** and displays the expanded image on the display unit **230**.

[0087] The backlight unit **240** emits light for displaying the image received from the computer **100** on the display unit **230**. According to an exemplary embodiment of the present invention, the backlight unit **240** emits light, and may be replaced with a light emitting diode (LED) according to characteristics of the electronic frame **200**.

Therefore, the controller **160** can control the amount of light emission by turning on/off the backlight unit **240** or the LED.

[0088] The electronic frame **200** further includes the data storage unit **260**. The data storage unit **260** may store image data. When the electronic frame **200** is not connected with the computer **100**, the display controller **250** reads image data from the data storage unit **260** and displays the image data on the display unit **230**.

[0089] The monitor **300** includes a microcomputer (not shown), a scaler (not shown), and a display panel (not shown). The display panel is a module on which an image is displayed, and includes, but is not limited to, a cathode ray tube (CRT) and a liquid crystal display (LCD). In addition, the monitor **300** may be provided as a digital television.

[0090] The computer **100** enters one of the plurality of power modes depending on how a user currently uses the computer **100**. The controller **160** determines a power mode which the computer **100** enters, and performs a series of processes corresponding to the determined power mode.

[0091] The power mode can be classified as a normal mode, a standby mode, a suspended mode, and an off mode, for example.

[0092] When the normal mode is determined by the controller **160**, the controller **160** reads image data from a storage unit (not shown), such as an internal/external hard disk or an external memory, transmits the read image data to the image generator **110**, and controls the image generator **110** to generate an image. In addition, the controller **160** may receive an air-wave broadcasting signal, a terrestrial digital multimedia broadcasting (DMB) signal, and a satellite DMB signal. The controller **160** may capture the received image signal, convert the captured image signal to image data, and store the image data in a storage unit.

[0093] That is, the controller **160** may transmit captured image data to the image generator **110** and may control the image generator **110** to generate an image corresponding to the image data.

[0094] According to an exemplary embodiment, the image signal may be generated as a typical image, like a photo. The image generator **110** generates an image and transmits the image to the electronic frame **200** through the USB port **130**. The image transmitted to the electronic frame **200** may be a compressed image or a non-compressed image.

[0095] Compression of the image is performed by the image compressor **120**. Data transmitted to the electronic frame **200** may include, but is not limited to, an image signal, a first control signal, and a voice signal. When the computer **100** transmits the voice signal, the computer **100** should include a voice generator (not shown) for transmitting the voice signal. The voice generator may be included in the image generator **110**, for example.

[0096] The controller **160** transmits the first control signal to the electronic frame **200**. According to an exemplary embodiment, the first control signal includes information regarding a current power mode. If the current power mode is set to the normal mode, then the information regarding the power mode indicates the normal mode.

[0097] When the current power mode is set to the normal mode, the controller **160** transmits a second control signal including a vertical synchronization signal and a horizontal synchronization signal.

[0098] The display controller **250** of the electronic frame **200** receives the image and the first control signal through the

USB port of the second transmitting/receiving unit **210** to which the USB cable **a** is connected. The display controller **250** displays the image on the display unit **230**. In addition, the display controller **250** turns on the backlight unit **240** since the power mode information received through the first control signal indicates the normal mode. As such, the display unit **230** displays the received image.

[0099] The electronic frame **200** further includes the image expanding unit **220**, and when the received image is a compressed image, the display controller **250** controls the image expanding unit **220** to expand the compressed image and then displays the expanded image. According to an exemplary embodiment, the image expanding unit **220** may be included in the display controller **250**.

[0100] The controller **160** of the computer **100** transmits at least one of image data, voice data, the vertical synchronization signal, and the horizontal synchronization signal. The controller **160** controls the image processor **140** to process an image signal to transmit the image signal. In addition, the controller **160** may control a voice processor (not shown) for transmitting a voice signal.

[0101] The monitor **300** receives the at least one of the image signal, the voice signal, the vertical synchronization signal, and the horizontal synchronization signal through the second transmitting/receiving unit **150**. The microcomputer (not shown) provided inside the monitor **300** generates an image by changing the image signal according to characteristics of the monitor **300** and then displays the generated image. After receiving the vertical synchronization signal and the horizontal synchronization signal, the monitor **300** does not perform any operation so as to save power.

[0102] When the power mode of the computer **100** is set to the standby mode by the controller **160**, the controller **160** reads image data from a storage unit (not shown) such as an internal/external hard disk or an external memory, transmits the read image data to the image generator **110**, and controls the image generator **110** to generate an image according to the image data. The image generated by the image generator **110** can indicate that the current power mode is not the normal mode. In general, a black image indicates that a current power mode is not the normal mode. Thus, the image generator **110** may generate a black image and transmit the black image to the electronic frame **200** through the USB port **130**. When the computer **100** transmits a voice signal to the electronic frame **200**, the computer **100** may further include a voice generator (not shown) for generating voice signals.

[0103] In addition, the controller **160** transmits a first control signal to the electronic frame **200** through the USB port of the first transmitting/receiving unit **130**. According to an exemplary embodiment, the first control signal includes information indicating that the current power mode is the standby mode.

[0104] The display controller **250** of the electronic frame **200** receives the black image and the first control signal through the USB port of the second transmitting/receiving unit **210**. The display controller **250** displays the black image on the display unit **230**, and determines the power mode included in the first control signal. The display controller **250** turns off the backlight unit **240** or reduces brightness of the backlight unit **240** after determining that the power mode is set to the standby mode. Accordingly, power consumption of the backlight unit **240** of the electronic frame **200** can be reduced.

[0105] In addition, the controller **160** transmits a second control signal including a vertical synchronization signal to the monitor **300** so as to inform that the current power mode is set to the standby mode. According to an exemplary embodiment, unlike the normal mode, the horizontal synchronization signal is not transmitted to the monitor **300**. The controller **160** can control the image processor **140** and the voice processor (not shown) to read image data or voice data stored in the storage unit provided inside the computer **100**, to generate an image signal or a voice signal, and to transmit the image or voice signal. However, when the current power mode is not set to the normal mode, the controller **160** transmits only the second control signal to the monitor **300**.

[0106] The monitor **300** receives a predetermined image signal, generates an image by changing the image signal according to the characteristics of the monitor **300**, and displays the image. In addition, the monitor **300** may reduce power consumption needed for the horizontal synchronization since it receives only the vertical synchronization signal. The amount of power consumption in the standby mode is less than in the normal mode and greater than the suspended mode.

[0107] When the power mode of the computer **100** is set to the suspended mode, or is set to the off mode by the controller **160**, the controller **160** reads image data from the storage unit (not shown) such as the internal/external hard disk or the external memory, transmits the read image data to the image generator **110**, and controls the image generator **110** to generate an image corresponding to the image data. According to an exemplary embodiment, the image generator **110** may generate a black image. In addition, the controller **160** transmits a first control signal to the electronic frame **200** through the USB port of the first transmitting/receiving unit **130**. According to one exemplary embodiment, the first control signal includes information indicating that the current power mode is set to the suspended mode or the off mode.

[0108] The display controller **250** of the electronic frame **200** receives the black image and displays the black image on the display unit **230**. The display controller **250** determines the power mode included in the first control signal and turns off the backlight unit **240** to block light emitted to the display unit **230** when the power mode is set to the suspended mode or the off mode. Therefore, the display controller **250** can reduce power consumption needed for light emission of the backlight unit **240** when the power mode is set to the suspended mode or the off mode.

[0109] In addition, the controller **160** transmits a second control signal including the horizontal synchronization signal to the monitor **300** so as to indicate that the power mode is set to the suspended mode. According to an exemplary embodiment, the controller **160** may control the image processor **140** and the voice processor (not shown) to read the image data or voice data stored in the storage unit provided in the computer **100**, generate an image signal or a voice signal, and transmit the image signal or the voice signal. However, the controller **160** transmits only the second control signal to the monitor **300** when the power mode is not set to the normal mode.

[0110] The monitor **300** receives the second control signal, generates an image corresponding to the suspended mode, and displays the generated image. The image displayed on the monitor **300** is the same as the image displayed on the electronic frame **200**.

[0111] When the power mode is set to the off mode, the controller **160** transmits a second control signal to the moni-

tor 300 so as to inform that the power mode is set to the off mode. According to an exemplary embodiment, the second control signal does not include either the horizontal synchronization signal or the vertical synchronization signal. The controller 160 may control the image processor 140 and the voice processor (not shown) to read the image data or voice data stored in the storage unit provided in the computer 100, generate an image signal or a voice signal, and transmit the image signal or the voice signal. When the current power mode is not set to the normal mode, the controller 160 transmits only the second control signal to the monitor 300.

[0112] The monitor 300 receives the second control signal and determines that the current power mode is set to the off mode by determining the horizontal synchronization signal and the vertical synchronization signal are not included in the second control signal. The monitor 300 then generates a predetermined image corresponding to the off mode and displays the image. According to an exemplary embodiment, the predetermined image may be the black image.

[0113] Therefore, when the power mode is set to the suspended mode, the monitor 300 can save power that would be consumed for the vertical synchronization signal, and when the power mode is set to the off mode, the monitor 300 can save power that would be consumed for the vertical and horizontal synchronization signals.

[0114] When the power mode of the computer 100 is set to a power mode other than the normal mode, an image displayed on the monitor 300 and an image displayed on the electronic frame 200 may be different from each other, but the two images may be the same. A user can determine a current power mode of the computer 100 through the images displayed on the electronic frame 200 and the monitor 300.

[0115] When the power mode of the computer 100 is set to the normal mode, the images displayed on the monitor 300 and the electronic frame 200 may be the same, but generally, the two images are different from each other.

[0116] FIG. 5 is a flowchart showing a display method using an image processing apparatus having a plurality of power modes and a first display apparatus connected with the image processing apparatus, consistent with an exemplary embodiment of the present invention.

[0117] As shown in FIG. 5, the image processing apparatus generates an image corresponding to one of the plurality of power modes (S10). The image processing apparatus then transmits the generated image to the first display apparatus (S20). The first display apparatus receives and displays the generated image (S30). The image processing apparatus transmits a first control signal including information regarding a current power mode to the first display apparatus (S40). The first display apparatus turns on/off a backlight unit based on the information regarding the current power mode (S50). A second display apparatus may also be connected to the image processing apparatus, and the second display apparatus receives a second control signal including information regarding the current power mode from the image processing apparatus, generates a predetermined image based on received information, and displays the predetermined image (S60).

[0118] According to an exemplary embodiment, the current power mode may be classified as at least one of a plurality of power modes according to a predetermined specification, and may include a DPMS power mode defined by the VESA.

[0119] The image processing apparatus and the first display apparatus transmit/receive at least one of the image and the

first control signal by using the USB transmission method. In addition, the voice signal can be transmitted by using the USB transmission method.

[0120] The image processing apparatus can generate a compressed image, transmit the compressed image to the first display apparatus, expand the compressed image received from the image processing apparatus, and display the expanded image.

[0121] The image processing apparatus may be connected with the second display apparatus, and the second display apparatus may receive a second control signal including information regarding the power mode from the image processing apparatus, generate a predetermined image based on the power mode information, and display the predetermined image.

[0122] FIG. 6 is a flowchart showing a control method of an image processing apparatus connected with a first display apparatus and having at least one of a plurality of power modes, consistent with an exemplary embodiment of the present invention.

[0123] As shown in FIG. 6, an image corresponding to one of the plurality of power modes is generated (S110). The image is transmitted to the first display apparatus to be displayed on the first display apparatus (S120). In order to turn on/off a backlight unit provided in the first display apparatus, a first control signal including power mode information is transmitted to the first display apparatus (S130). The image processing apparatus may be further connected with a second display apparatus, and a second control signal is transmitted to the second display apparatus so that the second display apparatus generates an image based on the power mode and displays the image (S140). According to this exemplary embodiment, the second control signal includes at least one of a horizontal synchronization signal and a vertical synchronization signal.

[0124] The power mode may be classified as at least one of a plurality of power modes, and may include a DPMS power mode defined by the VESA.

[0125] According to an exemplary embodiment, the control method may further include compressing an image and transmitting the compressed image to the first display apparatus.

[0126] At least one of the image and the first control signal is transmitted to and received from the first display apparatus by using the USB transmission method. In addition, voice data can be transmitted/received by using the USB transmission method.

[0127] The image processing apparatus may be connected with the second display apparatus, and a second control signal may be transmitted to the second display apparatus so that the second display apparatus can generate an image based on a power mode and display the image. According to an exemplary embodiment, the second control signal includes at least one of the horizontal synchronization signal and the vertical synchronization signal.

[0128] FIG. 7 is a flowchart showing a control method of a display apparatus which is connected with an image processing apparatus having a plurality of power modes and includes a backlight unit that emits light for displaying an image received from the image processing apparatus.

[0129] As shown in FIG. 7, an image corresponding to a power mode is received from the image processing apparatus (S210). Then, the received image is displayed (S220). A control signal including power mode information is received

from the image processing apparatus (S230). Finally, the backlight unit is turned on/off corresponding to the power mode information (S240).

[0130] According to an exemplary embodiment, the power mode can be classified as at least one of a plurality of power modes according to a predetermined specification, and the power mode may include a DPMS power mode defined by the VESA.

[0131] At least one of the image and the control signal is transmitted to and received from the image processing apparatus by using the USB transmission method. In addition, voice data can be transmitted/received by using the USB transmission method.

[0132] The control method further includes determining whether the image received from the image processor is a compressed image, and expanding the image if it is compressed.

[0133] The image processing apparatus may be provided not only as a computer but also as a personal digital assistant (PDA) or a cellular phone according to other exemplary embodiments of the present invention. In addition, the display apparatus is a pseudo display apparatus such as an electronic frame, and may include other apparatuses having an image display function similar to the display apparatus. A display module on which an image is displayed may also include, but is not limited to, an LCD, a PDP, and a CRT.

[0134] As described above, a display method using a display system, an image processing apparatus, and a display apparatus according to exemplary embodiments of the present invention enable controlling power consumption of a pseudo display apparatus in accordance with a plurality of power modes.

[0135] Although a few exemplary embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that numerous changes or modifications may be made to these exemplary embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the appended claims and their equivalents.

What is claimed is:

1. A display system comprising:
 - an imaging processing apparatus which generates an image in accordance with one power mode of a plurality of power modes; and
 - a first display apparatus which receives the image from the image processing apparatus and displays the image.
2. The display system of claim 1, wherein the power mode comprises a display power management signaling power mode defined by the Video Electronics Standards Association.
3. The display system of claim 2, wherein the first display apparatus comprises a light source unit that emits light for displaying the received image,
 - wherein the image processing apparatus transmits a first control signal comprising information regarding the power mode, and
 - wherein the first display apparatus further comprises a display controller which controls the light source unit in accordance with the first control signal received from the image processing apparatus.
4. The display system of claim 1, wherein the image processing apparatus transmits/receives at least one of the image

and a first control signal comprising information regarding the power mode, to/from the first display apparatus by using a universal serial bus.

5. The display system of claim 4, wherein the image processing apparatus generates a compressed image by compressing the image,

- wherein the image processing apparatus transmits the compressed image to the first display apparatus, and
- wherein the first display apparatus expands the compressed image received from the image processing apparatus and displays the expanded image.

6. The display system of claim 5, further comprising a second display apparatus connected to the image processing apparatus.

7. The display system of claim 1, wherein the first display apparatus comprises an electronic frame.

8. The display system of claim 3, wherein the display controller controls the light source unit in accordance with the existence of a vertical synchronization signal and a horizontal synchronization signal.

9. A display apparatus connected with an image processing apparatus having one power mode among a plurality of power modes, the display apparatus comprising:

- a receiving unit which receives an image and a control signal from the image processing apparatus by using a universal serial bus;
- a display unit which displays the image received by the receiving unit;
- a light source unit which emits light to the display unit for displaying the image; and
- a display controller which controls the light source unit in accordance with information regarding the power mode, which is included in the control signal received from the image processing apparatus.

10. The display apparatus of claim 7, wherein the power mode comprises a display power management signaling power mode defined by the Video Electronics Standards Association.

11. The display apparatus of claim 8, further comprising an image expanding unit which receives a compressed image from the receiving unit and expands the compressed image, wherein the display controller controls the image expanding unit to expand the compressed image and display the expanded image on the display unit.

12. The display apparatus of claim 9, wherein the image processing apparatus is connected with a second display apparatus, and

- wherein an image displayed on the display unit comprises an image displayed on the second display apparatus.

13. The display apparatus of claim 8, wherein the image processing apparatus is connected with a second display apparatus, and

- wherein an image displayed on the display unit comprises an image displayed on the second display apparatus.

14. The display apparatus of claim 11, further comprising a data storage unit which stores data,

- wherein the display controller displays image data stored in the data storage unit on the display unit.

15. The display apparatus of claim 10, further comprising a data storage unit which stores data,

- wherein the display controller displays image data stored in the data storage unit on the display unit.

16. A method for controlling a display apparatus which is connected with an image processing apparatus having a plu-

ality of power modes and comprises a light source unit which emits light to display an image received from the image processing apparatus, the method comprising:

receiving an image corresponding to a power mode of the plurality of power modes from the image processing apparatus;

displaying the received image;

receiving a control signal which comprises information regarding the power mode from the image processing apparatus; and

controlling the light source unit in accordance with the power mode information.

17. The method of claim **14**, wherein the power mode comprises a display power management signaling power mode defined by the Video Electronics Standards Association.

18. The method of claim **15**, wherein at least one of the image and the control signal is received from the image processing apparatus by using a universal serial bus transmission method.

19. The method of claim **16**, further comprising:

determining whether the image received from the image processing apparatus is a compressed image; and expanding the image, if the received image is a compressed image.

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