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(54) DISPLAY DEVICE AND CONTROL METHOD

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(57) **ABSTRACT**

Provided is a display device including an imaging unit that captures a moving image in a predetermined range in an image display direction, a moving body detection unit that detects whether or not a moving body is present in a predetermined range in the image display direction, an image analysis unit that analyzes the moving image captured by the imaging unit to detect whether or not a face is present, and a power control unit that controls power consumption with different patterns according to a plurality of modes that are set by combining whether or not the face detected by the image analysis unit is present and whether or not the moving body detected by the detection unit is present.

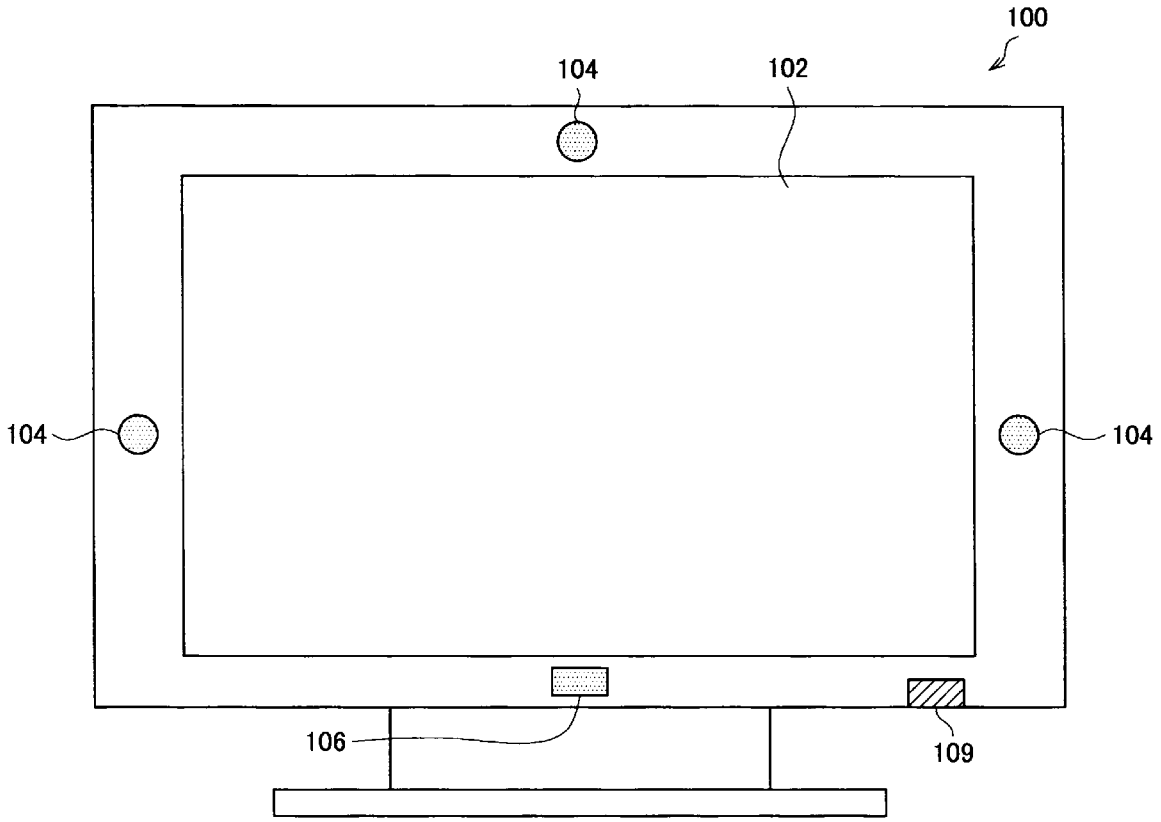


FIG. 1

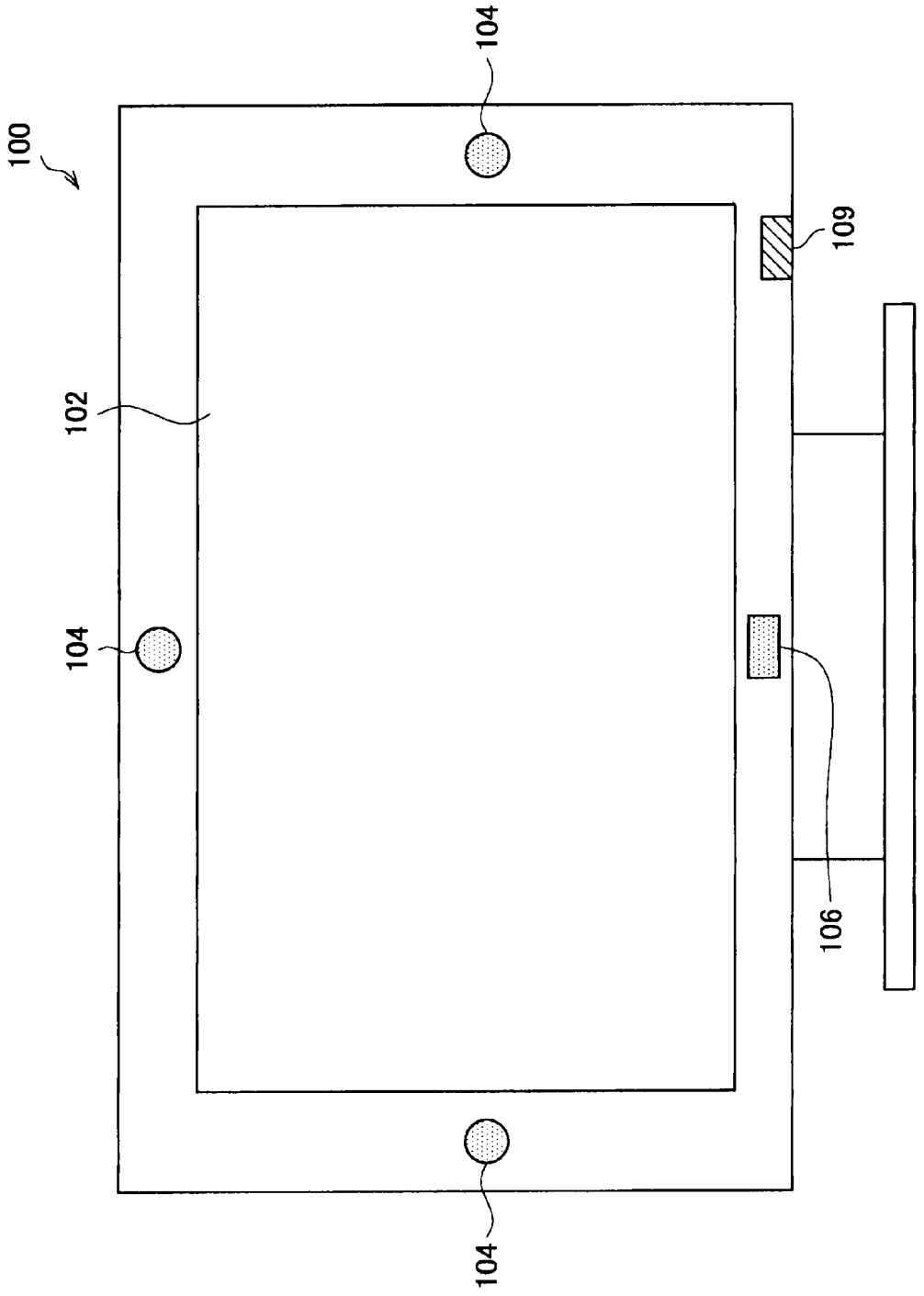


FIG. 2

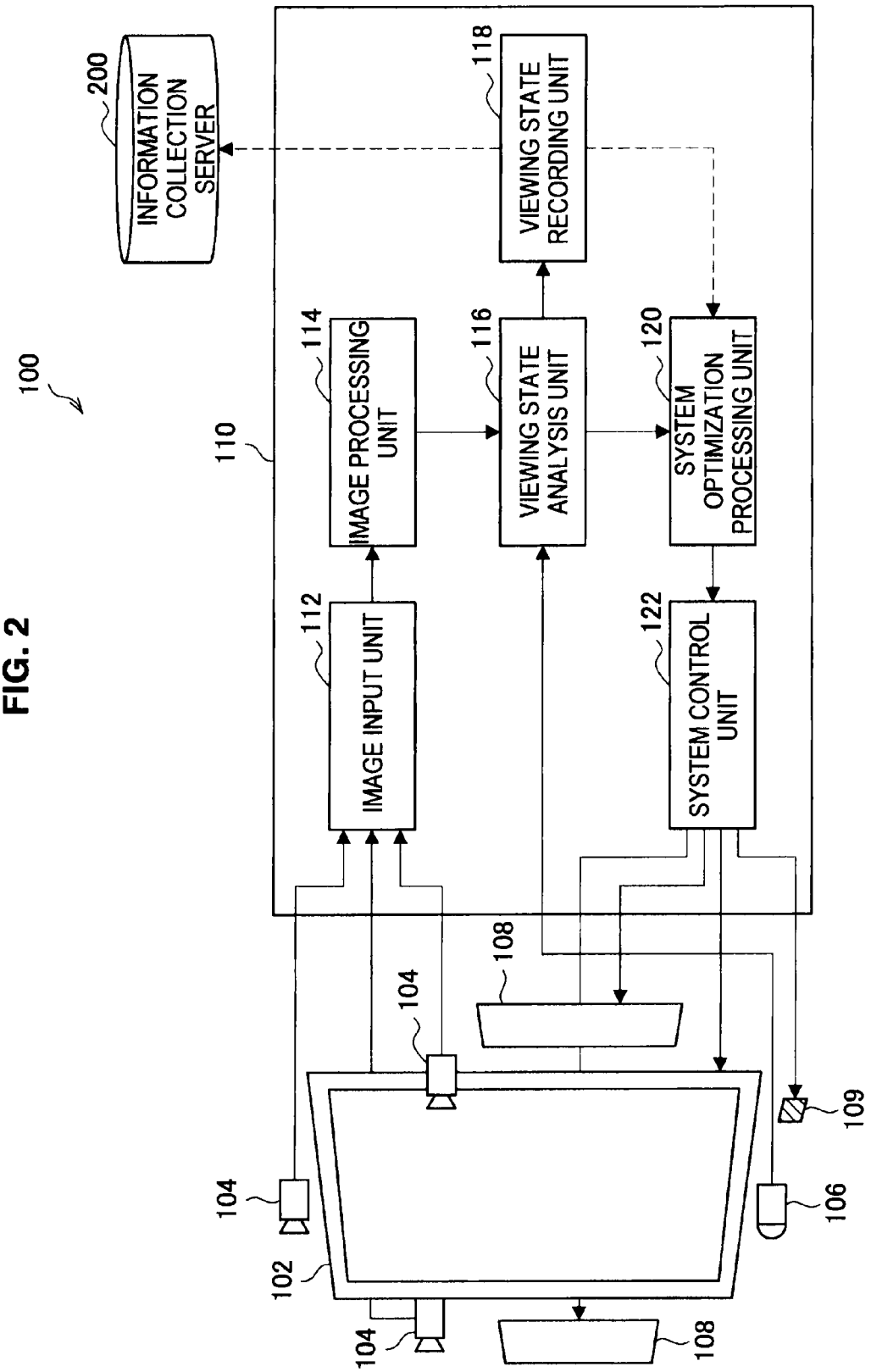

100
200
INFORMATION COLLECTION SERVER
110
118
VIEWING STATE RECORDING UNIT
114
IMAGE PROCESSING UNIT
116
VIEWING STATE ANALYSIS UNIT
120
SYSTEM OPTIMIZATION PROCESSING UNIT
112
IMAGE INPUT UNIT
122
SYSTEM CONTROL UNIT
104
104
104
108
108
102
106
109

FIG. 3

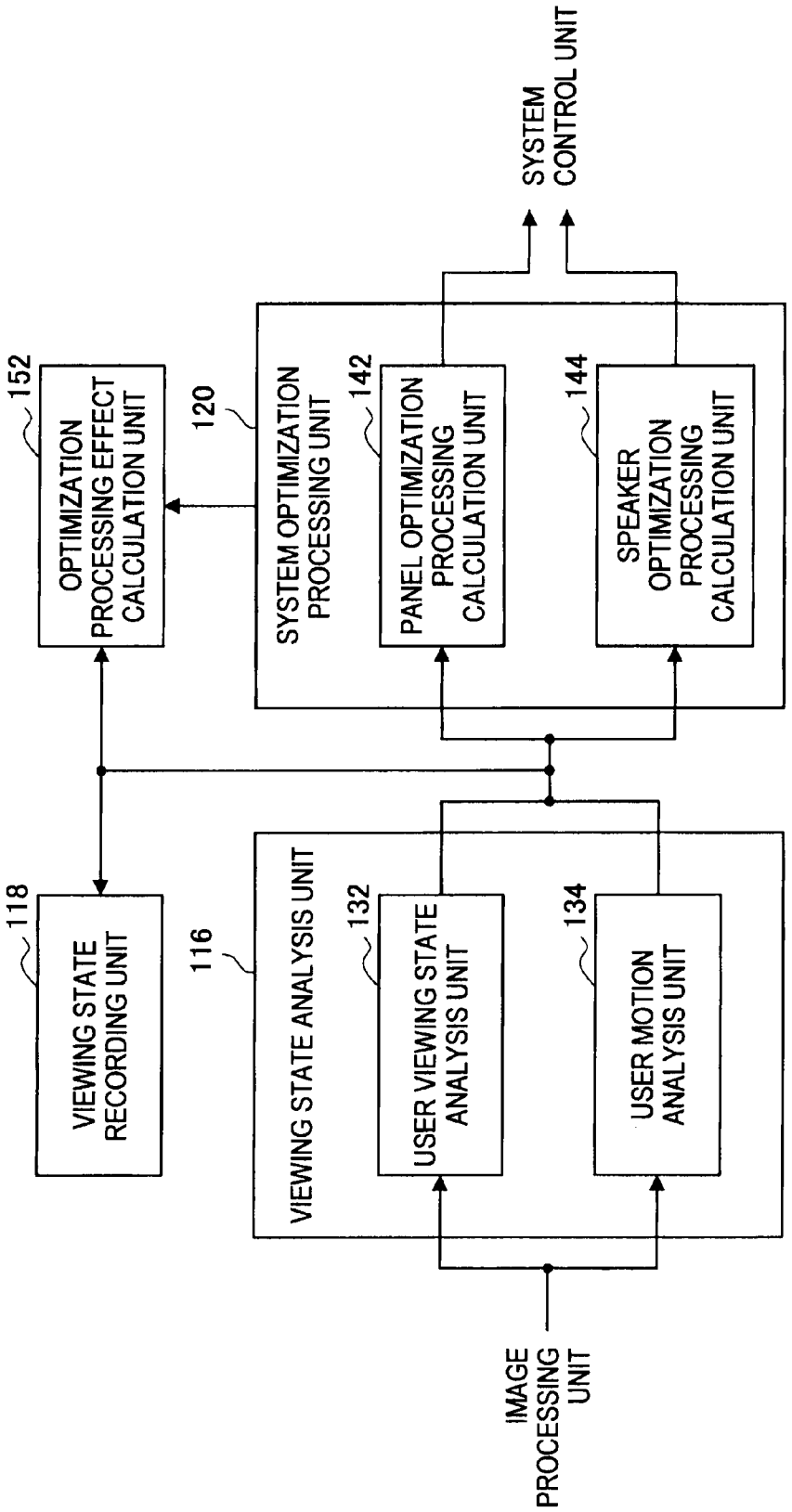

152
OPTIMIZATION PROCESSING EFFECT CALCULATION UNIT
118
VIEWING STATE RECORDING UNIT
120
SYSTEM OPTIMIZATION PROCESSING UNIT
116
VIEWING STATE ANALYSIS UNIT
142
PANEL OPTIMIZATION PROCESSING CALCULATION UNIT
132
USER VIEWING STATE ANALYSIS UNIT
144
SPEAKER OPTIMIZATION PROCESSING CALCULATION UNIT
134
USER MOTION ANALYSIS UNIT
SYSTEM CONTROL UNIT
IMAGE PROCESSING UNIT

FIG. 4

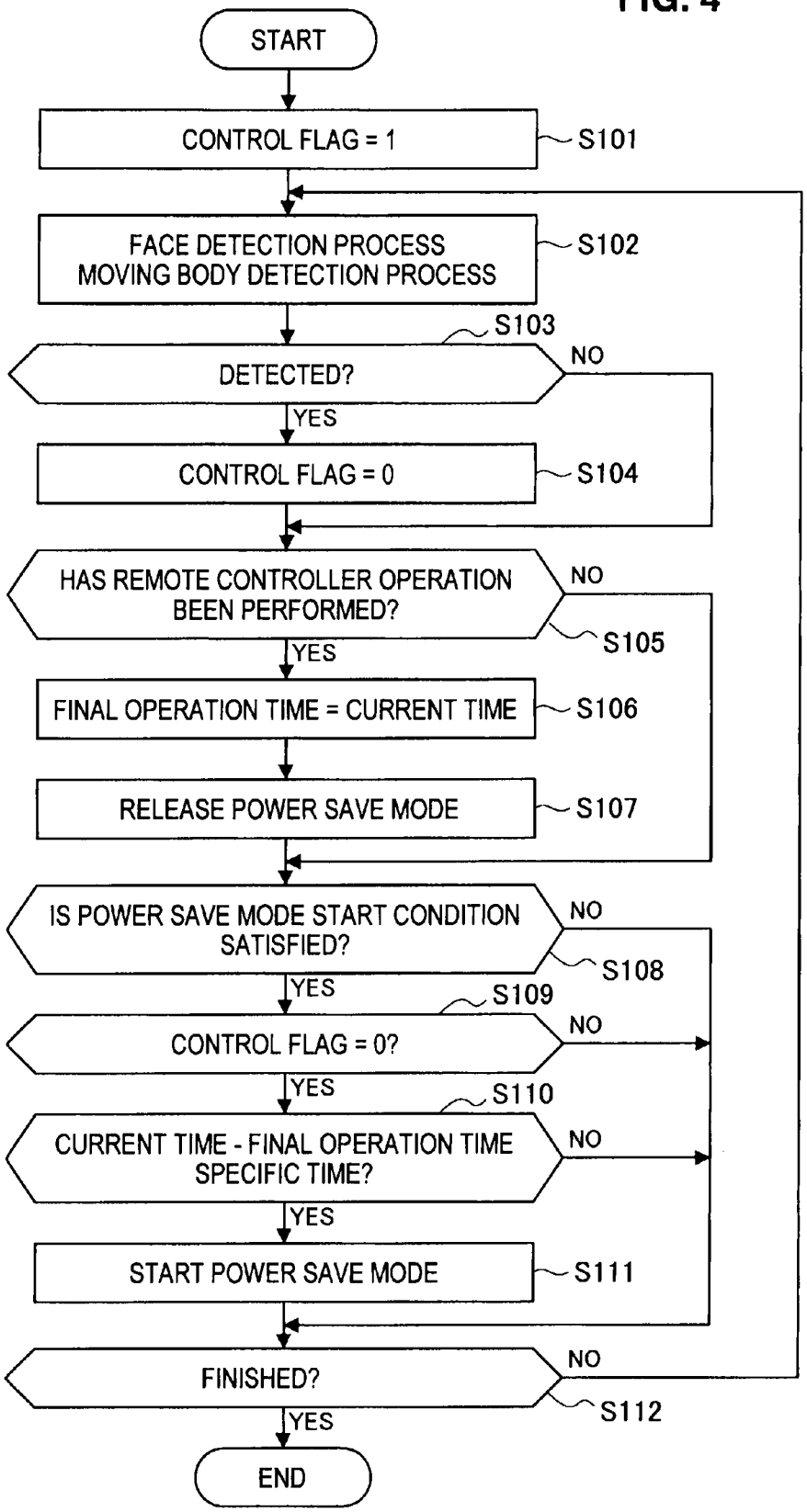

START
CONTROL FLAG = 1
S101
FACE DETECTION PROCESS
MOVING BODY DETECTION PROCESS
S102
S103
DETECTED?
NO
YES
CONTROL FLAG = 0
S104
HAS REMOTE CONTROLLER OPERATION BEEN PERFORMED?
NO
S105
YES
FINAL OPERATION TIME = CURRENT TIME
S106
RELEASE POWER SAVE MODE
S107
IS POWER SAVE MODE START CONDITION SATISFIED?
NO
S108
YES
S109
CONTROL FLAG = 0?
NO
YES
S110
CURRENT TIME - FINAL OPERATION TIME SPECIFIC TIME?
NO
YES
START POWER SAVE MODE
S111
FINISHED?
NO
S112
YES
END

FIG. 5

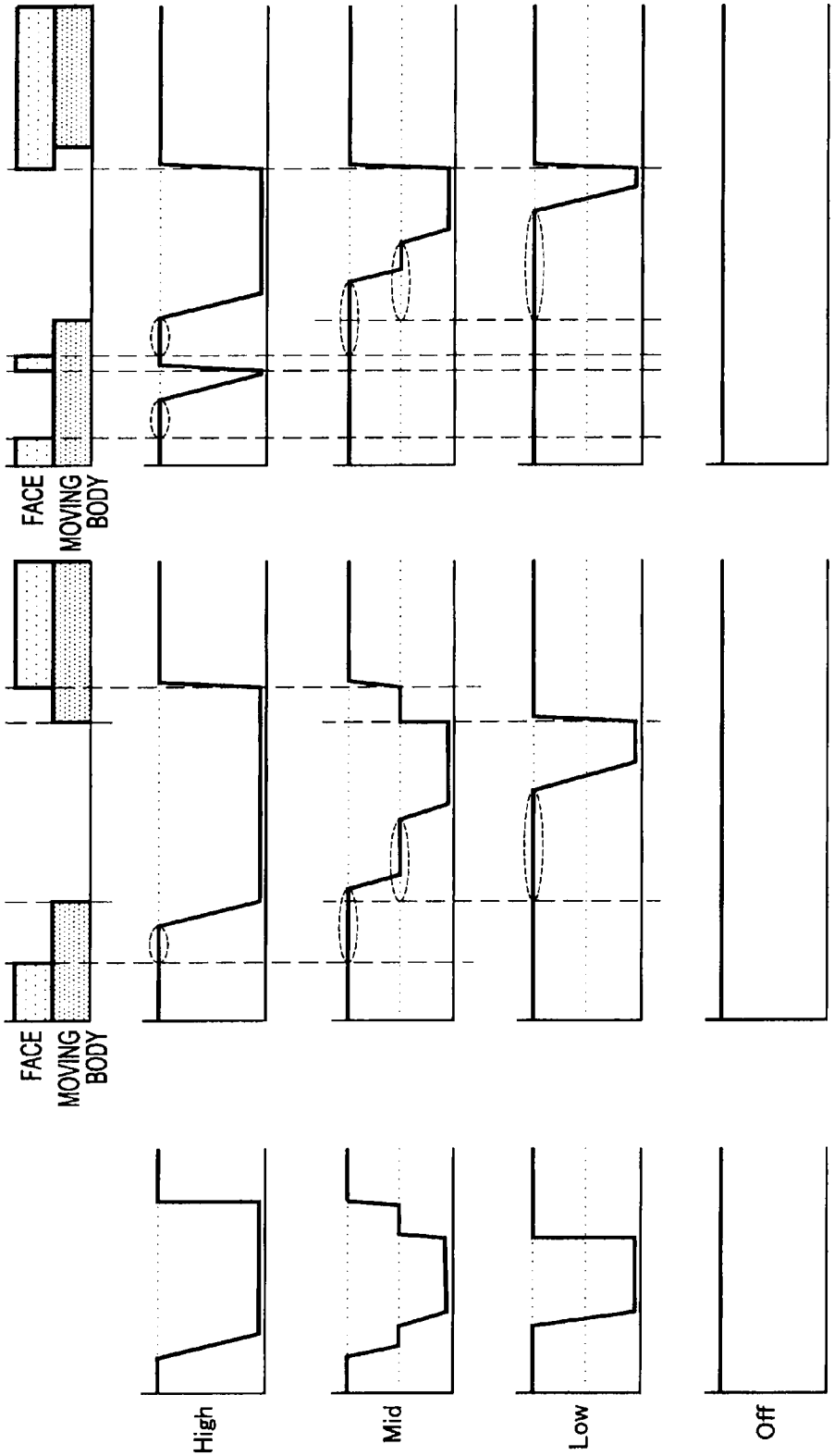
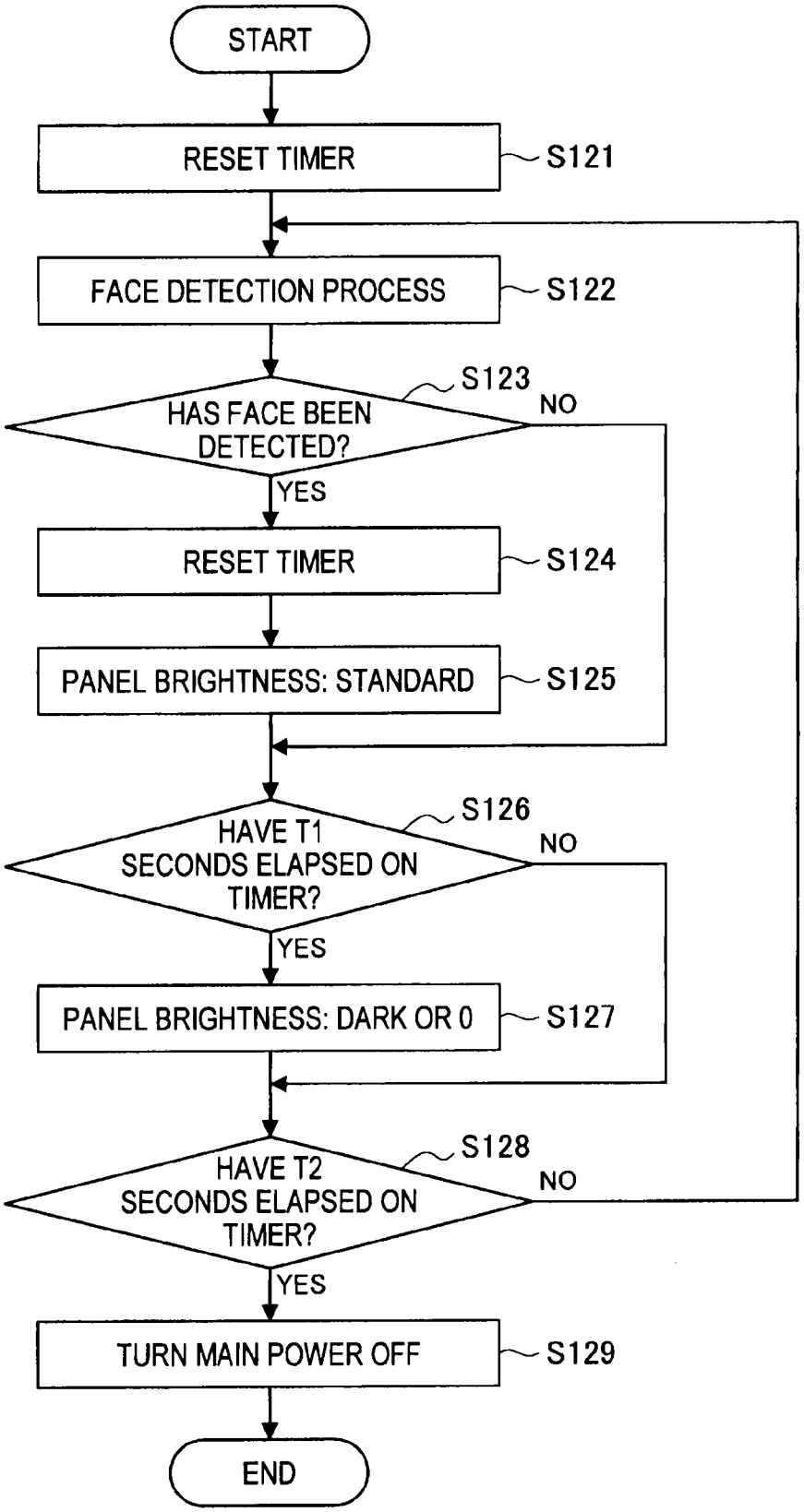


FIG. 6


START
RESET TIMER
S121
FACE DETECTION PROCESS
S122
S123
HAS FACE BEEN DETECTED?
NO
YES
RESET TIMER
S124
PANEL BRIGHTNESS: STANDARD
S125
S126
HAVE T1 SECONDS ELAPSED ON TIMER?
NO
YES
PANEL BRIGHTNESS: DARK OR 0
S127
S128
HAVE T2 SECONDS ELAPSED ON TIMER?
NO
YES
TURN MAIN POWER OFF
S129
END

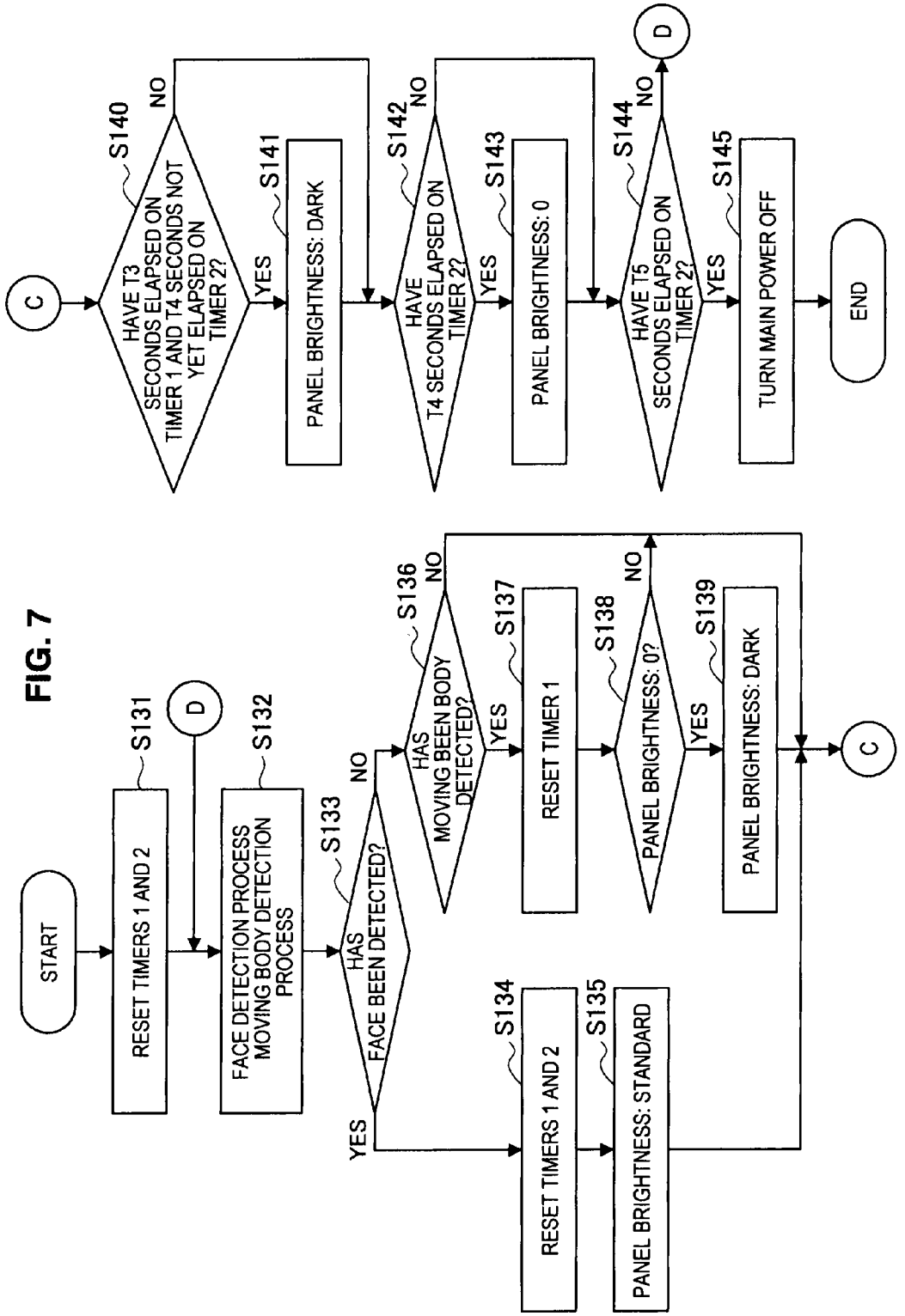
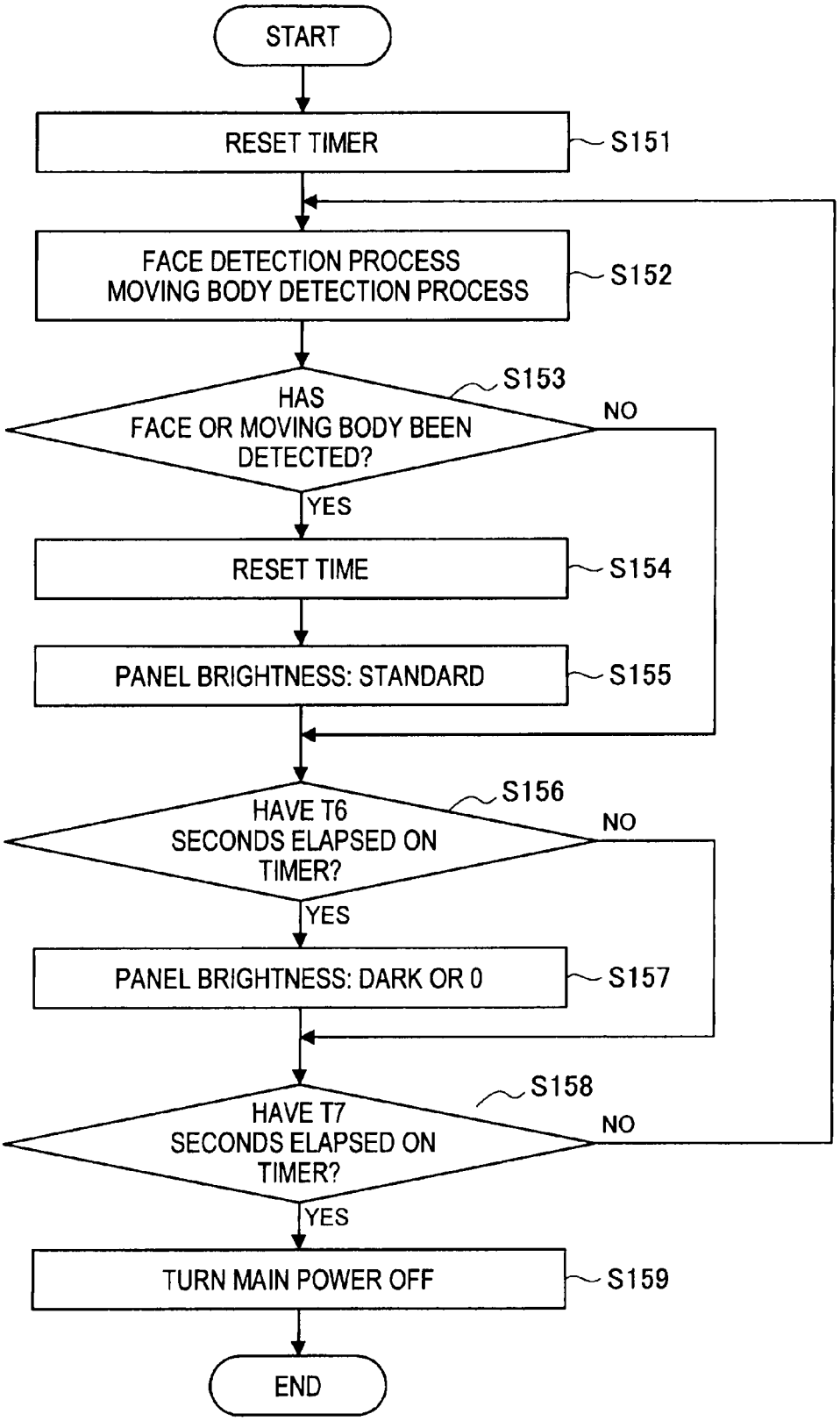

START
RESET TIMERS 1 AND 2
S131
D
FACE DETECTION PROCESS MOVING BODY DETECTION PROCESS
S132
HAS FACE BEEN DETECTED?
S133
YES
NO
RESET TIMERS 1 AND 2
S134
PANEL BRIGHTNESS: STANDARD
S135
HAS MOVING BEEN BODY DETECTED?
S136
YES
NO
RESET TIMER 1
S137
PANEL BRIGHTNESS: 0?
S138
YES
NO
PANEL BRIGHTNESS: DARK
S139
C
C
HAVE T3 SECONDS ELAPSED ON TIMER 1 AND T4 SECONDS NOT YET ELAPSED ON TIMER 2?
S140
YES
NO
PANEL BRIGHTNESS: DARK
S141
HAVE T4 SECONDS ELAPSED ON TIMER 2?
S142
YES
NO
PANEL BRIGHTNESS: 0
S143
HAVE T5 SECONDS ELAPSED ON TIMER 2?
S144
YES
NO
D
TURN MAIN POWER OFF
S145
END

FIG. 7

FIG. 8


START
RESET TIMER
S151
FACE DETECTION PROCESS
MOVING BODY DETECTION PROCESS
S152
HAS
FACE OR MOVING BODY BEEN
DETECTED?
S153
NO
YES
RESET TIME
S154
PANEL BRIGHTNESS: STANDARD
S155
HAVE T6
SECONDS ELAPSED ON
TIMER?
S156
NO
YES
PANEL BRIGHTNESS: DARK OR 0
S157
HAVE T7
SECONDS ELAPSED ON
TIMER?
S158
NO
YES
TURN MAIN POWER OFF
S159
END

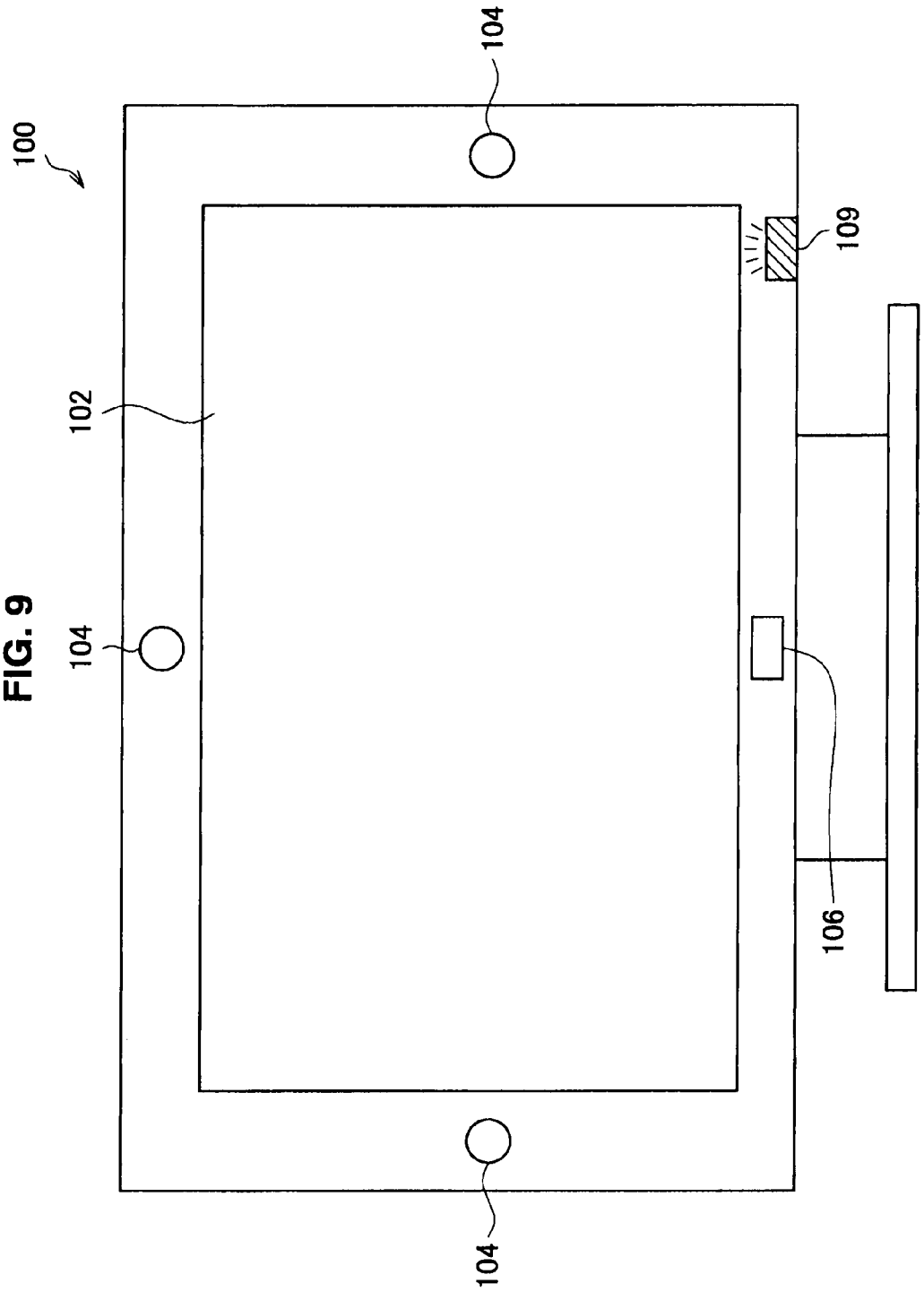
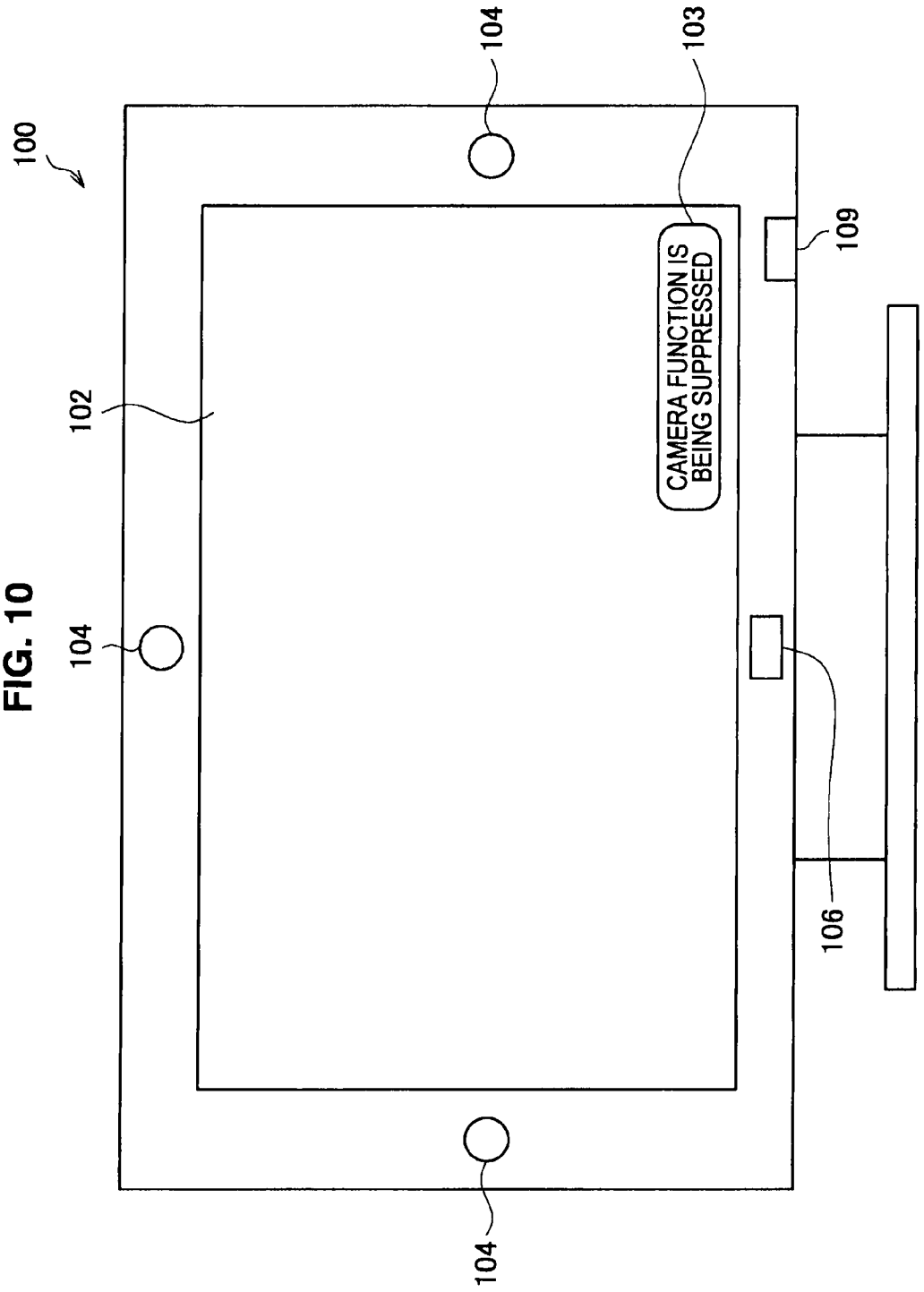


FIG. 9

FIG. 10


100
104
102
104
104
103
CAMERA FUNCTION IS BEING SUPPRESSED
109
106

DISPLAY DEVICE AND CONTROL METHOD

TECHNICAL FIELD

[0001] The present invention relates to a display device and a control method.

BACKGROUND ART

[0002] According to the survey of Japan Electronics and Information Technology Industries Association (JEITA), an average television viewing time per day is 4.5 hours. However, it has been found that a television is not viewed continuously during the 4.5 hours due to recent changes in lifestyle.

[0003] For example, when viewing the television while preparing to go to work or school in the morning or while having a meal, a screen of the television may not be continuously viewed. Further, when a program that is sufficient by an input from a voice such as a weather forecast is being broadcasted, viewers may not look at the screen, or may have a conversation with another person. Then, a behavior of beginning to view the screen of the television again due to an interesting keyword running in topical news or sports news is frequently done.

[0004] That is, as a representative television viewing form, the television is turned on instead of a clock in the morning, and "simultaneous viewing" of listening to a sound of the television while operating a personal computer (PC) at night has recently increased. When "simultaneous viewing" is performed, power is unnecessarily expended in a state in which the screen of the television is turned on. For this reason, a display device in which an imaging device is installed around the television screen, and power save control optimal for a viewing state is executed by performing face detection through the image device and analyzing a user's viewing state has been proposed.

SUMMARY OF INVENTION

Technical Problem

[0005] However, in the power save control using only face detection, there has been a problem in that even when it is desired to continuously view the display device, for example, when it is difficult to detect the user's face due to an installation environment of the television or when the user looks away during a certain time period, it is ultimately judged that viewing, that is, the face, is not present, and thus the display is turned off. Further, since the face detection process requires a relatively long image processing time compared to moving body detection, in an environment in which a computation rate or a resource is restricted, there has been a problem in that a response from when the user comes in front of the display device for viewing to when the image is displayed is delayed.

[0006] Further, there is a display device in which power save control is performed by detecting a moving body or the user's action through an imaging device or a pyroelectric infrared element and analyzing the user's viewing state. However, there has been a problem in that when the user keeps viewing without moving, it is erroneously judged that the user is not present, and the screen display is turned off. In order to avoid such a malfunction, it is necessary to increase a time until the power save control starts, which in turn deteriorates a power save effect.

[0007] The present invention is made in view of the above-mentioned issues, and aims to provide a display device and a control method which are novel and improved, and which are capable of efficiently executing the power save control with a high degree of accuracy by combining the user's moving body detection and face detection.

Solution to Problem

[0008] According to an aspect of the present invention in order to achieve the above-mentioned object, there is provided a display device including an imaging unit that captures a moving image in a predetermined range in an image display direction, a moving body detection unit that detects whether or not a moving body is present in a predetermined range in the image display direction, an image analysis unit that analyzes the moving image captured by the imaging unit to detect whether or not a face is present, and a power control unit that controls power consumption with different patterns according to a plurality of modes that are set by combining whether or not the face detected by the image analysis unit is present and whether or not the moving body detected by the detection unit is present.

[0009] The power control unit may have a first mode in which power consumption of the display device is controlled only according to whether or not the face detected by the image analysis unit is present, and when the image analysis unit has not been able to detect the presence of the face during a predetermined time, power consumption decreases.

[0010] The power control unit may have a second mode in which power consumption of the display device is controlled using whether or not the face detected by the image analysis unit is present and whether or not the moving body detected by the moving body detection unit is present, power consumption decreases up to a predetermined level when the image analysis unit has not been able to detect the presence of the face during a first predetermined time, and, after the decrease, power consumption further decreases when the moving body detection unit has not been able to detect the presence of the moving body during a second predetermined time.

[0011] The power control unit may have a third mode in which power consumption is controlled using whether or not the face detected by the image analysis unit is present and whether or not the moving body detected by the moving body detection unit is present, and when the image analysis unit has not been able to detect the presence of the face during a predetermined time and the moving body detection unit has not been able to detect the presence of the moving body during the predetermined time, power consumption decreases.

[0012] The power control unit may control power consumption of the display device by increasing or decreasing brightness of a display panel that display an image.

[0013] The power control unit may control power consumption of the display device by increasing or decreasing a sound volume of a speaker that display a voice.

[0014] The power control unit may control power consumption of the display device by controlling an operation of a circuitry configured to increase an image quality of a display image.

[0015] The display device may further include a notification unit that notifies that control of power consumption is stopped when the power control unit stops control of power consumption of the display device.

[0016] The image analysis unit may specify an individual through analysis on the moving image captured by the imag-

ing unit, and the power control unit may automatically select the mode corresponding to the individual specified by the image analysis unit.

[0017] The power control unit may automatically select the mode corresponding to the details of content to be displayed.

[0018] The power control unit may not start control of power consumption of the display device until the face or the moving body is first detected after power is turned on.

[0019] According to another aspect of the present invention in order to achieve the above-mentioned object, there is provided a control method including an imaging step of capturing a moving image in a predetermined range in an image display direction, a moving body detection step of detecting whether or not a moving body is present in a predetermined range in the image display direction, a face detection step of analyzing the captured moving image to detect whether or not a face is present, and a power control step of controlling power consumption with different patterns according to a plurality of modes by combining whether or not the face is present and whether or not the moving body is present.

Advantageous Effects of Invention

[0020] As described above, according to the present invention, a display device and a control method which are novel and improved, and which are capable of efficiently executing the power save control with a high degree of accuracy by combining the user's moving body detection and face detection can be provided.

BRIEF DESCRIPTION OF DRAWINGS

[0021] FIG. **1** is an explanation diagram for explaining an appearance of an image display device according to an embodiment of the present invention.

[0022] FIG. **2** is an explanation diagram illustrating a configuration of the image display device **100** according to an embodiment of the present invention.

[0023] FIG. **3** is an explanation diagram for explaining a configuration of a control unit **110**.

[0024] FIG. **4** is a flowchart illustrating an example of a power save process performed by the image display device **100** according to an embodiment of the present invention.

[0025] FIG. **5** is an explanation diagram for explaining a power save operation in respective power save modes in the image display device **100** according to an embodiment of the present invention.

[0026] FIG. **6** is a flowchart illustrating a power save operation of the image display device **100**.

[0027] FIG. **7** is a flowchart illustrating a power save operation of the image display device **100**.

[0028] FIG. **8** is a flowchart illustrating a power save operation of the image display device **100**.

[0029] FIG. **9** is an explanation diagram illustrating an operation example of the image display device **100** when a power mode is intentionally being suppressed.

[0030] FIG. **10** is an explanation diagram illustrating an operation example of the image display device **100** when a power mode is intentionally being suppressed.

DESCRIPTION OF EMBODIMENTS

[0031] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the appended drawings. Note that, in this specification and the drawings, elements that have substantially the same function and structure are denoted with the same reference signs, and repeated explanation is omitted.

[0032] Further, a description will be made in the following order:

[0033] <1. Embodiment of the Present Invention>

[0034] [1-1. Configuration of Image Display Device]

[0035] [1-2. Configuration of Control Unit]

[0036] [1-3. Power Save Process]

[0037] <2. Summary>

[0038] <1. Embodiment of the Present Invention>

[0039] [1-1. Configuration of Image Display Device]

[0040] First, a configuration of an image display device according to an embodiment of the present invention will be described. FIG. **1** is an explanation diagram for explaining an appearance of an image display device **100** according to an embodiment of the present invention. FIG. **1** is a front view in which the image display device **100** is viewed from the front. An appearance of the image display device **100** according to an embodiment of the present invention will be described below with reference to FIG. **1**.

[0041] As illustrated in FIG. **1**, the image display device **100** according to an embodiment of the present invention includes an imaging unit **104**, which captures a moving image, disposed in an upper-central part and left and right central parts of a display panel **102** that displays a still image or a moving image. The imaging unit **104** captures the moving image in a direction in which the image display device **100** displays the still image or the moving image through the display panel **102**. The image display device **100** according to the present embodiment analyzes an image captured by the imaging unit **104** and detects a user's face reflected on the image. The image display device **100** is characterized in that its internal operation state changes depending on whether or not the user's face is included in the image captured by the imaging unit **104**.

[0042] Further, the image display device **100** according to an embodiment of the present invention includes a sensor **106** disposed in a lower central part of the display panel **102**. The sensor **106** detects whether or not a person is present in front of the image display device **100**. The image display device **100** is also characterized in that its internal operation state changes depending on whether or not a person is present in front of the image display device **100**.

[0043] Further, the image display device **100** according to an embodiment of the present invention includes a light emitting diode (LED) **109**. The LED **109** notifies the user of a status of the image display device **100** through a lighting status or an emission color.

[0044] Further, in the image display device **100** illustrated in FIG. **1**, the imaging unit **104** that captures the moving image is disposed at three positions around the display panel **102** of the image. It should be understood that in the present invention, an image input position at which the moving image is captured is not limited to the example. For example, a device separate from the image display device **100** may be disposed, the corresponding device may be connected with the image display device **100**, and the moving picture may be captured by the corresponding device. Further, it should be understood that the number of image input units is not limited to three, and two or fewer or four or more image input units may be disposed to capture an image. Further, it should be understood that the number of the sensors **106** is not limited to one, and two or more sensors may be disposed to detect the presence of a person.

[0045] Further, although not shown in FIG. **1**, the image display device **100** may further include a signal reception unit that can receive a control signal from a remote controller (not shown) in an infrared ray manner, a wireless manner, or the like.

[0046] The appearance of the image display device **100** according to an embodiment of the present invention has been described above with reference to FIG. **1**. Next, a configuration of the image display device **100** according to an embodiment of the present invention will be described.

[0047] FIG. **2** is an explanation view illustrating a configuration of the image display device **100** according to an embodiment of the present invention. A configuration of the image display device **100** according to an embodiment of the present invention will be described below with reference to FIG. **2**.

[0048] As illustrated in FIG. **2**, the image display device **100** according to an embodiment of the present invention includes the display panel **102**, the imaging unit **104**, the sensor **106**, a speaker **108**, and a control unit **110**.

[0049] The control unit **110** includes an image input unit **112**, an image processing unit **114**, a viewing state analysis unit **116**, a viewing state recording unit **118**, a system optimization processing unit **120**, and a system control unit **122**.

[0050] The display panel **102** displays a still image or a moving image based on a panel drive signal. In the present embodiment, the display panel **102** displays the still image or the moving image through a liquid crystal. Of course, it should be understood that the present invention is not limited to the example. The display panel **102** may display the still image or the moving image by a display device of a light-emitting type such as an organic electroluminescence (EL).

[0051] The imaging unit **104** is disposed in the upper central part and the left and right central parts of the display panel **102** that displays the still image or the moving image as described above. When the panel drive signal is supplied to the display panel **102** and the moving image is displayed on the display panel **102**, the imaging unit **104** acquires the moving image in a direction in which the image display device **100** displays the moving image through the display panel **102**. The imaging unit **104** may capture the moving image by a charge coupled device (CCD) sensor or a complementary metal oxide semiconductor (CMOS) sensor. The moving image captured by the imaging unit **104** is transmitted to the control unit **110**.

[0052] The sensor **106** is displayed in the lower central part of the display panel **102** that displays the still image or the moving image as described above. The sensor **106** detects whether or not a person is present in front of the image display device **100**. Further, when a person is present in front of the image display device **100**, the sensor **106** can detect the distance between the image display device **100** and the person. The detection result and the distance information obtained by the sensor **106** are transmitted to the control unit **110**. The speaker **108** outputs a voice based on a voice output signal.

[0053] The control unit **110** controls an operation of the respective components of the image display device **100**. The respective components of the control unit **110** will be described below.

[0054] The image input unit **112** receives the moving image captured by the imaging unit **104**. The moving image received through the image input unit **112** is transmitted to the image processing unit **114** and used for image processing performed by the image processing unit **114**.

[0055] The image processing unit **114** is an example of an image analysis unit of the present invention and executes a variety of image processing on the moving image, which is captured by the imaging unit **104**, received from the image input unit **112**. The image processing executed by the image processing unit **114** includes a detection process of a moving body included in the moving image captured by the imaging unit **104**, a detection process of the number of people included in the moving image, and a detection process of a face and a facial expression included in the moving image. A result of a variety of image processing performed by the image processing unit **114** is transmitted to the viewing state analysis unit **116** and used for analysis on the presence of a person who is viewing the image display device **100** or a state of a person who is viewing the image display device **100**.

[0056] For example, the image processing unit **114** may use a technique disclosed in Japanese Patent Application Laid-Open (JP-A) Nos. 2007-65766 and 2005-44330 for the face detection process of detecting the face included in the image. The face detection process will be simply described below.

[0057] In order to detect the user's face from the image, the position of the face, the size of the face, and a direction of the face in the supplied image are detected, respectively. When the position and the size of the face are detected, a face image part can be cut from the image. Feature parts (facial feature positions) of the face such as an eyebrow, an eye, a neck, a nose, and a mouse are detected based on the cut face image and information of the direction of the face. The facial feature positions may be detected by detecting the feature positions, for example, using a technique called active appearance models (AAM).

[0058] When the facial feature positions are detected, a local feature quantity is calculated on each of the detected facial feature positions. The local feature quantity is calculated, and the calculated local feature quantity is stored in conjunction with the face image, and thus the face can be distinguished from the image captured by the imaging unit **104**. As the face distinguishing method, for example, a technique disclosed in JP-A Nos. 2007-65766 and 2005-44330 may be used, and thus a detailed description thereof will be omitted. Further, it can be judged based on the face image or the facial feature positions whether a face appearing in the supplied image is a man or a woman or whether a face appearing in the supplied image is an adult or a child. Further, since face information is previously recorded, it is possible to search for a person appearing in the supplied image from recorded faces and specify an individual.

[0059] The viewing state analysis unit **116** receives the result of the various image processing performed by the image processing unit **114** and the detection result and the distance information obtained by detection of the sensor **106**. The viewing state analysis unit **116** analyzes the presence or a state of a person who is viewing the image displayed by the image display device **100** using the result of the various image processing performed by the image processing unit **114** and the detection result and the distance information obtained by detection of the sensor **106**. Since the viewing state analysis unit **116** analyzes the presence of a person or a state of a viewer, the image display device **100** can decrease brightness of the display panel **102** or control the direction of the display panel **102** depending on whether or not a person who is viewing the image display device **100** is present. An analysis result of the analysis process performed by the viewing state

analysis unit **116** is transmitted to the viewing state recording unit **118** and the system optimization processing unit **120**.

[0060] Further, the viewing state analysis unit **116** can detect the moving body based on the detection result and the distance information obtained by detection of the sensor **106**, but when the distance between the sensor **106** and the moving body is equal to or more than a predetermined distance, the moving body can be excluded from a detection target.

[0061] The viewing state recording unit **118** records the analysis result obtained by the analysis process performed by the viewing state analysis unit **116**. The analysis result of the viewing state analysis unit **116** recorded in the viewing state recording unit **118** is used for a system optimization process in the system optimization processing unit **120**. Further, the analysis result of the viewing state analysis unit **116** recorded in the viewing state recording unit **118** may be transmitted to an external information collection server **200**.

[0062] The system optimization processing unit **120** is an example of a power control unit of the present invention. The system optimization processing unit **120** calculates system control information for executing the system optimization process on the respective components of the image display device **100** using the analysis result obtained by the analysis process of the viewing state analysis unit **116**. The system optimization process on the respective components of the image display device **100** includes power control of the image display device **100**, brightness control of the display panel **102**, direction control of the display panel **102**, display content control of the display panel **102**, sound volume control of a voice output from the speaker **108**, and operation control of a circuitry (not shown) configured to increase the image quality of the moving image displayed on the display panel **102**.

[0063] As the circuitry configured to increase the image quality of the moving image displayed on the display panel **102**, for example, a speed increasing circuit that increases a frame rate twice, three times, or the like may be used. Power consumption of the image display device **100** may be controlled by stopping a part or all of a circuit operation of the circuitry configured to increase the image quality of the moving image such as the speed increasing circuit.

[0064] The image display device **100** can execute a power save process based on the system control information calculated by the system optimization processing unit **120**. The system control information calculated by the system optimization processing unit **120** is transmitted to the system control unit **122**.

[0065] Further, the image display device **100** according to the present embodiment executes a power save operation according to a plurality of power save modes which will be described later. In each power save mode, the power save operation is executed based on the system control information that is created, by the system optimization processing unit **120**, to have a different pattern according to the analysis result of the viewing state analysis unit **116**.

[0066] The system control unit **122** executes the system optimization process on the respective components of the image display device **100** based on the system control information calculated by the system optimization processing unit **120**. Specifically, the system control unit **122** executes brightness control of the display panel **102**, direction control of the display panel **102**, display content control of the display panel **102**, and sound volume control of the voice output from the speaker **108** based on the system control information calculated by the system optimization processing unit **120**.

[0067] A configuration of the image display device **100** according to an embodiment of the present invention has been described above with reference to FIG. **2**. As described above, the image display device **100** according to an embodiment of the present invention analyzes the user's viewing state through the imaging unit **104** and the sensor **106**. In the conventional art, the imaging process is performed by the imaging unit **104**, and the user's viewing state is analyzed only through the face detection process that judges whether or not a face is included in the image captured by the imaging unit **104**. However, when the user's viewing state is analyzed only through the face detection process, there has been a problem in that even when it is desired to continuously view the display device, for example, when it is difficult to detect the user's face or when the user looks away during a certain time period, it is ultimately judged that viewing is not present, and thus the display is turned off. Further, since the face detection process requires a relatively long image processing time compared to the moving body detection process using the sensor or the like, in an environment in which a computation rate or a resource is restricted, a response from when the user comes in front of the display device for viewing to when the image is displayed has been delayed.

[0068] Meanwhile, there is a display device in which power save control is performed by detecting the moving body or the user's action through a pyroelectric infrared element or other sensors and analyzing the user's viewing state. However, there has been a problem in that when the user keeps viewing without moving, it is judged that the user is not present, and thus the screen display is turned off. In order to avoid such a malfunction, it is necessary to increase a time until the power save control starts, which in turn deteriorates a power save effect.

[0069] The image display device **100** according to an embodiment of the present invention combines the face detection process on the image captured by the imaging unit **104** and the moving body detection process performed by the sensor **106**. Thus, the user's viewing state can be more effectively analyzed.

[0070] Next, a configuration of the control unit **110** included in the image display device **100** according to an embodiment of the present invention will be described in detail.

[0071] [1-2. Configuration of Control Unit]

[0072] FIG. **3** is an explanation view for explaining a configuration of the control unit **110** included in the image display device **100** according to an embodiment of the present invention. Particularly, FIG. **3** illustrates configurations of the viewing state analysis unit **116** and the system optimization processing unit **120** among the components included in the control unit **110**. The configurations of the viewing state analysis unit **116** and the system optimization processing unit **120** will be described below with reference to FIG. **3**.

[0073] As illustrated in FIG. **3**, the viewing state analysis unit **116** includes a user viewing state analysis unit **132** and a user motion analysis unit **134**. The system optimization processing unit **120** includes a panel optimization processing calculation unit **142** and a speaker optimization processing calculation unit **144**.

[0074] The user viewing state analysis unit **132** receives the result of the various image processing performed by the image processing unit **114**, and the detection result and the distance information obtained by detection of the sensor **106**. The user viewing state analysis unit **132** detects whether or

not a person who is viewing the image display device **100** is present, and a direction or a size of a face of a person who is viewing the image display device **100** using the result of the various image processing performed by the image processing unit **114**, and the detection result and the distance information obtained by detection of the sensor **106**.

[0075] The user motion analysis unit **134** receives the result of the various image processing performed by the image processing unit **114**, and the detection result and the distance information obtained by detection of the sensor **106**. The user motion analysis unit **134** analyzes whether or not a person who is viewing the image display device **100** is present, based on time-series or special state or record of the user's motion, using the result of the various image processing performed by the image processing unit **114**, and the detection result and the distance information obtained by detection of the sensor **106**.

[0076] Here, the image processing unit **114** transmits the captured image, face detection information (for example, information such as central coordinates [a**1**,b**1**], the size of a face [w**1**,h**1**], and a direction of a face [i**1**]) of each user who is using the image display device **100** in the captured image, and moving body information (for example, information such as central coordinates [c**1**,d**1**], the size of a facial area [s**1**]) to the viewing state analysis unit **116**. The viewing state analysis unit **116** performs the analysis process on whether or not a person who is viewing the image display device **100** is present using the information received from the image processing unit **114** through the user viewing state analysis unit **132** and the user motion analysis unit **134**.

[0077] The panel optimization processing calculation unit **142** calculates a process (a power save implementation process) capable of implementing optimum power save in the display panel **102** using the result of the analysis process performed by the user viewing state analysis unit **132** and the user motion analysis unit **134**. For example, the process capable of implementing optimum power save in the display panel **102** may include a process of controlling power consumption by increasing or decreasing brightness of the display panel **102** according to whether or a person who is viewing the image display device **100** is present and a time in which a person who is viewing the image display device **100** is not present, or controlling power consumption by increasing or decreasing the sound volume of the voice output from the speaker **106**. The power save implementation process calculated by the panel optimization processing calculation unit **142** is transmitted to the system control unit **122** and used in the power save process of the display panel **102**.

[0078] The speaker optimization processing calculation unit **144** calculates a process (a power save implementation process) capable of implementing optimum power save in the speaker **108** using the result of the analysis process performed by the user viewing state analysis unit **132** and the user motion analysis unit **134**. For example, the process capable of implementing optimum power save in the speaker **108** may include a process of controlling a sound volume of the speaker **108** according to whether or a person who is viewing the image display device **100** is present and a time in which a person who is viewing the image display device **100** is not present. The power save implementation process calculated by the speaker optimization processing calculation unit **144** is transmitted to the system control unit **122** and used in the power save process of the speaker **108**.

[0079] Further, for calculation of the power wave implementation process in the system optimization processing unit **120**, an optimization processing effect calculation unit **152** may be used. The optimization processing effect calculation unit **152** calculates control information for the optimum power save process corresponding to the user's viewing state using the analysis result of the viewing state analysis unit **116** and the calculation result of the power save implementation process performed by the system optimization processing unit **120**.

[0080] The configuration of the control unit **110** included in the image display device **100** according to an embodiment of the present invention has been described with reference to FIG. **3**. Next, the power save process performed by the image display device **100** according to an embodiment of the present invention will be described.

[0081] [1-3. Power Save Process]

[0082] FIG. **4** is a flowchart illustrating the power save process performed by the image display device **100** according to an embodiment of the present invention. The power save process performed by the image display device **100** according to an embodiment of the present invention will be described below with reference to FIG. **4**.

[0083] The flowchart illustrated in FIG. **4** illustrates an example of a transition process to a mode (a power save mode) of suppressing power consumption of the image display device **100**. A transition process to the power save mode by the image display device **100** according to an example of the present invention will be described below in detail. When the image display device **100** is powered on, the system optimization processing unit **120** sets a control flag to one (1) (step S**101**). The control flag is a flag for deciding whether or not the power save mode is to be executed in the image display device **100**. The power save mode is not executed when the flag is 1, but when the flag is zero (0), the power save mode is executed. The viewing state analysis unit **116** performs the face detection process and the moving body detection process to judge whether or not a person who is viewing the image display device **100** is present (step S**102**).

[0084] The viewing state analysis unit **116** judges whether or not the presence of a person who is viewing the image display device **100** has been detected as a result of the face detection process and the moving body detection process of step S**102** (step S**103**). When it is judged in step S**103** that the viewing state analysis unit **116** has detected the presence of a person who is viewing the image display device **100**, the system optimization processing unit **120** sets the control flag to 0 (step S**104**). However, when it is judged in step S**103** that the viewing state analysis unit **116** has not detected the presence of a person who is viewing the image display device **100**, the control flag remains as 1.

[0085] Subsequently, it is judged whether or not the user has performed an operation on the image display device **100** through the remote controller for operating the image display device **100** (step S**105**). The operation judgment may be executed by the viewing state analysis unit **116**.

[0086] When it is judged in step S**105** that the user has performed an operation on the image display device **100** through the remote controller, information of a final operation time retained in the image display device **100** is set to a current time (step S**106**). Setting the information of the final operation time to the current time may be performed, for example, by the viewing state analysis unit **116**.

[0087] When information of the final operation time retained in the image display device **100** is set to the current

time in step S**106**, the system optimization processing unit **120** releases the power save mode (step S**107**).

[0088] However, when it is judged in step S**105** that the user has not performed an operation on the image display device **100** through the remote controller, step S**106** and step S**107** are skipped.

[0089] Subsequently, the system optimization processing unit **120** judges whether or not a power save mode start condition is satisfied (step S**108**). The power save mode start condition depends on the power save mode designated by the user. An example of the power save mode start condition in the image display device **100** according to an embodiment of the present invention will be described below, but it should be understood that the number of power save modes and the power save mode start condition of each power save mode are not limited to the example.

[0090] The image display device **100** according to an embodiment of the present invention has three kinds of power save modes including "High," "Medium," and "Low." The system optimization processing unit **120** calculates the system control information corresponding to each power save mode, and the system control unit **122** executes a variety of control based on the calculated system control information. Thus, power consumption of the respective components of the image display device **100** can be controlled with different patterns.

[0091] "High" is a power save mode in which when the viewing state analysis unit **116** has not recognized the face during a specific time period, transition to a power save operation of suppressing power consumption is performed.

[0092] "Medium" is a power save mode in which when the viewing state analysis unit **116** has not recognized the face during a specific time period, transition to a power save operation of suppressing power consumption is performed, and when the viewing state analysis unit **116** has not recognized the face and the moving body during a specific time period, transition to a power save operation of suppressing power consumption is further performed.

[0093] "Low" is a power save mode in which when the viewing state analysis unit **116** has not recognized the face and the moving body during a specific time period, transition to a power save operation of suppressing power consumption is performed.

[0094] FIG. **5** is an explanation diagram for explaining the power save operation in the respective power save modes in the image display device **100** according to an embodiment of the present invention. A graph illustrated in the uppermost row of FIG. **5** represents patterns of face detection and moving body detection chronologically. In the other graphs of FIG. **5**, a horizontal axis denotes time, and a vertical axis denotes power consumption.

[0095] As illustrated in FIG. **5**, when the power save mode is "High," if the viewing state analysis unit **116** cannot recognize the face during a specific time (for example, between 3 seconds and 10 seconds), power consumption is steadily suppressed, for example, by decreasing the brightness of the display panel **102** or decreasing the sound volume of the speaker **108**. However, when the viewing state analysis unit **116** can recognize the face or when an operation on the image display device **100** has been performed by the remote controller, the power save mode is released.

[0096] Further, when the power save mode is "Middle," if the viewing state analysis unit **116** cannot recognize the face during a specific time (for example, between 10 seconds and 30 seconds), power consumption is steadily suppressed up to about half, for example, by decreasing the brightness of the display panel **102** or decreasing the sound volume of the speaker **108**. Further, if the viewing state analysis unit **116** cannot recognize the face and the moving body during a specific time (for example, between 1 minute and 3 minutes), power consumption is further suppressed, for example, by decreasing the brightness of the display panel **102** or decreasing the sound volume of the speaker **108**. However, when the viewing state analysis unit **116** can recognize the face or when an operation on the image display device **100** has been performed by the remote controller, the power save mode is released.

[0097] Further, when the power save mode is "Low," if the viewing state analysis unit **116** cannot recognize the face and the moving body during a specific time (for example, between 3 minutes and 10 minutes), power consumption is steadily suppressed, for example, by decreasing the brightness of the display panel **102** or decreasing the sound volume of the speaker **108**. However, when the viewing state analysis unit **116** can recognize the face or when an operation on the image display device **100** has been performed by the remote controller, the power save mode is released.

[0098] FIG. **5** illustrates the power save operation in the respective power save modes using two patterns of face detection and moving body detection. A pattern illustrated in a middle column of FIG. **5** illustrates a case in which the moving body is not detected after the face has not been detected, the moving body is detected, and the face is detected after the detection. The pattern is referred to as "pattern **1**." Further, a pattern illustrated at the right of FIG. **5** illustrates a case in which the face is detected again after the face had not been detected, the face is not detected again, the moving body is not detected again, the face is first detected, and then the moving body is detected. The pattern is referred to as "pattern **2**."

[0099] If the power save mode is "High," since transition to the power save mode is performed only according to whether or not the face is present, a power save operation illustrated in a graph of a second step from the top of FIG. **5** is performed on each of the case of pattern **1** and the case of pattern **2**. If the power save mode is "Medium," since power consumption is suppressed by first performing transition to the power save mode according to whether or not the face is present and then further suppressing power consumption according to whether or not the moving body is present, a power save operation illustrated in a graph of a third step from the top of FIG. **5** is performed on each of the case of pattern **1** and the case of pattern **2**. If the power save mode is "Low," since power consumption is suppressed by first performing transition to the power save mode according to whether or not the face and the moving body are present, a power save operation illustrated in a graph of a fourth step from the top of FIG. **5** is performed on each of the case of pattern **1** and the case of pattern **2**.

[0100] When the system optimization processing unit **120** judges that the power save mode start condition is satisfied in step S**108**, the system optimization processing unit **120** judges whether or not the control flag is 0 (step S**109**).

[0101] When the system optimization processing unit **120** judges that the control flag is 0 in step S**109**, the system optimization processing unit **120** judges whether or not a time obtained by subtracting the final operation time set in step S**106** from the current time has exceeded a specific time (step S**110**). For example, in the case in which the power save mode

of the image display device **100** is set to "High," the system optimization processing unit **120** judges whether or not the time obtained by subtracting the final operation time set in step S**106** from the current time has exceeded 10 seconds.

[0102] When the system optimization processing unit **120** judges that the time obtained by subtracting the final operation time set in step S**106** from the current time has exceeded the specific time in step S**110**, the image display device **100** starts the power save mode (step S**111**). For example, in the case in which the power save mode of the image display device **100** is set to "High," if the time obtained by subtracting the final operation time set in step S**106** from the current time has exceeded 10 seconds, the image display device **100** starts the power save mode, and decreases the brightness of the display panel **102** or decreases the sound volume of the speaker **108** to steadily suppress power consumption.

[0103] After transition to the power save mode is performed in step S**111**, when the system optimization processing unit **120** judges that the power save mode start condition is not satisfied in step S**108**, when the system optimization processing unit **120** judges that the control flag is not 0 in step S**109**, or when the system optimization processing unit **120** judges that a time obtained by subtracting the final operation time from the current time has not exceeded the specific time in step S**110**, it is judged whether or not an operation of the image display device **100** has been finished, for example, because power is turned off (step S**112**). If the operation of the image display device **100** has been finished, the process is finished as is. However, if the operation of the image display device **100** has not been finished, the process returns to step S**102**, and execution of the face detection process and the moving body detection process is continued by the viewing state analysis unit **116**.

[0104] The power save process performed by the image display device **100** according to an embodiment of the present invention has been described above with reference to FIG. **4**. Next, the power save operation of each power save mode in the image display device **100** according to an embodiment of the present invention will be described.

[0105] FIG. **6** is a flowchart illustrating the power save operation when the power save mode in the image display device **100** according to an embodiment of the present invention is "High." The power save operation when the power save mode in the image display device **100** according to an embodiment of the present invention is "High" will be described below with reference to FIG. **6**.

[0106] First, a timer retained in the image display device **100** is reset in advance before starting the power save operation (step S**121**). For example, resetting of the timer in step S**121** may be executed by the viewing state analysis unit **116**.

[0107] Subsequently, the viewing state analysis unit **116** executes the face detection process (step S**122**). The viewing state analysis unit **116** judges whether or not a human face is included in the image transmitted to the image input unit **112** as a result of executing the face detection process through the viewing state analysis unit **116** (step S**123**).

[0108] When the viewing state analysis unit **116** judges that a human face is included in the image transmitted to the image input unit **112** in step S**123**, the timer retained in the image display device **100** is reset again (step S**124**). For example, resetting of the timer in step S**124** may be executed by the viewing state analysis unit **116** similarly to resetting of the timer in step S**121**.

[0109] When the timer is reset in step S**124**, the system optimization processing unit **120** sets the brightness of the display panel **102** to standard brightness (brightness at the time of ordinary use) (step S**125**).

[0110] However, when the viewing state analysis unit **116** judges that a human face is not included in the image transmitted to the image input unit **112** in step S**123**, the system optimization processing unit **120** judges whether or not T**1** seconds (for example, 10 seconds) have elapsed on the timer (step S**126**).

[0111] When the system optimization processing unit **120** judges that T**1** seconds have elapsed on the timer in step S**126**, the system optimization processing unit **120** sets the brightness of the display panel **102** to be dark or zero (0) (step S**127**).

[0112] When the system optimization processing unit **120** sets the brightness of the display panel **102** to be zero or darkest in step S**127** or when the system optimization processing unit **120** judges that T**1** seconds have not elapsed on the timer yet in step S**126**, the system optimization processing unit **120** judges whether or not T**2** seconds have elapsed on the timer (here, T**2**>T**1**) (step S**128**).

[0113] When the system optimization processing unit **120** judges that T**2** seconds have elapsed on the timer in step S**128**, the system optimization processing unit **120** executes a process of turning main power of the image display device **100** off (step S**129**). However, when the system optimization processing unit **120** judges that T**2** seconds have not elapsed on the timer in step S**128**, the process returns to step S**122**, and the face detection process is continued by the viewing state analysis unit **116**.

[0114] The power save operation when the power save mode in the image display device **100** according to an embodiment of the present invention is "High" has been described above with reference to FIG. **6**. Next, the power save operation when the power save mode in the image display device **100** according to an embodiment of the present invention is "Medium" will be described.

[0115] FIG. **7** is a flowchart illustrating the power save operation when the power save mode in the image display device **100** according to an embodiment of the present invention is "Medium." The power save operation when the power save mode in the image display device **100** according to an embodiment of the present invention is "Medium" will be described below with reference to FIG. **7**.

[0116] First, two timers (hereinafter, for convenience of description, the two timers are referred to as timers **1** and **2**, respectively) retained in the image display device **100** are reset in advance before starting the power save operation (step S**131**). For example, resetting of the timers **1** and **2** in step S**121** may be executed by the viewing state analysis unit **116**. The timer **1** measures a time in which the viewing state analysis unit **116** has not detected the face, and the timer **2** measures a time in which the viewing state analysis unit **116** has not detected the presence of the moving body.

[0117] Subsequently, the viewing state analysis unit **116** executes the face detection process and the moving body detection process (step S**132**). The viewing state analysis unit **116** judges whether or not a human face is included in the image transmitted to the image input unit **112** as a result of executing the face detection process through the viewing state analysis unit **116** (step S**133**).

[0118] When the viewing state analysis unit **116** judges that a human face is included in the image transmitted to the image

input unit **112** in step S**133**, the timers **1** and **2** retained in the image display device **100** are reset again (step S**134**). For example, resetting of the timers in step S**134** may be executed by the viewing state analysis unit **116** similarly to resetting of the timers in step S**131**.

[0119] When the timers are reset in step S**134**, the system optimization processing unit **120** sets the brightness of the display panel **102** to standard brightness (brightness at the time of ordinary use) (step S**135**).

[0120] However, when the viewing state analysis unit **116** judges that a human face is not included in the image transmitted to the image input unit **112** in step S**133**, the viewing state analysis unit **116** judges whether or not the sensor **106** has detected the moving body (step S**136**).

[0121] When the viewing state analysis unit **116** judges that the sensor **106** has detected the moving body in step S**136**, the timer **2** is reset (step S**137**). For example, resetting of the timer **2** in step S**137** may be executed by the viewing state analysis unit **116** similarly to resetting of the timers in step S**131** and step S**134**.

[0122] When the timer **2** is reset in step S**137**, it is judged whether or not the brightness of the display panel **102** is zero (0) (step S**138**). For example, the judgment on the brightness of the display panel **102** may be executed by the system optimization processing unit **120**.

[0123] When the system optimization processing unit **120** judges that the brightness of the display panel **102** is zero in step S**138**, the system optimization processing unit **120** regards that the user is in front of the image display device **100** but the user's face is not facing the direction of the display panel. Thus, the system optimization processing unit **120** calculates the system control information for performing control to lower the brightness of the display panel **102** and lowers the brightness of the display panel **102** (step S**139**).

[0124] Subsequently, the system optimization processing unit **120** judges whether or not T**3** seconds (for example, 30 seconds) have elapsed on the timer **1** and T**4** seconds (for example, 180 seconds), which is longer than T**3** seconds, have not elapsed on the timer **2** yet (step S**140**).

[0125] When the system optimization processing unit **120** judges whether or not T**3** seconds have elapsed on the timer **1** and T**4** seconds have not elapsed on the timer **2** yet in step S**140**, the system optimization processing unit **120** regards that the user is in front of the image display device **100** but the user's face is not facing the direction of the display panel. Thus, the system optimization processing unit **120** calculates the system control information for performing control to lower the brightness of the display panel **102** and lowers the brightness of the display panel **102** (step S**141**).

[0126] However, when the system optimization processing unit **120** judges that T**3** seconds have not elapsed on the timer **1** yet in step S**140**, the system optimization processing unit **120** skips step S**141**.

[0127] Subsequently, the system optimization processing unit **120** judges whether or not T**4** seconds have elapsed on the timer **2** (step S**142**). When the system optimization processing unit **120** judges that T**4** seconds have elapsed on the timer **2** in step S**142**, the system optimization processing unit **120** regards that the user is not in front of the image display device **100**. Thus, the system optimization processing unit **120** calculates the system control information for performing control to bring the brightness of the display panel **102** to zero and brings the brightness of the display panel **102** to zero (step S**143**).

[0128] However, when the system optimization processing unit **120** judges that T**4** seconds have not elapsed on the timer **2** yet in step S**142**, the system optimization processing unit **120** skips step S**142**.

[0129] Subsequently, the system optimization processing unit **120** judges whether or not T**5** seconds, which is longer than T**4** seconds, have elapsed on the timer **2** (step S**144**). When the system optimization processing unit **120** judges that T**5** seconds, which is longer than T**4** seconds, have elapsed on the timer **2** in step S**144**, the system optimization processing unit **120** regards that the user is not in front of the image display device **100**. Thus, the system optimization processing unit **120** executes a process of turning main power of the image display device **100** off (step S**145**). However, when the system optimization processing unit **120** judges that T**5** seconds, which is longer than T**4** seconds, have not elapsed on the timer **2** in step S**144**, the process returns to step S**132**, and the face detection process and the moving body detection process are continued by the viewing state analysis unit **116**.

[0130] The power save operation when the power save mode in the image display device **100** according to an embodiment of the present invention is "Medium" has been described above with reference to FIG. **7**. Next, the power save operation when the power save mode in the image display device **100** according to an embodiment of the present invention is "Low" will be described.

[0131] FIG. **8** is a flowchart illustrating the power save operation when the power save mode in the image display device **100** according to an embodiment of the present invention is "Low." The power save operation when the power save mode in the image display device **100** according to an embodiment of the present invention is "Low" will be described below with reference to FIG. **8**.

[0132] First, a timer retained in the image display device **100** is reset in advance before starting the power save operation (step S**151**). For example, resetting of the timer in step S**151** may be executed by the viewing state analysis unit **116**.

[0133] Subsequently, the viewing state analysis unit **116** executes the face detection process and the moving body detection process (step S**152**). The viewing state analysis unit **116** judges whether or not the face or the moving body has been detected, that is, a person is in front of the image display device **100**, as a result of executing the face detection process and the moving body detection process through the viewing state analysis unit **116** (step S**153**).

[0134] When the viewing state analysis unit **116** judges that the face or the moving body has been detected in step S**153**, the timer retained in the image display device **100** is reset again (step S**154**). For example, resetting of the timer in step S**154** may be executed by the viewing state analysis unit **116** similarly to resetting of the timer in step S**151**.

[0135] When the timer retained in the image display device **100** is reset in step S**154**, the system optimization processing unit **120** sets the brightness of the display panel **102** to standard brightness (brightness at the time of ordinary use) (step S**155**).

[0136] However, when the viewing state analysis unit **116** judges that the face and the moving body have not been detected in step S**153**, the system optimization processing unit **120** judges whether or not T**6** seconds (for example, 600 seconds) have elapsed on the timer (step S**156**).

[0137] When the system optimization processing unit **120** judges that T**6** seconds have elapsed on the timer in step S**156**,

the system optimization processing unit **120** sets the brightness of the display panel **102** to be dark or zero (0) (step S**157**).

[0138] When the system optimization processing unit **120** sets the brightness of the display panel **102** to be zero or darkest in step S**157** or when the system optimization processing unit **120** judges that T**7** seconds have not elapsed on the timer yet in step S**156**, the system optimization processing unit **120** judges whether or not T**7** seconds have elapsed on the timer (here, T**7**>T**6**) (step S**158**).

[0139] When the system optimization processing unit **120** judges that T**7** seconds have elapsed on the timer in step S**158**, the system optimization processing unit **120** executes a process of turning main power of the image display device **100** off (step S**159**). However, when the system optimization processing unit **120** judges that T**7** seconds have not elapsed on the timer in step S**158**, the process returns to step S**152**, and the face detection process and the moving body detection process are continued by the viewing state analysis unit **116**.

[0140] The power save operation when the power save mode in the image display device **100** according to an embodiment of the present invention is "Low" has been described above with reference to FIG. **8**.

[0141] <2. Summary>

[0142] As described above, according to the image display device **100** according to an embodiment of the present invention, it is judged whether the user is in front of the image display device **100** according to whether or not a human face is included in the image captured by the imaging unit **104** and whether or not the moving body has been detected by the sensor **106**. Since the face detection process and the moving body detection process are combined as described above, the presence of the user who is in front of the image display device **100** can be detected with a high degree of accuracy.

[0143] Further, according to the image display device **100** according to an embodiment of the present invention, a plurality of power save modes can be implemented by combining the face detection process and the moving body detection process. That is, the image display device **100** according to an embodiment of the present invention can execute the power save mode using only the face detection process and can execute the power save mode in which the face detection process and the moving body detection process are combined. Since a plurality of power save modes can be implemented, it is possible to execute the power save mode suitable for the user's use state of the image display device **100**.

[0144] Further, a series of processes described above may be implemented by hardware or software. When a series of processes is implemented by software, a program that constitutes the software is installed into a computer integrated in dedicated hardware or a general-purpose personal computer in which a variety of functions can be executed by installing a variety of programs from a program recording medium.

[0145] While the preferred embodiments of the present invention have been described above with reference to the accompanying drawings, the present invention is of course not limited to the above examples. A person skilled in the art may find various alterations and modifications within the scope of the appended claims, and it should be understood that they will naturally come under the technical scope of the present invention.

[0146] For example, the user's use state may be recorded in the image display device **100** in order, and using a result of learning the user's recorded use state, the system optimization processing unit **120** may automatically select the power save mode from among a plurality of power save modes. An example of an automatic selection process of the power save mode will be described below.

[0147] For example, the user may be specified by performing a face recognition process on an image captured by the imaging unit **104**, and the system optimization processing unit **120** may automatically select the power save mode for each of the specified users. For example, a power save mode in which image erasing is performed less and the power save effect is low may previously be set to the image display device **100** for a father, and a power save mode in which image erasing is frequently performed and the power save effect is low may previously be set to the image display device **100** for a mother. Depending on whether a person included in the image captured by the imaging unit **104** is the father or the mother, the system optimization processing unit **120** may automatically select the power save mode.

[0148] For example, the system optimization processing unit **120** may automatically select the optimum power save mode through analysis on a viewing style of a specific individual. For example, in the case of the user who is more likely to turn on the television for a long time but to view the television less, transition to image erasing is easily performed. However, in the case of the user who is more likely to keep viewing a program for a short time, transition to image erasing becomes difficult to perform. Since it is necessary to record the user's viewing style during a specific time period for analysis of the viewing style, automatic setting cannot be used from the beginning, but upon acquisition of necessary data, an automatic setting option can be effectively used.

[0149] Further, for example, a mode may be automatically selected according to content that is being viewed through the image display device **100**. For example, when content such as a movie is viewed through the image display device **100**, continuous viewing may be treated as a priority, and a time until image erasing may increase. When information different from the content such commercials is provided at a regular interval, a time until image erasing may increase or decrease in the content part and the other parts. Further, information on content that is being viewed through the image display device **100** may be acquired, for example, from data of an electronic program guide (EPG) or may be acquired from a genre of the content currently being viewed, and set to the image display device **100** by the user of the image display device **100**.

[0150] Further, for example, in view of a situation in which normal image processing cannot be performed due to backlight or shielding or a situation in which a malfunction in which the power save mode starts regardless of whether or not the user views the device occurs, for example, in an environment in which the user views the device outside an angle of view, the system optimization processing unit **120** may not start the power save mode even if the face or the moving body is not detected until at least one face is first detected after the power save process starts.

[0151] In order to avoid a malfunction during a time period (or a certain time period thereafter) after the face is detected at least once and the image display device **100** starts the power save mode, and the user is considered to execute an active operation through the remote controller, for example, powering the image display device **100** on or changing the content being displayed on the display panel **102**, the system optimization processing unit **120** may not start the power save mode even if the face or the moving body is not detected.

[0152] Further, in the case in which the power save mode is intentionally being suppressed, the image display device **100** may notify the user of a suppression status of the power save mode through a state notification means (for example, an LED or a user interface (UI) indication inside a screen) included therein. FIGS. **9** and **10** are explanation diagrams illustrating operation examples of the image display device **100** when the power save mode is intentionally being suppressed. FIG. **9** illustrates an example in which an LED **109** emits light of predetermined color as an indicator representing that the power save mode is being suppressed when the power save mode is intentionally being suppressed. FIG. **10** illustrates an example in which a graphical user interface (GUI) indicator **103** representing that the power save mode is being suppressed is displayed on the display panel **102** when the power save mode is intentionally being suppressed.

REFERENCE SIGNS LIST

[0153] **100** image display device
[0154] **102** display panel
[0155] **104** imaging unit
[0156] **106** sensor
[0157] **108** speaker
[0158] **109** LED
[0159] **110** control unit
[0160] **112** image input unit
[0161] **114** image processing unit
[0162] **116** viewing state analysis unit
[0163] **118** viewing state recording unit
[0164] **120** system optimization processing unit
[0165] **122** system control unit
[0166] **132** user viewing state analysis unit
[0167] **134** user motion analysis unit
[0168] **142** panel optimization processing calculation unit
[0169] **144** speaker optimization processing calculation unit
[0170] **152** optimization processing effect calculation unit

1. A display device, comprising:
an imaging unit that captures a moving image in a predetermined range in an image display direction;
a moving body detection unit that detects whether or not a moving body is present in a predetermined range in the image display direction;
an image analysis unit that analyzes the moving image captured by the imaging unit to detect whether or not a face is present; and
a power control unit that controls power consumption with different patterns according to a plurality of modes that are set by combining whether or not the face detected by the image analysis unit is present and whether or not the moving body detected by the detection unit is present.

2. The display device according to claim **1**, wherein the power control unit has a first mode in which power consumption is controlled only according to whether or not the face detected by the image analysis unit is present, and when the image analysis unit has not been able to detect the presence of the face during a predetermined time, power consumption decreases.

3. The display device according to claim **1**, wherein the power control unit has a second mode in which power consumption is controlled using whether or not the face detected by the image analysis unit is present and whether or not the moving body detected by the moving body detection unit is present, power consumption decreases up to a predetermined level when the image analysis unit has not been able to detect the presence of the face during a first predetermined time, and, after the decrease, power consumption further decreases when the moving body detection unit has not been able to detect the presence of the moving body during a second predetermined time.

4. The display device according to claim **1**, wherein the power control unit has a third mode in which power consumption is controlled using whether or not the face detected by the image analysis unit is present and whether or not the moving body detected by the moving body detection unit is present, and when the image analysis unit has not been able to detect the presence of the face during a predetermined time and the moving body detection unit has not been able to detect the presence of the moving body during the predetermined time, power consumption decreases.

5. The display device according to claim **1**, wherein the power control unit controls power consumption by increasing or decreasing brightness of a display panel that display an image.

6. The display device according to claim **1**, wherein the power control unit controls power consumption by increasing or decreasing a sound volume of a speaker that plays a voice.

7. The display device according to claim **1**, wherein the power control unit controls power consumption by controlling an operation of a circuitry configured to increase an image quality of a display image.

8. The display device according to claim **1**, further comprising a notification unit that notifies that control of power consumption is stopped when the power control unit stops control of power consumption.

9. The display device according to claim **1**, wherein the image analysis unit specifies an individual through analysis on the moving image captured by the imaging unit, and the power control unit automatically selects the mode corresponding to the individual specified by the image analysis unit.

10. The display device according to claim **1**, wherein the power control unit automatically selects the mode corresponding to the details of content to be displayed.

11. The display device according to claim **1**, wherein the power control unit does not start control of power consumption until the face or the moving body is first detected after power is turned on.

12. A control method, comprising:
an imaging step of capturing a moving image in a predetermined range in an image display direction;
a moving body detection step of detecting whether or not a moving body is present in a predetermined range in the image display direction;
a face detection step of analyzing the captured moving image to detect whether or not a face is present; and
a power control step of controlling power consumption with different patterns according to a plurality of modes by combining whether or not the face is present and whether or not the moving body is present.

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