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(54) **IMAGE DISPLAYING APPARATUS AND METHOD OF OPERATING THE SAME**

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G06T 3/40	(2006.01)
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(57) **ABSTRACT**

An image display apparatus includes a display configured to display a first image corresponding to a region of a 360-degree image, and to display an indicator in a three-dimensional (3D) shape including a pointer pointing to a location of the region, a sensor configured to sense an input for moving the region, and a controller configured to control movement of the region and to display a second image corresponding to a region to which the region has been moved, and to move the pointer within the indicator based on the movement of the region. The pointer is movable in an altitudinal direction and an azimuthal direction within the indicator.

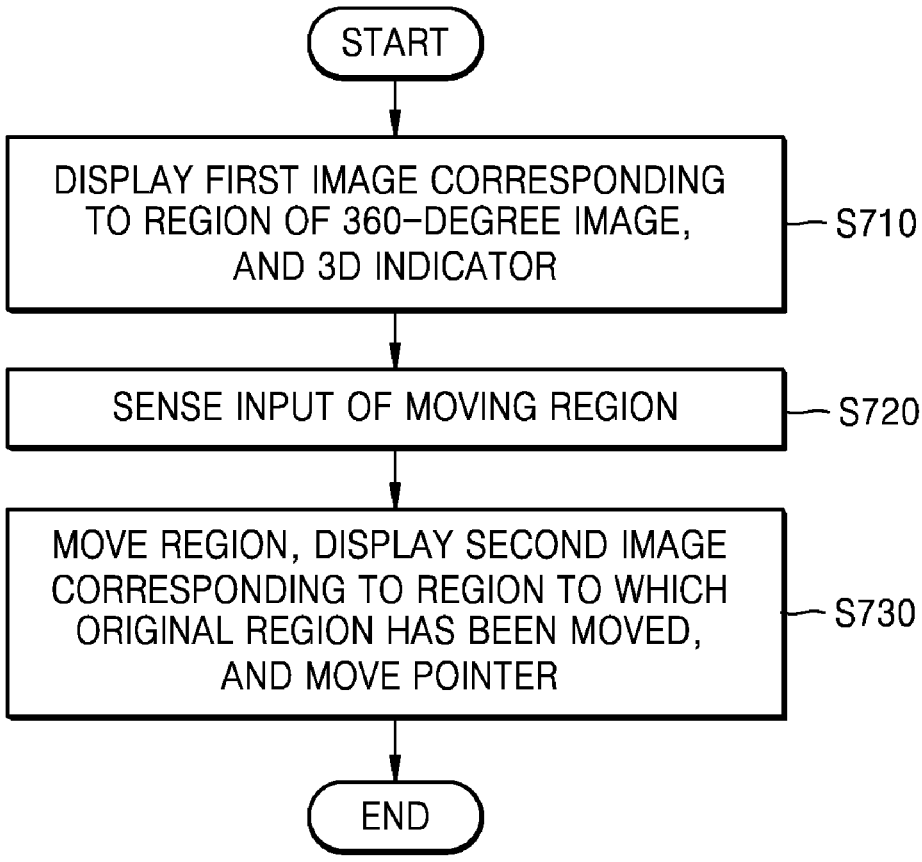

FIG. 1

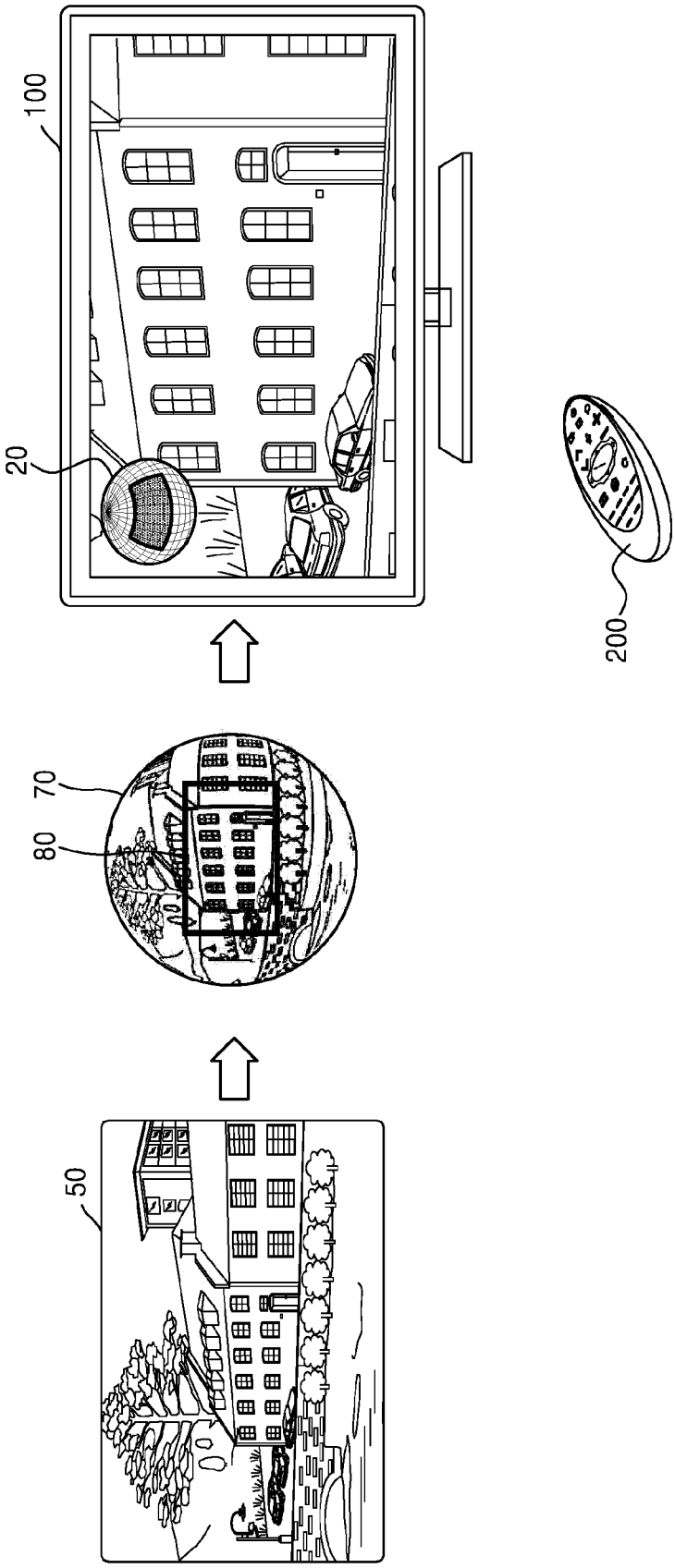

FIG. 2

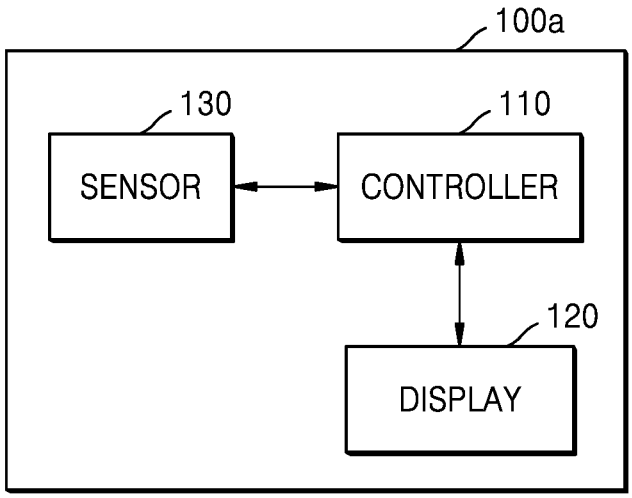

FIG. 3

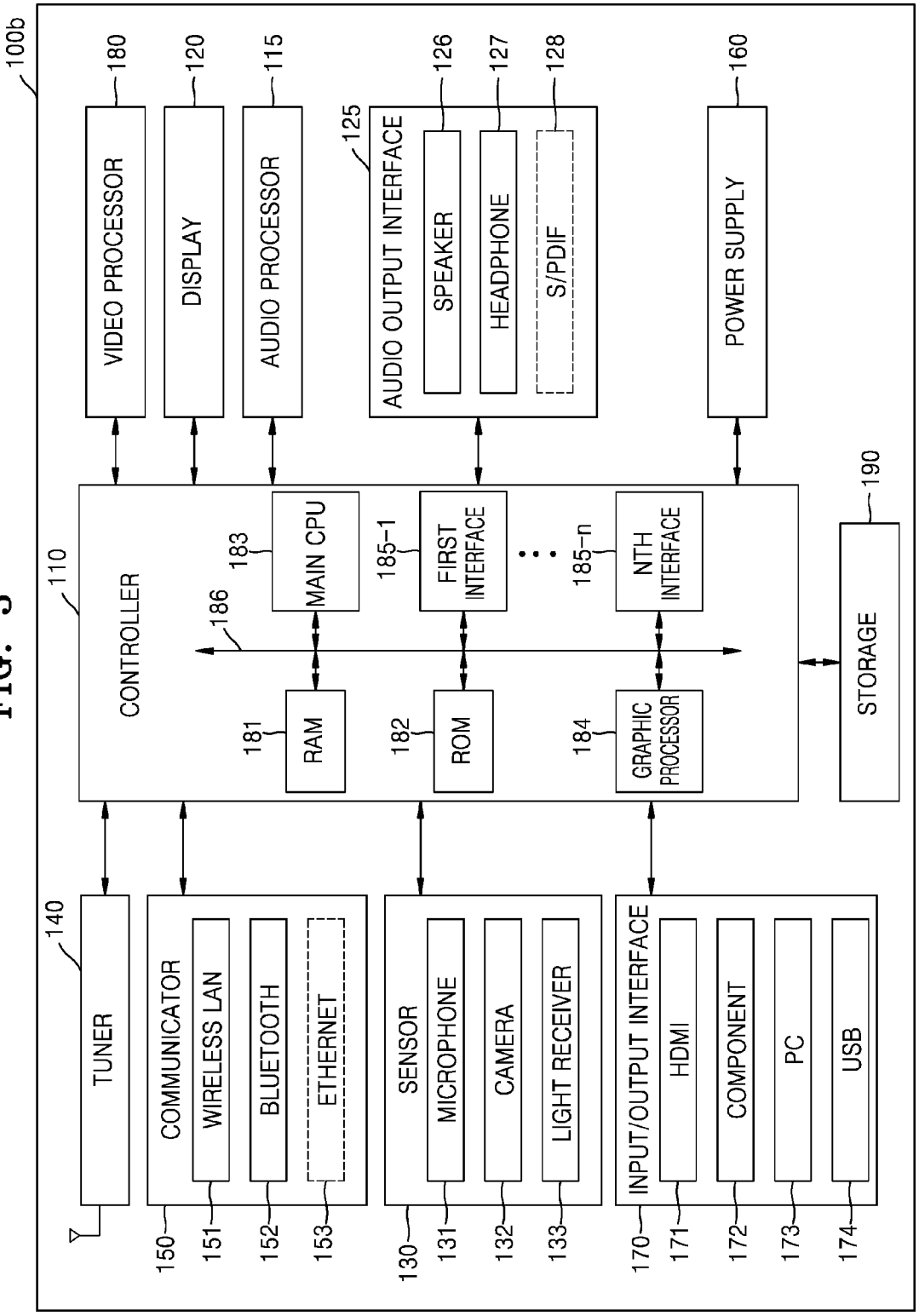
100b
VIDEO PROCESSOR
180
DISPLAY
120
AUDIO PROCESSOR
115
AUDIO OUTPUT INTERFACE
125
SPEAKER
126
HEADPHONE
127
S/PDIF
128
POWER SUPPLY
160
CONTROLLER
110
MAIN CPU
183
FIRST INTERFACE
185-1
NTH INTERFACE
185-n
186
RAM
181
ROM
182
GRAPHIC PROCESSOR
184
STORAGE
190
TUNER
140
COMMUNICATOR
150
WIRELESS LAN
151
BLUETOOTH
152
ETHERNET
153
SENSOR
130
MICROPHONE
131
CAMERA
132
LIGHT RECEIVER
133
INPUT/OUTPUT INTERFACE
170
HDMI
171
COMPONENT
172
PC
173
USB
174

FIG. 4

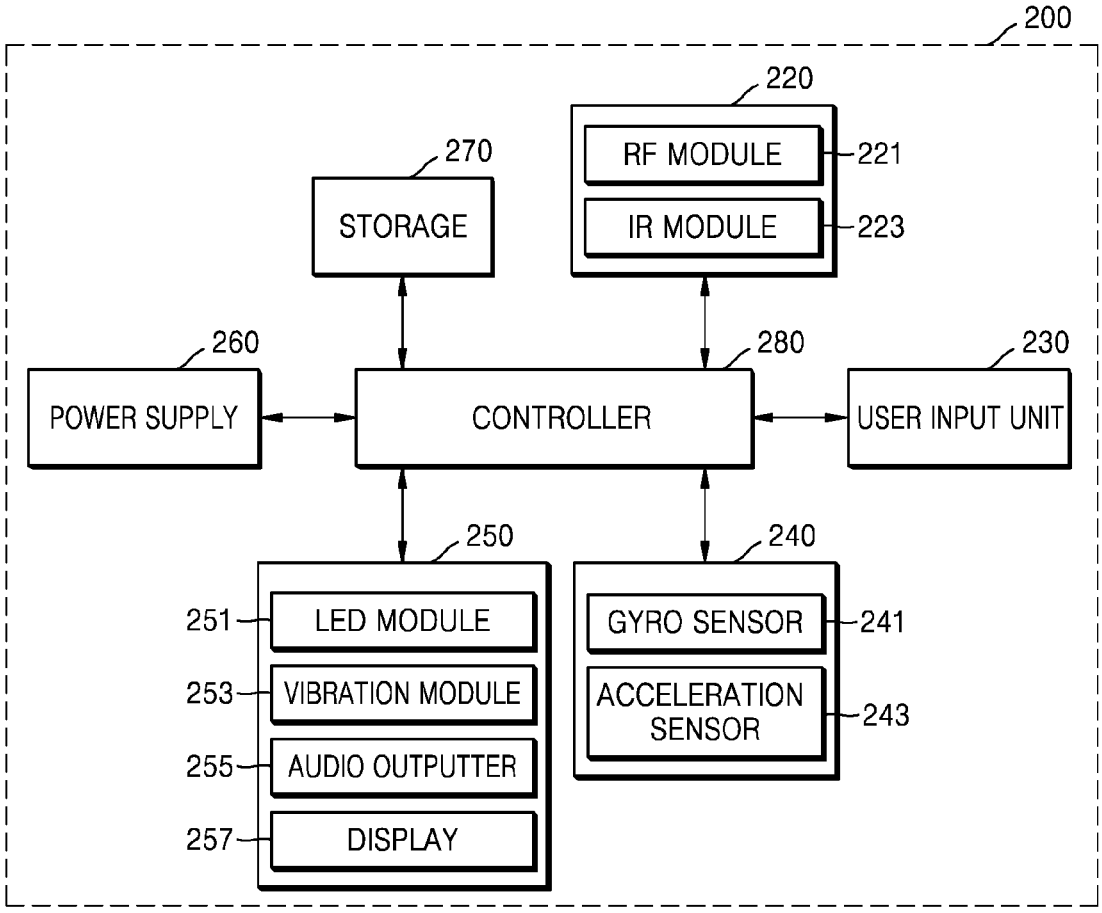
200
220
RF MODULE
221
IR MODULE
223
270
STORAGE
260
POWER SUPPLY
280
CONTROLLER
230
USER INPUT UNIT
250
251
LED MODULE
253
VIBRATION MODULE
255
AUDIO OUTPUTTER
257
DISPLAY
240
GYRO SENSOR
241
ACCELERATION SENSOR
243

FIG. 5A

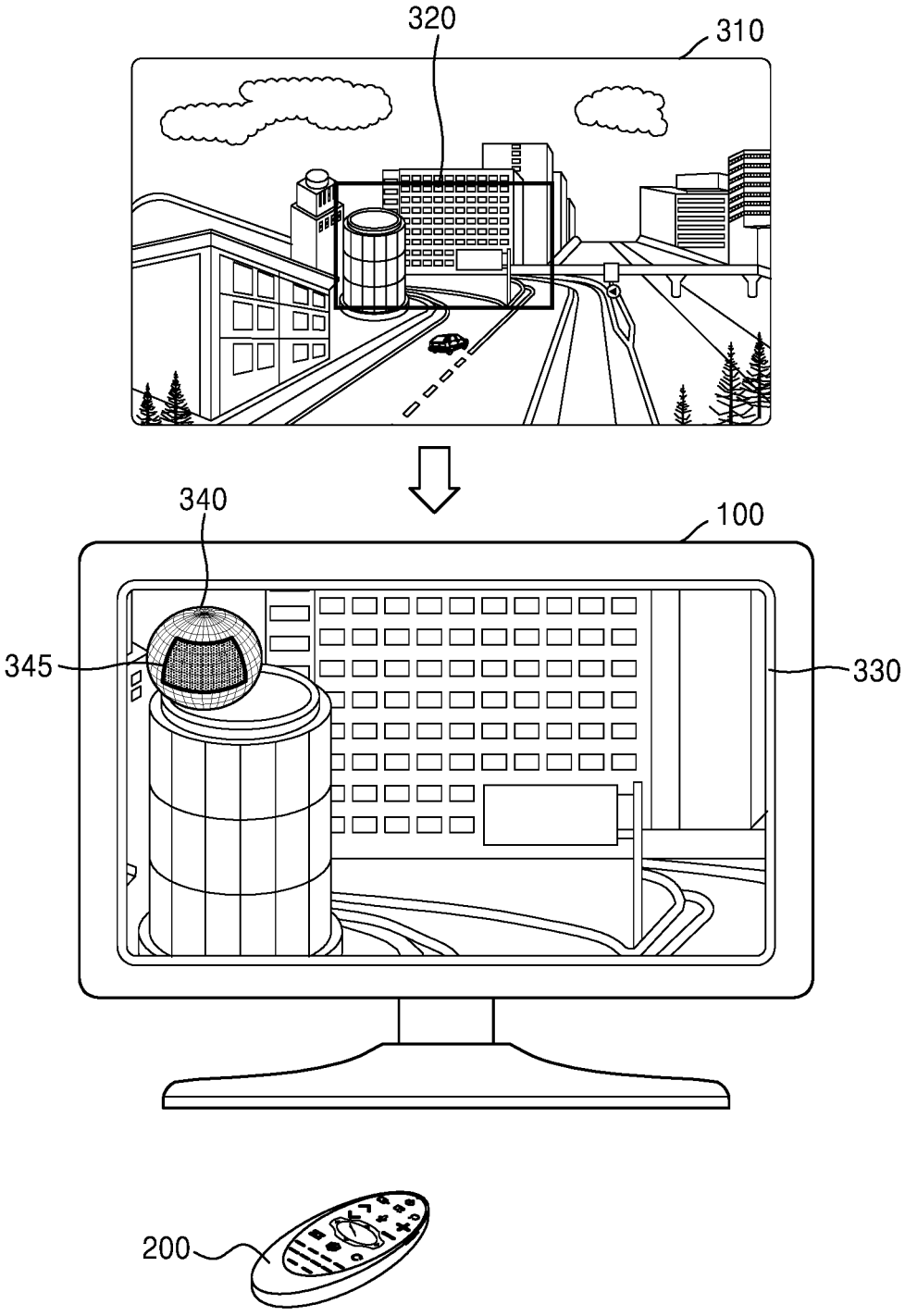

FIG. 5B

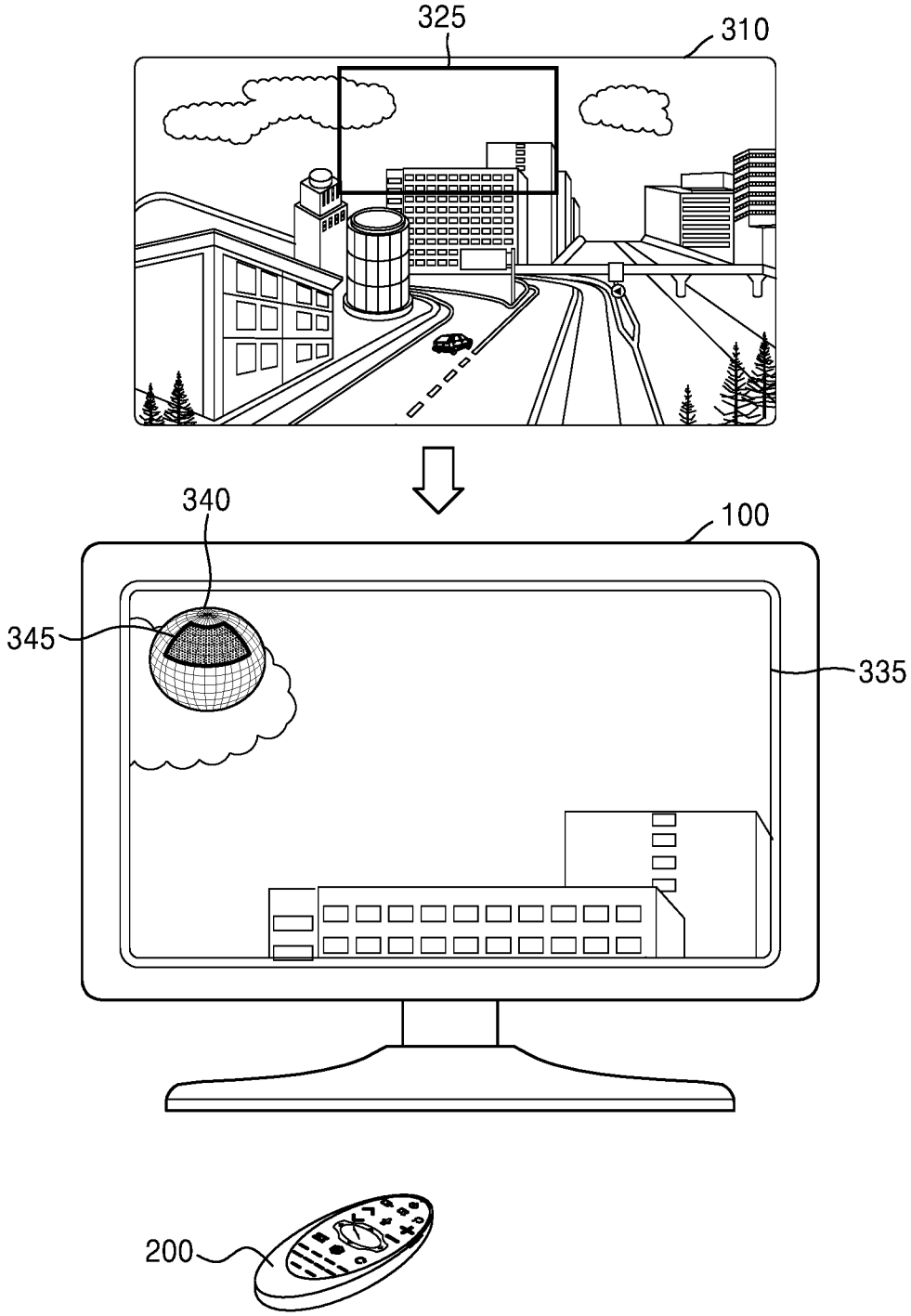

FIG. 5C

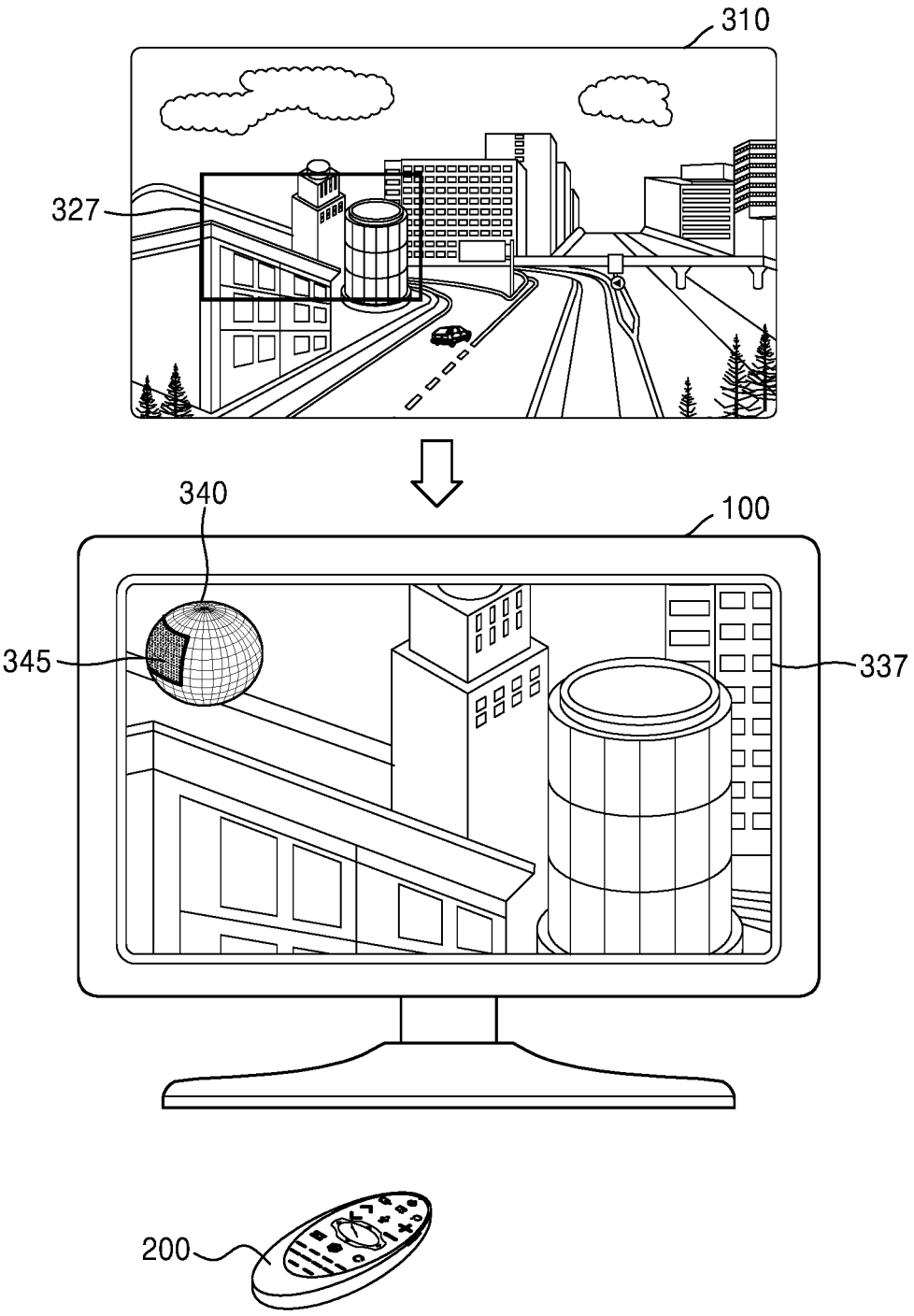

FIG. 6B

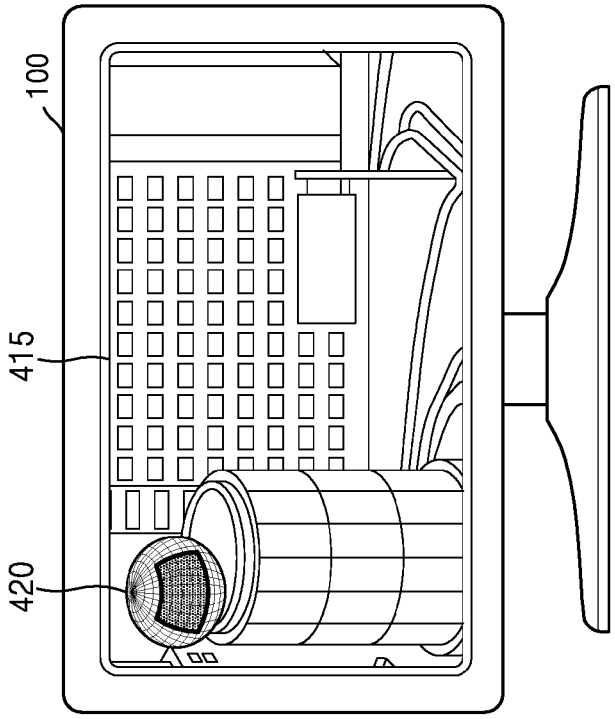

FIG. 6A

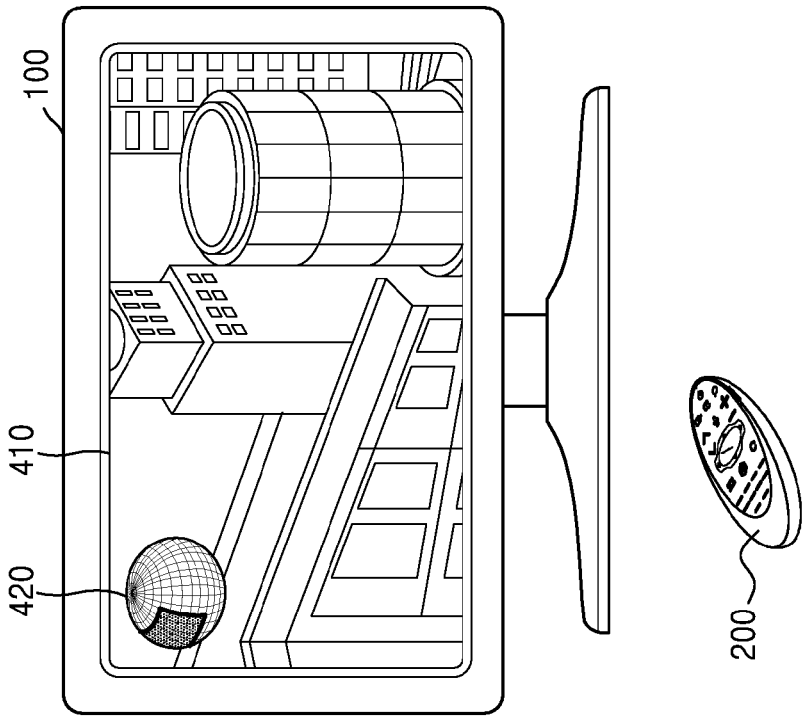

FIG. 7B

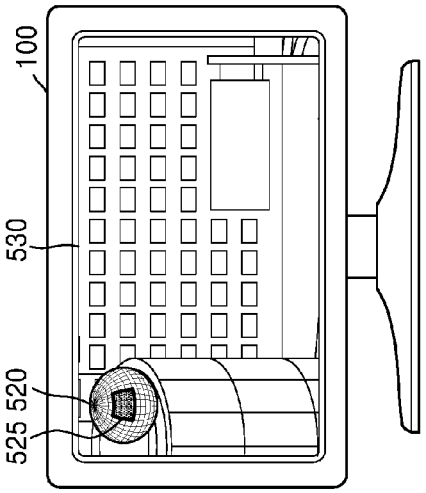

FIG. 7C

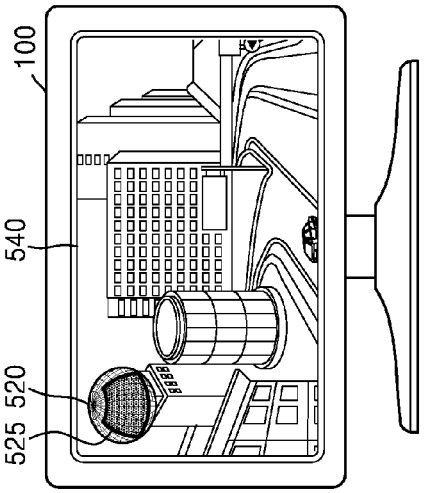

FIG. 7A

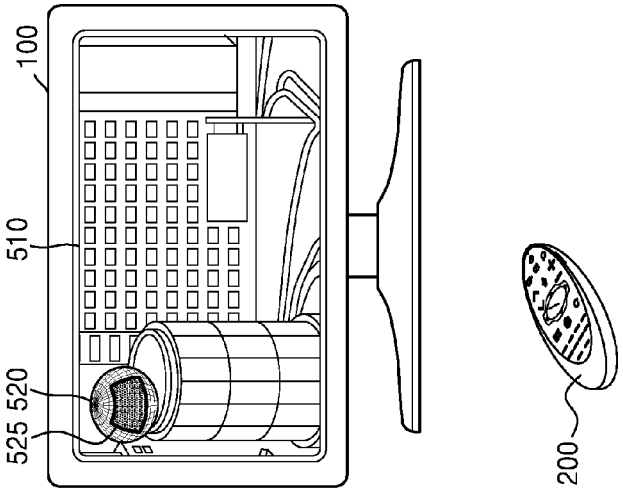

FIG. 8A

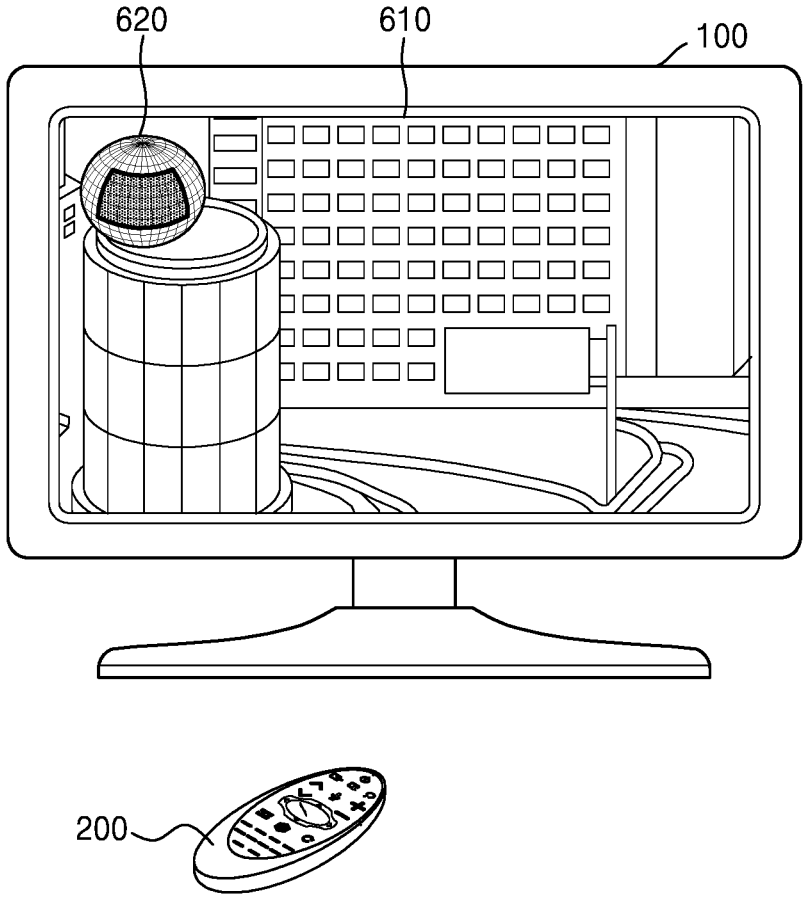

FIG. 8B

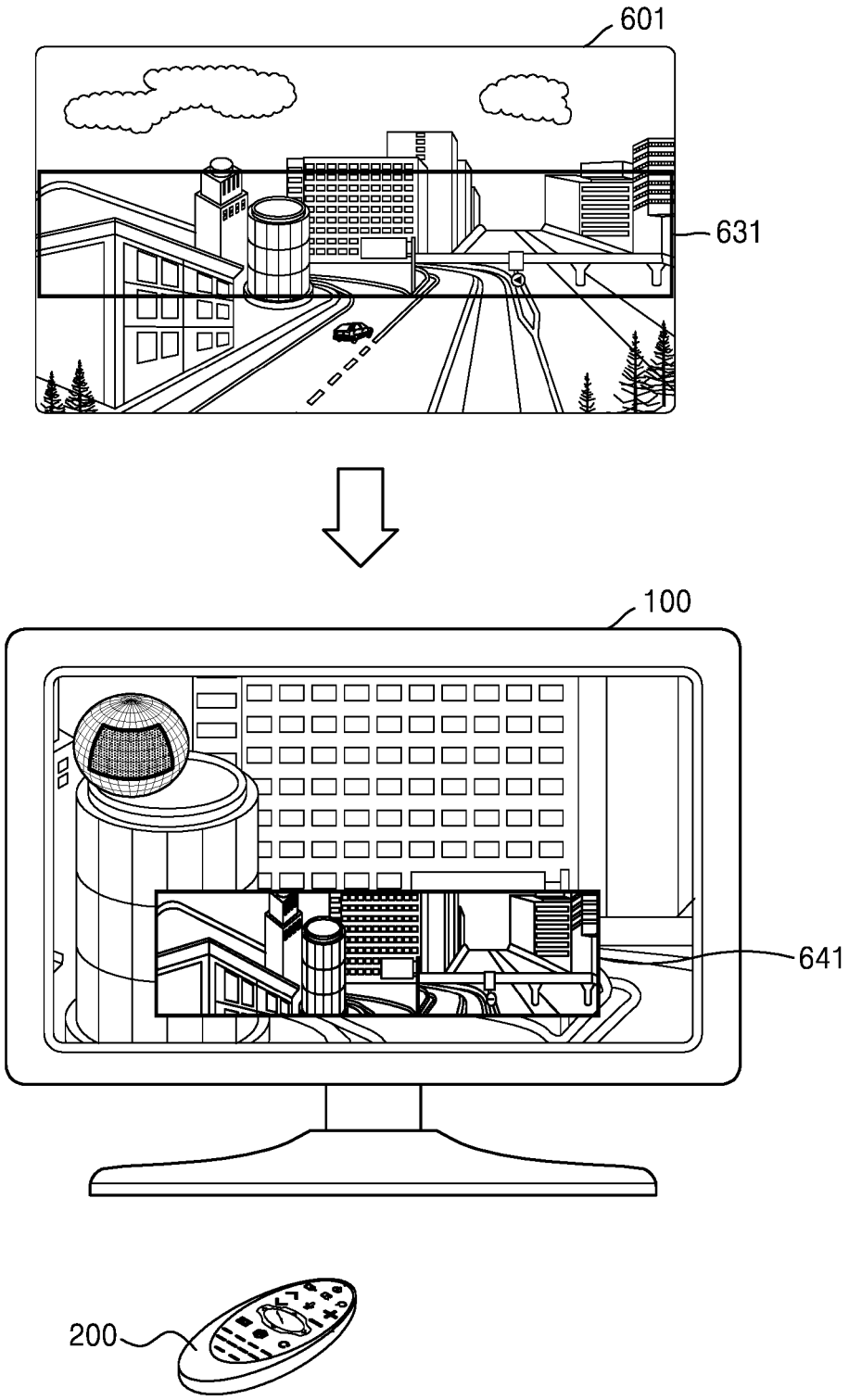

FIG. 8C

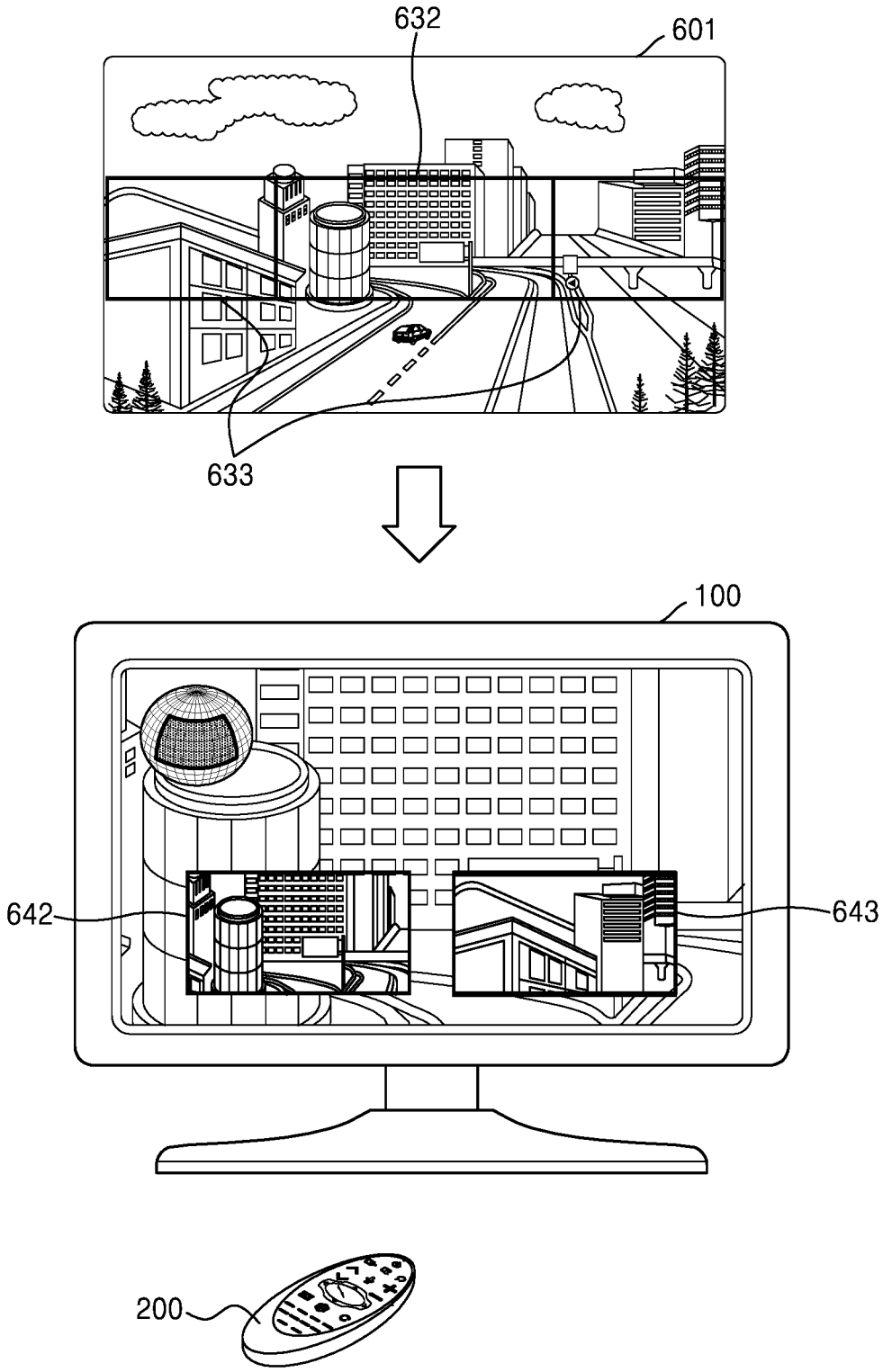

FIG. 8D

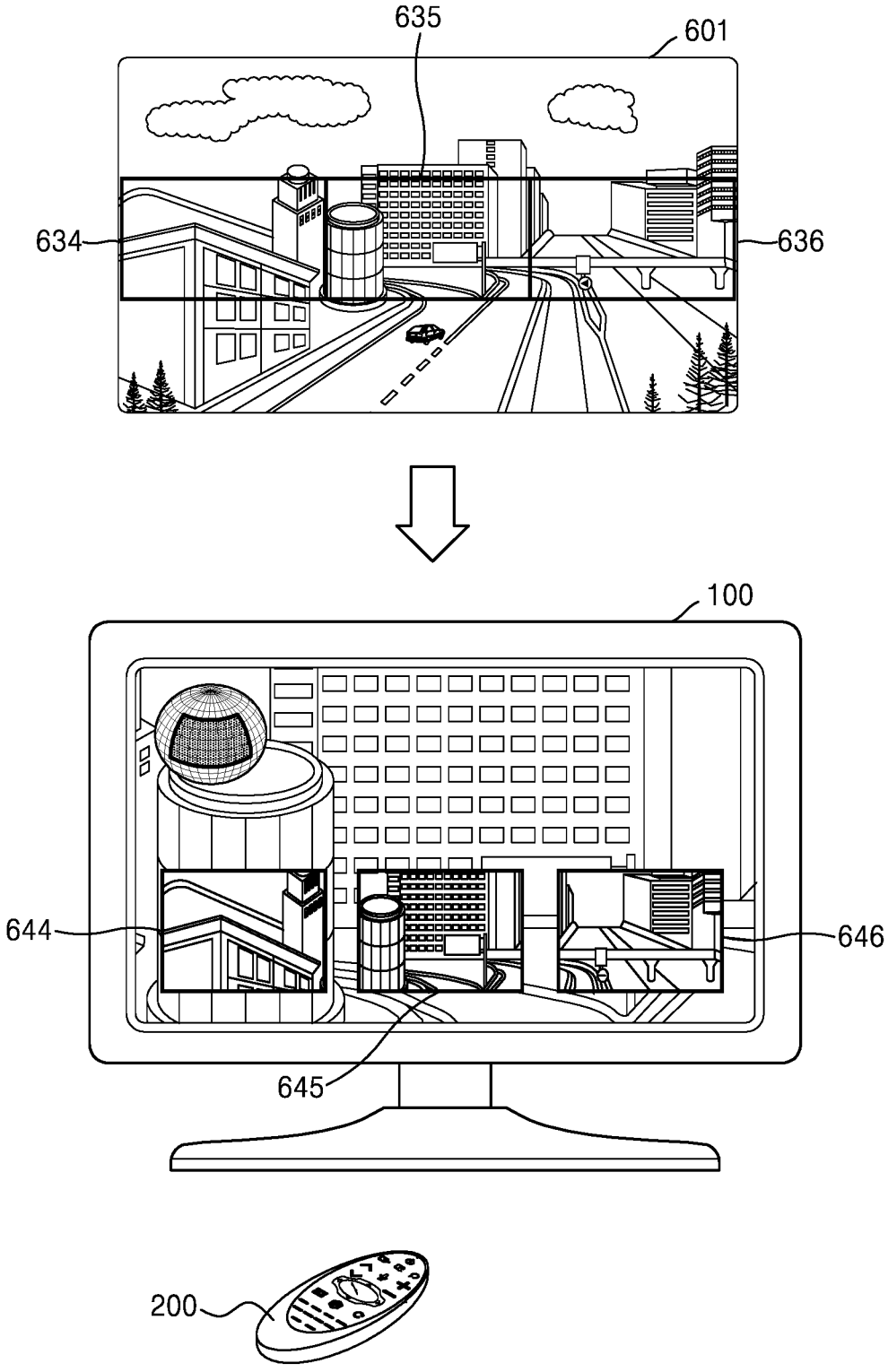

FIG. 9

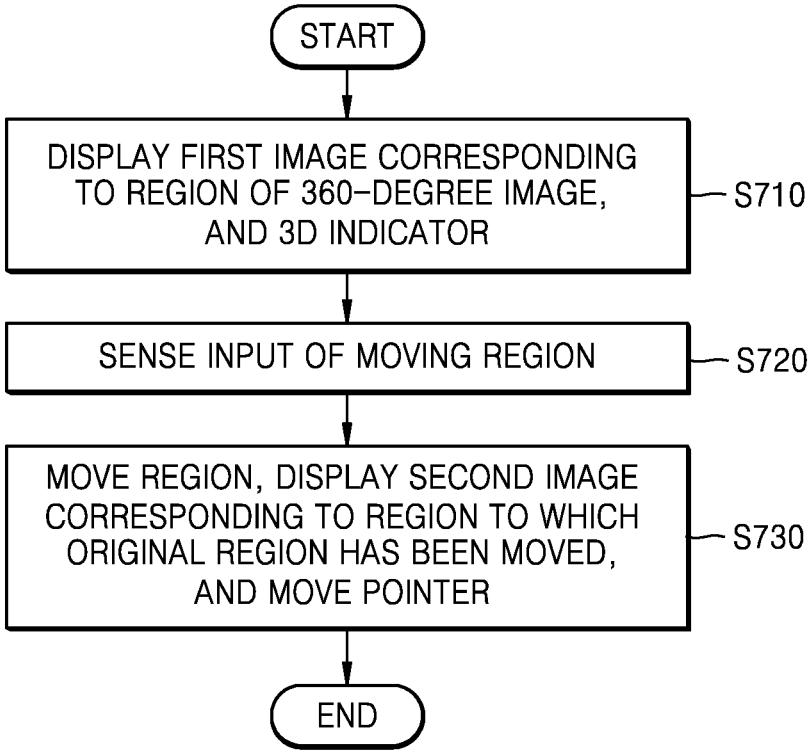
START
DISPLAY FIRST IMAGE CORRESPONDING TO REGION OF 360-DEGREE IMAGE, AND 3D INDICATOR
S710
SENSE INPUT OF MOVING REGION
S720
MOVE REGION, DISPLAY SECOND IMAGE CORRESPONDING TO REGION TO WHICH ORIGINAL REGION HAS BEEN MOVED, AND MOVE POINTER
S730
END

FIG. 10

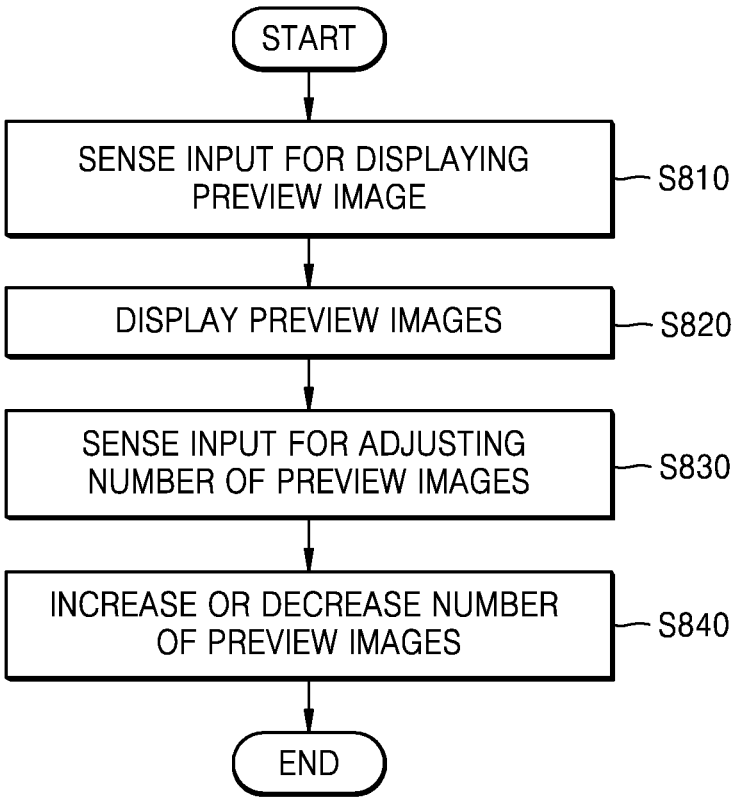
START
SENSE INPUT FOR DISPLAYING PREVIEW IMAGE
S810
DISPLAY PREVIEW IMAGES
S820
SENSE INPUT FOR ADJUSTING NUMBER OF PREVIEW IMAGES
S830
INCREASE OR DECREASE NUMBER OF PREVIEW IMAGES
S840
END

IMAGE DISPLAYING APPARATUS AND METHOD OF OPERATING THE SAME

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is based on and claims priority under 35 U.S.C. §119 to Korean Patent Application No. 10-2016-0054686, filed on May 3, 2016, in the Korean Intellectual Property Office, the disclosure of which is incorporated by reference herein in its entirety.

BACKGROUND

1. Field

[0002] The present disclosure relates generally to image display apparatuses and methods of operating the same, and for example, to an image display apparatus capable of displaying a 360-degree image and a method of operating the image display apparatus.

2. Description of Related Art

[0003] Image display apparatuses display an image that can be viewed by users. Users can view a broadcast via an image display apparatus. Image display apparatuses display, on a display included therein, a broadcast selected by a user from among broadcasting signals transmitted by a broadcasting station. Currently, most countries around the world have switched from analog broadcasting to digital broadcasting.

[0004] In digital broadcasting, a digital image signal and a digital audio signal are transmitted. When compared to analog broadcasting, digital broadcasting is resilient against external noise, thus, suffering little data loss, is favorable to error correction, and provides high-resolution and high-definition screen images. In addition, digital broadcasting can provide a bidirectional service, in contrast with analog broadcasting.

[0005] Smart televisions (TVs) providing various types of content in addition to a digital broadcasting function have been recently provided. Smart TVs aim to analyze and provide content desired by a user without manipulation by the user, instead of manually operating according to a selection by the user.

SUMMARY

[0006] An image display apparatus that provides an interface via which a user is able to easily control a 360-degree image, and a method of operating the image display apparatus are provided.

[0007] Additional aspects will be set forth in part in the description which follows and, in part, will be apparent from the description.

[0008] According to an aspect of an example embodiment, an image display apparatus includes a display configured to display a first image corresponding to a region of a 360-degree image, and an indicator in a three-dimensional (3D) shape including a pointer pointing to a location of the region, a sensor configured to sense an input for moving the region, and a controller configured to control movement of the region and to display a second image corresponding to a region to which the region has been moved, and to move the pointer based on the movement of the region. The pointer is movable in an altitudinal direction and an azimuthal direction within the indicator.

[0009] According to an aspect of another example embodiment, a method of operating an image display apparatus includes displaying a first image corresponding to a region of a 360-degree image, and an indicator in a three-dimensional (3D) shape including a pointer pointing to a location of the region; sensing an input for moving the region; moving the region based on the input, displaying a second image corresponding to a region to which the region has been moved, and moving the pointer based on the movement of the region, wherein the pointer is movable in an altitudinal direction and an azimuthal direction within the indicator.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] These and/or other aspects, features and attendant advantages of the present disclosure will become apparent and more readily appreciated from the following detailed description, taken in conjunction with the accompanying drawings, in which like reference numerals refer to like elements, and wherein:

[0011] FIG. **1** is a diagram illustrating an example image display apparatus and example control apparatus, according to an example embodiment of the present disclosure;

[0012] FIG. **2** is a block diagram illustrating an example structure of an image display apparatus according to an example embodiment of the present disclosure;

[0013] FIG. **3** is a block diagram illustrating an example structure of an image display apparatus according to an example embodiment of the present disclosure;

[0014] FIG. **4** is a block diagram illustrating an example control apparatus according to an example embodiment of the present disclosure;

[0015] FIGS. **5**A, **5**B and **5**C are diagrams illustrating an example embodiment of the present disclosure in which a 360-degree image and an indicator are displayed on a display;

[0016] FIGS. **6**A and **6**B are diagrams illustrating an example embodiment of the present disclosure in which a 360-degree image is displayed on a display;

[0017] FIGS. **7**A, **7**B and **7**C are illustrating an example method of zooming in or out a 360-degree image, according to an example embodiment of the present disclosure;

[0018] FIGS. **8**A, **8**B, **8**C and **8**D are diagrams illustrating an example embodiment of the present disclosure in which a preview image is displayed on a display;

[0019] FIG. **9** is a flowchart illustrating an example method of operating an image display apparatus, according to an example embodiment of the present disclosure; and

[0020] FIG. **10** is a flowchart illustrating an example method of operating an image display apparatus, according to an example embodiment of the present disclosure.

DETAILED DESCRIPTION

[0021] The terminology used herein will now be briefly described as the present disclosure will be described in detail based on this terminology.

[0022] Although general terms widely used at present were selected for describing the present disclosure in consideration of the functions thereof, these general terms may vary according to intentions of one of ordinary skill in the

art, case precedents, the advent of new technologies, and the like. Terms arbitrarily selected may also be used in a specific case. In this case, their meanings need to be given in the detailed description of the present disclosure. Hence, the terms must be defined based on their meanings and the contents of the entire disclosure, not by simply stating the terms.

[0023] The terms "comprises" and/or "comprising" or "includes" and/or "including" when used in this disclosure, specify the presence of stated elements, but do not preclude the presence or addition of one or more other elements. The terms " . . . unit" and " . . . module" when used in this disclosure may refer, for example, to a unit in which at least one function or In operation is performed, and may be implemented as hardware, software, or a combination of hardware and software.

[0024] Various example embodiments are described in detail herein with reference to the accompanying drawings so that this disclosure may be easily performed by one of ordinary skill in the art to which the present disclosure pertain. The disclosure may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein. In the drawings, parts irrelevant to the description are omitted for simplicity of explanation, and like numbers refer to like elements throughout.

[0025] The term "user" used herein denotes a person who controls a function or operation of an image display apparatus by using a control apparatus. Examples of the user may include a viewer, a manager, or an installation engineer.

[0026] FIG. **1** is a diagram illustrating an example image display apparatus **100** that displays a 360-degree image, and a control apparatus **200**, according to an example embodiment of the present disclosure.

[0027] Referring to FIG. **1**, the image display apparatus **100** may display a 360-degree image. The 360-degree image according to an embodiment may be an image having an angle of view of 360 degrees. For example, the 360-degree image may be an image generated based on a plurality of images captured in a direction of 360 degrees by using at least one camera. In this regard, the captured plurality of images may be mapped to a sphere, and contact points of the mapped images may be stitched, and thus a spherical 360-degree image may be generated. Also, the spherical 360-degree image may be converted into a planar 360-degree image **50** so as to be transmitted to or stored in another device as illustrated in FIG. **1**.

[0028] The image display apparatus **100** according to an embodiment may convert the planar 360-degree image **50** into a spherical 360-degree image **70** by performing graphics processing on the planar 360-degree image **50**. The image display apparatus **100** may select a region **80** from the spherical 360-degree image **70** and display an image corresponding to the selected region **80** on a display. In this regard, the image display apparatus **100** may scale the image corresponding to the selected region **80** according to a resolution of the display and display the scaled image on the display. The image display apparatus **100** according to an embodiment may display a three-dimensional (3D) indicator **20** indicating a location of the region **80** within the 360-degree image **70**.

[0029] The image display apparatus **100** according to an embodiment may be a TV, but this is merely an embodiment and the present disclosure is not limited thereto. The image display apparatus **100** may be implemented as an electronic device including a display. For example, the image display apparatus **100** may be any type of electronic device, such as a mobile phone, a tablet personal computer (PC), a digital camera, a camcorder, a laptop computer, a desktop computer, an e-book terminal, a digital broadcast terminal, a personal digital assistant (PDA), a portable multimedia player (PMP), a navigation device, an MP3 player, or a wearable device, or the like. In particular, example embodiments of the image display apparatus **100** may be easily implemented in a display apparatus having a large display, such as a TV. However, embodiments are not limited thereto. The image display apparatus **100** may be fixed or movable, or a digital broadcast receiver.

[0030] The image display apparatus **100** may be implemented as not only a flat display apparatus but also a curved display apparatus having a curvature or a flexible display apparatus with an adjustable curvature. An output resolution of the display apparatus **100** may be, for example, a high definition (HD), a full HD, an ultra HD, or a resolution that is clearer than an ultra HD.

[0031] The image display apparatus **100** may be controlled by a control apparatus. The control apparatus **200** may be implemented as any of various types of devices for controlling the image display apparatus **100**, such as, for example, and without limitation, a remote controller or a mobile phone.

[0032] The control apparatus **200** may control the display apparatus **100** via short-range communication including, for example, infrared or Bluetooth. The control apparatus **200** may control a function of the display apparatus **100** by using at least one selected from keys (including buttons) included in the control apparatus **200**, a touch pad, a microphone (not shown) capable of receiving voices of users, and a sensor (not shown) capable of recognizing motions of the control apparatus **200**.

[0033] For example, the control apparatus **200** may include 4 directional keys (or 4 direction buttons). The 4 directional keys may be used to move the location of the region **80** displayed on the display within the 360-degree image **70**.

[0034] The control apparatus **200** may be a pointing device. For example, when the control apparatus **200** receives a certain key input, the control apparatus **200** may operate as a pointing device. When the control apparatus **200** operates as a pointing device, the image display apparatus **100** may be controlled by a user input for moving the control apparatus **200** upward, downward, leftward, or rightward, or tilting the control apparatus **200** in any random direction. Information about a motion of the control apparatus **200** that is sensed via the sensor of the control apparatus **200** may be transmitted to the image display apparatus **100**. The image display apparatus **100** may move the region **80** displayed on the display within the 360-degree image **70**, based on the motion information of the control apparatus **200**.

[0035] Alternatively, when the control apparatus **200** includes a touchpad, according to a displacement value of a subject moving on the touchpad, for example, a user's finger, the image display apparatus **100** may move the region **80** displayed on the display within the 360-degree image **70**.

[0036] FIG. **2** is a block diagram illustrating an example structure of an image display apparatus **100***a* according to an example embodiment of the present disclosure. The image

display apparatus **100***a* of FIG. **2** may be an embodiment of the image display apparatus **100** of FIG. **1**.

[0037] Referring to FIG. **2**, the image display apparatus **100***a* may include a controller (e.g., including processing circuitry) **110**, a display **120**, and a sensor **130**.

[0038] The display **120** may generate a driving signal by converting an image signal, a data signal, an on-screen display (OSD) signal, and a control signal that are processed by the controller **110**. The display **120** may be a plasma display panel (PDP), a liquid-crystal display (LCD), an organic light-emitting device (OLED), a flexible display, or a 3D display. The display **120** may be configured as a touch screen, and thus may serve as an input device as well as an output device.

[0039] The display **120** may display an image corresponding to a region of a 360-degree image and a 3D indicator indicating a location of the region.

[0040] The sensor **130** may sense a user input and transmit a signal corresponding to the sensed user input to the controller **110**. Examples of the user input received from the control apparatus **200** and sensed by the sensor **130** may include turning power on/off, selecting channels, raising and lowering channels, and setting a screen. In addition, the sensor **130** may sense an input for moving the location of the region displayed on the display **120** from among the 360-degree image, an input for zooming in or out the image displayed on the display **120**, an input for displaying preview images corresponding to the region displayed on the display **120** and the other region, an input for adjusting the number of preview images, and an input for displaying an image corresponding to a region at a specific location from among the 360-degree image. However, embodiments are not limited thereto.

[0041] The controller **110** may include various processing circuitry and process an image signal and transmit the processed image signal to the display **120**. Accordingly, an image corresponding to the processed image signal may be displayed on the display **120**. The controller **110** may control the image display apparatus **100***a* via a user command detected by the sensor **130** or an internal program.

[0042] For example, according to an embodiment, the controller **110** may move the location of the region displayed on the display **120** from among the 360-degree image according to the detected user input, and may control the display **120** to display an images corresponding to the moved region. The controller **110** may also move a pointer included in a 3D indicator such that the pointer points the moved location of the region.

[0043] The controller **110** may decrease or increase the range of the region displayed on the display **120** from among the 360-degree image, according to the sensed zoom-in or zoom-out input. Accordingly, the controller **110** may decrease or increase the size or area of a pointer corresponding to the region.

[0044] The controller **110** may also control the display **120** to display the preview images of one or more regions different from the region displayed on the display **120**, according to the sensed preview image display input. The controller **110** may also increase or decrease the number of preview images, according to the input for adjusting the number of preview images.

[0045] FIG. **3** is a block diagram illustrating an example structure of an image display apparatus **100***b* according to an example embodiment of the present disclosure. The image display apparatus **100***b* of FIG. **3** may be an embodiment of the image display apparatus **100** of FIG. **1**.

[0046] Referring to FIG. **3**, the display apparatus **100***b* may further include a video processor **180**, an audio processor **115**, an audio output interface (e.g., including audio output circuitry) **125**, a power supply **160**, a tuner **140**, a communicator (e.g., including communication circuitry) **150**, an input/output interface (e.g., including input/output interface circuitry) **170**, and a storage **190**, in addition to the controller **110**, the display **120**, and the sensor **130**.

[0047] With regard to the controller **110**, the display **120**, and the sensor **130**, elements and features as described with reference to FIG. **2** will not be repeated.

[0048] The video processor **180** may include various circuitry and/or program elements that process video data that is received by the image display apparatus **100***b*. The video processor **180** may perform a variety of image processing, such as decoding, scaling, noise filtering, frame rate transformation, and resolution transformation, on video data.

[0049] The display **120** displays video included in a broadcasting signal received via the tuner **140** on the screen thereof, under the control of the controller **110**. The display **120** may also display content (for example, a moving picture) that is input via the communicator **150** or the inputter/outputter **170**. The display **120** may output an image stored in the storage **190** under the control of the controller **110**. The display **120** may also display a voice user interface (UI) (e.g., including a voice command word guide) for performing a voice recognition task corresponding to voice recognition, or a motion UI (e.g., including a user motion guide for motion recognition) for performing a motion recognition task corresponding to motion recognition.

[0050] The audio processor **115** may include various circuitry and/or program elements that process audio data. The audio processor **115** may perform a variety of processing, such as decoding, amplification, or noise filtering, on the audio data. The audio processor **115** may include a plurality of audio processing modules to process audios corresponding to a plurality of pieces of content.

[0051] The audio output interface **125** may include various circuitry that outputs audio included in a broadcasting signal received via the tuner **140**, under the control of the controller **180**. The audio output interface **125** may also output audio (for example, a voice or a sound) that is input via the communicator **150** or the inputter/outputter **170**. The audio output interface **125** may also output audio stored in the storage **190** under the control of the controller **110**. The audio output interface **125** may include various audio output circuitry, such as, for example, and without limitation, at least one selected from a speaker **126**, a headphone output port **127**, and a Sony/Philips Digital Interface (S/PDIF) output port **128**. The audio outputter **125** may include a combination of the speaker **126**, the headphone output port **127**, and the S/PDIF output port **128**.

[0052] The power supply **160** supplies power that is input from an external power source, to the internal components of the image display apparatus **100***b*, under the control of the controller **110**. The power supply **160** may also supply power that is output by one or more batteries (not shown) located in the image display apparatus **100***b*, to the internal components of the image display apparatus **100***b*, under the control of the controller **110**.

[0053] The tuner **140** may tune and select only a frequency of a channel which the image display apparatus **100***b* wants

to receive from among many radio wave components that are obtained via amplification, mixing, resonance, or the like of a wired or wireless broadcasting signal. The broadcasting signal includes audio, video, and additional information (for example, an electronic program guide (EPG)).

[0054] The tuner **140** may receive a broadcasting signal in a frequency band corresponding to a channel number (e.g., cable broadcasting No. 506) according to a user input (for example, a control signal received from the control apparatus **200**, e.g., a channel number input, a channel up-down input, and a channel input on an EPG screen image).

[0055] The tuner **140** may receive a broadcasting signal from various sources, such as terrestrial broadcasting, cable broadcasting, satellite broadcasting, and Internet broadcasting. The tuner **140** may also receive a broadcasting signal from a source such as analog broadcasting or digital broadcasting. The broadcasting signal received via the tuner **140** is decoded (for example, audio decoding, video decoding, or additional information decoding) and is thus divided into audio, video, and/or additional information. The audio, the video, and/or the additional information may be stored in the storage **190** under the control of the controller **110**.

[0056] The image display apparatus **100***b* may include a single tuner **140** or a plurality of tuners **140**. The tuner **140** may be all-in-one with the image display apparatus **100***b*, or implemented as a separate apparatus (for example, a tuner that is connected to a set-top box and the input/outputter **170**) having a tuner that is electrically connected to the image display apparatus **100***b*.

[0057] The communicator **150** may include various communication circuitry and connect the image display apparatus **100***b* to an external apparatus (for example, an audio apparatus) under the control of the controller **110**. The controller **110** may transmit/receive content to/from the external apparatus connected via the communicator **150**, download an application from the external apparatus, or perform web-browsing. The communicator **150** may include various communication circuitry, such as, for example, and without limitation, a wireless local area network (LAN) **151**, a Bluetooth network **152**, or a wired Ethernet network **153** in correspondence to a performance and a structure of the image display apparatus **100***b*. The communicator **150** may include a combination of the wireless LAN **151**, the Bluetooth network **152**, and the wired Ethernet network **153**. The communicator **150** may receive a control signal of the control apparatus **200** under the control of the controller **110**. The control signal may be implemented as a Bluetooth signal, a radio frequency (RF) signal, or a Wi-Fi signal.

[0058] The communicator **150** may further include short-range communication (for example, near field communication (NFC) or Bluetooth low energy (BLE)), in addition to the Bluetooth network **152**.

[0059] The sensor **130** may include various circuitry that senses a voice of a user, an image of the user, or an interaction with the user, and may include, for example, and without limitation, a microphone **131**, a camera **132**, and a light receiver **133**.

[0060] The microphone **131** receives an uttered voice of the user. The microphone **131** may transform the received voice into an electrical signal and output the electrical signal to the controller **110**. The user voice may include, for example, a voice corresponding to a menu or function of the image display apparatus **100***b*.

[0061] The camera **132** may receive an image (for example, consecutive frames) corresponding to a motion of the user including a gesture within a recognition range of the camera **132**. The controller **110** may select a menu that is displayed on the image display apparatus **100***b* by using a result of the recognition of the received motion, or perform control corresponding to the result of the motion recognition. For example, the control may be channel adjustment, volume adjustment, indicator movement, cursor movement, movement of a region displayed on a display from among a 360-degree image, and movement of a pointer included in a 3D indicator.

[0062] The light receiver **133** receives an optical signal (including a control signal) from the control apparatus **200** via a light window (not shown) of the bezel of the display **120**. The light receiver **133** may receive an optical signal corresponding to a user input (for example, touch, pressing, a touch gesture, a voice, or a motion) from the control apparatus **200**. A control signal may be extracted from the received optical signal under the control of the controller **110**.

[0063] The input/output interface **170** may include various input/output circuitry and receives video (for example, a moving picture), audio (for example, a voice or music), and additional information (for example, an EPG) from outside the image display apparatus **100***b* under the control of the controller **110**. The input/output interface **170** may include various circuitry, such as, for example, and without limitation, a High-Definition Multimedia Interface (HDMI) port **171**, a component jack **172**, a PC port **173**, or a USB port **174**. The inputter/outputter **170** may include a combination of the HDMI port **171**, the component jack **172**, the PC port **173**, and the USB port **174**.

[0064] The controller **110** may include various processing circuitry and controls an overall operation of the image display apparatus **100***b* and signal transfer among the internal components of the image display apparatus **100***b* and processes data. When there is an input of a user or stored preset conditions are satisfied, the controller **110** may execute an operation system (OS) and various applications that are stored in the storage **190**.

[0065] The controller **110** may include random-access memory (RAM) **181** that stores a signal or data input by an external source of the image display apparatus **100***b* or is used as a memory area for various operations performed by the image display apparatus **100***b*, read-only memory (ROM) **182** that stores a control program for controlling the image display apparatus **100***b*, and a processor **183**.

[0066] The processor **183** may include a graphics processing unit (not shown) for performing video graphics processing. The processor **183** may be implemented by using a System On Chip (SoC) into which a core and a GPU are incorporated. The processor **183** may include a single core, a dual core, a triple core, a quad core, or a multiple core thereof.

[0067] The processor **183** may include a plurality of processors. For example, the processor **183** may be implemented by using a main processor and a sub-processor operating in a sleep mode.

[0068] A graphics processor **184** generates a screen image including various objects, such as an icon, an image, and a text, by using an arithmetic unit and a rendering unit. The arithmetic unit calculates attribute values, such as a coordinate value, a shape, a size, a color, and the like, with which

each object is to be displayed according to layouts of the screen image, based on the user interaction sensed by the sensor **130**. The rendering unit generates screen images of various layouts including objects, based on the attribute values calculated by the arithmetic unit. The screen images generated by the rendering unit are displayed on a display area of the display **120**. As described above with reference to FIG. **1**, the graphics processor **184** may map a planar 360-degree image to a sphere to generate a spherical 360-degree image.

[0069] First through n-th interfaces **185-1** through **185-*n*** are connected to the above-described components of the image display apparatus **100*b***. One of the first through n-th interfaces **185-1** through **185-*n*** may be a network interface that is connected to an external apparatus via a network.

[0070] The RAM **181**, the ROM **182**, the processor **183**, the graphics processor **184**, and the first through n-th interfaces **185-1** through **185-*n*** may be connected to each other via an internal bus **186**.

[0071] The term "a controller of an image display apparatus" used in the present embodiment includes the processor **183**, the ROM **182**, and the RAM **181**.

[0072] The storage **190** may store various data, programs, or applications for driving and controlling the image display apparatus **100*b*** under the control of the controller **110**. The storage **190** may store input/output signals or data corresponding to driving of the video processor **180**, the display **120**, the audio processor **115**, the audio outputter **125**, the power supply **160**, the tuner **140**, the communicator **150**, the sensor **130**, and the inputter/outputter **170**. The storage **190** may store a control program for controlling the image display apparatus **100*b*** and the controller **180**, an application initially provided by a manufacturer or downloaded from outside the image display apparatus **100*b***, a graphical user interface (GUI) associated with the application, objects (for example, an image text, an icon, and a button) for providing the GUI, user information, a document, databases, or related pieces of data.

[0073] According to an embodiment, the term "storage unit" includes the storage **190**, the ROM **182** or the RAM **181** of the controller **180**, or a memory card (e.g., a micro SD card or a USB memory) mounted in the image display apparatus **100*b***. The storage **190** may include a non-volatile memory, a volatile memory, a hard disk drive (HDD), or a solid state drive (SSD).

[0074] The image display apparatus **100*b*** having the display **120** may be electrically connected to an external apparatus (for example, a set-top box) having a tuner. For example, the image display apparatus **100*b*** may be implemented by using an analog TV, a digital TV, a 3D TV, a smart TV, an LED TV, an OLED TV, a plasma TV, a monitor, or the like, but it will be easily understood by one of ordinary skill in the art that embodiments are not limited thereto.

[0075] The block diagrams of the image display apparatuses **100*a*** and **110*b*** illustrated in FIGS. **2** and **3** are merely example embodiments. Components illustrated in FIGS. **2** and **3** may be combined or omitted according to the specifications of the image display apparatus **100** when being actually implemented, or additional components may be included in the block diagrams of FIGS. **2** and **3**. In other words, according to need, two or more components are combined into a single component, or a single component may be divided into two or more components. A function performed in each block is only an example to explain embodiments, and a detailed operation or device of each block does not limit the scope of the embodiments.

[0076] FIG. **4** is a block diagram illustrating an example control apparatus **200** according to an example embodiment of the present disclosure.

[0077] Referring to FIG. **4**, the control apparatus **200** may include a wireless communicator (e.g., including wireless communication circuitry) **220**, a user input interface (e.g., including input circuitry) **230**, a sensor **240**, an outputter (e.g., including output circuitry) **250**, a power supply **260**, a storage **270**, and a controller **280**.

[0078] The wireless communicator **220** may include various communication circuitry and transmit and receive signals to and from any of the above-described image display apparatuses **100**, **100*a***, and **100*b***. The wireless communicator **220** may include various wireless communication circuitry, such as, for example, and without limitation, an RF module **221** that may transmit and receive signals to and from the image display apparatus **100** according to an RF communication standard, and an IR module **223** that may transmit and receive to and from the image display apparatus **100** according to an IR communication standard.

[0079] The user input interface **230** may include various input circuitry, such as, for example, and without limitation, a keypad, buttons, a touchpad, or a touch screen. The user may manipulate the user input unit **230** to input commands related to the image display apparatus **100** to the control apparatus **200**.

[0080] For example, the user input interface **230** may include 4 direction buttons or 4 directional keys. The four direction buttons or four direction keys may be used to control a window, an area, an application, or an item displayed on the display **120**. Four direction buttons or keys may be used to indicate up, down, left, and right movements. It will be understood by one of ordinary skill in the art that the user input interface **230** may include two direction keys or two direction buttons instead of four direction buttons or four direction keys. The user input interface **230** may also include various types of input units that may be manipulated by the user, such as a scroll key or a jog key.

[0081] The user input interface **230** may receive a user input for dragging, touching, or flipping via the touchpad of the control apparatus **200**. The image display apparatus **100** may be controlled according to a type of received user input (for example, a direction in which a drag command is input or time when a touch command is input).

[0082] The sensor **240** may include a gyroscopic (gyro) sensor **241** or an acceleration sensor **243**. The gyro sensor **241** may sense information about movements of the control apparatus **200**. The acceleration sensor **243** may sense information about a movement speed of the control apparatus **200**. The gyro sensor **241** may additionally include a distance estimation sensor that may sense a distance between the control apparatus **200** and the image display apparatus **100**.

[0083] The outputter **250** may include various output circuitry and output an image signal or an audio signal which corresponds to a manipulation of the user input unit **230** or a signal received by the image display apparatus **100**. The user may recognize whether the user input unit **230** is manipulated or whether the image display apparatus **100** is controlled, via the outputter **250**. For example, the outputter **250** may include various output circuitry, such as, for

example, and without limitation, an LED **251**, a vibration module **253**, an audio outputter **255**, or a display **257**.

[0084] The power supply **260** supplies power to the control apparatus **200**.

[0085] The storage **270** may store programs or application data necessary for control of the control apparatus **200** or an operation thereof.

[0086] The controller **280** may include various processing circuitry and controls overall operations related to controlling the control apparatus **200**. The controller **280** may transmit a signal corresponding to a predetermined key manipulation of the user input unit **230** or a signal corresponding to a movement of the control apparatus **200** sensed by the sensor **240**, to the image display apparatus **100** via the wireless communicator **220**.

[0087] A signal transmitted by the control apparatus **200** is detected by the sensor **130** and transmitted to the controller **110** of the image display apparatus **100**. The controller **110** may determine information about the operations and a key manipulation of the control apparatus **200** based on the signal transmitted by the control apparatus **200**, and control the image display apparatus **100** according to the information.

[0088] FIGS. **5**A, **5**B and **5**C are diagrams illustrating an example embodiment of the present disclosure in which a 360-degree image is displayed on a display.

[0089] Referring to FIG. **5**A, the image display apparatus **100** may display a first image **330** corresponding to a region **320** of a planar 360-degree image **310**, and a 3D indicator **340** indicating a location of the region **320**. The 3D indicator **340** may include a pointer **345** indicating the location of the region **320**.

[0090] For example, the first image **330** may be an image in a front direction from within a 360-degree image. As illustrated in FIG. **5**A, the first image **330** may be an image corresponding to the region **320** located at the center from within the planar 360-degree image **310**. The 3D indicator **340** may be a spherical indicator or a cylindrical indicator, but embodiments are not limited thereto. An example in which the 3D indicator **340** is a spherical indicator will now be described for convenience of description. For example, the pointer **345** may have a curved shape corresponding to a surface shape of the spherical indicator **340**. Alternatively, the pointer **345** may have an arrow shape that pointing to one spot of the region **320**, but embodiments are not limited thereto. The size or area of the pointer **345** may be previously set or may be set based on a user input.

[0091] The image display apparatus **100** may sense an input for moving the location of the region **320** displayed from within the planar 360-degree image **310**. For example, the image display apparatus **100** may sense inputs of the 4 directional keys included in the control apparatus **200**, an input for moving the control apparatus **200** upward, downward, leftward, or rightward or tilting the control apparatus **200** in an arbitrary direction, and a touch input on a touch pad included in the control apparatus **200**, but embodiments are not limited thereto.

[0092] The image display apparatus **100** may move the location of the region **320**, in response to an input for moving the location of the region **320**. For example, the image display apparatus **100** may move the location of the region **320** within the planar 360-degree image **310** upward, downward, leftward, or rightward or may move the location of a region from within a spherical 360-degree image in an altitudinal direction or an azimuthal direction.

[0093] For example, when an input of an upward key among the 4 directional keys of the control apparatus **200** is sensed, as illustrated in FIG. **5**B, the image display apparatus **100** may move the location of the region **320** upward within the planar 360-degree image **310**. When the location of the region **320** is moved, the image display apparatus **100** may display a second image **335** corresponding to a region **325** to which the region **320** has been moved. The image display apparatus **100** may also move the pointer **345** in the altitudinal direction within the spherical indicator **340** in order to indicate the location of the region **325**.

[0094] Alternatively, when an input of a leftward key among the 4 directional keys of the control apparatus **200** is sensed, as illustrated in FIG. **5**C, the image display apparatus **100** may move the location of the region **320** leftward within the planar 360-degree image **310**. When the location of the region **320** is moved, the image display apparatus **100** may display a third image **337** corresponding to a region **327** to which the region **320** has been moved. The image display apparatus **100** may also move the pointer **345** in the azimuthal direction within the spherical indicator **340** in order to indicate the location of the region **327**.

[0095] FIGS. **6**A and **6**B are diagrams illustrating an example embodiment of the present disclosure in which a 360-degree image is displayed on a display.

[0096] Referring to FIG. **6**A, the image display apparatus **100** may display an image **410** corresponding to a region of a 360-degree image, and a 3D indicator **420** indicating a location of the region. In this regard, the image **410** displayed on the display may be an image corresponding to a region to which a certain region located at the center within a spherical 360-degree image has been rotated by a certain angle in the azimuthal direction.

[0097] For example, the image display apparatus **100** may sense a user input of a specific key included in the control apparatus **200**. However, embodiments are not limited thereto.

[0098] The image display apparatus **100** may move the region to a specific location in response to the input of the specific key, and may control the display to display an image of a region corresponding to the specific location. For example, as shown in FIG. **6**B, the image display apparatus **100** may move the region to a front direction location within the spherical 360-degree image or move the region to the center of the planar 360-degree image, and thus may control the display to display a front direction image **415**.

[0099] Different specific locations and different specific regions may be set for the number keys included in the control apparatus **200**. For example, a front direction image may be set for a number key '1', an image rotated 90 degrees from a front direction to the azimuthal direction may be set for a number key '2', and an image rotated 180 degrees from a front direction to the azimuthal direction may be set for a number key '3'. However, embodiments are not limited thereto.

[0100] Accordingly, a user may first display a 360-degree image by moving the region to various locations within the 360-degree image, and then may display an image of a specific region on the display in response to an input of a specific key.

[0101] FIGS. **7**A, **7**B and **7**C are diagrams illustrating an example method of zooming in or out a 360-degree image, according to an example embodiment of the present disclosure.

[0102] Referring to FIG. **7**A, the image display apparatus **100** may display an image (first image **510**) corresponding to a region of a 360-degree image, and a 3D indicator **520** indicating a location of the region. For example, the image **510** displayed on the display may be a front direction image corresponding to a region located in the front direction from within the spherical 360-degree image, but embodiments are not limited thereto.

[0103] Accordingly, a pointer **525** may be displayed at a front direction portion of the 3D indicator **520** in a spherical shape, and the area of the pointer **525** may be a first area.

[0104] The image display apparatus **100** may sense a user input for zooming in an image that is displayed. For example, the image display apparatus **100** may sense a user input of an upward key or a rightward key among the four directional keys included in the control apparatus **200**, but embodiments are not limited thereto.

[0105] In response to a zoom-in input, the image display apparatus **100** may display a second image **530** obtained by zooming in the first image **510**, as shown in FIG. **7**B. Accordingly, the size of a region corresponding to the second image **530** may decrease. When the size of the region decreases, the image display apparatus **100** may decrease the area of the pointer **525** displayed on the 3D indicator **520** in the spherical shape from the first area to a second area.

[0106] The image display apparatus **100** may sense a user input for zooming out an image that is displayed. For example, the image display apparatus **100** may sense a user input of a downward key or a leftward key among the four directional keys included in the control apparatus **200**, but embodiments are not limited thereto.

[0107] In response to a zoom-out input, the image display apparatus **100** may display a third image **540** obtained by zooming out the first image **510**, as shown in FIG. **7**C. Accordingly, the size of a region corresponding to the third image **540** may increase. When the size of the region increases, the image display apparatus **100** may increase the area of the pointer **525** displayed on the 3D indicator **520** in the spherical shape from the first area to a third area.

[0108] FIGS. **8**A, **8**B, **8**C and **8**D are diagrams illustrating an example embodiment of the present disclosure in which a preview image is displayed on a display.

[0109] Referring to FIG. **8**A, the image display apparatus **100** may display an image **610** corresponding to a region of a 360-degree image, and a 3D indicator **620** indicating a location of the region. The image display apparatus **100** may sense a user input for displaying a preview image. For example, the image display apparatus **100** may sense an input of a specific key included in the control apparatus **200**, but embodiments are not limited thereto.

[0110] In response to a preview display requesting input, the image display apparatus **100** may display a first preview image **641** corresponding to a first region **631** of a 360-degree image **601**, as illustrated in FIG. **8**B. A preview image may be displayed on a region of the display.

[0111] The image display apparatus **100** may sense a user input for adjusting the number of preview images, when preview images have been displayed. For example, the image display apparatus **100** may sense an input of a directional key or a number key included in the control apparatus **200**, but embodiments are not limited thereto.

[0112] When an input for adjusting the number of preview images is sensed, the image display apparatus **100** may increase or decrease the number of preview images. For example, when the first preview image **641** has been displayed and an input of an upward key or a rightward key is sensed, the image display apparatus **100** may display a second preview image **642** corresponding to a second region **632** of the 360-degree image **601** and a third preview image **643** corresponding to a third region **633** of the 360-degree image **601**, as illustrated in FIG. **8**C.

[0113] When the second and third preview images **642** and **643** have been displayed and an input of an upward key or a rightward key is sensed or an input of a number key '3' is sensed, the image display apparatus **100** may display a fourth preview image **644** corresponding to a fourth region **634** of the 360-degree image **601**, a fifth preview image **645** corresponding to a fifth region **635** of the 360-degree image **601**, and a sixth preview image **646** corresponding to a sixth region **636** of the 360-degree image **601**, as illustrated in FIG. **8**D.

[0114] On the other hand, when the second and third preview images **642** and **643** have been displayed and an input of a downward key or a leftward key is sensed or an input of a number key '1' is sensed, the image display apparatus **100** may display the first preview image **641** corresponding to the first region **631** of the 360-degree image **601**, as illustrated in FIG. **8**B.

[0115] When an input of selecting one of at least one preview image displayed on the display is sensed, the image display apparatus **100** may display an image corresponding to the selected preview image on the entire screen of the display.

[0116] FIG. **9** is a flowchart illustrating an example method of operating the image display apparatus **100**, according to an example embodiment of the present disclosure.

[0117] Referring to FIG. **9**, the image display apparatus **100** may display a first image corresponding to a region of a 360-degree image, and a 3D indicator, in operation S**710**.

[0118] For example, the image display apparatus **100** may display an image corresponding to a region of a planar 360-degree image or a spherical 360degree image. The 3D indicator may be a spherical indicator or a cylindrical indicator. The 3D indicator may include a pointer that points to a location of the region. The pointer may have any of various shapes, and the size or area of the pointer may be previously set or may be set based on a user input.

[0119] In operation S**720**, the image display apparatus **100** may sense an input (e.g., a user input) of moving the region.

[0120] For example, the image display apparatus **100** may sense inputs of the 4 directional keys included in the control apparatus **200**, an input for moving the control apparatus **200** upward, downward, leftward, or rightward or tilting the control apparatus **200** in an arbitrary direction, and a touch input on a touch pad included in the control apparatus **200**, but embodiments are not limited thereto.

[0121] In operation S**730**, the image display apparatus **100** may move the region, control the display to display a second image corresponding to a region to which the region has been moved, and move a pointer based on the movement of the region.

[0122] For example, the image display apparatus **100** may move the location of the region **320** within the planar 360degree image **310** upward, downward, leftward, or rightward or may move the location of the region from within the spherical 360-degree image in the altitudinal direction or the azimuthal direction.

[0123] When the location of the region is moved, the image display apparatus **100** may display a second image corresponding to the region to which the region has been moved. The image display apparatus **100** may also move the pointer in the altitudinal direction or the azimuthal direction within the 3D indicator in order to indicate the location of the region to which the region has been moved.

[0124] FIG. **10** is a flowchart illustrating an example method of operating the image display apparatus **100**, according to an example embodiment of the present disclosure.

[0125] Referring to FIG. **10**, in operation S**810**, the image display apparatus **100** may sense a user input for displaying a preview image.

[0126] For example, the image display apparatus **100** may sense an input (e.g., a user input) of a specific key included in the control apparatus **200** while displaying an image corresponding to a region of a planar 360-degree image or a spherical 360-degree image. However, embodiments are not limited thereto.

[0127] In operation S**820**, the image display apparatus **100** may control the display to display preview images of one or more regions different from the region displayed on the display, according to the user input for displaying a preview image.

[0128] In operation S**830**, the image display apparatus **100** may sense an input (e.g., a user input) for adjusting the number of preview images, when the preview images have been displayed. For example, the image display apparatus **100** may sense an input of a directional key or a number key included in the control apparatus **200**, but embodiments are not limited thereto.

[0129] When the input for adjusting the number of preview images is sensed, the image display apparatus **100** may increase or decrease the number of preview images, in operation S**840**. For example, when a single preview image has been displayed and an upward key or a rightward key is sensed, the image display apparatus **100** may display two preview images respectively corresponding to different two regions.

[0130] On the other hand, when two preview images have been displayed and a downward key or a leftward key is sensed, the image display apparatus **100** may display only a single preview image.

[0131] According to an embodiment, an indicator indicating the location or range of a region displayed on a display from among a 360-degree image is displayed, and thus a user may easily ascertain the location or range of a currently-being displayed image.

[0132] In addition, according to an embodiment, in response to receiving an input, an image of a preset region may be displayed, a preview image may be displayed, or the number of preview images may be adjusted, and thus the user may easily control the 360-degree image.

[0133] A method of operating an image display apparatus according to an embodiment may be embodied as program commands executable by various computer means and may be recorded on a computer-readable recording medium. The computer-readable recording medium may include program commands, data files, data structures, and the like separately or in combinations. The program commands to be recorded on the computer-readable recording medium may be specially designed and configured for embodiments of the present disclosure or may be well-known to and be usable by one of ordinary skill in the art of computer software. Examples of the computer-readable recording medium include a magnetic medium such as a hard disk, a floppy disk, or a magnetic tape, an optical medium such as a compact disk-read-only memory (CD-ROM) or a digital versatile disk (DVD), a magneto-optical medium such as a floptical disk, and a hardware device specially configured to store and execute program commands such as a ROM, a random-access memory (RAM), or a flash memory. Examples of the program commands are advanced language codes that can be executed by a computer by using an interpreter or the like as well as machine language codes made by a compiler.

[0134] While one or more example embodiments have been described with reference to the figures, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope as defined by the following claims.

What is claimed is:

1. An image display apparatus configured to display a 360-degree image, the image display apparatus comprising:

a display configured to display a first image corresponding to a region of the 360-degree image, and to display an indicator in a three-dimensional (3D) shape including a pointer pointing to a location of the region;

a sensor configured to sense an input for moving the region; and

a controller configured to control movement of the region and to display of a second image corresponding to a region to which the region has been moved, and to move the pointer within the indicator based on the movement of the region,

wherein the pointer is movable in an altitudinal direction and an azimuthal direction within the indicator.

2. The image display apparatus of claim **1**, wherein

the sensor is further configured to sense four directional key inputs as the input for moving the region, and

the controller is further configured to move the pointer in an altitudinal direction within the indicator in response to an upward or downward key input from among the four directional key inputs and to move the pointer in an azimuthal direction within the indicator in response to a leftward or rightward key input from among the four directional key inputs.

3. The image display apparatus of claim **1**, wherein

the sensor is further configured to sense a specific key input, and

the controller is further configured to control displaying of an image of a preset region of the 360-degree image in response to the specific key input.

4. The image display apparatus of claim **1**, wherein

the sensor is further configured to sense a zoom-in input or a zoom-out input, and

the controller is further configured to zoom in to an image displayed on the display and decrease a size or area of the pointer within the indicator in response to the zoom-in input, and zoom out from the image displayed

on the display and increase a size or area of the pointer within the indicator in response to the zoom-out input.

5. The image display apparatus of claim **1**, wherein

the sensor is further configured to sense an input for displaying a preview image, and

the controller is further configured to control displaying of preview images of one or more regions different from the region displayed on the display, in response to the input for displaying a preview image.

6. The image display apparatus of claim **5**, wherein

the sensor is further configured to sense an input for adjusting a number of preview images, and

the controller is further configured to increase or decrease the number of preview images displayed on the display in response to the input for adjusting the number of preview images.

7. The image display apparatus of claim **5**, wherein

the sensor is further configured to sense an input for selecting one of the preview images displayed on the display, and

the controller is further configured to control the display to display the selected preview image as an entire image in response to the input of selecting one of the preview images.

8. A method of operating an image display apparatus configured to display a 360-degree image, the method comprising:

displaying a first image corresponding to a region of the 360-degree image, and displaying an indicator in a three-dimensional (3D) shape including a pointer pointing to a location of the region;

sensing an input for moving the region; and

moving the region, displaying a second image corresponding to a region to which the region has been moved, and moving the pointer within the indicator based on the movement of the region,

wherein the pointer is movable in an altitudinal direction and an azimuthal direction within the indicator.

9. The method of claim **8**, wherein

the sensing of the input for moving the region comprises sensing four directional key inputs, and

the moving of the pointer comprises moving the pointer in an altitudinal direction within the indicator in response to an upward or downward key input from among the four directional key inputs, and moving the pointer in an azimuthal direction within the indicator in response to a leftward or rightward key input from among the four directional key inputs.

10. The method of claim **8**, further comprising:

sensing a specific key input; and

displaying an image of a preset region of the 360-degree image in response to the specific key input.

11. The method of claim **8**, further comprising:

sensing a zoom-in input or a zoom-out input; and

zooming in to an image displayed on a display and decreasing a size or area of the pointer within the indicator in response to the zoom-in input, and zooming out from the image displayed on the display and increasing a size or area of the pointer within the indicator in response to the zoom-out input.

12. The method of claim **8**, further comprising:

sensing an input for displaying a preview image; and

displaying preview images of one or more regions different from the region displayed on a display, in response to the input for displaying a preview image.

13. The method of claim **12**, further comprising:

sensing an input for adjusting a number of preview images; and

increasing or decreasing the number of preview images displayed on the display in response to the input for adjusting the number of preview images.

14. The method of claim **12**, further comprising:

sensing an input for selecting one of the preview images displayed on the display; and

displaying the selected preview image as an entire image on the display in response to the input of selecting one of the preview images.

15. A non-transitory computer-readable recording medium having recorded thereon a computer program, which, when executed by a computer, performs the method of claim **8**.

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