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Kim

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(54) **A/V RECEPTION APPARATUS AND WIRELESS DISPLAY SYSTEM**

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CPC ***H04N 7/0125*** (2013.01); ***G06T 7/0002*** (2013.01); ***G06V 10/25*** (2022.01); ***H04N 21/4402*** (2013.01)

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(Continued)

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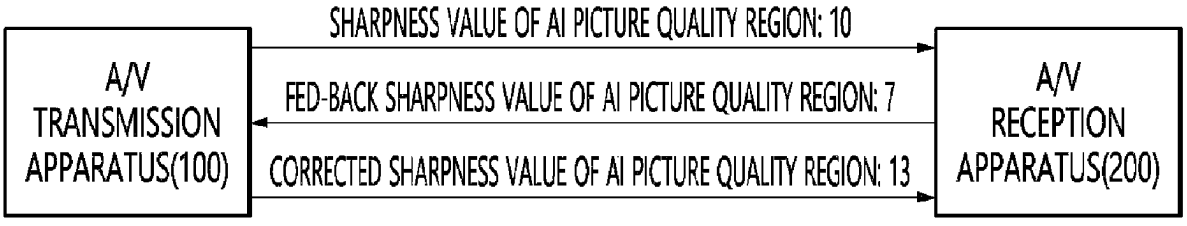
(57) **ABSTRACT**

An A/V reception apparatus according to an embodiment of the present disclosure may comprise: a display; a radio frequency (RF) reception module that receives a compressed RF packet from an A/V transmission apparatus, the compressed RF packet including a video frame corresponding to a content video, and AI picture quality information regarding an AI picture quality region indicating at least a partial region of the content video; and a microcomputer that acquires a value of a picture quality factor of the AI picture quality region on the basis of the AI picture quality information, transmits the value of the picture quality factor to the A/V transmission apparatus, receives, from the A/V transmission apparatus, a picture quality correction value in which the value of the picture quality factor of the AI picture quality region has been corrected, and outputs the video frame via the display on the basis of the received picture quality correction value.

13 Claims, 8 Drawing Sheets



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(58) **Field of Classification Search**
CPC H04N 21/43615; H04N 9/68; H04N 17/02; H04N 21/2343; H04N 21/426; G06T 7/0002; G06V 10/25
See application file for complete search history.

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FIG. 1

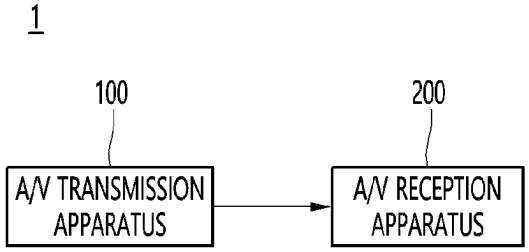

1
100
200
A/V TRANSMISSION APPARATUS
A/V RECEPTION APPARATUS

FIG. 2

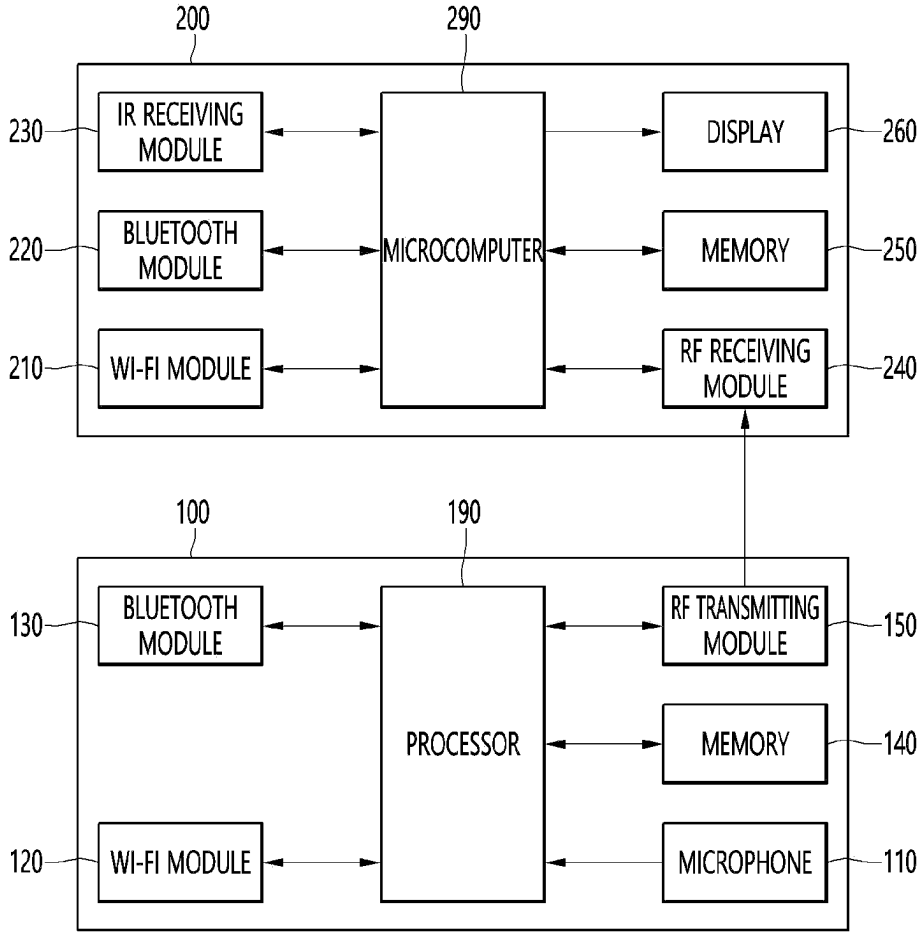

200
290
230
IR RECEIVING MODULE
220
BLUETOOTH MODULE
210
WI-FI MODULE
MICROCOMPUTER
DISPLAY
260
MEMORY
250
RF RECEIVING MODULE
240
100
190
130
BLUETOOTH MODULE
120
WI-FI MODULE
PROCESSOR
RF TRANSMITTING MODULE
150
MEMORY
140
MICROPHONE
110

FIG. 3

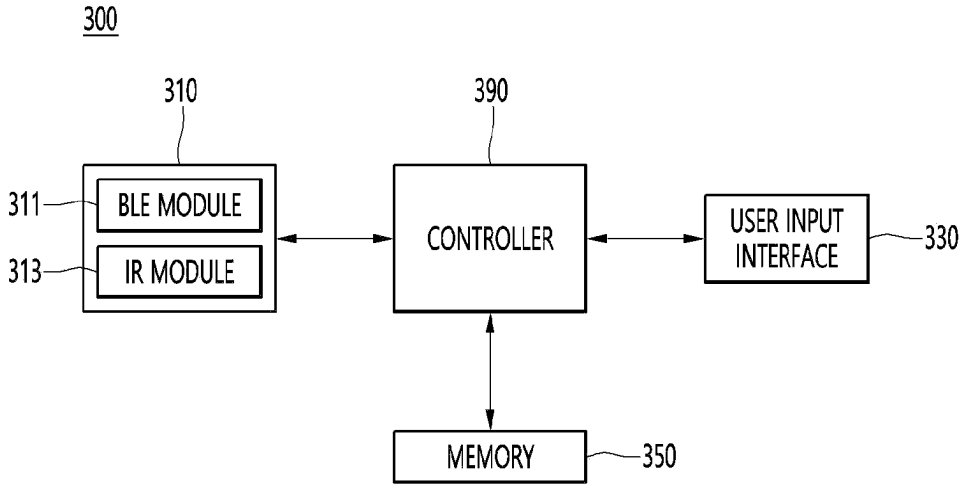

300
310
390
311
BLE MODULE
313
IR MODULE
CONTROLLER
USER INPUT INTERFACE
330
MEMORY
350

FIG. 4

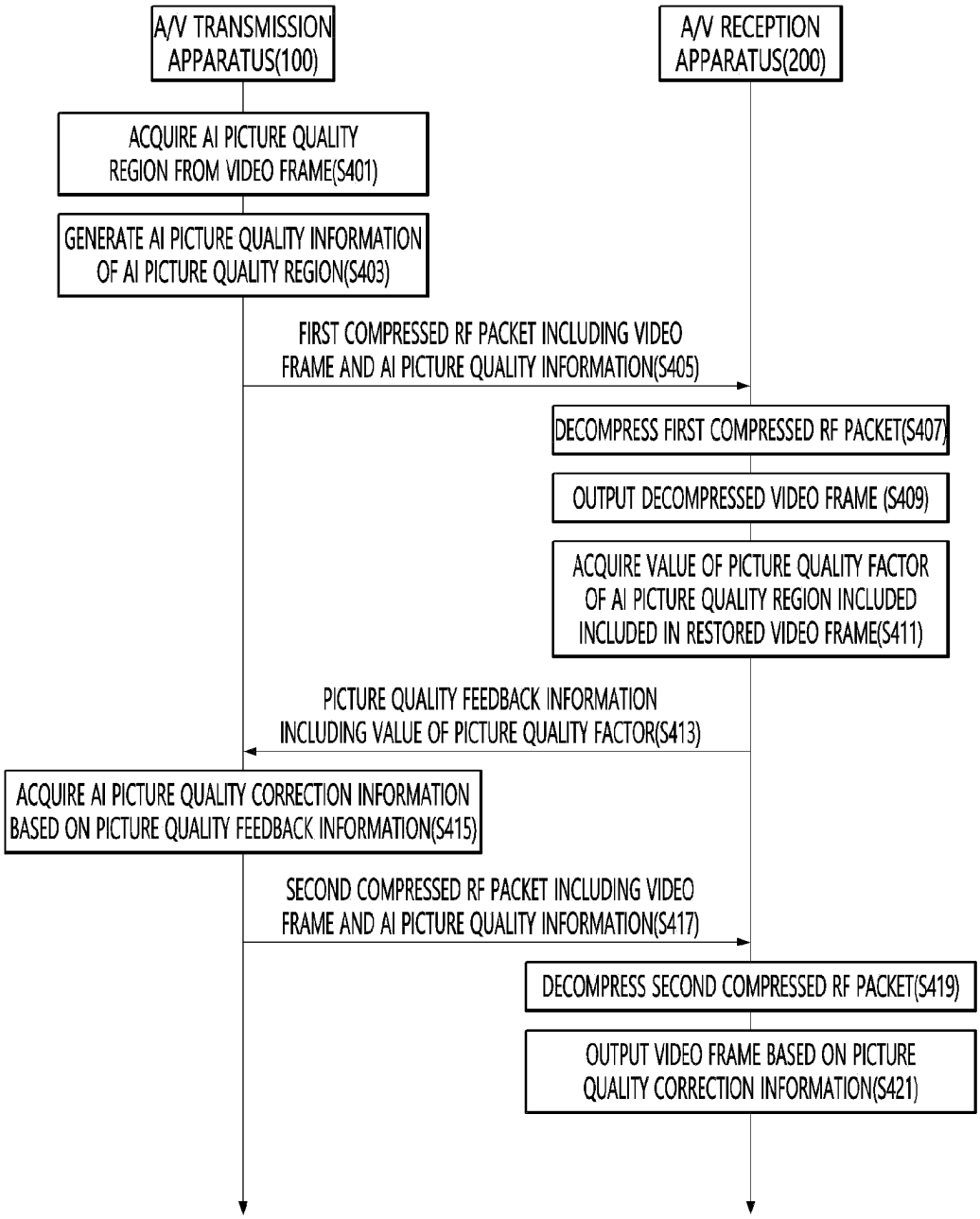

A/V TRANSMISSION APPARATUS(100)
A/V RECEPTION APPARATUS(200)
ACQUIRE AI PICTURE QUALITY REGION FROM VIDEO FRAME(S401)
GENERATE AI PICTURE QUALITY INFORMATION OF AI PICTURE QUALITY REGION(S403)
FIRST COMPRESSED RF PACKET INCLUDING VIDEO FRAME AND AI PICTURE QUALITY INFORMATION(S405)
DECOMPRESS FIRST COMPRESSED RF PACKET(S407)
OUTPUT DECOMPRESSED VIDEO FRAME (S409)
ACQUIRE VALUE OF PICTURE QUALITY FACTOR OF AI PICTURE QUALITY REGION INCLUDED INCLUDED IN RESTORED VIDEO FRAME(S411)
PICTURE QUALITY FEEDBACK INFORMATION INCLUDING VALUE OF PICTURE QUALITY FACTOR(S413)
ACQUIRE AI PICTURE QUALITY CORRECTION INFORMATION BASED ON PICTURE QUALITY FEEDBACK INFORMATION(S415)
SECOND COMPRESSED RF PACKET INCLUDING VIDEO FRAME AND AI PICTURE QUALITY INFORMATION(S417)
DECOMPRESS SECOND COMPRESSED RF PACKET(S419)
OUTPUT VIDEO FRAME BASED ON PICTURE QUALITY CORRECTION INFORMATION(S421)

FIG. 5

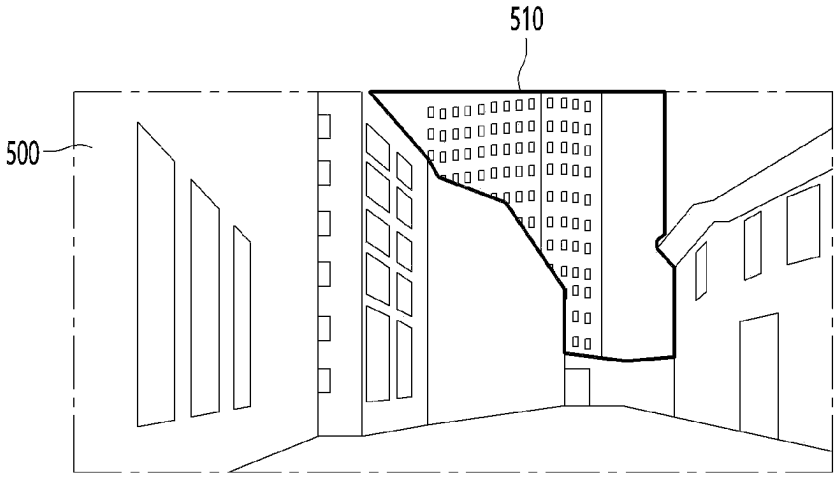

510
500

FIG. 6

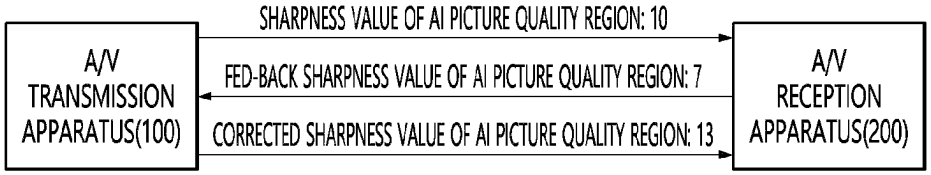

SHARPNESS VALUE OF AI PICTURE QUALITY REGION: 10
A/V TRANSMISSION APPARATUS(100)
FED-BACK SHARPNESS VALUE OF AI PICTURE QUALITY REGION: 7
CORRECTED SHARPNESS VALUE OF AI PICTURE QUALITY REGION: 13
A/V RECEPTION APPARATUS(200)

FIG. 7

LOS (Line Of Sight) CONDITION

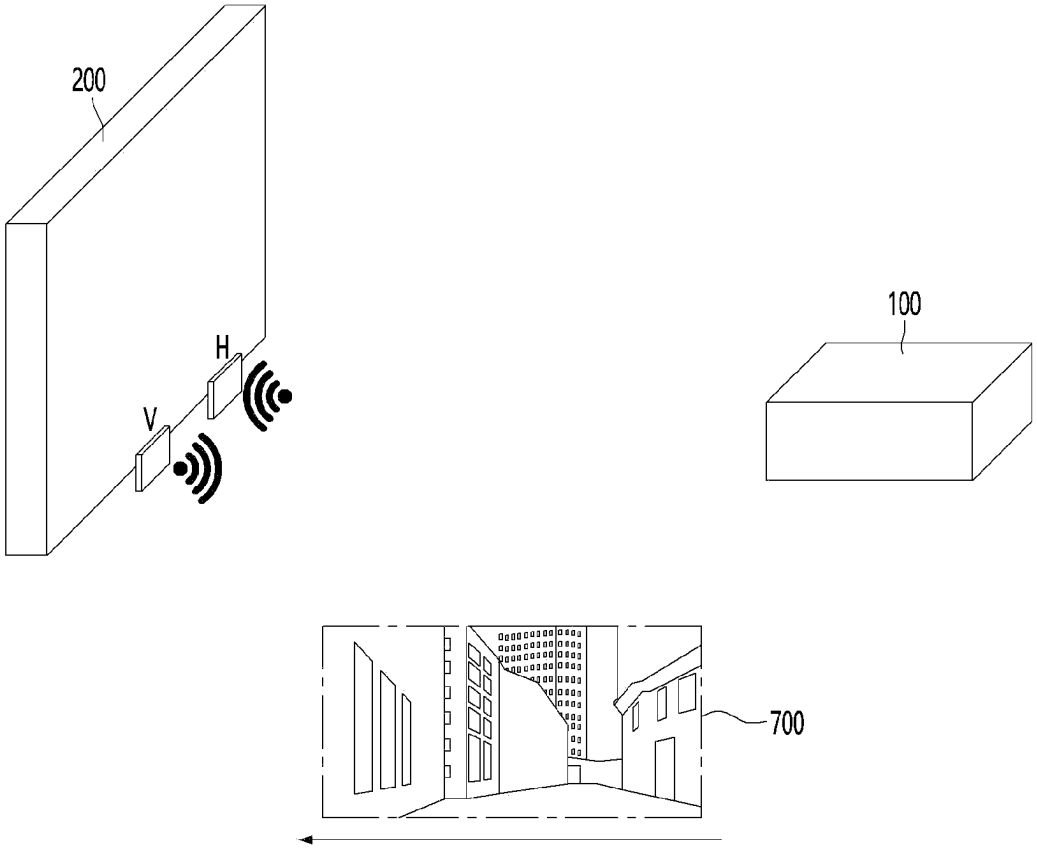


FIG. 8

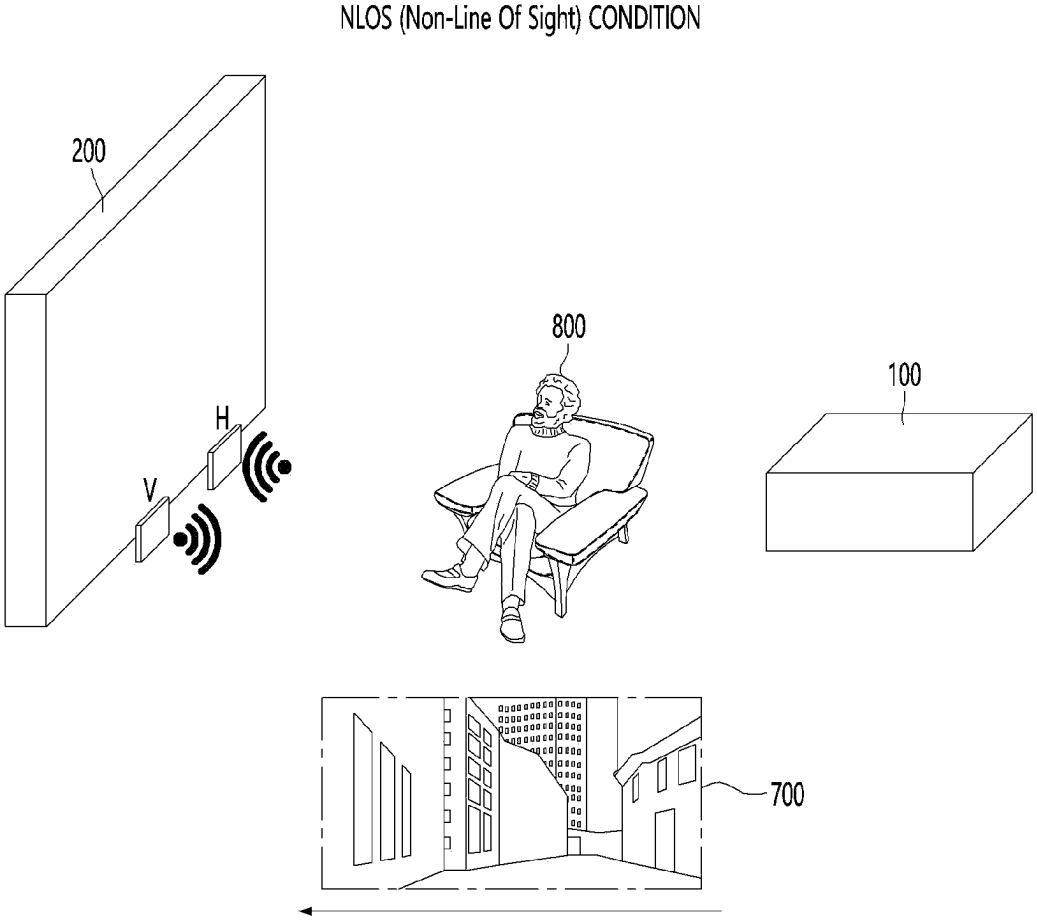


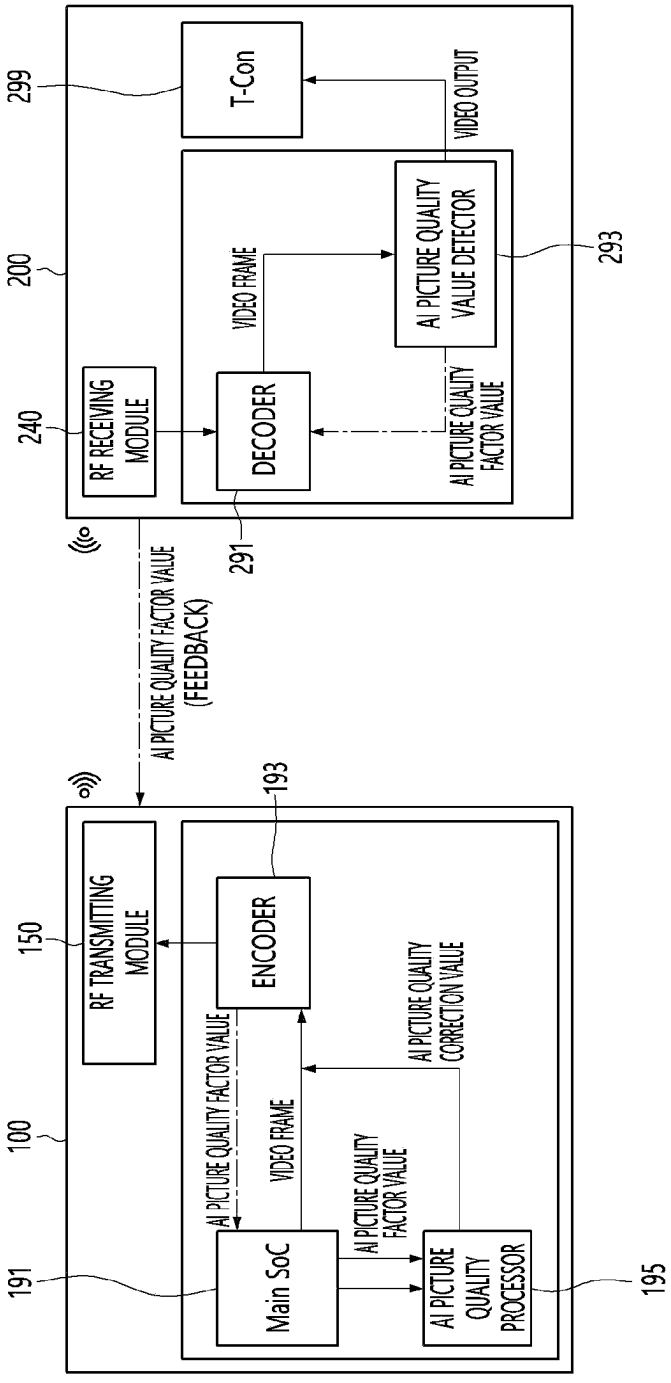
FIG. 9

	LOS CONDITION - SNR	NLOS CONDITION - SNR
NON PERFORMANCE OF AI PICTURE QUALITY CORRECTION	30dB	10dB
PERFORMANCE OF AI PICTURE QUALITY CORRECTION	30dB	30dB

FIG. 10

	LOS CONDITION - COMPRESSION RATIO	NLOS CONDITION - COMPRESSION RATIO
NON PERFORMANCE OF AI PICTURE QUALITY CORRECTION	8	16
PERFORMANCE OF AI PICTURE QUALITY CORRECTION	8	8

FIG. 11


299
T-Con
VIDEO OUTPUT
200
AI PICTURE QUALITY VALUE DETECTOR
293
VIDEO FRAME
240
RF RECEIVING MODULE
DECODER
AI PICTURE QUALITY FACTOR VALUE
291
AI PICTURE QUALITY FACTOR VALUE (FEEDBACK)
193
150
RF TRANSMITTING MODULE
ENCODER
AI PICTURE QUALITY CORRECTION VALUE
100
AI PICTURE QUALITY FACTOR VALUE
VIDEO FRAME
AI PICTURE QUALITY FACTOR VALUE
191
Main SoC
AI PICTURE QUALITY PROCESSOR
195

A/V RECEPTION APPARATUS AND WIRELESS DISPLAY SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

This application is the National Phase of PCT International Application No. PCT/KR2021/009095, filed on Jul. 15, 2021, all of which is hereby expressly incorporated by reference into the present application.

TECHNICAL FIELD

The present disclosure relates to a wireless display system that transmits and receives A/V data wirelessly.

BACKGROUND ART

As video technology has changed from analogue to digital, evolution has been made from SD (Standard-Definition) to HD (Hi-Definition) to provide more realistic video closer to actual scenes. SD supports a resolution of 704×480 and consists of about 350,000 pixels, while HD is classified into HD and Full HD, of which Full HD supports a higher resolution of 1920×1080 and consists of 2 million pixels, providing significantly higher quality videos compared to SD.

In recent years, video technology has grown beyond Full HD to Ultra High-Definition (UHD), and UHD, which supports ultra-high definition and ultra-high resolution, is attracting attention as the next generation media environment. UHD supports 4K (3840×2160) and 8K (7680×4320) resolutions and up to 22.2 channels of surround audio. Compared to HD, UHD provides four times clearer picture quality in 4K UHD, and 16 times clearer picture quality in 8K UHD.

Recently, wireless display systems have emerged that transmit high-resolution images to display devices via wireless.

A wireless display system is a system that transmits and receives A/V data between an A/V transmission apparatus and an A/V reception apparatus through a local area network.

The A/V reception apparatus displays the A/V data received from the A/V transmission apparatus.

The A/V transmission apparatus may also transmit video data to which artificial intelligence picture quality has been applied. Image quality to which artificial intelligence (AI) is applied refers to adjusting the values of certain quality factors in a partial region constituting a video differently from the values of certain quality factors in surrounding regions.

When transmitting video data to which AI picture quality is applied, the picture quality of a relevant region may decrease due to packet loss caused by the deterioration of network environment.

In other words, when the compression ratio of packets increases as the network environment deteriorates, the picture quality of a region to which the AI quality factor value is applied may decrease.

DISCLOSURE OF INVENTION

Technical Problem

The present disclosure aims to enable a transmission apparatus to maintain optimal AI picture quality when the transmission apparatus transmits a video including an AI image quality region in a wireless display system.

The present disclosure aims to enable a transmission apparatus to maintain optimal AI image quality regardless of network environment when the transmission apparatus transmits a video including an AI image quality region in a wireless display system.

Technical Solution

According to an embodiment of the present disclosure, an Audio/Video (A/V) reception apparatus includes a display, a radio frequency (RF) reception module that receives a compressed RF packet from an A/V transmission apparatus, the compressed RF packet including a video frame corresponding to a content video, and AI picture quality information regarding an AI picture quality region indicating at least a partial region of the content video, and a microcomputer that acquires a value of a picture quality factor of the AI picture quality region on the basis of the AI picture quality information, transmits the value of the picture quality factor to the A/V transmission apparatus, receives, from the A/V transmission apparatus, a picture quality correction value in which the value of the picture quality factor of the AI picture quality region has been corrected, and outputs the video frame via the display on the basis of the received picture quality correction value.

According to an embodiment of the present disclosure, a wireless display system includes an audio/video (A/V) transmission apparatus that generates a radio frequency (RF) packet, compress a generated RF packet and transmits a compressed RF packet to an A/V reception apparatus via RF communication, the compressed RF packet including a video frame corresponding to a content video, and AI picture quality information regarding an AI picture quality region indicating at least a partial region of the content video, and the A/V reception apparatus that acquires a value of a picture quality factor of the AI picture quality region on the basis of the AI picture quality information, transmits the value of the picture quality factor to the A/V transmission apparatus, receives, from the A/V transmission apparatus, a picture quality correction value in which the value of the picture quality factor of the AI picture quality region has been corrected, and outputs the video frame via a display on the basis of the received picture quality correction value.

Advantageous Effects

According to an embodiment of the present disclosure, a video with consistent AI picture quality may be provided even when the network environment is poor.

Accordingly, users may watch videos with AI quality applied without significant influence by the network environment.

BRIEF DESCRIPTION OF DRAWINGS

FIGS. **1** and **2** are diagrams for describing a configuration of a wireless display system according to an embodiment of the present disclosure.

FIG. **3** is a block diagram for describing a configuration of a remote control device according to an embodiment of the present disclosure.

FIG. **4** is a ladder diagram for describing a method of operating a wireless display system according to an embodiment of the present disclosure.

FIG. **5** is a diagram for describing an AI picture quality region according to an embodiment of the present disclosure.

FIG. **6** is a diagram for describing a process in which the value of an picture quality factor for an AI picture quality region is corrected, according to an embodiment of the present disclosure.

FIGS. **7** to **10** are diagrams showing comparison of measured SNR and compression ratio when AI picture quality correction is performed under LOS (Line Of Sight) conditions and NLOS (Non-Line Of Sight) conditions.

FIG. **11** is a diagram for describing a detailed configuration of a wireless display system according to an embodiment of the present disclosure.

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, embodiments of the present disclosure will be described in detail with reference to the drawings. The suffixes "module" and "unit or portion" for components used in the following description are merely provided only for facilitation of preparing this specification, and thus they are not granted a specific meaning or function.

An audio/video (A/V) transmission apparatus according to an embodiment of the present disclosure, for example, as an artificial device that adds a computer supporting function to a broadcast receiving function, can have an easy-to-use interface such as a writing input device, a touch screen, or a spatial remote control device as an Internet function is added while fulfilling the broadcast receiving function.

Then, with the support of a wired or wireless Internet function, it is possible to perform an e-mail, web browsing, banking, or game function in access to Internet and computers. In order to perform such various functions, standardized general purpose OS can be used.

Accordingly, since various applications are freely added or deleted on a general purpose OS kernel, an A/V transmission apparatus described herein, for example, can perform various user-friendly functions.

FIGS. **1** and **2** are diagrams for describing a configuration of a wireless display system according to an embodiment of the present disclosure.

Referring to FIG. **1**, a wireless display system **1** according to an embodiment of the present disclosure may include an A/V transmission apparatus **100** and an A/V reception apparatus **200**.

The wireless display system **1** may be a system in which the A/V transmission apparatus **100** wirelessly transmits A/V data to the A/V reception apparatus **200**, and the A/V reception apparatus **200** outputs the A/V data.

The A/V transmission apparatus **100** may be a device capable of encoding video and audio and transmitting the encoded content video and audio in a wireless manner.

The A/V transmission apparatus **100** may be a set-top box.

The A/V transmission apparatus **100** may be connected to an external device such as a set-top box or a USB memory. The A/V transmission apparatus **100** may transmit a video signal or an audio signal received from the connected external device to the A/V reception apparatus **200**.

The A/V reception apparatus **200** may be a display apparatus capable of wirelessly receiving an encoded video and audio and decoding the received video and audio.

The A/V transmission apparatus **100** and the A/V reception apparatus **200** may constitute a video wall display system.

In a video wall, a display having a thin bezel plays an important role in the visualization of content images. For a thin bezel of a display, it is efficient that components capable of minimal functions are only provided and a circuit or a component for a main function is provided in a separate device.

The A/V transmission apparatus **100** may determine a type of the content image input from the outside, and determine a compression ratio of the content image based on the determined type. The compression ratio of a content video may be defined as the ratio of the size of video data before encoding to the size of video data after encoding.

The type of the content image may include a still image type, a general video type, and a game video type.

The A/V transmission apparatus **100** may compress the content video according to the determined compression ratio, and wirelessly transmit the compressed content video to the A/V reception apparatus **200**.

The A/V reception apparatus **200** may restore the compressed content video received from the A/V transmission apparatus **100** and display the restored content video on the display.

FIG. **2** is a block diagram illustrating detailed configurations of the A/V transmission apparatus **100** and the A/V reception apparatus **200**.

Referring to FIG. **2**, the A/V transmission apparatus **100** may include a microphone **110**, a Wi-Fi module **120**, a Bluetooth module **130**, a memory **140**, an RF transmitting module **150** and a processor **190**.

The microphone **110** may receive an audio signal and transmit the audio signal to the processor **190**.

The microphone **110** may receive a speech uttered by a user.

The Wi-Fi module **120** may perform wireless communication through the Wi-Fi standard. The Bluetooth module **120** may perform wireless communication with an external device or the A/V reception apparatus **200** through the Wi-Fi standard.

The Bluetooth module **130** may perform wireless communication through the Bluetooth Low Energy (BLE) standard.

The Bluetooth module **130** may perform wireless communication with an external device such as a remote control or the A/V reception apparatus **200** through the Bluetooth Low Energy (BLE) standard.

The memory **140** may store a program for signal processing and control and store a signal-processed video, audio, or data signal.

The memory **140** may perform a function for temporarily storing video, audio, or data signals input from the outside, and store information on a predetermined image through a channel storage function.

The RF transmitting module **150** may transmit an A/V signal to an RF receiving module **240** of the A/V reception apparatus **200** through RF (Radio Frequency) communication.

The RF transmitting module **150** may include one or more antennas.

The RF transmitting module **150** may transmit a compressed A/V signal in digital form to the RF receiving module **240**.

The RF transmitting module **150** may transmit an A/V signal to the RF receiving module **240** through one or more channels.

The processor **190** may control overall operation of the A/V transmission apparatus **100**. The processor **190** may be configured in the form of a system on chip (SoC).

A plurality of processors **190** may be provided.

The processor **190** may compress an externally input video signal or audio signal and transmit the compressed signal to the RF transmitting module **150**.

The processor **190** may include an encoder for compressing a video signal or an audio signal.

The processor **190** may be referred to as a main SoC.

The processor **190** may include one or more interfaces for connection with an external device. For example, the processor **190** may include one or more HDMI ports and one or more USB ports.

The processor **190** may include a tuner for receiving a broadcast signal.

The A/V receiving apparatus **200** may include a Wi-Fi module **210**, a Bluetooth module **220**, an IR module **230**, an RF receiving module **240**, a memory **250**, a display **260**, and a microcomputer **290**.

The Wi-Fi module **210** may perform wireless communication through the Wi-Fi standard.

The Wi-Fi module **120** may perform wireless communication with an external device or the A/V transmission apparatus **100** through the Wi-Fi standard.

The Bluetooth module **220** may perform wireless communication through the Bluetooth Low Energy (BLE) standard.

The Bluetooth module **220** may perform wireless communication with an external device such as a remote control or the A/V transmission apparatus **200** through the Bluetooth Low Energy (BLE) standard.

The IR module **230** may receive a signal from the remote control **300** to be described later through IR (Infrared) communication.

The RF receiving module **240** may receive an A/V signal from the RF transmitting module **150**.

The RF receiving module **240** may include a plurality of antennas. The RF receiving module **240** may be disposed at the lower end of the display **260**.

The RF receiving module **240** may include a first antenna module and a second antenna module. Each of the first antenna module and the second antenna module may include a plurality of antennas.

The RF receiving module **240** may receive a compressed A/V signal in digital form from the RF transmitting module **150** and transmit the received A/V signal to the microcomputer **290**.

The memory **250** may store a program for signal processing and control and store a signal-processed video, audio, or data signal.

The display **260** may display a video signal received from the microcomputer **290**.

The display **260** may display a video signal according to the operation of a timing controller (not shown).

The microcomputer **290** may control the overall operation of a display device **200**.

The microcomputer **290** may decompress the compressed A/V signal received by the RF receiving module **240**. To this end, the microcomputer **290** may include a decoder.

FIG. **3** is a block diagram for describing a configuration of a remote control device according to an embodiment of the present disclosure.

Referring to FIG. **3**, a remote control device **300** may include a wireless communication interface **310**, a user input interface **330**, a memory **350**, and a controller **390**.

The wireless communication interface **310** may be an interface for performing wireless communication with the A/V transmitting apparatus **100** or the A/V receiving apparatus **200**.

The wireless communication interface **310** may include a Bluetooth Low Energy (BLE) module **311** and an InfraRed (IR) module **313**.

The BLE module **311** may transmit a signal for controlling the operation of the A/V transmitting apparatus **100** to the A/V transmitting apparatus **100**.

The BLE module **311** may transmit a signal for triggering a pairing operation of the A/V transmitting apparatus **100** to the A/V transmitting apparatus **100**.

The user input interface **330** may include a keypad, a button, a touch pad, a touch screen, or the like.

The user input interface **330** may generate a control command for controlling the operation of the A/V transmission apparatus **100** or the A/V reception apparatus **200** according to a user's operation command.

When the user input interface **330** includes a hard key button, the user may operate the hard key through an operation of pushing the hard key button.

The user input interface **330** may include various types of input means that can be operated by the user, such as a scroll key or a jog key.

The memory **350** may store a program for the operation of the controller **390** and may temporarily store input/output data.

The controller **390** may control operation related to an application program and generally control overall operation of the remote control device **300**.

FIG. **4** is a ladder diagram for describing a method of operating a wireless display system according to an embodiment of the present disclosure.

The processor **190** of the A/V transmission apparatus **100** may acquire an AI picture quality region of a video frame (**S401**).

In one embodiment, the AI picture quality region may be a region for emphasizing the value of a specific picture quality factor among the entire area of the image frame. The AI picture quality region may be a region in which the values of one or more picture quality factors are set differently from other regions among the entire area of the video frame.

For example, the AI picture quality region may be a region representing a specific object, such as a human face or a building.

In another embodiment, the AI picture quality region may vary depending on the genre of a video. For example, when the genre of a video is a movie, the AI quality region may be the entire region of the video frame.

As described above, the AI picture quality region may be a region for emphasizing values of a specific picture quality factor in a partial region or the entire region.

The picture quality factor may be any one of sharpness, brightness, luminance, and contrast.

In one embodiment, the processor **190** may extract an AI picture quality region from the entire region of a video frame using a feature point extraction technique. The feature point extraction technique may be a technique for extracting a point for identifying an object included in a video frame. In general, a feature point may be a corner point that forms a corner of an object. Known techniques may be used as the feature point extraction method.

FIG. **5** is a diagram for describing an AI picture quality region according to an embodiment of the present disclosure.

Referring to FIG. **5**, a video frame **500** may include an AI picture quality region **510**. The AI picture quality region **510** may be a region representing a building among objects included in the video frame **500**.

The processor **190** may extract a plurality of feature points included in the region representing the building and acquire the AI picture quality region **510** connecting the plurality of extracted feature points.

The processor **190** may acquire values of one or more picture quality factors for the AI picture quality region **510** using an picture quality factor determination model.

Description will be given referring again to FIG. **4**.

The processor **190** of the A/V transmission apparatus **100** may generate AI picture quality information in the acquired AI picture quality region (S**403**).

The processor **190** may generate AI picture quality information including values of one or more picture quality factors for the AI picture quality region.

The processor **190** may determine values of one or more picture quality factors suitable for the acquired AI picture quality region.

The processor **190** may acquire AI picture quality information for the AI picture quality region based on the picture quality factor determination model.

The picture quality factor determination model may be an artificial neural network-based model supervised through deep learning or machine learning algorithms.

The picture quality factor determination model may be a supervised learning model based on a training data set including object image data and one or more picture quality factor values labeled thereto.

The picture quality factor determination model may be stored in the memory **140** of the A/V transmission apparatus **100**.

The processor **190** may acquire values of one or more picture quality factors through the picture quality factor determination model by using an image for the AI picture quality region as input data.

The AI picture quality information may include position information indicating a position at which the AI picture quality region is to be displayed on a display. That is, when the AI picture quality region is a partial region of the video frame, the AI picture quality information may include coordinate information of the AI picture quality region.

The reason for this is to receive a feedback on the actual measured values of picture quality factors for the AI picture quality region in the future.

The processor **190** of the A/V transmission apparatus **100** may transmit a first compressed packet including a video frame and AI picture quality information for an AI picture quality region to the A/V reception apparatus **200** through the RF transmitting module **150** (S**405**).

The encoder of the processor **190** may compress a packet including a video frame, AI picture quality information, and picture quality information for a region other than the AI picture quality region to generate the first compressed packet.

The processor **190** may transmit the first compressed packet to the RF receiving module **240** of the A/V reception apparatus **200** through the RF transmitting module **150** including a plurality of antenna modules.

The microcomputer **290** of the A/V reception apparatus **200** may decompress the received first compressed packet (S**407**) and output the decompressed video frame (S**409**).

The microcomputer **290** may decompress the first compressed packet through a decoder.

The microcomputer **290** may output the video frame to a display **260** based on the AI picture quality information according to the decompression result.

The microcomputer **290** of the A/V reception apparatus **200** may acquire the value of the picture quality factor of the AI picture quality region included in the decompressed video frame (S**411**).

The microcomputer **290** may acquire values of one or more picture quality factors for the AI picture quality region using coordinate information of the AI picture quality region included in the AI picture quality information.

That is, the microcomputer **290** may identify the AI picture quality region through the coordinate information of the AI picture quality region included in the AI picture quality information. The microcomputer **290** may measure the values of one or more picture quality factors for the identified AI picture quality region.

The microcomputer **290** may measure one or more of sharpness, contrast, and brightness for the AI picture quality region using technology to be known.

The microcomputer **290** of the A/V reception apparatus **200** may transmit picture quality feedback information including the value of the picture quality factor, which is measured through the RF receiving module **240**, to the A/V transmission apparatus **100** (S**413**).

The microcomputer **290** may transmit the picture quality feedback information to the A/V transmission apparatus **100** for picture quality correction for the AI picture quality region by the A/V transmission apparatus **100**.

In one embodiment, the microcomputer **290** may transmit the picture quality feedback information to the A/V transmission apparatus **100** in real time.

In another embodiment, when a difference between the value of the picture quality factor of the AI picture quality region included in the AI picture quality information and the measured value of the picture quality factor of the AI picture quality region is greater than or equal to a preset value, the microcomputer **290** may transmit the picture quality feedback information to the A/V transmission apparatus **100**.

It is assumed that the sharpness of the AI picture quality region included in the AI picture quality information is 10, the actually-measured sharpness is 7, and the preset value is 2.

As the network environment deteriorates and packets transmitted from the A/V transmission apparatus **100** to the A/V reception apparatus **200** are lost,

the difference between the two values is 3, which is greater than the preset value 2, so that the microcomputer **290** may transmit a sharpness value 7 in the AI picture quality region to the A/V transmission apparatus **100**.

The processor **190** of the A/V transmission apparatus **100** may acquire AI picture quality correction information for the AI picture quality region based on the picture quality feedback information (S**415**).

The processor **190** may acquire an AI picture quality correction value based on the difference between the value of the picture quality factor of the AI picture quality region and the value of the picture quality factor included in the picture quality feedback information.

For example, when the sharpness of the AI picture quality region first processed in the A/V transmission apparatus **100** is 10 and the sharpness included in the picture quality feedback information is 7, the difference value in sharpness may be 3.

The processor **190** may perform processing such that the difference value in sharpness **3** is further reflected to the AI picture quality region. Specifically, the processor **190** may increase the existing sharpness of the AI picture quality

region from **10** to **13**. The value of increased sharpness may be the AI picture quality correction value.

The AI picture quality correction information may include adjusted values of one or more picture quality factors.

The processor **190** of the A/V transmission apparatus **100** may transmit a second compressed packet including a video frame and AI picture quality correction information to the RF receiving module **240** through the RF transmitting module **150** (S**417**).

The processor **190** may compress the AI picture quality correction information including the value of the corrected picture quality factor for an AI picture quality region together with the video frame to generate the second compressed packet.

The microcomputer **290** of the A/V reception apparatus **200** may decompress the received second compressed packet (S**419**) and output the video frame based on the AI picture quality correction information (S**421**).

The microcomputer **290** may correct the value of the picture quality factor of the AI picture quality region based on the AI picture quality correction information.

That is, the microcomputer **290** may adjust the value of a first picture quality factor (before feedback) to the value of a second picture quality factor (after feedback) for the AI picture quality region.

The microcomputer **290** may apply the adjusted value of the second picture quality factor to the AI picture quality region and output the video frame to which the adjusted value of the picture quality factor has been applied.

According to an embodiment of the present disclosure, it is possible to adjust the value of the picture quality factor for the AI picture quality region, in real time, even when the network environment deteriorates. Accordingly, AI picture quality may be maintained even after wireless transmission of video signals.

FIG. **6** is a diagram for describing a process in which the value of an picture quality factor for an AI picture quality region is corrected, according to an embodiment of the present disclosure.

Hereinafter, a description will be given by taking the AI picture quality region **510** of FIG. **5** as an example.

The A/V transmission apparatus **100** may extract the AI picture quality region **510** from the video frame **510**.

Thereafter, the A/V transmission apparatus **100** may determine the sharpness value of the AI picture quality region **510** to be 10, and transmit the determined sharpness value 10 and the coordinate information of the AI picture quality region **510** to the A/V reception apparatus **200**.

The A/V reception apparatus **200** may measure the sharpness value for the AI picture quality region **510** based on the coordinate information of the AI picture quality region **510**.

The A/V reception apparatus **200** may transmit the measured sharpness value 7 to the A/V transmission apparatus **100** as feedback.

The A/V transmission apparatus **100** may compare the sharpness value 7 for the AI picture quality region **510** received from the A/V reception apparatus **200** with an existing sharpness value 10.

The A/V transmission apparatus **100** may acquire a difference **3** between the existing sharpness value 10 and the fed-back sharpness value 7, and add 3 to the existing sharpness value 10. The A/V transmission apparatus **100** may acquire the summed sharpness value 13 as the AI picture quality correction value. Adding up sharpness values is merely an example method.

The A/V transmission apparatus **100** may transmit the corrected sharpness value 13 for the AI picture quality region **510** to the A/V reception apparatus **200**.

Even though the A/V transmission apparatus **100** sets the compression ratio high and transmits compressed packets due to a deteriorated network environment, the A/V transmission apparatus **100** has set the sharpness value of the AI picture quality region **510** in consideration of this.

Even when data loss occurs during the decompression of a packet compressed at a high compression ratio, the sharpness value of the AI picture quality region **510** may be sufficiently maintained.

As described above, according to an embodiment of the present disclosure, in a wireless display system, even when network quality deteriorates, AI picture quality for videos may be sufficiently maintained.

Accordingly, a user may experience the AI picture quality for videos without any inconvenience, regardless of the network environment.

FIGS. **7** to **10** are diagrams showing comparison of measured SNR and compression ratio when AI picture quality correction is performed under LOS (Line Of Sight) conditions and NLOS (Non-Line Of Sight) conditions.

According to the embodiment of FIG. **4**, the AI picture quality correction is an embodiment in which the value of the AI picture quality factor is fed back to the A/V transmission apparatus **100** in real time, and accordingly, the A/V transmission apparatus **100** corrects and transmits the value of the AI picture quality factor in real time.

In FIGS. **7** and **8**, the A/V transmission apparatus **100** may transmit video data **700** to the A/V reception apparatus **200**.

First, as shown in FIG. **7**, an LOS condition may be a condition that there are no obstacles between the A/V transmission apparatus **100** and the A/V reception apparatus **200**.

As shown in FIG. **8**, an NLOS condition may be a condition aht an obstacle **800** exists between the A/V transmission apparatus **100** and the A/V reception apparatus **200**.

Accordingly, under the LOS condition, the network quality between the A/V transmission apparatus **100** and the A/V reception apparatus **200** is better than that under the NLOS condition.

The microcomputer **290** of the A/V reception apparatus **200** may measure a signal to noise ratio (SNR) and a compression ratio under each of the LOS condition and the NLOS condition.

The microcomputer **290** of the A/V reception apparatus **200** may measure the SNR and the compression ratio from video signals received under each of the LOS condition and the NLOS condition.

The compression ratio may indicate the magnification at which the A/V transmission apparatus **100** compresses the video signal.

The compressed packet received by the A/V reception apparatus **200** may include information about the compression ratio.

The microcomputer **290** of the A/V reception apparatus **200** may acquire the compression ratio in the process of decompressing compressed packets through a decoder.

In another embodiment, the A/V transmission apparatus **100** may transmit the compression ratio to the A/V reception apparatus **200**.

Referring to FIG. **9**, under the LOS condition, when AI picture quality correction is not performed, the measured

SNR may be 30 dB. Under the NLOS condition, when AI picture quality correction is not performed, the measured SNR may be 10 dB.

Under the NLOS condition, when AI picture quality correction is not performed, the network quality is lower than in the LOS condition, so that the SNR value decreases.

Conversely, when AI picture quality correction is performed under the LOS condition and the NLOS condition, the measured SNR may be the same at 30 dB.

This is because, under the NLOS condition, the values of the picture quality factors in the AI picture quality region are automatically adjusted (performing AI picture quality correction) and transmitted to the A/V reception apparatus **200**, resulting in the effect of the network quality remaining the same.

Referring to FIG. **10**, under the LOS condition, when AI picture quality correction is not performed, the measured compression ratio may be 8 times. Under the NLOS condition, when AI picture quality correction is not performed, the measured compression ratio may be 16 times.

This is because, when AI picture quality correction is not performed under the NLOS condition, the network quality is lower than in the LOS condition, so that the A/V transmission apparatus **100** needs to transmit packets by increasing the compression ratio.

Conversely, when AI picture quality correction is performed under the LOS condition and the NLOS condition, the measured compression ratios may be the same which is 8 times.

This is because under the NLOS condition, the values of the picture quality factors in the AI picture quality region are automatically adjusted (performing AI picture quality correction) and transmitted to the A/V reception apparatus **200** to remove a need to adjust the compression ratio in consideration of network quality.

In this way, when the measured SNR or compression ratios are the same under the LOS condition and the NLOS condition, it can be seen that AI picture quality correction, which is an embodiment of the present disclosure, has been performed.

FIG. **11** is a diagram for describing a detailed configuration of a wireless display system according to an embodiment of the present disclosure.

Referring to FIG. **11**, a processor **190** of an A/V transmission apparatus **100** may include a main Soc **191**, an encoder **193**, and an AI picture quality processor **195**.

The main Soc **191** may transmit a video frame corresponding to a content video to the encoder **193**.

The main SoC **191** may determine whether AI picture quality is applied to the content video.

The main SoC **191** may determine whether AI picture quality is applied to the content video according to the genre of the content video. The main SoC **191** may determine that AI picture quality needs to be applied to the content video when the genre of the content video is a movie.

In another embodiment, the main SoC **191** may determine that the value of the AI picture quality factor needs to be applied to a partial region of the content video.

When the AI picture quality region is extracted, the main SoC **191** may transmit coordinate information for the AI picture quality region and values of one or more AI picture quality factors for the AI picture quality region to the encoder **193**.

The encoder **193** may compress video signals and AI picture quality information. The encoder **193** may generate a compressed RF packet through color sampling and transmit the generated RF packet to the RF transmitting module **150**.

The RF transmitting module **150** may transmit the compressed RF packet to the RF receiving module **240** of the A/V reception apparatus **200**.

The AI picture quality processor **195** may generate an AI picture quality correction value based on the value of the AI picture quality factor for the AI picture quality region received from the A/V reception apparatus **200**, and forward the generated AI picture quality correction value to the encoder **193**.

The microcomputer **290** of the A/V reception apparatus **200** may include a decoder **291** and an picture quality value detector **293**.

The decoder **291** may restore an RF packet received by the RF receiving module **240**.

The decoder **291** may restore a video signal and AI picture quality information included in the compressed RF packet.

The picture quality value detector **291** may extract an AI picture quality region from the AI picture quality information and detect the value of the picture quality factor of the extracted AI picture quality region.

The picture quality factor may be any one of luminance, brightness, gradation, and sharpness.

The picture quality value detector **293** may transmit the value of the picture quality factor of the AI picture quality region to the decoder **291**.

The picture quality value detector **293** may output the video frame restored through the decoder **291** to a timing controller **299**.

The RF receiving module **240** may transmit picture quality value information to the RF transmitting module **150**.

The value of the AI picture quality factor may be fed back to the A/V transmission apparatus **100**.

The main Soc **191** may transmit the received value of the AI picture quality factor to the AI picture quality processor **195**.

The AI picture quality processor **195** may be included in the main SoC (**191**).

As described above, it is possible to maintain a special picture quality effect for the AI picture quality region through a feedback process for the value of the picture quality factor of the AI picture quality region.

Accordingly, users may watch videos with special picture quality effects for the AI picture quality region.

According to an embodiment of the present disclosure, the above-described method may be implemented with codes readable by a processor on a medium in which a program is recorded. Examples of the medium readable by the processor include a ROM (Read Only Memory), a Random Access Memory (RAM), a CD-ROM, a magnetic tape, a floppy disk, an optical data storage device, and the like.

The display device as described above is not limited to the configuration and method of the above-described embodiments, but the embodiments may be configured by selectively combining all or part of each embodiment such that various modifications can be made.

The invention claimed is:

1. An Audio/Video (A/V) reception apparatus comprising:

a display;

a radio frequency (RF) reception module configured to:

receive a compressed RF packet from an A/V transmission apparatus, the compressed RF packet including a video frame corresponding to a content video, and AI picture quality information regarding an AI picture

quality region in which the value of the picture quality factor including one of luminance, brightness, gradation, and sharpness is set differently from other regions in at least a partial region of the content video; and

a microcomputer configured to:

decompress the received compressed RF packet,

output the video frame to the display based on the AI picture quality information according to the decompression result,

identify the AI picture quality region included the decompressed video frame,

measure the values of one or more picture quality factors for the identified AI picture quality region,

transmit picture quality feedback information including the measured value of the picture quality factor to the A/V transmission apparatus,

receive, from the A/V transmission apparatus, a picture quality correction value in which the value of the picture quality factor of the AI picture quality region has been corrected based on the picture quality feedback information, and

output the video frame via the display on the basis of the received picture quality correction value.

2. The A/V reception apparatus of claim **1**, wherein the microcomputer is configured to apply the picture quality correction value to the AI picture quality region to output the video frame through the display.

3. The A/V reception apparatus of claim **1**, wherein the AI picture quality information includes position information of the AI picture quality region indicating a position at which the AI picture quality region is to be displayed on the display, and

wherein the microcomputer is configured to measure the value of the picture quality factor in the AI picture quality region based on the position information.

4. The A/V reception apparatus of claim **1**, wherein the AI picture quality region includes a specific object and is an area in which the value of the picture quality factor is set differently from other regions among an entire region of the video frame.

5. The display device of claim **1**, wherein the AI picture quality region is an entire region of the content video when genre of the content video is a movie.

6. The display device of claim **1**, wherein the microcomputer is configured to transmit the measured value of the picture quality factor to the A/V transmission apparatus when a difference between the value of the picture quality factor of the AI picture quality region included in the AI picture quality information and the measured value of the picture quality factor of the AI picture quality region is greater than or equal to a preset value.

7. A wireless display system comprising:

an audio/video (A/V) transmission apparatus configured to generate a radio frequency (RF) packet, compress a generated RF packet and transmit a compressed RF packet to an A/V reception apparatus via RF communication, the compressed RF packet including a video frame corresponding to a content video, and AI picture quality information regarding an AI picture quality region in which the value of the picture quality factor including one of luminance, brightness, gradation, and sharpness is set differently from other regions in at least a partial region of the content video; and

the A/V reception apparatus configured to decompress the received compressed RF packet, output the video frame to the display based on the AI picture quality information according to the decompression result, identify the AI picture quality region included the decompressed video frame, measure the values of one or more picture quality factors for the identified AI picture quality region, transmit picture quality feedback information including the measured value of the picture quality factor to the A/V transmission apparatus receive, from the A/V transmission apparatus, a picture quality correction value in which the value of the picture quality factor of the AI picture quality region has been corrected, based on the picture quality feedback information, and output the video frame via a display on the basis of the received picture quality correction value.

8. The wireless display system of claim **7**, wherein the A/V reception apparatus is configured to apply the picture quality correction value to the AI picture quality region to output the video frame through the display.

9. The wireless display system of claim **7**, wherein the AI picture quality information includes position information of the AI picture quality region indicating a position at which the AI picture quality region is to be displayed on the display, and

wherein the A/V reception apparatus is configured to measure the value of the picture quality factor in the AI picture quality region based on the position information.

10. The wireless display system of claim **7**, wherein the AI picture quality region includes a specific object and is an area in which the value of the picture quality factor is set differently from other regions among all regions of the video frame.

11. The wireless display system of claim **7**, wherein the AI picture quality region is an entire region of the content video when genre of the content video is a movie.

12. The wireless display system of claim **7**, wherein the A/V reception apparatus is configured to transmit the measured value of the picture quality factor to the A/V transmission apparatus when a difference between the value of the picture quality factor of the AI picture quality region included in the AI picture quality information and the measured value of the picture quality factor of the AI picture quality region is greater than or equal to a preset value.

13. The A/V reception apparatus of claim **7**, wherein the A/V transmission apparatus is configured to acquire the picture quality correction value of the AI picture quality region on the basis of the value of the picture quality factor received from the A/V reception apparatus.

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