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(54) **Title**: ADAPTIVE 3-D SHUTTERING DEVICES

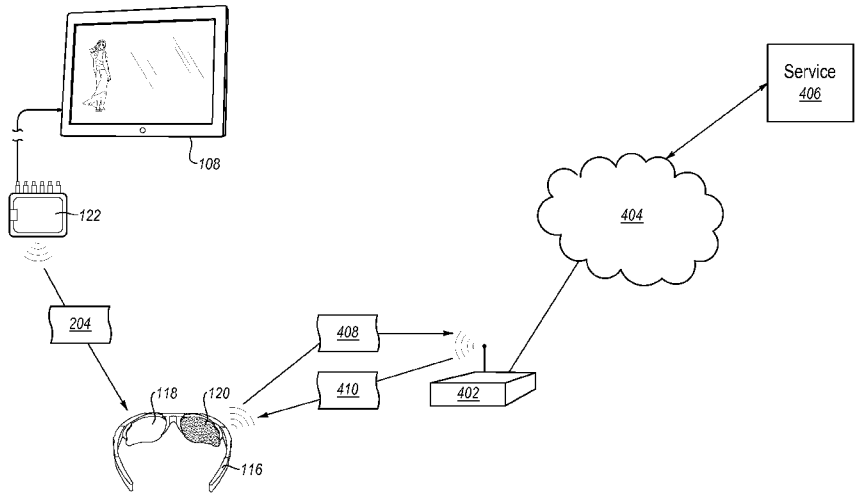

Fig. 4A

(57) **Abstract**: Controlling a shuttering device. A method includes detecting from a use environment a set of encoded signals for use in controlling a shuttering device. The set of encoded signals are analyzed to determine an encoding scheme for the set of encoded signals. The encoded signals are prospectively decoded in the environment according to the determined encoding scheme to control the shuttering device.

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ADAPTIVE 3-D SHUTTERING DEVICES

The Field of the Invention

This invention relates to systems, methods, and computer program products related to conversion and presentation of three-dimensional video content.

Background and Relevant Art

Three-dimensional (3D) display technology involves presenting two-dimensional images in such a manner that the images appear to the human brain to be 3D. The process typically involves presenting "left" image data to the left eye, and "right" image data to the right eye. When received, the brain perceives this data as a 3D image. 3D display technology generally incorporates the use of a filtering device or blanking device, such as glasses, which filter displayed image data to the correct eye. Filtering devices can be passive, meaning that image data is filtered passively (e.g., by color code or by polarization), or active, meaning that the image data is filtered actively (e.g., by shuttering).

Recently, 3D display devices designed specifically for displaying 3D content have become increasingly popular. These 3D display devices are generally used in connection with active filtering devices (e.g., shuttering glasses) to produce 3D image quality not previously available from traditional display devices. These 3D display devices, however, are often based on proprietary signals and shuttering patterns. For example, one manufacturer of 3D display devices may display right eye information for a frame before left eye information for the frame while another manufacturer may display left eye information for a frame before right eye information for the frame. Other timing and signal protocol differences may exist as well. However, hardware for 3D display devices, including the active shuttering glasses, may be expensive.

The subject matter claimed herein is not limited to embodiments that solve any disadvantages or that operate only in environments such as those described above. Rather, this background is only provided to illustrate one exemplary technology area where some embodiments described herein may be practiced.

BRIEF SUMMARY

One embodiment illustrated herein is directed to a method of controlling a shuttering device. The method includes detecting from a use environment a set of encoded signals for use in controlling a shuttering device. The set of encoded signals are analyzed to determine an encoding scheme for the set of encoded signals. The encoded signals are prospectively decoded in the environment according to the determined encoding scheme to control the shuttering device.

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

Additional features and advantages of exemplary implementations of the invention will be set forth in the description which follows, and in part will be obvious from the description, or may be learned by the practice of such exemplary implementations. The features and advantages of such implementations may be realized and obtained by means of the instruments and combinations particularly pointed out in the appended claims. These and other features will become more fully apparent from the following description and appended claims, or may be learned by the practice of such exemplary implementations as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to describe the manner in which the above-recited and other advantages and features of the invention can be obtained, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. It should be noted that the figures are not drawn to scale, and that elements of similar structure or function are generally represented by like reference numerals for illustrative purposes throughout the figures. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

Figure 1 illustrates a schematic state diagram of a method of shuttering three-dimensional (3D) content in accordance with one or more implementations of the invention;

Figure 2 illustrates a timing diagram demonstrating a received shuttering signal and corresponding displayed 3D content in accordance with one or more implementations of the invention;

Figure 3 illustrates a schematic diagram of a shuttering device in accordance with one or more implementations of the invention;

Figure 4A illustrates a schematic diagram of a system for receiving updated encoding scheme information from a service;

Figure 4B illustrates another schematic diagram of a system for receiving updated encoding scheme information from a service;

Figure 4C illustrates a schematic diagram of a system for receiving updated encoding scheme information over the same channel as encoded signals are received;

Figure 5 illustrates a schematic diagram of a system for viewing 3D content in accordance with one or more implementations of the invention; and

Figure 6 illustrates a method of controlling a shuttering device.

DETAILED DESCRIPTION

Some implementations described herein are directed to shuttering devices, such as 3D shuttering glasses, that are configured to work with various different manufacturers and protocols, such that a single shuttering device can be adaptively used for different display devices or content devices. Some embodiments allow the shuttering devices to store information about different encoding schemes for 3D shuttering signals. The shuttering devices can detect encoded signals in an environment. The detected encoded signals can be compared to stored encoding schemes to determine the encoding scheme for the detected encoded signals. The encoding scheme can then be used by the shuttering devices to control shuttering of the shuttering devices according to encoded signals in the environment.

Some embodiments may further include functionality for obtaining new encoding schemes at the shuttering devices. For example, the shuttering devices may detect encoded signals in an environment. The shuttering devices may determine that they do not have a stored encoding scheme corresponding to the detected encoded

signals. The shuttering devices can then obtain an appropriate encoding scheme corresponding to the detected encoded signals. The obtained encoding scheme can then be used to control shuttering of the shuttering devices according to encoded signals in the environment.

Encoding schemes can be obtained by the shuttering devices in a number of different ways. For example, the shuttering devices may include network connectivity capabilities. For example, the shuttering devices may include a wireless network transceiver, such as an 802.11a, b, n or g transceiver or a Bluetooth transceiver. The shuttering devices can connect to a network using the transceiver. Through the network, the shuttering devices may be able to provide information about the detected signals to a service. The service may be able to determine the encoding scheme for the detected signals. The service can then provide the encoding scheme to the shuttering devices. In an alternative embodiment, the service can periodically provide additional encoding schemes to the shuttering devices as they become available without a request from the shuttering devices. In yet another alternative embodiment, the shuttering devices may be updated over the same channel as encoded signals are received, such as infrared or Bluetooth. These embodiments will be discussed in more detail below.

Figure 1, for example, illustrates a schematic state diagram for shuttering 3D content in accordance with one or more implementations of the present invention. In particular, Figure 1 illustrates that one or more shuttering devices 116 can shutter (or obfuscate) the display of 3D content at a display device 108. In one or more implementations, the shuttering device 116 can comprise stereoscopic shuttering glasses that include two or more shuttering components 118, 120, which are capable of selectively obfuscating all or part of a wearer's view of the display device 108. In one or more implementations, the shuttering components correspond to lenses or portions of lenses of shuttering glasses. As discussed more fully herein after, a shuttering signal can control the shuttering device 116.

Figure 1 illustrates that shuttering 3D content can include at least three different shuttering states 102, 104, and 106. In state 102, for example, the shuttering device 116 can process a shuttering instruction 124 (blank right) received from a video processing device 122. As instructed by the shuttering instruction 124, the

shuttering device 116 can use a shuttering component 120 to shutter all or part of the user's right eye view of the display device 108. Additionally, the shuttering device 116 can place shuttering component 118 in an un-shuttered or open state, allowing the user's left eye to view the video frame 110 displayed by the display device 108. State 102 may correspond to at least a portion of a period of time in which the display device 108 displays a video frame 110, which comprises 3D video content intended for viewing by the user's left eye.

Similarly, in state 106, the shuttering device 116 can process a shuttering instruction 128 (blank left) received from the video processing device 122. In response, the shuttering device 116 can use a shuttering component 118 to shutter all or part of the user's left eye view of the display device 108. Additionally, the shuttering device 116 can place shuttering component 120 in an un-shuttered or open state, allowing the user's right eye to view the video frame 114 displayed by the display device 108. State 106 may correspond to at least a portion of a period of time in which the display device 108 displays a video frame 114 comprising 3D video content intended for viewing by the user's right eye.

One will appreciate that states 102 and 106 are not limited to shuttering left and right eyes in the manner illustrated. For instance, in state 102, the shuttering device 116 can use the shuttering component 118 to shutter the viewer's left eye during display of right eye content. Furthermore, in state 106, the shuttering device 116 can use the shuttering component 120 to shutter the viewer's right eye during display of left eye content. It will be appreciated, then, that states 102, 104, 106 should not be interpreted as necessarily occurring in the illustrated order.

In state 104, the shuttering device 116 can process and respond to an inter-frame shuttering instruction 126 (blank both) by using both shuttering components 118, 120 to concurrently shutter the user's left and right eye views of the display device 108. State 104 may correspond to at least a portion a frame transition period in which the display device 108 transitions between displaying two video frames. For instance, the display device 108 might be transitioning from display of the "left eye" video frame 110 to the "right eye" video frame 114, or vice versa. Thus, in one or more implementations, the display device 108 displays a frame transition 112, in which the display device 108 concurrently displays at least a portion of two or more

different video frames (e.g., video frame 110 and video frame 114). By shuttering both of the user's eyes during display of the frame transition 112, the shuttering device 116 can prevent the user from viewing all or part of the frame transition 112 during all or part of the frame transition period.

One will appreciate that the appropriate shuttering of a single eye, as in states 102 and 106, synchronous with the display of appropriate 3D video content, can provide the illusion that two-dimensional images are actually 3D. Furthermore, inter-frame shuttering, or the synchronous shuttering of both eyes during frame transition periods, can enhance the clarity of the perceived 3D image. For example, inter-frame shuttering can reduce or eliminate undesirable effects such as motion blurring and ghosting. Thus, the disclosed inter-frame shuttering techniques can allow for viewing 3D content on display devices that may have lower frame-rates and/or longer frame overlap or transition periods.

Figure 2 shows a timing diagram 200 demonstrating a received shuttering signal 204 and corresponding displayed 3D content 202 in accordance with at least one implementation. In particular, Figure 2 illustrates a snapshot of time that includes a plurality of time periods (e.g., time periods 206, 208, 210, 212, 214) during which the shuttering device 116 receives the shuttering signal 204 and shutters displayed 3D content. The horizontal ellipses 216 and 218 indicate that any number of additional time periods can extend to any point before or after the illustrated snapshot. As illustrated, the displayed 3D content 202 can comprise a plurality of video frames 110, 114, 222 as well as plurality of frame transitions 112, 220. Correspondingly, the received shuttering signal 204 can comprise a plurality of shuttering instructions 124, 126, 128 that instruct the shuttering device 116 to shutter the user's view of the displayed 3D content 202.

Figure 2 illustrates that the shuttering device 116 can receive a shuttering instruction 124 ("BR," or blank right) in connection with a "left eye" video frame 110 of the displayed 3D content 202. This instruction can instruct the shuttering device 116 to shutter the user's right eye during all or part of the time period 206 in which the display device 108 displays the "left eye" video frame 110. In response, the shuttering device 116 can shutter the shuttering component 120 during all or part of the time period 206. The shuttering device 116 can open, or un-obscure, the other

shuttering component 118 during all or part of the time period 206, allowing the viewer to view the left eye video frame 110 with the left eye.

The shuttering device 116 can also receive an inter-frame shuttering instruction 126 ("BB," or blank both) in connection with a frame transition 112 of the displayed 3D content 202. The frame transition 112 may occur as a result of the display device 108 transitioning between display of the "left eye" video frame 110 and a "right eye" video frame 114. The inter-frame shuttering instruction 126, can instruct the shuttering device 116 to concurrently shutter both of the user's eyes during all or part of the time period 208 in which the display device 108 displays the frame transition 112. In response, the shuttering device 116 can shutter both of shuttering components 118, 120 during all, or part of, the time period 208, preventing the viewer from seeing all or part of the frame transition 112 with either eye.

In addition, the shuttering device can receive a shuttering instruction 128 ("BL," or blank left) in connection with the "right eye" video frame 114 of the displayed 3D content 202. This instruction 128 can instruct the shuttering device 116 to shutter the user's left eye during all or part of the time period 210 in which the display device 108 displays the "right eye" video frame 114. This may occur, for example, after the display device 108 fully transitions to display of the "right eye" video frame 114. In response, the shuttering device 116 can shutter the shuttering component 118 during all or part of the time period 210. The shuttering device 116 can open, or un-obscure, the other shuttering component 120 during all or part of the time period 210, allowing the viewer to view the right eye video frame 114 with the right eye.

Additionally, in time periods 212 and 214, the display device 108 can subsequently pass through another frame transition 220 to display another left video frame 222. In connection therewith, the shuttering signal 204 can include appropriate shuttering instructions 126, 124. In response to which, the shuttering device can shutter the appropriate shuttering components 118, 120.

Figure 2 shows that the displayed 3D content 202 comprises a series of alternating left and right video frames (in any order), and that the shuttering signal 204 comprises an appropriate corresponding sequence of shuttering instructions 124, 126, 128. One will appreciate in view of the disclosure herein, however, that one or

more implementations extend to shuttering any sequence of video frames. In one or more implementations, for example, the displayed 3D content 202 comprises differing sequences of left and right video frames (e.g., left, left, right, right). In one or more other implementations, the displayed 3D content 202 comprises only video frames intended for viewing with both eyes. In yet other implementations, the displayed 3D content 202 comprises a combination of different video frame types. One combination, for instance, can include both video frames intended for viewing with both eyes, as well as video frames intended for viewing with a single eye.

Thus, one will appreciate in light of the disclosure herein that the shuttering signal 204 can include any appropriate sequence of shuttering instructions that correspond to the displayed 3D content 202. For instance, if displayed 3D content 202 includes a different sequence of left and right video frames, the shuttering signal 204 can include an appropriate different sequence of shuttering instructions. Furthermore, the shuttering signal 204 can depart from the illustrated shuttering instructions. For example, shuttering signal 204 can refrain from shuttering during one or more frame transition time periods. Furthermore, shuttering signal 204 can include any number of additional shuttering instructions, such a shuttering instruction that does no shuttering (e.g., when the display device 108 displays a video frame intended for viewing with both eyes).

In one or more implementations, the shuttering device 116 receives the shuttering signal 204 prior to the display of the 3D content 202 by the display device 108. Thus, the shuttering device 116 may store (e.g., cache) at least a portion of the shuttering signal 204 prior to performing any instructed shuttering. In additional implementations, the shuttering device 116 receives the shuttering signal 204 concurrently (or substantially concurrently) with the display of the 3D content 202 by the display device 108. Furthermore, in some instances, the shuttering instructions of the shuttering signal 204 can instruct the shuttering device 116 to shutter entire time periods. One will appreciate, however, that the shuttering instructions can also instruct the shuttering device 116 to shutter only a portion of a corresponding time period. Furthermore, the shuttering signal 204 can also instruct the shuttering device 116 to shutter more than a corresponding time period.

Figure 3 illustrates a schematic diagram of a shuttering device 116 in accordance with one or more implementations. As noted herein above, the shuttering device 116 may, in one or more implementations, take the form of shuttering glasses worn by a user. In alternative implementations, the shuttering device 116 can take any appropriate alternate form that can filter displayed 3D content in the manner disclosed. For example, the shuttering components 118, 116 may take the form of shuttering contact lenses (or other eye shield with separated left and right lenses) wirelessly coupled with other appropriate components. Accordingly, none of the disclosure herein should be viewed as limiting the shuttering device 116 to glasses. Furthermore, none of the disclosure herein should be viewed as limiting the shuttering components 118, 116 to physically separated components.

Figure 3 illustrates that the shuttering device 116 can include a receiver 302. In one or more implementations, and as illustrated, the receiver 302 can comprise a wireless receiver (e.g., Wi-Fi, BLUETOOTH, infrared, etc). The receiver 302 can, in other implementations, comprise a wired receiver (e.g., optical digital signals, electronic wire digital signals, electronic wire analog signals, etc). In any event, the receiver 302 can receive a shuttering signal 204. As illustrated, the shuttering signal 204 can comprise a plurality of shuttering instructions 124, 126, 128, etc. In one or more embodiments, the shuttering signal 204 comprises a digital signal which includes a plurality of data packets. In such instances, each of the data packets can include one or more shuttering instructions. In one or more other embodiments, the shuttering signal 204 comprises an analog signal which can encode the shuttering instructions as a waveform. For example, the shuttering instructions may comprise frequency shift keyed (FSK) signals or phase shift keyed signals (PSK) indicating shutter state. For example, in a FSK embodiment, four frequency shift range deviations may be used to indicate one of four states corresponding to no eyes shuttered, right eye shuttered left eye un-shuttered, both eyes shuttered, and left eye shuttered right eye un-shuttered. Similarly, in PSK four phase shift ranges may be used, for example 0-90°, 91° to 180°, 181° to 270°, and 271° to 359°.

In any event, the receiver 302 can communicate the shuttering signal 302 as a whole, or the shuttering instructions individually, to a processing component 308. Figure 3 illustrates that the processing component 308 can include a plurality of

subsidiary processing components or modules, such as a shuttering signal processor 310 and a user input processor 312. As illustrated by the arrows between the shuttering signal processor 310 and the user input processor 312, any of the subsidiary components or modules of the processing component 308 can be communicatively coupled in any appropriate manner. Further, as illustrated by the vertical ellipses between the shuttering signal processor 310 and the user input processor 312, the processing component 308 can include any number of additional subsidiary components or modules, as appropriate.

Illustratively, the processing component 308 can use the shuttering signal processor 310 to identify shuttering instructions in the shuttering signal 302. Once identified, the shuttering signal processor 310 can instruct one or more of the shuttering components 118, 120 to alter a shuttering state (e.g., shuttered or not shuttered), as appropriate for the shuttering instruction. The shuttering signal processor 310 can use any number of other processing components or modules to perform the processing and to instruct the shuttering components. For instance, when the shuttering signal processor 310 identifies an inter-frame shuttering instruction 126, the shuttering signal processor 310 can instruct both the shuttering components 118, 120 to enter a shuttered state. If one or more of the shuttering components 118, 120 is already in the shuttered state, the shuttering signal processor 310 can instruct the shuttering component to remain in the shuttered state.

Figure 3 also illustrates that the shuttering device 116 can include additional components, such a transmitter 304 and a user input component 314. The shuttering device 116 can communicate with one or more other devices via the transmitter 304. For example, the shuttering device 116 can use the transmitter 304, to communicate with other shuttering devices, the video processing device 122, the display device 108, the Internet, etc. In one or more implementations, the shuttering device combines the transmitter 304 and the receiver 302 as a single component, while in one or more other implementations the transmitter 304 and the receiver 302 are separate components. The transmitter can transmit an output signal 306 that can be separate from or combined with the shuttering signal 204 and that can contain one or more instructions or packets 320. Similar to the receiver 302, the transmitter 304 can also use any wired or wireless communications mechanism, analog or digital.

The user input component 314 can comprise any means for receiving user input, including any combination of one or more buttons, switches, touch devices, microphones, cameras, light sensing devices, pressure sensing devices, etc. The user input processor 312 can process user input received via the user input component 314. The user input can comprise any appropriate type of user input, and the shuttering device 116 can use the user input in any appropriate manner. For example, user input may comprise volume control, selection of a shuttering signal type, user feedback to be sent to another device (e.g., the video processing device 122), selection of a mode of the shuttering device (e.g., on, off, standby, configuration, update), etc.

As illustrated by the vertical ellipses between the user input component 314 and an "other" component 322, the shuttering device 116 can include any number of additional components. The additional components can communicate with the processing component 308 or any other component where appropriate. Additional components may include, for example, one or more speakers, a power source, lights, one or more microphones, etc. When additional components are present, components already discussed may be modified accordingly. For instance, when the other components include speakers, the receiver 302 can also receive an analog or digital audio signal, either as part of the shuttering signal 204 or as a separate signal. Then, the processing component 308 may include an audio decoder which sends a decoded audio signal to the speakers.

In one or more implementations, the other component(s) 322 can include a shuttering signal continuity component, which ensures that shuttering occurs, even for intermittent shuttering signals 204 or when the shuttering signal 204 is lost. For instance, the shuttering signal continuity component can implement a phase lock loop (or any similar logic) that analyzes the shuttering signal 204 and generates a replacement signal at the shuttering device 116, when appropriate. The analysis can include determining average sequence and timing information about the shuttering instructions contained in the shuttering signal 204, and developing a model of this information. Then, the shuttering signal continuity component can use phase lock loop (or other logic) to generate a series of substitute shuttering instructions that are estimated to duplicate any shuttering instructions that would have been received if the shuttering signal 204 had not been lost. These generated shuttering instructions can

be used to control the shuttering components 118, 120 in the absence of the shuttering signal 204. When the shuttering signal 204 is regained, the shuttering signal continuity component can synchronize the generated substitute shuttering instructions with the shuttering signal 204. In some embodiments, when the shuttering signal 204 is again detected in the environment, re-synching can be done at the shuttering device 116 to correct for any time, frequency, or phase drift that may have occurred when the shuttering signal 204 is not present in the environment.

The shuttering signal 204 may be lost for a variety of reasons, such as physical or electromagnetic interference, loss of signal strength, insufficient transmission bandwidth, etc. For example, if the shuttering signal 204 is transmitted via an infrared transmission, the shuttering signal 204 may be lost if a person or animal walks between the wearer of shuttering glasses and the transmission source, if the wearer turns his or her head, etc. Similarly, if the shuttering signal 204 is transmitted via a BLUETOOTH or Wi-Fi transmission, the shuttering signal 204 may be lost due to interference on the same frequency as the transmission (e.g., from a microwave oven or other wireless devices), if the wearer moves out of range, if data packets in the transmission arrive out of order or delayed, etc.

In some embodiments, the shuttering signal may be intentionally intermittent as a consequence of how the shuttering signal is transmitted. For example, in one embodiment, the shuttering signal 204 may be transmitted using a Bluetooth interface. In one illustrative example, the shuttering signal 204 may be transmitted on an asynchronous Bluetooth audio channel, such as an a2dp channel or other audio channel. The Bluetooth channel is a multiplexed channel, meaning that the channel is shared amongst a number of different entities resulting in periods where the shuttering signal 204 is not transmitted on the channel. Thus, by reconstructing shuttering instructions at the shuttering device 116, based on previously received shuttering instructions 124, 126, and/or 128, control of the shuttering components 118 and 120 can be maintained even when the shuttering signal 204 is not being transmitted on the channel. When the shuttering signal 204 is transmitted on the channel, re-synching can be done at the shuttering device 116 to correct for any time, frequency, or phase drift that may have occurred when the shuttering signal 204 is not present in the environment.

The shuttering components 118, 120 can comprise any component that can selectively obfuscate/shutter all or a portion of a user's view of the display device 108. For example, in one or more implementations the shuttering components 118, 120 can comprise one or more liquid crystal layers that respond to applied voltage. The liquid crystal layers can have the property of becoming opaque (or substantially opaque) when voltage is applied (or, alternatively, when voltage is removed). Otherwise, the liquid crystal layers can have the property of being transparent (or substantially transparent) when voltage is removed (or, alternatively, when voltage is applied). One will recognize in view of the disclosure herein that liquid crystal layers are not the only available shuttering technology. For example, alternate electronic shuttering technologies (e.g., polarized lead lanthanum zirconate titanate (PLZT)) and mechanical shuttering technologies are also available and within the scope of the disclosure herein.

In one or more implementations, the shuttering device 116 can comprise a universal shuttering device. When the shuttering device 116 is a universal device, the processing component 308 can include any number of other processing components for identifying a signal type of the shuttering signal 204. Thus, the receiver 302 can receive any of a number of types of shuttering signals 204, both analog and digital, and the processing component 308 can determine the type of signal and process it accordingly.

Illustratively, Figure 3 illustrates a storage device 318 storing encoding schemes. The stored encoding schemes stored in the storage device 318 include information regarding how shuttering components 118 and 120 are controlled with respect to the shuttering signal 204 and shuttering instructions 124, 126, and 128. This allows the shuttering device 116 to be configured to work with various different manufacturers and protocols, such that a single shuttering device 116 can be adaptively used for different devices. Thus, the storage device 318 stores information about different encoding schemes for 3D shuttering signals. The storage device 318 may be in one or more of a number of different forms. For example, the storage device318 may be some form of non-volatile storage, such as flash memory magnetic storage, etc. Alternatively or additionally, the storage device 318 may include one or more volatile memory devices, such as DRAM or other appropriate volatile memory.

The shuttering device 116 can detect encoded signals, such as the shuttering signal 204, in an environment. The detected encoded signals can be compared using the processing component 308 to encoding schemes stored in the storage device 318 to determine the encoding scheme for the detected encoded signals. The determined encoding scheme can then be used by the shuttering device 116 to control shuttering of the shuttering components 118 and 120 according to encoded signals in the environment.

Some embodiments may further include functionality for obtaining new encoding schemes at the shuttering device 116 for storage on the storage device 318. For example, the shuttering device 116 may detect encoded signals 204 in an environment. The shuttering device 116 may determine that it does not have an encoding scheme stored at the storage device 318 corresponding to the detected encoded signals 204. The shuttering device 116 can then obtain an appropriate encoding scheme corresponding to the detected encoded signals 204. The obtained encoding scheme can then be used to control shuttering of the shuttering components 118 and 120 according to encoded signals 204 in the environment.

Encoding schemes can be obtained by the shuttering devices in a number of different ways. Reference is now made to Figure 4A, which illustrates one way in which encoding schemes may be obtained. In the example, illustrated in figure 4A, the shuttering device 116 includes network connectivity capabilities. For example, the shuttering device 116 may include a wireless network transceiver, such as an 802.11a, b, n or g transceiver or a Bluetooth transceiver. The shuttering device 116 can connect to a network using the transceiver. For example, Figure 4A illustrates that the shuttering device 116 connects to a router 402, which connects to a network 404. Through the network 404, the shuttering device 116 may be able to provide information 408 about the detected signals 204 to a service 406. The service 406 may be able to determine the encoding scheme for the detected signals 204. The service 406 can then provide the encoding scheme 410 to the shuttering device 116, where it can be used by the shuttering device 116 to control the shuttering components 118 and 120 (Figure 3). Additionally, in some embodiments, the encoding scheme 408 can be stored to the storage device 318 where it can be used for subsequent decoding of shuttering signals 204.

In an alternative embodiment, as illustrated in Figure 4B, the service 406 can provide additional encoding schemes 408 to the shuttering devices as they become available without a request from the shuttering device 116. In particular, the shuttering device 116 may be configured to receive updates, such as firmware updates or other updates, from the service 406. When the service 406 has those updates available, it may push them to the shuttering device 116.

In yet another alternative embodiment, illustrated in Figure 4C, the shuttering device 116 may be updated over the same channel as encoded shuttering signals 204 are received. For example, Figure 4C illustrates receipt of an encoding scheme 410 over the same channel as a shuttering signal 204 is received. For example, the channel may be infrared, Bluetooth, Wi-Fi or some other channel. Both the shuttering signal 204 and additional encoding schemes 410 may be received over the channel. The encoding schemes 410 may be delivered as they become available at the video processing device 122 or when requested by the shuttering device 116. The video processing device 122, or other similar device that delivers the encoding schemes 410 may receive the encoding schemes 410 via network or other connections, including internet, local network, or signals embedded in television or radio signals.

In one or more implementations, the shuttering device 116 can comprise a configurable shuttering device. When the shuttering device 116 is a configurable shuttering device, the processing component 308 can include any number of other processing components for receiving updates. Thus, the shuttering device 116 can receive any of a number of updates, such as updates to processing components, updates to signal types, new signal types, etc.

The shuttering device 116 may be a battery operated device in that one or more battery units may provide power for operating the various electronic components within the shuttering device 116. The battery units may be single use user replaceable batteries or rechargeable batteries. In some embodiments, the rechargeable batteries may be recharged using mechanical electrical contacts. Alternatively, embodiments may use an inductive charging system. In particular, an inductive charging system may be used to couple inductive coils from a charger to inductive coils in the shuttering device. The inductive coils in the shuttering device

116 may be coupled to charging circuitry, which in turn is coupled to one or more battery units to charge the battery units.

Figure 5 illustrates a schematic diagram of a system 500 for viewing 3D content, in accordance with one or more implementations. The system 500 is one possible environment in which the shuttering techniques disclosed herein may be used. Figure 5 illustrates that the system 500 can include the video processing device 122, one or more shuttering devices 116, and the display device 108. These devices can be separate or combined. For instance, in one or more implementations the video processing device 122 and the display device 108 are separate units, while in one or more other implementations these devices form a single unit.

In one or more implementations, the video processing device 122 receives 3D content from a media device. The media device can comprise any number of devices capable of transmitting 3D content to the video processing device 122. For example, Figure 5 illustrates that the media device can comprise a streaming source 508 (e.g., a satellite box, cable box, the Internet), a gaming device (e.g., device 510, or device 516), a storage media player device (e.g., Blu-Ray player 512, DVD player 514) capable of reading storage media 518, and the like. The video processing device 122 can, itself, comprise one or more media devices.

The video processing device 122 can communicate with the display device 108 and the shuttering device(s) 116 in any appropriate manner. For instance, an appropriate wired mechanism, such as HDMI, component, composite, coaxial, network, optical, and the like can couple the video processing device 122 and the display device 108 together. Additionally, or alternatively, an appropriate wireless mechanism, such as BLUETOOTH, Wi-Fi, etc., can couple the video processing device 122 and the display device 108 together. Furthermore, as discussed herein above, any appropriate wired or wireless mechanism (e.g., BLUETOOTH, infrared, etc.) can couple the video processing device 122 and the shuttering device(s) 116 together.

The video processing device 122 can generate an appropriate output signal comprising 3D content received from a media device. For example, when the video processing device 122 and the display device 108 are coupled via a digital mechanism (e.g., HDMI), the video processing device 122 can generate a digital output signal.

On the other hand, when the video processing device 122 and the display device 108 are coupled via an analog mechanism (e.g., component, composite or coaxial), the video processing device 122 can generate an analog output signal. The video processing device 122 can process 3D content received from the media device to convert the received 3D content to a format more suited for the particular display device 108. Additionally, the video processing device 122 can generate and send a shuttering signal to the shuttering device(s) 116 that is synchronized to the output signal.

One will appreciate in view of the disclosure herein that the video processing device 122 can take any of a variety of forms. For example, the video processing device 122 may be a set-top box or other customized computing system. The video processing device 122 may also be a general purpose computing system (e.g., a laptop computer, a desktop computer, a tablet computer, etc.). Alternatively, the video processing device 122 may be a special purpose computing system (e.g., a gaming console, a set-top box, etc.) that has been adapted to implement one or more disclosed features.

The display device 108 can be any one of a broad range of display devices that incorporate a variety of display technologies, both current and future (e.g., Cathode Ray, Plasma, LCD, LED, OLED). Furthermore, the display device 108 can take any of a number of forms, such as a television set, a computer display (e.g., desktop computer monitor, laptop computer display, tablet computer display), a handheld display (e.g., cellular telephone, PDA, handheld gaming device, handheld multimedia device), or any other appropriate form. While the display device 108 can be a display device designed specifically to displaying 3D content, the display device 108 can also be a more traditional display device, such as a lower frame-rate device. One will appreciate in light of the disclosure herein that the display device 108 can include both digital and analog display devices.

Accordingly, Figures 1-5 provide a number of components and mechanisms for shuttering the display of 3D content. Thus, one or more disclosed implementations allow for viewing of 3D content on a broad range of display devices, even display devices that may have lower frame-rates and/or lower frame transition periods.

Additionally, implementations of the present invention can also be described in terms of flowcharts comprising one or more acts in a method for accomplishing a particular result. Along these lines, Figure 6 illustrates a flowchart of a computerized method of shuttering displayed 3D content in response to a shuttering signal. The acts of Figure 6 are described herein below with respect to the schematics, diagrams, devices and components shown in Figures 1-5.

Referring now to Figure 6, a method 600 is illustrated. The method 600 includes acts for controlling a shuttering device, such as the shuttering device 116. The method 600 includes detecting from a use environment a set of encoded signals for use in controlling shuttering device (act 602). For example, the shuttering device 116 may detect the shuttering signal 204.

The method 600 further includes analyzing the set of encoded signals to determine an encoding scheme for the set of encoded signals (act 604). For example, the processing component 308 may include functionality for analyzing the shuttering signal 204 to determine an encoding scheme for the shuttering signal. In some embodiments, the determination can be made by comparing the encoded signals 204 to encoding schemes stored in the storage device 318.

The method 600 further includes prospectively decoding encoded signals in the environment according to the determined encoding scheme to control the shuttering device (act 606). For example, shuttering signals 204 can be decoded, such as for example to determine shuttering instructions, to control the shuttering components 118 and 120.

The method 600 may be practiced where analyzing the set of encoded signals to determine an encoding scheme for the set of encoded signals comprises identifying a four state encoding scheme comprising a left eye open, right eye closed state; a left eye closed, right eye open state; a left eye open, right eye open state; and a left eye closed, right eye closed state.

The method 600 may be practiced where detecting a set of encoded signals includes detecting infrared signals. Alternatively, the method 600 may be practiced where detecting a set of encoded signals includes detecting RF signals. The infrared signals may be analog or digital signals. When the signals are digital signals, shuttering instructions may be transmitted in data packets. When the signals are

analog signals, shuttering instructions may be transmitted such that detecting signals comprises detecting frequency shift keyed (FSK) signals. Alternatively, when the signals are analog signals, shuttering instructions may be transmitted such that detecting signals comprises detecting phase shift keyed (PSK) signals.

The method 600 may be practiced where detecting a set of encoded signals comprises detecting Bluetooth signals. In these embodiments, analyzing the set of encoded signals to determine an encoding scheme for the set of encoded signals may comprises analyzing one or more packets of data.

As noted above, the method 600 may be practiced where analyzing the set of encoded signals to determine an encoding scheme for the set of encoded signals comprises comparing the detected set of signals to information defining encoding schemes stored in a computer readable storage medium at the shuttering device. For example, comparisons may be made to encoding schemes store on a storage device 318.

As illustrated above, when the computer readable storage medium does not include information defining an encoding scheme that matches the detected set of signals, some embodiments of the method 600 may be practiced to further include obtaining the encoding scheme for the detected set of signals from another entity using a same channel that the detected set of signals were transmitted over. For example, Figure 4C illustrates an example where an encoded signal 204 is received over the same channel as the encoding scheme 410.

As illustrated above, when the computer readable storage medium does not include information defining an encoding scheme that matches the detected set of signals, some embodiments of the method 600 may be practiced to further include obtaining the encoding scheme for the detected set of signals from another entity using a different channel than the channel that the detected set of signals were transmitted over. The different channel may include a wired connection such as a USB connection or wired network connection. For example, the shuttering device 116 may be connected to a general purpose computing system capable of receiving encoding schemes 410 from a service and transmitting them to the shuttering device through the wired connection. Alternatively or additionally, the shuttering device

may be able to connect to a network 404 through a wired connection to obtain encoding schemes 410 from a service 406.

Alternatively or additionally, the different channel may include a wireless channel, such as a Bluetooth connection or wireless network connection. Examples of such a system are illustrated in Figure 4A and 4B.

The implementations of the present invention can comprise a special purpose or general-purpose computing systems. Computing systems may, for example, be handheld devices, appliances, laptop computers, desktop computers, mainframes, distributed computing systems, or even devices that have not conventionally considered a computing system, such as DVD players, Blu-Ray Players, gaming systems, and video converters. In this description and in the claims, the term "computing system" is defined broadly as including any device or system (or combination thereof) that includes at least one physical and tangible processor, and a physical and tangible memory capable of having thereon computer-executable instructions that may be executed by the processor.

The memory may take any form and may depend on the nature and form of the computing system. A computing system may be distributed over a network environment and may include multiple constituent computing systems. In its most basic configuration, a computing system typically includes at least one processing unit and memory. The memory may be physical system memory, which may be volatile, non-volatile, or some combination of the two. The term "memory" may also be used herein to refer to non-volatile mass storage such as physical storage media. If the computing system is distributed, the processing, memory and/or storage capability may be distributed as well. As used herein, the term "module" or "component" can refer to software objects or routines that execute on the computing system. The different components, modules, engines, and services described herein may be implemented as objects or processes that execute on the computing system (e.g., as separate threads).

Implementations of the present invention may comprise or utilize a special purpose or general-purpose computer including computer hardware, such as, for example, one or more processors and system memory, as discussed in greater detail below. Embodiments within the scope of the present invention also include physical

and other computer-readable media for carrying or storing computer-executable instructions and/or data structures. Such computer-readable media can be any available media that can be accessed by a general purpose or special purpose computer system. Computer-readable media that store computer-executable instructions are physical storage media. Computer-readable media that carry computer-executable instructions are transmission media. Thus, by way of example, and not limitation, embodiments of the invention can comprise at least two distinctly different kinds of computer-readable media: computer storage media and transmission media.

Computer storage media includes RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store desired program code means in the form of computer-executable instructions or data structures and which can be accessed by a general purpose or special purpose computer.

A "network" is defined as one or more data links that enable the transport of electronic data between computer systems and/or modules and/or other electronic devices. When information is transferred or provided over a network or another communications connection (either hardwired, wireless, or a combination of hardwired or wireless) to a computer, the computer properly views the connection as a transmission medium. Transmissions media can include a network and/or data links which can be used to carry or desired program code means in the form of computer-executable instructions or data structures and which can be accessed by a general purpose or special purpose computer. Combinations of the above should also be included within the scope of computer-readable media.

Further, upon reaching various computer system components, program code means in the form of computer-executable instructions or data structures can be transferred automatically from transmission media to computer storage media (or vice versa). For example, computer-executable instructions or data structures received over a network or data link can be buffered in RAM within a network interface module (e.g., a "NIC"), and then eventually transferred to computer system RAM and/or to less volatile computer storage media at a computer system. Thus, it should

be understood that computer storage media can be included in computer system components that also (or even primarily) utilize transmission media.

Computer-executable instructions comprise, for example, instructions and data which, when executed at a processor, cause a general purpose computer, special purpose computer, or special purpose processing device to perform a certain function or group of functions. The computer executable instructions may be, for example, binaries, intermediate format instructions such as assembly language, or even source code. Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the described features or acts described above. Rather, the described features and acts are disclosed as example forms of implementing the claims.

Those skilled in the art will appreciate that the invention may be practiced in network computing environments with many types of computer system configurations, including, personal computers, desktop computers, laptop computers, message processors, hand-held devices, multi-processor systems, microprocessor-based or programmable consumer electronics, network PCs, minicomputers, mainframe computers, mobile telephones, PDAs, pagers, routers, switches, and the like. The invention may also be practiced in distributed system environments where local and remote computer systems, which are linked (either by hardwired data links, wireless data links, or by a combination of hardwired and wireless data links) through a network, both perform tasks. In a distributed system environment, program modules may be located in both local and remote memory storage devices.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

CLAIMS

1. A method of controlling a shuttering device, the method comprising:

detecting from a use environment a set of encoded signals for use in controlling a shuttering device;

analyzing the set of encoded signals to determine an encoding scheme for the set of encoded signals; and

prospectively decoding encoded signals in the environment according to the determined encoding scheme to control the shuttering device.

2. The method of claim 1 wherein analyzing the set of encoded signals to determine an encoding scheme for the set of encoded signals comprises identifying a four state encoding scheme comprising a left eye open, right eye closed state; a left eye closed, right eye open state; a left eye open, right eye open state; and a left eye closed, right eye closed state.

3. The method of claim 1 wherein detecting a set of encoded signals comprises detecting infrared signals.

4. The method of claim 3, wherein detecting infrared signals comprises detecting frequency shift keyed (FSK) signals.

5. The method of claim 3, wherein detecting infrared signals comprises detecting phase shift keyed (PSK) signals

6. The method of claim 1 wherein detecting a set of encoded signals comprises detecting Bluetooth signals, and wherein analyzing the set of encoded signals to determine an encoding scheme for the set of encoded signals comprises analyzing one or more packets of data.

7. The method of claim 1 wherein analyzing the set of encoded signals to determine an encoding scheme for the set of encoded signals comprises comparing the detected set of signals to information defining encoding schemes stored in a computer readable storage medium at the shuttering device.

8. The method of claim 7 wherein the computer readable storage medium does not include information defining an encoding scheme that matches the detected set of signals, the method further comprising obtaining the encoding scheme for the detected set of signals from another entity using a same channel that the detected set of signals were transmitted over.

9. The method of claim 7 wherein the computer readable storage medium does not include information defining an encoding scheme that matches the detected set of signals, the method further comprising obtaining the encoding scheme for the detected set of signals from another entity using a different channel than the channel that the detected set of signals were transmitted over.

10. The method of claim 9, wherein the different channel comprises a wired connection, including at least one of a USB connection.

11. The method of claim 9, wherein the different channel comprises a wireless channel including at least one of a Bluetooth connection or wireless network connection.

12. The method of claim 7 wherein the computer readable storage medium does not include information defining an encoding scheme that matches the detected set of signals, the method further comprising obtaining the encoding scheme for the detected set of signals from another entity through a firmware update

13. The method of claim 1, wherein prospectively decoding encoded signals in the environment according to the determined encoding scheme comprises decoding in a partially asynchronous manner, such that the shuttering device can be controlled according to the decoding scheme during periods of intermittent loss of ability to detect encoded signals in the environment.

14. The method of claim 13, wherein intermittent losses are caused by loss of a line of sight channel for IR signals.

15. The method of claim 13, wherein the encoded signals are sent over a Bluetooth audio interface, and the intermittent losses are caused by an asynchronous nature of the Bluetooth audio interface.

16. The method of claim 1 further comprising, charging the shuttering device using an inductive charging connection between a charger and the shuttering device.

17. A physical computer readable storage medium comprising computer executable instructions that when executed by one or more processors cause the following to be performed:

detecting from a use environment a set of encoded signals for use in controlling a shuttering device;

analyzing the set of encoded signals to determine an encoding scheme for the set of encoded signals; and

prospectively decoding encoded signals in the environment according to the determined encoding scheme to control the shuttering device.

18. The physical computer readable storage medium of claim 17, wherein analyzing the set of encoded signals to determine an encoding scheme for the set of encoded signals comprises identifying a four state encoding scheme comprising a left eye open, right eye closed state; a left eye closed, right eye open state; a left eye open, right eye open state; and a left eye closed, right eye closed state.

19. A shuttering device, the shuttering device comprising:

one or more receivers configured to receive shuttering signals;

one or more processors coupled to the one or more receivers;

a plurality of shuttering components coupled to the one or more processors;

one or more physical computer readable media coupled to the one or more processors, wherein the one or more physical computer readable media comprise computer executable instructions that when executed by one or more of the one or more processors causes the following to be performed:

using the receiver, detecting from a use environment a set of encoded signals for use in controlling a shuttering device;

analyzing the set of encoded signals to determine an encoding scheme for the set of encoded signals; and

prospectively decoding encoded signals in the environment according to the determined encoding scheme to control the plurality of shuttering components of the shuttering device.

20. The shuttering device of claim 20, wherein analyzing the set of encoded signals to determine an encoding scheme for the set of encoded signals comprises identifying a four state encoding scheme comprising a left eye open, right eye closed state; a left eye closed, right eye open state; a left eye open, right eye open state; and a left eye closed, right eye closed state.

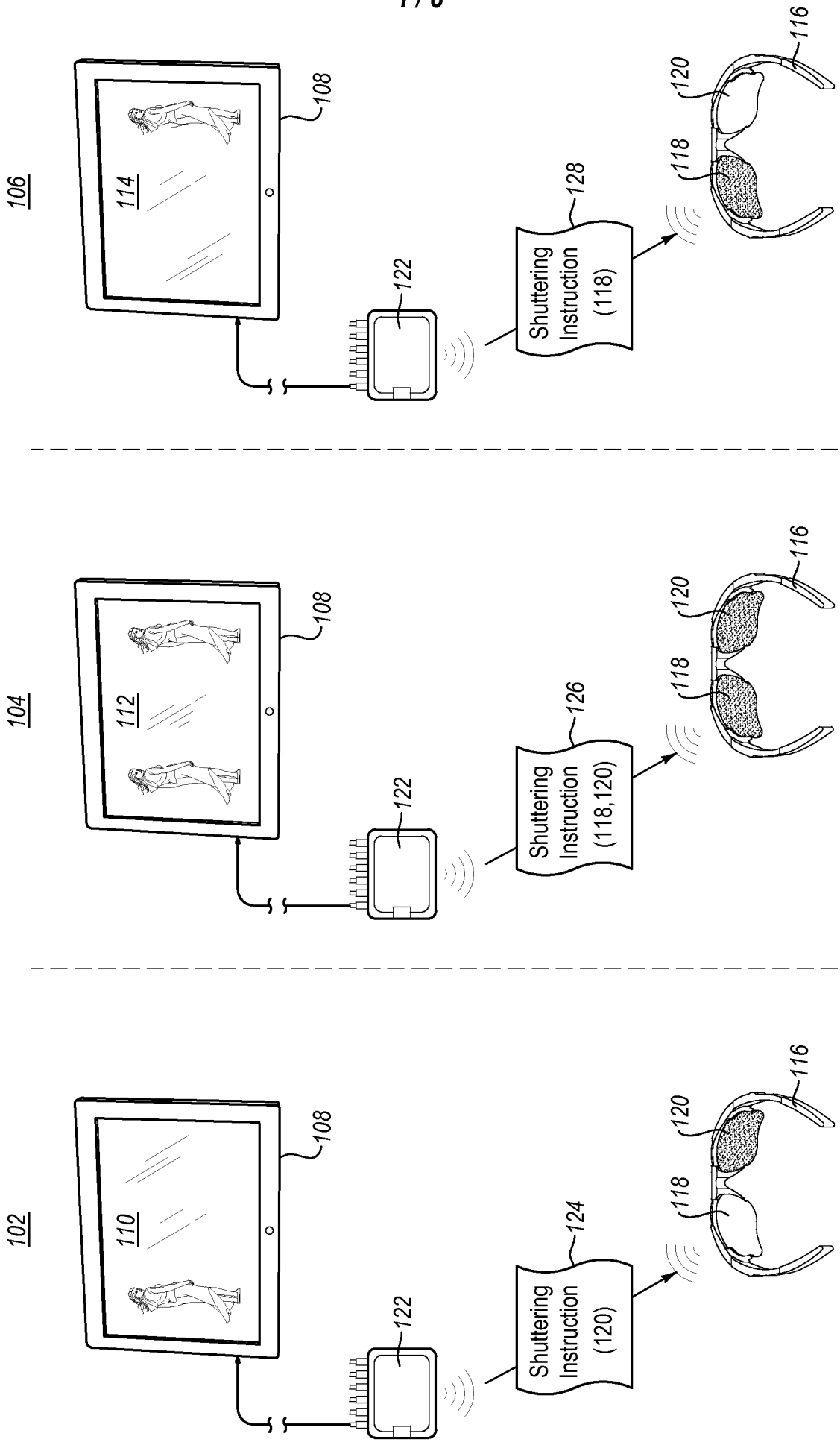
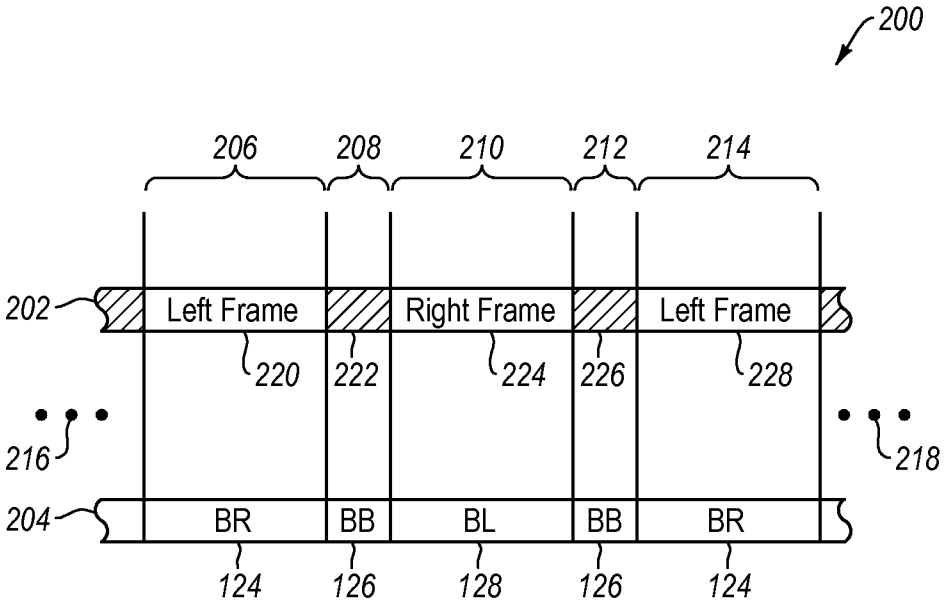

106
114
108
122
Shuttering Instruction (118)
128
116
120
118
104
112
108
122
Shuttering Instruction (118,120)
126
116
120
118
102
110
108
122
Shuttering Instruction (120)
124
116
120
118

Fig. 1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206
208
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212
214
202
Left Frame
Right Frame
Left Frame
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222
224
226
228
216
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204
BR
BB
BL
BB
BR
124
126
128
126
124

Fig. 2

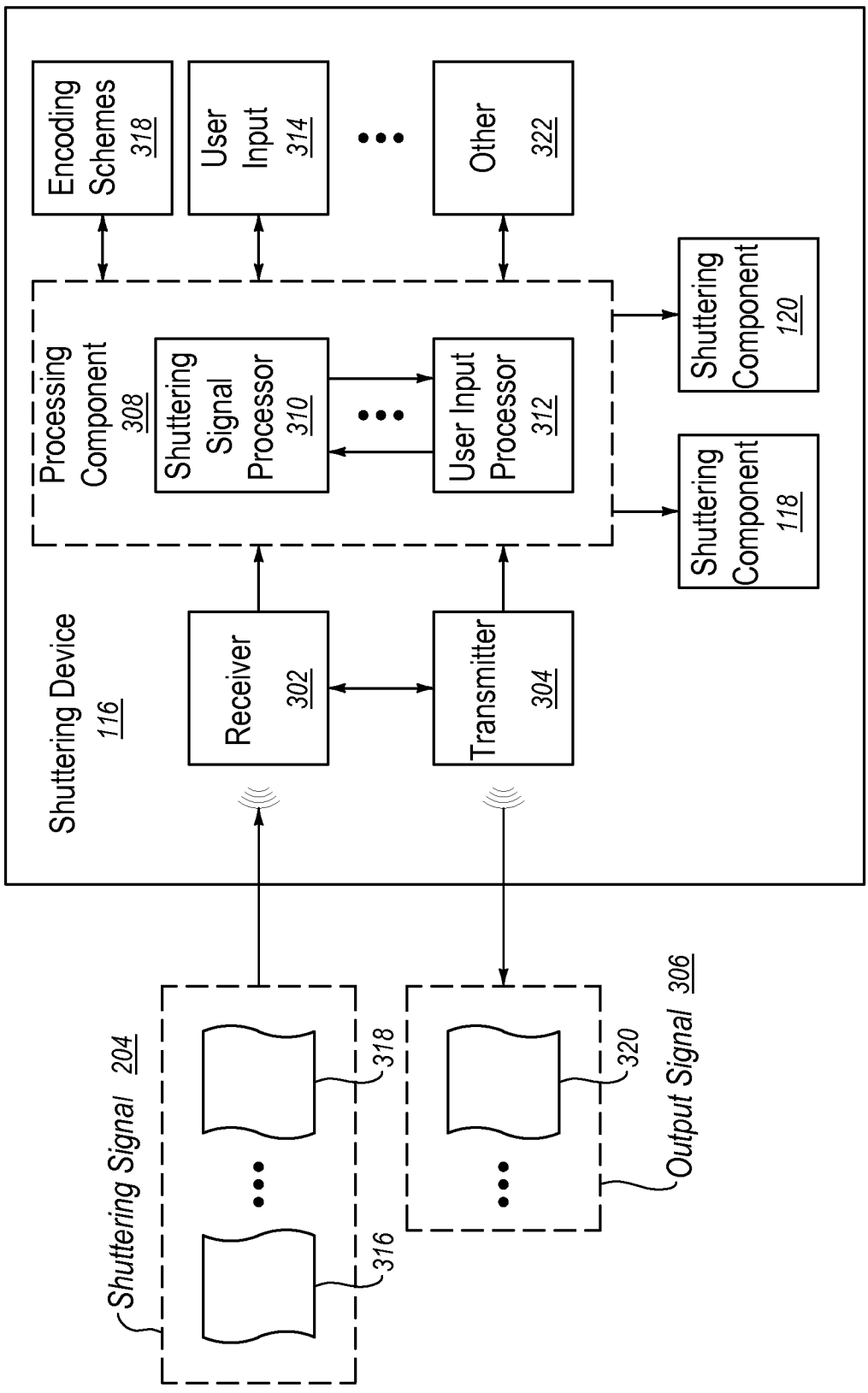
Shuttering Device 116
Receiver 302
Transmitter 304
Processing Component 308
Shuttering Signal Processor 310
User Input Processor 312
Encoding Schemes 318
User Input 314
Other 322
Shuttering Component 118
Shuttering Component 120
Shuttering Signal 204
316
318
Output Signal 306
320

Fig. 3

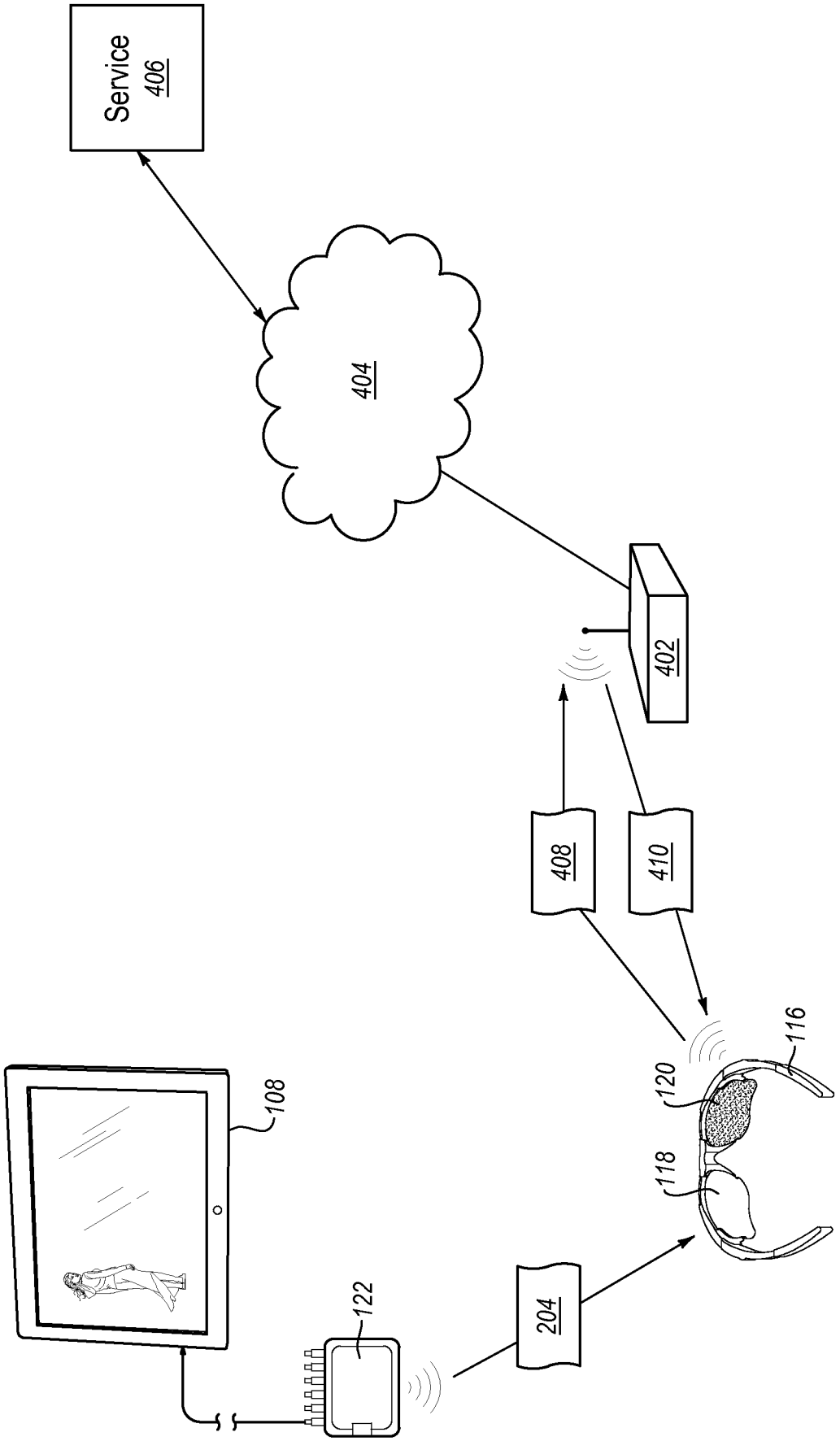

Fig. 4A

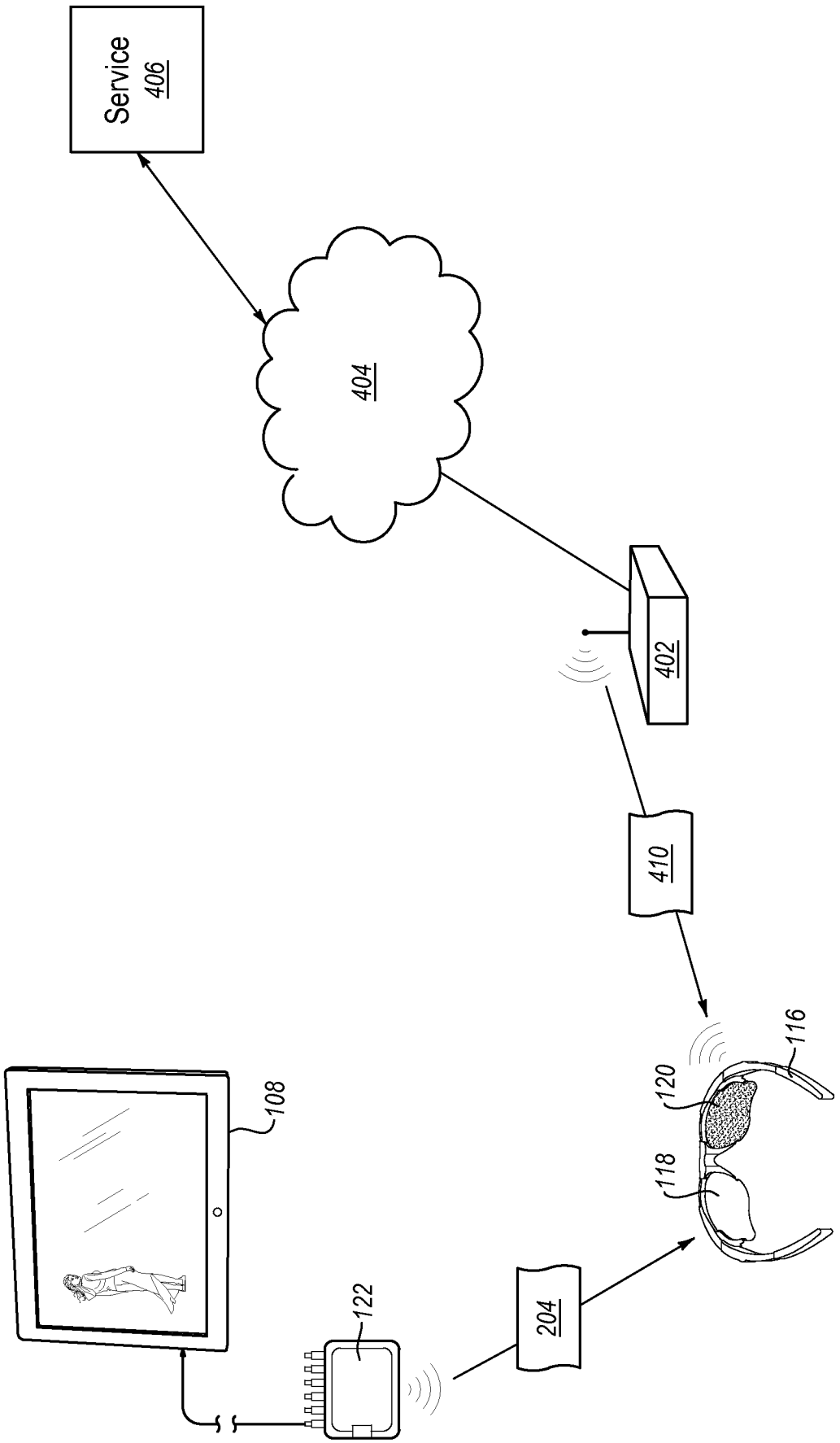

Fig. 4B

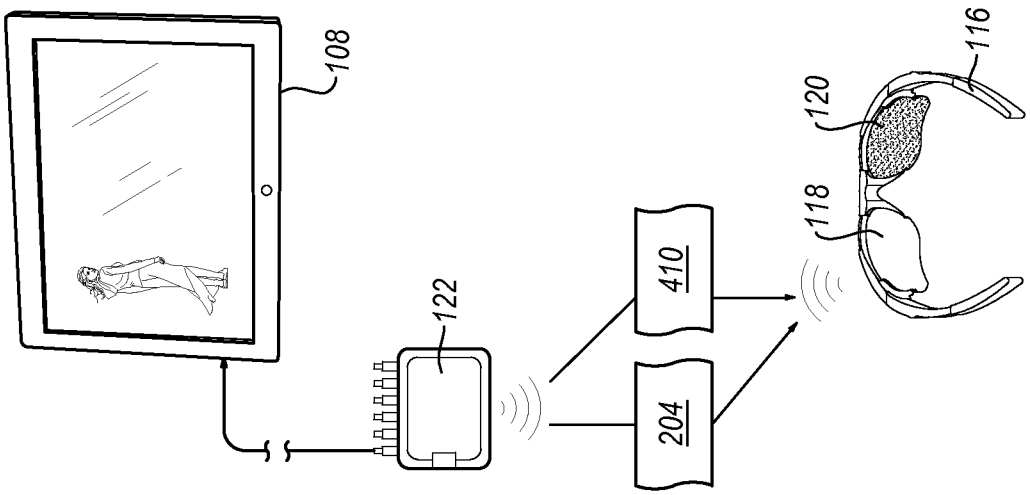

Fig. 4C

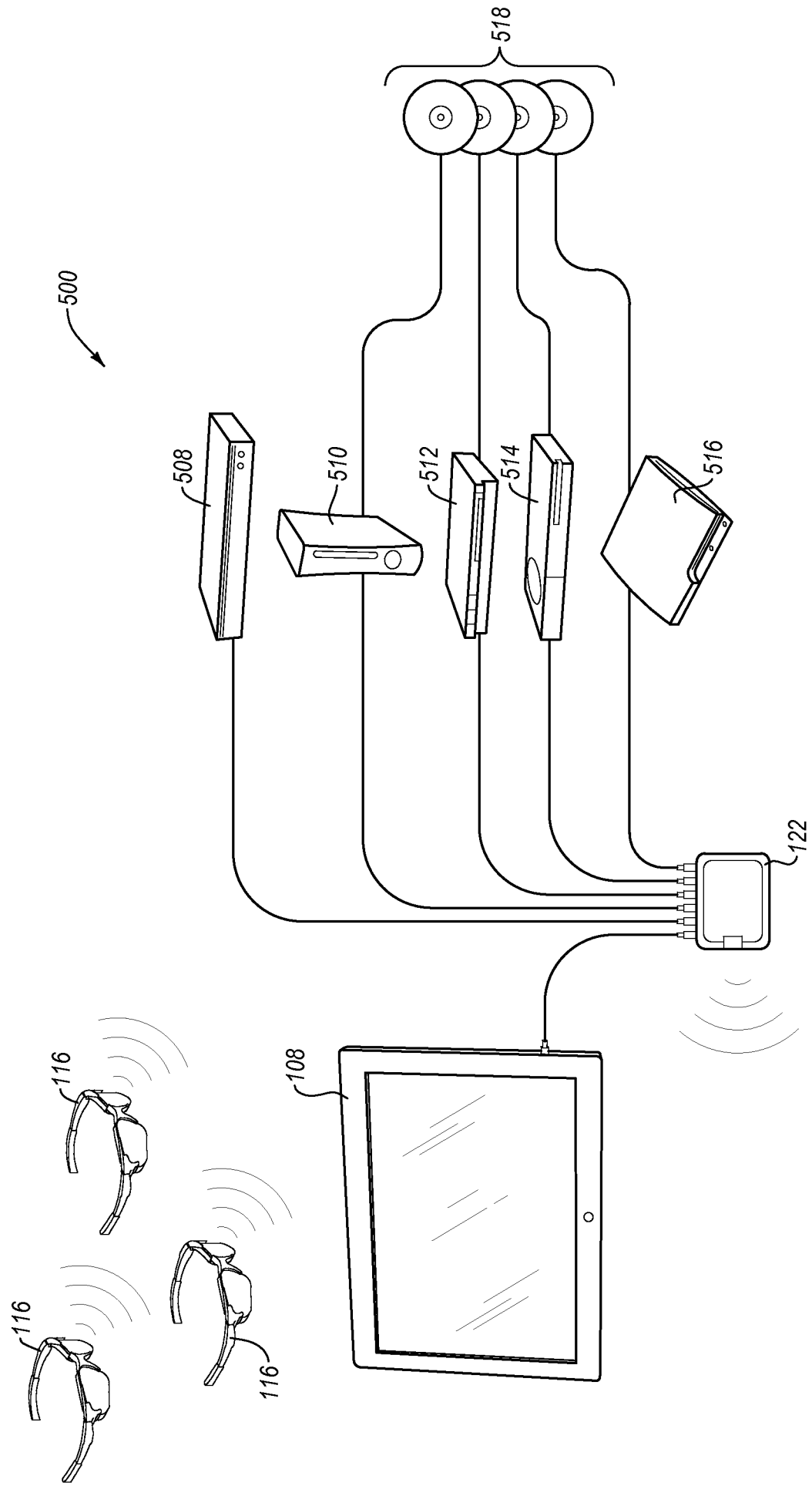

Fig. 5

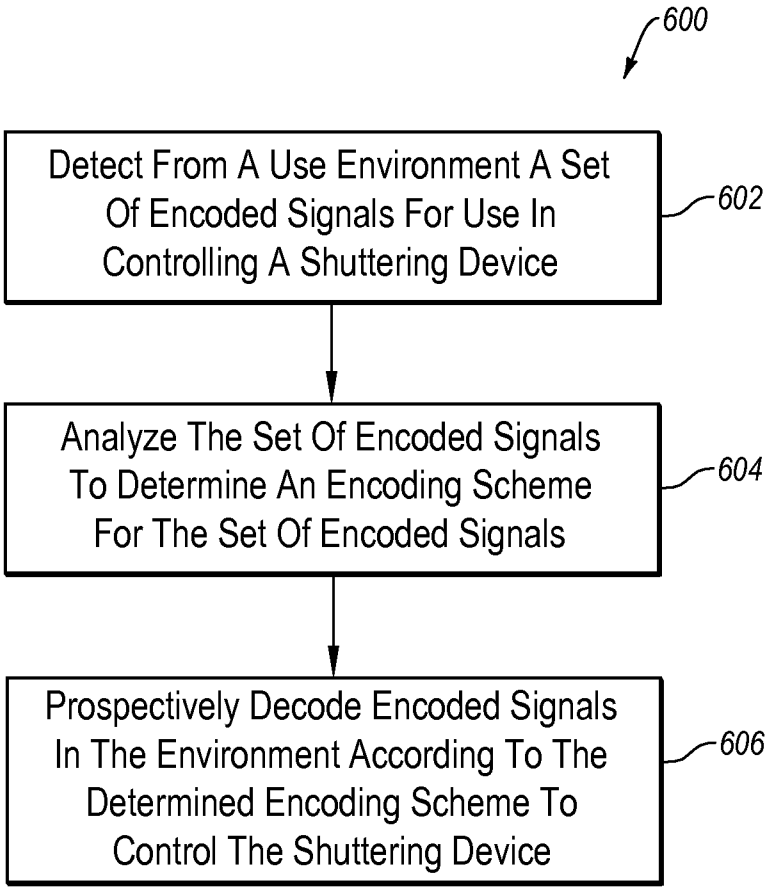
600
Detect From A Use Environment A Set Of Encoded Signals For Use In Controlling A Shuttering Device
602
Analyze The Set Of Encoded Signals To Determine An Encoding Scheme For The Set Of Encoded Signals
604
Prospectively Decode Encoded Signals In The Environment According To The Determined Encoding Scheme To Control The Shuttering Device
606

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/032549

A. CLASSIFICATION OF SUBJECT MATTER

H04N 13/00(2006.01)i, G02B 27/22(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04N 13/00; G02F 1/13; H04N 13/04; G09G 5/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: SHUTTERING, ENCODED SIGNAL, INFRA-RED, and similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 11-098538 A (SANYO ELECTRIC CO LTD) 09 April 1999 See abstract, paragraphs [0007]-[0015], [0026]-[0030]	1-20
A	JP 08-079799 A (SONY CORP) 22 March 1996 See abstract, paragraphs [0009]-[0014]	1-20
A	WO 2007-126904 A2 (NVIDIA CORPORATION et al.) 08 November 2007 See abstract, page6, line1-page14, line6	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 NOVEMBER 2011 (25.11.2011)	**25 NOVEMBER 2011 (25.11.2011)**

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 189 Cheongsa-ro,
Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

SHIN, Jae Chul

Telephone No. 82-42-481-8215

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2011/032549

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