September 12, 2019

Casting Virtual Reality (VR) Content Over A Network

Anonymous

Casting Virtual Reality (VR) Content Over A Network

ABSTRACT

A user of a virtual reality (VR) application uses a head-mounted display (HMD) to view VR content, such as graphics rendered by the VR application in the HMD. While the VR user is viewing the VR content, the VR user can cast the viewed VR content to friends or contacts enabling them to view the same VR content. The sharing is over a network and works regardless of the locations, devices, or types of networks being used. Audio from the VR user and/or from the VR application is also sent to the other users, e.g., via voice over internet protocol (VoIP). Further, audio from the other users can be sent (also via VoIP) to the VR user and other users, thereby providing multi-way communication.

KEYWORDS

- Virtual reality (VR)
- Augmented reality (AR)
- Video call
- Videoconferencing
- Voice over internet protocol IP (VoIP)
- Web real-time communication (WebRTC)

BACKGROUND

Virtual reality (VR) involves the use of a computer to create a simulated three-dimensional (3D) world that a VR user can manipulate, explore, or otherwise interact with. For example, VR may be implemented in applications that provide electronic games, education/training, entertainment, etc. where the presentation of graphics, audio, and other VR

content enhances the user experience. VR content is usually presented to the user via a head-mounted display (HMD), e.g., VR goggles or helmet. A HMD provides a monitor or other type of display mechanism that can be used to present VR content for viewing by one or both eyes of the VR user. The HMD can also provide eye tracking or body tracking devices, such that the VR content is updated as the VR user looks up/down/sideways, moves their head or a limb, etc. In this manner, the VR user is provided the impression of movement within the virtual world.

In addition to HMDs, VR content can also be presented through other VR environments, such as specialized rooms with multiple display screens. As with a HMD, such VR environments may use feedback (e.g., eye or body tracking) from the VR user to update the VR content being presented.

Technologies related to VR are also available. For example, augmented reality (AR) is similar to VR in that a 3D world can be presented to a user. However, while VR typically presents a purely computer-generated 3D world, e.g., a fantasy world in an electronic game, AR implementations involve the presentation of the real-world view of the AR user (such as via a HMD in combination with a camera), which is then augmented by computer-generated content. For example, the AR user may wear a HMD to present a real-world view the AR user's room, and that view may be supplemented by icons or other computer-generated graphics that are superimposed over the real-world view.

While VR and AR technologies provide an enhanced viewing experience to users, the experience is limited to the particular user that is actually using a HMD (or other VR device/environment) to interact with the virtual world.

DESCRIPTION

Being able to share the VR interaction with other users can provide a fuller experience and appreciation for the VR content. For example, other users may wish to see and hear a VR user's interaction in the virtual world in real-time or near real-time, for purposes of sharing in the experience, training, etc.

This disclosure describes techniques to share VR content with other users. Per the described techniques, while a VR user interacts with VR content, the VR content and corresponding user interaction is cast to other users over a network. Thus, the other users are able to view the same VR content that is being viewed by the VR user during the course of the interaction. The other users may be friends, contacts, or other persons that the VR user has invited to view the VR content. By transmitting the VR content over a network, other users present at any location remote from the VR user and that use different types of devices, networks, and communication platforms are provided with the ability to view the VR content.

Further, audio from the VR content and/or from the VR user (e.g., user speech) can also be sent to the other users. Furthermore, audio from the other users can be shared with the VR user or with other users via voice over internet protocol (VoIP), thereby providing multi-way audio communication between the users during the VR user's interaction with the VR content.

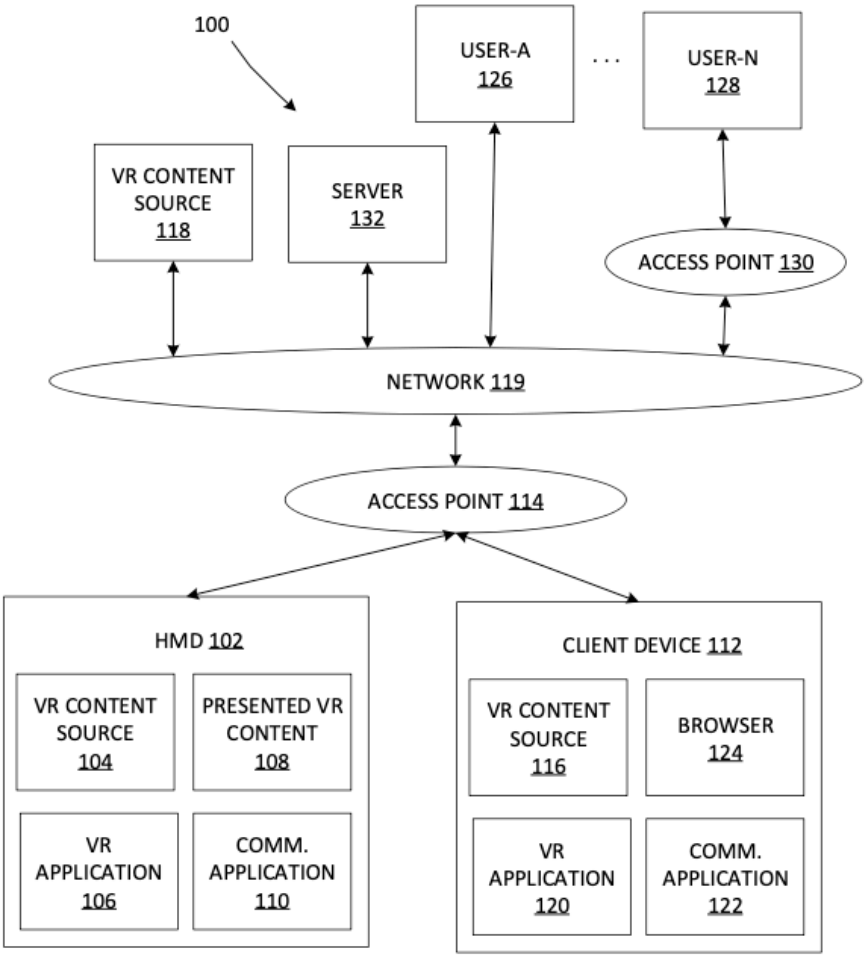

Figure 1

Figure 1 is a diagram of an example system 100 that can implement the sharing of VR content to multiple users. The system includes a HMD 102 that can be worn by a VR user to receive and interact with VR content, such as VR content in the form of graphics and audio presented in a virtual world. Alternatively, the VR user can receive and interact with VR content in a VR environment, such as in a room with multiple display screens, without necessarily using the HMD. For the sake of simplicity of explanation, the techniques are described herein in the context of the VR user operating the HMD, with the understanding that the techniques can also be used for other VR environments.

The HMD may include a VR content source 104 (such as memory that stores graphics and audio) and a VR application 106. The VR content source can provide VR content that is rendered by the VR application for presentation to the VR user as presented VR content 108. The presented VR content can be, for example, a 3D world that presents graphics and audio for interaction with the VR user.

The HMD can also include one or more communication applications 110. The communication application enables the HMD to communicate with a client device 112 of the VR user, such as a smartphone, laptop computer, desktop computer, or other communication device of the VR user. The communication may be performed directly between the HMD and the client device, or via an access point 114, e.g., a wired or wireless network access point.

The communication application can be any online communication application, e.g., an instant messaging or chat application that enables audio/video communication over an internet protocol (IP) network. The communication application may be a standalone application, or may be part of the VR application. The communication application can utilize a protocol such web real-time communication (WebRTC) to exchange data with other user devices. The communication application enables the HMD to communicate the presented VR content (graphics and audio) to other users via streaming.

The HMD can include other components, such as a microphone to capture audio of the VR user, a camera to capture images of the VR user and/or the VR user's environment, eye tracking and body tracking devices, one or more processors, and other elements.

Alternatively, or additionally to obtaining VR content from the VR content source in the HMD, the VR application can obtain the VR content from a VR content source 116 at the client device, and then render that obtained VR content as the presented VR content. Further, the VR

application can obtain VR content from a VR content source 118 of a third-party content provider, and render that obtained VR content as the presented VR content. The VR application can obtain VR content from the third-party VR content source by using the communication application to connect to the third-party VR content source via a network 119.

While the foregoing description generally refers to the HMD 102 as a largely self-contained device that includes most of the elements that are usable for operation in connection with providing the presented VR content to the VR user and sharing the presented VR content with other users, some of these elements may be additionally or alternatively located at other devices. For example, all or parts of the VR application may be located at the client device, as a VR application 120. Thus, the VR application at the client device can be launched and executed at the client device, to obtain VR content from any one or more of the VR content sources, and the VR application at the client device can push the obtained VR content to the HMD for presentation to the VR user.

Further, the communication application can reside in whole or in part as a communication application 122 at the client device. The communication application at the client device can thus operate to communicate with the HMD to obtain the presented VR content and to share the presented VR content with other users via the network. Further, either or both the communication application at the HMD and the communication application at the client device can provide the presented VR content to a browser 124 of the client device, so as to enable the browser to render the VR content on a display screen of the client device, in addition to the VR content being presented to the VR user via the HMD, or for sharing the VR content rendered by the browser with other users via the network. Further, a single device can perform the functions

of both the HMD and the client device, and alternatively, more than two devices can be used for these functions.

The other users that can view the VR content are shown in Figure 1 as user-A 126 through user-N 128. The users may be from a friend list of the VR user, users from a contact list of the VR user, or any other user that the VR user wishes to send the presented VR content. The users themselves may not necessarily be users of VR applications, but can be any type of user that may be interested in viewing graphics or other media from the VR user, plus receiving or transmitting audio. These other users may be in communication with each other (and also in communication with the VR user) using their respective client devices. The users communicate with each other via the network or directly with each other (such as via a peer-to-peer communication link). Moreover, one or more of the users (such as the user-N) may be connected to an access point 130 (such as a wi-fi network or other LAN).

The system may further include one or more servers 132. An example of the server(s) can be a multi-way server that supports the WebRTC platform for communicating from the HMD and/or the client device to other users (e.g., the user-A through the user-N) to send the presented VR content to these other users during the course of the VR user's interaction with the VR application and the presented VR content. Such a server can thus be operable to identify the devices (e.g., the HMD and/or the client device of the VR user, and the client devices of the other users) that participate in the communication via WebRTC, and to establish the signaling and other configuration requirements for the communication.

The communication of the presented VR content to the other users via WebRTC may thus be a casting/transmission of the VR content in real-time or near-real-time as the VR user interacts with the VR application and the presented VR content. Thus, the other users see and

hear the same VR content as the VR user (e.g., the rendered VR graphics and VR audio). The communication may therefore be thought of as a VR group messaging or VR casting, similar to an online video call, except that the content being transmitted is the graphics/audio of the presented VR content rather than content captured by a camera.

Further, the audio of the VR user and the other users can also be provided in addition to the audio from the VR application. For example, the VR user may be speaking/narrating during the course of interacting with the presented VR content. The communication application uses VoIP to communicate the VR user's audio to the other users. This VoIP communication of the VR user's audio can be carried by the WebRTC connection, or the VoIP communication can be a separate from the WebRTC connection. Analogously, audio from any of the other users can be sent to the VR user via VoIP. Such audio can be, for example, advice from the user-A sent to the VR user as to where and how to navigate through the 3D world rendered by the VR application. Furthermore, since the users are connected in a same session or group conference, VoIP audio from any of the users may be sent to and heard by any of the other users. In this manner, the system provides multi-way communication between the users, with downstream audio and graphics being sent by the VR user to the other users, and upstream audio being sent from the other users to each other or to the VR user.

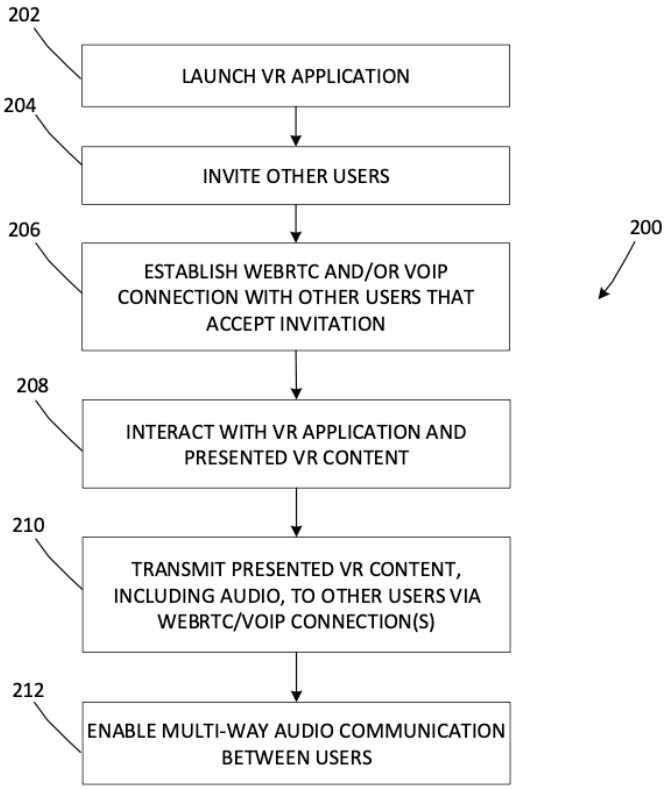

Figure 2

Figure 2 is a flowchart of an example method 200 that can be performed in the system of Figure 1 to share VR content with multiple users. The method can include one or more operations, functions, or actions illustrated by one or more blocks, such as blocks 202 to 212. The various blocks of the method and/or of any other process(es) described herein may be combined into fewer blocks, divided into additional blocks, supplemented with further blocks, and/or eliminated based upon the desired implementation. The operations of the method can be performed in a pipelined sequential manner. In other embodiments, some operations may be performed out-of-order, in parallel, etc.

The VR user, e.g., wearing the HMD, launches the VR application to begin an interaction with VR content in a 3D world (202). The VR user operates the communication application to send an invitation (204) to other users, e.g., the user-A through the user-N. The invitation can be

in the form of an email, text message, or other form of communication that invites the other users to view/listen to the VR content that is presented to the VR user. The invitation can be a uniform resource locator (URL) or other type of link that the other user can select in order to join a group communication/session for receiving the VR content.

A WebRTC connection is established by the server between the VR user (HMD and/or client device of the VR user) and the client devices of the other users that accepted the invitation (206). This connection may be a peer-to-peer connection between the browser (or other communication tool) of the other users' client devices and the HMD (or the VR user's client device, via the browser of that client device). A VoIP connection (which can be supported in the WebRTC connection) can also be established between the VR user and the other users, and also amongst the other users, for audio communication.

The VR user interacts with the VR application and the presented VR content (208). For example, the VR user may be navigating through a computer-generated mythical 3D world in an electronic game. The VR user may also be speaking/narrating during the course of this interaction, so as to provide audio that is in addition to the audio provided by the VR content.

The communication application transmits (210) the presented VR content to the client devices of the other users via the WebRTC connection. Thus, the other users are able to view the graphics of the presented VR content concurrently with the VR user. Further, the communication application transmits the audio of the presented VR content, and/or other audio from the VR user, to the other users. This audio may also be sent via the WebRTC connection or via a separate VoIP connection.

Multi-way audio communication is enabled for the users (212). For example, any of the user-A through the user-N can send an audio message to the VR user and/or to each other, such as via the WebRTC connection.

While the foregoing description specifically referred to VR implementations, it is understood that the techniques can also be used other VR-type implementations, such as augmented reality (AR). In example AR implementations, the AR content (real-world content captured by a camera in combination with computer-generated graphics/audio superimposed over the real-world content) may also streamed or otherwise transmitted to other users using the techniques described above, thereby enabling the AR content to be shared with the other users as the AR user interacts with the AR content.

Other modifications are also possible, including the use of other communication platforms (alternatively or additionally to WebRTC and VoIP) that enables groups of users to view/listen to content being presented to one of the users.

CONCLUSION

The techniques described herein enable VR content presented to a VR user to be shared with other users over a network. The other users are thus able to view and listen to the same VR content as the VR user, as the VR user interacts with the VR content. The VR content can be shared with other users that utilize different types of devices or platforms via WebRTC. Furthermore, audio from the VR content and/or from the VR user can be shared with the other users via VoIP. VoIP may also be used to share audio from the other users to the VR user, and also amongst the other users.