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Method and System to Display User Face in a Mixed Reality

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Abstract

The present disclosure describes a mixed reality capture (MRC) system that displays entire face of a user to convey the user's expressions and reactions in a mixed reality (MR) environment. The MRC system includes the MR environment in which a number of users are interacting with each other or are immersed in a virtual scene. The MRC system deploys two methods: a video capture method within a mixed reality (MR) headset and a method for compositing facial areas (obscured due to the MR headset), captured by the video capture method, into an MRC composition system. The video capture method employs a plurality of cameras, which are mounted within a headset eyebox of the MR headset. The plurality of cameras captures a video of the obscured facial areas. The video of the obscured facial areas is projected as a rendered surface in the MR environment at a correct location and a correct orientation. The location and the orientation of the rendered surface are such that the rendered surface is in a complete synchronization with location and orientation of the MR headset. In other words, the rendered surface moves accordingly with changes in the location and the orientation of the MR headset. The MR headset of each of the users includes an MRC camera and a virtual camera. The rendered surface captured by the virtual camera and the MR environment captured by the MRC camera are provided as inputs to the MRC composition system. The MRC composition system composites the rendered surface with the MR environment to generate an MRC output frame. The MRC output frame is further displayed on a display device associated with the MR headset of each of the users.

Problem statement

In prior art, mixed reality capture (MRC) systems create a composition with both a virtual reality scene camera and a real-world camera. Figure 1 illustrates an example of an output from the MRC system that composites a virtual scene with a video recorded by the real-world camera. Figure 2 shows a standard MRC output frame from the MR headset of the MRC system in prior art. The standard MRC output frame includes a rear virtual scene layer and a front virtual scene layer, to enable the composition with the real-world camera in between. However, the MR headset obscures the facial areas (eyes, eye lids and upper cheeks) of the user from being able to be video recorded by the real-world camera. Therefore, neither the virtual reality scene camera nor the real-world camera can display the obscured facial area of the user.

Hence, it is not feasible for the MRC system to display the user's entire face to convey the user's expressions and reactions in the MR environment.

Figure 1: An output from the mixed reality capture (MRC) system in prior art

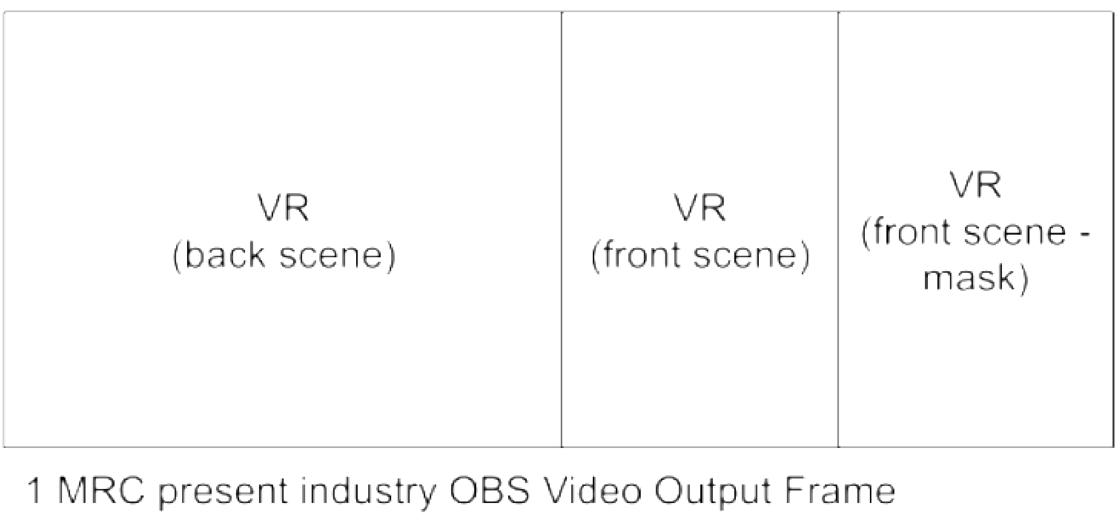

Figure 2: The standard MRC output frame from the MRC system in prior art

The present disclosure provides a novel solution to address the aforementioned problem.

System and working

The present disclosure describes a mixed reality capture (MRC) system that displays entire face of a user to convey the user's expressions and reactions in a mixed reality (MR) environment. The MRC system includes the MR environment in which a number of users are interacting with each other or are immersed in a virtual scene. The MRC system deploys two methods to display facial areas (eyes, eye lids and upper cheeks) of each user that are otherwise obscured due to a mixed reality (MR) headset: a video capture method implemented at the MR headset and a method for compositing the facial areas, captured by the video capture method, into an MRC composition system.

Figure 3 illustrates a process flow of a video capture method 100 and the method for compositing the facial areas being executed by the MRC system. The process flow begins with the video capture method 100 being executed by the MRC system.

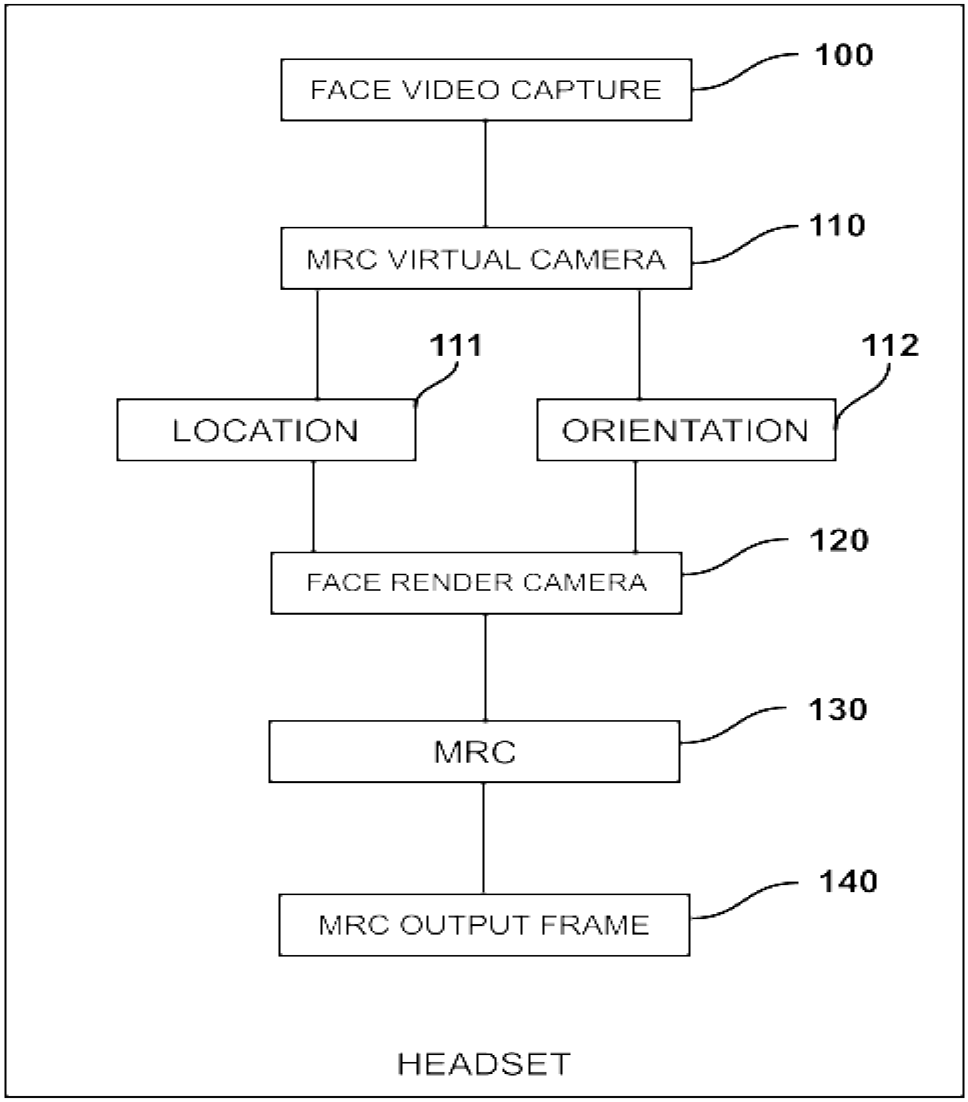

Figure 3: The process flow of the MRC system

Figure 4 illustrates a structural architecture of an MR headset 201 to implement the video capture method 100. The MR headset 201 employs a plurality of cameras 203, which are mounted within a headset eyebox 202 of the MR headset 201 worn by a user 200. In one example, the plurality of cameras 203 includes wide-angle fish-eyed color cameras. The plurality of cameras 203 is capable of recording in a night mode by utilizing infrared illumination. There is a plurality of infrared light sources 204 installed within the headset eyebox 202. As the user 200 wears the MR headset 201, the plurality of infrared light sources 204 turns on and douses a field of view of the plurality of cameras 203 with infrared light. The infrared light is completely invisible to a naked eye. Also, a video recorded in the night mode always looks black and white. Thus, a recorded video of facial areas 205 by the plurality of cameras 203 is of a greyscale order.

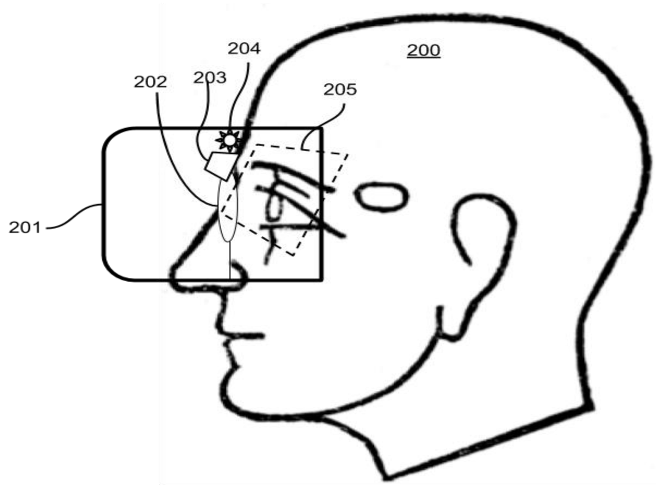

Figure 4: The structural architecture of the MR headset 201 to implement the video capture method 100

The recorded video of the facial areas 205 is then projected on front side of the MR headset 201. The recorded video is projected as a rendered surface 300 (shown in Figure 5) in the MR environment at a correct location 111, and a correct orientation 112. The location 111 and the orientation 112 of the rendered surface 300 are such that the rendered surface 300 is in a complete synchronization with location and orientation of the MR headset 201. In other words, the rendered surface 300 moves accordingly with changes in the location and the orientation of the MR headset 201. The MR headset 201 of each of the users further includes an MRC camera 120 and a virtual camera 110. The rendered surface 300 is then captured by the virtual camera 110 of each of the users who are present in the vicinity of the user 200. The MRC camera 120 captures the MR environment, which includes a virtual reality scene 500 and an external video capture 400 of the user 200 in which the facial areas 205 are obscured.

Figure 5: The rendered surface 300 projected on the front side of the MR headset 201 in the MR environment

The MRC camera 120 is located at the same point as the virtual camera 110 in order to ensure that the rendered surface 300 captured by the virtual camera 110 is calibrated with the MR environment captured by the MRC camera 120. The rendered surface 300 and the MR environment are provided as inputs to an MRC composition system 130. The MRC composition system 130 composites the rendered surface 300 with the MR environment to generate an MRC output frame 140.

The MRC output frame 140 includes a rear virtual scene layer, a front virtual scene layer along with the rendered surface 300 that is provided as a separate layer (shown in Figure 6). Thus, the MRC output frame 140 includes the separate layer for face data associated with the facial areas 205. The separate layer for the face data enables the MRC composition system 130 to determine whether the facial areas 205 are to be displayed or not in a display device associated with the MR headset 201 worn by each of the users who are present in the vicinity of the user 200. In one example, the user 200 does not want to display the facial areas 205 to other users for a period of time, the user 200 sends a first command to the MRC composition system 130 using a “hide facial areas” option on a user interface (UI) of the user’s 200 display device. In response to the first command, the MRC composition system 130 removes the separate layer for the face data from the MRC output frame 140. Then, after the period of time, the user 200 sends a second command to the MRC composition system 130 using a “show facial areas” option on the UI of the user’s 200 display device. In response to the second command, the MRC composition system 130 adds the separate layer for the face data to the MRC output frame 140. This allows the user 200 to switch between the MR environment including the facial areas 205 and the MR environment excluding the facial areas 205.

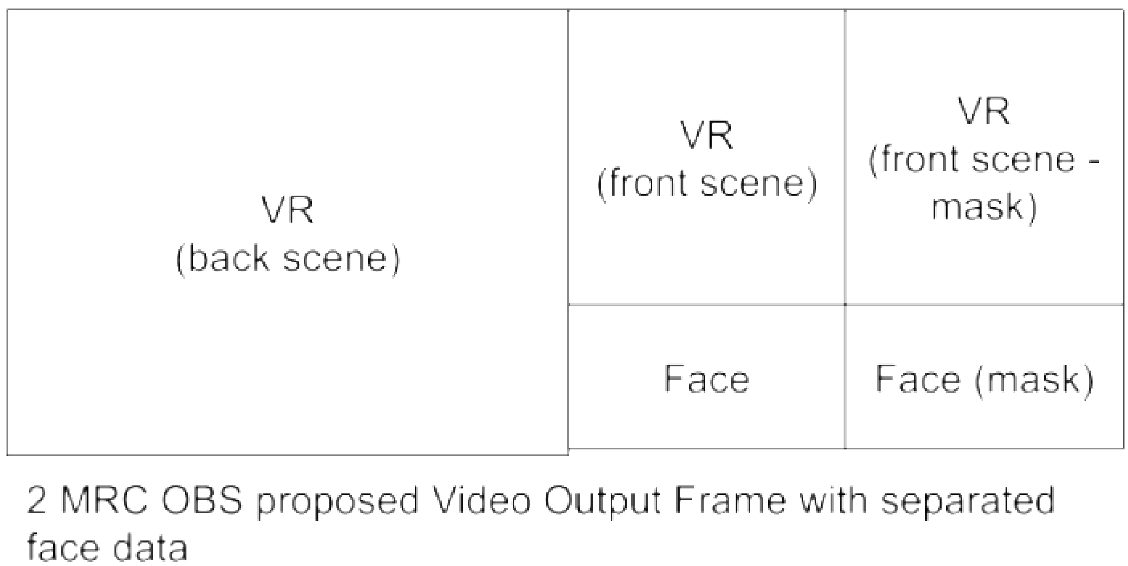

Figure 6: The MRC output frame 140 with the face data as the separate layer

Figure 7 shows the completed composition of the user 200 that includes the facial areas 205 in the MR environment. The completed composition is displayed on the display device associated with the MR headset 201 worn by each of the users who are present in the vicinity of the user 200. As the facial areas 205 of the user 200 are clearly visible to the other users, the user 200 conveys his/her expressions and reactions to the other users.

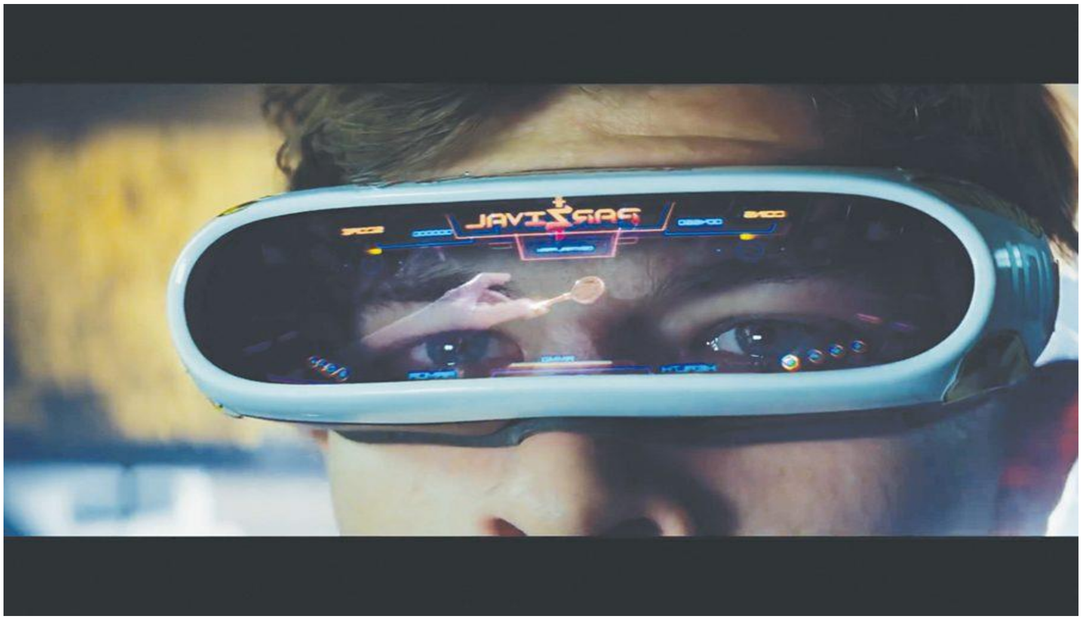

Figure 7: The completed composition of the user 200 including the facial areas 205

Additional embodiments

In another embodiment, the MRC output frame 140 includes the rear virtual scene layer, the front virtual scene layer integrated with the face data associated with the facial areas 205 (shown in Figure 8). However, this configuration of the MRC output frame 140 requires the MR headset 201 to control whether the facial areas 205 are displayed or not. In this case, the MRC composition system 130 cannot turn off the face data in the MRC output frame 140. In order to switch between the MR environment including the facial areas 205 and the MR environment excluding the facial areas 205, the plurality of cameras 203 within the headset eyebox 202 needs to be turned on/off.

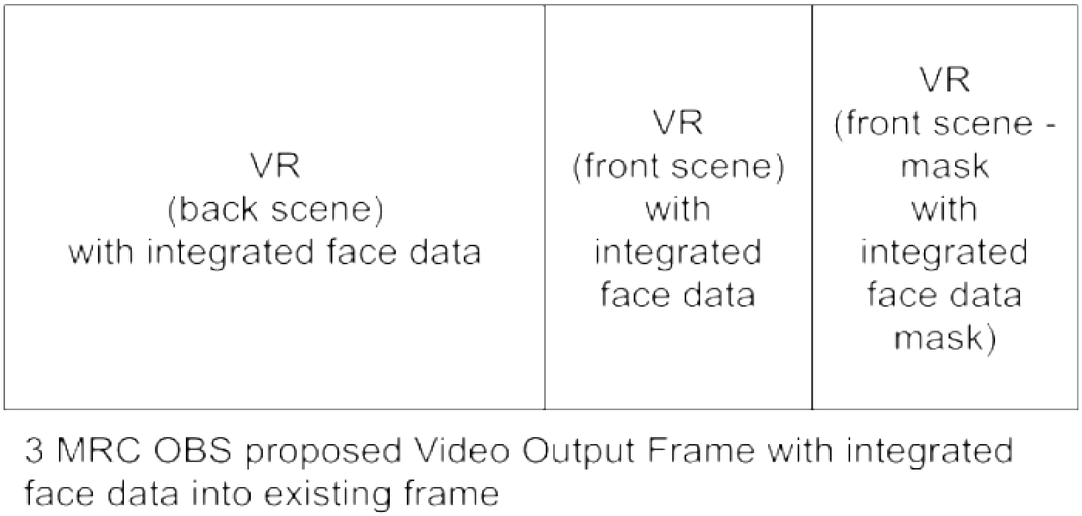

Figure 8: The MRC output frame 140 with the integrated face data

In a yet another embodiment, the plurality of cameras 203 mounted inside the headset eyebox 202 are color capable, thus able to record the facial areas 205 in color. This is achieved by momentarily illuminating the headset eyebox 202 for a fraction of a second to take a color reference frame.

Conclusion

Mixed reality is dominating technology headlines in today’s world with its ability to provide an immersive experience to its users. The mixed reality has got tremendous applications in the field of gaming, military training, simulation-based learning, healthcare, aviation, business, and many more. The true potential of the mixed reality can be explored by enhancing the user experience in the mixed reality (MR) environment. The user experience of the MR environment can be enhanced by making it more interactive and engaging. In current mixed reality capture (MRC) systems, the upper and middle facial areas of the user are obscured due to the MR headset, thus not visible to other users and the users are unable to interact effectively. The present disclosure overcomes this challenge by disclosing an MRC system in which the users convey their expressions/gestures and reactions interactively to other users as the entire face of the user is visible to other users.