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Switching of control inputs modes for a wearable display device

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Abstract

The present disclosure describes a switching system capable of switching a control input mode provided to a wearable display device between a hand tracking mode and a controller tracking mode. In the hand tracking mode, user's hand gestures are used as a control input to the wearable display device, whereas in the controller tracking mode, controller's inputs, for example button-based inputs, are used as the control input. The wearable display devices may include, but not limited to, virtual reality (VR) headsets or an augmented reality (AR) headset such as a head-mounted display (HMD) unit, an optical head-mounted display (O-HMD) unit, and the like. Typically, the switching system takes inputs from an input provider that provides either of the control inputs to the wearable display device to control the rendering of content on a display panel of the wearable display device. In an example, the switching system may receive an instruction in the form of a stimulus to change the control input mode. The switching system, in response to a stimulus, changes the control input mode. In some examples, the stimulus may include one or more of the following - user's instruction(s), launch of an application, motion detection, and the like.

Problem statement

Generally, the wearable display device includes a display mounted on the wearable display device, which, based on the type of wearable display device occupies, either partially or completely, a field of view of the user when the wearable device is worn by the user. For instance, the display in the OHMD unit occupies the field of view of the user partially while the display in the HMD unit completely occupies the field of view of the user. The wearable display device further includes the input provider using which the user can provide one or more control inputs to the wearable display device. Such an input can eventually control an operation of the wearable display device such as rendering of the content on the display. In an example, the input provider includes controllers such as buttons, both physical and haptic, to provide the control inputs. Some of the input providers also allow the user to provide control inputs in the form of hand gestures. Such input providers generally include transducers that can sense user's hand gestures,

thereby generating a response signal that is provided as the control inputs. Conventionally, the two types of control inputs are provided by the input provider in tandem to the switching system.

A major problem faced in the current wearable display devices is to determine the type of control input that should be used in controlling an operation of the wearable display device. There may be case where one of the two type of control inputs is required to operate the wearable display device but both types of control inputs are provided to the wearable display device simultaneously. In such a case, the control input generated by controllers may conflict with the control inputs generated based on the hand gestures. As a result, the wearable display device may not be able to operate in a prescribed way, which may either abort the rendering of content or may cause a delay in in content rendering. Moreover, a lot of computational resources (e.g. processing power) gets wasted in resolving the conflicted control inputs.

The present disclosure proposes a novel solution to overcome the above-mentioned problem.

Switching system and working

The present disclosure describes a switching system that switches a control input mode for a wearable display device between a hand tracking mode and a controller tracking mode. In the hand tracking mode, user's hand gestures are used as a control input to the wearable display device, whereas in the controller tracking mode, controller's inputs, for example button-based inputs, are used as the control input. For the foregoing embodiments, the switching system is explained with respect to an HMD unit, although implementations of the switching system with respect to other types of wearable display devices are well within the scope of the present disclosure.

The switching system includes following modules:

I. Processing module

II. Switching module

For the foregoing embodiments, the switching system operates an input provider which can operate in both the control input modes, as shown in Figure 1 below.

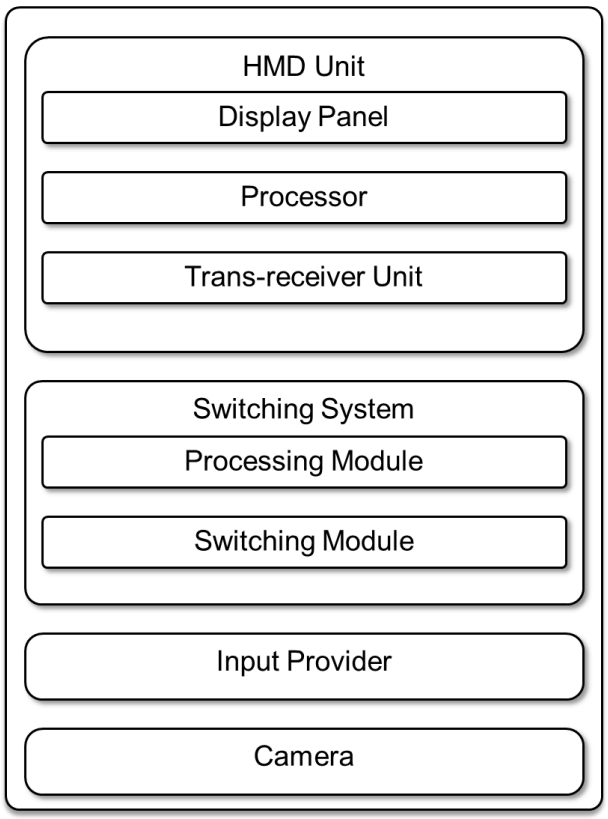

Figure. 1

In another example, the switching system may communicate with two separate input providers for the two control input modes, as shown in Figure 2 below. Also, in the foregoing embodiments, the switching system is integrated into the HMD unit although an embodiment of the switching system being a separate entity from the HMD unit is well within the scope of the present disclosure.

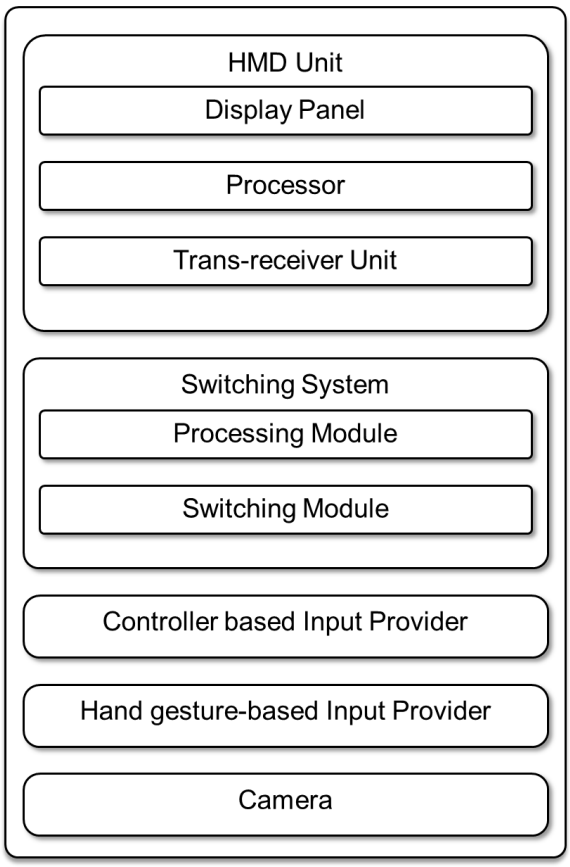

Figure. 2

In the above-shown embodiments, the HMD unit includes a display panel mounted inside the HMD unit in such a way that the display panel covers a field of view of the user. In addition, the HMD unit includes a processor that regulates the rendering of the content on the display panel. Further, the HMD unit includes a trans-receiver unit coupled to the processor and is configured to receive an audio/video (A/V) signal from a source, such as a computing device. In the illustrated examples, the trans-receiver unit is coupled to the computing device via a multimedia interface, such as high-definition multimedia interface (HDMI) cable. The trans-receiver unit is also configured to send instructions to the computing device to send the A/V signal for rendering the content as per the user's input. For the purpose of receiving the user's input, the trans-receiver unit is coupled to the input provider over a wired or wireless connection through the switching system. As mentioned before, the input provider can provide both the controller-based control inputs and the hand gestures-based control inputs. For instance, the input provider provides the controller-based control input if the user operates any button on the input provider, whereas the input provider provides the hand gestures-based control inputs based on the movement of user's hand.

Initially, when the user starts the HMD unit, the switching system selects the control input mode for the HMD unit which is set as the default control input by either the manufacturer or the user. Once the control input mode is selected, the switching system checks if the switching system has received an instruction to switch the control input mode. As soon the switching system receives the instruction/signal to switch the control input mode, the switching system switches the control input mode to the requisite control input mode. The instructions received to switch the control input mode can be explicit instruction from the user, for example, user's command, launch of an application in the HMD unit, and the like.

The HMD unit also includes other components, such as a camera mounted on the HMD unit which captures an image or video of a region where the user is pointing. In one example, the camera captures the image of a region in front of the user which the user otherwise would see in case user has not worn the HMD unit. Further, the camera may feed the captured image to the display panel in a passthrough mode of the HMD unit. The captured image, in one example, can be used to tag a position and orientation of the input provider to perform various operations, such as, but not limited to, allow the user to identify the placement of the input provider, calibrate the input provider, and the like.

The foregoing embodiments provide a few exemplary switching signals/instructions that may be provided to the control input to switch between the hand tracking mode and the controller tracking mode.

Exemplary embodiments

Scenario 1: Explicit user's command

The HMD unit is switched on and the switching system selects the controller-based control input as a default input mode. Accordingly, the switching system will allow the controller-based control inputs to provide instructions to the processor. In one example, the input provider may send both the controller-based inputs, when the user operates the controller-based control inputs (for example, buttons), as well as the hand gestures-based control inputs. However, the switching system allows the controller-based control inputs while it disregards the hand gestures-based control inputs. Further, during the operation of the HMD unit, the user may wish to change the control input mode. In order to change the control input mode, the user operates a switch button mounted on the HMD unit. In another case, the switch button can be in the form of a virtual button presented on the interface and the user operates the input provider to operate the virtual button and provide the selection. In either case, upon operating the switch button, the processing module in the switching system receives a signal generated from the switch button and determines that the user has requested a change in the control input mode. Accordingly, the

processing module operates the switching module inside the switching system so that the switching module now transmits the hand gestures-based control unit to the processor, whereas the switching module prevents the controller-based control inputs from being transmitted to the processor of the HMD unit. Once the switching module switches the control input mode, the processor can now allow the user to control the rendering of the content using hand gestures. Simultaneously, the processing module also sends a signal to the input provider to enter into a power saver mode in which the input provider does not record any input when the user presses any controller on the input provider. This operation is done to save the energy stored in the input provider.

Further, in case the user wants to change the control input mode back to the controller-based control input, the user will operate the switch again to instruct the switching system to change the control input mode. As the switch is operated, the switch generates another signal for the processing module of the switching system. Accordingly, the processing module operates the switching module of the switching system so that the switching module, at first, sends a wake-up signal to change the input provider from the power saving mode to operational mode. Thereafter, the switching module receives and transmits the controller-based control inputs to the processor while the switching module prevents the hand gestures-based control inputs from going to the processor.

Scenario 2: Application based command

In this scenario, the HMD unit is switched on and the switching system selects the controller-based control input as the default input mode. Accordingly, the switching system will allow the controller-based control inputs to provide instructions to the processor. In one example, the input provider may send both the controller-based inputs, when the user operates the controller-based control inputs (for example buttons), as well as the hand gestures-based control inputs which the input provider generates in response to sensed hand gestures. However, the switching system allows the controller-based control inputs while it disregards the hand gestures-based control inputs. Further, the user may send an instruction to launch an application on the display panel. The application, for instance, can be a gaming application. Further, in this scenario, the gaming application is configured to receive hand gestures-based control inputs in order to run. Accordingly, when the application is launched, the application sends a request to the processor to receive hand gesture-based control inputs. Upon receipt of the request, the processor sends an instruction to the switching system to allow the hand gesture-based control input. Further, upon receipt of the instruction, the processing module determines the current control input mode. In case the processing module determines that the current control input mode is the hand gesture-

based control input, the processing module instructs the switching module to transmit the control inputs without performing any switching. However, in case the processing module determines that the current control input mode does not match with the requested control input mode, the processing module operates the switching module so that the switching module transmits the hand-gesture based control inputs to the processor, while preventing the controller-based control inputs from being transmitted to the processor. In addition, the processing module sends a sleep command to the input provider through the switching module to put the input provider in the power saving mode until required. If the application is running, the switching system continues to allow transmission of the hand gestures-based control input.

Further, when the application stops, for example, when the user closes the application, the processor sends another instruction to the input provider to revert the control input mode. Accordingly, the processing module sends a wake-up signal to the input provider and thereafter, operates the switching module to change the control input mode to the controller-based control input mode. Alternatively, the processor may retain the currently selected hand gesture based-control input mode and does not send the instructions to the switching system to change the control input mode until another application is launched which requires controller-based control inputs.

Scenario 3: Controller-based activation

In this scenario, the HMD unit is switched on and the switching system selects the hand gesture-based control input as a default input mode. Accordingly, the switching system will allow the hand gestures-based control inputs to provide instructions to the processor. Also, unlike the previously explained scenarios, in this scenario the input provider can sense the operation of the controllers, and a request signal indicative of user's request to change the control input mode is generated whenever the user operates any controller.

In the illustrated scenario, in case the user presses any controller (for example, button) on the input provider, the input provider sends the request signal to the switching module. Further, upon receipt of the request signal by the processing module through the switching module, the processing module operates the switching module to change the control input to the controller-based control input.

Additional Embodiments

As additional embodiments, in case there are machine learning models associated with both type of control input modes for the purpose of improving the control input modes and each machine learning

model uses their respective control inputs, the switching between the two control input modes activates or deactivates one of the machine learning models so that computational resources are used only for the activated machine learning model.

Conclusion

Switching between the control input mode alleviates the conflict between the use of different control input modes. Moreover, the switching between the control input mode can be automatic thereby preventing the user to switch the control input mode, which also makes the operation of the HMD unit user friendly. Moreover, the proposed solution does away the need to process two different control inputs simultaneously thereby saving the computational resource of the processor.