Technical Disclosure Commons

September 12, 2019

Systems and methods for targeting with a mobile device in a virtual environment

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Abstract

The present disclosure describes a system to target and select graphical user interface (GUI) elements in a virtual environment. A user wears a head-mounted display (HMD) device and views a graphical user interface (GUI) surface to select the GUI elements on the GUI surface. The user holds a hand-held device (HHD) to provide an input and enable targeting by using a capacitive touch interface (CTI) in conjunction with a ray-casting process. Targeting refers to pointing at the GUI element using an input device, while interacting in the virtual environment. Initially, the ray-casting process is utilized for pointing at the GUI surface until a selection reticle is near the GUI element of interest. Once the selection reticle is near the GUI element of interest, the user places a finger on the CTI to snap the selection reticle onto the GUI surface. Thereafter, the ray-casting process is disabled and changed to a precision-mode to enable more precise selections.

Problem statement

Currently, targeting in the virtual environment is difficult due to hand tremors of the user and design of the GUI elements in the virtual environment. Ray-casting techniques are used predominantly to perform a selection of the GUI element using the input device in the GUIs. The ray-casting process is executed by emitting a virtual ray from the input device. However, targeting the GUI element using the ray-casting process is noisy due to a low value of a pointing accuracy and a precision of the input device, and the hand tremors of the user. Thus, the GUI elements are generally designed large (in size). Therefore, interface designers are limited to using large GUI elements only. Further, the HHD, such as a mobile device, does not have a dedicated button to signal the selection to the virtual environment or a mechanism to improve the pointing accuracy and the precision.

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

System and working

The present disclosure describes a system to target and select graphical user interface (GUI) elements on a GUI surface in a virtual environment.

The system comprises following components:

- a head-mounted display (HMD) device
- a hand-held device (HHD)

Further, the HMD device includes following components:

I. a graphical user interface (GUI)

II. a communication interface

III. a processing unit

A user wears the HMD device and views the GUI surface using the GUI of the HMD device to select the GUI elements. The HMD device is wirelessly connected to the HHD via a network. The HHD acts as an input device for targeting and selecting the GUI elements. Targeting refers to pointing at the GUI element using an input device, while interacting in the virtual environment. The HHD further allows the user to wirelessly interact with the virtual environment by sending an input to the HMD device. The HHD includes a capacitive touch interface (CTI) and a capacitance sensor. A virtual reality (VR) application is also installed on the HHD. The user holds the HHD to enable targeting by using the CTI in conjunction with a ray-casting process.

The user starts the ray-casting process by enabling a ray-casting mode in the VR application. The ray-casting process is enabled for an initial pointing until the user touches the CTI. The ray-casting process creates a virtual ray, which originates at the HHD and projects onto the GUI surface. The GUI elements are shown to the user using the HMD device. The user then starts pointing the virtual ray at the GUI element, which is to be selected, with the aid of a selection reticle (which is seen in the GUI of the HMD device).

The selection reticle is a visual aid with a pattern or a series of fine lines or markings to aim at the GUI element within the GUI surface. The lines mark out a location where the HHD is pointing. Once the lines mark out the location near the GUI of interest, the user places a finger on the CTI. The capacitance sensor detects the user's finger on the CTI. The VR application automatically disables the ray-casting process when the user touches the CTI and enables a precision-mode. The precision-mode allows the user to use

relative finger movements on the CTI to direct the selection reticle to the GUI element of interest for more precise selections. The selection reticle is snapped onto the GUI surface and the user can reposition the HHD to a comfortable position without worrying about pointing. A touch of the user's finger, which is the input, results in a distortion in an electrostatic field of a screen of the CTI. The distortion in the electrostatic field is measured as a change in a capacitance of the screen. The distortion in the electrostatic field is received as a signal at the communication interface and then sent to the processing unit. The processing unit enables the selection of the GUI element based on the distortion in the electrostatic field.

Exemplary embodiment

Figure 1 illustrates the user holding the HHD to select the GUI element in the virtual environment. The user wears the HMD device in which the GUI surface can be viewed. The HMD device is wirelessly connected to the HHD and the HHD captures the input for selection from the user. In the given example, the GUI element (i.e. a target) is small, hence the user encounters issues in aligning the virtual ray using the ray-casting process to perform the successful selection of the GUI element. The ray-casting process is used here for initial positioning.
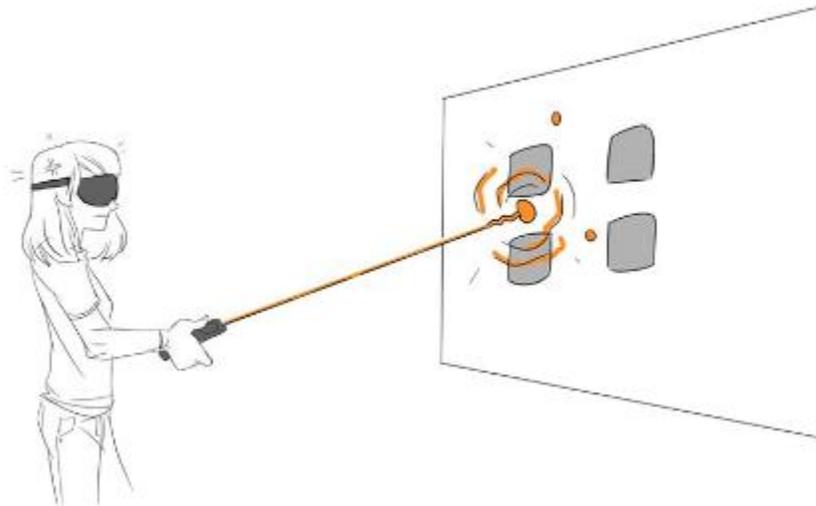

Figure 1: The user holding the HHD to point on the GUI element using the ray-casting process

Figure 2 illustrates the user using the CTI to snap the selection reticle. The system allows the user to place fingers onto the CTI to snap the selection reticle to the GUI surface. Now, the ray-casting process is disabled, and the precision-mode is enabled.
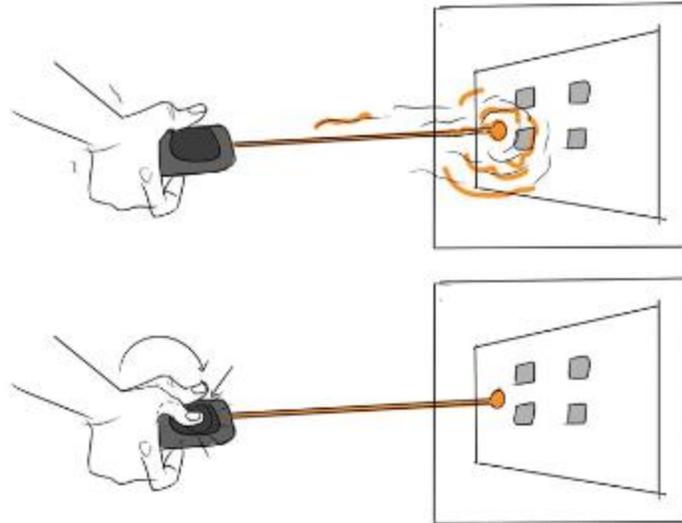
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Figure 2: The user using the CTI to snap the selection reticle

Figure 3 illustrates the selection reticle being snapped to the GUI surface. The user's finger is touching the screen of the CTI, and a free movement of the HHD to a comfortable pose is allowed. This is because the selection reticle is snapped to the GUI surface.
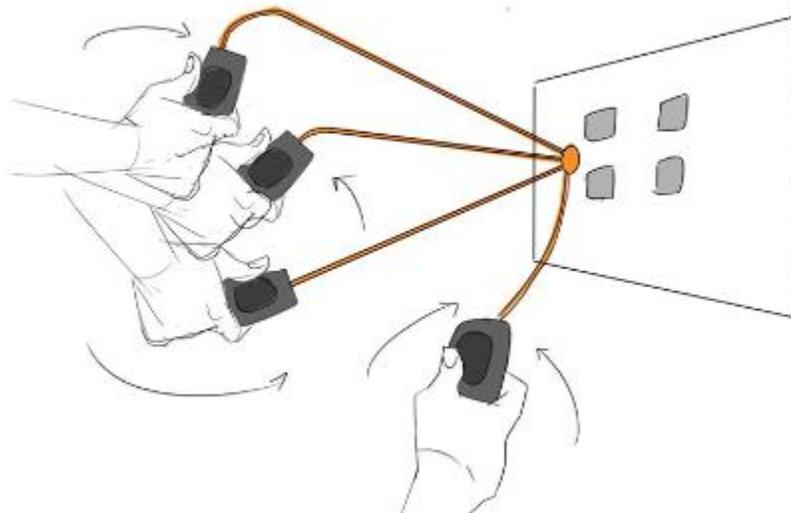

Figure 3: The selection reticle snapped to the GUI surface

Figure 4 illustrates the user controlling the selection reticle using the CTI. The user slides the finger on the CTI of the HHD. The HHD takes the input and enables controlling of the selection reticle on the GUI surface to a desired location.
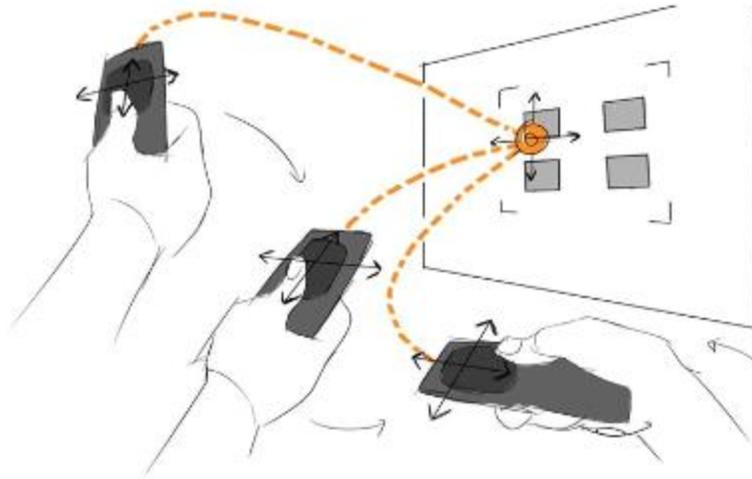
Figure 4: The user controlling the selection reticle using the CTI

Figure 5 illustrates the user performing the selection on the GUI surface. The user performs the selection of the GUI element on the GUI surface by releasing the finger from the CTI. Upon release of the finger, the VR application reverts the HHD to execute the ray-casting process.
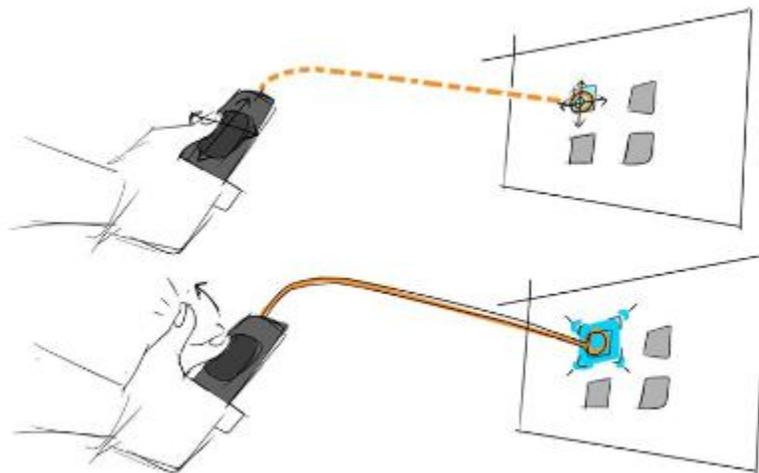

Figure 5: The user performing the selection of the GUI element on the GUI surface

Additional Embodiments

In an additional embodiment, a voice sensor may be embedded in the HMD device. The voice sensor aids in collecting a secondary input, for example, a voice command from the user. Further, the secondary input, such as the voice command aids in accelerating the selection of the GUI element.

Conclusion

Targeting and selecting the GUI elements are the most common and important tasks in interactive systems. These tasks are used in various interactive applications (such as, VR gaming, *etc*.) in virtual environments. Therefore, targeting and selecting the GUI elements precisely in the virtual environment become essential. The proposed solution improves the pointing accuracy and enables precise selection of the GUI elements using the ray-casting process in conjunction with the capacitive touch interface.