A Viewpoint Control Method for 360° Media Using Helmet Touch Interface

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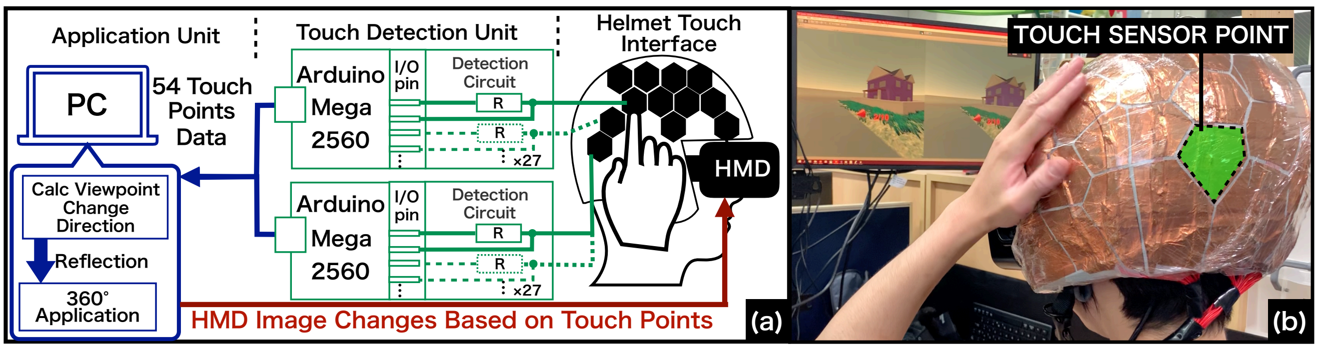

Figure 1: (a): Implementation, (b): scene of use.

ABSTRACT

We have developed a helmet touch interface for the viewpoint control of a 360° media. The user of this interface can control the camera in 360° media by touching the surface of the helmet. To detect touch, two micro-controllers and 54 capacitive touch sensor points mounted on the interface surface are used.

CCS CONCEPTS

• **Human-centered computing** → **Virtual reality**; *Interaction devices*; Gestural input.

KEYWORDS

virtual reality; 360° media; touch interface; viewpoint control

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1 INTRODUCTION

To navigate and orient in VR, techniques based on head movement, VR controllers, and touch interfaces are used to control the viewpoint. Viewpoint manipulation based on head movement is a technique in which the position and direction of the viewpoint in the VR content changes depending on the user's head movement while wearing a head-mounted display (HMD). One of the advantages of this technique is the intuitive viewpoint control, which provides a more adequate immersion experience. In contrast, previous work also reported negative aspects of the head movement approach [3].

There is a lot of related work in this area. For example, GlobeMouse and GlobeFish [1] are six degrees of freedom desktop input devices which enable precise interaction with virtual objects. Jackson et al. [2] proposed a rod-shaped, lightweight, tangible interface for controlling 3D visualization. They are basically designed for manipulating 3D objects, not for viewpoint manipulation.

The purpose of this study is to realize natural and comfortable touch interaction for viewpoint control in 360° media. We developed a helmet form factor touch interface device, and designed a viewpoint control method for it.

2 VIEWPOINT CONTROL METHOD

In our viewpoint control method, a user wearing a HMD and the helmet touch interface can control the direction of the viewpoint in the 360° media displayed on the HMD by touching the helmet surface.

There are two basic concepts in controlling viewpoints: (1) directly touching the direction of the user's viewpoint on the helmet. For example, in Fig. 2 (a), the user wants to look at the object A, and touches the helmet surface at the direction of the object A; in Fig. 2 (b), the user wants to look at the object B, and the user touches the back of the helmet surface which is at the direction of the object B. Another concept is (2) rotating the viewpoint camera as if it is placed on the head, and the user directly manipulating it with their hand. For example, as shown in Fig. 2 (c), sliding the hand from the forehead to the top of the head rotates the pitch so that the forward-facing camera points upward. Similarly, as shown in Fig. 2 (d), sliding the hand from the back of the head to the top of the head rotates the pitch of the camera in the opposite direction.

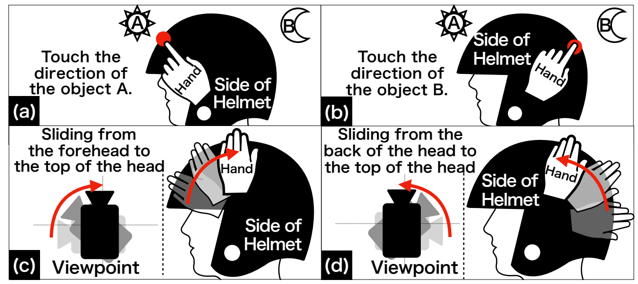

Figure 2: (a) (b): Viewpoint control with touch, (c) (d): viewpoint control by sliding.

3 IMPLEMENTATION

We implemented the prototype of the helmet touch interface device and a VR application to evaluate our viewpoint control method. The overview of the system is shown in Fig. 1 (a). This system is roughly composed of a helmet touch interface part, a touch detection part, and an application part. The application part was developed using Oculus Rift DK2, its SDK, and Unity.

3.1 HELMET TOUCH INTERFACE

Fig. 1 (b) shows the helmet touch interface. On the surface of a motorcycle helmet, 54 capacitive touch sensor points are implemented. Each touch region is formed by cutting the copper foil pasted on the entire helmet surface. One wire per sensor point is connected to the back of the copper foil, and the other end is taken out from the rear of the helmet. A total of 54 wires are connected to the touch detection unit (as shown in Fig. 1 (a)).

3.2 TOUCH DETECTION UNIT

The touch detection unit is composed of two Arduino Mega 2560 (micro-controller) and a touch detection circuit. The touch detection unit combines two micro-controllers and the developed circuit. The circuit detects the presence or absence of touch in 54 points based on the change of the capacitance value of each touch sensor point and transmits the results to the application part on the computer. The Capacitive Sensing Library[1] is used for capacitive touch sensing.

3.3 360° APPLICATION

The application part receives 54 points of touch information from two micro-controllers and performs the viewpoint control. This application allows the user to watch 360° media.

In the application, touching the position of the desired direction on the helmet surface allows the user to manipulate the viewpoint so that the touched position becomes the frontal view.

The user can modify the view-direction point after touching the helmet surface by sliding the touching finger. The viewpoint change occurs about 2 seconds after the touch release.

In addition to the above viewpoint control method, head tracking can be used to control viewpoint as well. This is especially useful to move the viewpoint downward, which tends to be difficult using only the helmet touch interface.

[1] https://playground.arduino.cc/Main/CapacitiveSensor

4 USE CASE

One possible use case of our interface is a VR planetarium where the full sphere is filled with stars. In this case, there is no top and bottom. The viewpoint in the sky must be sometimes changed drastically, which is difficult by the head movement control. In addition, our interface is hands-free when not used, thus suited for long-time viewing of such contents.

Another possible use case is 3D-CG production in VR space. Our interface is naturally used together with existing 3D controllers. Most 3D controllers are suited for manipulating target 3D-CG objects, while our helmet touch interface is designed for manipulating the viewpoint. Again, our interface is hands-free when not used; thus the users can smoothly use both devices alternately.

5 CONCLUSION AND FUTURE WORK

In this study, we developed helmet touch interface for viewpoint manipulation in 360° media, and designed an interaction method for this interface. Using this device and method, users can control their viewpoint by directly touching the direction of the 360° media camera.

In the future, we plan to evaluate our helmet touch interface by comparing it with the existing approaches such as hand-held 3D controllers and the head movement approach. Evaluation criteria include the feeling of fatigue and 3D motion sickness as well as control performance and error rates. We also plan to investigate the user's perception of the analogy of our control method.

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