Electric Bow Interface 3D

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1 Introduction

Amongst immersive interface works, Jones’ “Room Alive” [Jones et al. 2014], which uses an HMD, i.e., head mounted display, and multiple projectors, is representative; however, the HMD disturbs the depth direction of a player’s eyes, and especially, the player cannot see his or her own body and hands through the HMD in real space. Also, using multiple projectors costs a lot of money and means the system requires a lot of time to set up.

In comparison, our Electric Bow Interface 3D, which is an enhanced version of our previous device, “E-Yumi 3D” [Yasumoto and Teraoka 2015], is a gaming device for AR games. It is inexpensive and does not require a lot of processing power because the device displays only the direction in which the player is facing. This device consists of a real bow’s components added to Willis’s interface with a mobile laser projector [Willis et al. 2013; Huber 2014], Windows PC, 9-axis sensor, and some pieces of equipment. Also, the device is an immersive system that changes a room into a virtual space, surrounding the user in 360° (Figure 1), in which techniques of drawing a bow and shooting real arrows can be practiced. We describe this device system and its application in this paper.

2 System

As shown in Figure 2, Electric Bow Interface 3D is based on an archery bow and also includes a mobile laser projector, Windows PC, 9-axis sensor (VN-100 Rugged1), a microcomputer (Arduino Nano and control board), distance sensor, which was not equipped in E-Yumi 3D, and a battery. When a player holds this device, an image determined from the parameters of the 9-axis sensor and the player’s shoulder height and arm length is projected in the player’s shooting direction. If the player aims at targets in any direction, this system can display images corresponding to each direction; therefore, players can play content in a room as if the room were changed into an all virtual space.

Additionally, when the player draws this bow device, the system obtains the parameters of fine strain on the bow’s limb from the strain gauges and amplifies it in a differential amplifier circuit. Then, the system inputs the parameters to the microcomputer and sends such information to the Windows PC from the microcomputer. Thus, the shooting of the 3D bow can be detected from the strain gauges on the bow’s limbs.

As shown in Figure 3, when playing with this bow device, the player can rotate around only his or her rotation axis to search for

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1 VN-100 Rugged (http://www.vectornav.com/products/vn100-rugged) is a 10-axis sensor that contains 3-axis accelerometers, a 3-axis gyroscope, 3-axis magnetic sensors, and a barometric pressure sensor; the electric bow does not use the barometric pressure sensor.
and shoot projected targets. In this system, the distance from the rotation axis to the mobile projector (“N” in Figure 3) is fixed, and the virtual camera in the virtual world is set at the same distance from the axis. By setting this distance, projected views become more realistic when the player is rotating and changing the shooting direction; however, the distance from the projector to the projection wall (“L” in Figure 3) changes with each rotation if the player is not at the center of a spherical room. In fact, E-Yumi 3D had the following problem; this distance for each rotation was different from that between the virtual camera and the wall, so projected background objects, which must be viewed at the same place, moved for each rotation. To solve this problem, a distance sensor, which can measure the distance from the mobile projector to the wall, is implemented in Electric Bow Interface 3D. Therefore, the system can obtain the parameter of “L” for each rotation, solving this problem. Along with these enhancements, the electric bow uses a real bow’s components, and its system makes the projected virtual space feel more realistic; therefore, the player can get a feel for using a real bow, aiming at targets, and shooting them.

3 Application

Our game, “Shadow Shooter,” shown in Figure 4, provides a 360-degree all-around virtual space. The projected image is displayed only in front of the player. This is because, when Shadow Shooter is used with our device, the room must be completely dark because the light quantity of the mobile projector is low. Hence, we made the game concept so that a player can see only a part of the playing field by shining a flashlight in a completely dark room in-game. This game is just like a horror shooting game where players search for enemies that are coming at them from all directions and shoots them (Figure 4).

4 Conclusion

Electric Bow Interface 3D helps players experience the drawing and shooting of a bow more realistically than our previous device because its system can get the distance between the mobile projector and the projection wall. In the future, we will make a new version of the electric bow and extend its system so that multiple bows can be used at the same time.

References


