The Electric Bow Interface

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Abstract. The research intends the establishment of the cognitive space where the force feedback, the sense of immersion and existence are implemented in interactive space functioned as the input of physical movements. The Electronic Bow Interface system has been developed based on a Japanese archery with consideration to apply the application of games such as FPS(First Person Shooting) into it; furthermore, contents are also developed with the Electronic Bow Interface system. This research also attempts the actualization of the realistic forced feedback and the interface where physical movement can be reflected.

Keywords: interface, game, interactive art.

1 Introduction

A game pad, a mouse and keyboards with a fingertip were the mainstream of inputs in the territory of interactive contents including video games. The game devices such as Wii Remote[1], PlayStation Eye[2] and Kinect[3] have made possible to the input of various physical movements. Especially, Kinect is possible to process inputs by taking body movement into image analysis, while holding nothing on hands[4]. The spread of these new devices make possible to implement Natural Interaction even other studies apart from video games. However, several issues are caused when these inputs are applied to the standard contents of video games.

Firstly, it is difficult to implement realistic physical movement with high flexibility. The input of an interface has been developed in the way that body movement as input information can take into a computer. However, Output still depends on the fixed image output. In other words, the players still need to pay attention to the fixed images when the players move around their body. Problems of images relation can be happened in video games accompanying no physical movement. 3D contents are functioned with the rotation of images in order to represent the rotation of sights, but it is not functioned with human body movement itself. In other words, human body such as the movement of muscles and centrifugal force does not react to them. Thus, it is necessary to develop the sense of sight motions with high flexibility of realistic physical movement.

Moreover, another difficulty is to give the force feedback to a camera utilized for the reorganization of physical movement when nothing on hands. In case of human body, they do not recognize manipulation only with sights and hearing, but they also recognize the condition of touch. The sense of a fingertip, pressure to muscles and

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temperature are useful information. The information of them is significant to give the sense of immersion and the sense of existence to the players.

This issue also rises up questions to interactive contents production which physical movement information is utilized. Therefore, in this research, the contents, the issues of sights and an interface are contemplated to overcome technical difficulty in order to implement realistic physical movement in the Electronic Bow Interface device. We would like to introduce "The Light Shooter", this work contains an interactive content, and the Electronic Bow Interface device by mean of a controller a design and construction of exhibition space.

2 Related Works

In this research, the construction of contents utilized with force feedback is significant. In many cases, an actuator as the feedback of a hand hold type of a controller brings vibration to the players. It is suitable for transmitting the condition of a road surface in a race game. However, since it only conveys simply vibration, it is not versatile. The examples of high versatile researches are as follows. One is in regard to counterforce and impulsive force represented by controlling a spindle [5]; the other is regarding to the sense of being pulled over gives to a user by controlling the rotation movement [6]. However, the amount of strain is limited comparing to realistic physical movement, and it is pseudo and not correct. The impression from uses is different from the manipulation of an original one. It is hard to adopt human physical ability into a virtual space such as games.

The method that versatile devices imitate the faction of original objects is implemented, the game with the shape of a handle and rifle is also available. Their abilities remain poor from a feedback point of view. On the contrary, they can give the sense of reality in motion of a player since the same position of a hand movement is applied to them.

Moreover, although there is no versatility for this, but another case study has been confirmed. One is the interface which includes the feature of a stuffed toy by inserting a sensor into its toy [7]. The other case is a Balance Ball Interface [8], which the back is centralized to adjust the whole body movement. However, they are not reacted by the operation of the players in the force feedbacks. Thus, it is still difficult to feedback from contents randomly. Since objects in reality are used in the interface, a feedback itself brings realistic sensation to the players. These stuffed toy and balance balls can be rebounded and change their shapes with a sensor or without, if pushed. On the contrary, their texture is almost as same as objects in reality, but these are initially made for another purpose, not for operation.

Therefore, the bow interface is developed for making possible to utilize a force feedback repetitively. A player can pull over a bow without an arrow, which means that the position can generate an interface. Moreover, a bowstring is precisely adjustable and controllable by a player.

A bow is a weapon as the same as a rifle, due to their uses and images, violent impression tends to apply for a bow as well. To avoid this impression, simple Biological

Motion [9], adapted in ”Dot Man, Line Man” [10] in “Transform yourself Exhibition” [11], is utilized for simple graphics in the application of the Electronic Bow Interface.

3 Overview of the Electric Bow Interface

3.1 Concept

The Concept intends that the sense of touch and temperature contained in objects and a life are expressed in the force feedback.

The reason of a bow being adapted in this research as follows; firstly, a bow can aim the target at 360 degrees and from a distance. Secondly, it is hand- portable. Thus, it can apply flexible physical movement and the accordance to directions of sights and images into expressions.

A bow is different from a rifle in terms of distance and speed being controllable to a certain extent. The strength of arm is necessary in order to shoot an arrow for a distance and fingers holding a bowstring are also pressured more in proposition. When an arrow is let off, it generates vibration and impact on a bow. Namely, these functions are significant for the force feedback to distinguish its operation as a player wishes. From these reasons, the archery interface is possible design realistic physical motion with the information of physical motion in reality.

An arrow relatively takes time to reach to the target. The construction of archery does not allow rapid fire, which means that it can provide time to a player to consider.

In addition, Contents, urging a player consideration, can be constructed as well.

3.2 Overview of the Electronic Bow Interface System

We have produced the Electronic Bow Interface based on the material and structure of Japanese traditional archery. This system is composed of a player, a projector, PC and a screen (Fig. 1). The information of a bow is acquired, disposed to the Electronic Bow device itself and correspondent to PC, thus, it is possible to use at any location. Moreover, real time calculation is possible due to the advanced calculation of the position of a bow, a player; distance; and the fixation of screen.

The Electronic Interface device is based on the structure and material of Japanese bow. Thus, the touches, sensation, impact of lunching are almost the same as an original Japanese bow. Therefore, a player can apply a bow and Japanese bow experiences to this operation. Similar to archery operation in reality, it is necessary to pull the both side of arms strongly to shoot an arrow, and if an arrow is aimed at longer distance, a bowstring needs be dragged stronger and the strength needs to be added to their hands to prevent a bow to slide due to its reaction. For these reasons, a player does not need to learn new operation procedure with a certain experience of archery due to the availability of the same force feedback in human reactions; a player can start playing immediately.

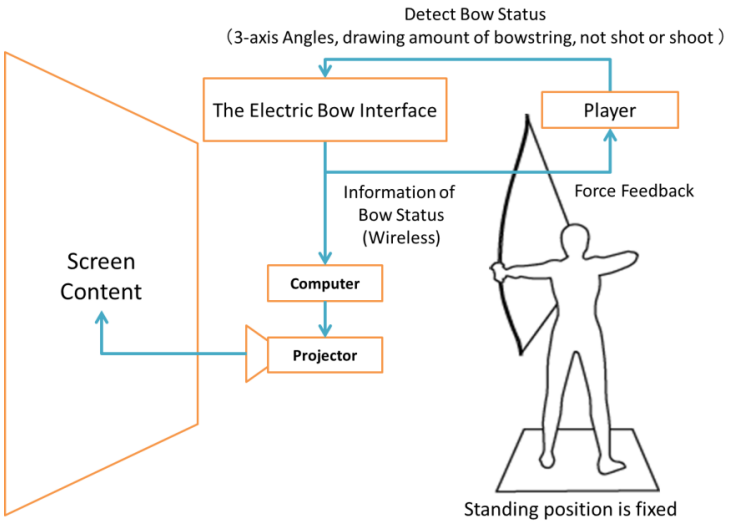

Fig. 1. Overview of the Electronic Bow Interface System

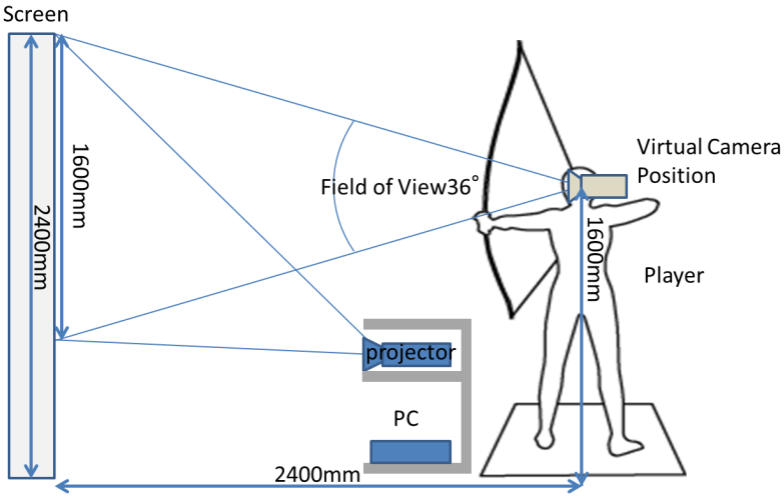

Fig. 2. Positional relationship between the screen and the virtual camera and the player

The position of a player and a screen are fixed. Therefore, the sight angle of a player can correspond with the angle of contents. As a result, a player can acquire immersive experience in the electronic bow (Fig. 2).

3.3 The Electronic Bow Interface Device

The Interface Archery Device is based on the structure and material of Japanese bow. It is utilized by holding a grip attached to the center of a bow with the left hand (Fig. 3).

All electronic devices are contained in its grip. The ArduinoFio [12] is utilized as a Micro Computer to process information sent from each sensor (Fig. 4). Then the Xbee [13] Module is equipped to correspondent to PC. The battery is also equipped in the grip. The three axis accelerate sensor is to gain the slant of archery; the Terrestrial Magnetism Sensor is to get the direction of archery; and the strain gauge is to make sure if an arrow is shot to the target or not. These are attached to it. Moreover, the small size laser pointer is also installed in front. It is for the calibration of directions the bow aims at.

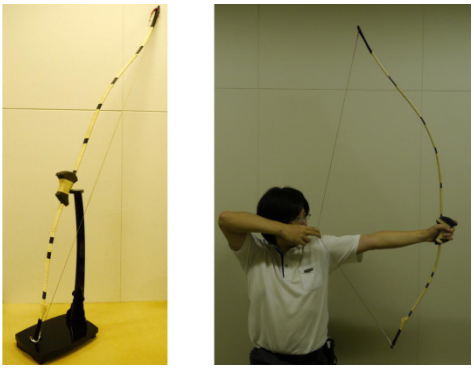

Fig. 3. The Electronic Bow Interface Device

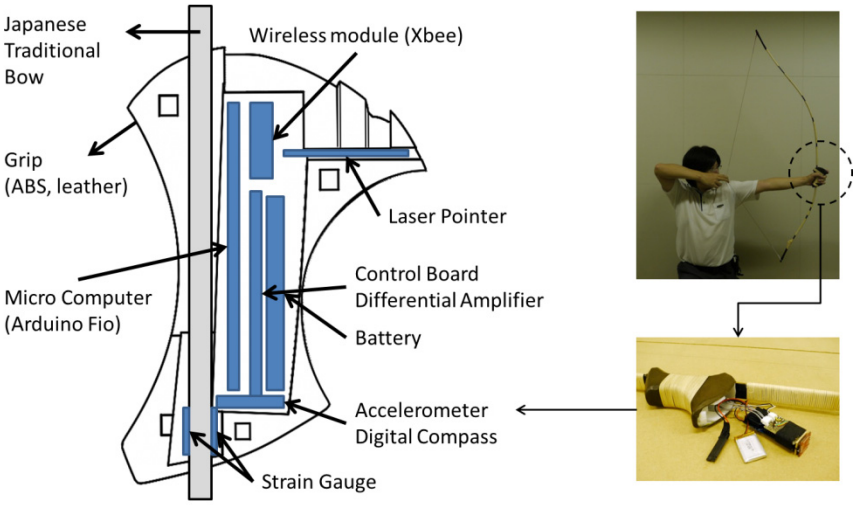

Fig. 4. Detail of The Electronic Bow Interface Device

The grip is produced with ABS resin to protect from the shock of shooting and hand strength. The part of grip is covered with cowhide and the other whole parts are covered with rattan peel used also for traditional Japanese bow. The strength and accuracy of the Electronic Bow device has been confirmed due to the examination by nearly 1000 examiners in the Tokyo Game show 2012.

4 Application

The game application is produced for the experiment to the Electronic Archery interface. First idea is that blocks on screen are simply targeted and destroyed (Fig. 5). For this experiment and entertainment, the device is reproduced in the way that a player can shoot light into darkness where targets are more difficult to be found.

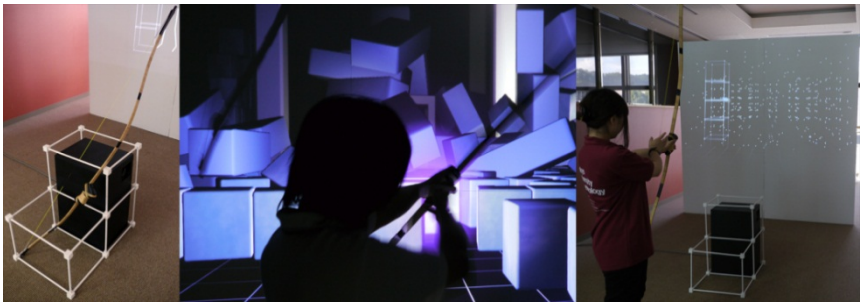

Fig. 5. Applications of The Electronic Bow Interface

4.1 The Light Shooter

The Light Shooter is the interactive art work where the Electronic Archery Interface is equipped, and the function as a game is highlighted (Fig. 6). Firstly, Darkness is shown on the screen, secondly, once the electronic archery is targeted on screen, the target area is expanded, and white dots appears on the screen. These processes utilize the phenomenon of human reactions called, the Biological Motion, which humans

Fig. 6. The Light Shooter

recognizes a life even with a little information such as a few dots. With this phenomenon, the players can distinguish white dots composed of a life enemies and obstacles and they can shoot enemies appearing on the screen for defense. When an arrow is shot to the target, an arrow turns to be a light and it flashes the white lines of the edge composed of a life and obstacles.

In the exhibition, this work is displayed with a mat black color wall, floor and screen. A speaker, a computer and a projector, are all cover up not to disturb well focus on the work.

5 Conclusions

The Light Shooter had been shown in Tokyo Game Show 2012 and SENSE OF WONDER NIGHT 2012 and other exhibitions. We have found that the visitors of the archery experienced operate well than one without. Thus, this device can be more suitable for the experienced. We will continue the research including this issue. Furthermore, we would like to develop the mobile projector, where three dimensions configuration data is included is attached to the electronic archery device itself. With this development, the electronic archery will provide 360 degrees directions mobility to the players.

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