Shoe-Shaped I/O Interface

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ABSTRACT

In this research, we propose a shoe-shaped I/O interface. The benefits to users of wearable devices are significantly reduced if they are aware of them. Wearable devices should have the ability to be worn without requiring any attention from the user. However, previous wearable systems required users to be careful and be aware of wearing or carrying them. To solve this problem, we propose a shoe-shaped I/O interface. By wearing the shoes throughout the day, users soon cease to be conscious of them. Electromechanical devices are potentially easy to install in shoes. This report describes the concept of a shoe-shaped I/O interface, the development of a prototype system, and possible applications.

ACM Classifications: H5.2 [information interface and presentation]: User Interfaces.

General terms: Experimentation, Human Factors

Keywords: Shoe-shaped interface, wearable devices, projectors.

INTRODUCTION

There have been many recent studies on wearable devices [1, 2, 3]. However, wearable devices are not in common use. One of the reasons for this is that wearing them is uncomfortable. In the field of wearables, there are many kinds of devices, such as embedded touch-sensor clothes [4], a waist-mounted projector, and a microcomputer that attaches to the hand [5]. However, to use their functionality, one must "wear" the appropriate devices.

Clothes must be washed often. However, the washing machine is a harsh environment for electromechanical wearable systems. Furthermore, many such wearable systems consist of hard materials that can reduce the comfort of the clothes. When attaching devices to the waist or hands, one must make sure they are properly connected. Dealing with such issues can be burdensome to many users.

In summary, the daily use of wearable devices should be transparent to the user and need minimum attention. To solve this problem, we focus on using shoes as a wearable device. Typically people are not conscious of "wearing" their shoes in daily life.

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Furthermore, it is easy to mount devices to the shoe sole, and shoes are not generally laundered.

RELATED WORK

The use of shoes as wearable devices has been the subject of a number of varied studies. Junji et al. proposed shoes that guide users by means of shoe vibrations while walking [6]. Hockman et al. proposed shoes that use the pace of the runner to change the tempo of the music being listened to [7]. By equipping a pair of shoes with a sensor and an iPod, the motion data acquired from a person's jogging can be analyzed to count calories, calculate the distance traveled and play music [8]. These devices are only effective as information input devices and are not suitable for use in our applications. Tetsuya et al. proposed shoes with an accelerometer for operating devices while jogging [9]. However, this method restricts the use of the shoes to certain situations and lacks versatility.

If we regard a shoe as an interface, interfaces need to be equipped with input and output facilities. Furthermore, the ideal situation is for information to be available at any time. Thus we propose a shoe-shaped interface.

SYSTEM DESCRIPTION

Initially, when regarding shoes as an interface, it is useful for them to be observed using a graphical user interface (GUI) type concept. In addition, we aimed to flexibly and easily manipulate a number of information sources. For our prototype system, we considered motion as an input source and a graphical display as an output facility. To detect a user's motion, the prototype system was installed with an acceleration sensor and a gyro sensor from a Wii Remote.

Considering the requirements, we used the easily implemented motion sensor from the Wii Remote and a small-sized projector. In implementing the system, we used Japanese "geta" clogs as the shoes. Geta have a strap to hold your foot. In addition, geta have supporting wooden pieces below their baseboard called "teeth" that allow space for attaching the projector. We solved the problems of projector attachment and projection function by attaching the projector as shown in Figure 1 and reflecting the projection toward the ground using a mirror. This system enables the graphics and foot movement to interact. Using this shoe-shaped I/O interface, we were able to consider various applications.

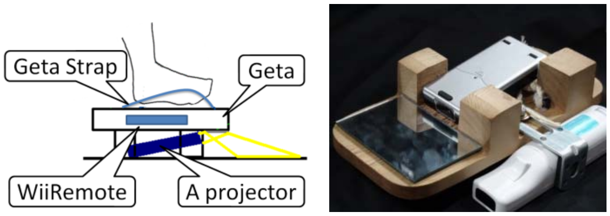

Figure 1:Overview of the shoe-shaped I/O interface.

One typical application of this system is music, especially instruments with pedals. For example, electric guitar players have to use both hands while they are playing. Furthermore, they are also required to control sound parameters with effectors by using pedals or knobs. Pedals should not affect guitar play but they have poor ability for controlling parameters. On the other hand, knobs are suitable for precise tuning of sound parameters but they require the player to stop playing. This interruption and action is a nuisance to the player. Researchers in previous studies have tried to address this problem using a playing style augmented with physical action. However, this playing style forced the player to practice and memorize how to perform the action. In contrast to such systems, our system enables us to manipulate the music parameter simply, intuitively, and hands-free.

In this study, we adapted our geta prototype to a guitar effect controller. Our trial guitar system is shown in Figure 2. Player reactions to the projected image are input though the Wii Remote motion sensor using Bluetooth. The operation of the effect pedals is implemented by the ChucK programming language, and the communication between the shoes and the PC uses an OSC (Open Sound Control).

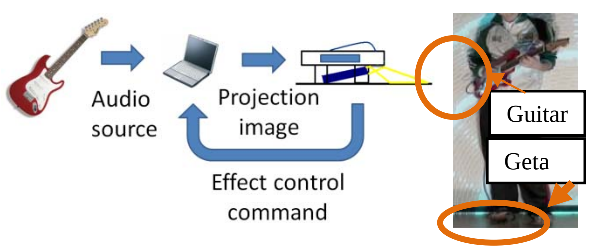

Figure 2: shoe-shaped effect pedal.

Using our interface, we mounted the effect pedal, which can manipulate music parameters by using graphics. The functions of the effect pedal that we implemented were tuning sound parameters and the Self-duo and Play-solo Music functions. We confirmed that the manipulations were achieved without the use of the hands, while playing the guitar.

The shoe-shaped I/O interface has a graphic emitting device and motion sensors, and could potentially be applied in the field of entertainment as an interactive system. Here, we focused on the game we implemented in which the graphics change with each step. The game is shown in Figure 3.

Figure 3: The graphic changes depending on the proximity of the shoe-shaped I/O interface.

FUTURE WORK AND CONCLUSIONS

In this report, we propose the new concept of a shoe-shaped I/O interface. Then we describe a prototype system which is constructed as a guitar playing-assistance device. However, this system is not only for the guitar assistance device but for a wearable system that can be used in daily life.

In future work, we will reinforce the capability as a wearable device by installing communication functions between shoe systems or between shoe systems and other information devices. Such networked shoe systems can send and receive information that relates to the shoe wearer, such as medical information and navigation information. At the same time, shoe systems should enable wearers to check this information and communicate to each other through their shoes.

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