Actual Remote Control: A Wearable Remote Control on Wrist

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ABSTRACT

Consumer electronic devices became more complex and diverse. We suggest a wristwatch-type wearable that offers a unified way to control various devices using motion on virtual menu. Finally we compare our wearable remote control to the conventional remote control through an experiment in terms of user convenience and efficiency.

I. INTRODUCTION

There has been many researches to achieve efficient control of consumer electronics. This is especially the case for the children and the elderly where there is a need to provide easy control of devices. Many developers are putting efforts on user interface that has a good product design, graphical design, and menu design and are looking at this very early in the development stage. A recent study has shown that wristwatch-type wearable devices have the most accessibility [1]. This paper suggests a wristwatch-type wearable remote that can control various consumer electronics devices in the same way with motion gesture.[1]

II. PREVIOUS WORK

As with our similar work in 2006, we have developed a Wearable Pointing and Gesture Band (WPGB) for controlling consumer electronics using gesture commands [2]. This system enables natural gesture interface that gives advantages over the conventional universal remote control.

However, it has disadvantages because the gestures used are individually mapped with particular functions. In case of volume or channel control, for example, where the continuous or repetitive control is required, the user has to repeat the same gesture. Also, extending the gesture command set is a difficult, because not only the recognition rate can go down but also a user only remembers and uses limited number of gestures [3].

III. IMPLEMENTATIONS

In order to improve the disadvantage of our previous work, we have developed the Actual Remote Control (ARC) with better functionalities.

A. Hardware

The hardware consists of a main module (ARM processor, 8M flash, and 4M SRAM), a sensor module (Gyro, Accelerometer, and Piezoelectric sensor) for hand motion tracking, a feedback module (speaker, vibrator, and LED) and a Bluetooth module for communication. For smooth design and comfortable wear, 5 rigid PCBs are connected through flexible PCBs as shown in Figure 1. It has better form factor, design, and battery power than the previously developed WPGB [2]. Also, we have produced a custom-built interfacing box which connects ordinary consumer electronics and the developed ARC.

Figure 1. ARC Hardware

B. Hand Motion Recognition

We modeled the continuous arm motions that are occurred in device control such as navigating through a menu or controlling a level bar. It is classified as pantomimic gesture (expressing a certain task or interaction with things) [4]. These simple arm movements help to achieve user-independence in using our system. ARC recognizes four directions (RIGHT, LEFT, UP and DOWN), Finger Tap action (CLICK) [2], and wrist rotations (SPIN-LEFT, SPIN-RIGHT).

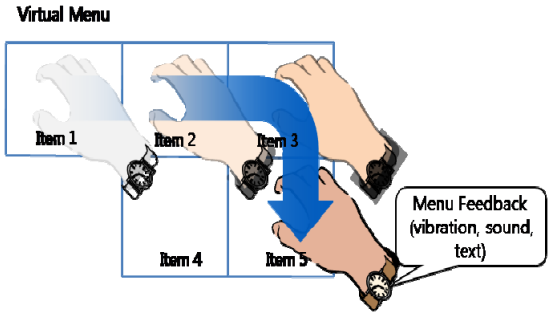

Figure 2. Hand Motion for Menu Navigation

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C. Virtual Menu and Menu Navigation

For the unified control of various consumer electronics, we develop a virtual menu. Ordinary control panels in electronic appliances have control elements such as a button, dial, or a level bar. Virtual menu is to define and map the actual elements in control panel, and express those into a 2-d space using the virtual control elements. Figure 2 shows the virtual menu and its navigation as if the control panel is right in front of a user while the actual control panel can be far away. The user can interact with the virtual menu as if he or she controls the actual control panel elements because every control element in the virtual menu provides text and audio feedback.

Figure 3. Navigating Virtual Menu

ARC downloads the virtual menu when needed from the selected electronic appliances. After the download, a user can navigate through the menu by moving his or her arm in four directions continuously as if one touches a 2-d menu layer. The Finger Tap Button is also used to generate actions when selecting menu items [2].

Virtual menu has to reflect the hand motion properties well and represent functions of electronic appliances. We implemented the virtual menu in XML to represent basic menu construction and its properties as well as continuous and combinational hand motions that are different from discrete gesture commands.

IV. Experiment and Results

An experiment was completed in order to evaluate conventional remote control, WPGB, and ARC. 6 participants took part in the experiment: three male, and three female with an average age of 33. There are two objectives in this experiment. First is to compare the task completion time on given tasks, and second is to evaluate usability of each controller.

For the completion time comparison, we have defined a total of 6 tasks. One task consists a combination of two basic functions (such as to increase volume by 3 units and change channel by 3). To evaluate usability, each participant was asked to fill out NASA-TLX survey. Figure 4. shows the result of completion time for 6 tasks.

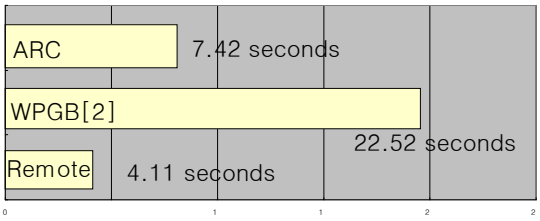

Figure 4. Average Task Completion Time for Simple Tasks

As a result, WPGB showed the worst performance. This is due to the characteristic of its discrete gesture commands. ARC showed more improved result in task completion time. In the user work load survey, ARC was measured almost equal to conventional remote control in mental demand, temporal demand and performance. However, physical demand, effort, frustration measured relatively higher on ARC compare to conventional remote control.

V. Conclusions and Future Work

We developed wristwatch-type wearable remote control that runs on and interacts with virtual menu through natural hand motion. Through the actual implementation and experiment, we have evaluated task completion time and usability of each device.

Considering the fact that ARC provides easy and unified control through natural hand motion, and the demand from the elderly who are not familiar with every advanced function buttons on a remote control, the experimental result shows potential of ARC in the future. Future research will consider more situations and age groups in mobile environment.

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