Textile++: Low Cost Textile Interface Using the Principle of Resistive Touch Sensing

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Figure 1: Cuffs UI operation

ABSTRACT

Here we introduce our system Textile++, a touch-sensitive cloth consisting of fiber materials. With this system, it is possible to detect the XY coordinate position of the substance touching the cloth. In addition, pressure can be detected. Textile++ is flexible and lightweight, making it is easy to apply to conventional clothes. Compared to existing methods, the structure is simple, so it is possible to manufacture at very low cost. This paper explains the proposed Textile ++ system and its application to a cuff-based user interface (UI) created for a jacket (Figure 1).

CCS CONCEPTS

• **Human-centered computing → Pointing devices**;

KEYWORDS

Textile Interface, Wearable Interface, Resistive Touch Sensor, Cloth, Low Cost

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1 INTRODUCTION

In recent years, wearable computing has become widespread through the miniaturization and light-weightedness of computing technology. For example, devices of various shapes such as smart watches, smart glasses and other clothing have been created. On the other hand, since wearable computing is equipped with various sensors, batteries, etc., it tends to be too expensive to become a daily necessity for many people. Furthermore, as advanced technology and clothing have seamlessly merged, the cost of electronic devices and also the cost of costume design and manufacturing has tended to increase. We consequently believe that affordable cost is one of the most important requirements for further adoption of wearable computing. Therefore, we propose Textile++ — a fiber-based system that can be applied to various fields, including wearable computing. By stroking the cloth with one's finger like a track-pad, it is possible to detect the XY coordinate position and pressure of the finger(Figure 2). Since the sensing part is comprised of cloth, it can be applied directly to conventional clothing construction through methods such as folding and sewing. Textile++ uses the principle of resistive touch-sensing. It consists of two conductive fibers and one nonconductive fiber. As a result, not only is the structure simple but it is also easy to mount, and it can be manufactured at very low cost compared with conventional fiber touch-sensing technology.

Figure 2: Prototype of our Textile++ system.

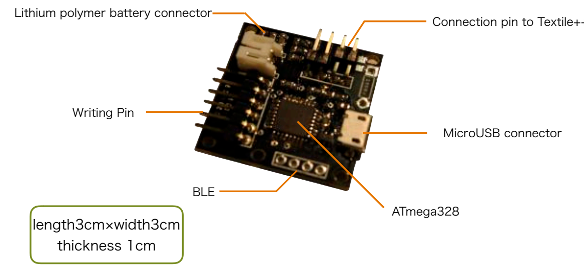

Figure 3: The microcomputer used in our system.

2 RELATED WORK

There has been previous research conducted into how to utilize cloth as an input interface. Bieling et al.'s *Capacitive Textile Touchpad* [Tom et al. 2017] system is the most simple method of touch-sensing for textile materials. In this method, conductive threads were sewed in a lattice pattern on cloth and recognized the touched XY coordinate position by touching the intersecting portion of the conductive thread.

In addition, there is *Project Jacquard* [Poupyrev et al. 2016], in which GoogleATAP is conducting research applying this principle. In this research, conductive thread is woven into clothes to make touch recognition and gesture recognition possible. Conductive threads can be produced using existing textile machines It is possible to make conductive yarns of many material thickness color.

We consider the drawback of this method to be that sewn conductive threads need to be connected to each device one by one, which makes implementation difficult.

3 IMPLEMENTATION

3.1 Structure of Textile++ and microcomputer

In our Textile++ system, the principle of resistive touch sensing is applied. Conductive cloth (SparkFun DEV - 10070) is used instead of a conductive film panel, which is used for conventional resistive touch-sensing. Mesh fabric (non-conductive material) is used to separate the upper and lower conductive cloths when not touching. Mesh fabric made of polyester was used. By superimposing these, we developed a flexible and lightweight Textile++ (length 15 cm × width 15 cm). Since the principle of resistive touch-sensitivity is applied, it is possible to detect the X and Y coordinates of the contacted substance. Furthermore, pressure can be detected. The microcomputer (3 cm in length × 3 cm in width and 1 cm in thickness) uses an ATmega 328 microcomputer and BLE (Bluetooth low energy) for wireless communication. By using BLE, power consumption is much lower when compared to other wireless communications. A lithium polymer battery is used for power supply (Figure 3).

3.2 Cuff User Interface and Application

We implemented our system by creating our own clothes. Textile++ (length 5 cm × width 15 cm) is incorporated in the left cuff of a jacket. There is a control base in the pocket of the lower arm. Textile++ and the microcomputer are connected via cables inside the clothes. The X and Y coordinate data, and the pressure data, are transmitted by wireless communication to an application on a PC or smartphone (Figure 4). We used Openframeworks (an open-source C++ framework, which has many powerful libraries) for application development. In implementing this system we developed various applications. For example, we created an app for visualization of coordinate data and pressure data, and a music playback application. In this music application, playback of the sound source is controlled by pressing the cuff for several seconds. The sound volume can be controlled according to the coordinate position of the finger.

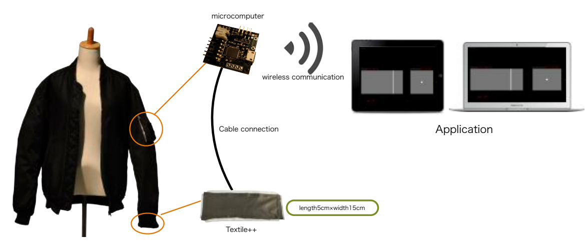

Figure 4: Implementation of our system in a piece of clothing.

4 CONCLUSION AND FUTURE WORK

In this study, we proposed Textile++, which applies the principle of resistive touch-sensing, and implemented it in the cuff of a jacket. This implementation demonstrates how it is possible to manufacture very inexpensively when compared with existing methods. Furthermore, we believe it can have numerous applications in the field of wearable computing. However, there are some issues to be addressed. As part of our future work, we will aim to replace the connection method between Textile++ and the microcomputer by using materials other than cables. In addition, we are considering applying our system to various parts of clothing other than cuffs.

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