Development of Compact Data Glove System

Dongchul Lee
Hanyang University
ddamjil@hanyang.ac.kr

Youngjin Choi*
Hanyang University
cyj@hanyang.ac.kr

Abstract – This work presents the development process of compact data glove system. The suggested system consists of two main components such as a data glove module including inner flex sensors for taking the finger motion data and wireless data transfer module using ZigBee wireless communication protocol. The first prototype for compact design has been currently tested for further development. As initial experiments, we are to discriminate the hand posture such as rock-paper-scissors.

Keywords - data glove, flex sensor, ZigBee, hand posture

1. Introduction

Wearable data glove systems have been developed for many useful applications such as virtual reality, rehabilitation engineering, and sports science. The development objective of data glove system is mainly to obtain the hand posture in real-time. Recently, the wearable data glove has been fabricated by using magnetic induction coils and electro conductive fibers in [1,2,3], and by using flex sensor modules for body sensor network (BSN) in [4,5]. The compact data glove system to be proposed in this paper makes use of flex sensor modules for obtaining hand posture and ZigBee wireless communication module for transferring data in real-time.

This paper is organized as follows; section 2 offers the system schematics for hardware descriptions; section 3 suggests the data processing method; section 4 shows experimental results to confirm the validity of the suggested compact data glove system, and finally we draw the conclusion in section 5.

2. Hardware Descriptions

The compact data glove system to be suggested in this paper can be divided into two parts; the one is a human hand motion interface part for capturing a human hand posture through finger motion data and the other is for wireless data transfer using ZigBee protocol in real-time. The internal structure of the suggested system is illustrated in Fig. 1. First, real finger motions are captured using eight flex sensors and the analog sensor data are converted into digital data using 8-bit microprocessor unit. Second, the digital data are transferred to the remote server computer using the ZigBee wireless communication module. Third, the transferred data are converted into virtual finger motion in the server computer using the GUI.

Fig. 1. Schematic diagram of the suggested compact data glove system.

The first prototype was fabricated as shown in Fig. 2. The glove has eight flex sensors in the inner part, and the small microprocessor unit and ZigBee module are mounted on the upper part as shown in Fig. 2.

Fig. 2. First prototype of the developed compact data glove system

* Corresponding Author
This work was supported in part by the Mid-career Researcher Program through NRF grant funded by the MEST (No. 2008-0061778), and in part by the Ministry of Knowledge Economy (MKE) and Korea Industrial Technology Foundation (KOTEF) through the Human Resource Training Project for Strategic Technology, and in part by the Ministry of Knowledge Economy (MKE) under the Human Resources Development Program for Convergence Robot Specialists, Republic of Korea.
3. Data Processing
As mentioned before, the finger motion data have been obtained using flex sensors because they are thin and flexible. Also, the flex sensors are able to guarantee the linearity of sensor values within operating range. After obtaining human five fingers data, the data are transferred to the remote server using the ZigBee module. The communication speed of the ZigBee module is set as 115200[bps]. The commercial Zigbee module was utilized for development of the compact data glove system. The data received at the remote server are plotted in the real-time viewer as shown in Fig. 3. This viewer is programmed using MFC and Matlab.

![Fig. 3. Experimental result for rock-paper-scissors motions](image)

4. Application Example
This compact data glove system is composed of eight flex sensors. From deflections of these sensors we are able to get information on the hand postures. In this work, we are to utilize the binary information for recognizing the hand postures. For instance, 0 means the bending status of corresponding finger joint. Since we have eight flex sensors, we are expecting to discriminate 256 hand postures through the developed data glove system. Fig. 3 shows the discrimination results of rock-paper-scissors game. Among 8 sensors, we chose data of 5 sensors from five fingers one by one. As shown in Fig. 3, the rock hand posture requires the bending status of all fingers; thus five sensors have all 1’s, also, the scissors hand posture requires the spreading out status of thumb/index fingers and the bending status of the remaining fingers, finally, the scissors hand posture requires the spreading out status of all fingers; thus five sensors have all 0’s. As initial experiments, we have succeeded in the rock-paper-scissors discrimination. For future works, we are planning to extend this research to two directions; the one is to extract the joint angles of all fingers in real-time and the other is to enlarge the number of hand postures to be discriminated, ultimately to discriminate available 256 hand postures.

5. Conclusion
This work has described the sequential development procedures of the suggested compact data glove system. Also, the first prototype was fabricated to confirm the validity of the suggested system. We have focused on the compact design of wearable glove with small weight. Through further study, we are planning to develop the data glove system for rehabilitation application and teleoperation.

References