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Contents

Performance Evaluation of improved textile proximity sensor for medication adherence evaluation system

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Abstract

In this paper, we have fabricated a textile proximity sensor by studying medication adherence system that helps and administers medication using conductive textile. Unlike the previous sensor, the improved textile proximity sensor consists of three layers. The bottom layer is composed of conductive copper foil, the conductive textile is formed on the bottom layer, and the non-woven fabric is placed on the top layer. In order to evaluate the performance of the textile proximity sensor, we measured the data according to the quantity of pill, detected the data change according to quantity, and compared with the data of the previous sensor. Data were acquired through C# Application, and data on the quantity of pill were evaluated by deriving the average value of the data. As a result, we can see that the sensor is superior to the previous sensor. We will conduct a system for evaluating medication use in the future of the sensor.

Keywords: medication adherence, conductive fiber, textile proximity sensor

1. Introduction

In modern Society, average life span is gradually increasing due to the development of science and medicine. Accordingly, there is also an increasing proportion of elderly in the total population, and chronic diseases are also developing. The most effective and appropriate method for chronic diseases is to take medications continuously. It has a very important role in the treatment of diseases. Medication adherence refers to taking medication in accordance with a set time and amount. However, many patients are not compliant with medication adherence. As a representative example, the rates of hypertension and diabetes mellitus among the chronic diseases were 13.7% and 15.1%, respectively. [1] The development of systems to help and manage medication adherence to resolve problems that do not comply with medication adherence has been studied previously. [2-4] Among them, researches using textile sensors have advantages in that they can be easily manufactured in various forms. [4] However, textile sensors in previous experiments have high sensitivity. In this paper, we evaluated the performance of the sensor with the previous sensor to improve the medication adherence system.

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2. Method

2.1 Textile Proximity Sensor Design

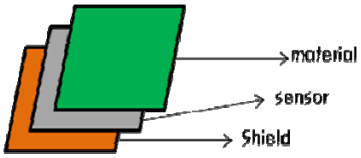

Fig. 1. Design of textile proximity sensor

The textile proximity sensor consists of three layers as shown in **Fig. 1**. Materials were placed in the top layer, conductive fibers in the middle layer, and conductive copper foil in the bottom layer. We used the principle of the proximity sensor fiber, as Shown in **Fig. 2**, the material was placed on the sensor to reduce the sensitivity of the data.

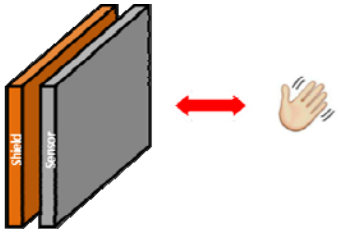

Fig. 2. Principle of textile proximity sensor

2.2 System Architecture

The system is constructed as shown in **Fig. 3**, to measure data that varies according to the quantity of pills based on the sensor manufactured. The data measured by the sensor can be displayed and stored in real time through C# based application program.

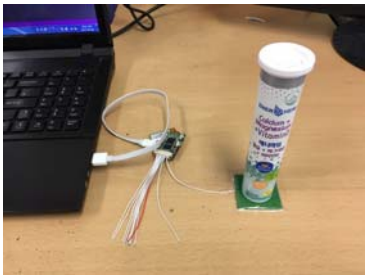

Fig. 3. System Architecture

3. Experimental Result

Based on the system, we measured and stored the real-time data while removing the pill from the pill case one by one to measure the change of the data about the quantity of pills. We used vitamin pill case(Enerheim, Germany), and confirmed the data change of the quantity of pills from 15T to 0T. The data were acquired by setting the sampling rate to 100 Hz and the data graph is shown in **Fig. 4**.

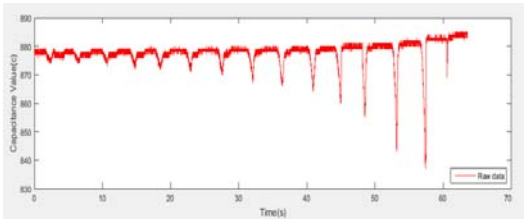

Fig. 4. Raw data of textile proximity sensor

Then, a moving average filter (MAF, N=5) was applied to remove the noise and the data graph is shown in Fig. 5. After sub-sampling to derive the data for each pill, the mean value was derived and compared with the data of the previous sensor and the performance was evaluated.

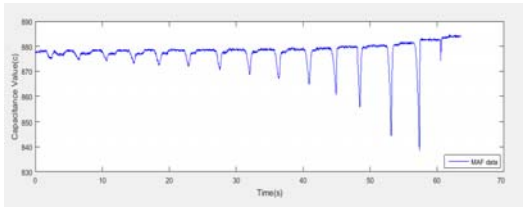

Fig. 5. MAF data of textile proximity sensor

A comparison of an improved sensor and the data of the previous sensor result is shown in **Fig. 6**. In the case of the previous sensor, the data according to the quantity of pills is changed rapidly, but the data according to the quantity of pills is changed steadily in the case of the improved sensor.

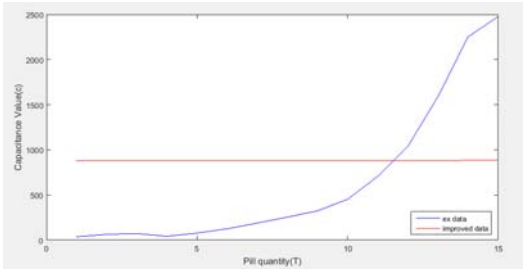

Fig. 6. Improved sensor data (red) and previous sensor data (blue) for quantity of pills

In addition, the graphs of the improved sensor data (7-a) and the previous sensor data (7-b) are shown in **Fig. 7**. Both graphs show a similar line shape, and data can be seen to increase with the quantity of pills. Also, although the data distribution with the previous sensor is similar, it is comfirmed that the sensitivity to the data classification can be reduced by acquiring the data more stably by lowering the sensitivity of the sensor.

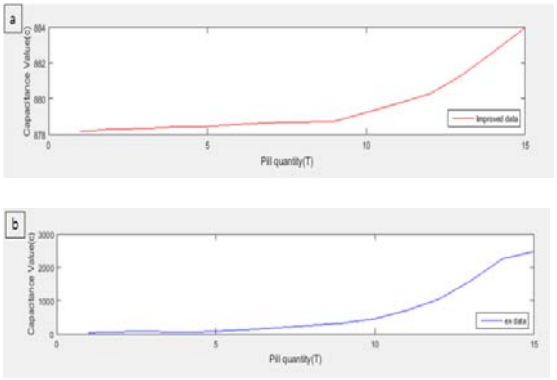

Fig. 7. Improved sensor data (a) and previous sensor data (b) for quantity of pills

4. Conclusions

The purpose of this study was fabricated a sensor improved by study of the medication adherence system using a textile proximity sensor and conducted a study to evaluate the performance as compared to sensors used in the previous study. The sensor consists of three layers, the conductive copper foil in the bottom layer, the conductive fiber in the middle layer, and the material in the top layer. The improved sensor measurs, compares and analyzes the data by the quantity of pills together with the sensor manufactured in the previous study. As a result, the sensor used in the previous study had a problem of high sensitivity and often saturation of the signal, but in the improved sensor, there was no saturation the signal and the sensitivity was greatly improved. We evaluated the improved sensor as an appropriate sensor for the medication adherence system through experiments. In future study it plans to conduct research that applies to life by establishing a medication adherence system based on the improved sensor and development algorithm to evaluate whether medication.

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