섬유 캐패시티브 센서를 이용한 수분섭취 모니터링 시스템의 기초연구

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A Preliminary Study of Water Intake Monitoring System by Textile Capacitive Sensor

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Abstract

In this study, we developed a water intake monitoring sensor using textile capacitive sensor. To evaluate the performance of our developed sensor, we measured different volumes of water in a plastic tumbler. The lateral side (L) and the bottom (B) of the tumbler exterior were covered with two separate channels of textile capacitive sensor to measure the frequency and amount of water intake, respectively. Results of our pilot study showed that the sensor on the bottom of the tumbler (B) was able to measure the changes in water volume, but the data acquisition performance of the sensor on the lateral exterior (L) was not as stable. Based on this study result, we will complement the accuracy problems of the sensor and perform further studies on a wider range of subjects to estimate the amount and frequency of daily water intake.

1. Introduction

Water accounts for more than 60% of the components that make up the human body and water intake is the most basic and important factor for maintaining health. Drinking water is also known to be effective in preventing obesity and its related diseases [1]. Lack of water intake induces exposure to various diseases such as hyperglycemia [2], chronic kidney disease, and cardiovascular disease [3]. Despite the research on the importance of water intake, it is not easy to drink water regularly every day. Therefore, a system for managing water intake is required. Currently, water intake management system is mostly provided in the form of applications, and studies are in progress to infer water drinking behavior by using inertial sensors in smart watches [4]. However, it still is difficult to make a quantitative assessment of how often and how much water a person drinks in a day. Therefore, we tried to develop a quantitative monitoring program that tracks and manages daily water intake. With this aim, this study conducted a pilot test on the performance of our developed sensor to measure the frequency and amount of water intake.

2. Methods

2.1 Development of textile capacitive sensor for water volume measurement

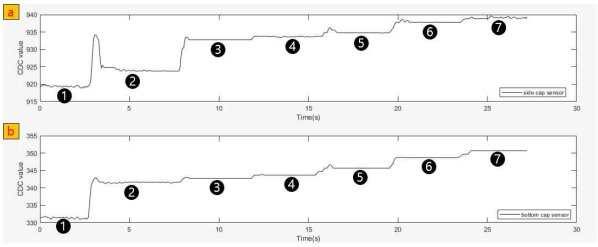
For this study, our sensor was manufactured to fit the size of the experimental tumbler based on the principle of capacitive sensing [5]. The lateral side (L) and the bottom (B) of the tumbler exterior were covered with two separate channels of textile capacitive sensor. The sensor on “L” was in the size of 3x4 cm^2 and was designed to measure the frequency of water intake. The sensor on “B” was in the size of 6x6 cm2 and was to measure the changes in water volume; the amount of water intake.

2.2 Experiment protocol

To test the performance of our developed sensor, 50 ml of water was repetitively measured for 6 times, totaling up to a cup of 300 ml water. For accuracy reference, an electronic measuring cup (Emotional, China) was used; to measure the exact volume of water at every trial. This experiment was repeated for seven times to observe the stability and accuracy of our sensor.

3. Results

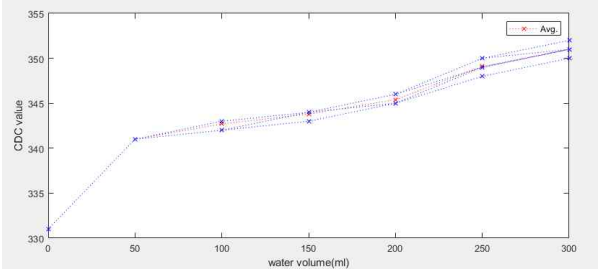
The changes in capacitance values acquired from our sensor are presented according to the changes in water volume as shown Fig. 1.



(Fig. 1.) Changes in capacitance value according to water volume

(a) Lateral sensor (b) Bottom sensor

Fig. 1 shows the 6 repetitions of water volume measurement in the increments of 50ml, starting from "no water" in the tumbler (labelled as "1"). Numbers from "2" to "7" in the figure refer to the order of experiments with 50 ml of additional water at each trial.



(Fig. 2.) Results of repeated tests on water volume measurement (Bottom sensor)

The values from the lateral sensor were not obtained well enough to be meaningfully analyzed. Data acquired from the bottom sensor were stable in measuring water volume changes as shown in Fig. 2.

4. Conclusions

In this study, we developed a textile capacitive sensor for the measurement of daily water intake. The results showed that our sensor can be applied in tracking and measuring drinking activities. Our future research will be tested on a wider range of subjects and various types of liquid.

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