Classification of Seated Postures by a Backrest Capacitive Pressure Sensor

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***Abstract*— In this study, we developed a smart backrest fabricated with textile capacitive pressure sensors aiming to classify four representative sitting postures from daily living. The results showed a 99.8% precision in classification of each posture. Using a backrest sensor to monitor seated postures and its feasibility in giving a feedback to correct unhealthy postures was found to be promising.**

I. INTRODUCTION

According to previous studies, the average office worker sits about 10 hours a day; most of the time in front of the computer. Habitually sitting in the wrong postures for a prolonged time can lead to diseases such as low back pain and scoliosis. Recent studies related to seated postures are focusing on developing and applying various types of sensors to analyze and monitor the characteristics of different postures in daily living [1-2]. In this study, we developed a smart backrest with textile capacitive pressure sensors and tested its feasibility in classifying four representative seated postures.

II. METHODS & RESULTS

Backrest sensors were fabricated based on capacitive sensor theory. The sensor consists of 9 channels as shown in Figure 1.

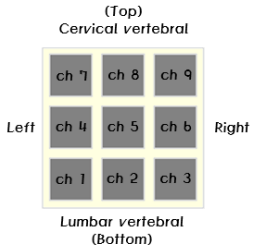

Figure 1. Backrest capacitive pressure sensor.

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Experiments were performed on 5 subjects (age: 25 ± 4.24 years, height: 167 ± 9.67 cm, body weight: 65.6 ± 4.24 kg). Four seated postures were set as study conditions: upright posture, left-shifted posture, right-shifted posture, and slouching posture.

Data were acquired while the subjects maintained each posture for 2 minutes. By removing 10 sec of start and end noise, the mid-1min 40sec of data were used for the analysis. Based on the data extracted from the backrest sensor, we extracted 13 features of each sensor channel data value and region-based sensor array value to classify each posture. The J-48 algorithm was used as a classifier, which is one of the Decision Tree models, and confirmed the precision of classification by applying 4-fold validation.

III. RESULTS

As a result of the classification of the four sitting postures, the precision of 0.998 was obtained and it was concluded that classification by each posture is possible.

TABLE I. RESULT OF SEATED POSTURE CLASSIFICATION

Posture	*TP rate*	*FP rate*	*Precision*	*Recall*	*F-measure*
upright	1.000	0.000	1.000	1.000	1.000
left-shifted	1.000	0.001	0.998	1.000	0.999
right-shifted	1.000	0.002	0.993	1.000	0.997
slouching	0.991	0.000	1.000	0.991	0.996
Avg. value	0.998	0.001	0.998	0.998	0.998

IV. DISCUSSION & CONCLUSION

In this study, a smart backrest sensor was developed and four seated postures were selected to evaluate the sensor's posture classification performance. Based on the results of this study, advancing our backrest to a high performance sensor for all types of chairs to monitor and correct unhealthy sitting postures would be meaningful in preventing posture-caused diseases.

REFERENCES

[1] Zemp, R., Taylor, W. R., & Lorenzetti, S., Seat pan and backrest pressure distribution while sitting in office chairs. *Applied ergonomics*, 2016, *53*, 1-9.

[2] Roh, J., Park, H. J., Lee, K., Hyeong, J., Kim, S., & Lee, B., Sitting posture monitoring system based on a low-cost load cell using machine learning. *Sensors*, 2018, *18*(1), 208.