Multidisciplinary Applied Research and Innovation Vol. 2 No. 3 (2021) 199 - 202

MARI

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/mari
e-ISSN :2773-4773

Study on Hand Gesture Recognition using a Wearable Sensing Glove and Forearm Surface-Mounted EMG

Safyzan Salim[1,2], Muhammad Mahadi Abdul Jamil[1]*, Radzi Ambar[1]

Biomedical Engineering Modeling and Simulation (BIOMEMS) Research Group,
Faculty of Electrical and Electronic Engineering,
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor,
MALAYSIA

[2]Universiti Kuala Lumpur British Malaysian Institute,
Bt 8 ¾ Sg Pusu, 53100 Gombak, Selangor, MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/mari.2021.02.03.041
Received 05 September 2021; Accepted 05 October 2021; Available online 15 December 2021

Abstract : There are many techniques for hand recognition. Each suited for certain applications due to their form factor and needs. The most popular is vision-based system by using either single or multiple cameras. Not to forget, Kinect and Leap Motion Controller also part of vision-based system. The problem of the architecture is-the user must be in front of the camera in order for the system to recognize any hand motions which limit the portability of the system. Furthermore, precision of image processing techniques using cameras are susceptible to illumination of background. The aim of this study is to document the potential of applying sEMG at forearm together with the effectiveness of sensory glove as the input to a hand gesture system. The sEMG will record the information produce during forearm muscle action. The flex sensors attached on the glove will produce the biofeedback of the fingers by tracking fine movement of finger joints. This will monitor and measure the subject's Flexor Digitorum Superficialis signal when performing hand movements. The subject need to wear a glove with flex sensors fixed at every finger which allow simultaneous measurement of the flexion and extension force. Both systems are coupled with a microcontroller that transmit the information gathered from activities to a computer for recording and analysis purposes. Hand gestures are widely applied on different type of applications, ranging from human safety, such as warning, controlling, and directing (robot/human), to pleasure, such as sports and games. In addition, hand gesture system is vastly used as a communication tool between hearing impaired person and normal person, thru the usage of sign language. This study will help to develop better hand gesture system that leads to efficient application especially in

*Corresponding author: mahadi@uthm.edu.my

reducing the communication gap between the deaf community and normal people without neglecting the system's portability.

Keywords: Hand Gesture Recognition, Wearable Sensing Glove, Electromyography, Flex Sensors

1. Introduction

Hand gesture recognition is regarded to be a significant aspect of with the advancement of today's technology and because humans naturally utilize hand gestures in their communication process to express their intentions [1]. From this study, it turns to be that there are a few popular techniques used to document hand gesture recognition, i.e., Microsost Kinect [2], Leap Motion Controller (LMC) [3] and web camera / video camera [4] (Figure 1).

However, according to McIntosh [5], these techniques and studies suited to certain applications due to their accuracy and form factors. Wu, J et al. [6] are exploring a hand gesture recognition system that is portable yet effective and to be used by the hearing impaired person as a communication tool with the normal person. The aim of this research is to investigate the effectiveness of surface-mounted EMG (sEMG) paired with sensory glove in detecting the forearm muscle activity and flexes of finger joints because many hand gesture include both these forms of movement.

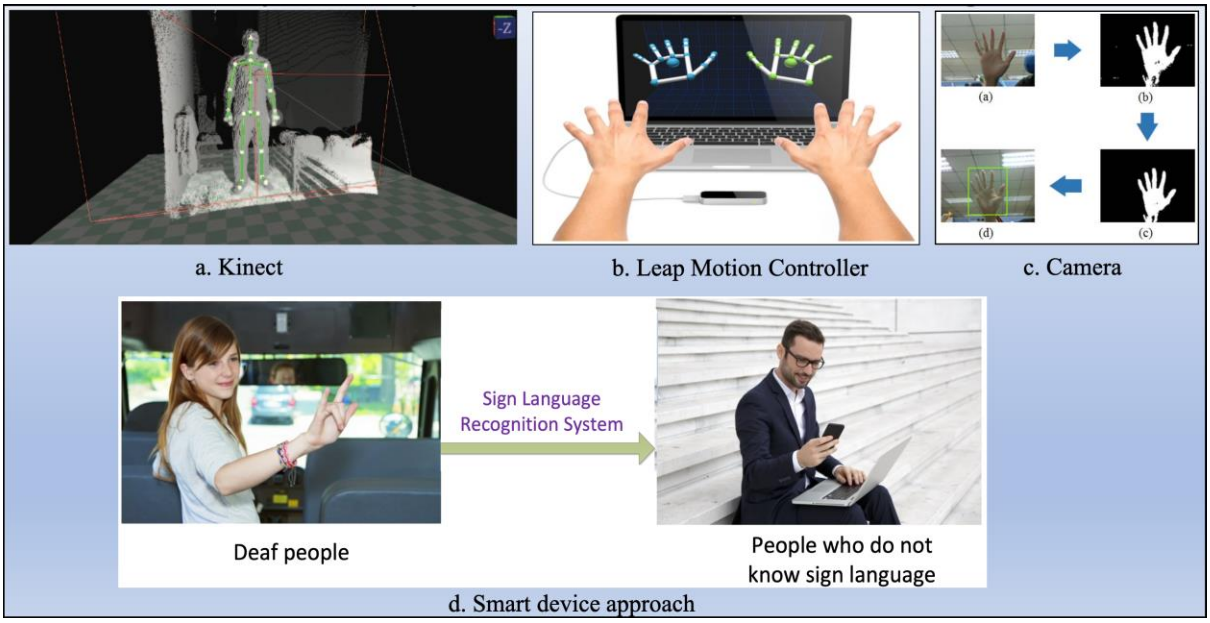
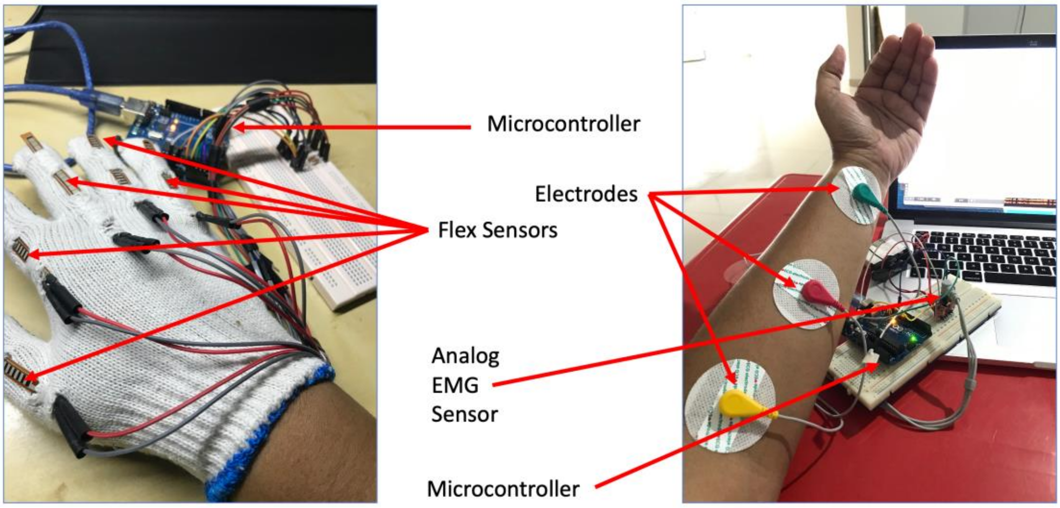


Figure 1: (a), (b) and (c) proposed techniques by researchers while (d) portable device to communicate with others

2. Materials and Methods

Electromyography-based hand-gesture identification is more difficult to execute compared to flex sensor of the sensory glove (Figure 2). It is a challenge to position the 3 electrodes at a good location in order to produce and record the muscle respond. The readings from both sensors were fed into a computer. Every single data captured were compared in order to study the pattern and to check whether its viable for this project or not.

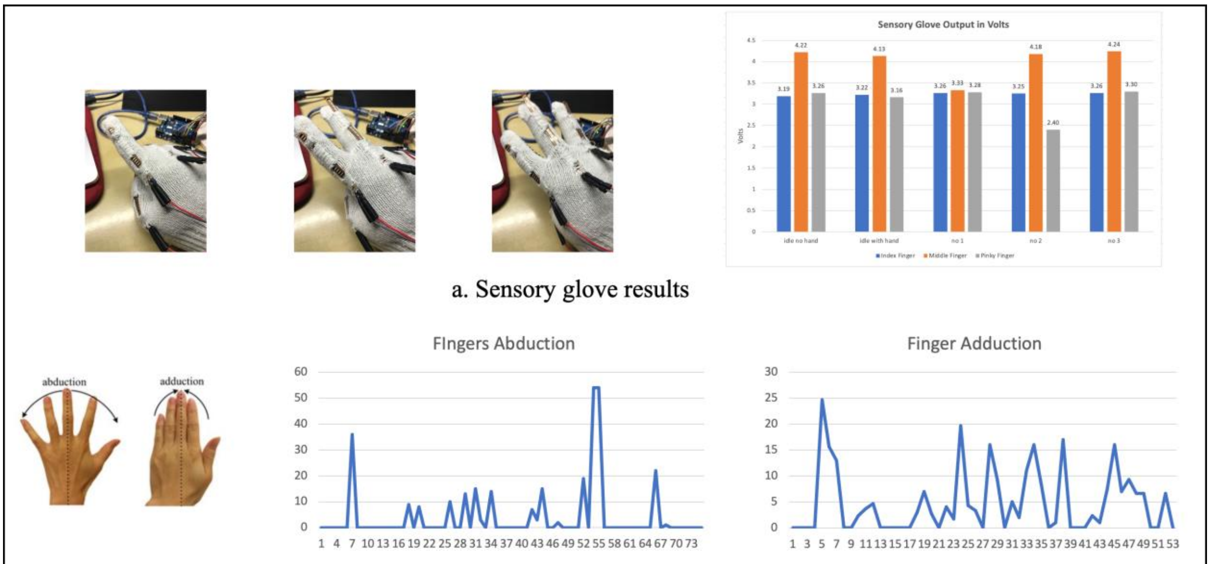


a. Sensory Glove with Flex Sensors and microcontroller. b. Surface-Mounted EMG with microcontroller

Figure 2: Hand gesture system experiment setup for both

3. Results and Discussion

This study demonstrated the combination of flex sensory glove and sEMG managed to produce substantial information by visualizing the forearm muscle electrical activities and joint flexion. The results of flex sensors that attached to the sensing glove was documented in Figure 3a. The subject was required to produce gesture of a few numbering system i.e., gesture number 1, gesture number 2, etc. Figure 3b shows the reading of sEMG. The sensors was attached to the subject's wrist and performed two different motions; abduct and adduct. This result also led us to widen the subjects and testing parameter which we believe, by doing this, the gesture recognition system's will be more sensitive to any input.



a. Sensory glove results

b. Surface-Mounted EMG results

Figure 3: Visual information from muscle and fingers' joint

4. Conclusion

In this study, we have proposed a system based by using sEMG and flex sensor glove for hand gesture recognition. Eventually, the system accuracy is still under diagnose, since the study is still in first phase of extracting the reliable information from the muscle and fingers. Despite of that, up next is to conduct feature extraction to the information before any standard pattern recognition techniques can be applied. Finally, judging from the hardware setup, it can ensure that the final product is portable enough for deaf person to carry around and use it.

Acknowledgement

This research was supported by Universiti Tun Hussein Onn Malaysia (UTHM) and Ministry of Higher Education (MOHE) through Fundamental Research Grant Scheme For Research Acculturation of Early Career (FRGS-RACER) (RACER/1/2019/TK04/UTHM//5).

References

[1] M. Yasen, S. Jusoh, "A systematic review on hand gesture recognition techniques, challenges and applications," PeerJ Computer Science 5:e218, 2019 pp. 330–335, https://doi.org/10.7717/peerj-cs.218

[2] M. Ahmed et al., "Deaf talk using 3D animated sign language: A sign language interpreter using Microsoft's kinect v2," 2016 SAI Computing Conference (SAI), 2016, pp. 330-335, doi: 10.1109/SAI.2016.7556002.

[3] M. Mohandes, S. Aliyu and M. Deriche, "Arabic sign language recognition using the leap motion controller," 2014 IEEE 23rd International Symposium on Industrial Electronics (ISIE), 2014, pp. 960-965, doi: 10.1109/ISIE.2014.6864742.

[4] H. -Y. Chung, Y. -L. Chung, and W. -F. Tsai, "An Efficient Hand Gesture Recognition System Based on Deep CNN," 2019 IEEE International Conference on Industrial Technology (ICIT), 2019, pp. 853-858, doi: 10.1109/ICIT.2019.8755038.

[5] J. McIntosh et al., "EMPress: Practical Hand Gesture Classification with Wrist-Mounted EMG and Pressure Sensing," in Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems, 2016. pp.2332-2342. 10.1145/2858036.2858093.

[6] J. Wu, L. Sun, and R. Jafari, "A Wearable System for Recognizing American Sign Language in Real-Time Using IMU and Surface EMG Sensors," in *IEEE Journal of Biomedical and Health Informatics*, vol. 20, no. 5, pp. 1281-1290, Sept. 2016, doi: 10.1109/JBHI.2016.2598302.