Evolution in Electrical and Electronic Engineering Vol. 2 No. 2 (2021) 57-64

EEEE

Homepage: http://publisher.uthm.edu.my/periodicals/index.php/eeee
e-ISSN : 2756-8458

Smart Glove Malaysian Sign Language Translator

Nor Syafiq Mohamad[1], Jais Lias[1,*]

[1]Faculty of Electrical and Electronic Engineering,
Universiti Tun Hussein Onn Malaysia, 86400 Parit Raja, Batu Pahat, Johor, MALAYSIA

*Corresponding Author Designation

DOI: https://doi.org/10.30880/eeee.2021.02.02.007
Received 07 July 2021; Accepted 14 August 2021; Available online 30 October 2021

Abstract: The medium for deaf and mute people to communicate is by sign language that using mostly hand gesture to make the sign. There are somewhere between 138 and 300 different types of sign language used throughout the world today. In Malaysia there were not much people can understand the sign language. Based on the research negative attitudes of Malaysian toward Children with disabilities (CWDs) have been disclosed recently. Azizan (2015, July 5) reported that low opportunities are given to CWDs and people with disabilities (PWDs) when enroll to schools and universities. The lack of communication between normal and these special people is one of the factor that make people lack of awareness. Smart glove MSL translation examines the possibility of recognizing sign language gestures using Flex sensor and explores their use in Sign Language recognition. This project focused on one hand gesture sign language that commonly used in a daily life. By using the 2 main sensor which is flex sensors and gyro sensor the parameter of some basic hand gesture movement can be measured. All the sensor is connected to the ESP32 which is have a feature to connect the project hardware to application software designed via Bluetooth or Wi-Fi. An experiment is carried out to measure the accuracy of the project, using 3 different people to use the glove and the data is recorded. The average accuracy of the project is 86.47% for every 11 sign gestures data collected. The output of this project is in form of a voice, text and picture that will be displayed on the smartphone screen

Keywords: Sign Language, Flex Sensor, MSL Translator

1. Introduction

The studies shows that 160,000 Malaysians are hearing impaired that majority of them is from Malay that compared to others is 9 percent only. The Borneo Post also stated that most of them not getting a suitable education schools and special needs that they deserve it. Not just that it getting worst in the rural area in Malaysia that most of them not even attend to schools and get the special attention that they

*Corresponding author: jaisl@uthm.edu.my

needs to help them communicate [1]. Communication is very important in socializing and there were many ways of communication type that have been created throughout the world. The sign language is the communication medium that been used by deaf community to help them communicate to other people throughout the whole world. There were many types of sign language in this world depending on the country language.

In Malaysia, the deaf community used Malaysian Sign Language to communicate with other people in a unique ways. Sign language is basically another type of language that need to be on the schools syllabus to make all people aware and understand better this community struggles. The unique part of this language is they are so organized with many types of movement or parameter that used to make many sign with different meaning [2]. Without a proper lesson this kind of people would have lost ability to communicate with other people properly. In this modern era even with the technological device such as smartphone for texting, the sign language still the primary medium for the hearing impaired people to communicate

Therefore, the aim of the project is to increase the communication access to hearing impaired and mute people in Malaysia. Smart glove is one of the invention to overcome this issue and several studies have been done in developing this product [3]-[4]. The objectives of this project are to develop a glove that can translate a basic communication speech sign into a text and voice, to design an application for translating hand gesture and to optimize the functionality of flex sensor on the data glove application.

2. Materials and Methods

2.1 Materials

The main materials that make up the prototype consist of ESP32 microcontroller, 2.2 inch Flex sensor, GY-521 MPU6050 Gyro and Acceleration sensor, MIT App Inventor 2 software and glove.

2.2 Sign language limitation

This project is focused on simple hand gesture movement that can do with 1 handed only and a simple communication language such as hello, how are you, help and etc. There are many types of gesture movement these embrace lateral motion within the numerous directions, twisting the radiocarpal joint (supinating or pronating the hand), flexing the radiocarpal joint, gap or closing the hand from or into numerous handshapes, circling, squirming the fingers, approaching a location, touching, crossing, or touching it, and linking, separating, or interchanging the hands. In translating the sign gesture movement there were 5 parameters that need to take in account but due to the cost and lack of time there only 3 parameter is focused on. The parameter is orientation, hand shapes and hand movements. With this limitation there only a few basic communication can be detected using the sensors.

2.3 Testing and measurements

The project prototype is experimented to test both of hardware and software performance. The project hardware as Figure 1 shows the assembled component and attached flex sensor to the glove. The testing of functionality flex sensor is have to be done using the Arduino Uno due to simple configuration and the result testing will be recorded for calibrating the flex sensor in the final product.

Figure 2 shows the MIT App Ai companion screen of testing result. As the program have the function to identify gesture input that will match it with the data base and translated it into the text message.

Figure 1: project hardware testing

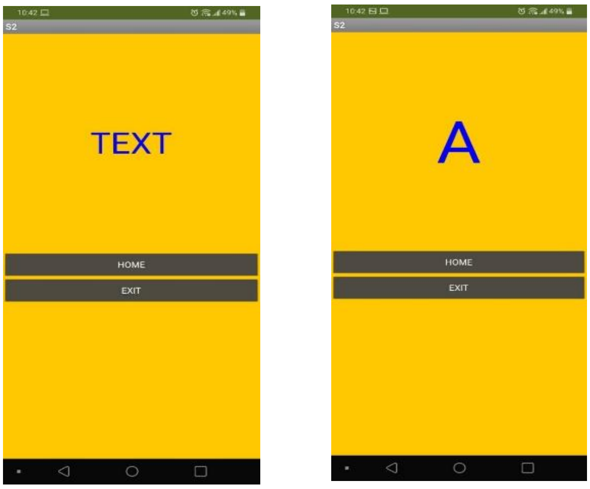

Figure 2: Testing result in software interface

2.4 Serial monitor testing

To make sure the hardware is fully functional as the algorithm setting, serial monitor function on Arduino is used that allow to record the bending value, gyro sensor value and the project behavioral. The testing is not using the mobile app as an output, that the Arduino is connected to the computer and the source power 9V DC is disconnected as shown on Figure 3.

Figure 3 shows the experiment setup for testing the functionality of the flex sensor and its bending angle calibration.

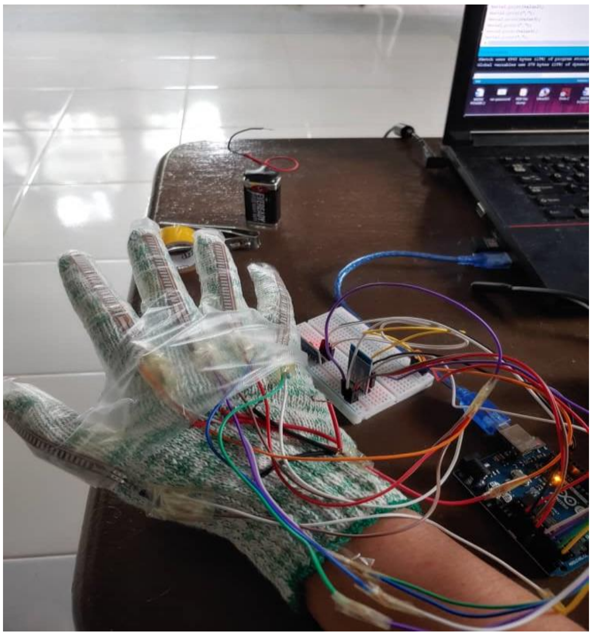

Figure 3: Project hardware calibration

Figure 4 shows the flex sensor output from the Arduino IDE serial monitor. The value of flex sensors indicate the bending pressure measurements

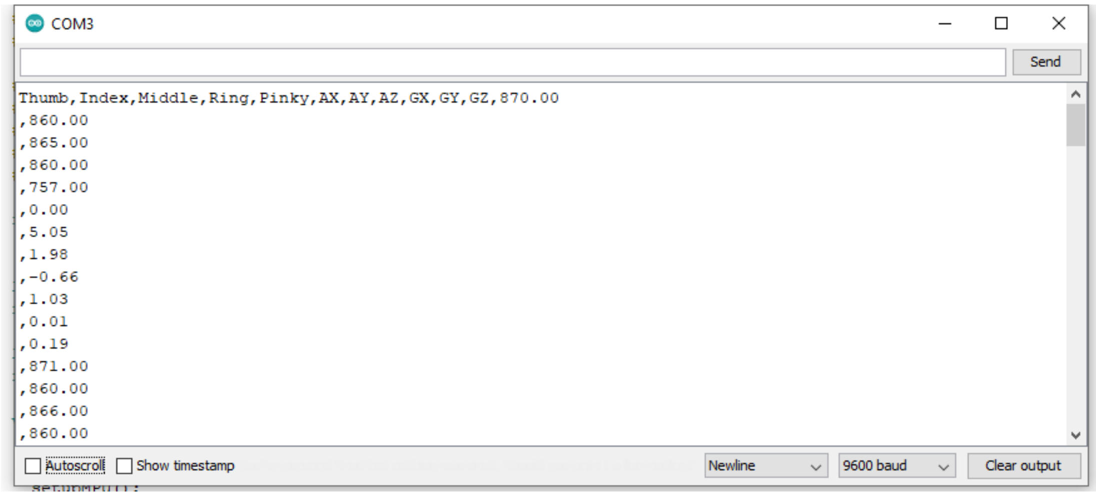

Figure 4: Serial monitor result

3. Results and Discussion

3.1 Results

To measure the accuracy for this project, an experiment has been done by collecting a data of the glove performance. There are 2 different variable in analyzing the glove accuracy which is the user hands size and the performance of the flex sensor in detecting a bending finger per seconds. The experiment procedure is by choosing 3 different user with a different hand size that will testing out the glove performance in detecting the correct output. Each user have to perform every gesture within given delay time to achieve a high accuracy and all the data is recorded. Every user have to perform 10 times gesture for each words and the glove will be reset every time new user testing the glove to make sure the bend sensor is in straight condition and the sensor is perfectly placed on the user bend finger parts. The result is plotted to the graph in Figure 5.

Figure 5 shows that an accuracy differences for each gesture and the users. The accuracy value is divided by 3 category which is High accuracy (90~100), medium accuracy (70~90) and Low accuracy (0~70). According to the data collected the average accuracy for all the gestures is 86.47% that calculated using formula below.

$$\frac{The\ number\ of\ succesful\ signs\ produced}{The\ total\ number\ of\ trials}\ x\ 100 \qquad Eq.1$$

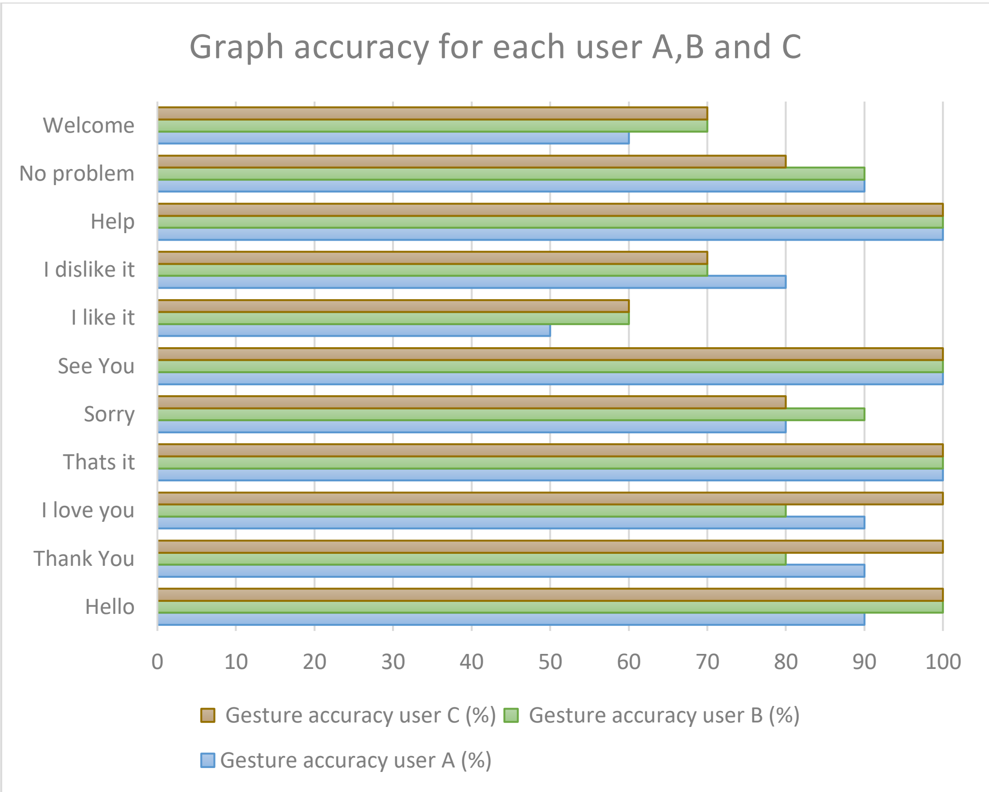

Figure 5: Graph of data glove accuracy

Table 1 shows the recorded sensitivity result for this project from a different users. Every time the users changed the input (sign language gestures) the delay time between the output changes is recorded as the sensitivity for this project. This delay actually can be manipulated in software coding but the shorter time delay gives a lower accuracy. The 3 seconds time delay is the optimized time delay to maintain the accuracy score for each 11 gestures.

Table 1: Sensitivity results

Users	Time delay in seconds
A	3
B	3
C	3

3.1 Discussions

The repeated experiment and testing on the project to measure its accuracy shows the decreasing of the Flex sensor performance. This can be prove by the time period and condition of the flex sensor is the main reason for the difference value of accuracy that recorded in the data. The smart glove MSL translator can translate 11 basic communication into a voice with the average of accuracy 86.47%. This result analysis also shows that every word or sign language that not used a gyro sensor tend to be more accurate and The flex sensor need more delay to be accurate due to the bending value is decreasing slowly after get a repeated pressure. This project consist of two main part which is hardware and software for the app design.

Figure 6 shows how all the combined component is attached to the glove. The flex sensor is attached to the glove using a strong glue and it connected with the ESP32.

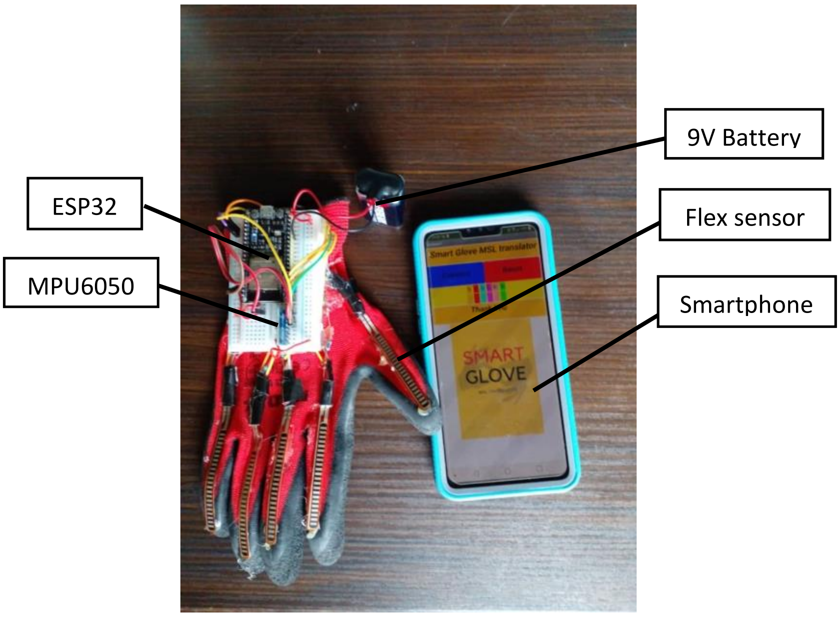

Figure 6: Hardware final product

Figure 7 shows the MIT App Ai companion Interface that was linked to the prototype. This allowed the prototype to send the input gesture to the app and it will translate the gesture into a voice, text and picture.

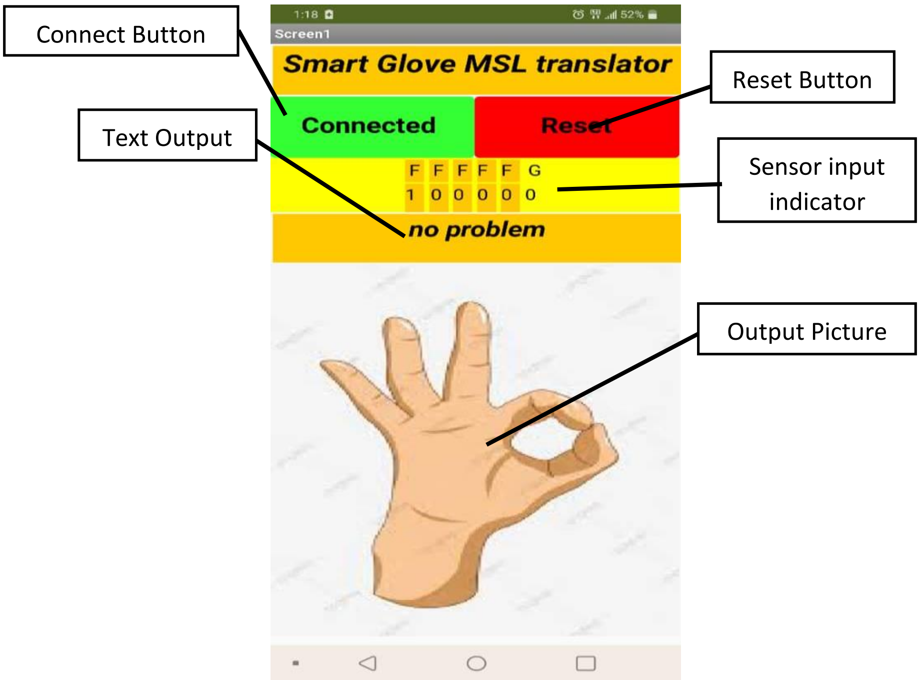

Figure 7: MIT App Ai companion Interface

Figure 8 shows the "see you soon" hand gestures sign with the smart phone that shows the output of the product from the MIT App inventor 2 Ai companions App.

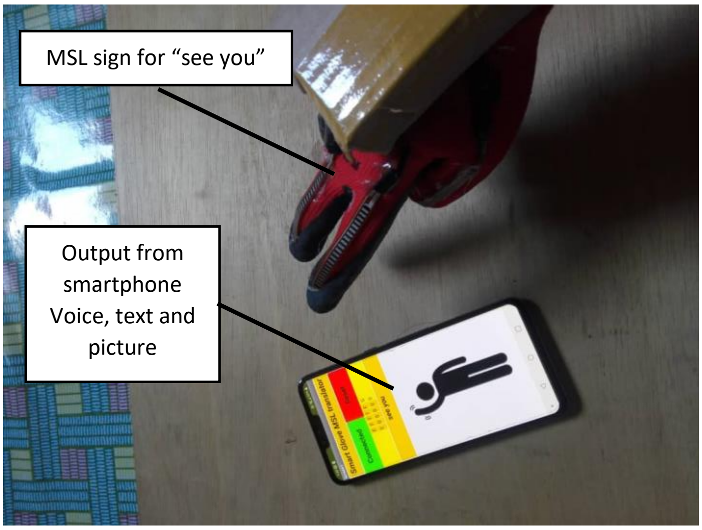

Figure 8: Smart Glove MSL translator demonstration

4. Conclusion

In this paper, the prototype of the Smart Glove MSL Translator has been presented. The prototype is manage to translate 11 basic daily used Malaysian sign language with the accuracy higher than 86.47% in average. The testing result also shows that the prototype not only can translate the sign language into a text but also in a voice and an illustration image of the gesture. The software part for this project is made by using the MIT App inventor 2 that have a features that suitable for this project. The MSL translator Application can receive the input gesture from the glove and translate it by using 'if else' function into a text. There were a special feature that allow user to change automatically text into a voice that used the smart phone audio speaker. The output of the ESP32 data is in binary number that will translated by the software into a speech as it programmed. Every time there was an improvement to the data input it also has to be updated to the application software .From data analysis record shows that the project average accuracy is 86.47% and the sensitivity is 3 seconds delay. After the final product is finished it can be conclude that all the 3 objective in this project is achieved successfully.

Acknowledgement

The authors would like to thank the Faculty of Electrical and Electronic Engineering, Universiti Tun Hussein Onn Malaysia for its support and learning opportunities.

References

[1] World Health Organization. (2021, March 3). *Deafness and hearing loss*. Retrieved December 29, 2020, from https://www.who.int/health-topics/hearing-loss

[2] Ensuring a more inclusive world for the deaf. (2018, December 01). *The deaf community* Retrieved December 29, 2020, from https://www.theborneopost.com/2018/12/02/ensuring-a- more-inclusive-world-for-the-deaf/

[3] Haratiannejadi, K., Fard, N. E., & Selmic, R. R. (2019). Smart Glove and Hand Gesture-based Control Interface For Multi-rotor Aerial Vehicles. 2019 *IEEE International Conference on Systems, Man and Cybernetics (SMC)*.doi:10.1109/smc.2019.891446

[4] P. (P.Prakhargurunani.). Arduino Project Hub. 2021. *Smart Hand Glove*. Retrieved on December 29, 2020, from https://create.arduino.cc/projecthub/prakhargurunani/smart-hand-glove-84e046