International Journal of Science and Research (IJSR)
ISSN: 2319-7064
ResearchGate Impact Factor (2018): 0.28 | SJIF (2018): 7.426

Low-Cost Glove Device for Malaysian Sign Language Recognition

Muhammed Akthem

Sultan Idris Education University, Faculty of Art, Creative Computing Industry, Perak, Tanjung Malim, Malaysia

Abstract: ***Hearing and speech impaired people they faced difficulty in many subjects in their lives. In this study, a glove equipped with a flex sensor is developed to translate Malaysian sign language to text. The glove is designed to collect finger movement. The system is evaluated with 24 letters of Malaysian sign language. The recognition system provides very good accuracy reach up to 86.36%. The sign language glove seems to be very useful to help communicate with deaf people. We believe that such a translator can be an effective milestone for those who wish to learn sign language.***

Keywords: Sign language, Glove, Sensor, Flex sensor**.**

1. Introduction

One million people worldwide are deaf where they inability to hear the sounds using their ears. Consequently, this kind of disability prevents them to express themselves[1, 2].This limitation creates an obstacle to understanding between ordinary and speechless person. It is a challenge for the deaf and mute to effectively communicate with others they meet in their daily lives [3]. To eliminate the communication problem. Malaysian sign language is introduced to help Malaysian deaf to communicate. Figure 1 presents the alphabets of Malaysian sign language [2].

Figure 1: The letters of the Malaysian sign language

The prototype system consisted of six inertial measurement units (IMUs); five were at the upper-part of each finger, and one was on the wrist. The recognition process was carried out through Appling Linear Discriminant Analysis (LDA) on input signals. The system achieved 85% accuracy [4]. Glove-based systems are important techniques that are used to obtain hand movement data [5]. Despite them having been around for more than three decades, this field of research is still extremely active [6]. It is also obvious that technological advancements in computing, materials, sensors, and processing-classification methods will contribute to making the new generation of glove systems more powerful, highly accurate, comfortable, cheap, and possible to use in many applications [7, 8]. A glove can be an assistive interpreter tool for hearing- and speech-impaired persons to communicate with non-disabled individuals who do not understand SL [9]. The fuzzy rule-based system was used to perform the gesture classification process [10]. The real-time architecture was presented to recognize Spanish SL using A 5DT Data Glove 14 Ultra. A distance-based hierarchical classifier has been proposed to recognize 30 signs of the Spanish alphabet [2]. 3-axis ACC was mounted on the back of the forearm near the wrist to capture information about hand orientations and trajectories. The overall recognition rate of the system was up to 72.5% [11].

We have developed a glove with a five-flex sensor to provide a low-cost solution to enable speech impaired persons to communicate by the assist of new technology. It is easy for the user to use the device as it converts sign language to speak, and a lot of people who are speech impaired communicate with hand gestures. Our glove can learn from user gestures. Therefore the system can convert more gestures into words even in different languages.

2. Overview of the System

Figure 1 shows an electronic system design of the proposed system for the Sign to text is presented in figure 1. The system consists of 5 flex sensors, five resistors of 10 ohms, an Arduino Lilypad, a Bluetooth and 3.7 volts battery.

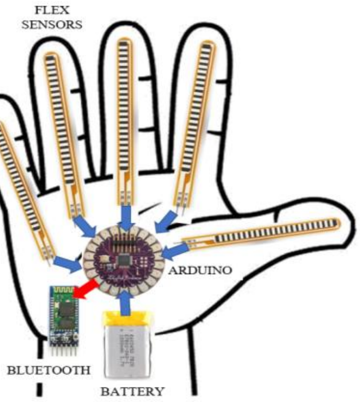

Figure 1: Electronic design system for the intelligent glove using sensor flexometers and Arduino Lilypad

In this device, the hand gestures are recognized using a flex sensor (see Figure 2). These sensors are attached to the gloves. Flex sensor is similar to a potentiometer, i.e. variable resistor. The resistance of the sensor varies according to the amount of its bending, which intern depends on the movement of the finger. To precisely measure the bending flex sensor are used. The flex sensors have an average flat resistance about 10k ohms. When the sensor is bent the resistance offered by them increases. Adult human hand usually has a finger size above 90mm. The sensor size is so chosen that its size is greater than the size of the finger so that the bending can be precisely measured.

Figure 2: 4.5 flex sensor

As per to an official Arduino website [12], " An Arduino is an open-source electronics platform based on handy usage of hardware and software." It provides an interface to write and upload the code on ATMEGA32. Using Arduino has following advantages: Inexpensive - Arduino boards are relatively economical compared to other microcontrollers. Cross-platform - The Arduino Software (IDE)is supported by Linux, Macintosh OSX, and Windows operating systems. Simple, clear programming environment - The Arduino Software (IDE) is convenient for learners, yet adaptable enough for advanced users to take advantage of as well. Open source and extensible software - The Arduino software is published as open source tools, accessible for an extension by professionals. The language can be expanded through C++ libraries. Open source and extensible hardware - The design of the Arduino boards are published under a Creative Commons license, so professional circuit makers can make their version of Arduino extending it and enhancing it. Also, comparatively inexperienced users can design the breadboard version of the module to understand how its working and save money.

3. Software Implementation

After building the device, the program was developed to display the output messages corresponding to input information from the sensors. The flowchart shown in Figure 2 shows the steps in the program.

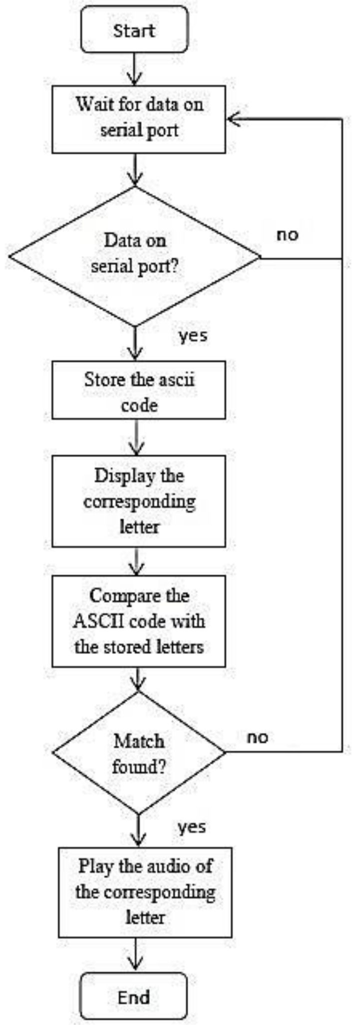

Figure 3: Figure 2: 4.5 flex sensor

The program starts by reading the analogue inputs of origin the flex sensors (F1 to F5) and stored in the asci code in the library in training mode. In the classification mode, the new sensors reading are checked with the patterns stored in the library. If the pattern found then the software, display the corresponding letter. If else, the system will ask the user to repeat the sign.

4. Results

The experimental results of the system evaluated with ten letters of Malaysian sign langue. The signer performs the gesture ten times then we calculate the error rate for each time. Table 1 present the accuracy of the system

Table 1: accuracy and error values.

letter	*Detected Not Detected*	*Detected Not Detected*
A	10	0

B	10	0
D	10	0
F	8	2
G	6	4
H	8	2
I	10	0
k	9	1
L	8	2
p	9	1
q	7	3

5. Conclusion and Future Work

This study has presented the recognition alphabet letter based on the Malaysian sign language. The recognition system implemented is designed by placed flex sensor on the glove dorsal and the sign recognized on the microcontroller. The performed gestures successfully recognized almost 86.36% of a letter in Malaysian sign language. The spelling gloved proposed believed to be as an alternative method to the deaf-mute person in communication with normal people. This glove is more reliable due to its cost and mobility compared to the current alternative communications mode. For future work, add different type of sensors able the system to capture more data helped to a recognized wide range of gestures.

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