Smart Glove for Deaf

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Abstract. Smart glove is used to help deaf to interpret their communication. This tools is an interesting topic to be explored because its need improvement for the feature that user friendly and easy to used. In this paper, flex sensor and accelero-gyro is used. By using this tools, all of the sign language will be interpreted based on system database that registered before. Then, all of data will be displayed as text in the smartphone. The results prove that the proposed method can interpret the language system correctly.

Keywords: Smart glove, communication, flex sensor, accelero-gyro.

1. Introduction

Communication is the most important ways in the human interaction. In our society there are many people with their limitation to communicate. Deaf have limitation in verbal communication. Their way to communicate to others is used sign language. This method can’t be understood easily by others. Because of this case, we need a tool to interpret of sign language.

The previous research is used computational software to read data from sensor that resemble artificial neural network [1]. The other research is concern to interpret of alphabets and numeric cues [2] [3]. The other method used webcam and integrational software to interpret of sign language. This software had been used for interpret sign language through hand gesture. The success rate is 44.57% [4] and [5] are concerned to sign language dictionary application of letters, numbers, prefixes and suffixes that are in relate with SIBI. In the application displays a sign language video of the selected letters, numbers, prefix and suffix. But this app is a simple dictionary app that only displays videos of the sign language.

The contribution of this paper is combining the use of flex sensor and accelero-gyro with system database that registered before. The aims of combining that system could make all of the sign language will be interpreted based on system database that registered before. Then, all of data will be displayed as text in the smartphone. The system is integrated in a glove. By using this glove all of sign language that has been registered in database can be interpret and easy to used also easy to operated.

2. System Overview

In this chapter, input output diagram is presented. Flex sensor is used to detect the finger movements as sign language representation. then arduino is used to process the data. The output will be displayed on smartphone by using bluetooth connection. Input output diagram is shown in Fig 1.
2.1. Design

Fig 2 is smart glove design. The smart glove is done by integration glove, flex sensor, arduino, accelerometer gyroscope and bluetooth HC-05.

2.2. Hardware Configuration

From Figure 3, it can be seen configuration of flex sensor as arduino input. The flex sensor is used to read the curvature of each finger. flex sensor is described as a potentiometer because the working principle of the flex sensor as same as potentiometer.
The accelerometer sensor gyroscope referred to MPU6050 sensor has a function as determinant of the direction of hand movement providing the x and y angle values. Figure 4 shows pin configuration MPU6050 as arduino input.

![Pin configuration of MPU6050](image)

**Fig. 4.** Pin configuration of MPU6050

### 3. Proposed Algorithm

In this section, algorithm of smart glove system is presented. The aims of this algorithm could make the smart glove system working properly. Sensor as input. Arduino is used to process data from sensor, interpreted it, and all of data that process on arduino will be displayed on smartphone using bluetooth connection.

a. Detect finger movements using flex sensor and accelerometer gyroscope
b. If finger movement detected as sign language, processed in step 3, otherwise go to step 1
c. Arduino will be processed all of input data from sensor based on database of sign language
d. If the data appropriate with the database that registered before, the interpretation of sign language will displayed on smartphone using bluetooth connection. Otherwise go to step 3.
e. Finish

### 4. Experimental Results

In this chapter, the results of experimental testing are discussed. First, the data were taken from deaf in Jiwan's Dharma Wanita SLB. Second, using a sample of five different children. Third, every child practices three sign languages in accordance with SIBI which has been determined. Then one word test is carried out five times and counted how many tests are successful. The last, After completing data collection, each data is taken on average by the number of successes divided by the total experiment and multiplied by 100%. Figure 5 to Figure 6 shows the experimental testing of smart glove compare to SIBI. Based on Figure 5 to Figure 6 it shown that sign language can be interpreted as well as SIBI data and the interpretation of sign language can be displayed correctly in the smartphone.

![Experimental testing sign language of “meniru”](image)

**Fig. 5.** Experimental testing sign language of “meniru”
The results of experimental testing in several sign language and the number of successes are presented in Table 1. Based on Table 1, it can be concluded that the average percentage of success is 61.3%. The lowest percentage of success is 20%, this is due to several factors including different finger sizes so that the indentation reading on the flex sensor is different. While the highest percentage of success is 100%. This is because every deaf person is able to demonstrate the “membalik” and “melambai” sign language.

| No | Sign Language | Sample | Number of Successes |
|----|---------------|--------|---------------------|
| 1  | Makan         | ✓ ✓ ✓ ✓ | 80%                 |
| 2  | Minum         | ✓ ✓ ✓ ✓ | 80%                 |
| 3  | Mandi         | ✓ ✓ ✓ ✓ | 80%                 |
| 4  | Membalik      | ✓ ✓ ✓ ✓ | 100%                |
| 5  | Menelan       | ✓ ✓ ✓ ✓ | 80%                 |
| 6  | Meniru        | ✓ ✓ ✓ ✓ | 60%                 |
| 7  | Ibadah        | ✓ ✓ ✓ ✓ | 40%                 |
| 8  | Melambai      | ✓ ✓ ✓ ✓ | 100%                |
| 9  | Melihat       | ✓ ✓ ✓ ✓ | 40%                 |
| 10 | Memakai       | ✓ ✓ ✓ ✓ | 40%                 |
| 11 | Mencium       | ✓ ✓ ✓ ✓ | 40%                 |
| 12 | Menjewer      | ✓ ✓ ✓ ✓ | 20%                 |
| 13 | Menjual       | ✓ ✓ ✓ ✓ | 20%                 |
| 14 | Berpikir      | ✓ ✓ ✓ ✓ | 60%                 |
| 15 | Menyikat      | ✓ ✓ ✓ ✓ | 80%                 |
|    | **Average**   |        | **61.3%**           |

5. Conclusion

Smart Glove as a deaf aid for detecting hand movements and Arduino as the controller with the output in the form of text on the monitor serial and display on the Smartphone. The average success rate of the sign language translator is 61.3% with the highest success, namely when translating sign language “membalik” and “melambai” at 100%, while the lowest success is when translating sign language “menjewer” and “menjual” at 20%. The lowest 20% success rate is due to several factors, including the different finger size of each user, so that the curve on the flex sensor will produce a value that is not the same as the one specified, another factor is the movement of one word sign language with the word that is specified. Other is almost the same, this makes the output interpretation
has similar value or can be said to be the same. The highest success rate is 100% because the movements are easy and uniform so that the displayed data matches the desired data.

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