

Review on Hand Gesture Recognition using Sensor Glove

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Abstract: Hand Gesture Recognition is popular concept that has grown its wide roots in the field of technology. Hand Gesture Recognition is being used in various applications, in these one of the major is interpreting of sign language as voice or text using Sensor Glove. This makes use of various sensors such flex sensors, contact sensors and 3 axis accelerometer for making glove, that sends readings recorded by the sensors to the microcontroller that computes these values and generates speech(using voice module) or text(using LCD). Various methods have been implemented to recognise various sign languages for helping the speech impaired. Realization of this application allows speech impaired people to interact with other normal people using the same generic sign language they use to interact, with ease and confidence.

Keywords: Sign Language Recognition, Flex Sensors, Contact Sensor, 3-axis Accelerometer, microcontroller.

I. INTRODUCTION

Sign languages are the medium that allows the speech impaired people to communicate with rest of the world. But issue with sign language is that it is only confined to the people who are deprived of speech. In order to communicate, normal people also have to be aware of the sign language. Thus this paper explores the various methods that have been implemented to give voice to the speech impaired, so that they can interact with the normal people, with an ease.

Sign language makes use of various gestures made using hand that have their generic meaning in their respective languages. Thus Sign language is different for different countries and different languages. For developing gesture recognition system different techniques have been implemented to handle complexity of that particular language. The Fig. 1 shows the American Sign Language that includes 26 alphabets.

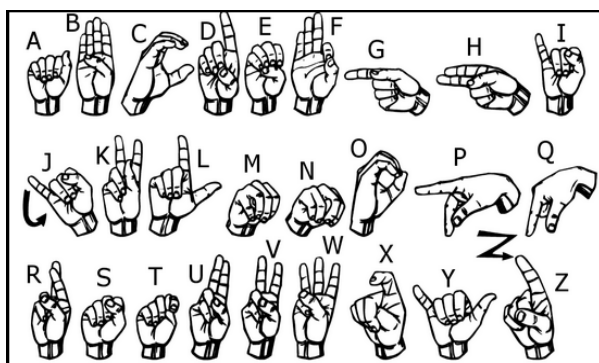


Fig.1 American Sign Language

Most of the implementations of hand gesture recognition systems uses three sensors, namely flex sensors, contact sensors and 3-axis accelerometer.

For Vietnamese Sign language [1], flex sensors and accelerometer have been used to sense curvature of the fingers and detect motion of the hand respectively. For American Sign Language [2], in addition to flex and accelerometer, contact sensors have been used to detect any contact between two fingers. The values received from the sensors are compared with the values in the database and signs corresponding to these values are identified. After matching correct signs they are send to voice module that generates speech. Some have utilized Artificial Neural Networks for recognition of sensor readings from sensor glove. Both for postural classification [5] and gesture classification [6-7], ANNs have been implemented. For Indian Sign Language [3], flex and accelerometers are used for two aspects, one is changing finger position but not hand position and orientation and, other changing both finger and hand position and orientation. Data Acquisition control [4] system was built that converts sign language into text which can be read by others. It was done for only 20 out of 26 alphabets of American Sign Language. In this way various methods have been used for various sign languages for hand gesture Recognition.

II. SENSORS FOR GESTURES RECOGNITION

There are three major sensors used for building a hand glove for gesture recognition.

A. Flex Sensors

Flex sensors are passive resistive devices that give change in resistance depending upon the amount of bending. Flex sensor work as analog voltage dividers, inside which are carbon resistive elements within a thin substrate, that are flexible. When substrate bends, sensor generates resistance output corresponding to the bend radius. More is the bend,

more is the output resistance. They are generally thin strips 1'' -5'' long. Flex sensors varying resistance can be used for getting different output voltages. Here the flex sensors are used for measuring the bend in the finger for gesture recognition.

B. Contact Sensors:

Contact Sensors can be just two metal plates with pull down resistance that sends high values to the microcontroller when they get connected to each other. They are used to check whether two fingers are in contact to each other or not.

C. 3-axis Accelerometer

Accelerometer is used to measure the acceleration or the motion of the hand. An accelerometer returns magnitudes of the projection of vector g to X-Y-Z axis, respectively. An example for accelerometer is ADXL345 [1], which is a small, thin, low power accelerometer with high resolution (13-bit) measurement up to $\pm 16g$.

It measure both static acceleration of gravity and dynamic acceleration resulted from motion. Output is digital data formatted as 16-bit 2's complement accessed by using either a SPI (Serial Peripheral interface) or I2C digital interface [8]. Fig. 2 shows accelerometer with its X-Y-Z axis [1] in which X-axis coincides with hands direction and the when hand is in horizontal plane then Z-axis is taken to be vertical.

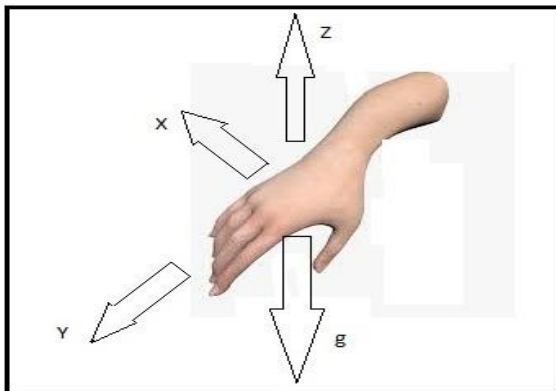


Fig. 2 X-Y-Z axis of the Accelerometer

In [2] MPU-6050 sensor is used, which has accelerometer and gyroscope integrated on single chip. It has 16 bits analog to digital conversion hardware, and is very accurate. It can capture readings for X-Y-Z axis at same time and uses I2C pin for interfacing Arduino.

III. DIFFERENT APPROACHES

As mentioned earlier different methods have been used by different authors for hand gesture recognition using the sensor gloves. For Vietnamese language[1], depending upon hand's posture i.e. vertical, horizontal or in motion, the sign language alphabets are divided into 3 categories. First, it recognises hand's postures. If hand's postures

relates to either of category 1 or category 2, then a matching algorithm is used for recognizing the hand gesture. Otherwise if it relates to category 3 then Dynamic Time Warping is applied to recognize the letter. The data processing and communication system handles sensor data and transfers the results to PC through USB port. Then the animation of the hand gestures and letter recognized is displayed using software running on pc. In this approach 10 flex sensors are used for one and with two of them placed on each hand as shown in fig. 3.

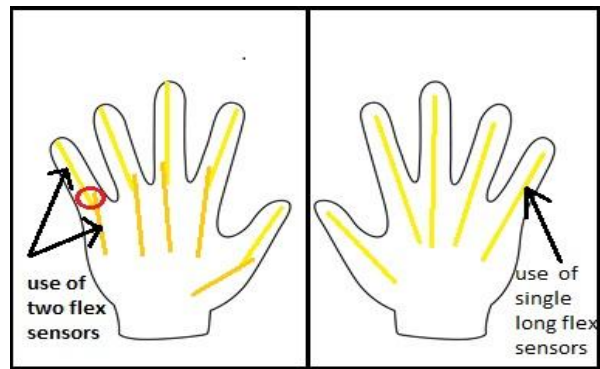


Fig. 3 Various Implementations of flex sensors in sensor glove.

In [4] all flex sensors are powered by 5V dc supply and connected to dividing resistors. This system checks the values of the 5 sensors. If the values match to the range of values that are stored in system then it generates the output as corresponding letter. Otherwise, when gesture is not recognized, then it continues to read the incoming values. It uses two void functions, namely setup and loop. The setup method runs when Arduino is booted and it initializes the hardware and software. In loop method, the regular routines for hand gesture recognition are coded and it runs continuously until it is explicitly stopped.

In this way, readings from flex, contact sensors and 6 DOF accelerometer/gyroscope embedded on same chip, mounted on the upper side of the hand, is send to micro controller system, which interprets the values from sensor and produces corresponding output gesture. This is then displayed on the LCD to microcontroller or a device with Bluetooth connectivity such as a smartphone.

IV. OUR PROPOSED APPROACH

Our approach is to take the hand gesture recognition to a higher level, connecting the sensors to the microcontroller such as Arduino ProMicro. The microcontroller will receive the values from these sensors and send it to the smartphone using a Bluetooth transceiver. This is where IoT comes into picture, smartphone can connect to a cloud server which will perform the desired computation or operations on values and send it back to smartphone. Finally the smartphone which is operated by everyone these days can be used to generate speech, which depicted in the fig 4.

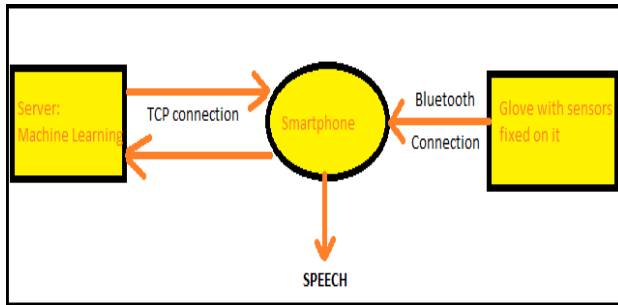


Fig. 4 Introduction to server based hand gesture recognition.

V. CONCLUSION

In this paper we reviewed different approaches proposed for hand gesture recognition. These approaches vary language to language. Basic implementation of sensor glove is done using flex sensors, contact sensors and accelerometer. There are basically two parts in all approaches, one is recognizing hand posture without motion (static) and one with motion (dynamic), where the accelerometer play their part. Our approach is to perform these complex computation and operations on the server and generate the speech on smartphone. Also all the above work only is to recognize alphabets or letters of sign language, which can be further extended to Words and Sentences.

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