ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 6, Issue 12, December 2017

GESTURE RECOGNITION TO VOICE CONVERSION USING ELECTRONIC HAND GLOVE

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Abstract-The main goal is to create a smart glove system that can continuously recognize sign language gesture and translate that into spoken words. The glove is fitted with a flex-sensors and magnetometer sensor to sense the movement made by fingers. New gestures can be added to the existing gesture library. This gives the system the flexibility to meet the high degree of variation among sign languages, and also the need to do some custom gestures for those industrial workers.

Keywords-.Hand gesture,smart glove system,STM32L476xx,Bluetooth transceiver, flex sensors and Strip board

I.INTODUCTION

In the recent years, there has been a rapid increase in the number of hearing impaired and speech disabled victims due to birth defects, oral diseases and accidents. When a speech impaired person speaks to a normal person, the normal person finds it difficult to understand and asks the deaf-dumb person to show gestures for his/her needs.

Sign language is used by deaf and mute people and it is a communication skill that uses gestures instead of sound to convey meaning simultaneously combining hand shapes, orientations and movement of the hands, arms or body and facial expressions to express fluidly a speaker‟s thoughts.

Gesture is a non-verbal form of communication. The series of gestures such as hand movements and facial expressions indicating words are referred to as sign language. Sign language recognition systems are used to convert sign language into text or speech to enable communication with people who do not know these gestures. Usually, the focus of these systems is to recognize hand configurations including position, orientation, and movements.

Accordingly, these configurations are captured to determine their corresponding meanings, using two approaches: sensor-based and vision-based. While the former entails wearable devices to capture gestures, it is usually simpler and more accurate. On the other hand, vision-based approaches utilize cameras to capture the sequence of images. Although, the latter is a more natural approach, it is usually more complex and less accurate. Although hand postures and gestures are often considered identical, there are distinctions between them. A hand posture is defined as a static movement. For example, making a fist and holding it in a certain position is considered a posture. With a simple posture, each of the fingers is either extended or flexed but not in between; for example a fist, pointing, and thumb is up. With a complex posture, the fingers can be bent at angles other than zero or ninety degrees. In this paper we propose a system for glove-based continuous SL recognition

II. PROPOSED METHOD

The proposed work Hand gestures are strong medium of communication for hearing impaired society. The deaf and dumb make use of sign language to communicate which is difficult to interpret by the individuals who are not well-aware of it. Thus, there is a need of building up a device that can interpret the gestures into text and speech.The main goal of this project is to create a smart glove system that can continuously recognize sign language gesture and translate that into spoken words. It is a new technique called artificial speaking mouth for dumb people.

The glove is fitted with a flex-sensor and a magnetometer to sense the movement made by fingers. A low power ARM Cortex-M4 microcontroller recognizes the movement by means of acquiring, processing and running a sensor fusion algorithm. The system translates the sign recognized into meaningful text. This text is then transferred to a smartphone app over a bluetooth channel where the text will be converted into speech. Another feature that makes this project interesting is that users can teach the system new gestures and add them to the existing standard gesture library. This gives the system the flexibility to meet the high degree of variation among sign languages. The system can be built as a low cost alternative to existing solutions.

III.HARDWARE IMPLEMENTATION

It consists of STM32L476 Cortex-M4 microcontroller with inbuilt LSM303C 3D MEMS Magnetometer which is interfaced to microcontroller using SPI protocol. The Flex sensors output is fed to the inbuilt ADC. A HC-05 Bluetooth Transceiver is interfaced to microcontroller using used to indicate the power supply, USB OTG connectivity, gesture matched indication and gesture unrecognized indication.

1 ARM Cortex-M4

The **ARM Cortex™-M4** processor is the latest embedded processor by **ARM** specifically developed to address digital signal control markets that demand an efficient, easy-to-use blend of control and signal processing capabilities. The

ARM® Cortex®-M4 processor is a high performance embedded processor with DSP instructions developed to address digital signal control markets that demand an efficient, easy-to-use blend of control and signal processing capabilities

BlockDiagram:

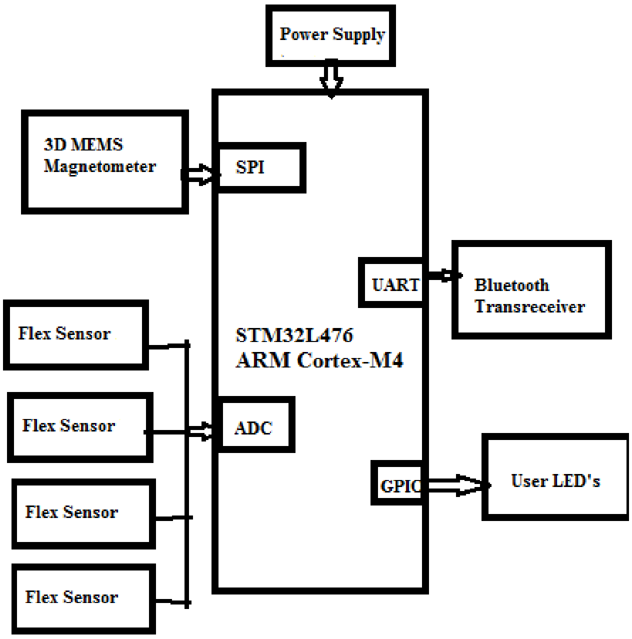

Fig 1:Block Diagram

2.STM32L476

The STM32L476xx devices are the ultra-low-power microcontrollers based on the high-performance ARM® Cortex®-M4 32-bit RISC core operating at a frequency of up to 80 MHz. The Cortex-M4 core features a Floating point unit (FPU) single precision which supports all ARM single-precision data-processing instructions and data types. It also implements a full set of DSP instructions and a memory protection unit (MPU) which enhances application security.

Fig 2: STM32L476

3.Serial peripheral interface (SPI)

Three SPI interfaces allow communication up to 40 Mbits/s in master and up to24 Mbits/s slave modes, in half-duplex, full-duplex and simplex modes. The 3-bit prescaler gives 8 master mode frequencies and the frame size is configurable from 4 bits to 16 bits. The SPI interfaces support NSS pulse mode, TI mode and Hardware CRC calculation. All SPI interfaces can be served by the DMA controller.

4.3D Magnetometer (LSM303C)

The LSM303C is 6 degrees of freedom (6DOF) inertial measurement unit (IMU). It is a system-in-package featuring a 3D digital linear acceleration sensor and a 3D digital magnetic sensor. The LSM303C has linear acceleration full scales of ±2 *g* / ±4 *g* / ±8 *g* and a magnetic field full scale of ±16 gauss. The LSM303C includes an I2C serial bus interface that supports standard and fast mode (100 kHz and 400 kHz) and an SPI serial standard interface.

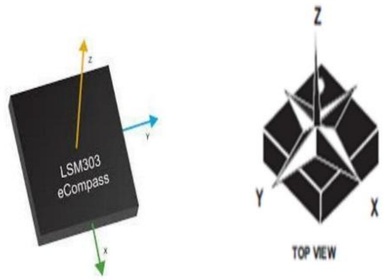

Fig 3: 3D Magnetometer (LSM303C)

5.Flex sensor

Flex sensor is also called Force Sensitive Resistance. FSRs are sensors that allow you to detect physical pressure, squeezing and weight. FSRs are basically a resistor that changes its resistive value (in ohms Ω) depending on how much it is pressed. So basically when you use FSRs you should only expect to get *ranges* of response.

Fig 4: Flex sensor

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This project consists of a hand glove as shown in the Fig 6.on which all the peripheral components like microcontroller, Bluetooth transceiver, flex sensors and Strip board are placed. Strip board consists of voltage divider network. Four flex sensors are placed on thumb, index finger, middle finger and ring finger of the glove .

Firstly, BT interface app is to be downloaded and installed in mobile and Atollic true studio, realterm software are to be installed in PC.After the successful installation, we have to interconnect the all the components placed on glove according to the circuit diagram. Power supply is given to the microcontroller by connecting USB cable from PC to USB OTG socket on microcontroller chip.Coming to the internal operation of this project is as follow firstly different signs are assigned by bending the flex sensors in different positions on the glove. As mentioned above as the bending of the flex sensors increases the resistance value changes accordingly. Here the voltage divider rule is applied that the change in the resistance value tends to vary the output voltage.

As the output voltage obtained from flex sensor is in analog form it is converted into digital form by using analog to digital converter (ADC). It converts all the flex sensors values form analog to digital form and forms a binary value like (1011). The binary value depends upon the position of the fingers on which the flex sensors are placed. The binary value obtained in the microcontroller is transferred to the mobile through the Bluetooth transceiver ie HC-05. Here the binary value is transferred to the BT Interface app where the text is going to be converted into voice output i.e., the binary value is compared with the before assigned binary value and gives the output in the form of voice.

The output voice is obtained only when the sign matches with the previously assigned sign and whether the sign is matched or not was displayed on the Real term software in our PC.

IV.SOFTWARE IMPLEMENTATION:

This flowchart describes the process of how the hand gestures are converted into voice. When user gives a hand gesture, corresponding data is generated by the sensor. Here comes two cases i.e., gesture data may be pre-recorded or may not be recorded in database.

If the gesture data is pre-recorded in the database then it is recognized the output is obtained in the form of voice. If the gesture doesn‟t contain any related data in database then it waits for another gesture input. Flow chart of this project is shown in Fig 5.

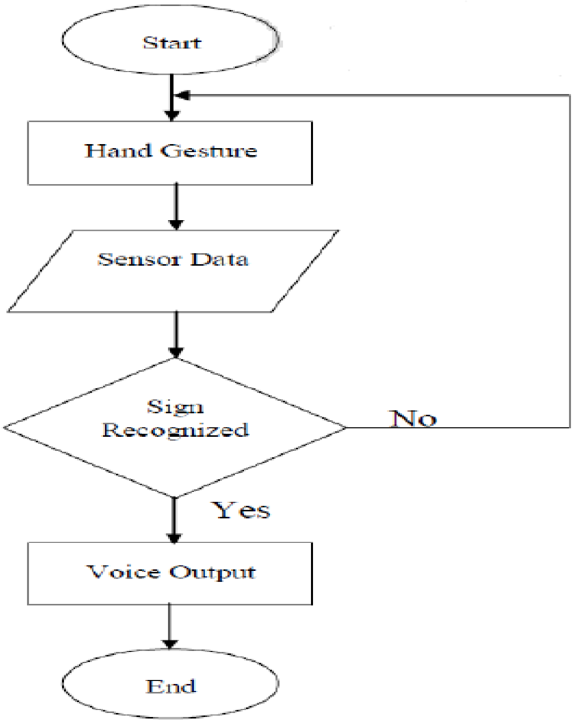

Fig 5: Flow graph

V.EXPERIMENTAL RESULTS

In this Prototype version, the user forms a sign and holds it for few seconds to ensure recognition. Suppose consider the gesture as shown below in Fig 6.

Fig 6. Hand Glove Gesture

The system is capable of recognizing the gesture more quickly and translates it into corresponding speech. This process of gesture recognition is visualized using realterm software as shown in Fig 7 . It displays that gestures is matched.

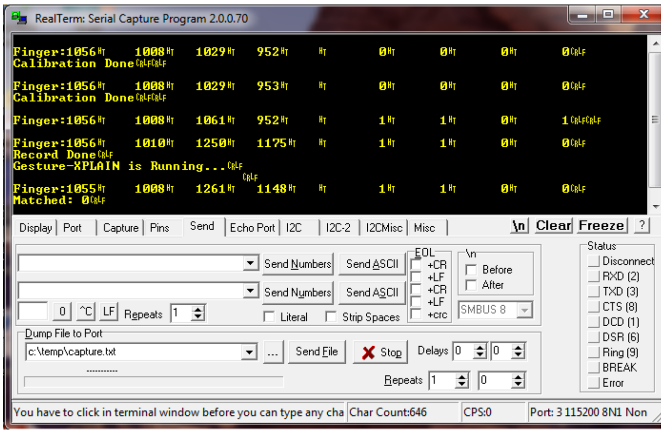

Fig 7. Real Term software

VI. CONCLUSION

The dumb people use their standard sign language which is not easily understandable by common people and blind people cannot see their gestures. This system converts the sign language into voice which is easily understandable by blind and normal people. Hence this system is useful for deaf and dumb people to communicate with the normal people and also blind people.

This area of research remains very active and it is evident that technological advances in computing, sensor devices, materials and processing/classification techniques will make the next generation of glove devices cheaper, more powerful, versatile. The same technique can be used in various languages also.

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