International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 02 | Feb 2020 www.irjet.net p-ISSN: 2395-0072

A Smart Assistant for Aiding Dumb People

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Abstract –*Speech is the major form of communication which is universally accepted. But due to various reasons, the vocally-impaired community is not able to use it. They find it difficult to convey their thoughts to normal people as majority of the regular people are not trained on hand sign language/gestures. They feel left out or unfitted at times of need and in social situations. So a smart system that acts as an assistant to help mute people in conveying their message to regular people using hand motions and gestures is proposed. It is to provide a flexible communication medium to those special people when around regular persons. This is to provide a location- based language usage for better communication with varied people around the world. It also ensures that they are safe and well informing in case of emergency with alarming facilities with GPS and GSM. With this, the special ones can be in par with the regular community.*

Key Words*: *Mute people, location based communication, embedded, gestures, Arduino Mega, GPS, GSM, two –way communication, dumb community.

1. INTRODUCTION

Research and development in science and technology has made human life more comfortable and easier. The concepts and implementations given by Internet of Things, machine learning and artificial intelligence have given a great revolution in the lifestyle of humankind. But there still exists a group of people who has not yet witnessed an innovative and ideal way that can make their way of communication better. The sign language and gestures act as the prime mode of interaction for the vocally impaired community. But, as it is not widespread among normal people, there arises a necessity for their thoughts to be interpreted and conveyed correctly. Many machine learning algorithms and data mining concepts have been used in various methodologies in design of embedded systems for the dumb people. Here this paper proposes a smart system which will aid the special community in bridging their gap in communication with the regular people. This paper emphasizes on developing a MEMS sensor-based hand glove which can be worn by the victim. The hand gestures are previously stored and automated using Arduino. ATmega2560p microcontroller is used along with Arduino Mega board for manipulations. Using this, when the gesture is made it is correlated with the stored content and corresponding text is displayed and the relevant audio is played back. GPS is used for location based language. GSM is used to send emergency notifications to their guardian in urgent situations. This system overcomes the drawbacks of flex sensors, static language, image processing based gesture recognition and MATLAB processing.

This paper consists of four sections. The first section shows the survey made on existing systems and the findings. The second section elaborates on the methodology or the proposed work. The third section shows the experimental setup and the results. The final section gives the conclusion and future work.

2. LITERATURE SURVEY

Basically, sign language automation and technological facilities for the dumb people will majorly fall under either of these two categories:

1. Vision based systems
2. Detector or non-vision based systems

The following section provides the details about the existing systems and related works. It gives the summary of the paper related to this domain.

A gesture based sensor device was developed to cover the minimum requirement for dumb people using non-vision technique in [1]. The concepts of GPS and GSM are used to provide location based security measures to the concerned community. The presented system uses flex sensors, PIC microcontroller automated using MPLAB X IDE software and an LCD through which the message is displayed along with the audio output being taken care by APR (Audio Playback Recorder).

V.Padmanabhan, et.al proposed an artificial speaking mouth which will uses the flex sensors and the accelerometer sensors in order to measure the gestures made by the mute people. It uses PIC microcontroller LM386 in order to coach and operate with the gestures. It also includes TTS256 (Text To Speech) block and Speak Jet for real-time outputs. The values for processing are taken using bend values of the sensors for all the five fingers accommodated in x, y and z axes (Three-axes coordinates)

B.D.Jadhav, et.al presents a system that efficiently translates the sign language gestures into auditory voice and text in [3]. The system uses flex sensors fitted in the glove which produces variations in resistance in accordance with change in the finger's position. Accelerometers are installed on the palm side of the glove so that the twisting of hands can be sensed well. It uses encoding and decoding methods to produce serial and parallelized data, to be fed to the microcontroller (PIC18F4520). The ADC (Analog to Digital Convertor) is in built with the microcontroller to digitize the analog signal from the sensors. The relevant voice is played back. The MP3- TF- 16P (DF Player) is used for voice output. It provides integrated MP3 and WMV hardware encoding.

This paper [4] provides a system based on non- vision based technique which could help visually and vocally impaired people to live without any obstacle . The automation is done using Arduino through Arduino IDE. The paper proposes the system which uses flex sensors and the ultrasonic sensors which will get the distance between the person and the obstacle. The ultrasonic sensor is used to measure the distance between obstacle and the impaired person. The data obtained from the sensors are sent to the Bluetooth module. The display module will display the data that is received from the Bluetooth receiver module.

The system proposed here [5] is based on the vision – based technique which will act as a translator to serve the voiceless people. The image processing is done through MATLAB in PC. The image processing passes through acquisition, pre-processing, feature extraction and image classification. The Wiener filter is used for filtering the received image. The feature extraction is done using Histogram of Oriented Gradients. The identification of the relevant or equivalent output from sign language is classified using Maximum Euclidean distance technique. The gesture is converted to corresponding text and is displayed in the LCD unit and the audio output is interfaced with the port.

2. PROPOSED WORK

The proposed system is based on non-vision based or detector- based approach which uses methodologies like Support Vector Machine, analog to digital conversion for processing.

The process is divided into 4 different phases which employs various algorithms and methods for implementation.

2.1. GESTURE SENSING

This module works with the sensors, Arduino Mega board and the microcontroller. The input is obtained from the user who wears the gloves. The glove has the sensors fixed at sensitive areas of the finger. The MEMS sensor is a micro-electro mechanical system which will help in identifying the moment changes that occur. The MEMS sensor has three axes x-y-z, according to which the values are determined. The sensor description is given in Fig-1.

As in Fig-2, the Arduino Mega is a microcontroller board based on ATMega2560. It has 54 digital I/O pins, 16 analog inputs and a larger space , 4 UARTs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button for operation.

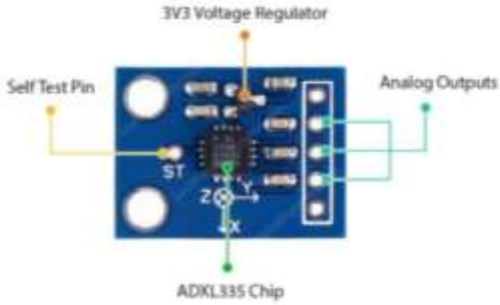

Fig -1: MEMS Sensor

Fig-2: Arduino Mega board with ATMega2560pmicrocontroller

When the user makes a gesture, the three axes values are sent to the microcontroller. The microcontroller in turn captures the values and stores them in its memory for the next processing.

2.2. MATCHING GESTURE WITH MEMORY

This module is concerned with the mechanisms that are involved in comparing and matching of the gestures made, with its pre-stored values. The operations of this module deal with the microcontroller and its memory. The values obtained from the sensors will be analog values. Such data are subjected to ADC process. The digital data from the ADC conversion is encoded and transmitted and are ready to be matched with the database.

The values obtained from the ADC process are received, and are used in calculation of the sensor-based parameters, the roll and the pitch. These values determine the commands for the gestures made. There are pre-defined values that are used for varied gestures.

The acceleration values are also considered along with the sensor values for calculations.

accvalue =((((double)(adc_value * 5)/1024)-1.65)/0.330)

The roll and pitch values are calculated from the values obtained. The values of roll and pitch determine the matching of commands. The matching is performed and the relevant command is selected.

2.3. CLASSIFICATION AND MESSAGE DISPLAY

The module, classification and message display deals with processes involved in determining the command type using classification and the in display text output.

The values from the previous module are classified using Support Vector Machine (SVM) algorithm. The roll and pitch values are calculated using the formulae.

roll =(((atan2(y,z)*180)/3.14)+180

pitch =(((atan2(z,x)*180)/ 3.14)+180

From the roll and pitch values obtained, the commands are classified according to its range. According to the range it lies in, the lower or upper plane of the SVM hyperplane is chosen i.e., if the values go beyond a certain range, they are considered as emergency command. Then the relevant command is displayed in the LCD unit. If that is an emergency command, then the emergency notification is displayed along with the command in the LCD. The emergency type will invoke the GSM to send message to its guardian as help needed through the location obtained from the GPS module.

2.4. SPEECH SYNTHESIS

The speech synthesis process involves the creation of the audio output for the relevant commands from the previous modules. The audio output is spoken out by using the interfaced speaker. When the data from the microcontroller is obtained, the system gets the latitude and longitude values from the GPS module.

Depending on the location specified by the module, the relevant language is used by the system to voice out the command in that specific language. In case, if it is an emergency command, an alarm sound is given to indicate the situation.

3. SYSTEM ARCHITECTURE

The Fig-3 shows the architecture diagram of the system proposed. The architecture involves the sensor, microcontroller, Arduino Mega board, GSM, GPS and so on.

The hand gesture is received from the user through the MEMS sensor. The data from the sensor is sent to the Arduino Mega board which contains the ATMega2560p microcontroller. The processing and matching of the data takes place in the board along with classification being done using Support Vector Machine.

The corresponding command data is displayed in the LCD unit. The data is sent to GSM, if it is an emergency command, in order to inform the guardian. The location details obtained from the GPS module is used in determining the language of the voice out. An alarm is triggered in case of emergency command.

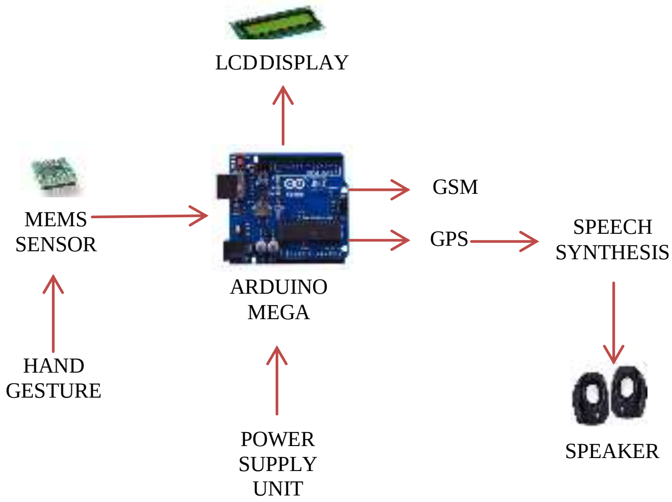

Fig -3: System Architecture

4. IMPLEMENTATION OF THE SYSTEM

The Arduino Mega board embedded with AtMega2560p microcontroller is used. The MEMS sensors are added to receive gestures from the user. The GSM, GPS modules are connected to the board for emergency notification and language selector options respectively. The LCD module shows the command display. Speaker provides the voice output. The implementation is shown in Fig-4.

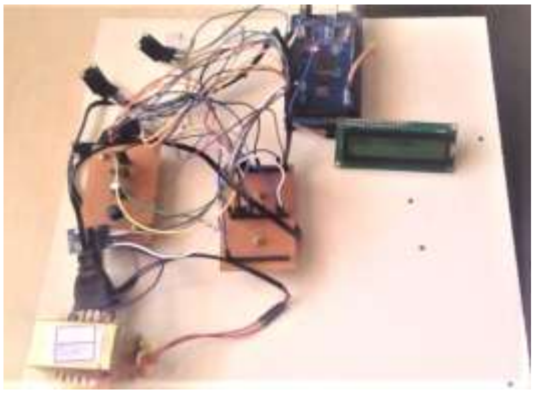

Fig -4: System Implementation

The SVM classification is carried out according to the roll values obtained.

	A	B
1	Roll	Command
2	234.75	need food
3	39.76	need fruits
4	10.16	need car
5	13.19	need clothes
6	34.39	need football
7	147.89	need books
8	238.24	need medicine
9	11.5	need car
10	11.35	need clothes
11	15.35	need football
12	153.51	need books
13	113.73	need pendrive
14	17.56	need car
15	15.31	need clothes
16	32.85	need football
17	317.8	need water
18	40.86	need fruits
19	349.39	need to go out
20	166.85	need to go shopping
21	327.09	emergency

Fig -5: Roll values

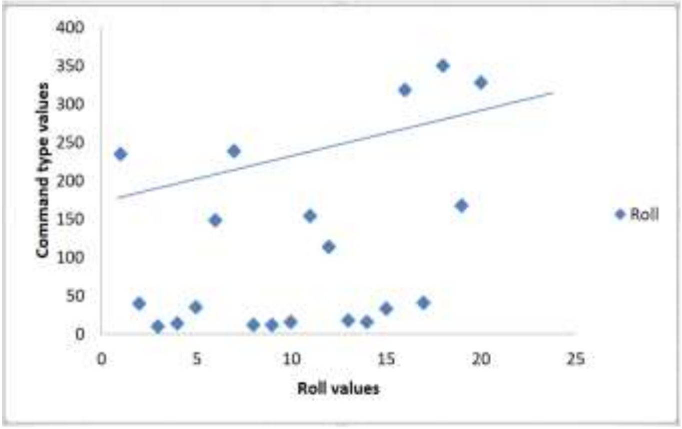

Chart-1: Implementation of SVM

5. RESULTS

The output of the system shows the command type with emergency or normal specification as shown in Fig-6 and Fig-7. The emergency command will trigger the GSM module which will send the emergency notification to the caretaker. The voice output for the corresponding command is given through the speaker module in the language specified by the GPS. In case of being an emergency command, the alarm goes off to indicate the urgent need.

Fig -6: Normal command

Fig -7: Emergency command

6. CONCLUSION AND FUTURE WORK

This system is useful for the mute community to form a flexible and easy communication platform when around other people. This helps the regular people to understand their way of speech better. In future work, the text output in LCD can be replaced by Android application which is much more flexible and portable. The language changer can be implemented using translators for more number of languages.

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