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"SMART GLOVE: Sign to Speech Conversion and Home Automation Control for Mute Community"

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Abstract: ***Communication plays a vital role for human beings. This project helps in improving the communication with the dumb people using flex device technology. a tool is developed that may translate totally different signs as well as Indian language to text also as voice format. The people who are communicating with dumb people might not perceive their signs and expressions. Through language, communication is feasible for a deaf-mute person without the means of acoustic sounds. The aim behind this work is to develop a system for recognizing the language, that provides communication between people with speech impairment and normal people, thereby reducing the communication gap between them. Compared to different gestures (arm, face, head and body), hand gesture plays a vital role, because it expresses the user's views in less time. within the current work flex sensor-based gesture recognition module is developed to acknowledge English alphabets and few words and a Text-to-Speech. Hence, an approach has been created and changed to listen to the gesture-based communication. it will be very useful to them for conveying their thoughts to others.***

Keywords: Raspberry-pi, Arduino Board, Python, GTTS Flex Sensor, Arduino IDE, Embedded C.

I. INTRODUCTION

People who are mute often tend to feel uncomfortable around other people, when drawing attention to their speaking problem. The sign languages are used as a communication medium for mute people. Sign languages uses hand gestures to convey thoughts. It involves hand shapes, hand movements to express the thoughts. They also convey combination of words and symbols (i.e. gestures). Gestures are different forms made by the curves and the finger bends. Gestures are the best medium for their communication. The main aim of this project is to create a sign language to speech conversion system which convey the thoughts of mute people to normal people using hand gestures. In our system we are using flex sensors to convey the thoughts.

Existing method of expressing thoughts is by using vision-based gesture recognition system, where a camera module is used to capture the hand gestures. The captured image is sent to image processing and it gives the output based on the image captured.

Compared to vision-based gesture recognition system, sensor-based gesture recognition is more accurate and less time consuming.

It also gives quick response in recognizing the gestures. Sensor based system requires flex sensor instead of camera module which makes it portable and low cost.

1. Sign Language representation by hand

With the help of flex sensors mute community people can easily communicate with other people and using this system the people can easily control the Home Automation (fan, lights, etc.). Compared to existing system the performance of proposed system is very good. It is easy to handle compared to existing system. This system can support languages like English, Telugu, Hindi, German and many more.

II. LITERATURE SURVEY

Myron W. Krueger first proposed the recognition of gestures as a new form of human-computer interaction in the mid-seventies.

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With the rapid development of computer hardware and vision systems in the last few years it has become a very important research field. Hand gesture recognition is a user-friendly and intuitive way of interacting with computers or smart machines (e.g. robot, car, etc.). In the area of human computer interaction, the work has received more and more interest. There are currently several techniques available which are applicable for hand gesture recognition, either based on sensing devices or computer vision [1].

A typical example based on widespread devices is data glove, created by Zimmerman in 1987. User wears a data glove in this system which is connected to the computer. Within 3-D space, the glove can determine the bending of fingers, the location and the hand orientation [2].

Data glove is capable of capturing the riches of a hand gesture. The successful example is the real-time recognition of American sign language. This strategy, however, does not meet the actual human-vehicle contact criteria under an outdoor environment. Applying this to vehicles in the context of public transport is cumbersome [3].

Recognition of the vision-based gesture has the advantages of being spontaneous, having no specialized hardware requirement and being independent of hand size. Recognition of hand shape segmentation in vision-based gesture is one of the toughest issues under a dynamic environment. The use of visible marks on the hands will simplify this. Some researchers have implemented sign language and gesture recognition based on various modes of marking [4].

Sawant Pramada has suggested an intelligent recognition of the sign language using image processing. In their project they introduced an efficient and rapid algorithm for identifying the number of fingers opened in a gesture representing the Binary Sign Language alphabet. This device didn't require a perfect alignment of the hand to the camera. The project used image processing system to identify, in particular the English alphabetic sign language used to communicate by the deaf. The open fingers indicated this method was used for the signs. They used the technique of color-coding. We added to the finger different colors, below each finger's end. The color element has also been preserved as it is by eliminating all other parts of thehand during pre-processing. The gesture was recognized by testing the sequence of these colors known as coordinate mapping, and their positions in 2D space. The system was implemented for sign language Binary only [5].

The system R developed. E. Kahn applies a variety of techniques (e.g. motion, color, edge detection) to the hand of the segmenting person; it can be used to interpret the gesture pointing. This system requires a static context, and relies on off-board computation that causes delays in recognition of gestures [6].

Singha, Joyeeta et al. Proposed an Indian Sign Language Recognition system in live video stream. In this the identification of specific Indian Sign Language alphabets is suggested where continuous video sequences of the signs are regarded. The method suggested consisted of three stages: pre- processing, extraction and labeling of items. The pre-processing step required extraction of the skin, following the histogram. Eigen values and Eigen Vectors were considered for the extraction stage of the function and eventually Eigen value was used for identifying the symbol. This interacted with bare hands, thereby encouraging the consumer to actually communicate with the device. The data set used to train the reconnaissance program consisted of 24 ISL signs for 20 individuals. For 20 images, they checked the program and obtained a good success rate of 96.25 percent. Attributes such as strong consistency, use of bare hands, understanding of both single and hand movements and operating with images have been accomplished [7].

Sakshi Goyal et al. Proposed another Sign Language Recognition (SLR) system for the deaf and stupid. We suggested the process or algorithm for an application that would help to understand Indian Sign Language's different signs. The photos are of the right- and left-hand side of the palm and are displayed at single signer runtime. First the photos were collected in real time and then placed in directory and extraction of features was performed to classify which symbol was expressed by the consumer via SIFT (Scale Invariance Fourier Transform) algorithm. The comparisons were created and then the outcome was generated appropriately by comparing key-points from the input picture to the image already registered in the directory or database for a particular letter after comparison. Of the 26 signs corresponding to each letter in Indian Sign Language, out of which the proposed algorithm produced 95 percent accurate results for 9 alphabets with their photos recorded at every angle and size [8].

Recognition system for sign language primarily has two well-known solutions viz. Image processing and other techniques are microcontroller and data glove based on sensors. These approaches are also known as techniques based on vision and sensors. Camera is used to capture the image / video in the image processing technique, in this static image are analyzed and the image recognition is performed using algorithms which generate sentences in the display. Secret Markov Mode (HMM), Artificial Neural Networks (ANN) and Amount of Total Difference (SAD) are the algorithms used in the eye-based sign language recognition system. The downside of vision-based approaches requires complex data-processing algorithms. Visual-based approaches mostly use camera chase technology, whereby the consumer usually wears a glove with specific colors or markings showing individual parts of the hands, especially the fingers. The cameras record the ever-changing picture and hand location because the consumer signs and also the photographs are then manipulated to obtain the form, direction and orientation of the object. Another difficulty of picture and video production requires variable lighting conditions, textures and limitations and occlusion on the field of view.

III. METHODOLOGY

Data from the flex sensor will be continuously taken. The output of the gloves gives values for each flex sensors which are rechecked with the database and it is then converted into text form.

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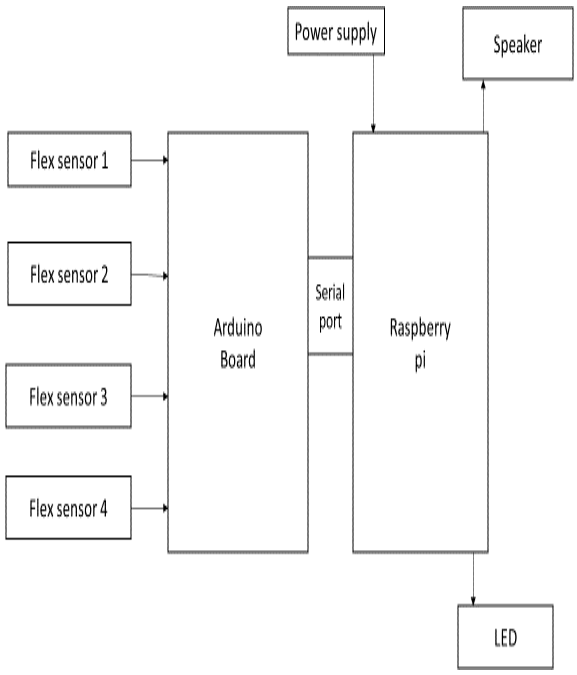
The microcontroller then sends the data to the microprocessor by serial communication. The data is then coded in python to get the desired output. Google Text To Speech (GTTS) library in order to attain a maximum efficiency of the model. We now access the speaker of the device and convert the text to speech using GTTS and the output is achieved in the form of speech.

A. Proposed Architecture



We propose an algorithm to describe the operation of the system.

B. Algorithm

Algorithm for proposed system

Step 1: Start.

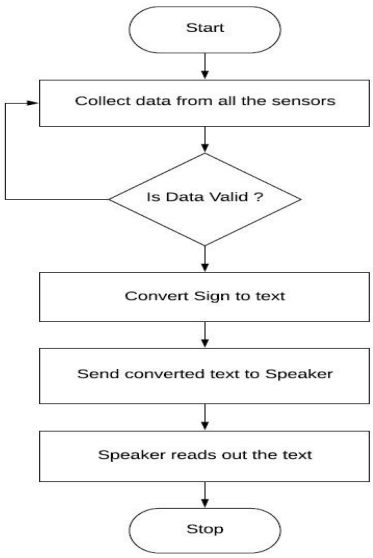
Step 2: Collect data from all the Sensors.

Step 3: Is there any meaning to values? If yes then sends conversion of sign language to text data to Speaker.

Step 4: Speaker collects the text and reads out the text.

Step 5: Stop.

C. Flow Chart



IV. TOOLS USED

Hardware Tools

A. Flex Sensor

A flex sensor is a sensor which measures the amount of deflection or bending. Each Flex Sensor is treated as a variable resistor which increases its resistance as the sensor bends. Each sensor is a part of its own voltage divider circuit, the output of which is processed through one of the analog to digital converters of the microcontroller (MCU).The analog voltage input into the MCU varies as a function of how much the corresponding finger is twisted, and a translation script can interpret the resulting digital MCU information.

B. Arduino Uno

The Arduino Uno is an open-source microcontroller module, based on the microcontroller Microchip ATmega328P developed by Arduino.cc. This operates on a 5 V operating voltage with the input voltage cut-off maximum being 6-20V.It includes 14 digital I / O pins and six analog input pins. The 5 analog input is connected to the 4 different flex sensors placed on the glove's fingers, so with the help of these pins we can get the reading. It has a 16Mhz clock speed which helps us process the information without having to face any difficulties.

C. Raspberry Pi

The Raspberry Pi is a series of small single-board computers that connects to a computer monitor or TV, using a standard mouse and keyboard.

D. Glove

Gloves are pieces of clothing which cover your hands and wrists and each finger has individual sections. You wear gloves to keep or protect your hands warm, or dry. Mostly device-based techniques involve some guide variety such as a glove or glove-like frame fitted with flex sensors are attached to the hand's glove finger position.

Software Tools

A. Python

Python is a programming language of high standard built to be easy to read and quick to implement. It is open source, meaning it can be used freely, even for commercial applications. Python, like Ruby or Perl, is considered a scripting language and is often used to create Web applications and dynamic Web content.

B. Embedded C

Embedded C programming language is an extension that is used in embedded systems to the traditional C programming language. The programming language of the embedded C uses the same syntax and semantics as the programming language of the C. The only extension of standard C programming language in the Embedded C language is I / O Hardware Addressing, Fixed-Point Arithmetic Operations, Address Space Access, etc.

C. Google Text-to-Speech (GTTS)

There are several APIs available for python translation o f text into voice. One such API is the Google Text To Spee ch API usually referred to as the gTTS API. GTTS is a ver y user- device that transforms entered text to audio that can be saved as an mp3 file.

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The gTTS API supports a variety of languages including E nglish, Telugu, Hindi, Tamil, German, French, Guajarati, Marathi and many more.

D. Arduino IDE

The Arduino Integrated Development Environment includes a text editor to write code, a message area, a text console, a toolbar with common function buttons, and a set of menus. It connects to and communicates with Arduino and Genuine Hardware to upload programs.

V. PERFORMANCE MEASURE

EXISTING SYSTEM

Sigh language to speech converter system was developed in May 2014. With the support of MATLAB this system transforms the gesture to audio. Yet the system's major downside is that it still needs a computer, so it's non-portable.

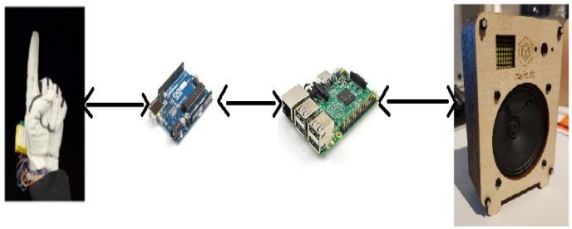
Vision-based gesture recognition system which uses a camera module to capture hand gestures. The picture captured is sent to image processing and it gives the output based on the captured picture.

PROPOSED SYSTEM

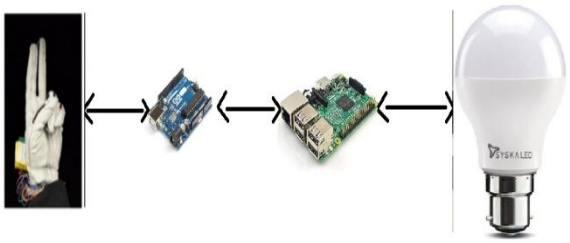
An electronic glove is developed for communication interpreter system that helps out the deaf and dumb individuals to speak with dependability. There are four flex sensors that are employed and every square measure fitted with length of every finger of glove. The hand gesture plays a vital role in this paper. The gestures are decoded by Raspberry pi. Every specific gesture (i.e, creating various positions of fingers) has a meaning associated with it. So, whenever a gesture is shown, a binary code with 4 digits will be generated.

Compared to vision-based gesture recognition system, sensor-based gesture recognition is more accurate and less time consuming. It also gives quick response in recognizing the gestures. Sensor based system requires flex sensor instead of camera module which makes it portable and low cost.

By using flex sensors home automation can also be done. In this paper glove was used for switching light on or off and also for the mute community to communicate with the normal people.



A. Sign to Speech Conversion



B. Sign to Home Automation Control

VI. RESULT ANALYSIS

Instead of taking a single text, we produced a full set of 16 s entences,5 of which are seen in the table below.

Table 1: Sign language to speech conversion

Sr.No	Sign language	Sign Language to Text-to-Speech conversion
1		Good morning
2		Hi, I need water
3		How are you
4		where are you from
5		what is your name

Table 2: checking accuracy of flex sensor

Sr.no	Excepted values	Actual values	Accuracy
1	>780	755	83%
2	>780	75	
3	>780	799	
4	>780	802	
5	>780	796	
6	>780	810	

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We took the flex sensor 2 and bend it for some time to check the accuracy of the flex sensor. The input of Arduino i.e. output of the flex sensor measured from analog pins is between730-770 when it is not bending. The following table shows the value of the flex sensor at different times when the bend is kept.

VII. CONCLUSION

Sign language is very helpful in facilitating communication between the deaf or mute population and normal people. This project is intended to bridge the gap between the deaf or mute community and the industrialized world in contact. The aim of this project was to be a test for the feasibility of using data gloves to understand the sign language. Hand gesture recognition and voice conversion was successfully executed for dumb and deaf people. The method takes sign language as input, and gives output expression. Implementation of this approach gives up to 90 percent accuracy and operates in most test cases successfully. There is a lot of research and advancement in different fields to address these conditions.

VIII. FUTURE SCOPE

To boost user interaction and make the system more stable the application can be integrated with other smartphone and IoT apps. Using neural networks, the program's precision can be further improvised. An alternative stress could be imposed on the use of the application in the fields of medicine, military, administration etc. A genuine combination of different technologies in the areas mentioned will make way for power tools and applications that will serve the community around the world. Finally, the use may be further designed to make the user more available. The whole point of making the solution for the users as a commercially viable product is to support the disabled community around the world.

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