Smart Glove for Physically Disabled

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***Abstract*—Smart Glove is a device that converts hand gestures of sign language into text as well as audio with the audio in Hindi/English language. The people communicating with speech impaired may not understand their sign language, this device is designed to understand the gesture-based communication. The gloves have Flex sensor stitched to each finger, the change in resistance due to bending of flex sensors is in the form of analog data, this data is converted into digital form using Arduino and serially communicated with Raspberry-Pi for further processing. The vocal outcome occurs with respect to gestures produced by the speech-impaired, the vocal output is a "letter" where each gesture is associated with a respective "letter". LCD screen displays vocal output for deaf. For bed ridden patients, the gloves also include a mode that can control home appliances such as fan, light, etc. helping them to access it with ease.**

***Keywords*—Hindi Language; Raspberry-Pi ; Flex Sensor; Arduino UNO; gTTS; Python**

I. Introduction

Loss of hearing and speech can cause people to be lonely and isolated resulting in adverse effects in both their social and working life. The development in embedded system provides a space for designing and developing a translator for sign language to assist in reducing the communication gap between speech and hearing-impaired people and normal people. Hand gesture or sign language is a way to communicate between impaired and normal people. Finding an expert interpreter for day to day activities is very difficult and expensive. For ease of communication between impaired and normal people, we employed various electronics and digital methods in order to design a glove that will help speech-impaired people to communicate easily with normal people. This project is aimed at creating a hand gesture-based vocalizer, a smart glove that can help the speech and hearing-impaired people to communicate with other people without any difficulty.The glove comprises of speaker that is capable of producing different voice commands in English as well as Hindi language based on the gesture produced by the speech-impaired person. It also consists of LCD display for the hearing impaired. Smart glove is implemented using Raspberry-Pi 3, Arduino UNO along with the flex sensors. Communication will become easier for the physically disabled and other able-bodied will also be able to understand better.

II. Related Work

A. Gesture-based system using pre-recorded audio

A system based on gestures where flex sensors were mounted on the glove and pre-recorded audio was played for certain gestures. Arduino Nano was used by the researchers for processing of sensory data and audio. Here, There is a limitation in number of words. Audio for only certain words can be played and use of wires and sensors is not user friendly for deaf and dumb [1].

B. Glove-based system using flex sensor and ADC

Flex sensor varies in resistance depending upon the amount of bend on the sensor that are attached along the length of the fingers to detect the bend of the fingers that formulate the gesture. Each flex sensor requires an ADC for conversion of analog data to digital data which makes the system bulky and costly [2].

C. The Vision based method

These systems require only a camera for interaction between humans and computers. It works on the principle of

image processing in which the captured image is compared with the image already present in the data-set. These system requires ability to be background invariant, light insensitive and independent of the presence of a person or a camera in order to obtain better performance. Such systems require high accuracy and robustness [3].

III. Proposed Methodology

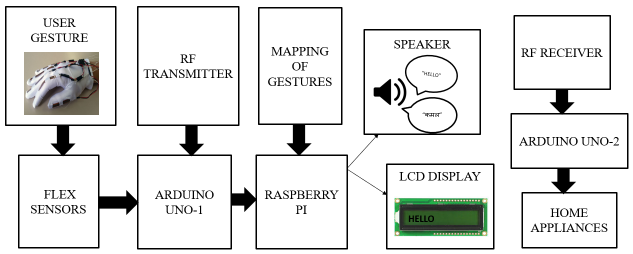

Fig. 1: Block Diagram

The basic idea of Smart glove is to extract the information based on the gesture produced by the user. Following steps illustrates design methodology of a smart glove for physically disabled people:

A. Hand Gestures

The hand gesture plays a vital role in this project as it is used for the mapping of gestures in order to produce respective voice command and display. 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 (digital) with 5 digits will be generated. Every 5-digit code is interpreted to a predefined letter

B. Data Acquisition

Data Acquisition consists of acquiring or collecting data from the flex sensors in the form of resistance corresponding to the gesture produced by the physically disabled person. Hand gesture produced by the physically disabled person results in change in resistance of flex sensors stitched to each finger of the glove, change in resistance is acquired and VDR(Voltage Divider Rule) is applied in order to get the corresponding Voltage value .

C. Conversion of Analog data to Digital data

The resistance of flex sensor is an analog signal whereas Raspberry-Pi accepts only digital signal for processing, thus Arduino UNO is used as an intermediate between flex sensor's and Raspberry-Pi for analog to digital data conversion.

D. Conversion of Digital data to Audio and Text

The digital data from Arduino UNO needs to be serially communicated with Raspberry-Pi for its conversion into text and audio format.

E. RF Transmitter and Receiver

This is used for home automation. RF transmitter module is connected arduino which is connected to the glove whereas the receiver module is connected on another arduino, this together acts as a receiver which is then connected to home appliances those to be operated[4].

IV. Execution Process

A. Software Implementation

1) Advanced IP Scanner: Advanced IP Scanner is a free, fast and powerful network scanner with a user-friendly interface. In a few seconds, Advanced IP Scanner can locate all the computers on your wired or wireless local network and conduct a scan of their ports. The app scans all network devices, and gives you access to shared folders and FTP servers. It provides remote control of computers (via RDP and Radmin) and can even remotely switch computers off. The program provides easy access to various network resources. It also enables you to detect all the IP addresses on your Wi-Fi network.

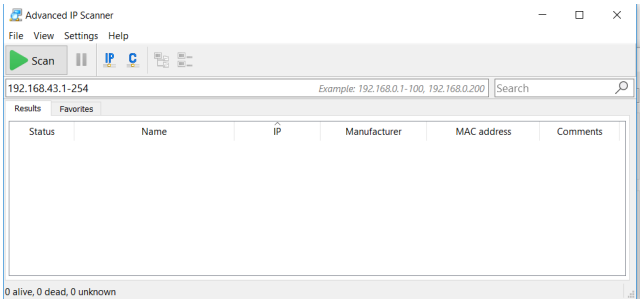

Fig. 2: Advanced IP Scanner

2) VNC Viewer: Virtual network computing (VNC) is a type of remote-control software that makes it possible to control another computer over a network connection. Keystrokes and mouse clicks are transmitted from one computer to another, allowing technical support staff to manage a desktop, server, or other networked device without being in the same physical location.

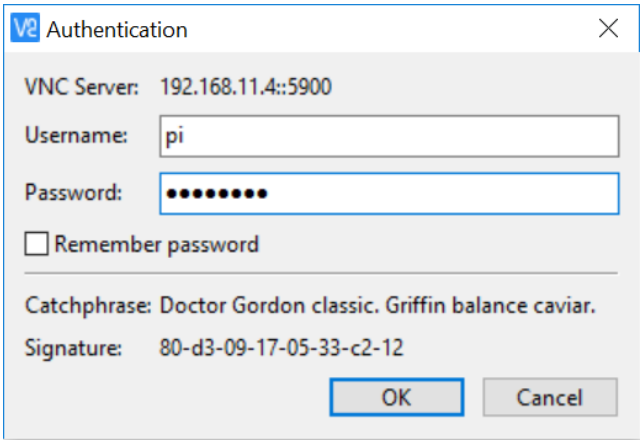

Fig. 3: VNC Viewer

3) PuTTY Software: PuTTY software was used to wirelessly connect the Raspberry-Pi with the laptop. The IP address of Raspberry-Pi is searched using the Advanced IP Scanner and put into PuTTY software which directly opens the Raspberry-Pi terminal where we add the login ID and password of Raspberry-Pi and access it wirelessly using VNC Viewer.

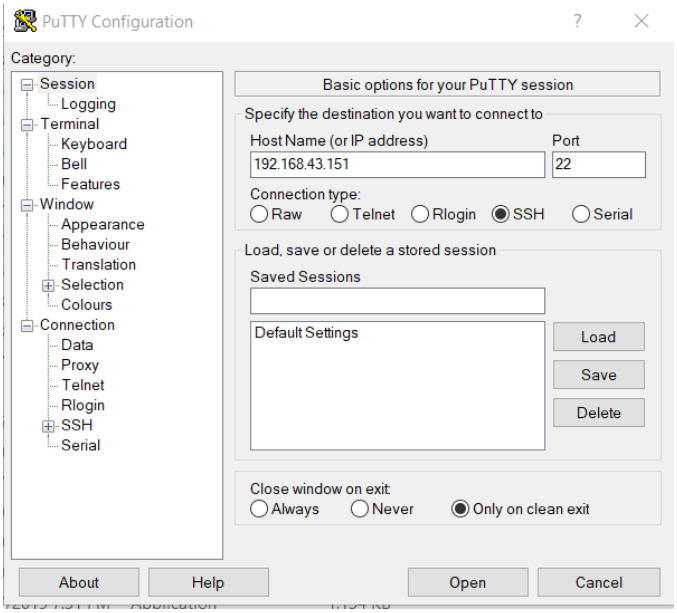

Fig. 4: PuTTY Software

B. Hardware Implementation

Fig. 5: Hardware Implementation

1) Flex Sensor: The flex sensors which are connected to the gloves act as variable resistors, their resistance value changes corresponding to the amount of curvature it undergoes. When the flex sensor is straight its resistance is around 40k ohms and when it is bent its resistance will keep increasing. Five such flex sensors are used on the glove one for each finger including the thumb.[5]

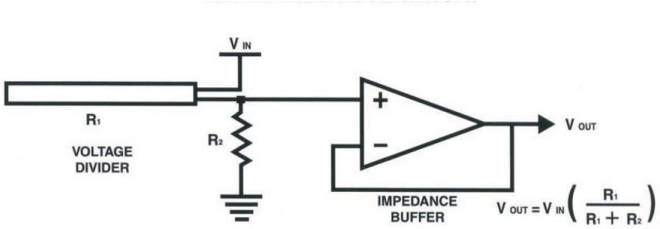

Fig. 6: Basic Flex Sensor Circuit Diagram

2) Arduino UNO: The voltage from the flex sensors is taken by using voltage divider circuit. A fixed resistor of suitable voltage is connected in series with the variable flex sensor resistor and the voltage across the variable resistor is given to the micro-controller, Arduino UNO. Since, Raspberry pi requires input in digital form, here Arduino is used to convert the data from flex sensor that is in analog form into digital form. If the finger in bent it sends '1' and if it is straight it sends '0' for each flex sensor.

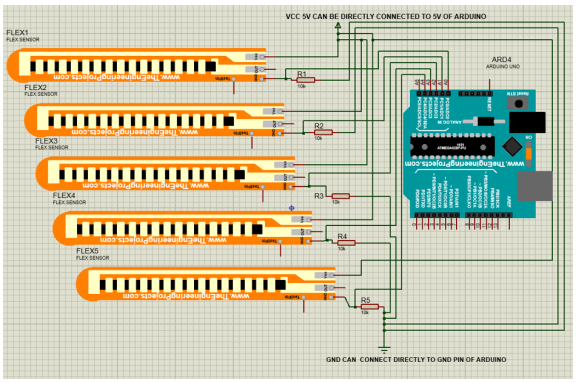

Fig. 7: Flex Sensors and Arduino UNO connection

3) Raspberry-Pi: The data from Arduino in digital form (Eg. 00000) is then mapped into a letter for example '00000' is stored as 'a'. Since there are 5 sensors and 532 combination can be stored. As a result 26 alphabets and 0-9 numbers can be stored. This mapping of gesture takes place in Raspberry pi using python programming.

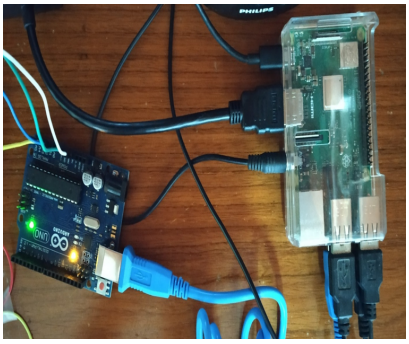

Fig. 8: Data sent to Raspberry Pi

4) LCD Display: The output in the form of data is displayed on 16x2 LCD Display. This LCD Display is connected

to Raspberry Pi.

5) Speaker: A Bluetooth speaker is connected to Raspberry Pi via inbuilt Bluetooth. The messages to be conveyed can be heard in the audio form through this speaker. The Google Text to Speech (gTTS) is used to convert data into audio form.

6) Hindi Language: There is a sliding switch connected to Arduino, when the input through the switch is '0' the language of the glove changes to Hindi and the messages can be heard in Hindi language. If the input through the switch is '1', the languages is set to English.

V. Experimental Results

When switch is equal to 1, English voice command as well as display will be generated.

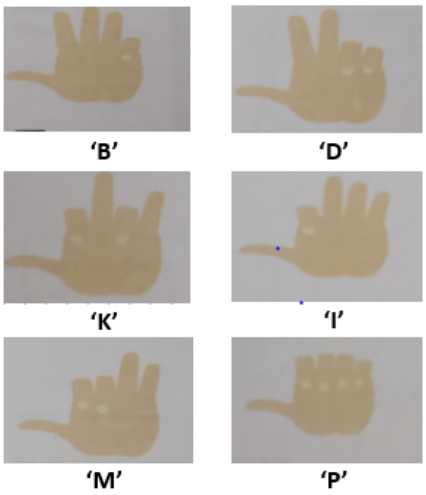

Fig. 9: English Language

When switch is equal to 0, Hindi voice command will be generated.

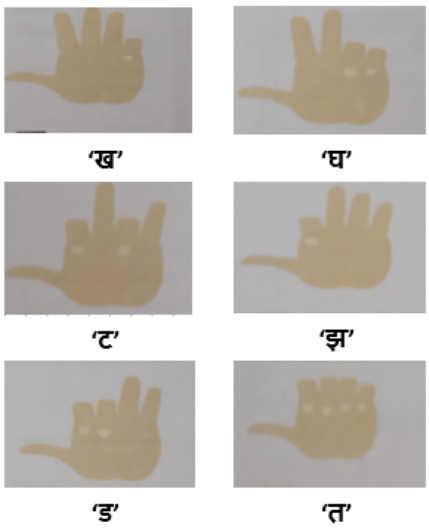

Fig. 10: Hindi Language

Display of messages on LCD:

Fig. 11: Display on LCD

VI. Conclusion

The project undertaken satisfies the need of physically disabled people giving voice to dumb and better understanding of sign language known by speech-impaired people. Generally, the speech-impaired people have their own sign language to communicate with the surrounding people, but there is a barrier of communication with people who don't know their sign language, Smart glove helps deaf and dumb people in conveying some important messages to the people who are not aware of their sign languages. The project proposes Smart gloves for physically disabled people where it will improve their communication with the world. Also, an addition of another mode in the same glove which can control the home appliances will help the bed ridden people in using some of the important home appliances without any assistance. Most of the Indian people are comfortable with Hindi language rather than English, Smart gloves consists of a speaker that produces voice commands in Hindi language.

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