International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072

# Assistive Device for Vision, Hearing and Speech Disability

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**Abstract -** *The top three of the disabled population are visually impaired, speech impaired and hearing impaired. According to the recent statistics, 1% of Indians are visually impaired, 0.2% are speech impaired and 0.1% are hearing impaired. The major misfortune for them is, they cannot communicate with the rest of the world. Though few methods were introduced for their communication, like Braille, Sign language etc., again the problem persists between them and normal people. This project is an approach to reduce this problem. A Raspberry Pi is used to convert the text to speech, display the message, speech to text and to convert the gesture to speech.*

***Key Words***: *Braille, display, gesture to speech, Raspberry Pi Sign language, speech to text, text to speech.*

## 1. INTRODUCTION

The project is a device that provides assistance to visually impaired, hearing impaired and speech impaired to communicate with the normal people naturally. Also, it provides assistance in communicating among different impaired people easily. For visually impaired, GSM module receives the SMS from a mobile and sends it to Raspberry Pi board, then text to speech synthesis is carried out using eSpeak synthesizer and speech is produced through speakers. The text is displayed in the LCD for hearing impaired. For replying, the speech input is taken from the microphone and is sent to Raspberry Pi board. Speech to text conversion is carried out using Google speech recognition and the text is sent as SMS to mobile using GSM and the text is displayed in the LCD. For speech impaired, gesture input is taken from the camera and image is sent to the Raspberry Pi board. Image pre-processing, feature extraction using LBP (Local Binary Pattern), SVM (Support Vector Machine) classifier are used to recognize the given gesture. A message is predefined for a particular gesture, and if that gesture is recognized, its corresponding message is read out as a speech using eSpeak synthesizer and that is heard using speakers.

## 2. RELATED WORK

First, there has been a lot of research related to text to speech and gesture to speech from recent times, but there is a need of intercommunication system among different disabled persons.

*A. The Study Of Gesture Recognition Based On SVM With LBP And PCA*

Gesture image is pre-processed, then for feature extraction LBP (Local Binary Pattern) is used, and sample feature vector is formed. SVM (Support Vector Machine) classifier is trained to obtain a model. The feature vector is obtained through projecting the image after feature extraction onto the PCA (Principal Components Analysis) mapping matrix. Finally, the prediction is based on classifier training model [5].

*B. Python Based Portable Virtual Text Reader*

This project has developed a technique on converting a text image directly to speech using Python and Raspberry Pi 3 minicomputer. Tesseract OCR is Optical Character Recognition algorithm used to recognize the characters or text in the image. eSpeak is used to read out the text in the image with more human compassion [8].

*C. A Real Time System For Two Ways Communication Of Hearing And Speech Impaired People*

The input gesture is given in camera, it pre-processes it, extracts the gesture, matches with the dataset and finally gives the voice output of that gesture. In the speech to gesture conversion, the input voice is given in the microphone, it is analyzed with the help of Google and its equal image is displayed [10].

*D. Development Of Device For Gesture To Speech Conversion For The Mute Community*

Flex sensors are fixed to fingers and based on the increase in the bend of the fingers (flex sensors) the resistance increases. Accelerometer is fixed on the wrist to detect the acceleration of a moving body. A sketch is written in the Arduino software using the sensor values characters are assigned and compared. Bluetooth module sends the data to MIT app inventor in mobile to convert text to speech [11].

## 3. PROPOSED SYSTEM

The proposed system is implemented using Raspberry Pi 3 model B. The other hardware equipment is GSM module, microphone, camera, speakers, LCD. The Figure. 1 presents a block diagram of hardware design for the system.

*3.1 Raspberry Pi 3 Model B:*

The Raspberry Pi has been chosen as a microcontroller in our system due to its compact size and portable convenience. It includes Broadcom BCM2837 processor, quad core Arm Cortex-A53, clock speed of 1.2GHz, 1 GB RAM, wireless LAN(Wi-Fi) and Bluetooth 4.1 and Camera interface with a 15-pin MIPI, 4 USB ports, 40 GPIO pins.

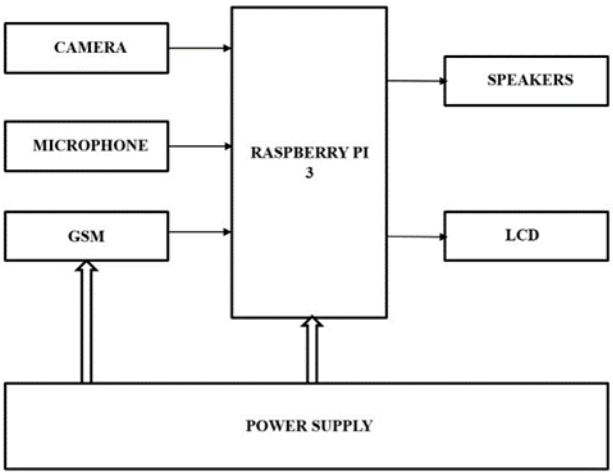


**Fig -1**: System Hardware Design

*3.2 GSM Module:*

GSM SIM 800L module is used in our system. GSM network consists of Mobile station, Base station subsystem, Network subsystem. SIM 800L is a cellular module which allows sending and receiving SMS making calls & receiving calls.

*3.3 Quantum QHM495LM 6 webcam:*

Quantum QHM495LM 6 webcam supports USB interface. The webcam is equipped with a 16 MP camera for capturing crisp videos. This is used to capture the gestures shown by a disabled person.

*3.4 LCD JHD 162A:*

LCD is used to display any message on screen. 16*2 LCD is used in our system, it constitutes of 16 columns and 2 rows.

*3.5 Microphone:*

An Omni directional microphone is used in our system. A microphone which picks up sounds from any direction equally is called an Omni directional microphone.

*3.6 Speakers:*

Speakers are transducers that convert electromagnetic waves into sound waves. Speakers are used in our system to produce speech output.

## 4. SYSTEM SOFTWARE DESIGN

The system software design consists of various phases which help in producing the end result. The software in this system is designed using Python language. Two separate program modules are designed for two modes. Open CV is an open source computer vision and machine learning library which is mainly used for image processing and operations related to images. The two modes are designed as follows,

*Mode 1:*

This mode assists the visually impaired, hearing impaired with the following method,

1) *Text input:* A text message is received from a mobile to GSM module. The GSM module gives the text to Raspberry Pi board, LCD.
2) *TTS:* That received text is converted to speech using a TTS (Text To Speech) synthesizer called eSpeak. TTS engine converts written text to a phonemic representation. Each text is scanned and converted into equivalent speech signal which is processed at pre-defined frequency to get audio output.
3) *Speech output:* Voice output for the corresponding text is produced through the speakers.
4) *Speech input:* The disabled can reply to the received SMS through giving input voice through microphone.
5) *SST:* Speech To Text is carried out using Google Speech Recognition system. It is the reverse process of text to speech.
6) *Text output:* the converted text is sent as SMS to mobile through GSM module.

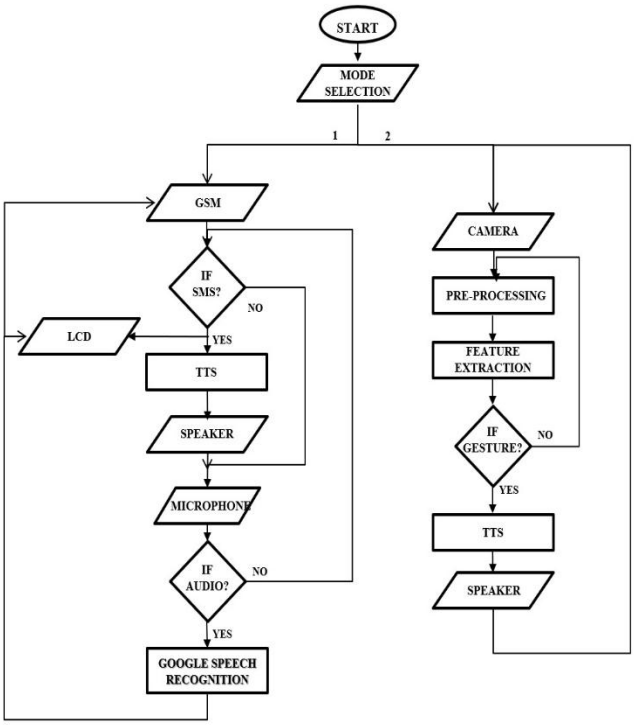


**Fig. 2:** Flow diagram of the system

*Mode 2:*

This mode assists the speech impaired people with the following method,

1) *Image preprocessing:* the gesture image from the camera is RGB which is converted to greyscale in the preprocessing.
2) *Feature extraction:* LBP (Local Binary Pattern) is used to separate the hand color from the background color and then it extracts the feature of each finger. SVM (Support Vector Machine) algorithm is used to ground the extracted feature of each finger.

3) *Feature matching:* The number of features in a gesture are counted and if matches with the pre-defined dataset, corresponding text is assigned to the matched feature.

4) *Speech output:* The corresponding text message is read out using eSpeak TTS which produces the Speech output for the given text.

## 5. RESULTS AND DISCUSSION

The Raspberry Pi is connected to laptop via Remote Desktop connection. The hardware setup constitutes Raspberry Pi 3 B, GSM module, microphone, camera, speakers, LCD.

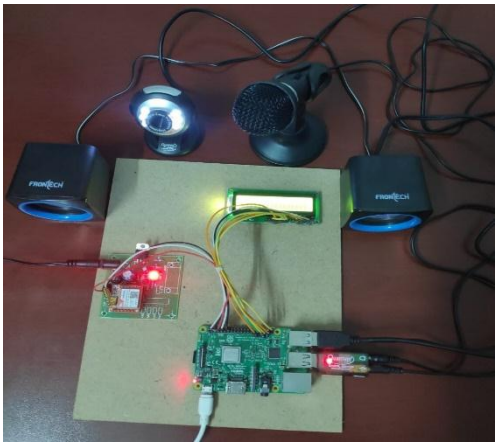

**Fig. 3:** Hardware setup

*5.1 Mode 1:*

In executing mode 1, the SMS is sent to GSM module through mobile and speech output is produced in the speakers using eSpeak TTS. Also, displayed in the LCD. For replying, the speech input is taken from the microphone, converted to text using Google speech recognition system and sent as SMS to mobile through GSM module. The screen shot of the SMS in mobile is shown in the Figure. 4,

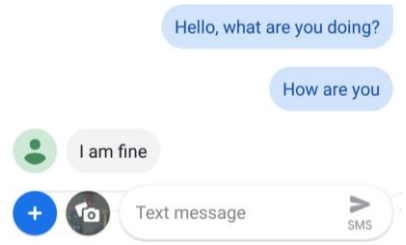


**Fig. 4:** SMS screen shot in mobile

*5.2 Mode 2:*

In executing mode 2, the gesture image is extracted using camera. Its respective predefined text message is converted to speech using eSpeak and is produced through speakers. Capturing gesture image and gesture recognition is shown in Figure. 5,

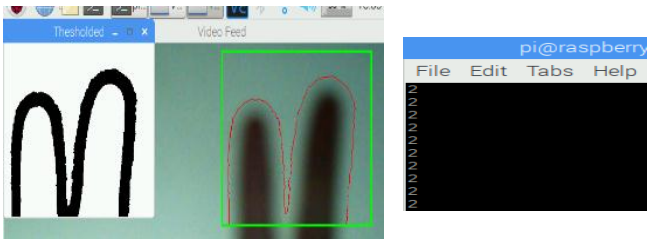


**Fig. 5:** (a) Capturing Gesture (b) Gesture recognition

## 6. CONCLUSION AND FUTURE SCOPE

The proposed system mainly aims to overcome the communication gap between the disabled and normal person. It also aims to provide the communication between the different classes of impaired people. This system provides intercommunication among visually impaired, hearing impaired and speech impaired people. It is easy to use and carry, as it uses simple hardware. The input is been tested for multiple times by considering various criteria. This system works for Text To Speech conversion and Speech to Text conversion, so it's a two way communication system.

In future, this project can be extended to using more than one mobile for sending and receiving SMS. More gestures can be stored in the dataset for gesture to speech conversion. More than one language can be implemented for reaching more users around the globe.

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