



A Self Assistive Device for Deaf & Blind People Using IOT

Kathu-Kann Thaan Thunai Eyanthiram

Vasanth K¹ · Mounika Macharla² · Varatharajan R³

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Abstract

This paper presents Google speech API based aid for deaf and blind people. The live streaming speech on the microphone is sent to Google API server which converts the speech signal into text and displaying onto a LCD screen and amplifies the speech via speaker. The aid will use Request procedure protocol to send the encoded Mp3 audio to Google API server where the speech signal is converted into suitable text and sent back to the Raspberry pi using repeated request protocol. This aid is designed to address issue with mild deafness and blind person. This will enable the deaf and blind persons to work effectively at home, office and any public places with ease. The aid works at low latency at good internet connectivity.

Keywords Google speech API · Hard of hearing literacy · Raspberry pi 3;multilevel IOT architecture

Introduction

Hearing and vision an essential part of how we interconnect with others and groups into sounds and pictures that take place in our immediate environment. The objective of the paper is to design an aid which is useful for person suffering from mild level deafness and permanent blindness. Generally deaf and blind person would rely on vision and sound to apprehend their environment around them. The hearing loss can be classified as follows

- Mild hearing loss 25 to 40 dB
- Moderate hearing loss 40 to 55 dB
- Moderate to severe hearing loss 55 to 70 dB
- Severe hearing loss 70 to 90 dB
- Profound loss 90

According to WHO (world health organization) report about 466 million people one deaf and blind in this world. In this 34 million people are kids. There is no cure rendered to these kids permanently but using the technology we could make their imparity disappear from their life. The literature survey gives knowledge of present systems and makes us do innovative technical developments. The information acquired has been enumerated as follows Yao chen et al. [1] proposal a technique that separate the target sound from a complicated background noise using acoustic modelling module to get expected output. Lotfi bendaoui et al [2] reduced the device size with less power consumption using discrete wavelength transform (DWT) on a field programmable gate array (FPGA). Mathews et al [3] did stimulation of ear shot assistive procedures which helped him improve delay sub band algorithms and equalization filters. Soon kwan et all [4] proposed the CI implants that uses PWM, FFT, DSP and CIs which improved the quality of the device. Chandari et al. [5] used a webcam that detects color and converts them into speech. Oliver oziokio et al. [6] developed a glove that communicates in both that way and makes life easy for deaf and blind persons. Siva kumar et al. [7] used touch sence to understand signals.

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✉ Vasanth K
vasanthecek@gmail.com

Mounika Macharla
macharlamounika85@gmail.com

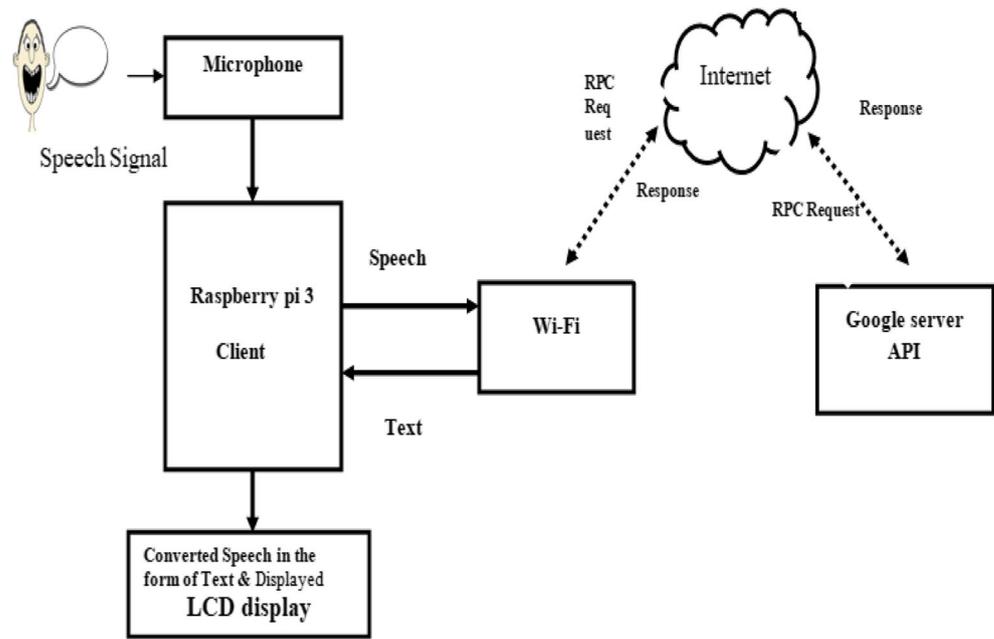
Varatharajan R
varathu21@yahoo.com

¹ Department of E.C.E, Vidya Jyothi Institute of Technology, Aziz Nagar, Chilukur Road, Hyderabad 75, India

² Department of E.C.E, Vidya Jyothi Institute of Technology, Aziz Nagar, Chilukur Road, Hyderabad 75, India

³ Deptment of Electronics and Communication Engineering, Sri Ramanujar Engineering College, Chennai, India

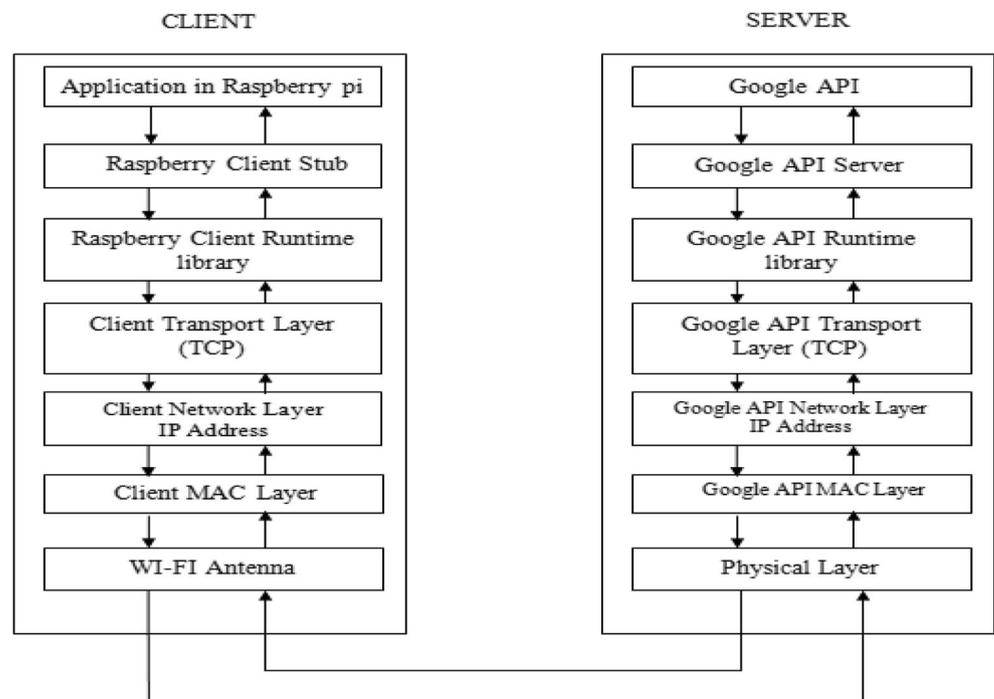
Fig. 1 Block diagram of the Proposed System



Mrimalfai, et al. [8] surveyed on app technology for tone deaf persons to link with the world. Girija et al. [9] establish the communication between disable person and normal person using wireless. Subbalakshmi et al. [10] used Mac based filter banks to increase the gain of the device in hearing aids. Ben et al. [11] developed a system that produces audio to text using reputation technique. Kumar et al. [12] proposed a system is helped for multi disable persons like deaf, dump and blind and converts sign language into speech. Priya darshini et al. [13] found the method to decrease cluster in digital hearing aids.

Nizghat et al. [14] introduced a software based analog data to text conversion which is used for disable persons. Matthias et al. [15] developed smart watch to identify shape recognition and consciousness of environmental echoes exists around deaf people. Radu et al. [16] used digital signal processor based hearing aids. Parul saxena et al. [17] proposed a methodology to remove unwanted amplitude segments and filter them to get derived output. Sethuraman et al. [18] introduced a methodology that reduced the communication gaps between normal people and deaf people. Maath et al. [19] reviewed the

Fig. 2 Remote Request Protocol between Raspberry client and Google API Server



authority judgment on D/HH literatures difficulties and display wisdom applications based outcomes. Hari Krishna et al. [20] introduced behavioral model for wireless hearing aid systems which is comprised of microphone, speaker, analog circuits, DSP circuitry, RF transmitter, modulation and demodulation. Sacristan et al. [21] implemented a system using tuned point, twos complement arithmetic with word length and decimal precision based on generic parameters. Rault et al. [22] acquired the speech from background and compressed the signal with feedback reduction algorithms. Prachi kibri et al. [23] used dissimilar speech recognition method and converted speech into written language which is 100% precise. Deepa et al. [24] developed software that permits one to study, identify their possible English language. It will also helps an add on feature which sustains the users communiqué abilities by script to speech conversion. Kevin lippert et al. [25] will describe some of the physical features which give us our audible range capabilities. The methodology formulated so far had good output with reduced size and operated at a very less power. The aids were created to offer high quality reception using high end processors with ease of transporting it and with consciousness of ecological sounds. Aids were more accurate, precise, and protective from sounds hazards of the back ground. An image based device capable of interacting with deaf and dump was used along with a device for hear and sight disability. The aids were also using high end feedback

algorithms that eliminates echo in hearing aids. The main drawback of existing aid is that it is barely visible, not easily portable, does not address multi disability issues, and differentiate noise from background, complex algorithms with reduced battery life. Hence a multi durable aid with reduced complexity and easy portable device has to be formulated. Section II illustrates the implementation of self assistive device and the role of Google speech API. Section III deals with hardware description of proposed work. Section IV deals with results and discussion and section V illustrate the connections of the work.

Hardware implementation of self assistive device with intellectual thinking for deaf people

Aids that address multiple disabilities are electronic gadgets used by means of people with moderate to profound Hearing Loss. They use a microphone to sense sounds that are then modulated (improved) and amplified to relaxed levels to help deaf person hear well. It's critical that word hearing aids do no longer restore hearing back to normal. Instead, we increase the analog speech signal energy and convert this into text the use of hardware and software program tool as shown in Fig. 1. Generally speech is pressure wave which is travel through air

Fig. 3 Flow chat of Google speech API converting speech to text

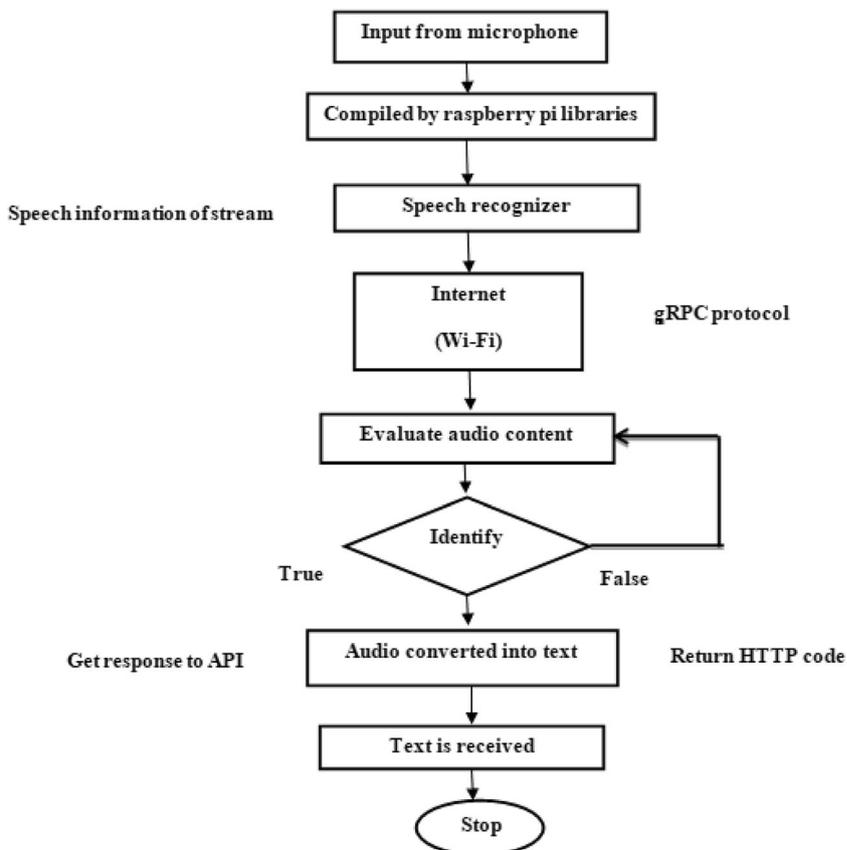
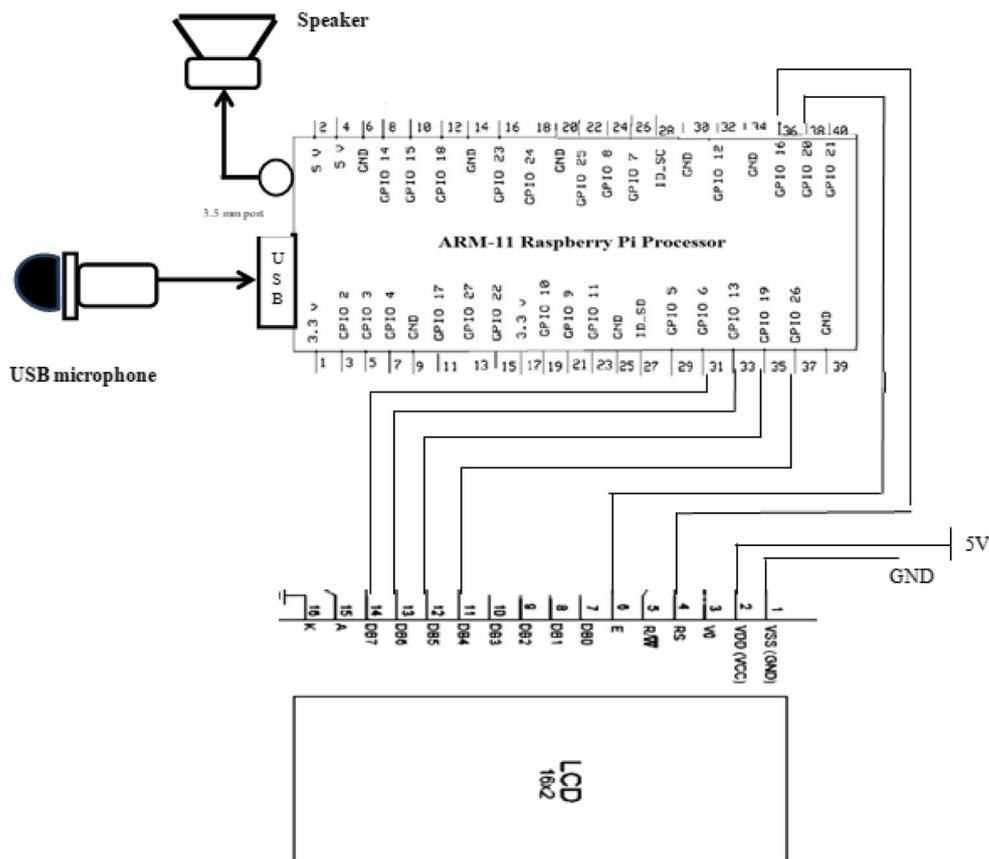


Fig. 4 circuit diagram of proposed system



varying from person to person. Normal human frequency range falls between 0.125 KHz to 12 KHz. This work converts of analog speech to text through a client server model and amplifies the audio as shown in the Fig. 1. This proposed system gives text output for the speech input through the remote Google API Server. The USB microphone is fancy electronic device which will convert the sound signals into electrical signals; it will capture the sound signals from all directions with eliminating unwanted noise of input signal. The USB microphone filtered output will provide to raspberry pi 3 boards through the USB port Raspberry Pi has memory unit (SD card) to run the software program on it. To transform the audio document to the text, a request is made to Google API server by raspberry pi board. The Salient feature of the proposed system is converting the live streaming speech signal

into textual content with the usage of Google server API. The block diagram of the proposed system is shown below in Fig. 1. The USB microphone will capture the speech signal and converts analog data into electric data which is given to Google speech API via the raspberry pi 3 boards and that audio record transcribed into the written text the usage of modules and instructions written in python language. To access the microphone with speech recognizer we want to install the PyAudio package in the raspberry pi and capture the input from microphone using listen method of the recognizer. This will record input from the microphone till a.

Predetermined silence is detected for a duration not less than 0.5 s. This duration will yield better results and clarity. The microphone input recorded in mp3 format (mp3 is audio compression with original high quality) and stored within the local file. A valid Speech is recognized by the speech synthesizer. Now, import the speech signal identified by speech recognizer as a source and specify the path details in the local storage. The noise from the recorded input is eliminated using

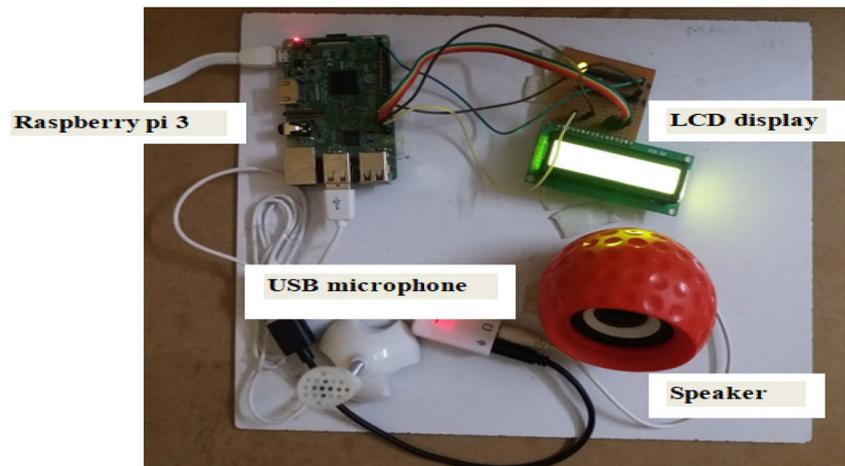
Table 1 Pin connections of hardware components

Raspberry pi pins	GPIO pins	LCD pins
38	20	RS pin-4
36	16	EN pin-6
37	26	D4 pin-11
35	19	D5 pin-12
33	13	D6 pin-13
31	6	D7 pin-14

Table 2 Pin connections of hardware components

Raspberry pi pins	Peripheral Devices
USB Slot	Microphone
3.5 mm Jack	Loud Speaker

Fig. 5 Hardware circuit diagram of proposed system



ambient noise method to recognize the noise level of audio. The communication between Raspberry pi and Google API server is done using Remote procedure protocol (RPC) (gprc) as shown in Fig. 2. The RPC makes a procedure call located in the remote server. The Raspberry pi and Google API server will have individual address space required during the procedure. The Process between client and server is initiated by the Raspberry client. The Raspberry application calls a local stub associated with raspberry client application. During the raspberry application development these local stub is compiled and linked. When this local stub is called the stub access the contents of the private address space and hands over to client run time library. This library converts the accessed parameters (Audio in the form of encoded format) into standard Network Data Representation (NDR) format for sending it to the Google API server via internet. The Google API is placed as remote host hence a suitable transport protocol (TCP in our case) is defined by the runtime library. Later, the RPC is sent to network layer where Internet protocol (IP) will give the IP address of the raspberry client. After specifying the operations of transport and network engine the encoded signals are sent to Mac layer as packet and sent via the WIFI to the internet. The RPC is sent via internet to the Google API server from a remote raspberry client. The transmitted RPC is received via suitable physical layer of the server (Ethernet) and later decoding the packet in the MAC layer and sends the received packet to the network buffer. Subsequently the runtime library

at the server side receives the request. Once RPC is received then the library calls for a Google API server stub procedure. This Stub procedure converts the NDR format into network transmission format. The RPC procedure run on the Google Server API and generates the output along with return value. In our case the generated output is the suitable text for the received speech request. The Google Server API will transmit the text to the Raspberry client via internet in the Network data representation format. The similar operation is carried out when the server serves the client with the required data. The raspberry client completes the request by receiving the text for the requested speech signal in NDR format and is later converted to form text vice versa operation. The flowchart of the proposed conversion methodology is given in Fig. 3.

The speech is received via a microphone which isolates the required frequency signal and sends it to a speech recognizer. The speech recognizer picks a valid speech and encodes in a Mp3 format. These audio signals are sent to Google API server using a Remote procedure protocol through the internet. The Google API server receives the request and evaluates the audio content and converts it into a text stream. These text streams are sent to the raspberry where the converted speech into text is displayed in the Liquid Crystal Display (LCD), which can be seen by the Deaf person. Simultaneously the converted text is also fed into a loud speaker where persons suffering from both blindness and mild Deafness will be benefitted as illustrated in Fig. 3.

Fig. 6 Indication of device



Fig. 7 Speech to text output on LCD



Hardware description of the proposed work

In this proposed system, a Raspberry pi acts as Processing unit. To which a microphone, a loud speaker and a 16X2 LCD display is interfaced, also the raspberry pi has an onboard WIFI module through which the processing unit connects to the internet. The above set up is considered as an aid which is beneficial for persons suffering from mild deafness and blindness. Hence this aid will help people with multiple disabilities. The transformed textual content received from Google API server is displayed at the LCD display screen. The Interfacing diagram of the proposed system is given in Fig. 4.

The proposed system uses 6 GPIO pins of raspberry pi, which are listed in Table 1 and the peripheral device connection is given in Table 2. The general purpose input-output pins are connected to the 16×2 LCD display and built the route to exchange the information.

A. Initialization Algorithm for the proposed work

The proposed work consists of Raspberry pi with on board WIFI, microphone and a loudspeaker. To explain the complete operation, the algorithm of the proposed method is outlined below.

A. Initializing Raspberry Pi

- Step 1: Power on the raspberry pi
- Step 2: Install the different modules required by Raspberry pi for interfacing.
- Step 3: All necessary files/Libraries are linked and compiled.
- Step 4: Interface microphone, onboard WIFI, Speaker to the raspberry pi as shown in Fig. 4.

B. Data Communication request from Raspberry client to Google API Server

Operations on the Client side (Raspberry pi side)

- Step 1: A speech is obtained via microphone; subsequently it is de-noised and sent to speech synthesizer
- Step 2: The speech synthesizer is a module coded in raspberry pi will check the speech is valid or not.
- Step 3: Audio file is encoded in MP3 Format and made in NDR format
- Step 4: Internet connectivity is established via WIFI
- Step 5: A Post command is sent to Google API server using HTTP protocol
- Step 6: Remote procedure protocol is issued by the client library of Raspberry pi.

Fig. 8 Device results on LCD



Step 7: A stub procedure is called that uses common memory space of raspberry pi.

C. Data communication in Internet

Step 1: Both Client and Server use TCP/IP protocol for data communication

D. Data Communication response from Google API Server to Raspberry client

Step 1: Remote procedure protocol is received by the Google API server.

Step 2: Server invokes a Stub to address the RPC received

Step 3: Google API server translates the encoded speech signal in text strings

Step 4: A Get command is sent to the client by the Google API Server

Step 5: Retransmission of data takes place on an uneventful transmission

Step 6: The text strings are returned to Raspberry pi.

E. Raspberry displays the string of results

Step 1: Raspberry receives the text strings from Google API server

Step 2: Raspberry pi displays the text strings in LCD 16X2

Step 3: Subsequently it amplifies the text in a loud speaker.

Results and discussions

The main objective of the proposed work to design an aid that works with people with multiple disabilities. The proposed aid works for people suffering from mild deafness and blindness. It will provide the outputs consisting of an amplified audio report and converted text form that is useful for the hard of hearing and blind people. The proposed system developed on Linux operating system. The hardware circuit of Fig. 5, the proposed system is tested with varies frequencies of a speech signal and it gives an expected output that speech to text conversion using Google speech API and speech recognition module, that's developed via the Python programming language. The indication of tool to take input is that text display on LCD as proven in Fig. 6.

The very last output of the speech recognizer is the series of letters that is decoding the speech into text shape. Now, this string output will show on LCD using GPIO pins on raspberry pi and LCD pin connection are shown in Table 1. The text output may be displayed on LCD like Fig. 7 and we will hear

the amplified audio from the speaker that is linked to the raspberry pi 3.5 mm jack port.

A good quality speech is detected as shown in Fig. 1. When a good quality speech is recognized for a definite time then a display indicating is shown in Fig. 7.

If we do not give the input properly, the device responds with the message "could understand the audio" and it shown on the LCD display as shown in the Fig. 8.

The proposed device is tested successfully, this output will help for the mild degree deafness people who are not hearing soft sounds and whispering sounds. These people lose their listening to-capable at 25 dB to 40 dB so we are technically improving the sound excellent to make them concentrate really. The aid helps people who are blind with the converted text is amplified through a loud speaker.

Conclusion

The Aid for helping for multiple disabilities in humans is developed by integrating using the modern technology at low cost with remarkable functionality. The proposed system is simple and the uniqueness of this work is that it uses network protocols that get speech converted into text and sound again with the help of Google API server. The proposed system aims at delivering a low cost simple solution for many who could afford costly aids.

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Compliance with Ethical Standards

Conflict of Interest No conflict exists: Vasanth Kishorebabu declares that he/she has no conflict of interest, Macharla Mounika declares she has no conflict of interest, Varatharajan declares that he has no conflict of interest. Ethical Approval: Articles do not contain studies with human participants or animals by any of the authors. The author has used augmented reality based hearing aid.

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