Smart Voice Assistive System for Speech Impaired People Using Raspberry Pi

A. SHANKAR GANESH
Department of Electronics
PSG College of Arts and Science
Coimbatore
shankar.psgcas@gmail.com

B.A. ANANDH
Department of Electronics
PSG College of Arts and Science
Coimbatore
anandh.ba@gmail.com

R. SAKTHIVEL
Department of Electronics
PSG College of Arts and
Science Coimbatore
rsgvel@gmail.com

D. MAHESH KUMAR
Department of Electronics
PSG College of Arts and Science
Coimbatore
dmaheshkumar76@gmail.com

***Abstract*---The main objective of the project is to help people with speech and hearing impairment to facilitate communication with normal people for their day-to-day activities. As everyone is not familiar with sign language, it is very difficult for people with speech and hearing impairment to communicate. In case of an emergency or other times when a speech and a hearing-impaired person is travelling along with new people, communication with nearby people or conveying a message or asking some details becomes very difficult for them, so here we proposed a smart-talking system that assists dumb persons to convey their information to other people using Raspberry pi. The system makes use of a speaker, Raspberry pi, 3.5- inch RPi touch display, virtual keyboard and a power supply. The raspberry pi is used for controlling the system and processing the data. The system consists of a Python GUI application, which stores sentences that helps speech and hearing impaired convey basic messages to normal people. The system can also be remotely programmed by using a personal computer which has Advanced IP Scanner and MobaXterm software installed on it, thus it has an entirely operational smart speaking system to assist people with speech and hearing impairment, communicate with regular people using this simple system which is more flexible to feed and remove information as per the requirement of the current situation**.

Keywords--- *Raspberry Pi, 3.5-inch RPi Touch Display, Python GUI Application, Speaker*.

I. INTRODUCTION

Disability is the biggest drawback in one's life. According to the 2011 census data of India, a total of 26 million suffer from some kind of disability [1]. As per World Health Organization, roughly 5% of the worldwide people, or 466 million individuals, suffer from hearing impairment [2,3]. Approximately 285 million people are visually impaired in theworld [4]. About 9.1 billion people are people with speech and hearing impairment in the world. They face plenty of problems in daily life due to hearing loss and speech impairment [5]. The communication between a speech and hearing impaired and anormal person is a disadvantage when compared tocommunication between blind and visual people.

The major communication among normal people is through speech. People with speech and hearing impairment are the minority in society. Normal people expect them to develop speech and to get socialized. But due to various factors like the nature of hearing loss, the structure and function of articulatory parts,availability of speech therapists, parents' involvement, etc. not everyone can develop speech. On the other side, the hearing people don't know sign language to communicate with them. It is also notpossible for the masses to learn signlanguage. Therefore, a large communication gap still exists between people with speech and hearing impairment and normal people. Advancement in technology makes many things possible in our day-to-day life. Assistive technology is devices that are adapted as per the need of persons with disabilities and are used to assist them to perform one or more activities. It is a boon to people with disabilities to overcome the hurdles faced by them. Text to speech system is an assistive device, which will be more useful for people with speech and hearing impairments to communicate with normal people.

A system is designed with a tiny credit card size computer named Raspberry Pi which helps speech impaired people to communicate with normal people more efficiently. Henceforth, this system is portable and translates the text into speech for speech impaired people who would be proficient to bridge the communication gap. The designed embedded system uses a Microcontroller, TFT-touch display, power supply and speaker which consume less power. This system is highly accurate and will produce speech based on the numerical input value fed by disabled people.

II. SYSTEM ARCHITECTURE

Fig.1 shows the architecture diagram of the implemented system. The system is controlled by Raspberry Pi 3 Model B+ and runs on Raspbian OS. After installing Python3 IDE in the system a GUI application is created using python. A 3.5-inch RPi touch display is attached to the system by the GPIO ports of Raspberry Pi. The device can display menu content and act as an input device for whoever is using it. Aspeaker is connected to the AUX port of the controller for audio output. A personal computer with an IP scanner and MobaXterm software is connected through Wi-Fi with the controller for wireless programming control to store and retrieve the sentences in the memory as per the requirement in the current situation of the user. The virtual keypad also can be used for the above-said process. A memory card is inserted in the memory slot of the controller to store the pre-defined phrases. The system operates at 5V and the power bank is usedas the 5V voltage source.

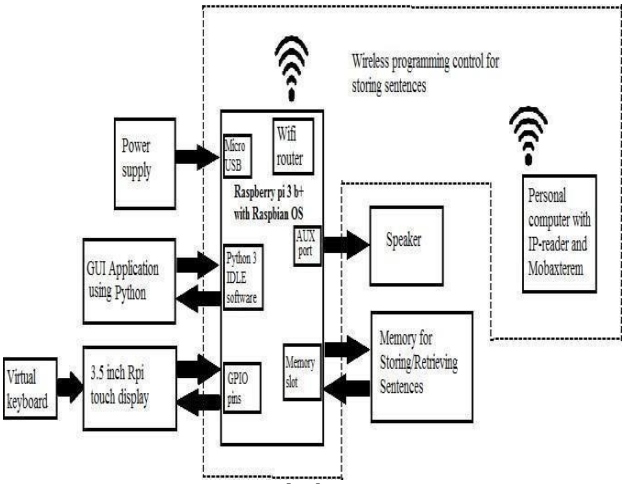

Fig. 1 Block Diagram

III. HARDWARE REQUIREMENT

A. Raspberry Pi 3 Model B+

Fig. 2 represents the Raspberry Pi 3 Model B+. It has a 64-bit quad-core Broadcom BCM2837B0, Cortex-A53 processor which runs at 1.4GHz speed. It has a 40 pin GPIO, an HDMI port, 2.4GHz and 5GHz dual-band wireless LAN, 300 Mbps Ethernet port, four 2.0 USB ports, and an SD card slot [6].

Fig. 2 Raspberry Pi 3 Model B+

B. Touch Display

This prototype uses a 3.5-inch RPi, 480 × 320 16-bit colour pixels and resistive touch, as seen in Fig. 3. It is somewhat larger than the Raspberry Pi 3 board, which makes it ideal for covering from the top [7]. The Pi is connected to the plate through a high-speed SPI interface, and the small display may be used as a console to display images or videos. It also plugs in on top and covers the Raspberry Pi. It uses the SPI and Power pins from the Raspberry Pi's GPIO pin, it just requires a single power supply from the Raspberry Pi, which is more than enough to power the screen.

Fig. 3. 3.5 Inch RPi Touch Display

C. Bluetooth Speaker

HP mini 300 Bluetooth speaker is used in this system. It has an inbuilt Lithium-ion battery which gives backup power for up to 8 hours. It consumes only 3 watts of power. This speaker is wirelessly connected to the system through Bluetooth.

IV. SOFTWARE REQUIREMENT

A. Raspbian OS

This is an open-source operating system based on the Linux kernel. A memory card is used to install the operating system on the board [8].

B. Advanced IP Reader

It is a trustworthy and open network analyzer for LAN analysis. The Advanced IP Reader is shown in fig.4a which helps in finding the IP addresses [9]. The Programme displays all network devices and allows programmers to host computers, helping in controlling computers remotely (through RDP and Radmin). It's very simple to use and comes with a portable version.

C. MobaXterm software

MobaXterm is the ideal remote computing toolkit which is shown in fig.4b. It offers a variety of services in a single Windows environment that is suited for administrators, programmers, and pretty much any user who needs to manage their distant tasks straightforwardly. MobaXterm is a portable executable file that brings all of the significant remote network tools and Unix commands to the Windows desktop [10].

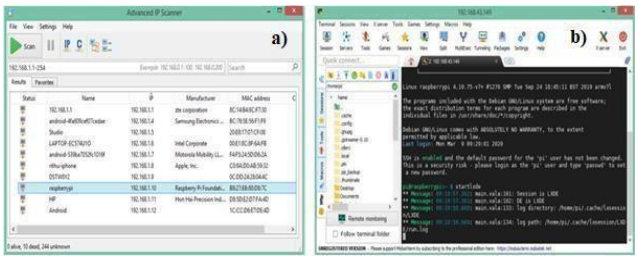

Fig. 4 a) The Advanced IP Reader b) MobaXterm software

V. System Function And Implementation

A. *Flow Chart*

The flow chart represented in fig. 5 depicts the full system function.

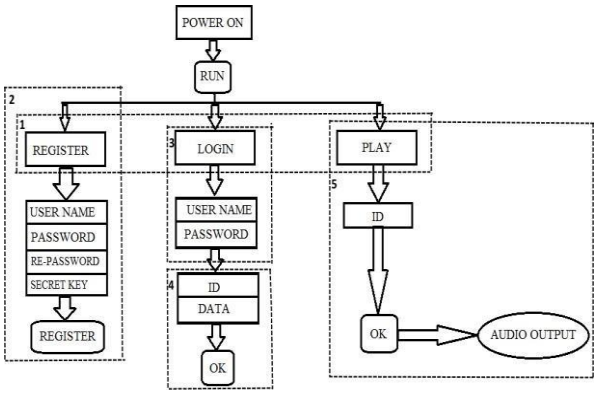

Fig.5 Flow Diagram

B. *Circuit Diagram*

The circuit diagram of the implemented system is depicted in fig. 6. The Circuit represents the interface of the touch display with the Raspberry Pi board. It also represents the interfacing of a speaker with the AUX port and Wi-Fi module communicating with a PC through an Advanced IP reader.

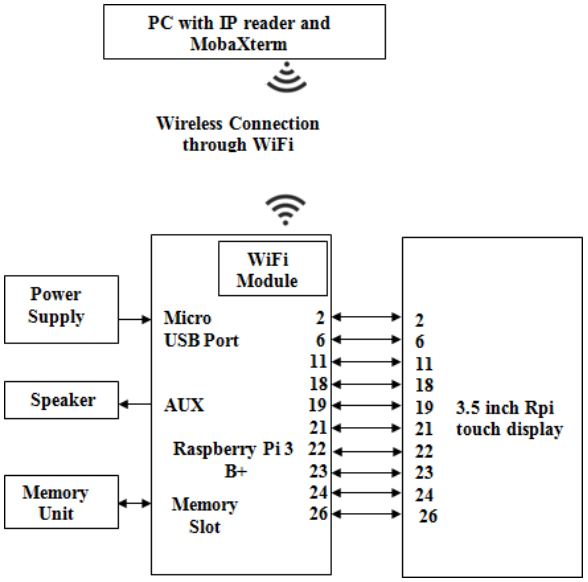

Fig. 6 Circuit Diagram

VI. Results And Discussion

Advanced IP Reader and MobaXterm software are used for wireless programming of the system. The controller should be connected to the same Wi-Fi network to which the computer is connected. The IP reader will display the IP address of the controller, then this IP address must be entered in the new SSH session of the MobaXterm. Now the controller can be programmed using the PC. The next step is to run the Python GUI application. The application displays three options in the menu screen (i) register, (ii) login and (iii) play which is shown in fig.7. The registration is shown in fig.8 and is the first step for the new user. In this process, the user must enter a username, password, re-enter the password and the secret key (00000) to finish the registration process. After registration, the user has to log in (Fig. 9) by using their registered username and password. The next step is to enter the ID (numerical value) and its corresponding data (phrases) as per the user's need which is shown in fig. 10. The user can store unlimited phrases using different ID's for corresponding phrases.

The Raspberry Pi is connected to an LCD and speaker. When the system is turned on it is ready with the pre-stored phrases with their corresponding numerical ID's. The speech-impaired person who is using the device can now play the programmed phrases by entering the ID's in the play options menu (Fig.11). When the person enters the ID of his choice, the corresponding phrase is delivered in audio format through the speaker. Fig.12 illustrates the entire real-time working system. If any additional phrases want to be entered, the user can login from the main menu and the additional phrases can be stored in the device. The same process can also be done remotely using Wi-Fi.

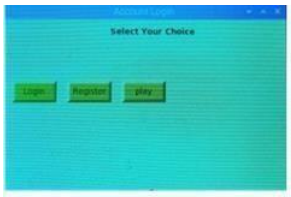

Fig.7 Main Menu

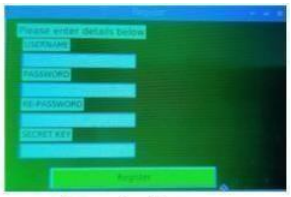

Fig.8 Registration Process

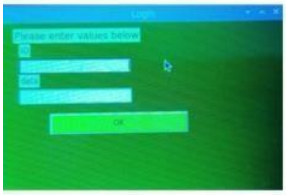

Fig.9 Login Process

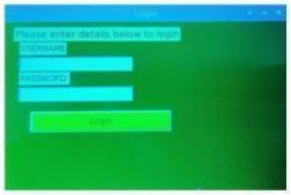

Fig.10 Phrase Storage Process

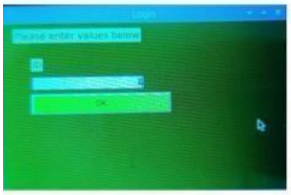

Fig.11 Play Process Menu

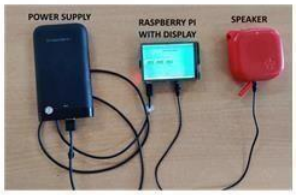

Fig.12 Real Time Working Setup

VII. Conclusion

The proposed system converts the text input given by the user to audio and helps the speech impaired people to convey their thoughts to the surrounding people. The difficulty faced by speech Impaired in communication can be overcome by utilizing this device. The system is more compact than any other device in the market and it can be easily carried to any place without any difficulty. Since we have a good power backup for this system, it can be used for long hours without any fear of power shortage for the device. The benefit of the system is, it requires less computational time, fast response

time in real-time usage, adjustable volume control, and can be programmed remotely by athird person to store the phrases or information in the device.

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