Bone Conduction Auxiliary Voice Data Processing for hearing Impaired Users

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***Abstract*- In this experiment, we have designed a GSM based Sound Bite hearing system allows people to hear the sounds via bone conduction to wear an intraoral device and a small microphone in the deaf ear to regain lost hearing. This device consists of GSM modem PIC controller and audio amplifier unit. GSM modem will receive incoming calls and automatically answer the call via AT Commands. Then incoming voice signal is converted into low frequency vibration signal that fed through the teeth to cochlea. Unlike implantable bone conduction hearing aids, Sound Bite requires no surgery. Rather, it is the world's first removable and non-surgical hearing solution to use the well-established principle of bone conduction to imperceptibly transmit sound via the teeth. Custom made for each person, Sound Bite is simple, removable, and totally non-invasive.**

Index Terms- Pic controller; GSM module; hearing aid; bone conduction; sound bite sensor

I. INTRODUCTION

Communication and Community are a hugely important part of life. But deaf people are cut-off from the usual forms of communicating and also deafness is the third most common disability in the world. This can be rectified by using various kinds of medical surgical treatments, which are costlier and high risk factor present in it [1].

Due to the emerging technology development, deafness in people can be rectified by using electronic devices and gadgets [2]. This deafness in people is caused due to three types of failures in the human ear classified as: Inner Drum failure, Middle Drum Failure and Outer Drum Failure. These failures can be removed by the bone-conduction principle [3].

We all hear sounds through both our bones (bone-conducted or bone-transmitted) and our eardrums (air- conducted or air-transmitted). Most sounds are heard by our eardrums. The eardrum converts the sound waves to vibrations and transmits them to the cochlea (or inner ear). However in some cases vibrations are heard directly by the inner ear bypassing your eardrums. In fact, this is one of the ways you hear your own voice. This is also how whales hear [3].

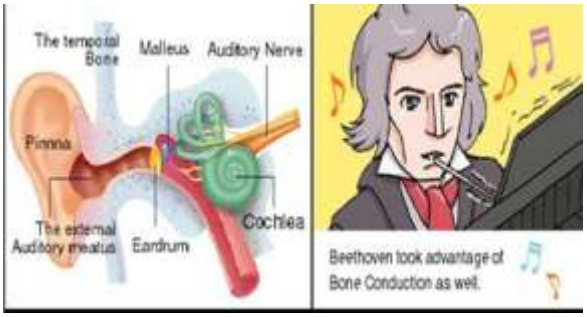

Fig. 1. Human Ear Architecture & Beethoven's Realization.

II. COST EFFICIENT SYSTEM

The proposed system consist of: GSM modem will receive incoming calls and automatically answer the call via AT Commands [1]. PIC microcontrollers (Programmable Interface Controllers), are electronic circuits that can be programmed to carry out a vast range of tasks. They can be programmed to be timers or to control a production line and much more [2]. Relay System to switch from playback device to GSM module and the vice-versa [3]. Vibration strip to be placed above the teeth in order to transmit sound vibrations into your cochlea through your teeth [4]. These devices are available at low cost, ease of

maintenance and risk free unlike implantable risky surgeries done in the medical field that are costlier and needs regular maintenance.

III. SYSTEM ARCHITECTURE

We have made the system architecture to be simple in order reduce the cost of this prototype. In case of original device the system design and architecture varies depending on the quality and features of the user requirements and emerging technology. There are different segments present in our system design, each one of them to perform their assigned task through the embedded system program coding techniques.

A. Block Diagram

The block diagram shows the diagrammatic representation of our proposed system effectively for clear cut overview and for understanding purpose.

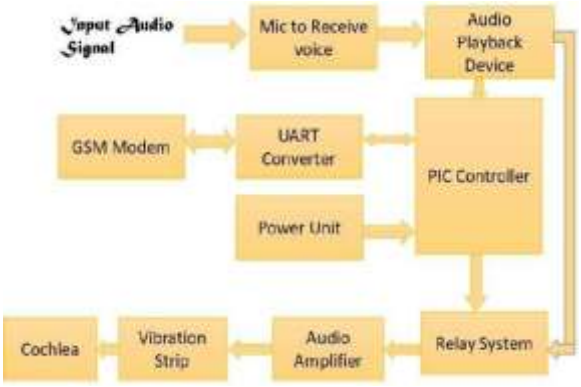

Fig. 2. Block Diagram of the System

Here the input signal is an audio signal, which is received by the mic. The incoming call is received by the GSM modem. Relay system acts as a switch between devices to operate at their stipulated time. PIC Controller (PIC16F877A) to transmit the sound to a piezoelectric actuator which needs very little power to generate the vibrations that travel through bone, which in turn sends those sound vibrations into your cochlea through your teeth. This way, the sound is transported from your impaired ear directly to your hearing ear.

1) PIC ASSEMBLED PCB:

This board is built with PIC16F877A as a microcontroller unit. The input supply to the board can be fed from both ac and dc. It uses a crystal oscillator for generating frequency. A serial communication is achieved by an UART protocol. This board is specially designed for connecting digital and analog sensors which has input voltage range 5 or 12VDC as well as it can be interfaced with serial communication devices, relay boards etc. The output can be monitored in LCD as well as pc. Data EEPROM is used to store data defined by the user. PCB design. When a variable is defined it is stored in program memory and the value of the variable is stored in data EEPROM Synchronous serial ports are used to communicate with other peripheral devices like serial EEPROMS, A/D converters and shift registers. PCB design. They have two modes. 1- SPI Serial Peripheral Interface 2- I2C Inter Integrated Circuit.

Fig. 3. PIC Assembled PCB

2) SIMCOM GSM MODEM:

This GSM Modem can accept any GSM network act as SIM card and just like a mobile phone with its own unique phone number. Advantage of using this modem will be that you can use its RS232 port to communicate and develop embedded applications. The SIM800C is a complete Dual- band GSM/GPRS solution in a SMT module featuring an industry-standard interface, the SIM800CS is a quad-band GSM/GPRS module that works on frequencies GSM850MHz, delivers performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption.

Fig. 4. SIMCOM GSM Modem

3) PLAYBACK MODULE:

WTV-SR is provided with mp3 mode, Key control one by one, parallel interface, one-line serial interface, three- line serial interface. It can record up to 252 segment voice (including fixed voice) and recording time up to 1600 seconds. It supports audio recording at 10 KHz or 14 KHz sample rate.

Fig. 5. 32 voice record/play back module

4) RELAY SYSTEM:

A relay is an electromechanical switch which is activated by an electric current. A single relay board arrangement contains driver circuit, power supply circuit and isolation circuit. A relay is assembled with that circuit. The driver circuit contains transistors for switching operations. The transistor is use for switching the relay.

An isolation circuit prevents reverse voltage from the relay which protects the controller and transistor from damage. The input pulse for switching the transistor is given from the microcontroller unit. It is used for switching of a single device

Fig. 5. 32 Dual Relay Board System

B. Softtware

In our proposed system, we have used MP-Lab IDE version 8.63. It is a proprietary freeware integrated development environment for the development of embedded applications on PIC and dsPIC microcontrollers.

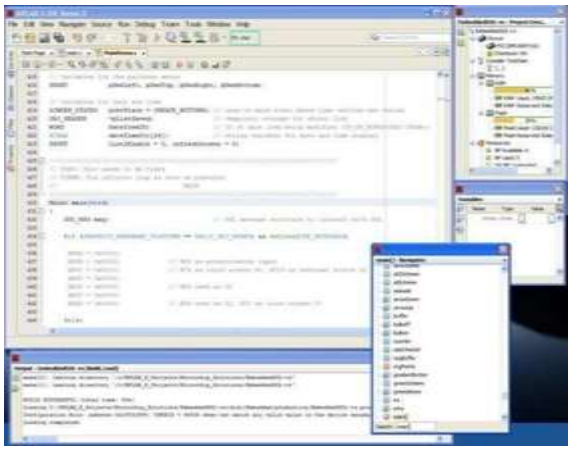

Fig. 6. MP-LAB IDE 8.63

C. Hardware

In our proposed system, we have implemented a simple hardware structure to ensure low cost and efficiency since, it acts as a prototype model. The overall hardware module of our proposed system is given as follows:

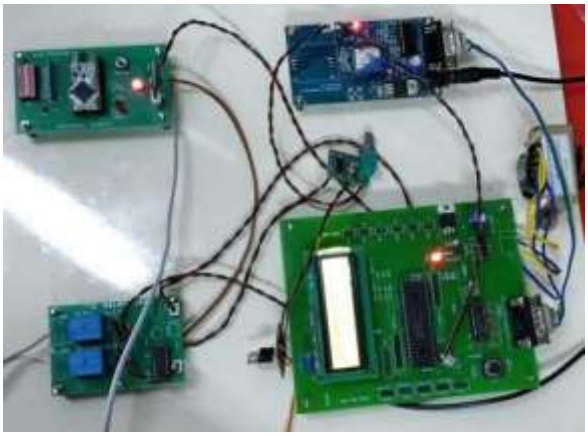

Fig. 7. Hardware Module of our Proposed System

IV. WORKING PRINCIPLE

This hearing device is designed to use the natural amplification of your ear to hear any sound that is coming from GSM Modem. It uses a digital processor (PIC16F877A) to transmit the sound to a piezoelectric actuator which needs very little power to generate the vibrations that travel through bone, which in turn sends those sound vibrations into your cochlea through your teeth.

This way, the sound is transported from your impaired ear directly to your hearing ear. This hearing device will be fitted to the upper or lower teeth in mouth. This doesn't require any of your teeth

to be altered, and the device can be inserted and removed easily. This hearing device is a flat piece (in Real- Time Product), which transmits the vibration directly to the cochlea through the bone conduction principle. Finally the audio waves are heard inside the inner drum present in the ear.

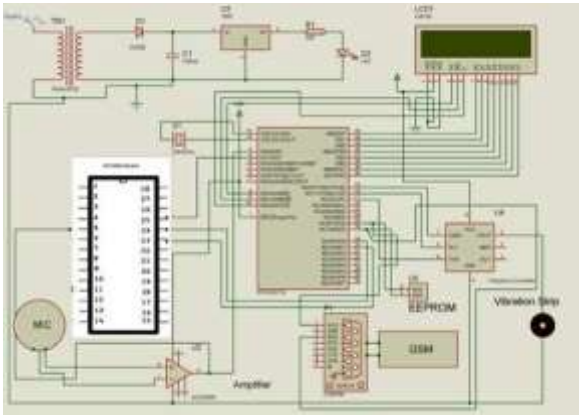

Fig. 8. Schematic Diagram of the Proposed System

V. CONCLUSION

Finally, through efficient utilization of this System helps to rectify the world's third most common disability (Deafness) without any implantable hearing aid surgeries, which are costlier and also risky process with small side effects. Our proposed system is cost efficient, risk free, less maintenance and ease to use. This will help more deaf people present in this world to get back their ability to hear as a normal person through simple process. This system will surely attain is contrasting heights because of the evolving technologies invented now a days.

VI. FUTURE SCOPE

Since it is a wired module in future it can be developed as a wireless module, later we can also integrate this project in mobile phones so that deaf people can enjoy all features in the mobile phones.

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