NON INVASIVE HEARING AID USING THE NATURAL AMPLIFICATION OF EAR THROUGH BONE CONDUCTION

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Abstract -- Several hearing aids have been invented for outer ear drum problems whereas inner ear drum problem is permanent and it can be fixed only by surgical means. This hearing aid is designed to use the natural amplification of ear. This device consists of an AVR controller, a GSM module, a playback module and a relay. Any signal that is received by the GSM module is transmitted to the piezoelectric actuator by the AVR controller which generates the vibrations that is sent to cochlea through the teeth. This way the sound is imported from the impaired ear to hearing ear. This device can be fixed on the teeth and no alteration of the teeth is required. It is completely non-invasive. The GSM module receives incoming calls and automatically answers the calls via AT commands. The playback module allows the user to hear music and receive the incoming calls giving priority to calls. A relay is used to switch between the music playback and GSM module. It is simple, removable and customizable according to the users will.

Index terms -- Bone conduction, AVR Controller, GSM module, Playback module.

1. INTRODUCTION

Communication is a major part of life. But deaf people are restricted from the normal form of communication and deafness is third most common disability in the world. This can be rectified by using various medical surgical treatments which are quite costlier. The human ear is separated into three sections inward, center and external ear. The eardrum changes over the sound waves into vibrations and transmits the vibrations into cochlea in turn which is connected to the auditory nerve system. Sometimes the sound wave directly goes into inner ear without the conversion. This is made possible through bone conduction. Whales hear through the process of bone conduction.

A well-known composer Ludwig van Beethoven found bone conduction in eighteenth century. He was hard of hearing and so as to tune in to the sound of piano he attached a string to the piano and gripped the other side of the string in his teeth. The vibration from the piano was transferred from the piano to his teeth. This proved that the sound waves or the vibrations can reach the inner ear through another medium.
2. LITERATURE SURVEY

The paper addresses the inner ear drum hearing misfortunes which does not amend the hearing misfortune but rather intensifies the sound waves, thus making it louder so that it reaches the cochlea. Hearing complications like temporal processing and abnormal spectral are complex and cannot be solved by amplification; hence it can be solved by bone conduction. The paper is about bone conduction devices which helps people with auditory impairment to regain their ability to hear without invasive surgery. They have also specified different bone conduction gadgets dependent on various properties.

3. BONE CONDUCTION

Bone conduction devices are utilized to exchange the sound vibration through the bones to the cochlea. Based upon the principle of conduction these bone conduction devices are classified into three major categories and they are

- (1) BCD based on skin
- (2) BCD using direct implants
- (3) BCD in the mouth

A. **BCD based on skin**

In these kinds of devices the sound vibrations are passed on with assistance of the skin and it won't harm the skin. These devices can be grouped into ordinary skin drive BCDs in which a large portion of the parts is outside the ear and the aloof transcutaneous skin drive BCDs in which magnets are embedded or fixed in an individual's body.

B. **BCD using direct implants**

In these sorts of devices, the vibrations are legitimately transmitted to the skull with assistance of a screw or through a skin infiltrating support. The most critical favorable position of this gadget over the others is, the transmission isn't hosed by delicate tissues. BCDs can be characterized into 2 sorts of gadgets percutaneous and dynamic transcutaneous devices.

C. **BCD in the mouth**
These sorts of devices depend on the way that sound is transmitted from the teeth to the skull, the sound vibrations are delivered by a piezoelectric actuator. The vibrations are remotely transmitted to the actuator inside the mouth and vibrations are sent from the teeth and after that transmitted to the cochlea through the skull and there is an amplifier which gets the vibrations, present at the back of the hard of hearing ear. This can be utilized for single sided hearing hindrance.

4. COMPONENTS

![diagram]

**Fig.2: AVR Controller**

A. **AVR CONTROLLER**

This AVR microcontroller has been used in many applications, mainly in prototyping of a project. This is an 32bit Reduced Instruction Set Computing (RISC) and it has on-chip programmable flash memory, SRAM and EEPROM.

| AVR          | PINS  | MEMORY   | FEATURES         |
|--------------|-------|----------|------------------|
| Tiny AVR     | 6-32  | 0.5-8 kb | SMALL SIZE       |
| Mega AVR     | 6-32  | 4-256 kb | EXTENDED PERIPHERALS |
| XMEGA AVR    | 44-100| 16-384 kb| DMA              |

These controllers are available in there categories,

- Tiny AVR
- Mega AVR
- Xmega AVR
i. **Tiny AVR**

This AVR is used only for simple applications such that it has a less memory varying from 0.5 to 8KB and also it is small in size.

ii. **Mega AVR**

Mega AVR is one of the microcontroller which having a good memory of up to 256KB. It can be used with many high-end applications because of the higher number of inbuilt peripherals.

![Mega AVR](image)

**Fig.3: Mega AVR**

iii. **Xmega AVR**

It is the microcontroller which needs maximum memory for storing programs because it has been used for compound applications. When comparing with all the other AVR’s it has the maximum speed.

B. **GSM MODULE**

GSM module is used in mobile communication. GSM stands for Global System for Mobile. Data services and mobile voice can be sent over/ transmitted over an open channel with the help of the GSM. It operates over frequency bands 800-1900 MHz. GSM uses TDMA (Time Division Multiple Access) for the communication procedure. Can even transmit at the speed of 120mbps. The module can be chips can use macro, micro, Pico and umbrella cells for architectural purposes. Each cell varies based on the principles. TDMA is the process by which each user is allotted with/over the same frequency band for the purpose of transmission of the data respectively. And the features of GSM are Improved spectrum productivity , International roaming, Compatibility with integrated services digital network (ISDN), Support for new administrators, SIM phonebook management, Fixed dialing number (FDN), Real time clock with alert management, High quality speech, Encryptions to make telephone calls secure, Short message services (SMS).
C. PLAYBACK MODULE

It is a single chip, high quality voice recording and playback module. WTV 040 can be operated using 3.3V or 5V microcontrollers directly. It has an inbuilt DAC and ADC. It is non-volatile and it uses flash memory, so no backup of battery is needed. It can record voice with any onboard microphone or any audio input. Also voice record up to 20 minutes and it is done at 4-8 kHz sample rate.

D. RELAY SYSTEM

A relay is an electromechanical switch which keeps running on electric flow. The relay board consists of driver circuit, power control unit and isolation circuit. The driver circuit in the relay board consists of transistors for switching purposes. The isolation circuit is used block the invert voltage from the hand-off which shields the controller and the transistor from harm. The input beat is given from the microcontroller for switching the transistor.

E. SOFTWARE

In our proposed system, we have used ATMELE Studio 6.2. Atmel studio is a part of a software suite known as Atmel which is an IDE that allows you to write programs in C/C++, compiles with a free compiler AVRGCC and produces files. It is free software used in the development of embedded application and AVR microcontroller.
F. SOUND BITE SENSOR

Sound bite sensor is a prosthetic device that transmits sound through the teeth. There are other surgical bone conduction devices, which require surgical implantation directly into the skull to conduct sound but this device is completely non-invasive. Conventional hearing devices which amplifies the sound can cause distortion for the patient. Sound waves travel through the medium (Bones) and reaches the inner ear through this device. It processes sound waves and wirelessly transmits the sound vibrations which can be picked up by the cochlea.

5. WORKING

This hearing device is designed to use the natural amplification of your ear. Any sound that is coming from GSM Modem, it uses a digital processor to transmit to the sound to the power unit which needs very little power to generate the vibrations that can 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. The hearing device will be fitted to the upper left or right teeth in the back of your 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) that contains a sealed rechargeable battery and electronics and wireless capabilities that can pick up sound transmissions from the behind-the-ear microphone.

6. CONCLUSION

Through the efficient usage of this system, it is possible to rectify and reduce the world’s third most common disability (deafness) without any implantable surgeries which are also costlier and might have side effects. Our proposed system is cost efficient, risk free, and less maintenance. This will help the deaf people to get back their lost ability through simple process. This system will attain great heights because of the fast evolving technology.

7. FUTURE SCOPE

Since it is wired module, in future it can be developed as a wireless module. It can be made more compact so that it can be carried in pocket like a mobile phone. Also we can integrate this system in
mobile phones so that deaf people can enjoy all the features in the mobile phone and no need of carrying the hearing aid as an additional gadget.

8. REFERENCES

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