IMPACT OF SIMPLE EAR-HEARING AID DURING COVID 19 ERA

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ABSTRACT
The ear is one of the most important sense organs which alerts one to changes that cannot be easily seen. For most animals it is early warming organ controlled by instinct, while for humans it is inevitable for effective communication. A hearing aid is electronic battery-operated device that amplifies and enhances sounds to allow for improved communication. Every conventional hearing aid has mainly three parts; a microphone used to collect the sound and convert into electrical impulse, an amplifier which modulate the electrical impulse making sounds louder and a speaker that converts amplified signal into sounds and feeds them into the ear. The main objective of this research is to implement a simple hearing aid using locally available materials and components. It improve the input state, pre-amplification stage, power amplification stage, output stage and power supply in order to determine the functionality and adaptability of the system.
Keywords: Microphone, earpiece, regulator, condenser etc.

INTRODUCTION

Keeping in view the global population of hearing impaired people in the world, there is huge market demand on hearing aid devices. Thanks to the micro electronics development, which attracts more and more the interest of industries attempting to exploit the micro-technologies for hearing aid devices (George *& Walter,* 2002).

A hearing aid is an electronic battery-operated device that amplifies and enhances sound to allow for improved communication. Hearing aids receive sound through a microphone, which then converts the sound waves into electrical signals. The amplifier increases the loudness of the signals and then sends the sound to the ear through a speaker. Every conventional electronic hearing aid has mainly three parts (Marion *& Michael,* 2003)

A microphone is usually used to collect the sound and convert into electrical impulses. Thus, reproduces the rise and fall of pitch of the sound (high or low) and the intensity (loudness measured in decibels) (Monein & Sharaf, 2002).

An amplifier modulates the electrical impulses and makes sounds louder. It has an integrated circuit comprising several transistors or a combination of integrated circuits. (Wu *& Liu*, 2003).

A speaker (earphone) converts the amplified signal into sounds and feeds them into the ear. Hearing aids have been around for centuries in one form or another. They have provided relief for the elderly who have lost the ability to hear clearly. Hearing aids also assist those who may have a hearing problem because of underlying medical issues (Michael , 2003).

The first version of a hearing aid was invented in the early 1500's. These early devices were crafted from wood and designed to look like the ears of animals known for excellent auditory perception. It was not until 1800 however, that hearing aids became consumer products. Manufacturers then created trumpet hearing aids, but they were only produced on a very small scale but were very large in size (Robert, 1999). The first well known product was a table top model. Obviously, only the affluent in the society could afford the model during this period.

Hearing aids effectively amplify sound especially voice and speech so that the patients has a better sense of what is being said around them. Although hearing aids have seen tremendous transformations over the years, the concept has remained the same.
(Wu & Liu , 2003).

HISTORY OF SIMPLE HEARING AID

Hearing aids have been developed for a long time since the year 1500 (Marion & Michael, 2003). The Greeks used shells and Romans had bronze funnels, but it was only in the 1800's that the first ear horns or trumpets were developed. In 1800's London FC Rein Company established itself as the first company to manufacture hearing aids on a commercial basis. In 1892 the first hearing aid was produced at the Pulitzer clinic in Vienna.

It consists of an earphone connected to a carbon microphone stened onto a battery box. Alexander Graham Bell is also credited as the first to build an earphone which amplifies sound for the hearing impaired (McAllister, 1995). The first commercial aid was the Akoulallion 1899, but this carbon ball invented in 1901 led to an increase in the quality and reliability of electrical hearing aids. An electrical hearing aid was used by the English Queen Alexandra for her coronation of 1902 (Yang *et al.*, '1999). The first vacuum tube aid was developed in England, consisting of a microphone, an earphone, an amplifier and two batteries. Vacuum tube technology rapidly became the hearing aid standard.

However, the new vacuum aid required two large batteries which usually last one day only (Trung *et al*, 2004). The transistor was invented by bell laboratory in which simple instrument were fabricated to make them smaller, cheaper and more effective. Other head worn aids are often attached to hair with a clip. Hybrid hearing aids combined both digital and analog circuitry. These were the first to include a digital chip and were a fraction of the size of previous hearing aids. Leading up to the 70's, behind the ear aids (BTE) almost fit behind the ear (Shahram, 2002). In the ear (ITE) aids became popular in the late 70's which are more reliable and smaller. The first programmable hearing aids were developed in 1980's. First digital hearing aid circuits are smaller to those in personal computers. Programmable aids allow user to control hearing in different situations (Marion & Michael, 2002).

The first fully digital hearing aid came out in 1997, while the first completely-in-the-canal (CIC) hearing aid was also announced around the same time. The completely-in-the- canal hearing aids now smaller than ever before, allowing truly "invisible" hearing for all. With the radio frequency (RF) technology and Integrated Circuit (IC) design development, a kind of wireless hearing aid was invented. At present, the wireless hearing aids are the research focus which would bring many advantages over the traditional hearing aids. The complement metal oxide semiconductor (CMOS) technology seems the most promising to provide high performance (Tinella *et al.*, 2001).

Hearing aid manufacturing is a highly technical and delicate task. Most of the hearing impaired persons' hearing losses are different from each other's hearing loss, so each hearing instrument has to be customized to match the User's exact needs (Ram *et al.*, 2004).

The elements which go into making a hearing aid should not be compared to a pair of spectacles which have mass-produced frames and lenses, but are actually closer to that of a sophisticated piece of specialist hi-fi equipment. As every patient's hearing loss in Unique, so every hearing aid is different. The type of hearing aid best suited to a customer depends largely on their type of hearing loss, in addition to physical and cosmetic Consideration (Robert, 1996).

Behind the ear (BTE) hearing aid, in the ear (ITE) hearing aid, in the canal (ITC) hearing aid, completely in the canal (C!C) hearing aid and cochlear implant hearing aid are a few range of styles and sizes of hearing instrument available in the market (Min & Hector, 2001).

Types of Hearing Aids.

Considering the fact that most of the hearing impaired person's hearing losses are different from each other's hearing loss, each hearing instrument has to be customized to match the user's exact needs. Here are some types of hearing instruments:

i. **Body Worn aids:** Fletcher invented the first type of hearing aid while working at Bell laboratory thanks to development in technology, they are now rarely used. These aids consist of a case, an ear mold and a cord. The case contains the amplifier components; the case is about the size of a pack of playing cards and is worn in the pocket or on a belt. The ear mold is connected to the case via a cord because of use of vacuum tubes. Body worn aids can provide loud amplification, this made them the first appropriate hearing aid for profound hearing losses. Today, body worn aid has largely been replaced by Behind-the -Ear (BTE) instruments (Shields *et al.*, 1998).

ii. **Behind-The-Ear (BTE) Aids**: Dictograph invented the BTE aid which of a case, a tube and an ear mold. The case is small and made of plastic. Generally, the case sits behind the pina (ear) with the tube coming down the front into the ear mold. The case contains the amplification system. The sound is routed from the hearing aid case

to the ear mold via the tube (Desloge *et al.*, 1997). The sound can be routed acoustically, or electrically. If the sound is routed electrically, the speaker (receiver) is located in the ear mold rather than in the case. It was created from an impression taken of the individual's outer ear. This usually ensures a comfortable fit and reduces the possibility of feedback. Ear mold are made from a variety of hard (firm) and soft (pliable,) materials.

The colour of the case and ear mold of a behind-the-ear (BTE) aid can be modified and optional decorations can be added (Koichi *et al.*, 1999).

BTEs can be used for mild and profound hearing loss. Due to the electrical components being located outside the ear, moisture and damaging of components are reduced. This increases the durability of a BTE aid and with proper case it can last for a number of years. BTES can be connected to assistive listening devices, such as Frequency Modulation (FM) system, is that it has the case of ear mold which was separated in order to make it easier and to replace. BTE aids are commonly worn by children who need a durable type of hearing aid. As children get older, they will require new ear mold on a regular basis.

Recent innovations in BTEs include miniature BTEs with thin hair-like sound tubes. These are often less visible than in-the-Ear ITE) aids. They use a larger vent than other hearing aid types. This keeps the ear canal more open, which allows sound to enter the ear without being amplified. This is helpful for listeners with normal hearing in the lower frequencies. Miniature BTEs are generally used for the mild to moderate high frequency losses. Behind the ear hearing aid (BTE) are usually cheaper, easier to adjust than other devices. It is fairly visible and usually more powerful, thus fewest number of problems with wax or infections (Farhand & Boroujeny, 1998).

iii **Completely In the Canal (CIC) Hearing Aid:** This cannot be seen and requires tight fit. It is hard to adjust and remove. CIC aid is so small that it is invisible. However, the battery capacity is limited, so the user needs to charge the battery more frequently. Behind the ear hearing aids are bigger in size than CIC aids. Hence more circuits can be built in with more functions, such as clearer voice (Hussain, 1999).

iv **In The Ear (ITE) Hearing Aid:** This device was fit the outer ear bowl. They are sometimes visible when standing face to face with someone. ITE hearing aid is custom made to fit each individual's ear. They can be used from mild to severe hearing losses. Feedback, squealing/whistling caused by sound (particularly high frequency sound) leaking may be a problem for severe hearing losses. Some modern circuits are able to provide feedback regulation or cancellation to assist with this. Another way to deal with feedback is venting. The vent is a tube primarily placed to offer pressure equalization. However, different vent sizes and styles can be used to influence and prevent feedback. Traditionally, ITE have not been recommended for young children because their fit could not be as easily modified as the earmold for a BTE and thus the aid had to be replaced frequently as the child grow. However, there are new in the ear (ITE) made from a silicon type material that mitigates the need for costly replacements.

(v) **In The Canal (ITC) Hearing Aid**: The visible and consumes less power than ITE. As a result, hearing impaired patients with tremor or poor eye sight are not good candidates for ITC and CIC aids (Trung *et al.*, 2004).

(vi) **Bone Anchored Hearing Aid (BAHA):** The Bone Anchored Hearing Aid uses the skull as a pathway for sound to travel to the inner ear. For people with conductive hearing loss, the Bone Anchored Hearing Aid was pass through the external auditory canal and middle ear, stimulating functioning cochlear. For those with unilateral hearing losses, the Bone Anchored Hearing Aid uses the skull to conduct the sound from the deaf side to the side with the functioning cochlear.

Individuals under the age of five typically wear the Bone Anchored Hearing Aid device on the head. Over age five, a titanium "post" can be surgically embedded into the skull with a small abutment exposed outside the skin. The Bone Anchored Hearing Aid sound processors sit on this abutment and transmit sound vibrations to the external abutment of the titanium implant. The implant vibrates the skull and inner ear, which stimulates the nerves fibers of the inner ear, allowing hearing (Bentler, 2000).

(vii) **Cochlear Implant Hearing Aid:** The sound was picked up by a directional microphone and sent from the microphone to the speech processor. Then the speech processor analyzes and digitizes the sound into coded signals. Coded signals are sent to the transmitter via radio frequency (RF). The transmitter sends the code across the skin to the internal implant. The internal implant converts the code to electrical signals. The signals are sent to the electrodes to stimulate the corresponding hearing nerve fibers. Finally, the signals are recognized as sounds by the brain, thus produce a hearing sense (Tsang *et al.*, 2003).

(viii) **Hearing Aid Batteries**

There are some rare instances that a hearing aid uses a rechargeable battery or a long-life disposable battery. The majority of modern hearing aids use one of five standard button cell zinc air batteries (older hearing aids often used mercury battery cells, but these cells have become banned in most countries today). Modern hearing aid battery cell types are typically referred to by their common name or the colour of their packaging.

They are typically loaded into the hearing aid via a rotating battery door, with the flat side (case) as the positive terminal (cathode) and the rounded side as the negative terminal (anode). These batteries all operate at 1 .35volts. The types of battery a specific hearing aid utilizes depends on the physical size allowable and the desired lifetime of the battery, which is in turn determined by the cower draw of the hearing aid device. Typical battery lifetime runs between 1 and 14 days, assuming 16 hours days (Chih *et al.*, 2003). The metal-oxide-semi conductor field effect transistor (MOSFET) spiral inductors and capacitors are often used in Low Noise Amplifier (LNA) circuits, the accurate radio frequency (RF) models are very important to predict the silicon performance of gigahertz circuits. The characteristics of transistor in low frequency are different from the one in high frequency. The parasitic effects of transistor should be included in the low circuit design, which are not included in the low frequency circuit design (Cabanillas *et al.*, 2002). So the transistor model for low frequency design is quite different from the model for high frequency design. Moreover, in high frequency, the inductance and Q value varies with the operating frequency, and capacitor also has parasitic effects. S inductor and capacitor models should also be studied carefully for correct design (Shields & Campbell, 1998).

(ix) **Hearing Aid Directional Microphone**

Most hearing aids has only one mini-directional microphone operated in the body unit. A mini-directional microphone amplifies more than the sound from the front & noise in different direction. This means that sounds originating from the direction the listener is facing are amplified more than sounds from behind and noise from a different directional microphone provides a better signal to noise ratio. Improving the signal to noise ratio improves speech understanding in noise (Welker, 1997). The microphone is the second best method to improve the SNR. The best method is the FM (Frequency Modulation) system. Many hearing aids now have both an mini-directional and a directional microphone. This is because speech often comes from directions other than in front of the listener. Usually, the mini-directional microphone is used in quiet listening situation (e.g living room), where the directional microphone is used in noisy listening situation (e.g. restaurant), the microphone mode is typically selected by using a switch. Some hearing aid automatically switches this microphone mode (Desloge, 1997).

Adaptive directional microphone varies the direction of maximum amplification. The direction of amplification is varied by the hearing aid processor. The processor attempts to provide maximum amplification in the direction of the speech signal. One disadvantage is that the background noise is often speech (e.g other talkers in a restaurant), this makes it difficult for the processor to select the desired speech signal. Another disadvantage is that noise often mimics microphone speech characteristic making it difficult to separate the speech from the noise. Despite the disadvantage, adaptive directional microphone can provide improved speech recognition in noise (Widrow, 2001).

Directional microphone is commonly worn best when the distance to the talker is small. In contrast, the FM (Frequency Modulation) system continues to provide a better Signal to Noise Ratio (SNR) even at large speaker to talker distance.

In 2003, the Federal Communication Commission (FCC) adopted rules to make digital wireless telephone compatible with hearing aid and cochlear implant through analog wireless wire which did not usually cause interference with hearing, aids Cochlear plant and digital wireless phones because of electromagnetic energy emitted by the phone antenna, back light and other components (Stanacevic, 2002). The FCC has set a timetable for the development and sale of digital wireless telephones that are compatible with hearing aids, this effort promises to increase the number of digital wireless telephones that are hearing aid compatible.

MATERIALS AND METHOD

Materials

There are various types of hearing aids but the one designed in this research is a simple hearing aid device. The utilization of available local materials and local technology were taken into consideration however, the simple hearing aid device is made up of the following:

Components:
Veroboard, Resistor, Capacitor, Diode, Battery, Earpiece, Switch, Condenser microphone, Speaker, Regulator, Transducer, Plastic casing, Battery plug, Transistor.

Vero board: Used for making permanent circuit and the components are Soldered

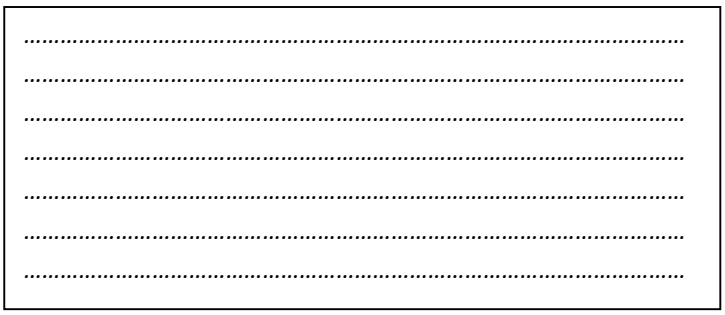


Figure 1a: The diagram of a vero board

Resistor: A component which provides resistance in an electric circuit resistors are used to reduce or limit the amount of current flowing in a circuit. It opposes the flow of current. This opposition is called resistance and it is measure in ohms (Ω). Large units of resistance are the Kilohms (KΩ) and the megohm (MΩ). A small resistor offers little resistance to the flow of current while large resistor offers a large resistance and thereby causes a small current to flow.

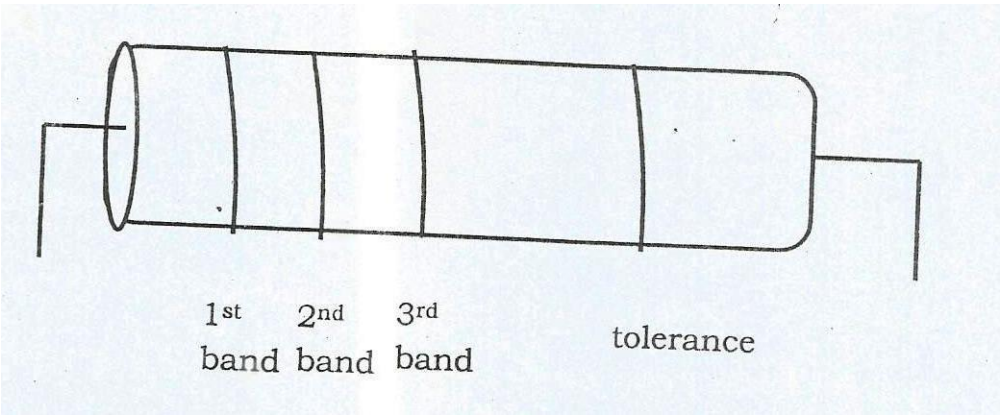


Figure 2: The diagram of a resistor

Capacitor: A capacitor which stores electric charge. It consist of two metal plate separated by an insulator called the dielectric. The capacitance of a capacitor is its charge storing ability and is measured in Farad (F).

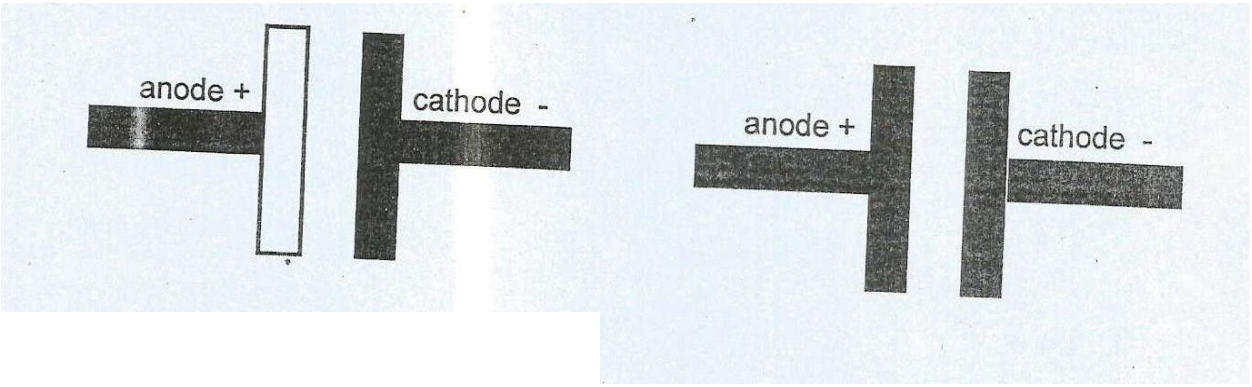


Figure 3: The diagram of a Capacitor

Diode: A semiconductor device which allows a current to flow through it one direction only. Diodes are made from germanium or Silicon and are commonly referred to as junction diodes due to the fact that they are made so that one

half of the material has a predominance of positive charge carriers, whilst the other half has a predominance of negative charge carriers.

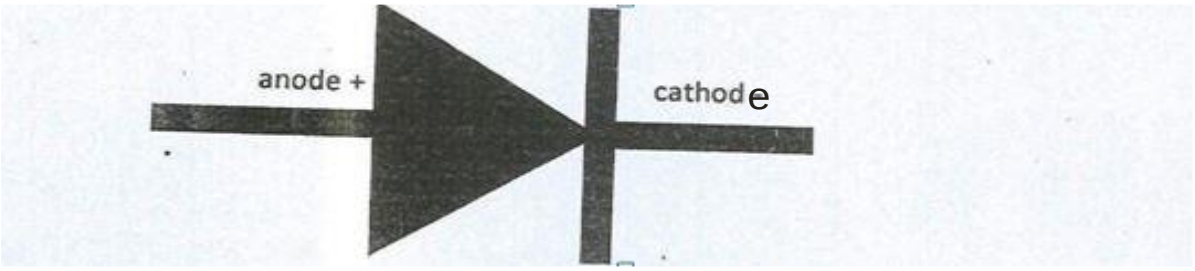


Figure 4: The diagram of a diode

Battery: This is a set of electrochemical or electrostatic.
Earpiece: A speaker placed inside or held to the ear.
Switch: A device to turn electric current on and off or direct its flow.
Condenser Microphone: A device used to convert Sound waves into a varying electric current, normally fed into an amplifier.
Speaker: An electromechanical transducer that converts an electrical signal into audible sound.
Regulator: A device that controls or limits voltage.
Transducer: A device that converts energy from one form into another.
Plastic casing: A plastic material which encloses or encases.

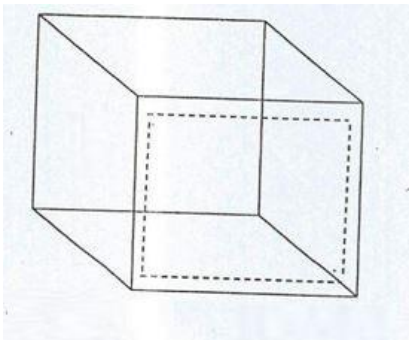


Figure 5: The diagram of plastic casting

Battery plug: A pronged connecting device which fits into a mating socket.
Transistor: A semi conduction device which is made either as a separate component or as part of integrated circuits where many are packed together in a chip. They are made from silicon or germanium, although today the silicon type is preferred to germanium as this can operate at higher temperatures. Transistors are of two types, The Bipolar Junction Transistor (BJT) and the Field Effect Transistor (FET) also known as the unijunction, although the bipolar transistor is more commonly used.

Transistors are the most important devices in electronic today, a device that can amplify, producing an output signal with more power in it than the input signal.

Bipolar Junction Transistor (BJT)

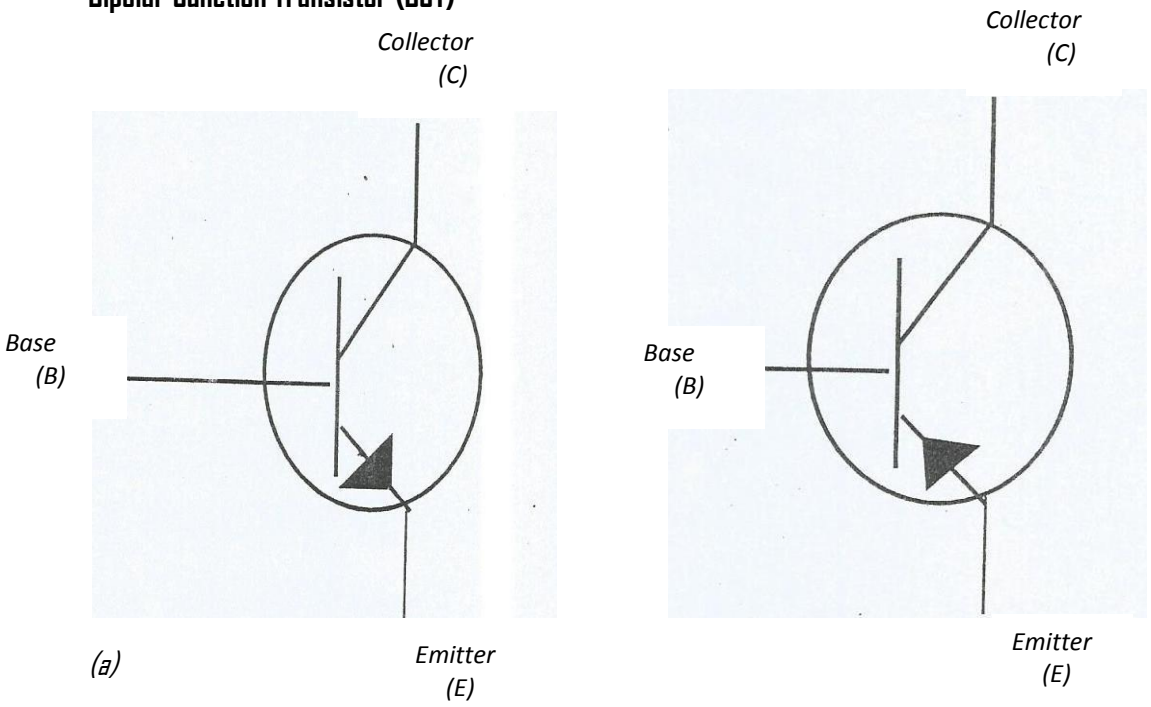
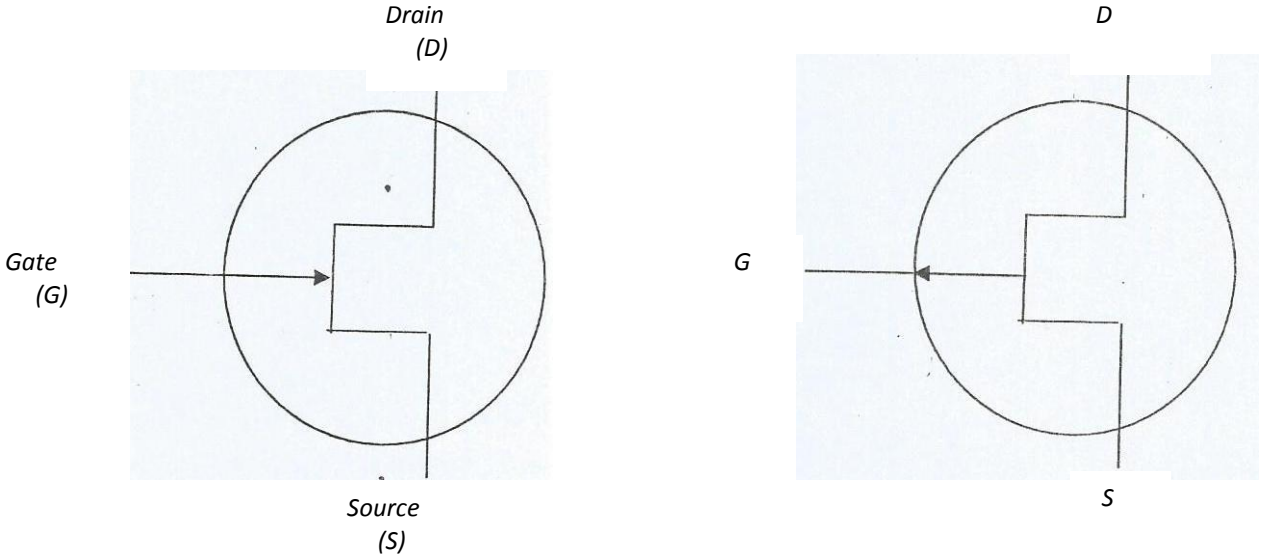


Figure 6a: The Field Effect Transistor



(b)

Figure 6b: The Symbols for different type of transistor

Testing of the Components

The evaluation process of the research work was carried out to determine the functionality and adoptability of the whole system. The following are various evaluation tests conducted.

- Evaluation before demonstration
- Evaluation after demonstration and assessment of the work.

Test of Resistor

Before assembling these components several tests were carried out using multi-meter to determine if they were in good condition. Multi-meter was used to test the resistors one by one with the probe of the meter connected to each legs of the resistor.

Visual Inspection

This involved physical inspection of all components to determine broken legs of components, dry joints and physical damage that might occur during mounting and soldering of the various components. This was carried out one after the other. It was observed that there were no broken legs or damaged components.

Smoke Test

The demonstration was subjected to test with power supply to determine its functionality. Power was supplied momentarily to observe if there was any smoke or heat from the component. It was observed that there was no smoke from the components after assembling. This meant that there was no damage by heat on the components.

Test of Capacitors

Multi-meter was used to test the terminals of the capacitor which was connected to the probes of the meter. It was observed that the meter was deflected rapidly to a maximum and then moved back to zero position. The rapid and sudden deflection of the meter implied that the capacitor was in good condition.

Test **on Volume Control**

During the testing it was observed that when the volume got to its maximum stage it produced a humming sound as the feedback. Then when the volume was reduced, the humming sound disappeared and gave a clear and good sound output.

Test on Battery

The battery was tested by inserting it into the hearing aid device and turning it on. While conducting test on the battery it was observed that when me battery was low it could only power the device but could not give the desired output until the battery was fully charged or changed.

Methodology

As a device that amplifies and enhances sound to allow for improved communication, the hearing aids have two or more stages of amplification. This chapter consists of the main stages which analyze the construction procedure of this research. The stages are listed below:

Input (microphone)

Pre-amplification stage, Power amplification stage, Output (earpiece), Power supply.

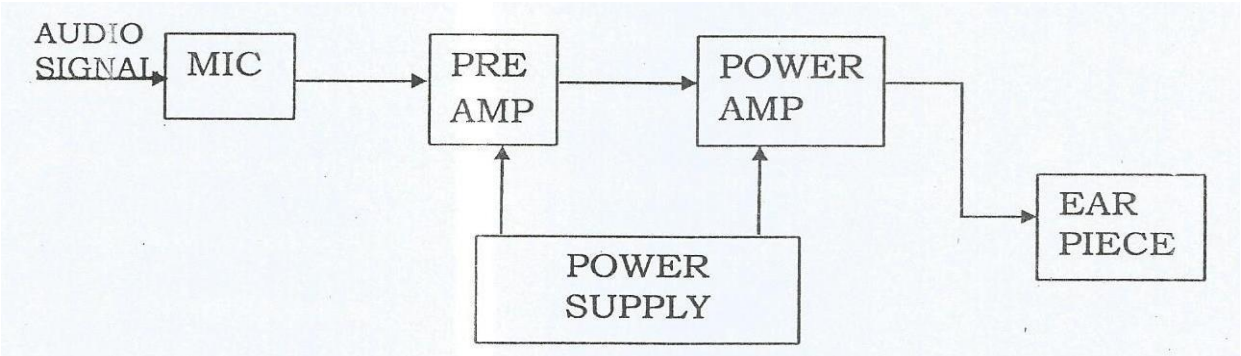


Figure 7: The block diagram of simple of a hearing aid

Input Stage (Microphone)

This input stage is the first stage, since it receives the sound with the help of a condenser microphone and prepares the input signal for amplification by the output stage. It works as a converter which converts sound into electrical signal. In this stage the signal meant for amplification is being originated .The signal received by the condenser microphone will be processed with the help of a transmitter to make it suitable for amplification. The process involves the conversion of an incoming sound signal into electrical vibrations to restrict the range of the audio frequencies and compress their amplitude range. Condenser microphone was chosen because of the overall best frequency response which makes it an ideal choice for this research.

Pre-Amplification Stage

In the pre-amplification or control amplifier stage, an electronic amplifier prepares electric signal for further amplification or processing. The main function of the pre-amplifier is to amplify a low- level signal to a high-level signal

from the source which is the condenser microphone. The pre- amplifier provides voltage gain but no significant current gain.

Power Amplification Stage

The power amplification stage is basically to provide the higher current necessary to drive the ear piece to a certain level.

Output Stage (Ear Piece)

The output stage is the portion which converts the weak input signal into a much more powerful replica which is capable of driving high power to the ear piece.

Power Supply

A direct current power supply of 9volts was used to power the circuit. Since there is no creation of energy according to the law of conservation of energy, the battery plays an important role in the circuit. Apart from powering the circuit, it formed an extra power that will make the input signal which to some degree would be amplified to a well hearing level. The proper use and understanding of batteries is important for a successful hearing aid. The basic understanding of batteries, i.e. size, current capacity and limitations of each type is important in assessing the different types of devices. The 9volts direct current battery used was because of the reliability of the battery since it will be used for a long time and its affordable. The output voltage is 9volts.

Overview

The basic components of this hearing aid include microphone, an amplifier, receiver and a power supply.

A microphone is the transducer that converts the sound signal into electrical energy. The pre-amplifier increases the amplitude of the electrical signal that is sent to the power amplifier. The power amplifier then changes the modified electrical signal back to into sound energy that is sent to the earpiece. Power is supplied to the hearing aid via a 9volts battery. Various microphone, amplifier and receiver are used depending on the type and degree of the hearing loss but in this case a condenser microphone is used.

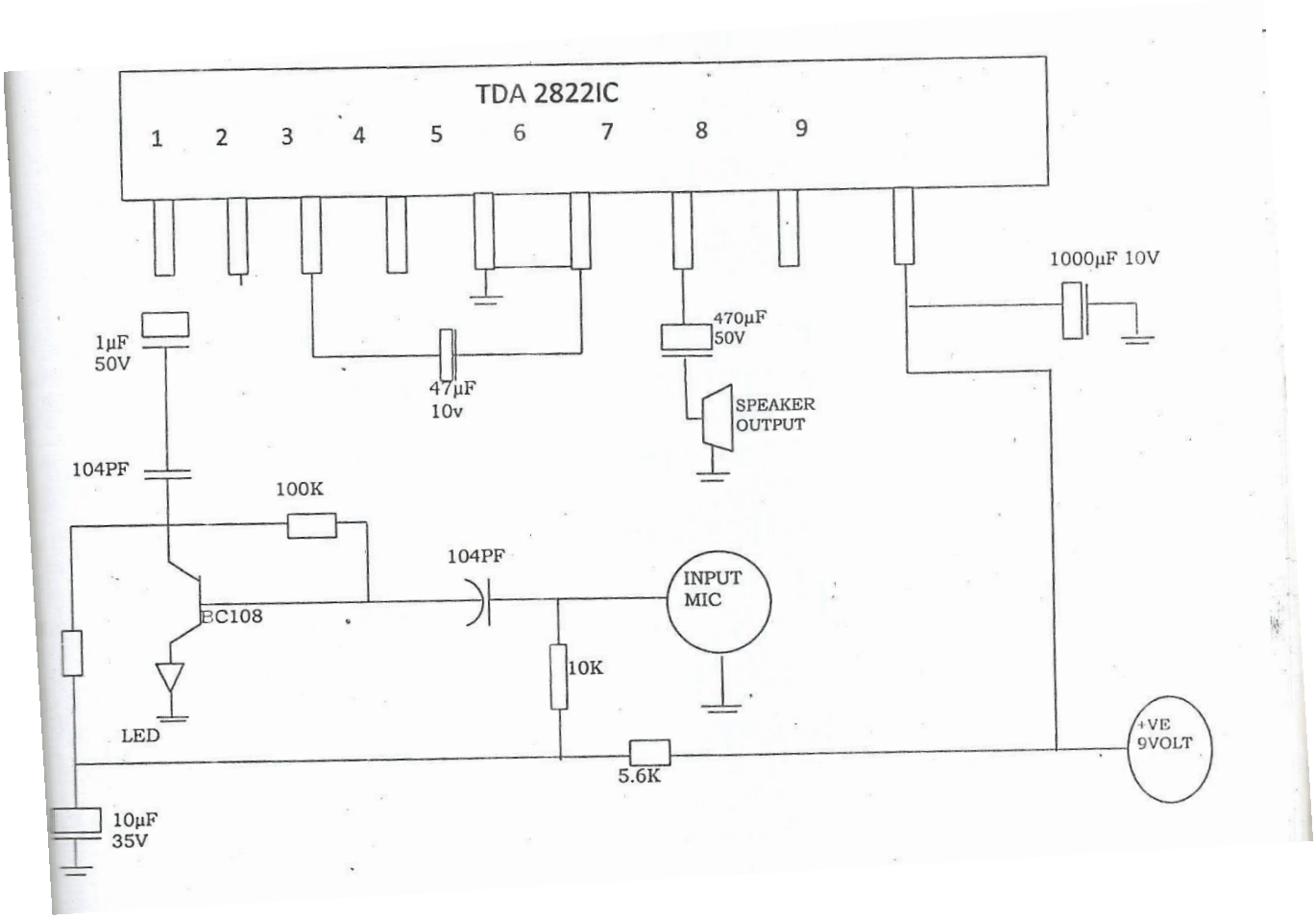


Figure 8: The general circuit diagram of a simple hearing aids.

The circuit is a couple arrangements with the initial biasing determined by the two resistors on the base of the transistor. The transistor is a common emitter amplifier.
The voltage on the base turns transistor ON. This causes the resistance between the collector to flow through the collector load resistor and emitter resistor.

In the circuit, transistor (BC 108) and associated components form the audio signal pre-amplifier for the acoustic signal picked up by the condenser microphone and converted into corresponding electrical signal. Resistor R5 (5.6k) and capacitor C3 (47volt) de couple the power supply of the pre-amplifier stage. Resistor R1 (10k) biases the internal circuit of the low voltage condenser microphone for the proper working. The audio output from the pre-amplifier stage is fed to the input of the medium power amplifier circuit via capacitor C2) and volume control.

The medium power amplifier section is wired around popular audio ampiffier integrated circuit IC TDA2822k. This integrated circuit specially designed for portable low power application is readily available in 9 pins. Here the IC is wired in bridge configuration to drive the 32ohm general purpose monophonic earphone. Red light emitting diode (LED) indicates the power status.

Methods of Achieving the Specific Objectives

i. By using locally available components the simple hearing aid device was constructed, rather than using foreign materials which would not be easily attainable in our locality as a result of importation.
ii. The aid can be made comfortable to wear by constructing a simple design which would be easier to adjust than other devices like in-the canal hearing aid. It would be fairly visible and more powerful, thus fewest number of problems with wax or infections. Therefore hearing-impaired patients with tremor or poor eyesight could be good candidates for this simple aid since they will have little or no difficulty using it as a result of its comfortability.
iii. A durable aid could be produced by using components which are tested and certified to be in good working condition. The utilization of locally available materials and local technology when taken into consideration would yield a cheap aid which would be easily affordable even by the poor, unlike the early aids which are expensive and owned by the affluent in the Society.
iv. A simple hearing aid with a high level of flexibility and precision, constructed with light weight components while employing the Radio Frequency (RF) technology and integrated Circuit (IC) design would result in low noise amplification and prevent feedback. Moreover adding these up in a functional yet simple aid would definitely make the aid a portable and user friendly one, unlike the early designs which were very big in size and had problems of feedback, wax and infections.
v. An effective human being is an effective communicator; optimized hearing is critical to effective communication. Modern hearing aids improve speech intelligibility and therefore communication. The evidence that hearing aids improve quality of life owing to the benefits of hearing aids (audiologically defined as improved speech intelligibility) have been demonstrated in rigorous scientific research. It would seem that if one could improve speech intelligibility by correcting for impaired hearing, that one should observe improvement in the social, emotional, psychological and physical functioning of the person with the hearing loss. The devastating impact of hearing loss on quality of life is that quality of life is primarily impacted by the fact that uncorrected hearing loss results in reduced speech intelligibility. However, the aid can help the hearing impaired live a healthy normal life in that hearing aids when fitted correctly improves speech intelligibility and therefore can restore ones ability to function more effectively in life.
vi. Discussing on the effects of hearing aid on the user, the research indicates that hearing loss is associated with: embarrassment, fatique, irritability, tension and stress, anger, avoidance of social activities, withdrawal from social situations, depression, negativism, danger to personal safety projection by others, reduced general health, loneliness, social isolation, less alertness to the environment, impaired memory, less adaptability to learning new tasks, paranoid, reduced copying skills and reduced overall psychological health. For those who are still in the workforce, uncorrected hearing loss has a negative impact on overall job effectiveness, opportunity for promotion and perhaps lifelong earning power. Few would disagree that uncorrected hearing loss is a serious issue. Specifically, hearing aid usage is positively related to the following quality of life issues:

Greater earning power (especially the top 60% of hearing losses).
Improved interpersonal relationships (especially for mild- moderates losses) including greater intimacy and lessening of negative dysfunctional communication.
Reduction in discrimination toward the person with the hearing loss.
Reduction in difficulty associated with communication (primarily severe to profound hearing losses).
Reduction in hearing loss compensation behaviour.
Reduction in anger and frustration.
Reduction in the incidence of depression and depression symptoms.
Enhanced emotional stability.
Reduction in paranoid feelings
Reduced anxiety symptoms
Reduced social phobias (primarily severely impaired subjects).
Improved belief that the subject is not in control of their lives.
Reduced self - criticism
Improvement cognitive functioning (primarily severe to profound hearing loss).
Improved health status and less incidence of pain. Enhanced group social activity.

Results and Discussion

For a long time, hearing impairment has been an inevitable severe problem in the medical community. However with technological evolutions, attempts have been made to provide hearing aids. With the increase of Integrated Circuit (IC) technology development, currently available hearing aid devices such as analog hearing aids, though help the patients up to certain extent but have the severe problems related with noise and echo. They do not satisfy user's need. With time, technology has been further advanced and it has opened a wider window to overcome such problems. More and more researchers show their interests in the, study of advanced hearing aid devices which give more benefit to the hearing impaired (George, 2002). Many of them focused on the issue of digital signal processing (DSP) method for noise cancellation, speech quality improvement, ultra low power consumption and lower price etc. However, there are a number of design challenges to bring the technology to the end user. It includes issues related with minimum power consumption, noise cancellation, size and portability etc.

Recommendations

An effective human being is an effective communicator; optimized hearing is critical to effect communication. Modem hearing aids improve speech intelligibility and therefore communication. This study clearly demonstrates that hearing loss is associated with physical, emotional, mental and social well- being. For some people uncorrected hearing loss is a "life and death issue".

Therefore this project construction and write-up is strongly recommended for the hearing impaired (from mild to profound hearing losses) to enhance their hearing capacity for effective communication. The write-up is especially recommended for those in the parts of the world where knowledge of hearing aid is not known to everyone.

The hearing aid is not recommended for people who do not have any problem with their hearing, the device is to facilitate hearing based on doctor's prescription and supervision. So for a person that has no hearing impairment, it will or may damage the auditory nerves as a result of the high level of output the hearing aid produces.

In construction, locally available material is recommended for this research work since they aid reachable and affordable. Like the battery which requires Continuous usage, there is need to change the battery when it runs down and replaced with a new one for quality output so rechargeable battery is recommended since it is more economical than buying new one each time it runs down. The use of mono-speaker or headphone is also recommended because using the two ears may be too high and Uncomfortable for the user.

This study challenges every segment of society to comprehend the devastating impact of hearing loss on individuals and their families, as well as the positive possibilities associated with hearing aid usage. Scientists need to help physicians recognize hearing loss for the important health issue that it is and help those with hearing loss who are currently in denial about their impairment, to understand the impact their hearing has on their life as well as that of their loved ones.

To ensure that hearing aids are recognized in society not just for their treatment of hearing loss, but also as a potential contributing factor to the successful resolution of other medical, emotional, social and psychological conditions.

This work is also demonstrates that individuals with even a mild hearing loss can experience dramatic improvements in their quality of life. This finding is significant because the challenge is to demonstrate to "baby-boomer&' (ages 45 - 59) with emerging hearing losses that hearing aids offer something to them of value early-on in their lives, and that they do not need to wait until retirement to receive the benefits of enhanced hearing.

Conclusion

Hearing aid is devices that in recent times has mitigated the predicament of the hearing-impaired and create a comfortable life for them. Basically, a lot has been discussed about hearing aid and it have been discovered that to be hearing-impaired does not necessarily mean that all hope is lost. The research had given the society more confidence that really facilitate in reducing the pains associated with this problem. Those with a mild, moderate or severe hearing loss who are still sitting on the fence are urged to consider all the benefits of hearing aids described above. Hearing aids hold such great potential to positively change so many lives.

In synopsis, this demonstration has changed the imagination of people, that most of the challenges in our society can be addressed with the use of locally available components in the science world.

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