LOW COST SOLUTIONS FOR DIFFERENTLY TALENTED IN OUR SOCIETY

by

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Abstract

In our daily life we see people with fully or partial deafness and dumbness. These people communicate among themselves using sign language. But these people are left alone from the rest of the society. Maybe because of their disability, or their fear/shyness to face the rest of the society, and live in isolated society of their own. We engineers can eradicate these unhealthy feelings of these less fortunate, but how? This paper gives an answer for this sensitive issue by providing information on, how the low cost hearing aid ($3.00 @ Feb.) and vocal aid ($3.50 @ Feb.) were designed and tested. At the time of writing, the laboratory tests are being carried out, and clinical trials have not been up to the level of expectancy.

1.0 Introduction

People with hearing and speech disabilities should not be kept in isolation; these people should be given opportunities to mingle along with the rest of the society. In Sri Lanka alone there are many thousands of people with partial hearing, and speech losses. In this category of people, most of them lost their hearing, oral communication at a tender age. These people cannot afford to purchase highly expensive hearing, and vocal aids. The commercially available hearing, and vocal aids are very expensive. The Hearing aid and vocal aid are preliminary approach in this regard. Hearing aid is capable enough to amplify speech signals within the range of 400 Hz to 4500 Hz.

2.0 Hearing Aid

2.1 Introduction

The hearing aid is a device that increases the loudness of sounds, in the ear of the wearer. The earliest hearing aid was the ear trumpet, which is characterized by a large mouth at one end for collecting the sound energy from a large area and a gradually tapering tube to a narrow orifice for insertion in the ear. The above (Fig. 1) shows the curve for Sensorineural hearing loss. Sensorineural hearing loss involves not only a reduction of sensitivity to sound as measured by the audiometric threshold, but also a predictable distortion of the perception of loudness growth. As the amount of threshold hearing loss increases, so does the proportion of abnormal loudness growth. This phenomenon is called recruitment. This kind of hearing loss can be overcome by the hearing aid thus designed.

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2.2 Design

Fig. 2

The hearing aid is capable of sensing frequencies in the range of 400 Hz to 4500 Hz which is the minimum requirement of a hearing aid. It is a body style hearing aid. The hearing aid consists of microphones, filter circuitry, amplification circuitry, earphone, and batteries (Fig 2). The amplification unit was designed using a cheap low cost, low power consumption audio amplifier (KA 2212). Provisions have been made to isolate the microphone, and the earphone to avoid feedback. This feedback is the cause of whistling noise commonly found among hearing aid users. This type of hearing aids are much better in minimising feedbacks than their counterpart: BTE (Behind The Ear type), ITE (In The Ear Type), and ITC (In The Canal type). (Fig 3). The unit has been designed with internal controls for input level adjustment, and has external volume control.

Commercially available Hearing Aids

Fig. 3

Types: ITE - In the ear, BTE -Behind The Ear, ITC - In The Canal

2.3 Implementation & Testing

The Aid, which can easily slide into a shirt pocket, weighs only 23 grams (with Batteries), and has a dimension of 75mm X 30mm X 20mm. To isolate both microphone, and the earphone from feedbacks. They were carefully placed inside a mould (as to minimise noise feedback). It was made out of epoxy resin (hardening agent was used in large amount than the filler). The unit was tested inside a sound proof chamber by applying various frequencies from a frequency generator, and the outputs were observed using oscilloscope.

2.4 Challenges

Sensing only the sounds related to speech, in a noisy area was a problem. To overcome the above problem three highly sensitive microphones were placed as shown below using an epoxy resin mould and was wired as mesh structure to increase the impedance to 19 kΩ. (Fig 4).

Fig. 4

Without the two AA size cells the circuitry is very small (i.e. 8 cm³). To minimize the cost, button type alkaline cells are not used in this aid. The ear mould was earlier made out of Teflon, but the level of skin irritation was somewhat high when compared to the epoxy resin mould, which gave promising results in this final design (Fig 5).

Fig. 5

3.0 Vocal Aid

3.1 Introduction

The commercially available vocal aids uses digital signal processing, and in some cases specialised ASIC (Application Specific Integrated Chip) are being used. The sound output is digital, a feature not very much appreciated by most Sri Lankan's, and of cause it is very expensive. In this particular design the speech output is analogue. It has been designed in such away as to be worn around the neck as neck collar (cosmetic aspect was also addressed) (Fig 6).

Fig. 6
3.2 Design

Both the microphone and speaker were placed in close proximity; isolation from feedback was established with the application of epoxy resin. The neck collar was made from cut pieces of synthetic material obtained from garment industry, with Velcro strap. The battery arrangement was kept far away from the collar inside a battery pack. The circuit was powered by two AA size dry cells.

3.3 Implementation & Testing

The aid was implemented using microphone, audio amplifier (KA2212), RC filters, and high impedance speaker.

Challenges

Obtaining a high impedance speaker for low cost, and size was a problem. Hence I used a impedance matching network at the output to match the impedance of the speaker (8Ω). Placing of microphones to capture the input signal was much challenging than designing a impedance matching network for the speaker. The same configuration given previously was used here except with a flexible resin mould (increased the filler content). With this configuration the mould easily touched the vocal code.

5.0 Conclusion

We Sri lankans can produce this kind of aids by an integrated effort by both engineers and doctors. Further clinical trials need to be carried out to make this a useful solution for the less fortunate in our society.

4.0 Acknowledgement

Mr. Sumathilaka: an engineering consultant attached to the OUSL, for giving me the idea, to do the hearing aid, and his guidance in the vocal aid. Mr. G.S.Gunasena, Senior lecturer OUSL for giving valuable reading materials, and to my numerous friends and colleagues.

6.0 References

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