Exploring a Microcontroller Based Hearing Aid with an Output Level Indicator

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Abstract:
This research explores the design and implementation of a microcontroller based electronic Hearing aid with output level indicator. The incoming sound oscillates the base of a transistor which in turn amplifies the signal at the collector. The output is interfaced to an ADC which converts the signal to digital output. After the conversion, the microcontroller processes the signal and further feeds it in to the DAC for an analog conversion. This output is now fed into the audio level indicator, LM3915, to indicate the level of the audio signal at the ear phone.

Keywords: Microcontroller, Hearing Aid, Digital, Ear, Noise, Electronics.

1. Introduction

Digital hearing aids can do wonders for faded hearing. With the technological advancement in the society, hearing aids can significantly enhance the quality of life for most people with hearing impairment. Therefore, the electronic hearing aid is designed to make sounds louder and therefore easier to hear. Also the design of the circuitry keeps the sound from becoming too loud and helps reduce the effects of background noise.

The two basic types of technology for hearing aids are analog and digital. The first to exist, analog hearing aids process electrical sound in the analog domain; the more recent digital hearing aids process electrical sound in the digital domain. The earliest analog hearing aids simply amplified both speech and noise, and were ordered after testing to determine the particular frequency response needed by the patient. Newer analog hearing aids can be programmed during the fitting process, and some have multiple listening profiles that the patient can select with a button on the hearing aid.[1]. Manufacturers are moving toward their third or fourth generation of digital products. Digital technology is more stable over time. There are fewer components to go wrong and fewer components that are susceptible to moisture and aging changes. This means that the sound you experience on the first day you receive the hearing aid stays consistent until the program is changed.[2] In recent years, there has been an increasing trend toward fitting BTE(Behind The Ear) hearing aids, including receiver-in-canal (RIC) instruments. It is estimated that 51% of the hearing aids fitted in the U.S. are BTE instruments, rather than custom products [3]. In a survey by Kochkin of 2500 hearing aid users, patients reported a desire for hearing aids that do not feedback (85%), fit comfortably (79%), and are less visible (52%) [4]. In this work, we will explore a digital hearing aid with Output level indicator (LM3915) using the microcontroller Atmel 89c52, analog and digital converters.

We preset in section 2 system design, section 3 principle of operation, section 4 user guide, section 5 Conclusion.

2. System Design

The system is designed in such a way that the output is an analog signal which needs to be converted into digital signal for onward interface to a microcontroller. In this work, the ADC was handy to settle the conversion problem. It converts the analog signal to digital signal. After the conversion processes, the microcontroller gives out a digital output which requires conversion back to its analog state. Hence, the output signal can be connected to a microphone to ascertain the nature of the signal.

This analog output is then fed into lm3915, an audio level indicator, to process and give a required graphic result of the signal strength. Apart from analog and digital conversions, the emphasis is also on the individual components of the devices employed and their relevance to the design.

Some of the materials used in this work are listed below:
Audio level indicator (LM3915)
Analog-to-digital converter (ADC0804)
Digital-to-analog converter (DAC0808)
Microcontroller (Atmel 89c52)
Resistors

Capacitors
Transistors
Light Emitting Diodes (LED)
Ear Phones

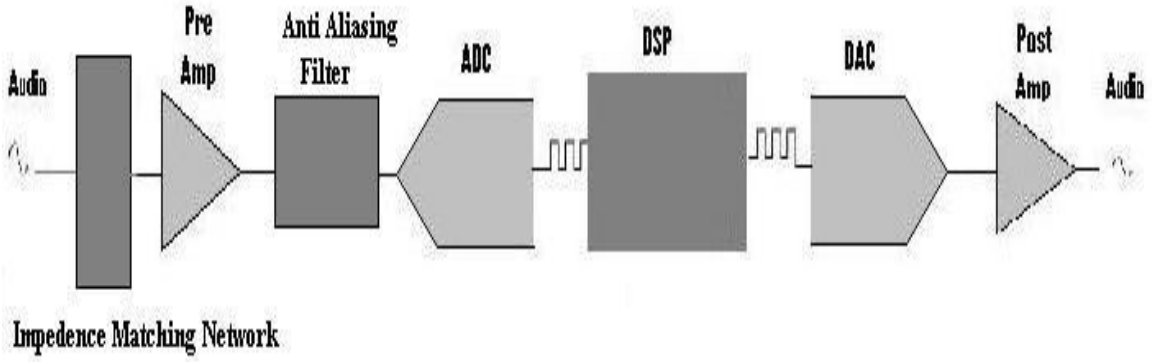

Figure 1: Block Diagram of Hearing Aid

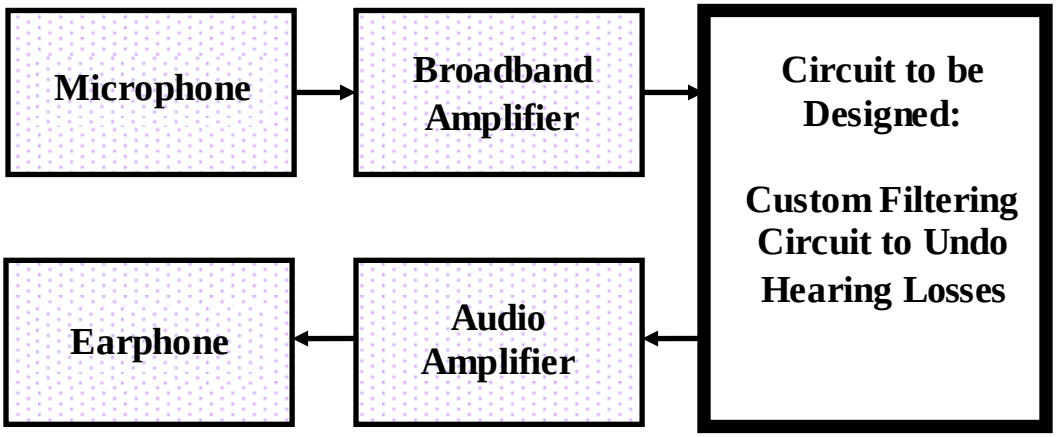

Figure 2. Functional Diagram of Hearing Aid.

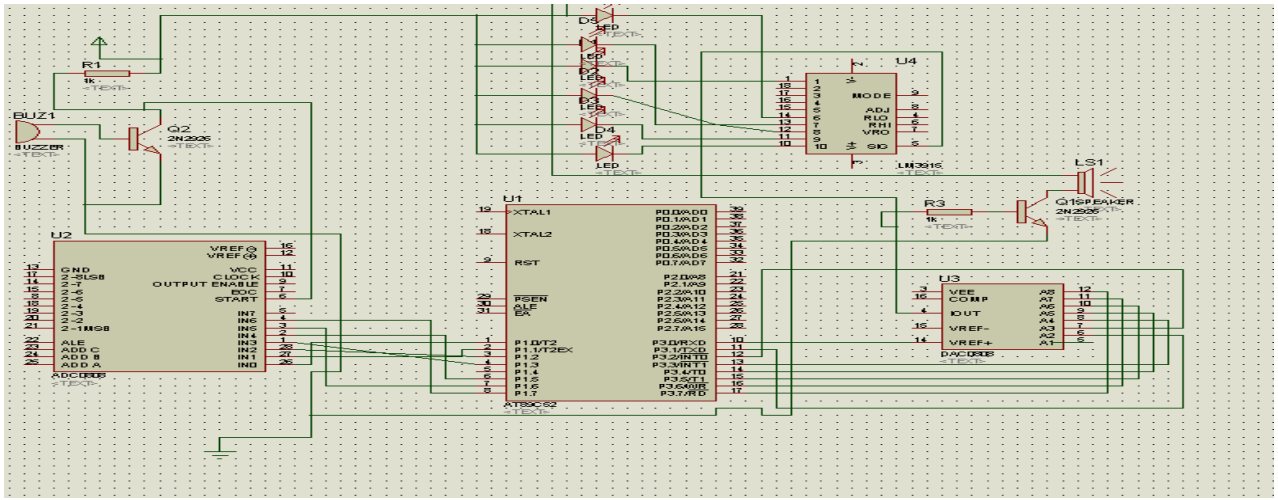

FIG 3. CIRCUIT DIAGRAM OF THE DESIGN

3. Principle Of Operation

The electret mic used in this project is positioned in such a way as to pick noise which is very suitable for hearing aid. The power supply should be 9V so as to pick small signal. The incoming sound oscillates the base of a transistor which in turn amplifies the signal at the collector. The output is interfaced to an ADC which converts the signal to digital output. This is necessary because the microcontroller cannot understand analog signal and therefore cannot process it. After the conversion, the microcontroller processes the signal and further feeds it in to the DAC for an analog conversion.

By so doing, the original signal is replicated at the other end, though in its amplified form. This output is now fed into the audio level indicator, LM3915, to indicate the level of the audio signal at the ear phone. However, this level can be controlled or adjusted according to one's desire, using a potentiometer. One end of the earphone is plugged into the jack on the system and the other end in the ear.

The subsystems of this work were interconnected or integrated to work as a system. The integration of this system is necessary so as to tailor each unit of the system to perform a targeted result. The transducer was interconnected to analog-to- digital converter to be able convert the analog quantity of the ambient temperature to a digital output. The ADC in turn was interfaced to a microcontroller for processing and giving its digital output to a DAC to reconvert to an analog signal. With all these interconnectivity, the different subsystems can now be said to be working as a system, in that they can interact with each other to produce a definite result.

USER GUIDE

To use the microcontroller based hearing aid, Power ON the switch and the red LED comes on. Plug in the Ear phones and Listen. The audio level is indicated by the five LEDs on the box. The loudest level is indicated by the yellow LED. Power OFF when not in use to avoid running the battery down. If the audio level LEDs glow continuously or do not correspond to the level of sound, then turn OFF the switch and ON again. If it persists, it could be as a result of either low battery or microcontroller lock up.

4. Conclusion

No matter what you do for a living, impaired hearing will affect your job performance. This is the information age and one of the primary ways to receive information is through hearing. The microcontroller based digital hearing aid can go a long way to achieve in people, increased enjoyment of social activities, improved ability to use the telephone, greater enjoyment of television and music, improved relationships and understanding of speech, increased ability to hear environmental sounds, increased self esteem and greater confidence. The design of the hardware using available components was achieved based on the principles of operation of individual electronic devices. The software program entails writing of programs that will drive the other subsystems to perform the desired operation.

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