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Monitoring and Analysis of Harmness Due to Wired and Wireless Headsets

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ABSTRACT: The Listening to music at loud levels is becoming more common and more accepted, as users tend to block out sounds around them in the streets, subway, or at the gym. While this can be very entertaining, it can also be detrimental, which is exactly where progressive hearing loss begins. This project aims to correct these issues with a sound level and temperature monitor system. The objectives of this design are to keep this system low-cost, user friendly, and seamlessly combined with any kind of headphones. The project acquires a sound signal using a 3.5mm audio jack or bluetooth headset processes it using a microcontroller, and relays it to an application that controls sound levels on an Android device. The headset works by constantly monitoring the volume levels in the headset and, if exceed a certain range, it will be reduced. The product development process lead to a product that is fully functional and effective in reducing the harm a user can cause to their hearing. This project hopes to generate a greater awareness for the potential consequences of extensive headphone volume use on a regular basis. Further improvement would account for children's safe sound levels and integration with wireless headsets. The final product is low-cost at around \$45, is small in size, and can be large produced since it meets all functional requirements and design constraints.

KEY WORDS: Headphones, ATmega328-Microcontroller, Audio processing circuit, Bluetooth driver modules, Transmitter and receivers, Application controller.

I. INTRODUCTION

In an era dominated by digital communication and multimedia consumption, headsets have become ubiquitous accessories for individuals across various sectors of society. Wired and wireless headsets offer unparalleled convenience, enabling users to engage in hands-free communication, immersive gaming experiences, and uninterrupted audio/video streaming. However, the prolonged and indiscriminate usage of these headsets raises worries about probable negative consequences on human health. This project aims to undertake a comprehensive monitoring and analysis of the potential harms associated with the usage of wired and wireless headsets. By employing a multidisciplinary approach encompassing technological assessment, physiological studies, and user behavior analysis, this endeavor seeks to elucidate the risks posed by prolonged headset usage and formulate informed recommendations for mitigating these harms. By means of methodical data gathering, examination and interpretation, this project endeavors to contribute valuable perceptions of the safe and responsible usage of headsets in contemporary digital environments.

A. Problem Statement

The human ear is a very intuitive and comprehensive organ that serves a significant role in general human functioning. While very dynamic and broad in the frequency range, the human auditory system is also rather sensitive, being susceptible to many types of auditory noise and interferences. These unwanted interferences can introduce hearing loss which will permanently damage hearing by causing wear or tear to the hairs or nerve cells within the cochlea, which transfers signals to the brain. In this modern day and age technology has grown rapidly and the way humans listen to music has changed drastically. Everywhere around us, we see people using headsets, either to listen to music or podcasts. With the constant development of various types of headphones or speakers, convenience becomes a more prominent factor and therefore a tendency of overuse begins to occur. However, progressive hearing loss requires treatment that is very expensive.

B. Objective

Wireless headsets emit radiation that can potentially pose health risks like DNA damage and infertility. Adding ferrite beads to wired headsets can help absorb RF Radiation, enhancing safety by filtering out a substantial portion of the radiation. To safeguard health and hearing, it is advisable to limit headphone use, maintain lower volume levels, and stay aware of surroundings whether using wired or wireless headphones.

II. LITERATURE SURVEY

- [1] A study discussed in a research paper analysed the reduced effect of electromagnetic radiation on the human brain from mobile phones when using Bluetooth headsets and earphones.
- [2] A report explored the dangers of wireless technology to one's health headphones and earphones, focusing on potential issues related to electromagnetic fields (EMF) technology, DNA damage, male sterility, and the differentiation from newer devices like earbuds.
- [3] Research investigated the impact of wireless Bluetooth earphones on human health, emphasizing the prevalence of these devices in daily life and their potential effects on brain health, cancer risk, genetic damage, reproductive system alterations, and overall well-being.
- [4] A comparison between Bluetooth and wired headphones highlighted the higher radiation emission from Bluetooth headsets, expressing worries about possible health hazards such as DNA damage, infertility, and thermal effects associated with RF Radiation exposure.
- [5] An auditory safety analysis discussed the correlation between wired headsets and radiation safety, emphasizing the higher radiation emission from wireless Bluetooth headsets compared to corded options.

III. BLOCK DIAGRAM AND ITS DESCRIPTION

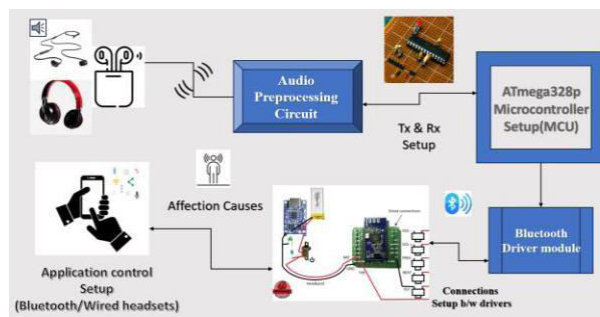


Fig. 1 Block Diagram

Microcontroller and Bluetooth Choice the original design of the project required the selection of a high speed microcontroller with ADC capabilities. This was due to the input coming from the microphone or headset. It was often high frequency and required a microcontroller that accounted for that. The Arduino Uno was first chosen for this application. The Uno was a great first board to test as, according to the ATmega328P datasheet, the Arduino Uno is equipped with a 16 MHz quartz, 6 analog inputs, a USB port, a power jack, an ICSP header, and 14 digital output/input pins. Arduino was additionally chosen as the board is inexpensive, open-source and easy-to-use. After the troubleshooting steps were performed, the size of the circuit had to be reduced.

A. ATmega328p Microcontroller:

The ATmega328p is an 8-bit microcontroller from Microchip, based on the AVR RISC architecture. It features 32 KB of flash memory, 1 KB of EEPROM, and 2 KB of SRAM. It has 23 general-purpose IO lines, 32 general-purpose working registers, and 3 flexible timer/counters with compare modes. The device can operate between 1.8 and 5.5 volts and can achieve throughput approaching 1 MIPS/MHz. It has a modified Harvard architecture 8-bit RISC processor core and features six power-saving modes. The ATmega328p is used in Arduino boards and is appropriate for many different purposes, such as power regulation, rectification, and DAC applications. It has a crystal oscillator, clock prescaler, internal oscillator, and serial communication module. It also has 28 pins, of which 20 are IO lines, and each pin is associated with one or more signals. The device has two 8-bit and one 16-bit timer/counters that can count

internal clock cycles or external events and generate an interrupt when reaching a specified count value. It also has six channels of 10-bit analog-to-digital converter (ADC) that can convert analog voltages to a binary value. The ATmega328p has a SPI (Serial Peripheral Interface) module that allows it to communicate with other devices using the SPI protocol.

ATMEGA328P Microcontroller

ULN2003A Pinout

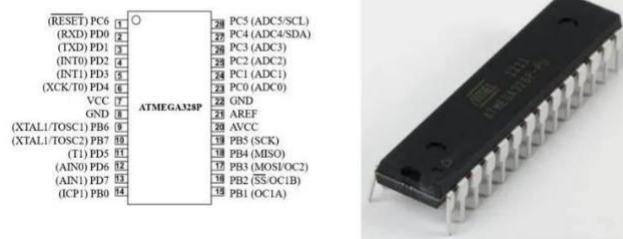


Fig. 2 ATmega328p-Microcontroller B. Bluetooth Driver Module :

B. A Bluetooth driver module is essential software that enables Bluetooth functionality on devices like computers and laptops. These drivers facilitate the communication between Bluetooth-enabled devices and the operating system. They are essential for developing connections with various Bluetooth peripherals such as mice, keyboards, and printers. Bluetooth driver modules come in different versions to support specific hardware configurations and operating systems. Regularly updating these drivers is recommended to ensure optimal performance and security of Bluetooth connections.

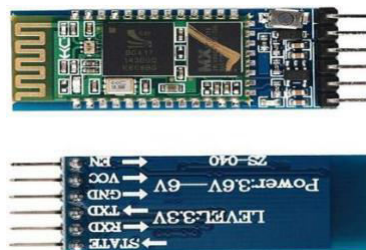


Fig. 3 Bluetooth Driver Module C. Wireless Transmitter & Receiver :

C. A wireless transmitter and receiver are electrical gadgets that let two or more devices to communicate wirelessly. The receiver receives a signal from the transmitter, decodes it, and takes the appropriate action. These gadgets are audio systems, where the transmitter sends audio signals to the receiver, which then plays the audio through speakers or headphones. They operate on various frequency bands, including 2.4GHz, 5.8GHz, and 6GHz, with the latter being less congested and offering more bandwidth. The transmitter and receiver can be paired with multiple devices, allowing for simultaneous communication between multiple devices. They are used in various applications, including audio systems, video transmission, and data communication.



Fig. 4 Tx-Rx

D. Wired & Wireless Headphones:

Wired headphones offer superior sound quality without signal loss, are reliable without needing a battery, and are typically more reasonably priced, although lack mobility due to cables and may require adapters for newer devices. Wireless headphones provide mobility and convenience with Bluetooth connectivity, advanced features like noise cancellation, and voice assistant integration but require a battery, can experience signal interference, and may be more expensive with potential sound quality compromises due to audio compression.



Fig. Headphones

E. Battery Usage:

Using rechargeable lithium-ion batteries for wireless headsets and nickel-metal hydride (NiMH) batteries for wired headsets. Rechargeable lithium-ion batteries, such as the ones used in wireless headsets like the Plantronics CS-50, CS-55, and CS-60, offer a longer battery life and are more cost-effective in the long run. NiMH batteries, on the other hand, are a good option for wired headsets as they offer a high energy density and are environmentally friendly. Additionally, you might think about employing using non-rechargeable AA or AAA batteries for wireless headsets that support them, as they can be easily replaced and offer a long battery life.

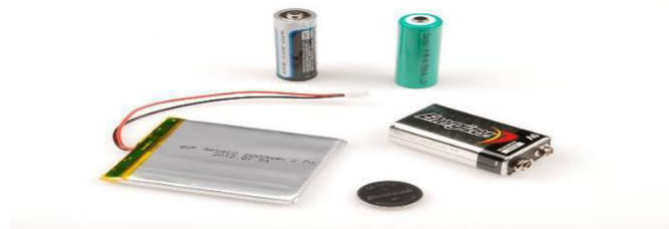


Fig. 6 Batteries

F. Audio Processing Unit:

Audio processing involves the manipulation and enhancement of audio signals captured from wired and wireless headsets. This process may include tasks such as filtering, equalization, noise reduction, and amplification to improve the quality and clarity of the audio output for analysis and monitoring purposes. Audio processing plays a crucial role in assessing the potential harm caused by headsets by analyzing the audio signals for any distortions, anomalies, or harmful frequencies that could impact the user's hearing or overall experience.

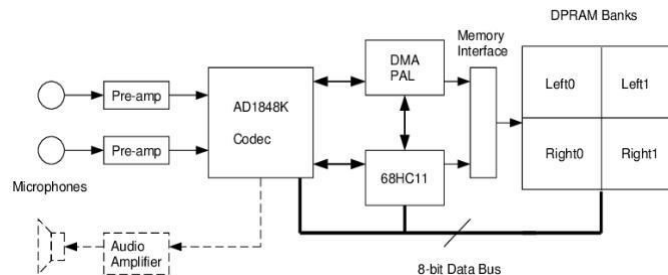


Fig. 7

IV. WORKING

Microcontroller and Bluetooth Choice the original design of the project required the selection of a high speed microcontroller with ADC capabilities. This was due to the input coming from the microphone or headset. It was often high frequency and required a microcontroller that accounted for that. The Arduino Uno was initially selected for this application. The Uno was a great first board to test as, according to the ATmega328P datasheet, The Arduino Uno is equipped with a 16 MHz quartz, 6 analog inputs, a USB port, a power jack, an ICSP header, and 14 digital output/input pins. Arduino was additionally chosen as the board is inexpensive, open-source and easy-to-use. After the troubleshooting steps were performed, the size of the circuit had to be reduced.

A. Detectable Faults:

- 1.Headset not being detected by the computer or device.
- 2.Low battery level on the Bluetooth headset causing connection issues.
- 3.Interference with Wi-Fi signals causing Bluetooth connection issues.
- 4.Bluetooth pairing settings not being correctly configured.
- 5.Damaged or faulty components in the headset, such as the speaker or microphone.
- 6.Distorted or low-quality audio output from the headset.
- 7.Ear fatigue or discomfort caused by prolonged use of the headset.
- 8.Overheating or overloading of the headset's battery or circuitry.
- 9.Compatibility issues between the headset and the device it is connected to.
- 10.Security vulnerabilities in the Bluetooth connection or headset software.

B. Benefits:

- 1.Understanding the potential harm caused by both wired and wireless headsets.
- 2.Identifying factors that contribute to harm, such as sound quality, battery life, and convenience.
- 3.Analyzing the impact of wired and wireless headsets on health and well-being.
- 4.Providing insights into the differences between wired and wireless headsets in terms of sound quality, convenience, and cost.
- 5.Offering recommendations for safer headset usage based on the findings of the monitoring and analysis process.

V. RESULTS AND DISCUSSION

1. **Comparative Analysis:** The study may reveal differences in harmness between wired and wireless headsets, highlighting factors such as radiation exposure, sound quality, and comfort.
2. **Health Implications:** Findings may discuss the potential health risks associated with prolonged headset use, including hearing damage, discomfort, and ergonomic issues.
3. **User Preferences:** Results could indicate user preferences for wired or wireless headsets based on factors like convenience, battery life, and audio quality.
4. **Technical Performance:** The analysis may delve into the technical performance of headsets, evaluating factors such as signal strength, latency, and audio fidelity.
5. **Recommendations:** The discussion could include recommendations for safer headset usage, ergonomic practices, and potential improvements in headset design to mitigate harmness.



Fig. 8 Hardware Setup Kit

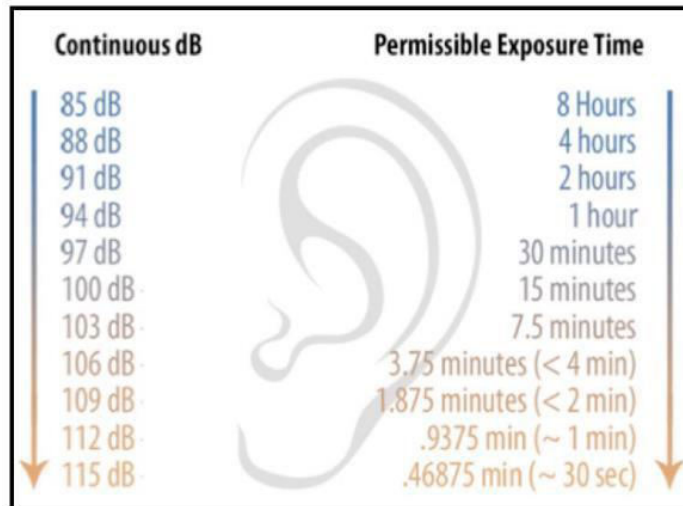


Fig. 9 Safe sound level and SPL and permissible exposure time

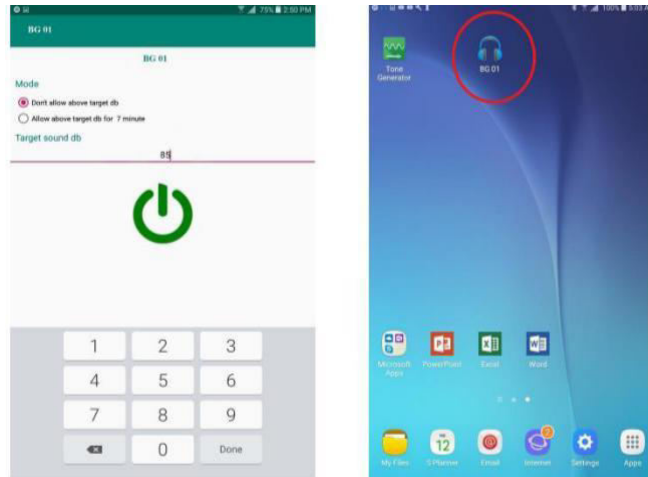


Fig. 10 Graphical user interface, Appearance of application named “BG01”.

VI.CONCLUSION

The project "Monitoring and Analysis of Harmness Due to Wired and Wireless Headsets" highlights the potential harm that can be caused by prolonged use of both wired and wireless headsets. The study found that wired headsets can cause harm due to the physical pressure they exert on the ears, while wireless headsets can cause harm due to the electromagnetic radiation they emit. The project also analyzed the impact of different types of headsets on the user's hearing and found that both wired and wireless headsets can cause harm if used at high volumes for extended periods. The study also found that wireless headsets can cause harm due to the interference they can cause with other electronic devices. The project recommends the use of wired headsets with volume limits and regular breaks to prevent harm to the user's ears. The study also suggests the use of wireless headsets with low electromagnetic radiation and proper placement help reduce the disruption caused by other electrical gadgets. The project emphasizes the importance of monitoring and analyzing the harm caused by headsets to ensure the safety of users. The study highlights the need for further research to better understand the impact of headsets on human health and to develop safer headset designs. The project also highlights the importance of educating users about the potential harm caused by headsets and the need to use them responsibly. The project concludes that monitoring and analysis of harm caused by headsets is crucial to ensure the safety and health of users, and to develop safer headset designs.

VII.FUTURE SCOPE

Investigating the long-term health effects of prolonged use of wired and wireless headsets on users, focusing on potential risks and mitigation strategies. Developing advanced monitoring technologies to assess the impact of electromagnetic radiation and sound exposure from wired and wireless headsets on human health. Exploring the integration of artificial intelligence and machine learning algorithms to predict and prevent potential harm caused by wired and wireless headsets. Collaborating with headset manufacturers to design safer headset models with features that prioritize user health and safety. Conducting comparative studies to evaluate the ergonomic design and user experience of wired and wireless headsets to enhance user comfort and minimize potential harm.

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