Smart Headphones

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Abstract— Smart Headphones are a basic need in today's era. People use headphones while driving, walking, exercising, relaxing etc. Our aim is to provide facilities like noise cancellation, gesture enabled controlling, warn if there is danger around which would enhance the way everyone uses their headphones. We have introduced a method for enhancing auditory awareness in which the system will detect the surrounding environment in real time and process the significant information to the user. This will reduce the probability of accidents. It can warn users of incoming traffic if it is in a close range and a horn is honked. Further we have provided touch control over headphone which will provide you the ease of access. These headphones also provide active noise cancelling (ANC) feature in which your surrounding noise will be filtered out. And this precarious feature appears in not only the noise cancelling headphones but also most of regular headphones in use throughout the daily life. We are providing a maximum detectable distance for incoming traffic that will help user from unwanted accidents.

Key words: Smart Headphones

I. INTRODUCTION

A. *Basics of Smart Headphones*

- Smart headphones are a basic necessity today. This is because the people today prefer technology with the safety on the side.
- Smart headphones thus provides the safety by HORN DETECTION using digital signal processing which would detect the horn in real time and mute the audio being played in the users headphones so that he can move aside avoiding accident.
- The signal processing will take place in real time so it is possible for the user to hear a small part of horn and predict the direction of vehicle.
- It also has GESTURE CONTROL. The Gesture Control provides ease of control to the user.
- This helps in controlling music in the headphones by sliding the fingers on the capacitive touch pad. Various controls like next/previous music, play/pause music and volume control can be provided to it.
- These headphones have Active Noise Cancelling feature that would provide the best music experience so that you can enjoy your favorite music.
- It also has additional features like Wi-Fi module for internet access, GPS tracker so that your last location can be sent to the emergency services in case of accident or any unwanted mishap.

B. *Need for Smart Headphones*

- According to an article published in THE GUARDIAN (1), experts studied data from 2004 to 2011. They found that 116 people in the US wearing headphones had died or been seriously hurt during that period.
- This number of people who died or were injured increased from 16 in 2004-05 to 47 in 2010-11.
- Of the accidents studied, 89% occurred in urban areas, and more than half of the victims i.e. 55% were struck by trains.
- According to the study, published online in the journal INJURY PREVENTION, 81 of the 116 incidents, or 70%, resulted in death.
- The study found that the wearing of headphones may in many cases have played a direct part in the incident, as the users could not hear warnings that they were in danger.
- In 29% of the cases, an explicit warning such as a shout, a horn or a siren had been sounded before the accident.
- This causes arise in the need of the Smart Headphones which provide not only good quality music through noise cancellation but also ensure the safety of the user.
- This is where technology meets safety and they walk hand in hand for a brighter future.

II. LIST OF COMPONENTS

- Arduino Uno
- Voice Recognition Module
- MP3 Audio Player
- Four Wire Touchpad
- Global System for Mobile Communications

A. *Arduino UNO*

- Arduino UNO is a microcontroller with 14 I/O pins that can be easily programmed to perform various tasks. It is provided with an open source software that can be used to support Arduino to perform tasks.

Fig. 1:

B. *Voice Recognition Module*

- Voice Recognition Module, as the name suggests is a device that recognizes the saved voice command and performs a pre-defined task. The input is taken in the analog form and after ADC conversion the sound is analyzed to match with the stored data.

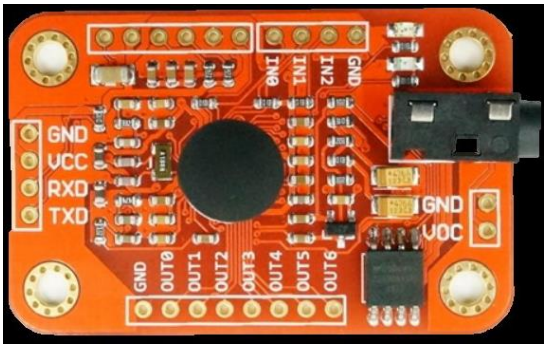

Fig. 2:

C. *MP3 Audio Player*

– MP3 audio player is an expedient through which the sound can be played in the headphones. It can take in various inputs like USB, SD Card, FM and AUX.

D. *Four Wire Touchpad*

– Microphone is a device that converts sound into electrical signal. Microphone are used in many applications such as live recording, music system, public concert etc. In it sound is first strike on the diaphragm and then it is converted to electrical signal. In wireless microphone it contains radio transmitter. Various microphones can be used such as dynamic, carbon, crystal or piezo, laser, liquid, MEMS (micro-electro-mechanical) microphones.

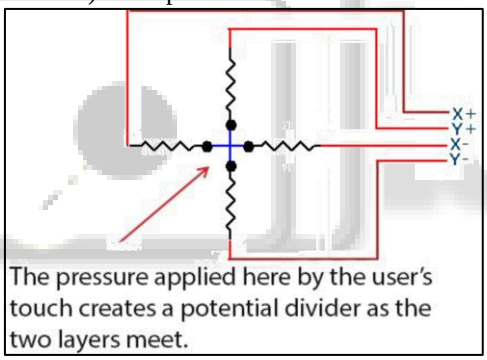

Fig. 3:

E. *Global System for Mobile (GSM)*

– Global System for Mobile (GSM) can be used to send a message to a number in various forms like ASCII, HEX etc. It is a standard developed by the ETSI to describe the protocols for second-generation digital cellular network.
– GSM networks operate in a number of different carrier frequency ranges (separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G), with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands.

III. CIRCUIT DIAGRAM OF DESIGNED CIRCUIT

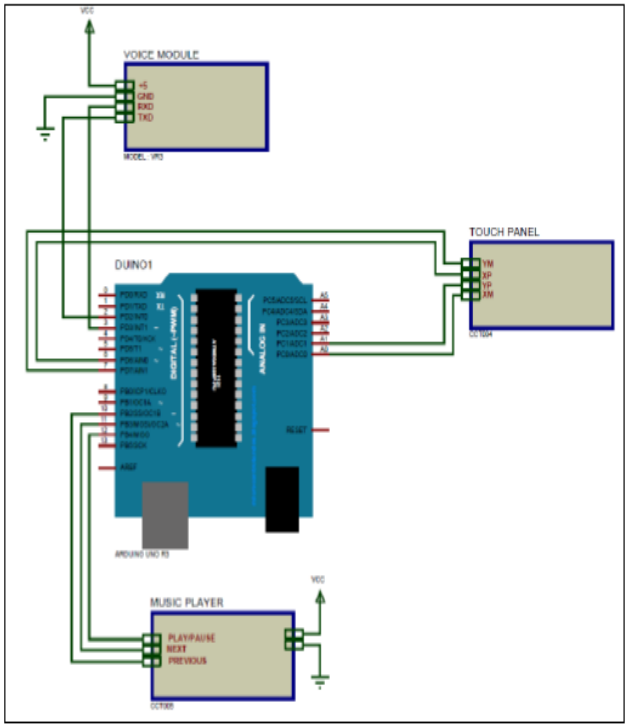

Fig. 4: Circuit Diagram

A. *Function of Arduino UNO in smart Headphones*

– Smart Headphones provide safety by analyzing the sound of the horn and then muting the music being played in the headphones.
– Arduino UNO is a microcontroller capable of performing such tasks. It has separated 6 Analog Pins and 14 Digital Pins. Moreover it uses an ATMEGA 328 microprocessor.
– It works on an average voltage between 7V to 12V.
– It has a flash memory of 32KB of which 0.5KB is used by the bootloader. This memory can be easily used to train the voice recognition module.
– It has 2KB of Single RAM and 1KB of EEPROM that enables fast processing along with quick response to the input.
– It does not have various inbuilt library for signal processing but these tasks can be performed without using header files as the coding in the Arduino IDE is easy.
– It can also be operated with the battery whose consumption is quite high but these feature can be used to make these headphones portable and long running after a single charge.

B. *Function of Four Wire Touchpad in Smart Headphones*

Four Wire Touchpad is a resistive touchpad that can be used to provide gesture control. It is used to provide four main features of Gesture Control which are as follows:

– Play/Pause 2. Next 3. Previous 4. Input Select
– The touchpad is divided in four different regions whose resistance is 300 Ω. When a key is pressed, the two resistive layers of the touchpad obtain a point of contact

due to conductance. This point of contact is confirmed by Voltage Divider rule.

– This touchpad would be implemented on the sides of the headphone so that the user can easily control them by avoiding to do whole procedure by taking the cell phone out.

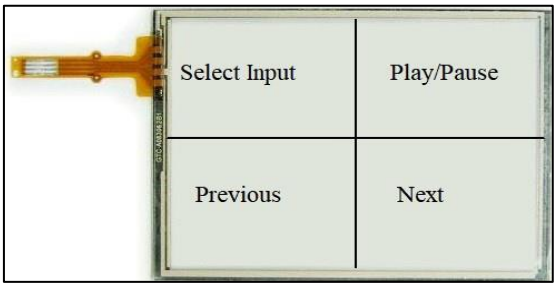

Fig. 5:

C. Function of Voice Recognition Module in Smart Headphones

– Voice Recognition Module is the vital component of our project. It is required for the detection of horn by training the module. For the project and budget purposes, we have trained the module with the most basic horns in the country.

– Once a horn is blown, the Voice Recognition Module tries to match the horn sound with the pre-fed data in the database of the Voice Recognition Module. If the data matches with the database, HORN DETECTION occurs and the Arduino is programmed to stop the music. In case of mismatch of the input data, no action is taken and the music is continued.

D. Function of GSM in Smart Headphones

– The GSM plays a vital role in our project. The use of GSM is to make voice calls, SMS service, call forwarding, call waiting, call hold, multiparty service etc.

– The role of GSM in smart headphones is to make user's families or friends to be informed if any accident takes place.

– By interfacing GSM with Arduino UNO makes the work of user easy for headphone upgrading applications.

– When a user meets with accident he/she may hit to some object like road, poles etc. may cause the headphone to fall off generating a vibration in the sensor.

– This vibration will be sensed by vibration sensor which is connected to the GSM in such a way that if the value reaches below its threshold value gsm will send a message to his/her relatives providing a quick medical attention.

IV. VARIOUS MATLAB SIMULATIONS

– For the simulation purposes we had used MATLAB software to analyse if the project can be implemented with the help of a Digital Signal Processor and various filter to obtain the real time processing of the sound waves.

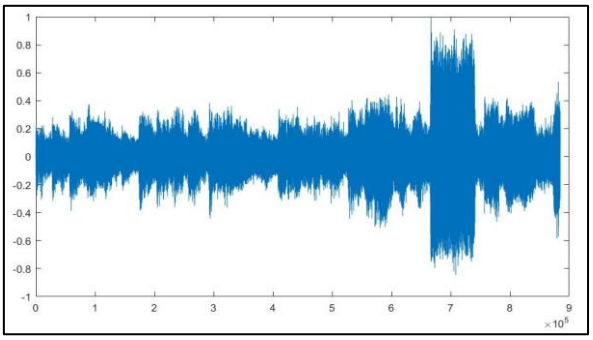

Fig. 1: Input Waveform

– Thereafter, we analysed the frequency spectrum of the horn that we had taken as a sample. This frequency spectrum makes it easy for the student to analyse the waveform.

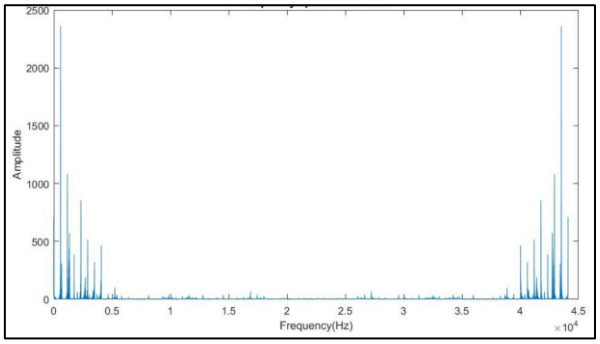

Fig. 2: Frequency Spectrum of Horn

– As said earlier the analysis and study of the frequency and phase response of the waveform is crucial because it helps in the analysis and detection of the waveforms.

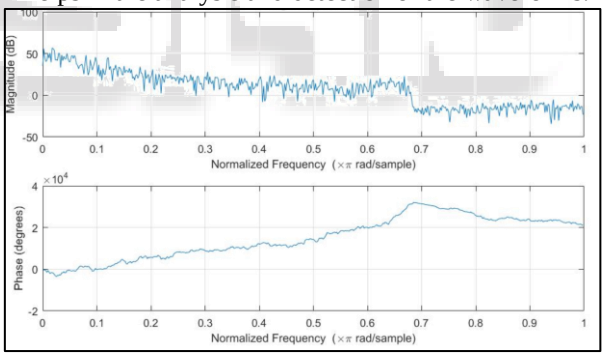

Fig. 3: Response of Input Waveform

The frequency response of the filter helps us know the range of frequencies in signal processing.

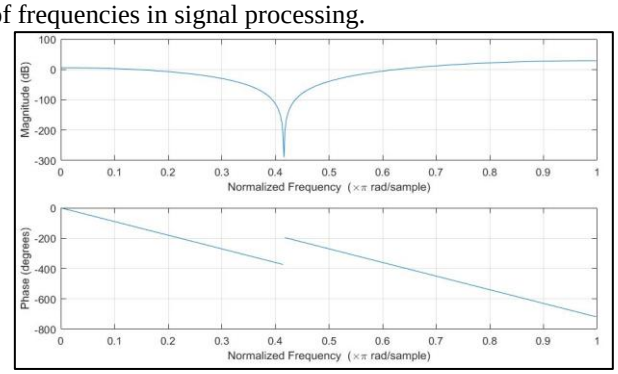

Fig. 4: Frequency Response of Filter

– The output of the filter thus can be seen in the frequency response graph below.

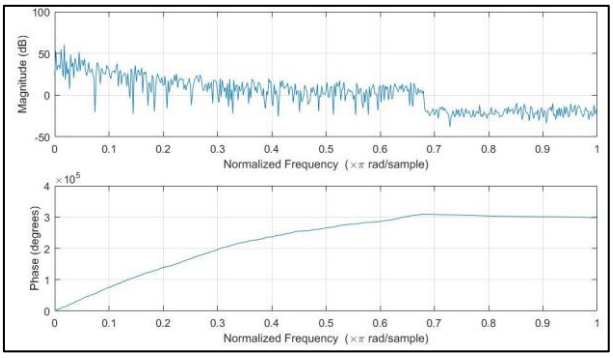

Fig. 5: Filter Output on the Waveform

V. CONCLUSION

- Smart Headphones will not only provide good music but also the safety to the consumer. The initial cost of the headphones might be more but safety is always the main concern. This project is intended to save the lives of as many people as possible.
- The Gesture Control is just a small step towards easing the use of headphones. After the completion of full project, we expect to provide safety as well as good quality music to the user.

VI. FUTURE SCOPE

- We have used the voice recognition module which can be replaced by a Digital Signal Processor 6000 series as it is a variable point processor that can enhance the real time processing of the sound.
- Various other libraries and techniques for Fast Fourier Transform (FFT) and other signal processing can enhance the way of detection of horn.
- These headphones can be developed into a complete new set if an Artificial Intelligence system (AI) is provided.

REFERENCES

Journal Papers

[1] C.Prabha, R. R. (Vol. 3, Issue 7, July 2014). "Automatic Vehicle Accident Detection and Messaging System Using GSM and GPS Modem." International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, 5.

[2] Meena, A., Iyer, S., Nimje, M., Joglekar, S., Jagtap, S., & Rahman, M. (2014). "Automatic Accident Detection and reporting framework for two wheelers." IEEE.

[3] Preeti Saini, P. K. (Volume4 Issue2, 2013). "Automatic Speech Recognition: A Review." International Journal of Engineering Trends and Technology, 5.

[4] Rohan Banerjee, A. S. (2012). "Two Stage Feature Extraction using Modified MFCC for Honk Detection." IEEE, 4.

[5] Usman Khalil, T. J. (2017). "Automatic road accident detection techniques." IEEE

Conference Papers

[6] George W.P. York, C. M. (2004). "Teaching Real-time DSP applications (Voice Removal) with the C6711 DSK and MATLAB." Proceedings of the 2004 American Society for Engineering Education Annual Conference & Exposition, 2.

[7] RUIZ, J. Z. (2006). "Rapid Development of Real-Time Applications Using MATLAB on TI6000." 5th WSEAS International Conference, 7.

Book

[8] Sound Capture and Processing: Practical Approaches by Ivan Tashev, Wiley Publications.

Web Reference

[9] Agencies, A. T. (2012, January 16). Listen up: wearing headphones can endanger life, study finds. Retrieved from The Guardian: https://www.theguardian.com/technology/2012/jan/16/headphones-can-endanger-life-study

[10] Texas Instruments. (2012, March 23). C5000™ Ultra-Low-Power DSP Audio Capacitive Touch BoosterPack. Retrieved from Texas Instruments: http://www.ti.com/lit/ml/sprt630/sprt630.pdf

