



Android Smart Phone Demonstrating as an Educational Tool for Hearing Impairment

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ABSTRACT: Hearing aids partially overcome auditory deficits and normally employed for the hearing impaired people to compensate hearing loss. This paper is an attempt on creating an android application to demonstrate android smartphone as an educational tool for hearing impairment. The system is developed using Android Studio. The system consist of different information regarding hearing loss also there are some of the additional features for user interface like, Audiogram graph generation, creating spectrogram of user speech, displaying time domain and spectrum analyser. Also there are some additional feature like speech conversion i.e. Text to Speech conversion and Speech to Text conversion, Pitch Tracker and Low pass Audio.

KEYWORDS: Audiogram, Spectrogram, spectrum analyser, time domain, android, speech.

I. INTRODUCTION

Hearing impairment or hearing loss is defined as partial or total inability to hear. It may occur by many factors such as genetics, age, exposure to noise, illness, chemicals and physical trauma. Hear test are conducted by doctor to determine the severity of hearing loss. Hearing loss is usually described as mild, mild-moderate, moderate, moderately severe, severe or profound. The severity of the hearing impairment is basically categorized based on the minimum sound that the person could heard with better ear. Higher the decibel the louder the sound [7].

- Mild hearing impairment: Sound ranging between 25 and 40 dB. In this the person cannot hear soft noises.
- Moderate hearing impairment: Sound ranging between 40 and 70 dB. In this the person face hearing problem for soft or moderate loud noises unless they use hearing aid.
- Severe hearing impairment: Sound ranging between 70 and 95dB. In this the person face problem for hearing most of the noises.
- Profound hearing impairment: Sound ranging between 90 dB and above. In the person may hear only very loud noises.

The audiogram gives information used to determine the most suitable help for an individual - which could be a hearing aid, cochlear implant, or other supportive device or equipment. A spectrogram is defined as visual representation of the spectrum of frequencies in a sound with variation of time. They are also called as spectral waterfalls, voiceprints or voice grams. They are extensively used in development in the fields of music, speech processing, sonar, etc. Spectrogram are usually formatted in two geometric dimensions where the horizontal axis represents time and the vertical axis represents frequency. In digital signal processing, spectrograms are generated where the calculation for the time signal is done using FFT. Time domain is known as the analysis of mathematical functions, physical signals or time series of environmental data with respect to time. Spectrum analysers are used for analysing frequency spectrum of audio signals. The FFT uses digital signal processing techniques for analysing a waveform with the help of Fourier transforms.

Android phones are used by most of people around the world [1], so with the help of it new devices would be created for hearing impaired people. It is continuously pushing the boundaries of hardware and software forward to bring new capabilities to users. It also gives us everything, needed to build best-in-class app experiences. It gives a single application model that deploys your apps. The objective of this paper is to demonstrate that the smart phone are used to share information and is also used as an educational tool. The software supporting the above platform is android



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studio. Android Studio is new software developed by Google to generate android app. Java language is basic platform for app creation. This app is only created for android smartphones. The main advantage of using Android Studio instead of Eclipse is that it have Maven-based build dependencies, Build variants and multiple-APK generation and advance android code completion and refactoring.

II. LITERATURE SURVEY

A. *An educational platform to demonstrate speech processing techniques on Android based smart phones and tablets[1].*

In this paper, there the use of integrating theory and practically applying it on smart phone. The application which is presented in this paper is called as “Speech Enhancement for Android” allowing to interact with surrounding environment which is done by recording and processing the speech of the user.

B. *Phoneme-Based Self Hearing Assessment on a Smartphone[4].*

In this paper, it shows that self-hearing assessment could be done using new smart phone. The author conducted test on different subject having different hearing loss. It was found to be sufficiently reliable to determine hearing threshold of the subject.

C. *Implementation and verification of a Platform for Bluetooth Linked Hearing Aids System with Smart Phone and Multimedia Devices[3].*

In this paper, the author designed and implemented a hearing aids using open platform which combines smart phone and other devices using Bluetooth for binaural hearing aids. Author also developed GUI using android for controlling volume and different parameters for hearing aid.

D. *A Sliding-band Dynamic Range Compression for use in Hearing Aids[5].*

In this paper, the author discuss about the sensorineural hearing loss. In this paper dynamic range compression technique is used to reduce the hearing loss. For applying the technique frequency dependent gain function was calculated based on different parameters like compression ratios, attack time, and release time. The technique was successfully implemented and tested with satisfactory real time operation.

E. *Android based sound detection application for hearing impaired using ADABOOSTM1 classifier with REPTree Weaklearner[6].*

In this paper, the author developed an application named AudiTion which helped the hearing impaired person for detecting sound and recognizing the surrounding sound. AdaBoostM1 is an algorithm for boosting method. Testing were done on four environment condition to determine the sound predication accuracy level. It has two sound database, first was for indoor sound and the second one was for outdoor.

III. SYSTEM DESIGN

The Figure 1 shows the block diagram illustrating the functionality of the interactive elements. Different blocks have different function. Based upon the user block is been executed. Depending upon the user block is been executed. If the user selects wants to know about audiogram then the user must select the audiogram button where the information regarding it is shown and the user could also test its ear and the result it is shown on graph at the end of test. When the user selects the spectrum analyser function, there would be real time display of the speech spectrum on android phone display.

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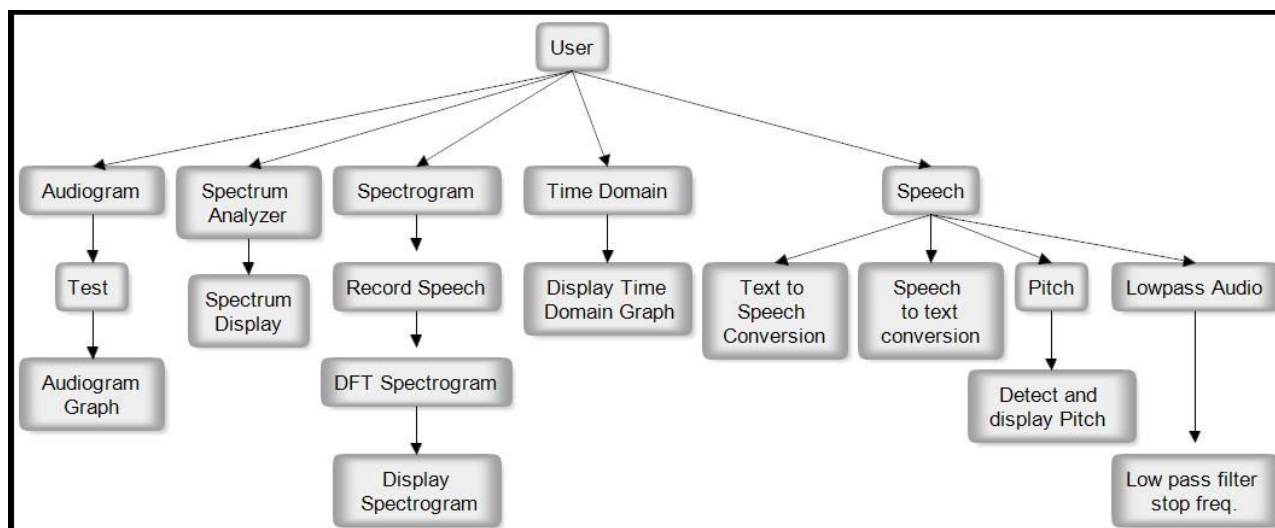


Figure 1: Block diagram illustrating the functionality of the interactive elements.

If the spectrogram function is selected, the speech of the user would be recorded, processed using digital signal processing and the later on spectrogram is generated and shown on android phone display. When the time domain function is been selected, the speech of the user would be processed and there would be real time display of time domain on the android phone display. If the user has selected the speech conversion function, this function would also be used by the person who is having hearing impairment. There are four features in speech conversion, first is text to speech conversion. In this the user could write which would be played through their android phone. The second feature is speech to text conversion, in this the recorded speech would be converted in the text format and the text is displayed on the android phone screen. Third feature is about pitch, in this there is a sample audio whose spectrogram and pitch graph is shown. There is an also additional feature in it for pitch detection; in this the android smart phone would detect the pitch of the speech and would show on the android display. The fourth and the last feature is Low pass audio; in this the user would set frequency and the surrounding sound which is coming under that frequency range only that sound would be heard to the user.

IV. HARDWARE SYSTEM DESIGN

The hardware required for this system is android smart phone and the software required for this system is android studio

A. Android smart phone

Android is most widely used smartphone OS. It is user friendly, easy to use, open source to create any application as per requirement.

B. Android studio

Android Studio is new software developed by 'Google' to generate android app. Java language is basic platform for app creation. This app is only created for android smartphones. The main advantage of using Android Studio instead of Eclipse is that it have Maven-based build dependencies, Build variants and multiple-APK generation and advance android code completion and refactoring

V. RESULTS AND DISCUSSION

We develop an android application using android studio. Figure 2 shows the screen shot of the android application.

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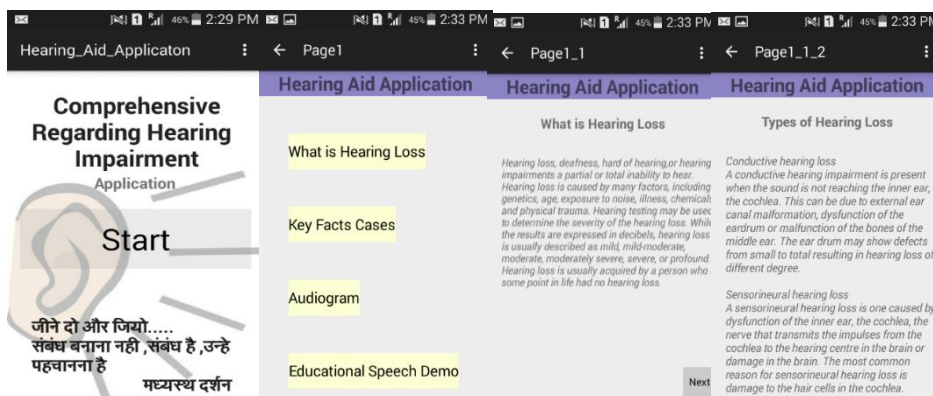


Figure 2.1

Figure 2.2

Figure 2.3

Figure 2.4

Figure 2.1 is the home page after clicking start button next page gets appear that's figure 2.2. It contains different function like 'What is hearing loss', 'Key Facts cases', 'Audiogram' and 'Educational Speech Demo'. Figure 2.3 shows information about the hearing loss, figure 2.4 shows the information about types of hearing loss.

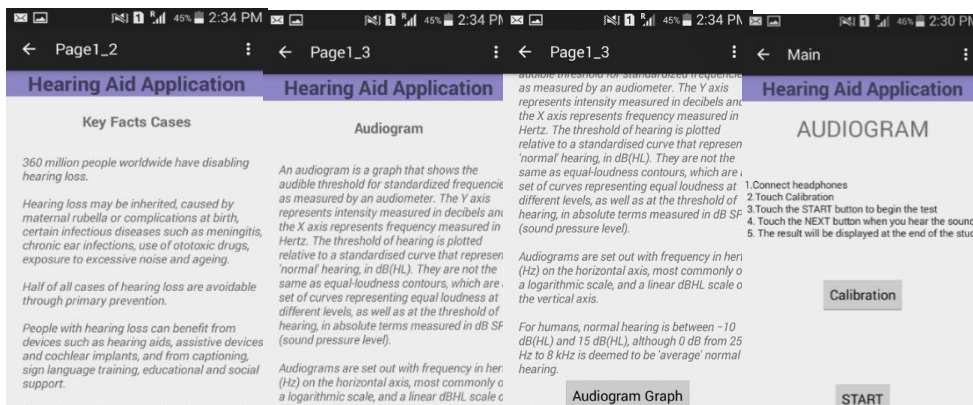


Figure 2.5

Figure 2.6

Figure 2.7

Figure 2.8

Figure 2.5 shows the shows the information about the key facts cases, figure 2.6 shows the information about Audiogram, figure 2.7 is the scroll down image of Audiogram page where it has button for the Audiogram graph test. If the Audiogram Graph button is clicked then the page similar to figure 2.8 appears where it shows steps for how to generate audiogram graph.

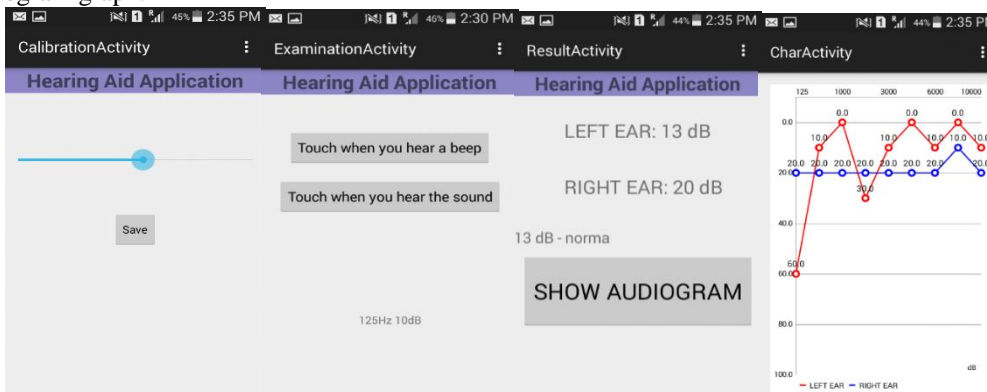


Figure 2.9

Figure 2.10

Figure 2.11

Figure 2.12

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When the calibration button is clicked the page similar to figure 2.9 appears, do your calibration and save the settings then go back and click start button. After that figure 2.10 appears where you have to touch as per you hear sound, after completion of that step result is generated and shown on the screen as shown on figure 2.11. If you want to see the graph between the left and right ear the click on the ‘Show Audiogram’ button, the resulted graph would be shown as in figure 2.12

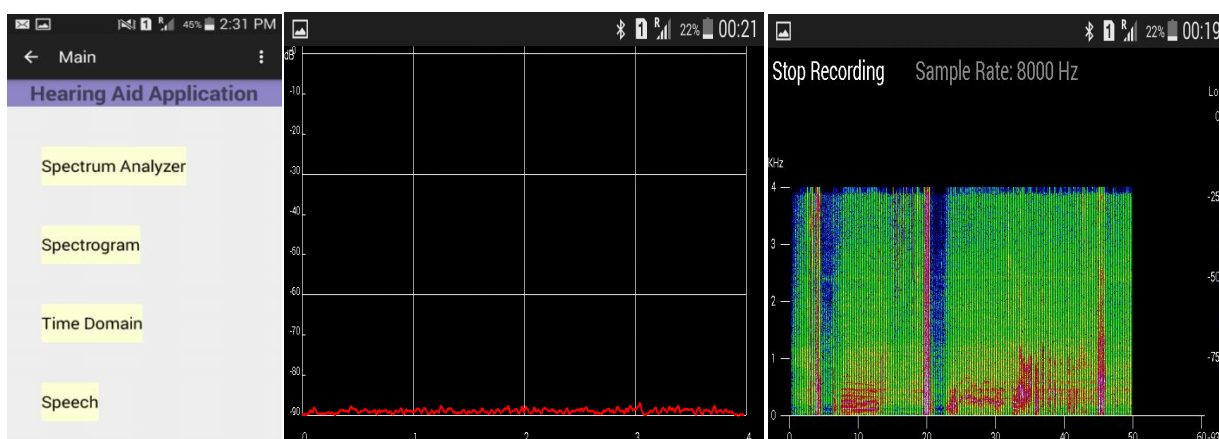


Figure 2.13

Figure 2.14

Figure 2.15

If the ‘Educational speech demo’ button is clicked from the figure 2.2 the figure 2.13 appears showing different functon. Figure 2.14 is showing spectrum analyzer, figure 2.15 shows spectrogram.

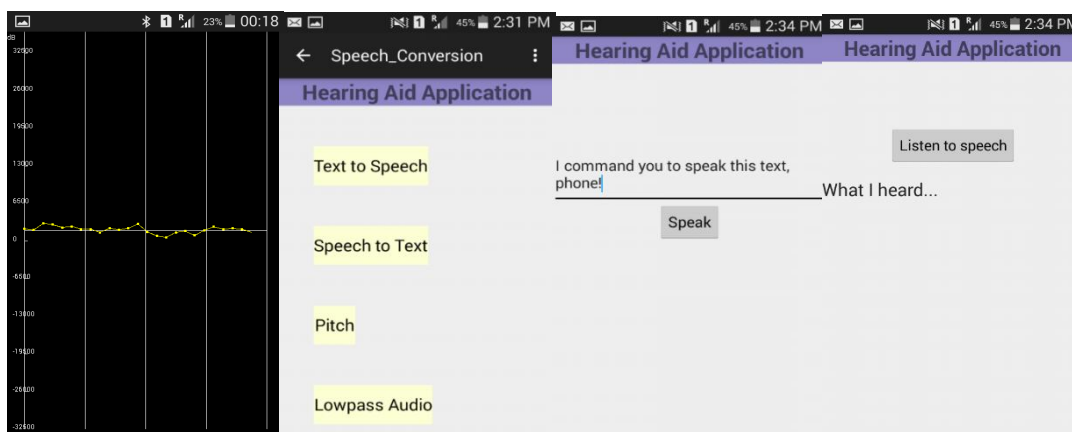


Figure 2.16

Figure 2.17

Figure 2.19

Figure 2.16 is shows time domain graph and if ‘Speech’ button is clicked from figure 2.13 then figure 2.17 appears, where it shows different speech conversion like ‘Text to Speech’ conversion as in figure 2.18, ‘Speech to Text’ conversion as in figure 2.19, ‘Pitch’ where it shows speech graph and spectrogram graph of sample audio and pitch tracker as shown in figure 2.20 and ‘Low pass audio’ where user would be able to hear surrounding audio till the frequency is set and this is shown in figure 2.21.

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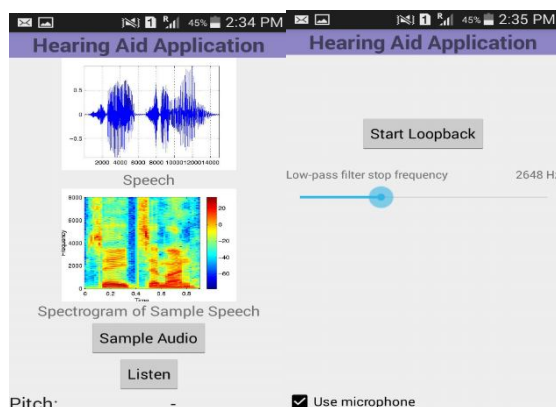


Figure 2.20

z Figure 2.21

Figure 2.1: Home Screen of android application, 2.2: Different function for information, 2.3 Information about hearing loss, 2.4 Information about types of hearing loss, 2.5 Information about key fact cases, 2.6 Information about Audiogram, 2.7 Button for Audiogram graph, 2.8 Main page for Audiogram Test, 2.9 Calibration screen, 2.10 Test for ear, 2.11 Result of Audiogram, 2.12 Graph of the Audiogram, 2.13 Function of Educational Speech Demo, 2.14 Spectrum Analyser, 2.15 Spectrogram, 2.16 Time domain, 2.17 Different function of Speech, 2.18 Text to Speech Conversion, 2.19 Speech to Text conversion, 2.20 Pitch format, 2.21 Lowpass Audio

VI. CONCLUSION

Smart phone devices are becoming readily available to most of the people. This paper has suggested the use of smart phone as educational tool for the hearing impairment. And it also shows that the android phone could be used as hearing aid for the hearing impaired person. The system is implemented using android studio. The information regarding the hearing impairment is shown in the android application. Audiogram graph is generated after testing the user ear. The spectrogram, time domain and spectrum analyzer is generated in real time using FFT. Some other feature like speech conversion low pass filter may also be used by hearing impaired person. And there is no need of extra hardware for the signal processing.

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BIOGRAPHY

Miralkumar Surati received the B.Tech. degree in Electronics and Telecommunication Engineering from U.V.Patel College of Engineering, Mehsana, India in 2013 and is currently pursuing the M.E. degree in VLSI and Embedded systems from MIT College of Engineering, Pune, completing project based on FPGA.

Dr. Mahesh T. Kolte obtained his Bachelor's degree in Electronics Engineering from SGGS College of Engineering, Nanded, Marathwada University. Then he obtained his Master's degree and PhD in Electronics and Telecommunication Engineering both from Amravati University, Maharashtra. Currently he is a Professor at Electronics and Telecommunication Engineering, MIT College of Engineering, Pune, having teaching experience of 22 years. His specializations include Embedded Systems and Signal Processing, Speech Signal processing, Image Processing.