AN APPLICATION FOR MOBILE CUSTOMERS USING SPEECH SYNTHESIS

Thesis submitted in partial fulfillment of the requirements for the award of degree of

Master of Engineering

in

Information Security

Submitted By

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PATIALA – 147004

June 2016

Certificate

I hereby certify that the work which is being presented in the thesis entitled, "*An Application for Mobile Customers using Speech Synthesis*", in partial fulfillment of the requirements for the award of degree of Master of Engineering in *Information Security* submitted in Computer Science and Engineering Department of Thapar University, Patiala, is an authentic record of my own work carried out under the supervision of *Ms. Rupinderdeep Kaur* and refers other researcher's work which are duly listed in the reference section.

The matter presented in the thesis has not been submitted for award of any other degree of this or any other University.

Keshav Rana

(Keshav Singh Rana)

This is to certify that the above statement made by the candidate is correct and true to the best of my knowledge.

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Thapar University
Patiala

Acknowledgement

First of all I would like to thank the Almighty, who has always guided me to work on the right path of the life. It is a great privilege to express my gratitude and admiration towards my respected supervisor **Ms. Rupinderdeep Kaur,** Lecturer, Computer Science & Engineering Department. She has been an esteemed guide and great support behind achieving this task. This work would not have been possible without the encouragement and able guidance of her. I also thank my supervisor for her time, patience, discussions and valuable comments. Her enthusiasm and optimism made this experience both rewarding and enjoyable. I am truly grateful to her for extending her total co-operation and understanding whenever I needed help and guidance from her. I am also heartily thankful to **Dr. Maninder Singh**, Associate Professor and Head, Computer Science & Engineering Department and **Dr. Jhilik Bhattacharya**, PG coordinator, for motivation and providing uncanny guidance and support throughout the preparation of the thesis report.

I will be failing in my duty if I do not express my gratitude to **Dr. S. S. Bhatia**, Senior Professor and Dean of Academic Affairs, for making provisions of infrastructure such as library facilities, computer labs equipped with net facilities, immensely useful for the learners to equip themselves with the latest in the field.

I am also thankful to the entire faculty and staff members of Computer Science and Engineering Department for their direct-indirect help, cooperation, love and affection, which made my stay at Thapar University memorable. Last but not least, I would like to thank my family for their wonderful love and encouragement, without their blessings none of this would have been possible.

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Abstract

In the past decade, demand for mobile phones has seen a consistent rise if other portable computing devices taken into consideration. When confronted with a query, people first take out their mobile phones with internet connections instead of going for other options such as Laptops or PCs. When it comes to software development, the first choice of a developer would be Android OS because of its open source licensing and the sheer number of users all around the world. Text to speech is a process of generating speech by a device on the basis of input text. The focus of proposed work is to develop an application for mobile customers who are unable to get solution to their problems because of the language barriers. Many companies do provide support for regional languages to solve their customer's issues, however they haven't yet developed a software application for Hindi. So, a questionnaire is formed on the basis of frequently asked questions by mobile customers and created a database as a solution for both English and Hindi. Speech synthesis will have an important role for the people with sight disabilities.

Table of Contents

List of Figures

List of Tables

Chapter 1: Introduction

1.1 Natural Language Processing

Natural Language Processing is a field of computer science that deals with an interaction between computer and human language. It is the ability and use of computer system under which a sentence (or sentences) in a language like English is been processed rather than in a computer language like C++. It is obvious that humans are able to process natural languages, but whether a computer system can or will process natural languages is the question arises.

Firstly, the phrase “natural language” is not used for actual language as it used for simple discourse, like actual use of English to communicate in day to day life. But, for a more restrict manner such as a human speaking language, one cleared of ambiguities and constructions that a computer system could not sort out.

Secondly, the phrase “natural language processing” is not used always in a same way. The phrase most of the time is taken away to include speech recognition.

1.2 Speech Recognition

Speech recognition mainly recognizes what you say, rather than what you actually mean. It is similar like when you click the mouse button, the computer give its response according to its programming when the button of the mouse is clicked. Similar thing is true with speech recognition as well. The user says words, the synthesizer recognizes those words and the engine (synthesizer) responses in accordance with its programming.

It is not an artificial intelligence as you are not yet be able to communicate with the computer system. There is a false belief that speech recognition is having a science fiction quality by which people are able to carry on an intelligent, conversation with the computer system.

1.3 Speech Recognition v/s Voice Recognition

Speech recognition and Voice recognition, both terms are used very rarely and most people thought that these terms are similar.

Speech Recognition: An ability of a computer system to understand the spoken words. It is simply a translation of sounds into predefined words to get recognized.

Voice Recognition: An ability to recognize a speaker depends on that speaker's style. People have their specific characteristics about own style like fingerprinting. This technology able to recognize the computer system to its distinct voices characteristics.

1.4 Speech Synthesis

A simulation of computer generated for human speech is a speech synthesis. It helps to translate written text or written information into speech text or information, which is very convenient for mobile applications. It also helped the vision-impaired person so that, for example, the text displaying on the screen can be read aloud to a sightless person. Speech synthesis is corresponds to speech or voice recognition. The first speech synthesis effort was made by a Russian professor in 1779. He created an apparatus based on human voice to demonstrate the physiological differences. The first voice synthesizer, named Dudley's VODER (Voice Operating Demonstrator) was displayed around 1939-40 world's fair. It was based on bell laboratories vocoder (voice coder) in the mid-thirties.

Speech prosthesis is a computer-generated speech for physical disable persons having difficulties to speak intelligibly. In this area, much of the research gives text and speech generation, even if the disabilities create problems with speech. It rarely make an entry of a text difficult too. The main objective is to develop a prosthetic system that will closely resemble a natural speech, with a least input required from the user. This type of prosthesis systems also makes an ease for people having visual disabilities to make them use of computer systems.

1.4.1 Text-to-speech

Text-to-speech (TTS) is a type of speech synthesis that used to create a vocal sound version of the text inputted in a computer system. TTS makes possible to the read the information displaying on the system for people having visual disabilities, or may easily be used to augment the reading of the text message. Recent TTS applications include voice enable e-mail and spoken prompts in voice systems. TTS is quite often used for voice recognition programs. A text-to-speech system is shown in figure 1.1.

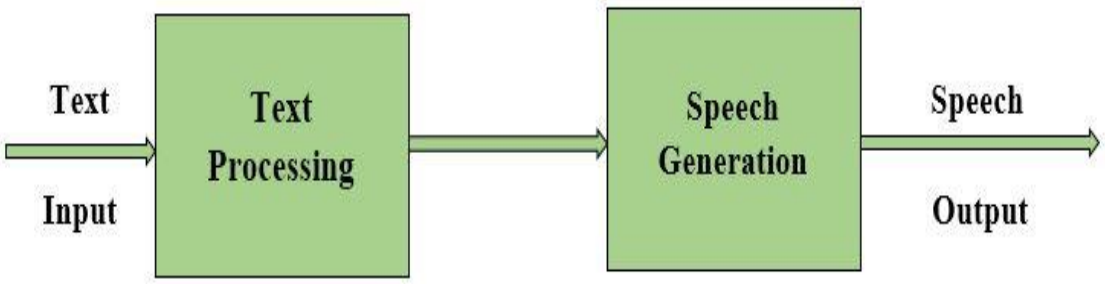

Figure 1.1 Text to speech system

In a proposed work, the text-to-speech synthesizer is a skilled system that transforms written text into natural speech. This synthesizer works on written, fully extended words. Moreover, input text not only contain full words like Customer, Mobile, Service but it also having other language units like numbers (17), dates (04/05/2016), abbreviations (*i.e.*), acronym (SIM), symbols (₹), *etc*. All language must be expanded consistently first into full words and after that they get synthesized.

1.4.2 Components of Text-to-speech

As shown in figure 1.2 a TTS synthesizer is composed of two parts:

- In front end, a phase that receives the text as input and outputs a symbolic linguistics representation.
- In back end, a phase that receives a symbolic linguistics as an input and outputs the synthesized speech.

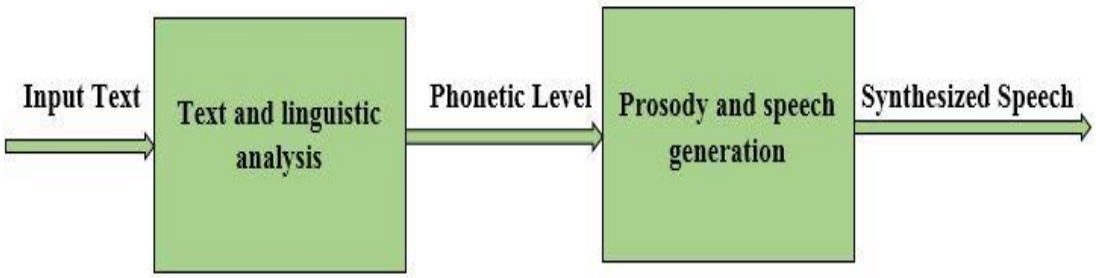

Figure 1.2 A TTS synthesizer

1.5 Synthesizer Techniques

The essential qualities of speech synthesis are intelligibility and naturalness. Intelligibility is to make an ease to understand the output while naturalness describes how nearly the output sounds similar to human speech.

Concatenative synthesis and Formant synthesis are the two primary technologies used to generating synthetic speech. Each technique is having strengths and weaknesses, and the use of a system will determine which approach is used.

1.5.1 Concatenative Synthesis

Concatenative synthesis is depend on the concatenation (joined together) of segments of speech recorded. Generally, concatenative synthesis gives the most natural-sounding speech.

Instead, differences among natural deviation in speech and quality of the automated techniques sometimes results in audible faults in the output.

1.5.2 Formant Synthesis

Formant synthesis not uses human speech samples at runtime. Rather, the synthesized speech output is developed using additive synthesis and an acoustic model.

1.5.3 Quality of a TTS Synthesizer

Naturalness and Intelligibility are the two most important qualities of speech synthesis.

- **Naturalness:** It concerns with how close the output sound is related or sounds like to that of the speech of a real speaker (person).
- **Intelligibility:** It concerns with the easiness by which the output can be realized and understood. It deals with several kind of units such as phrases, words, syllables, phonemes *etc*.

1.6 Challenges in TTS System

A system should be programmed well to perform the work perfectly. The programmer should search the cases that faces by the programmer. As it is difficult to find out every possible input to system, some techniques which are varies from the programming approach have been used. A text-to-speech system works on a natural language text which might be the reason it faces some problems.

1.6.1 Text Normalization challenge

Normalizing a text is rarely a straightforward process. As texts are full of numbers, abbreviations, and acronyms that all requires in a phonetic representation. There are so many words and spellings in English which are differently pronounced depends on its context.

1.6.2 Text-to-phoneme challenge

Two approaches used by a speech synthesis system to determine the word based pronunciation depends on its spelling, which is often called text-to-phoneme or grapheme-to-phoneme conversion. The easiest approach is dictionary-based approach among all the approaches, where a large dictionary consisting all the words of a language and their pronunciation stored by a program.

1.6.3 Applications of Speech Synthesis

The TTS systems is growing very fast in the field of applications as the quality of the system is steadily increasing as well. For common customers, these systems comes out to be more affordable which makes it worthy in day to day life. Some of the uses of TTS system is described below:

- **Source of learning for visually impaired**

  For blind people, listening is the most important skill among all others. Blind people depends only on their listening ability to get the information efficiently and quickly. Students get the information from the books by means of their sense of hearing by CD or tape. Also, to judge what is happening around them as well.

- **For Vocally Handicapped**

  For vocally handicapped people, a hand-held synthetic speech aid works better to express their words. The device is specially designed for these people in which it takes a required input and gives an output speech within a seconds.

- **Telecommunication and Multimedia**

  TTS system gives the facility to access text information over the phones. Texts consisting a heavy database so problem arises that it can read and stored hardly as digitized speech.

User questioning to such information retrieval systems and that could be placed though a single click, or through a keyboard.

- **Man-Machine Communication**

  In several kinds of man-machine interactions, speech synthesis can be used like a warning alarm systems, washing machine, smart home, clocks. To give more accurate information of the ongoing situation, speech synthesis can be used there most of the time. As compared to warning alarms or buzzers in emergency situations, speech signals are far better than that as it quickly to react to the signals if a person is not able to get the light hints because of some obstacles.

1.7 Language Barriers

Language is required for any kind of communication. People communicate with sign language if they have speech impairment. In situation where people are not able to understand other people language, it turn to be communication failure. The inability in communication using a language is known as language barriers. Some of the communication problems are:

- Communication Problems:
- Misinterpretation of communication
- Failure to understand an opponent's perspective
- Language differences
- Misinterpreted motives
- Poor listening skills
- Lack of communication channels
- Inflammatory statements

Language barrier is the most common communication barrier that impel to misinterpret and misunderstand among people. Many people in India do not speak English or even if they did, the other people is having lack in understanding it. There is no communication if the speaker

and receiver are not using the words which is not understand by the either party. It leads to make communication ineffective and stops message from being conveyed.

1.7.1 Strategies to overcome Language Barrier

1. Speak clearly and slowly
2. Ask for clarification
3. Frequently check to understood
4. Be specific
5. Choose the medium of communication
6. Provide information from multiple channels

1.8 Android Operating System

Android is a mobile operating system developed by Google in 2005. It is based on the Linux kernel and primarily designed for mobile devices (especially for touchscreen phones) and tablets.

1.8.1 Android Architecture

Android OS has become very popular in recent times. The android devices also assist the text-to-speech synthesis. Therefore, speech synthesis has turn to be a crucial modality on mobile devices as various characteristics like running, driving which curb the use of visual modality. Speech synthesis system for mobile devices are not an easy job as it has a small-scale storage capacity and performance.

1.8.2 Android Studio

Android studio was publicized in 16 may, 2013 at the Google I/O conference. It is the official IDE (Integrated Development Environment) for android development platform. It is freely available at the Apache License 2.0.

Features of Android Studio

- Build on a gradle-based support
- Android-specific quick fixes and refactoring
- App-signings and ProGuard integration
- Lint tools for catching the performance, version compatibility, usability and other issues.
- Support for Android Wear apps
- Build-in support for platform of Google Cloud

1.8.3 Genymotion

Genymotion is a third-party emulator which is used in place of default Android emulator. For starting and booting a virtual device, with Genymotion it only takes a few seconds and is three times quicker than loading an actual device.

1.8.4 Audacity

Audacity is an open source digital audio editor used to record the voices for computer software applications. It is freely available software on the internet. It is used post-processing for all types of audio, by adding effects like trimming, fading and normalization.

Chapter 2 Literature Review

A system should be programmed well to perform the work perfectly. The programmer should search the cases that faces by the programmer. As it is difficult to find out every possible input to system, some techniques which are varies from the programming approach have been used. A text-to-speech system works on a natural language text which might be the reason it faces some problems.

Devika Sharma, Kanwar Ranju [1] created a language translator that takes an input text, split up into individual words and after the identification w.r.t their phonetic factor. It connects with the library to find out the voice representation of that specific word. Furthermore the text is translate from one regional language to another with respect to the voice representation.

Mhamunkar, Priyanka V. *et. al* [2] created an application in which the user and the server are interacting in voice-to-text and text-to-voice form. Voice is converted into text and that text is searched in the dictionary present in application already and take out its meaning, which later will be converted into voice.

Sangle, Shailesh S., Nilesh M. Patil [3] created a social domain based application. They developed a system and combines voice synthesis with skype. It gives a person an ease who is having sound disorder to talk with another person localize anywhere in the world by removing a hurdle that creates a problem during phone call.

Kamble *et. al* [4] presented single text-to-speech system for language Hindi to generate speech. Two steps is been followed, processing of text and generating speech. To convert Hindi text to speech, a graphical user interface has been designed in java swings [4]. Concatenative speech synthesis approach is been used.

Hansen, John Paulin *et. al* [5] built a Bluetooth platform that contains audio messages, near

about information and one sided text-to-speech paging with the help of smart phones or it is a hardware that people might carry with them as well. This handy device plays an important role in places like shopping centers, hospitals and airports.

Subhaashini *et. al* [6] developed an android based application for ease communication between normal and hearing disable persons. As sign languages are mostly used by these persons. So, this application converts those sign languages into speech sound which later can easily be understand by the people who has no knowledge regarding this sign language.

Duke, I. *et. al* [7] presented a keyboard which is a combination of physical and gestural keyboards. They made an 8-button keyboard named Braille that can be connected to the smart phones via input wire. On the other side, the touchscreen endow gestures like thumb click for more difficult text editing operations. They help and gives economic and useful experience for users having sight problems.

Landicho, Junar A *et. al* [8] developed an application for the communication between two person both having problems like hearing and visual. Some of the keen features of this application are sending, replying, forwarding as it is a text based application.

In this paper, Miyabe Mai *et. al* [9] created a support system for medical domain. They developed a system to minimize the communication gap that arises because of not understanding a foreign language. It provides a function by which foreign patients will face no problem during communicating with the local receptionist. This system supports Japanese and English.

Aakash Agarwal [10] created an application which calculate the visual power of a patient. Its work is similar to that of an ophthalmologist who checks an eyesight with the help of a Snellen chart. The visual sense is calculated by means of text-to-speech conversion. Questionnaire is also followed after calculation, which uses Web Ontology Language (OWL).

Kuei-Chun Liu, *et. al* [11] developed an application for the visually disable persons, who need helpful tools to aviate digital devices. By that, these people will get the digital information while working, living and learning. They developed an assistive system for those who faces visual problems during the use of android devices.

Felix Burkhardt [12] created an application by keeping in mind a main target that is a car domain. A system is developed for office mobile and entertainment stuff. The input function consist of a touch screen and automatic speech acknowledgement and the output consist of a screen and speech synthesis.

Gaurang Kanvinder [13] developed an android based application for education domain. They developed an e-book reader for this platform but in a more handy way. It makes an ease for the people who are suffering from dyslexia. It contains the features that combines with already made functions that is text-to-speech technology and displaying the text in more orient way.

Sankar Mukherjee and Shyamal Kumar Mandal [14] implemented a speech synthesizer for Bengali language for mobile devices. For generating the speech, they used ESNOLA (Epoch Synchronous Non- Overlap Add) which is a concatenate based technique.

Jagmeet. Kaur and Parminder Singh [15] developed a Punjabi speech synthesizer that gives a speech output on mobile devices. Concatenative based speech synthesis approach is used which uses the phonemes for concatenate process.

Arun Gopi and Shobana Devi P [16] developed an android based application by using ESNOLA (Epoch Synchronous Non-Overlap Add) technique for Malayalam language. It is based on a concatenative based speech synthesis technique. They also apprise the implementation of Malayalam TTS, generate the database and access the database. It also manages the Malayalam character showing in android devices.

Sanja Primorac *et. al* [17] created an application named Voice SMS in which the spoken messages is converted into text form messages. Users are able to send those messages to their contact list. Speech recognition uses HMM (Hidden Markov Model) technique which is a most adaptable approach in speech recognition.

Ravina Mithe, *et. al* [18] developed an application which execute image to speech conversion using android platform. The OCR (Optical Character Recognition) takes an image as an input, extract the text from that image and then convert that text into speech form.

In this paper, Angelov, Krasimir *et. al* [19] presented an architecture for speech-to-speech translation on android devices which is based on Grammatical Framework (GF). The architecture is to avail for language-controlled like translator that gives very high quality, which is a strong point of GF.

Thad Hughes, Kaisuke Nakajima *et. al*. [20] presented a system for creating transcribed speech corpora having an utterances that is recorded by various speakers in different acoustic conditions. This system is having a client application on an android based mobile phones with internet connection in it. This application collects the information about the speaker, get the textual prompts from the server to read by the speaker, record the voice of a speaker and upload the audio and its metadata to the server.

Paulo A. Condado *et. al* [21] created an android based speech synthesis system that act as an interface between two different versions of information, known text-to-speech, to play effective communication between two people. The application developed is reliable and user friendly and also an effective communication is performed.

Zhuorui Yang *et. al* [22] developed an android based application that helps visual disable persons to cognize U.S banknotes. The application doesn't require any wireless connectivity or any infrastructure as it only rely on an android smartphones.

Ronald Yu *et. al* [23] designed and implemented an android application that makes a 3-dimensional model of a human head exalt the lip movement of the human speech from the text input. The application uses an android text to speech engine to convert the text which is entered by the user in a text box to human speech form in English.

S. Saychum *et. al* [24] developed a system consist of a Thai text processor along with the English text processor which inspects English text at high understandability. By using audio streaming optimization and HMM based speech unit, it converts highly smooth sound at a fast speed. CRF (Conditional Random Field) approach is used for the segmentation of Thai words.

Yu Zhong *et. al* [25] in 2014, developed this application construct a set of voices based on the context of an application, the commands are synthesized in a straight way from on-screen labels and accessibility parts of data. JustSpeak can remarkably improves the graphical interface for blind and gesture impaired people.

Amanda J. Stent, Shiri Azenkot [26] developed an iWalk application that helps people having vision problems. It is talk enable application that search the local places and gives navigation (directions) for needy person. It runs on smart phones. It assist speech input and gives live directions in both speech and text using information for time-to-turn with respect to street names so that the user has no need to look over to the street signs.

Table 2-1. Summary of Different Applications Develop under an Android platform

S. No	Platform	Domain	Language	Overview
1.	Android	Social Help	English, Hindi, French, German	Devika Sharma and Ranju Kanwar [1] created a language translator that takes an input text, split up into individual words and after the identification w.r.t their phonetic factor. It connects with the library to find out the voice representation of that specific word. Furthermore the text is translate from one regional language to another with respect to the voice representation.
2.	Android	Education	English	Mhamunkar, Priyanka V. *et. al* [2] created an application in which the user and the server are interacting in voice-to-text and text-to-voice form. Voice is converted into text and that text is searched in the dictionary present in application already and take out its meaning, which later will be converted into voice.
3.	Android	Social Help	English, Hindi	Sangle, Shailesh S. and Nilesh M. Patil [3] created a social domain based application. They developed a system and combines voice

				synthesis with skype. It gives a person an ease who is having sound disorder to talk with another person localize anywhere in the world by removing a hurdle that creates a problem during phone call.
4.	Android	Social Help	English, Hindi	Kamble *et. al* [4] presented single text-to-speech system for language Hindi to generate speech. Two steps is been followed, processing of text and generating speech. To convert Hindi text to speech, a graphical user interface has been designed in java swings [4]. Concatenative speech synthesis approach is been used.
5.	Android	Indoor Help	English	Hansen and John Paulin [5] built a Bluetooth platform that contains audio messages, near about information and one sided text-to-speech paging with the help of smart phones or it is a hardware that people might carry with them as well. This handy device plays an important role in places like shopping centers, hospitals and airports.

6.	Android	Social Help	English	Subhaashini *et. al* [6] developed an android based application for ease communication between normal and hearing disable persons. As sign languages are mostly used by these persons. So, this application converts those sign languages into speech sound which later can easily be understand by the people who has no knowledge regarding this sign language.
7.	Android	Social Help	English	Duke, I. *et. al* [7] presented a keyboard which is a combination of physical and gestural keyboards. They made an 8-button keyboard named Braille that can be connected to the smart phones via input wire. On the other side, the touchscreen endow gestures like thumb click for more difficult text editing operations. They help and gives economic and useful experience for users having sight problems.
8.	Android	Social Help	English	Landicho and Junar A [8] developed an application for the communication between two person both having problems like hearing and visual. Some of the keen

				features of this application are sending, replying, forwarding as it is a text based application.
9.	Android	Medical	English, Japanese	In this paper, Miyabe Mai *et. al* [9] developed a support system for medical domain. They developed a system to minimize the communication gap that arises because of not understanding a foreign language. It provides a function by which foreign patients will face no problem during communicating with the local receptionist. This system supports Japanese and English languages.
10.	Android	Medical	English	Aakash Agarwal [10] created an application which calculate the visual power of a patient. Its work is similar to that of an ophthalmologist who checks an eyesight with the help of a Snellen chart. The visual sense is calculated by means of text-to-speech conversion. Questionnaire is also followed after calculation, which uses Web Ontology Language (OWL).
11.	Android	Social Help	English	Kuei-Chun Liu, *et. al* [11]

				developed an application for the visually disable persons, who need helpful tools to aviate digital devices. By that, these people will get the digital information while working, living and learning. They developed an assistive system for those who faces visual problems during the use of android devices.
12.	Android	Corporate	English, German	Felix Burkhardt *et. al* [12] created an application by keeping in mind a main target that is a car domain. A system is developed for office mobile and entertainment stuff. The input function consist of a touch screen and automatic speech acknowledgement and the output consist of a screen and speech synthesis.
13.	Android	Education	English	Gaurang Kanvinder [13] developed an android based application for education domain. They developed an e-book reader for this platform but in a more handy way. It makes an ease for the people who are suffering from dyslexia. It contains the features that combines with already made functions that is text-

				to-speech technology and displaying the text in more orient way.
14.	Android	Social Help	English, Bengali	In this paper, Sankar Mukherjee and Shyamal Kumar Mandal [14] implemented a speech synthesizer for Bengali language for mobile devices. For generating the speech, they used ESNOLA (Epoch Synchronous Non- Overlap Add) which is a concatenate based technique.
15.	Android	Social Help	English, Punjabi	Jagmeet. Kaur and Parminder Singh [15] developed a Punjabi speech synthesizer that gives a speech output on mobile devices. Concatenative based speech synthesis approach is used which uses the phonemes for concatenate process.
16.	Android	Social Help	Malayalam	Arun Gopi *et. al* [16] Developed an android based application by using ESNOLA (Epoch Synchronous Non-Overlap Add) technique for Malayalam language. It is based on a concatenative based speech synthesis technique. They also apprise the implementation of

				Malayalam TTS, generate the database and access the database. It also manages the Malayalam character showing in android devices.
17.	Android	Communication	English	Sanja Primorac *et. al* [17] created an application named Voice SMS in which the spoken messages is converted into text form messages. Users are able to send those messages to their contact list. Speech recognition uses HMM (Hidden Markov Model) technique which is a successful and most adaptable approach in speech recognition.
18.	Android	Banking, Corporate	English	Ravina Mithe *et. al* [18] developed an application which execute image to speech conversion using android platform. The OCR (Optical Character Recognition) takes an image as an input, extract the text from that image and then convert that text into speech form.
19.	Android	Social Help	English, French, Italian	In this paper, Angelov and Krasimir [19] presented an architecture for speech-to-speech translation on

				android devices which is based on Grammatical Framework (GF). The architecture is to avail for language-controlled like translator that gives very high quality, which is a strong point of GF.
20.	Android	Social Help	17 Languages	Thad Hughes *et. al* [20] presented a system for creating transcribed speech corpora having an utterances that is recorded by various speakers in different acoustic conditions. This system is having a client application on an android based mobile phones with internet connection in it. This application collects the information about the speaker, get the textual prompts from the server to read by the speaker, record the voice of a speaker and upload the audio and its metadata to the server.
21.	Android	Social Network	English	Paulo A. Condado *et. al* [21] created an android based speech synthesis system that act as an interface between two different versions of information, known text-to-speech, to play effective communication between two people. The

				application developed is reliable and user friendly and also an effective communication is performed.
22.	Android	Banking	English(U.S)	Zhuorui Yang *et. al* [22] developed an android based application that helps visual disable persons to cognize U.S banknotes. The application doesn't require any wireless connectivity or any infrastructure as it only rely on an android smartphones.
23.	Android	Animation	English	Ronald Yu *et. al* [23] designed and implemented an android application that makes a 3-dimensional model of a human head exalt the lip movement of the human speech from the text input. The application uses an android text to speech engine to convert the text which is entered by the user in a text box to human speech form in English.
24.	Android	Social Help	English, Thai	S. Saychum *et. al* [24] developed a system consist of a Thai text processor along with the English text processor which inspects English text at high understandability. By using audio streaming optimization and HMM

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25.	Android	Social Help	English	Yu Zhong *et. al* [25] in 2014, developed this application construct a set of voices based on the context of an application, the commands are synthesized in a straight way from on-screen labels and accessibility parts of data.
26.	Android	Social Help	English	Amanda J. *et. al* [26] developed an iWalk application that helps people having vision problems. It is talk enable application that search the local places and gives navigation (directions) for needy person. It runs on smart phones. It assist speech input and gives live directions in both speech and text using information for time-to-turn with respect to street names so that the user has no need to look over to the street signs.

Chapter 3 Problem Statement

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3.1 Research Gap

The chief perspective of the topic is that many people are still hesitating when it comes to English language for communication purpose and to interact with others as well. As, mobile operator problems are on a high peak now a days. From my personal experience, people faces a lot of problems while interacting with the service provider helpline. People know that they offers native languages to interact in which people are comfortable with, by that people getting an ease to share its problem to them. But, with these benefits, some drawbacks are also there. In many cases, service providers hang up the call, transfer the call to some other person, put the call on hold, do not solve the issue completely and many more.

By surfing a lot of websites, people having a lot of issues by their mobile customer care. Figure 3.1 shows complaint volume chart of 2014-15 in telecom industries [27] and compared it with rest of the industries. As the level of volume of complaints is having a huge margin compared to rest of the industries that means a major problem is yet to be solved in this field. Considering all the queries, only few of them has been solved completely and make a customer satisfy. As mobile phones have become a best friend of today's people, they need every possible thing in it who make them ease to solve their issues.

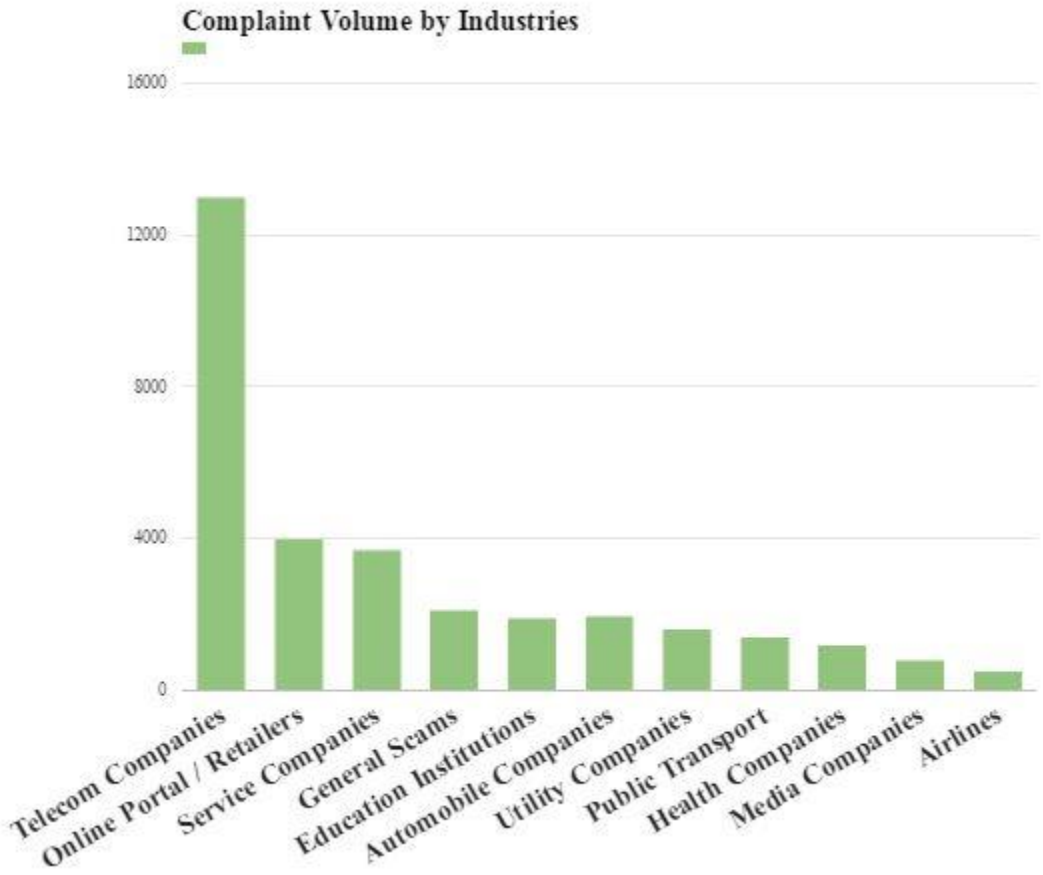

Figure 3.1 Complaint Volume Bar Chart [27]

3.2 Problem Statement

An android based application has been developed already for customers to interact and finding their query solutions, but not in language like Hindi. As Hindi is a language by which most of the people are comfortable to interact and discuss their problems. An application under android platform must solve this customer operator relations. So, to develop an application having both English-Hindi questionnaire that most of the people faced in their day to day life.

The mobile enterprise is expected to reach *approx*. $280 billion by 2019 in global market. It is nearly four times in size in comparison with this year's size. The "app" has evolved into the prime place since the origin of the mobile applications in 2008. It becomes a need for almost every enterprise. Previous year facts about how much time have been spent on mobile devices

The need of an android applications is becoming huge in demand with respect to the smartphones in real world. As it continuous to grow at a steady pace, the affordability and hardware independence impelled it in this speedy growing space.

3.3 Objective

Some of the prime objectives is discuss below:

- To collect a questionnaire of topmost query problems faced by customers.
- To prepare the data in both text and speech mode.
- To get a brief knowledge of Android Studio and Genymotion (simulator).
- To develop a front end of the Application.
- To train and test the Application.

Chapter 4 Methodology

This thesis work presents the steps followed for converting text to speech for English and Hindi language with the help of Microsoft translator API.

4.1 Android Architecture

Android OS has become very popular in recent times. The android devices also assist the text-to-speech synthesis. By that, speech synthesis has turn to be a crucial modality for mobile devices in various characteristics like running, driving which curb the use of visual modality. Speech synthesis system for mobile devices are not an easy job as it has a small-scale storage capacity and performance. An android architecture [17] is shown in figure 4.1.

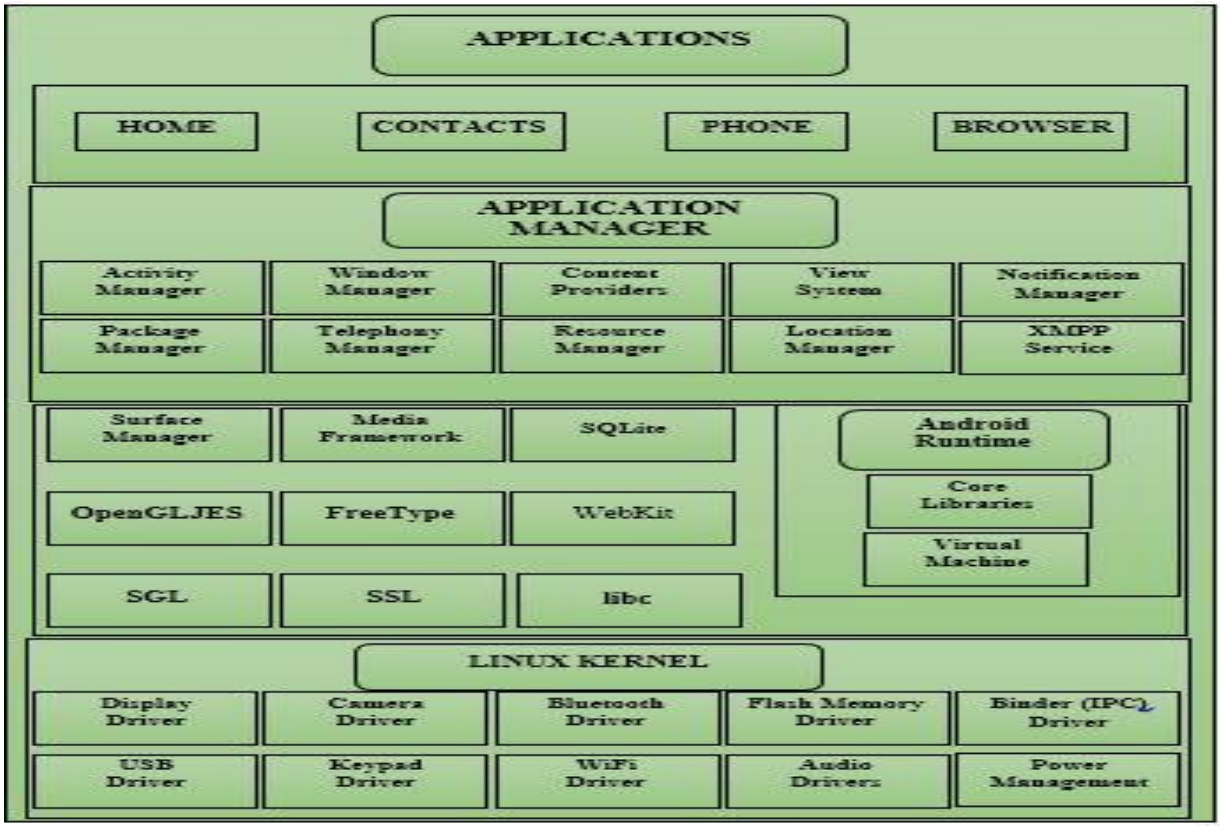

Figure 4.1 Android Architecture [17]

4.2 Android Activity Life Cycle

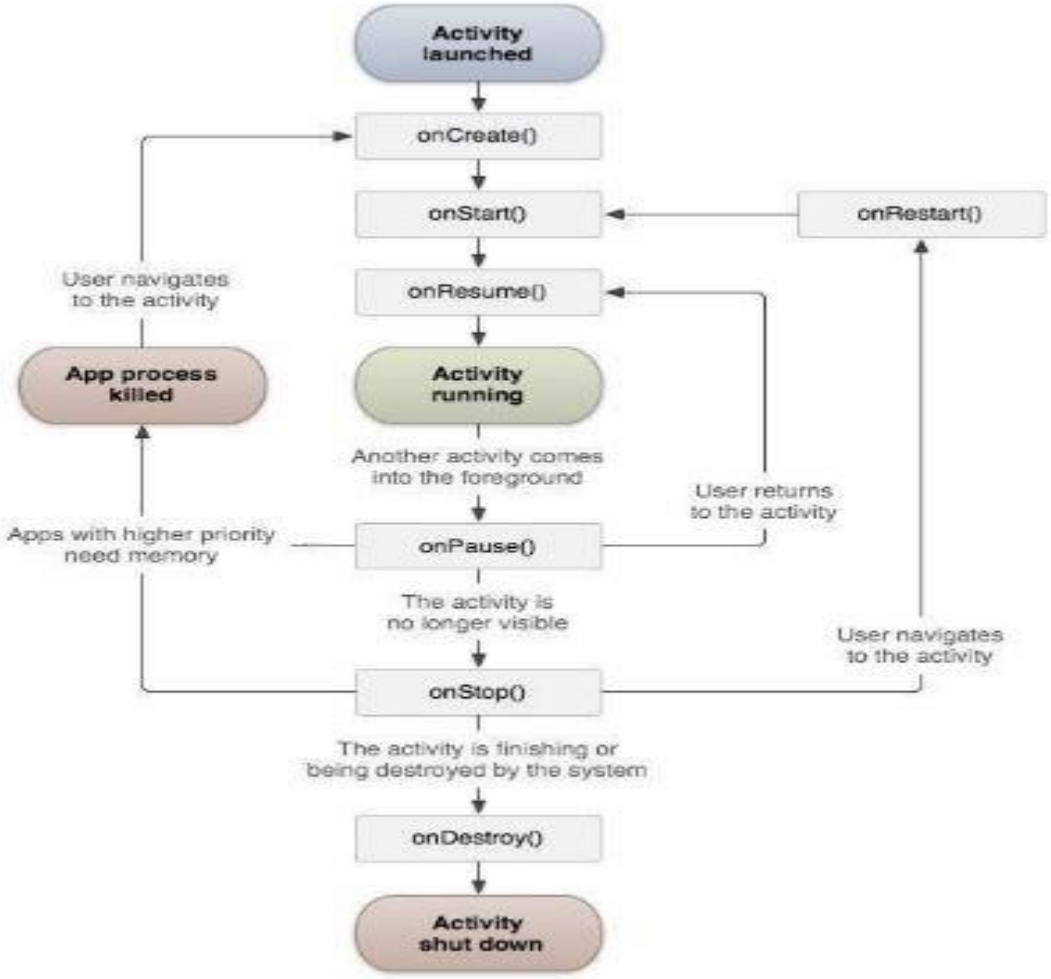

Figure 4.2 Activity Life Cycle [29]

Android system starts its program with an **Activity** starts with onCreate () callback method. There is an order of callback methods that initiates an activity follows by remaining callback methods that divided an activity as shown in above figure 4.2 of Activity life cycle diagram.

The **Activity** class defines different callbacks that is events mentioned in the below table 4-1. There is no need to implement all the callback methods. Moreover, it's crucial to understand rest and implement those that confirms an app behaves the way as user expect.

Table 4-1. Different Callbacks and its Description [29]

Callback	Description
onCreate()	Called when the activity is first created.
onStart()	Called when the activity is getting visible to the user.
onResume()	Called when the user and application starts interacting with each other.
onPause()	This activity does not receive user input and not able to execute the code and called when the activity is getting paused and the previous activity is getting resumed.
onStop()	Called when the activity is no longer exist.
onDestroy()	Called just before the activity is destroyed by the user.
onRestart()	Called when the activity after stopping it, restarts again

Chapter 5 Implementation

5.1 Installation

Following are the software that installs before begin:

5.1.1 Android Studio and Genymotion Installation

(a) First download the Android Studios and installed it in a system.

(b) After installation, need to download the latest SDK (Software Development Kit) tools and platform using the SDK manager

(c) Then, installed Genymotion which is a simulator for android apps.

5.2 Steps of Implementation

- Firstly, design a structure for operation buttons as shown in figure 5-1 that would be the overall operational view of an application.
- After getting the operations, start designing and placing of operation buttons in a meaningful places. By that, front end is ready.
- Now, the database (back end) work is started by collecting questionnaire according to the highness of the problem that mostly user faced in day to day life.
- According to those questionnaire, record the voices in Hindi language which is audible and easily be understand by the people, as English voices is inbuilt in an application itself.
- Now, looping and connectivity part of the text and its related speech sound is maintained accordingly, so that it will be an ease for the user to get a solution in a quick and easy way.
- Buttons like Hindi/English Translator, Speech, Previous, Next and Exit shows in the first design structure of figure 5.1 works accordingly to the need of the user and their problem, means what query a user wants is just under one click.
- Action of buttons are very important and in a sequence way that means you need to translate first, then use the speech button to listen to the problem solution in Hindi language.

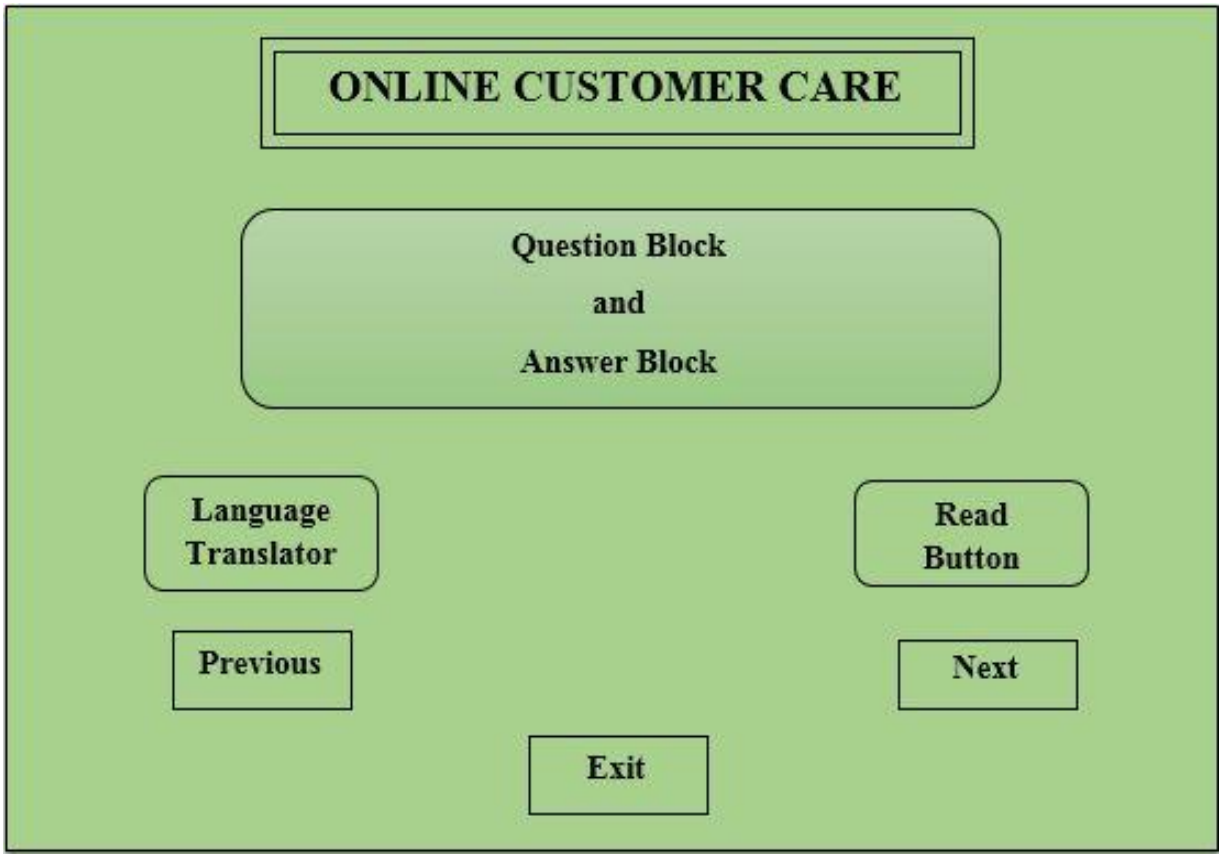

Figure 5.1 First Design of an Application

5.3 Application Flow Chart

The step to step procedure of the overall work of an application is shown in the given flow chart shown in figure 5.2. After it starts, it first displays an English question as a query. If a user is looking for some other problem solution, then user needs to search it in a database for that particular problem. The Translator Button translates the given English input query into Hindi language format so as for the answer as well. Speech synthesis is performed accordingly to the need of the user by using Speech Button.

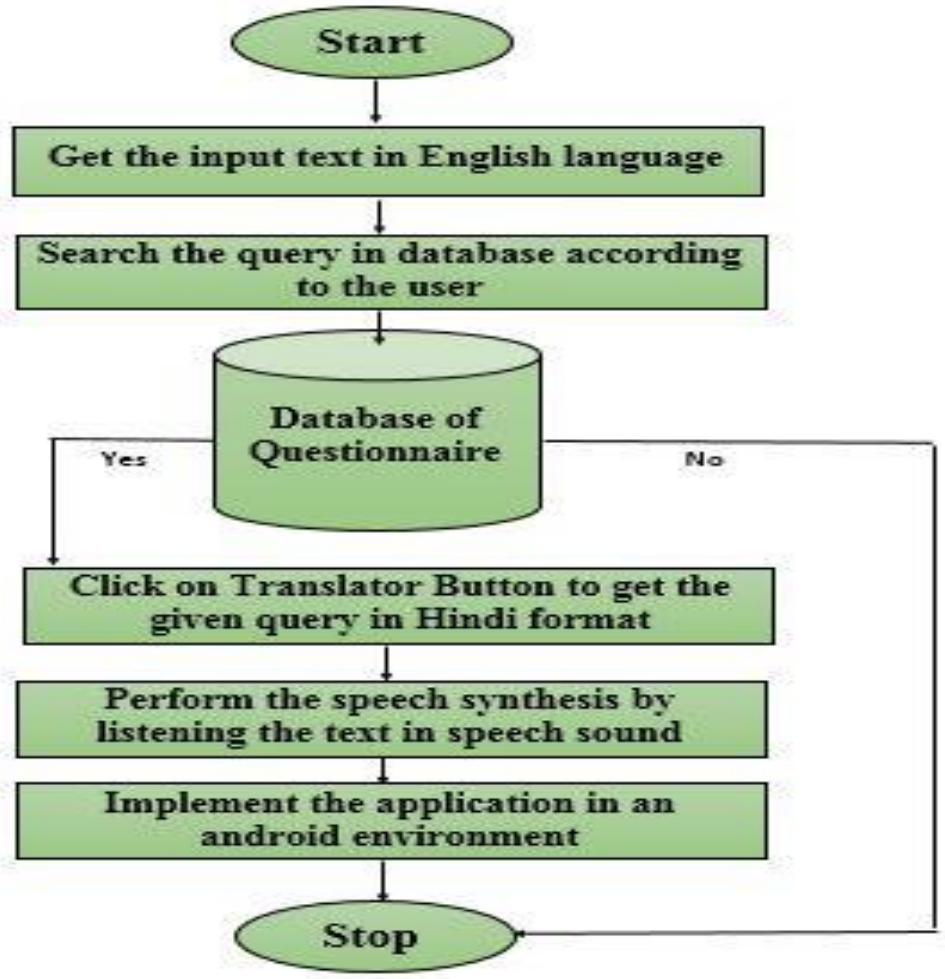

Figure 5.2 Application Flow Chart

5.4 Prepare a Questionnaire Database

After finish up the structural view of an application, next work is to find out the most happening complaints in a mobile telecom industry by searching and find out many websites, blogs, FAQ's of some websites and takes out 18-20 questions and prepared a questionnaire bank for it. After that, prepare a database for questions with solutions in English language, as it is the only language in which user can find the questionnaire's online.

5.5 Record Voices

Now, after collecting all the questionnaire, next work is to record the voices according to those questionnaire. As the synthesizer works in bilingual (English and Hindi) form, record the questions and solutions in both the languages. The voices should be in good quality. So, record the voices by using Audacity (Audio Editor) which is an open source digital audio editor available free on the internet.

Now by having all the database of the questionnaires and it corresponding voices stored. Next step is to connecting/ looping the questionnaires with those of voices and put it together. By that, when click on the read button it gives the exact question and its solution in speech form as the demand (click) by the user. It is very effective for people who wants the solution of the query in a speech output.

5.6 Algorithms for Text-to-Speech Conversion

Below are the list of algorithms used to convert text-to-speech in textual and audio form.

5.6.1 English Text to English Speech

The speech synthesis application is developed in Android 5.0. The procedure to convert English text to English speech is discuss below:

- Firstly, took a text in an English language as an input. By lexical analyzer, split that text into words individually. Then for an equivalent phonetics of those words, searched it in the library.
- After that according to the text, arrange its phonetics. By the corresponding phoneme, sounds were concatenated to create synthesized output speech.

English Text to Hindi Text

The procedure to convert Hindi text to Hindi speech is discuss below:

- The English text is converted into Hindi text under a single click of an application's translator button.
- The translation is done by means of a Microsoft translator API (Application Programming Interface). An API is consist of routines, tools and protocols for building applications and software.

5.6.2 Hindi Text to Hindi Speech

The procedure to convert Hindi text to Hindi speech is discuss below:

- The conversion in Hindi language is happened by clicking on the translator (English/Hindi) button.
- After the conversion, click on the READ button to listen to the questionnaire in Hindi speech.

5.7 Code Snippets

Some of the code snippet of functionality buttons are shown below:

5.7.1 ANS Button (For English Text)

```
buttonAnswer.setOnClickListener((v) → {
        String string = textViewN.getText().toString();
        if (string.equals("Q1.")) {
            textViewQ.setText("Can I apply for a prepaid connection online?");
            textViewA.setText("For applying prepaid connection you need to visit nearest Mobile store.\n" +
                    "OR You can also buy prepaid connection from independent sales agent or direct sales agent.\n");
            b1.setText("HINDI");
        }
        if (string.equals("Q2.")) {
            textViewQ.setText("What documents do I need to get a new prepaid connection?");
            textViewA.setText("To get a new prepaid connection you need just to fill up Prepaid Customer Application Form (CAF)
                    "Along with the duly filled CAF documents required:\n" +
                    "1. One colour/BW photograph\n" +
                    "2. Any one document from the list\n" +
                    "\n" +
                    "  -Passport\n" +
                    "  -Arms License\n" +
                    "  -Driving License\n" +
                    "  -Photo Identity Card having address\n" +
                    "  -Election Commission ID Card\n");
            b1.setText("HINDI");
```

Figure 5.3 Code Snippet for ANS Button

In the above code, a TextView displays text to the user and allows them to edit it optionally. A TextView is a text editor, however the configured basic class is not allow to edit it. A questionnaire is being set in the above code as you have seen in the above figure 5.3. Also, the text is been set for a language Hindi also for translating it in the further code.

5.7.2 ENGLISH/HINDI Button (Translation)

```
public void onClick(View v) {
    String string = textViewN.getText().toString();
    switch (string) {
        case "Q1.":
            if (v.getId() == R.id.button3) {
                textViewN.setText("Q2.");
                textViewQ.setText("What documents do I need to get a new prepaid connection?");
                textViewA.setText("");
                b1.setText("HINDI");
            }
            if (v.getId() == R.id.button2) {
                Toast.makeText(getApplicationContext(), "You are on the first page", Toast.LENGTH_LONG).show();
                b1.setText("HINDI");
            }
            if (v.getId() == R.id.bTranslate) {
                String s = textViewQ.getText().toString();
                String s2=textViewA.getText().toString();
                String s3=b1.getText().toString();
                if (s3.equals("HINDI")){
                    try {
                        String t = new Mytask().execute(s).get();
                        String t2=new Mytask().execute(s2).get();
                        textViewQ.setText(t);
                        textViewA.setText(t2);
                    } catch (InterruptedException e) {
                        e.printStackTrace();
                    } catch (ExecutionException e) {
                        e.printStackTrace();
                    }
                    b1.setText("ENGLISH");
                }
```

Figure 5.4 Code Snippet for Translation Button

As the Translate is highlighted in the above code, it is clearly signifies that this code is for the translation of English to Hindi language. The strings s and s2 is use to fetch the text view part of both question and its relative answer (or solution). The MyTask () method is used to fulfil the translation task.

5.7.3 READ Button (English Text)

```
b2.setOnClickListener((view) -> {
        String string =textViewN.getText().toString();
        if (string.equals("Q1.")) {
            String s = b1.getText().toString();
            if (s.equals("ENGLISH")) {
                String string2=b2.getText().toString();
                if (string2.equals("READ Q.")){
                    mp=MediaPlayer.create(getApplicationContext(),R.raw.qh1);
                    mp.start();
                    b2.setText("READ A.");
                }
                if (string2.equals("READ A.")){
                    mp=MediaPlayer.create(getApplicationContext(),R.raw.ah1);
                    mp.start();
                    b2.setText("READ Q.");
                }
```

Figure 5.5 Code Snippet for READ (Speech) Button

Android fulfils many ways to control playbacks of audio/video files. One of this way is through a MediaPlayer class. Android provides this MediaPlayer class for access built-in services like playing audio and video. For using MediaPlayer, a static method getApplicationContext () is called.

The second parameter is the name of the sound files that a user wants to play. User has to make a new folder under a project named **raw** and place the sound files into it. Once a MediaPlayer object is created, user can call some methods to start or stop the sound files.

By calling start () method, the sound file which is questionnaires in this synthesizer will start playing the file.

5.7.4 READ Button (Hindi Text)

```
        if (s.equals("HINDI")){
            String s2=textViewQ.getText().toString();
            String s3=textViewA.getText().toString();
            String string2=b2.getText().toString();
            if (string2.equals("READ Q.")){
                speakOut(s2);
                b2.setText("READ A.");
            }
            if (string2.equals("READ A.")){
                speakOut(s3);
                b2.setText("READ Q.");
            }
        }
    }
```

Figure 5.6 Code Snippet for READ (Hindi Text)

The above code is the continuation of the previous snippet and is for to listen the particular questionnaire in Hindi speech. By this, user able to listen the translated questionnaire in Hindi language which was the main motive of synthesizer.

5.8 Snapshots of TTS Synthesizer

Snapshots of a TTS synthesizer are given below

5.8.1 Question in English Text

When an application runs, it starts with one of the query, from all those questionnaire saved in a database. If a user is having some other query, he/she can find it by clicking on the NEXT button.

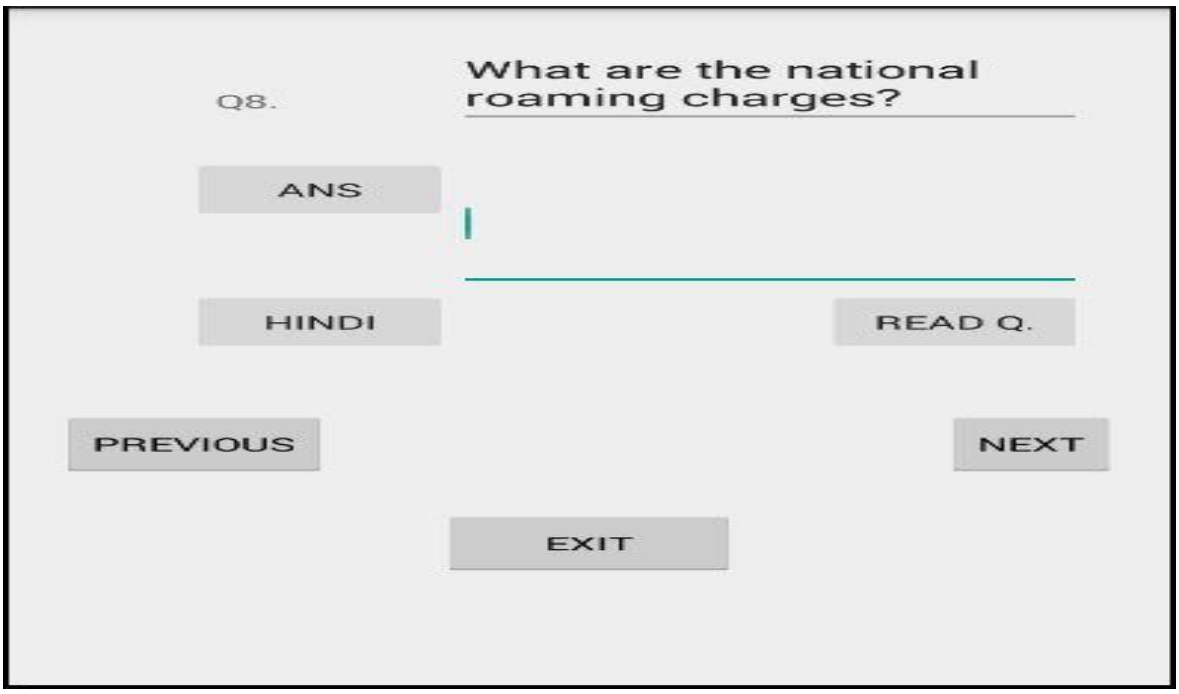

Figure 5.7 Question in English Text

5.8.2 Answer in English Text

To get a solution of a particular query, user need to click on an ANSWER button. By clicking on it, automatically a solution comes on the answer block.

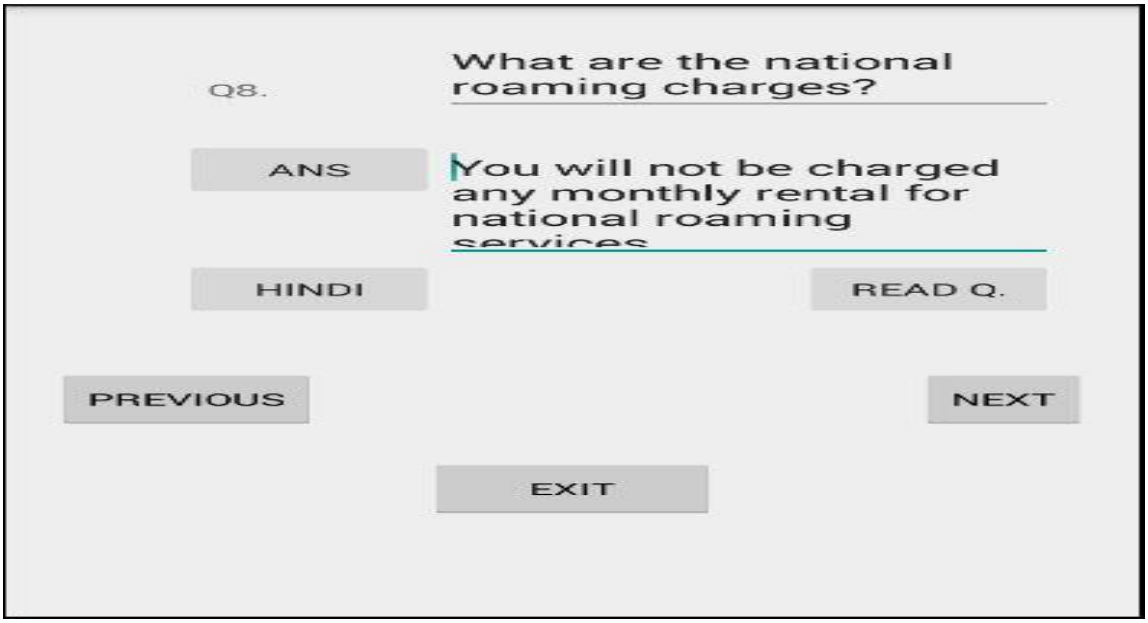

Figure 5.8 Answer in English Text

5.8.3 Listen in English Speech

To listen the particular query, user needs to click on the READ Q button. By clicking on it, user able to listen the query. Similarly for listening an answer, user needs to click on READ A button.

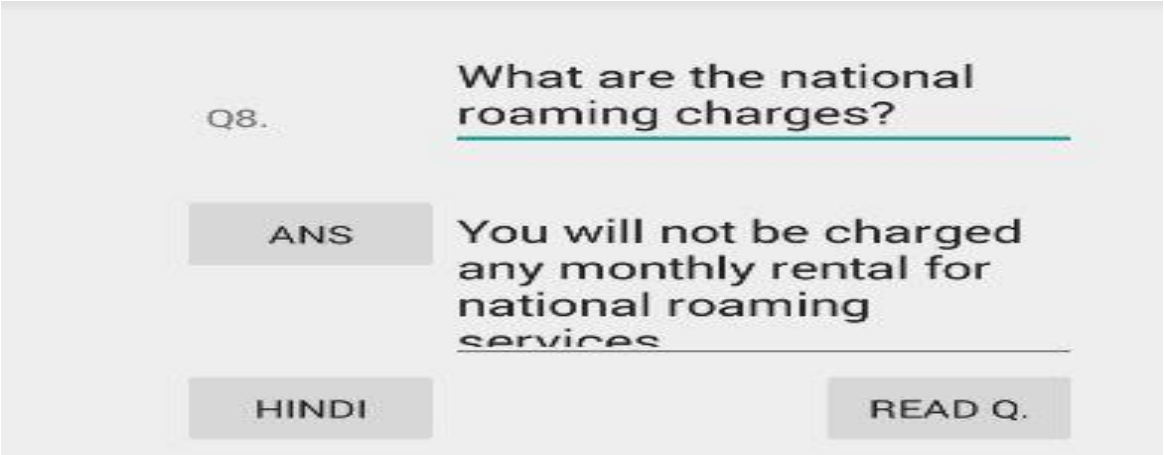

Figure. 5.9 Listen in English Speech

5.8.4 Translate in Hindi Language

For translating the particular query including the solution, user needs to click on a HINDI button which afterwards shows an ENGLISH word on a button as shown in below figure 5.4, consisting the translator function. By clicking it, the query and solution is automatically translated from English to Hindi text.

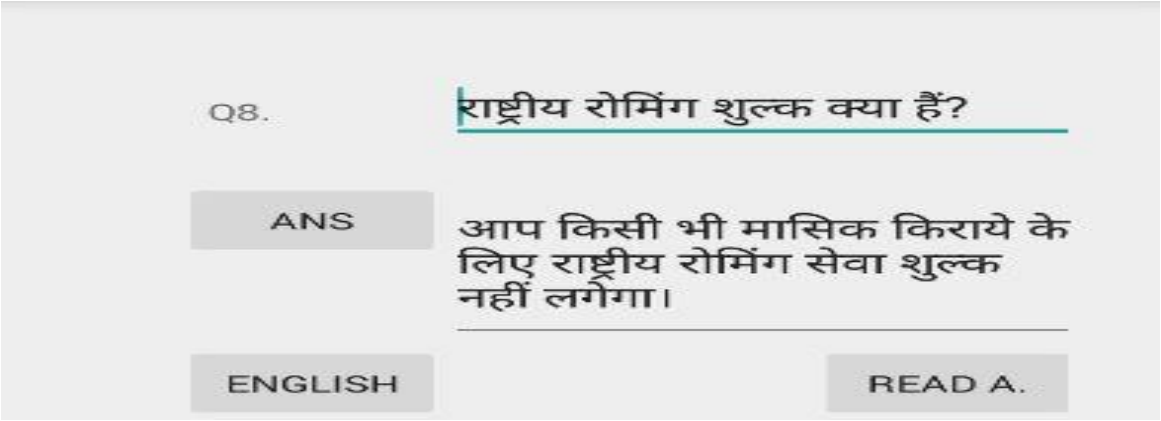

Figure 5.10 Translate in Hindi Text

5.8.5 Listen in Hindi Speech

To listen the particular query in Hindi language, user first need to translate it by clicking on a HINDI button which functioned as a translator. After that, user needs to click on the READ Q or READ A button to listen a query in Hindi language.

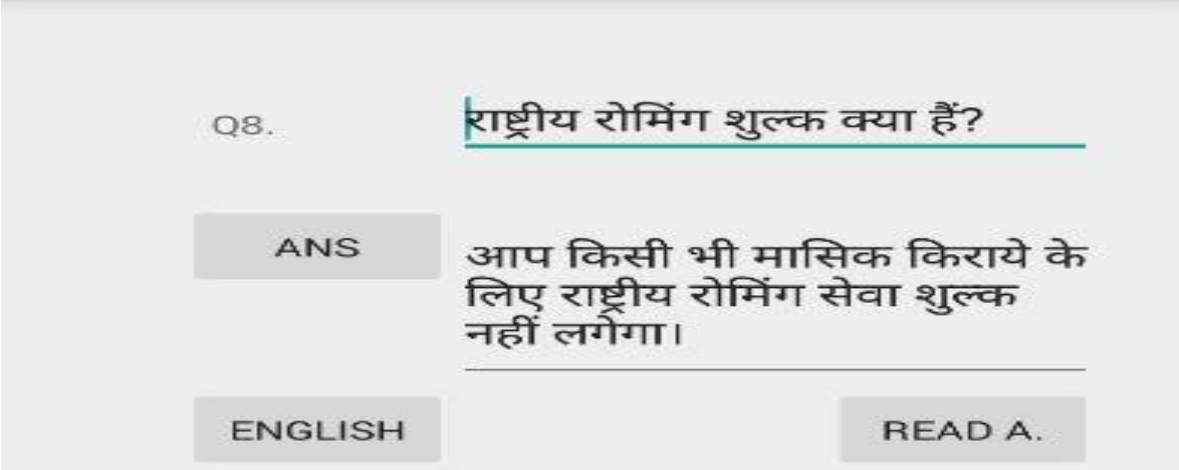

Figure 5.11 Listen in Hindi Speech

Chapter 6 Testing & Results

6.1 Beta Testing

Beta Testing is a type of UAT (User Acceptance Testing). It tests at customer's site. A system (or synthesizer) sends to the user, who uses it under a real-world working environment.

Beta Testing is the second phase of testing a software in which a group of audience or people tries the system out. It can be reflected "pre-release testing." The motive of this testing is to give an application in the hands of real audience of a field and find out any issues or flaws from their point of view and overcome those issues before the final release version of an application.

6.1.1 Closed Beta Testing

It is a version that is released for a selected users or group of individuals to test the application. These people are those who called by an invitation.

6.2 Comparative Result

Comparison of two subjects within a structured frame of reference is called a comparative result. Here considering the two situations, one is an already going by calling a customer care and the other is the same query will be available with a solution in an application.

By asking 15-20 people regarding their experience with the customer care conversation, the feedbacks are a bit expected. Some people are very unhappy with the query solving manner of operators and some are quite satisfied with their query solutions. A table shows in 6-1 below is make out by those responses.

By showing a synthesizer to them, in which most of the queries are what they were expecting and solution is also by which they get satisfy. A bar graph shows in fig 6.1.

Table 6-1 Behavior of users in both ways

Ways of Interaction	Bad	Average	Good	Excellent
Telephonic Way (out of 20 people)	11	4	3	2
Application way (out of 20 people)	2	8	5	5

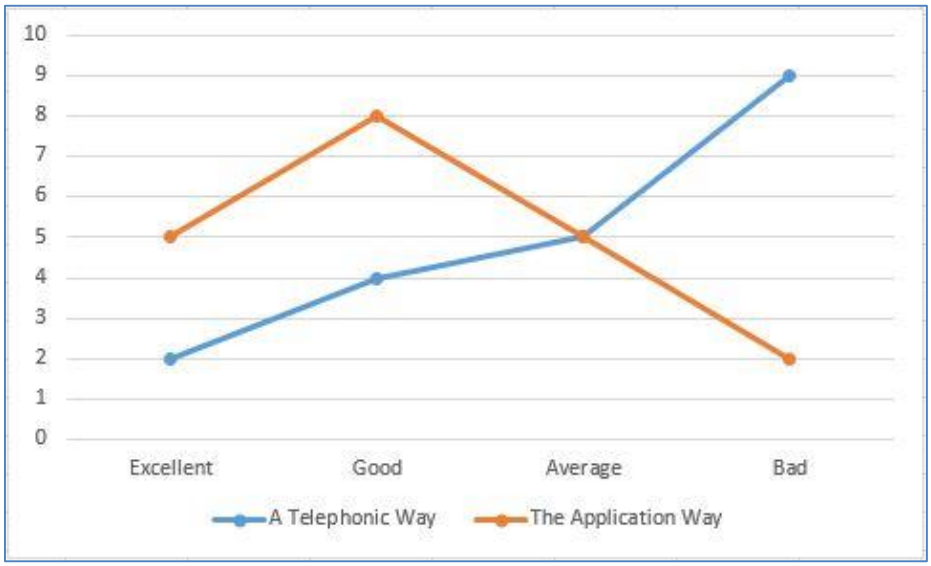

Figure 6.1 Comparative Graph

Chapter 7 Conclusions

7.1 Conclusion

In this research work, the text to speech conversion with intermediate language translator shows the useful result. The translation of language was done by Microsoft translator API. The voice is hearable with paragraphs and punctuation ambiguity [9]. Latest speech recognition API's are only having the capability for recognize a single word. It will raise the speech recognition to recognize a sentence. The cloud-based translation system used here for English-Hindi language. It helps for blind persons to hear the solutions of the problems after text is converted into speech. Time consumption will also be reduced that before was taken a lot of time during conversation between the customer and operator. The conversion of text-to-speech has been done for English and Hindi language. The individual not only able to hear the text but also can read the translated text with that of the language translator. It can also be done for rest of the regional languages as well as foreign language.

7.2 Future Work

An application of speech synthesis have been developed for android platform. The developed application is reliable and user friendly and performed an impressive communication. This system can be a problem solution for the people and specially targeting to those with audible problems as it would help them to listen to their problems that they faced regarding their mobile operators. The application work has been done for English and Hindi language. In future, this work can also be done for rest of the regional languages like Gujarati, Tamil, Telugu, *etc*.

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Annexure I

List of Publications

[1] Keshav Singh Rana and Rupinderdeep Kaur, "**An Android Application for Mobile Customers using Speech Synthesis**" in Volume 146, International Journal of Computer Applications (IJCA), July 2016 Edition. [**Published**]

ANNEXURE II

Video Link

https://www.youtube.com/channel/UCPR5qsbbldto9a2hHN4PGHg

ANNEXURE III

Plagiarism Certificate

Keshav_Thesis.pdf

ORIGINALITY REPORT

8%	4%	2%	6%
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