SANWADHA

Intelligent Assistant for Hearing Impairers to Interact with The Society

Software Requirement Specification Document

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DECLARATION

I declare that this is our own work and this software requirement specification does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of our knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

1. Introduction

The introduction of the Software Requirements Specification (SRS) document mainly provides a scope description and an entire overview of everything included in the Software Requirements Specification (SRS) document. This includes purpose, definitions, acronyms, abbreviations, references and overview of the SRS.

1.1. Purpose

The purpose of this document is to give a detailed description of the requirements for the project "Sanwadha" as an intelligent assistant for Hearing Impairers to interact with the society using Machine learning and Natural language processing. This document will illustrate the purpose and complete declaration of development of the system to give an in-depth insight of "Sanwadha". It will also explain product's target audience, system constraints, interfaces and interactions with other external applications, features of the system, functional requirements, nonfunctional requirements, data requirements, quality requirements, hardware requirements and software requirements. Issues related to the current system and actions to be performed by the development team are described in order to come up with a better solution. This document can be used to verify whether the software meets the user's actual needs and requirements. In Development team's perspective SRS is valuable as it describes scope of the project, plan system's design and eventual implementation.

In short, the purpose of this SRS document is to provide a detailed overview in Text and Voice translation to Sign language and creating 2D model of the software product "Sawadha", its parameters and goals.

The intended audience of this System Requirement Specification are, the members of the research group, project supervisor Prof. Samantha Thelijjagoda.

1.2. Scope

System Requirement Specification includes the requirement for the initial release of "Sanwadha" System. It's possible to change the specification if the requirement changes in future. And purpose of this document is to guide people who involve in system design and application developments for build full scaled and full featured "Sanwadha" System. Main purpose of the project team is to provide a document which completely covers all the essential features and requirements within this research. The document needs to cover an all-round description in statement of the work section. Even though while declaring everything, the reader may filter the anticipated benefits out to verify new things we will be done in the future.

The purpose of this project is to design and implement a multi featured chat application using deaf people. This chat application will include different means of communication other than the conventional text to text keyboard conversation. Things such as interpreting sign language signs to text and voice to text will be the most useful features of the system.

Main objective

- The major objective of our system is to minimize the barriers between deaf people and normal people.

Specific objectives

Barriers in communication: -

The main problem that the deaf people face is the communication difficulty. These barriers affect access to public information, opportunities to express oneself and access to essential services such as health, housing, transportation, education and employment. Even though we can't address all these areas, our system is an effort to minimize the barriers between differently able people and normal people in communication, by providing them a way to interact with other people and the society.

Barriers in education: -

People with disabilities often have access to less and inferior education than people without disabilities, because of many types of barriers. This system will provide them a good opportunity to share their knowledge and experiences with other each other.

Barriers in healthcare: -

There are numerous barriers encountered in the access and delivery of health services. The major unavoidable issues in health care are physical access issues, funding, attitudinal and communication issues. Our system can address most of these areas other than funding and attitudinal as they are depending on the person. The users can connect with their doctors via system and can get the opinion.

Barriers in developing human relationships: -

Isolation of differently able people in today's world has become a severe problem even though the modern and developed world today has failed to realize. Most of the time people who are differently able, not care for by their families, alone in places under the care of never met charity workers, are left out to be so alone. By using this system these people may able to interact with the outside world and develop good relationships with them.

Benefits

- Eliminate of the gap between differently able people and normal people.
- Better communication through more features.
- Overcome the loneliness of differently able people.

Goals

- Make a happy life for differently able people.
- Make a better communication application for connect people in modern world.

The system is a sign language to voice and voice to sign language converter which provides advanced technology for users to interact with non-hearing impaired people. Many research projects and tools are invented by using speech recognition technique. Mainly what focus throughout this project is to improve the issues those are not properly addressed by existing solutions. Outcome is an application where hearing impaired users have freedom to interact with non-hearing impaired user. In Sri Lanka, some people are not that much fluent in English. Therefore, it is helpful to develop a system with the capability of understanding human speech done in Sinhala language and Sinhala sign language. It helps to minimize the language barriers up to a certain level.

Main part of this system is to convert 2D model signs in to a text and signs into Gif real time manner. "Sanwadha" design 2D model with the blueprint of the bust of a man model essential aim is focusing on the hand structure. To convert 2D model signs in to a text has sub parts as,

1. Modeling 2D animations
2. Convert signs into text tags
3. Mapping tags with 2D scripts and animate them instantly.

Signs are created by using well animated 2D model which include hands and the bust of a human. Each finger joints have sensors with high flexibility. Hearing impaired user can bend and stretch very easily from each sense to create the user's sign. Sign movements are captured/created by model using sensors and convert into meaningful text by mapping with text. Apart from converting text, the application will also give the user suitable notifications like use facial expressions in messaging system, vibrations to notify about selected background noises which the user cannot hear. This would be another option to sending messages System should allow the user to record specific sound and the system will match the input sounds with the user defined sounds and give a notification when a suitable match is found. And going to familiarize Sending messages offline using mobile through "Sanwadha" app in the absence of internet facility.

And system is mainly focused on how the database should be handled and real time performance. Thus, this is developed as a mobile application, should be implemented with light weighted and using less resources.

1.3. Definitions, Acronyms and Abbreviations

1.3.1 Definitions

Term	Definition
Sanwadha	An intelligent assistant for hearing impairers to interact with the society
Sign language	A language which chiefly uses manual communication to convey meaning, as opposed to acoustically conveyed sound patterns. This can involve simultaneously combining hand shapes, orientation and movement of the hands, arms or body, and facial expressions to express a speaker's thoughts.
Hearing impaired	A hearing loss that prevents a person from totally receiving sounds through the ear.
Real time	A system in which input data is processed within milliseconds so that it is available virtually immediately as feedback to the process from which it is coming.
Natural Language Processing	Natural language processing (NLP) is a field of computer science, artificial intelligence and computational linguistics concerned with the interactions between computers and human (natural) languages.
Machine Learning	Machine learning is a type of artificial intelligence (AI) that provides computers with the ability to learn without being explicitly programmed. Machine learning focuses on the development of computer programs that can change when exposed to new data.
GIF	The Graphics Interchange Format is a bitmap image and lossless format for image files that supports both animated and static images.
API	Application program interface (API) is a set of routines, protocols, and tools for building software applications. An API specifies how software components should interact.
Animation	A simulation of movement created by displaying a series of pictures, or frames.Cartoons on television is one example of animation.

GZIP Compression Algorithm	GZIP is a file format and a software application used for file compression and decompression.
SRS	A software requirements specification (SRS) is a description of a software system to be developed. It lays out functional and non-functional requirements, and may include a set of use cases that describe user interactions that the software must provide.

Table 1.3.1.1: Definitions

1.3.2 Acronyms, and Abbreviations

2D	Two Dimensional.
SRS	Software Requirement Specification
GIF	Graphic Interchange Format
NLP	Natural Language Processing
ASR	Automatic Speech Recognition
SLU	Spoken Language Understanding
SLG	Spoken Language Generation
UI	User Interface
TTS	Text to Speech Synthesis
IM	Instant Messaging
API	Application Program Interface
HDD	Hard Disk Drive
RAM	Random Access Memory
D-User	Deaf user

Table 1.3.2.1: Acronyms and Abbreviations

1.4. Overview

The proposed system would give the perfect solution for the problems occurred in communication of hearing impairers and hearing people.

A language is an entirely human method for communicating thoughts and feelings. There is a gap between non-hearings impaired and hearing impaired people when it comes to communication. Most of the non-hearing impaired people cannot understand what Sign language is.

The main intention of the investigation is to deliver excessive support by enabling hearing impaired people to communicate with others, share feelings and ideas, actively interact with the society and help that they require with minimum amount of effort and time. And, allowing the hearing impairs to play the role by way of ordinary people without having desertions.

- To establish the pathway for investigation, research papers and documents were surveyed mostly. Furthermore, the real obligation was discovered through the interviews conducted with students of Deaf School.
- To determine the use of mobile applications for deaf people can be observed as a diligence that allows them regardless to utilize to any need of learning and communication at any time anywhere.
- To emerge the application in Sinhala language to reach the Sri Lankan deaf community in an effective way.
- To advance the text message to a Graphic Interchange Format (GIF) to get the message in sign language with more accurate and attractive manner.
- To allow the generation of own sign language using 2D model provided which makes hearing impairers more comprehend about the message they want to direct.
- To enhance Sinhala voice recognition algorithm.
- To interact with the most popular social media like Facebook Messenger.

This document contains a detailed description about user and system requirements of the system and how the system going to implemented according to those requirements. Format of the SRS and content of the next sections of this document is stated below.

Chapter 2 provides an overall description of the system with the product perspective, different interfaces of the system, memory constraints and operations. Further the chapter 2 describes

major product functions, user characteristics, the constraints that may limit developer's options, assumptions and dependencies and order in which requirements are to be implemented.

Chapter 3 describes external interface requirements such as user, hardware, software and communication interfaces. Classes/objects, performance requirements, design constraints and software system attributes like reliability, maintainability, availability is also described under chapter 3.

Finally, all the references and supporting information is provided at the end of the document.

2. Overall Descriptions

The proposed system is a mobile based application named as "Sanwadha". The main ideology of the system is to provide a real-time communication tool between deaf persons and normal persons. It converts text into sign language and voice into sign language.

When considering the system architecture basically it is an instant messaging application. All user interfaces are in mobile phone. But then again, some processing parts are implemented in a web server. Thus, the consumption of the processer of the mobile phone is very low. Because of we needed to make an application which is light weighted and efficient. Text to sign conversion, Voice to sign conversion, GIF conversion and displaying are done in the mobile phone. Other functionalities suchlike creating signs using 2D model are implemented in web server.

Since this is a mobile application it supports for portability but need to support for the real-time communication. The algorithms used must be efficient enough to speed up the application. Also, must be produced most accurate outcomes. To satisfy above requirements developers need to be in good understanding of each and every functionality of the application.
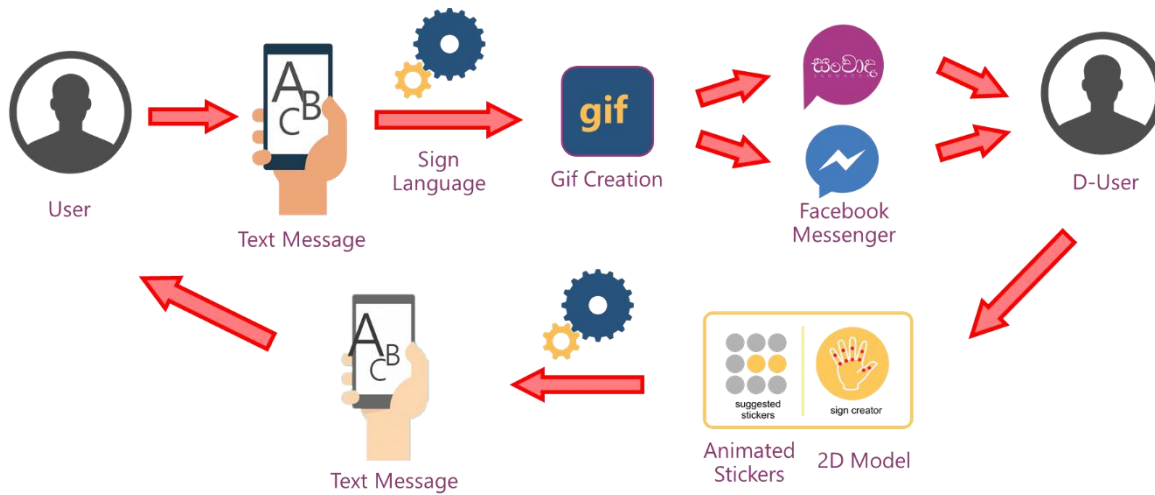
Figure 2.1: System diagram for Text conversion

Figure 2.1 mainly describes the text conversion of proposed system architecture. Text is entered and the text can be either Sinhala and Singlish. Input text would be converted into sign language which is in a format of String. Set of strings is transformed to the GIF format. GIF can be send via either Facebook messenger or proposed application "Sanwadha" to the hearing-impaired user. In the reply scenario, deaf user can select either 2D model or animated stickers. Reply is delivered to the Normal user as a text message.
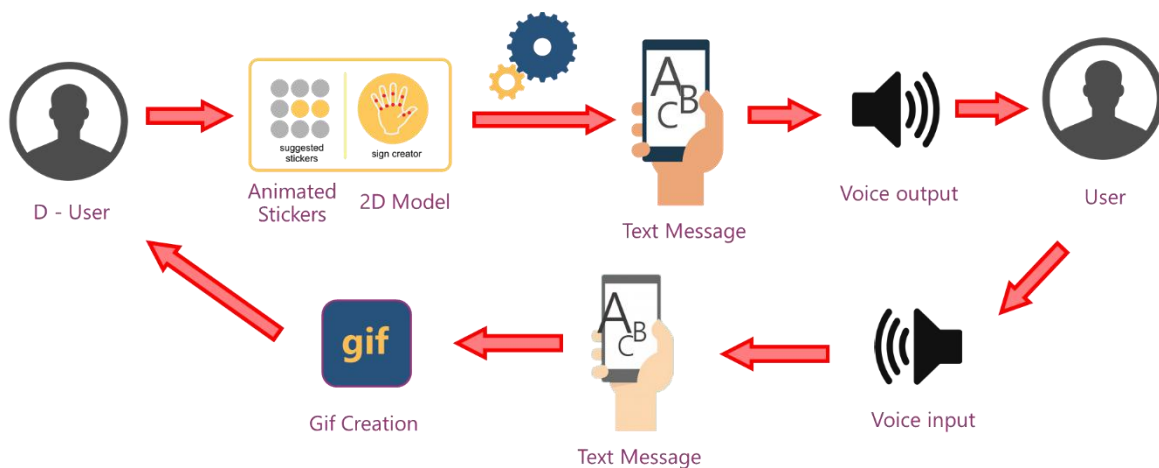

Figure 2.2: System diagram for Voice conversion

Figure 2.2 mainly describes the voice conversion of proposed system architecture. Deaf user can select either 2D model or animated stickers. That sign would be converted into text. Now the text to speech part is occurred in a high accuracy level. Finally, normal user get the voice

output. In the reply scenario, reply is delivered to the deaf user as a GIF message through the process of speech to text.

2.1. Project Perspective

There are few systems that are built for the aid for the deaf people up to date. These systems use different technologies and different ideas to achieve the same goal which is helping deaf people. Following are more details about the existing systems.

"Ahanna" System

It is mainly focus on teaching the Sinhala sign language to the users who uses that system. Also, it is web based online application and it has some videos to explain things in attractive manner.

The main intention of the "Ahanna" (listen) is to spread the pure Buddhism to the deaf community of Sri Lanka through Sri Lankan Sign Language (SLSL) while gifting many more valuable activities, innovative products & innovative ideas to improve the knowledge, education & quality of Sri Lankan Deaf Community [8].

"KATHANA" Sinhala speech recognition system

This application is a solution for recognizing and interpreting voice. Application converts an acoustic signal which represents human speech done in Sinhala language captured by a microphone, to a set of words. Emphasis is that this acoustic wave represents a human speech done in Sinhala language. The recognized words which are the results can be used for applications as commands, data entries or could be served as the input to further linguistic processing to achieve speech understanding. [9]

System consists of two main components

1. Processing acoustic signal captured by the microphone.

2. Interpret the processed signal and map the signal to words. Speech understanding. Hence the product will can track the human speech.

"Nihanda" system

This system used to aid for children who are diagnoses with hearing impaired. Used leap motion controller to track signs and convert them to voice. They implemented game based learning system to hearing impaired children to learn sign language easily. System demonstrate how to identify individual signs and phonetics though videos and images. Mind teaser games uses to self-motivate children to improve their learning abilities.

Deaf chat

Deaf Chat facilitates communication between Deaf and Hearing individuals. It replaces the pencil and paper that is frequently used, plus you can communicate over moderate distances.

A network connection is established between two devices (phones or tablets). The first individual can input text via voice recognition or the keyboard into his Local text area and send this to the second device. On the second device, the text will appear in the Remote text area. The second individual can respond back to the first by entering text into his Local text area, again using either voice recognition or the keyboard.

Using a network connection rather than Bluetooth allows the individuals to be near each other or separated by a large distance. The network connection will most likely be Wi-Fi, but it could be an Intranet or even a connection via the Internet [18].

Deaf - Hearing chat

DH Chat is a system for face-to-face communication between deaf and hearing people without a sign interpreter. If you are a hearing person, you can communicate with your deaf relatives, friends, clients, employees and so on. If you are a deaf person, you can make a face-to-face conversation with hearing people without sign interpreter. You can use the system everywhere: at home, at your work, at restaurants, during your education and so on [17].

Following Table have compared the functionalities of existing systems and the Project "Sanwadha"'s expected system.

Features	Deaf chat	Deaf hearing chat	Nihanda	Ahanna	Kathana	Sanwada
Speech to sign translation -Sinhala	✘	✘	✘	✘	✘	✓
Text to Sign language – Sinhala & Singlish	✘	✘	✘	✓	✓	✓
Translated sign language to GIF	✘	✘	✘	✘	✘	✓
Sign language using 2D modeling	✘	✓	✘	✘	✘	✓
Stickers and animated stickers	✓	✘	✓	✘	✘	✓
Interaction with Facebook messenger	✘	✘	✘	✘	✘	✓
Mobile application	✓	✓	✘	✘	✘	✓

Table 2.1.1 comparison of similar application.

This expected system will give following features

1. Capture hand movements accurately

2. Capture voice signal and filter noise and get accurate texts

3. Create more realistic animation

4. Real time actions

5. Database enhancements to work with real time environment

6. Light weighted, simple mobile application by giving opportunity to render models as soon as possible.

Considering the outcome of the literature review, it is conceivable to decide the most appropriate tools, technologies and software solutions for the implementation phase. In some cases of design conclusions, study more than one possible technologies and take performance and dependencies into deliberation.

The projected solution can be divided to following key components:

• 2D Model creation

• Text Conversion Mechanism

• GIF file Compression and Extraction Mechanism
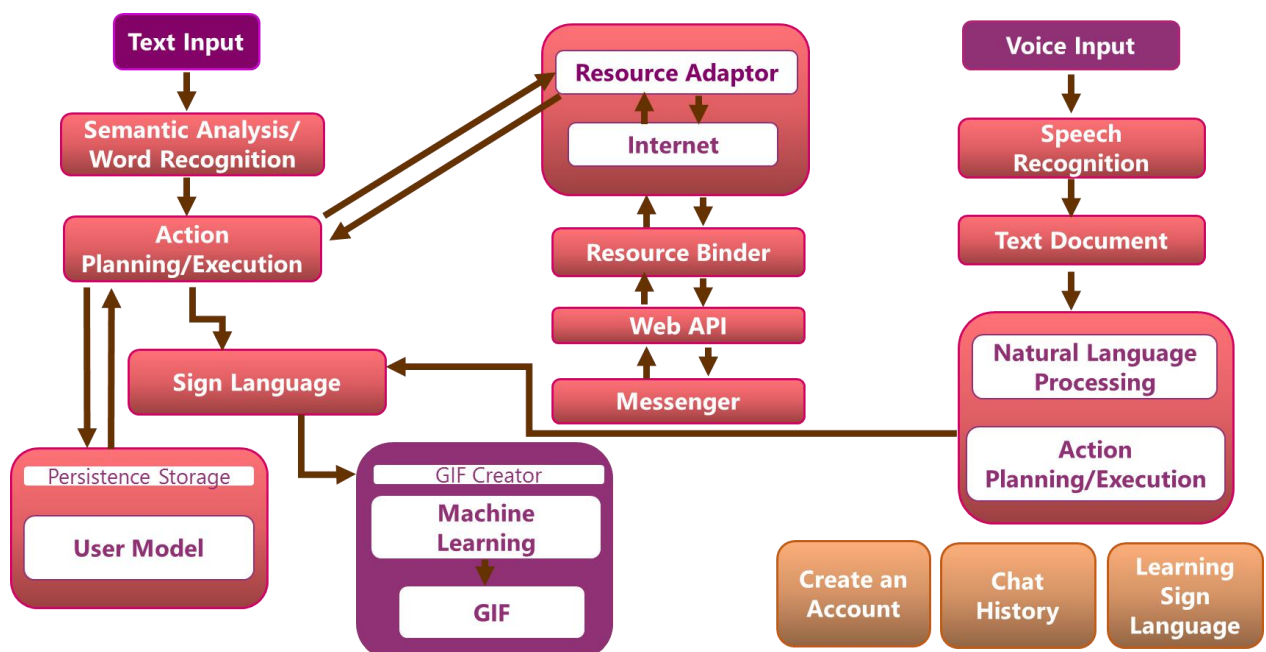
• Voice Recognition Module

Figure 2.1.1: Technical diagram for the system.

2D Model creation and Convert created 2D Model sign to Text

Main part of this system is to convert 2D model signs in to a text and signs into Gif real time manner. "Sanwadha" design 2D model with the blueprint of the bust of a man model essential aim is focusing on the hand structure. To convert 2D model signs in to a text has sub parts as,

1. Modeling 2D animations
2. Convert signs into text tags
3. Mapping tags with 2D scripts and animate them instantly.

Signs are created by using well animated 2D model which include hands and the bust of a human. Each finger joints have sensors with high flexibility. Hearing impaired user can bend and stretch very easily from each sense to create the user's sign. Sign movements are captured/created by model using sensors and convert into meaningful text by mapping with text. Created signs convert to meaningful text. In hear get the full idea of the whole signs and convert it to a text to make interaction between ordinary people and hearing impairers.

2D model with high flexibility is introduced in delivering the message or idea by hearing impaired user to other users. Generating the sign can be referred in 2D Hand Model procedure. (Figure 2.1.3: 2D Hand Model procedure)
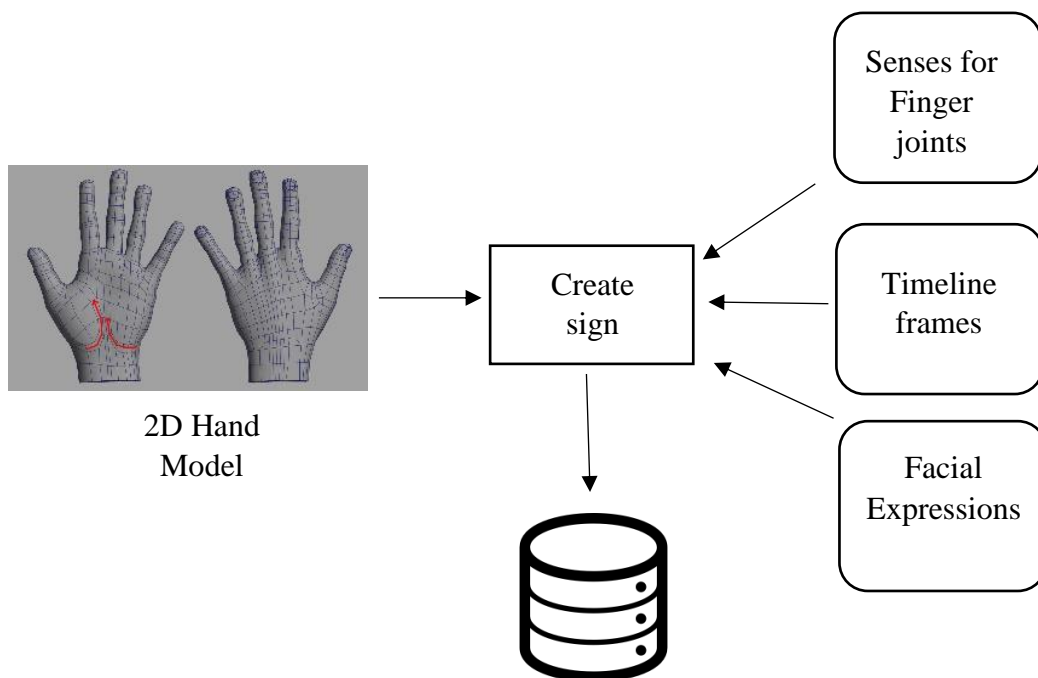

2D Hand Model

Figure 2.1.3: 2D Hand Model procedure

Basically, the 2D hand model is having Senses for each Finger joints with high flexibility. Hearing impaired user can bend or stretch very easily from each sense to create the user's sign.
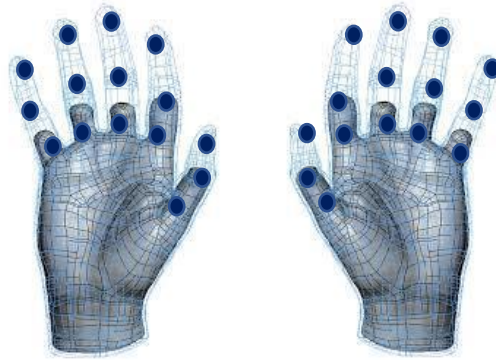

Figure 2.1.4: 2D Hand Model

Also, user can enhance the sign by adding Time frames, Facial expressions (Happy, Angry, Sad) where the sign creation makes more effective.
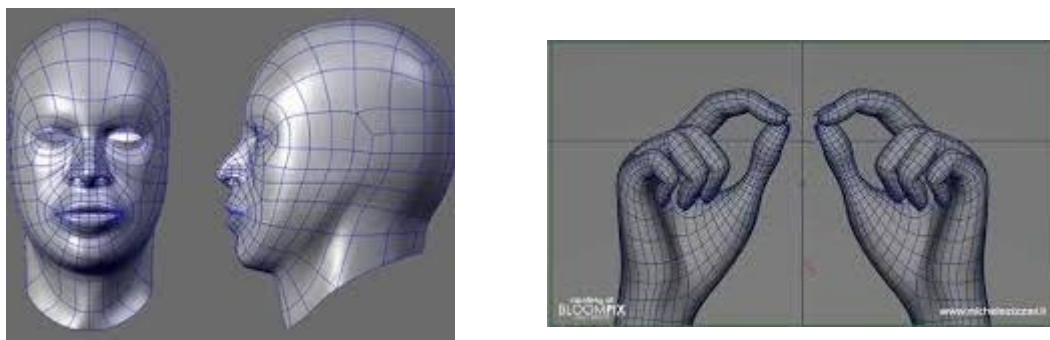

Figure 2.1.5: Design Models

Sign to Text Conversion Mechanism

Text conversion is a set of events that occurs between the input text and GIF response. This arrangement of events referred as Text adaptation. (Figure 2.1.6: Text Adaption)
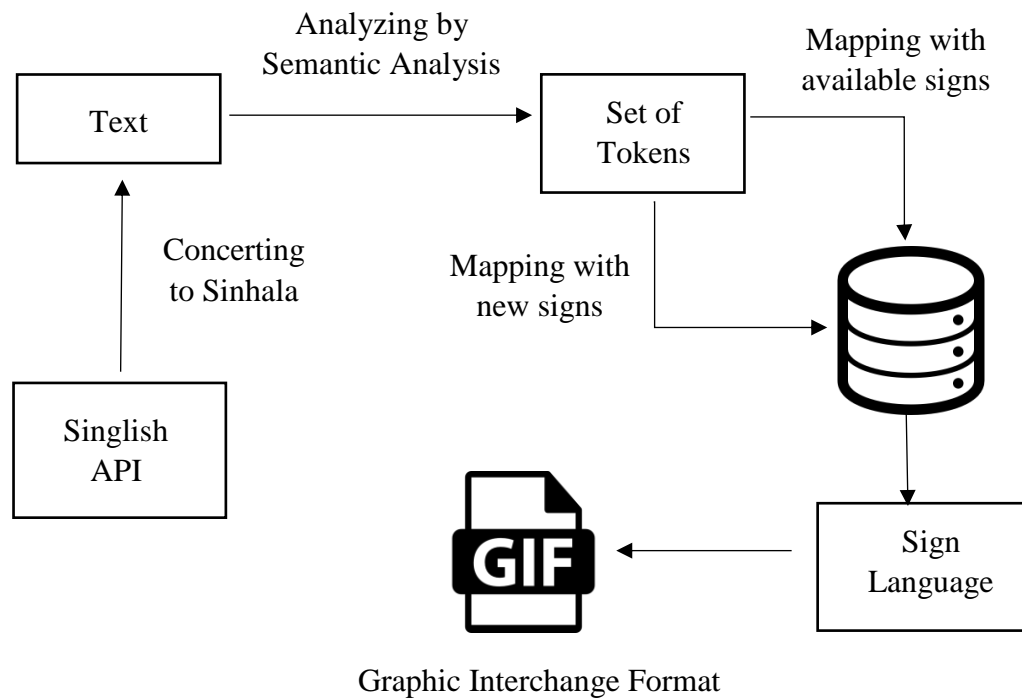
Figure 2.1.6: Text Adaption

And furthermore, going to familiarize Sending messages offline using mobile through "Sanwadha" app in the absence of internet facility. Apart from that will be introduced "Learning Signs" to those who willing to learn Sinhala sign language. It will be giving a chance to ordinary people to learn.

2.1.1. System Interfaces

The proposed system will interact with API's listed below

- Facebook messenger
- Singlish API
- Rest API

2.1.2. User Interfaces

Proposed system is a mobile application connected with a remote server. Additional libraries will be used to improve the appearance of the GUIs and offline messaging. All user interfaces are described in detailed in section 3.1.1.

Key user interfaces

- Main user interface
- Secondary interfaces
    i. Text messaging
    ii. Voice approach

2.1.3. Hardware Interfaces

Hardware requirements will need to run the developed application without having any problem. For the designing, implementation and testing purposes we have identified few hardware requirements. Suchlike,

- Mobile phones – Android
- Microphone
- Speaker
- Windows 10, Windows 8, Windows Embedded Standard 7
- 32-bit (x86) or 64-bit (x64) processor
- Dual-core 2.66-GHz or faster processor
- 2 GB RAM

2.1.4. Software Interfaces

These software components are mainly used created in this application.

- Windows 10 Operating System
- Microsoft Visual Studio 2017 (.Net)
- Microsoft Azure
- SQLite Database
- MAYA Autodesk

- Photoshop CC
- CorelDraw X7

2.1.5. Communication Interfaces

- 4G – 3G connection of the mobile phone will be used for data transmission between the mobile app and the web server.
- Wi-Fi - If the mobile data is not available, user can connect to an available Wi-Fi router to get the internet connection to use the application. And this will also be used for data transmission between the mobile app and the web server.
- Required Connection bandwidth might differ time to time. Since large data load is travelling through the network, having a high bandwidth internet connection will help a lot for the users to use the application with ease.

2.1.6. Memory Constraints

- 70 Memory Capacity.
- 1 GB RAM Android mobile phone.

2.1.7. Operations

System User is capable of following operations

- Create profile – User can provide user name and password in order to login to the application.
- View and edit profile – User can view the profile and update any information.
- View chat history – User can view the previous chat threads.
- Save model – User has the privilege to save the generated 2D models.
- View design history – The application save models and user can view design history.
- Add features to model – User can enhance the sign by adding Time frames, Facial expressions.
- Input text – User can input text either in Sinhala or Singlish
- Input voice – User can feed in voice to interact with deaf people

System Administrator is capable of following operations

- Login – Admin can provide user name and password in order to login to the application.
- Manage the user details – Has the privilege to manage user details.
- Upload 2D models – Application allow admin to upload models.
- Approve relevant signs – Accept the signs created by the deaf users.

2.1.8. Site Adaption Requirements

- Both normal and Deaf people are the main users of the application. Hence, it is a requirement to build the application in a simple, understandable and innovative manner to make the application more users friendly.
- Internet access should be provided to the mobile.
- The voice output should be clear and accurate to the user from the beginning.

2.2. Product Functions

Our team has determined the following functions to be most important and pertinent for system to provide.
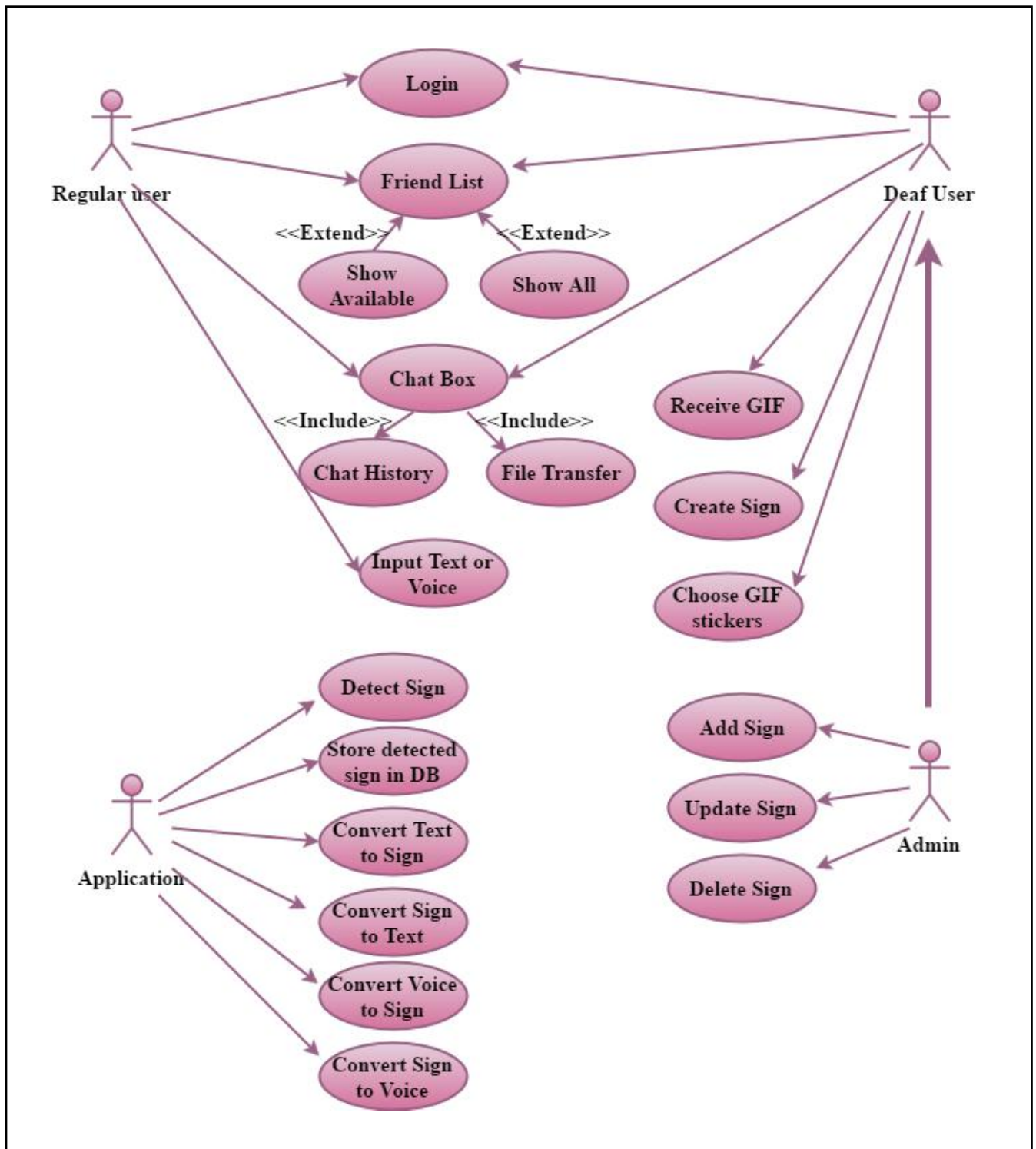

Figure 2.2.1: Use Case diagram of the system.

Use case Scenarios

Use Case Element	Description
Use Case Number	1
Application	Sanwadha
Use Case Name	User logging
Use Case Description	User Enter his username and password and logging to the system
Primary Actor(s)	User
Basic Flow	1.The use case starts when the user start the Sanwadha system 2.The user enter user information and logging to the system 3. User request the facility 4. The use case ends
Extensions	1.aThe entering data are not valid 1.a.1 Display Error Message
Priority	High
Performance	Data retrieval maximum lag: 5 sec
Channels to Actor(s)	Database, interface

Table 2.2.1 use case scenario of User logging

Use Case Element	Description
Use Case Number	2
Application	Sanwadha
Use Case Name	User registration
Use Case Description	New user enter to the system and Register
Primary Actor(s)	User
Basic Flow	1.The use case starts when the user start the Sanwadha system 2.The user direct to the registration page 3. User create a account 4. The use case ends
Extensions	None
Priority	Medium
Performance	Data retrieval maximum lag: 5 sec
Channels to Actor(s)	Database, interface

Table 2.2.2 use case scenario of User registration

Use Case Element	Description
Use Case Number	3
Application	Sanwadha
Use Case Name	Select chat mode
Use Case Description	User select the chat mode
Primary Actor(s)	User
Basic Flow	1.The use case starts when the user logged to the Sanwadha system 2.The user enter the chat mode 3. The use case ends
Extensions	2.a. if user not select the chat mode, system will be operating under text mode.
Priority	high
Performance	Data retrieval maximum lag: 3 sec
Channels to Actor(s)	interface

Table 2.2.3 use case scenario of Select the chat mode

Use Case Element	Description
Use Case Number	4
Application	Sanwadha
Use Case Name	Chat under voice mode.
Use Case Description	User selects the chat mode as voice. Al the inputs and out puts are based on voice.
Primary Actor(s)	User
Basic Flow	1. The use case starts when the user select chat mode as voice. 2. The user operates the system based on voice commands. 3. The use case ends
Extensions	None
Priority	High
Performance	Data retrieval maximum lag: 3sec
Channels to Actor(s)	interface

Table 2.2.4 use case scenario of chat with voice mode

Use Case Element	Description
Use Case Number	5
Application	Sanwadha
Use Case Name	Chat under sign language mode.
Use Case Description	User selects the chat mode as sign language. Al the inputs and out puts are based on sign language.
Primary Actor(s)	User
Basic Flow	1. The use case starts when the user select chat mode as sign language. 2. The user operates the system based on sign language commands. 3. The use case ends
Extensions	None
Priority	High
Performance	Data retrieval maximum lag: 3 sec
Channels to Actor(s)	Interface,database

Table 2.2.5 use case scenario of chat with sign language mode

Use Case Element	Description
Use Case Number	6
Application	Sanwadha
Use Case Name	Chat under sign language mode with sign panel
Use Case Description	User selects the chat mode as sign language and use sign panel as the input source.
Primary Actor(s)	User
Basic Flow	1. The use case starts when the user select chat mode as sign language. 2. The user operates the system based on sign language and use sign panel to input signs to the system. 3. The use case ends
Extensions	None
Priority	High
Performance	Data retrieval maximum lag: 3 sec
Channels to Actor(s)	Interface,database

Table 2.2.6 use case scenario of chat with sign language mode using sign panel

Use Case Element	Description
Use Case Number	7
Application	Sanwadha
Use Case Name	Hand sign to Text mapping
Use Case Description	Capture hand gestures and convert to text.
Primary Actor(s)	User
Basic Flow	1. Application is up and running 2. Identify Hand Gestures. 3. Transmit the generated signal. 4. Identify mapped Key words for the hand gestures from the database. 5. Map text.
Extensions	Only appears entered words in to the database.
Priority	Medium
Performance	Data retrieval maximum lag: 3 sec
Channels to Actor(s)	Interface, database

Table 2.2.7 Hand signs to text mapping

Use Case Element	Description
Use Case Number	8
Application	Sanwadha
Use Case Name	User logout
Use Case Description	Users can logout from the system when they want to exist from the system.
Primary Actor(s)	User
Basic Flow	1.The use case starts when the user wants to exit from the Sanwadha system 2.The user click the logout button 3. The use case ends
Extensions	none
Priority	low
Performance	Data retrieval maximum lag: 7sec
Channels to Actor(s)	Database, interface

Table 2.2.8 use case scenario of logout from the DAWN system

2.3. User Characteristics

This application is developing for special determination of helping people who are deaf. Users for this application can be

- Hearing Impaired people

- Ordinary people

- Application Developers

- Any other people who need study sign language

Since this is not a critical application developers have not defined any priority levels to the users of the application. Deaf people can use this application when they communicate with a person who has no idea about the sign language. With the use of this application they can communicate without any intimidation or trouble. Using this application for hearing impaired people can communicate with other hearing impairs. Likewise, this application can be used for teachers who teach the students at Ragama Deaf School and who guide for the hearing-impaired persons.

Application developer performs a main role here. Because updating the application and keep it bugs free is their responsibility. Research group will release new versions when this application and the database of this application have been updated.

As mention above sections, there is enormous communication gap between normal people and hearing impaired people in the Sri Lanka. Due to lack of knowledge about the sign language this problem has been occurred. Thus, this application can be used to get knowledge of the sign language. To get the support from ordinary person at any time anywhere. Furthermore, communication can be done in between ordinary users and hearing impaired user as well as among hearing impaired users.

2.4. Constraints

In this development process of the "Sanwadha" application, development team had to consider about many types of constraints which were affected to the projected application. Those identified constraints are as follows,

- Hardware constraint

This proposed application going to develop as mobile application. Because of that development team had to consider about resource limitations. In order to perform best out of this application, it is a must to upright microphone and speaker of mobile phone. Otherwise this may cause wrong outcomes to the end user. Another hardware limitation of this application is, to run this application it is a must to AMD Phenom™ II or Intel® Core™ i3, i5 or i7 processor; 2GB RAM; USB 2.0 port20GB free hard disk space and Internet connection.

- Software constraint

Use C# for Xmarine and Azure database to implement our application and custom the external library for offline messaging.

- Time constraints

The system should be completed by September 2017.

2.5. Assumptions and Dependencies

When designing this application there are some assumptions observed.
- Most of the deaf people uses mobile phones and prefer to update with the modern technologies.
- All deaf people and ordinary people who are willing to interact with the deaf community will download and install the application to the mobile phone.
- Users have at least a slight knowledge to operate the mobile phone and the application properly.
- Normal persons will help those deaf persons to communicate using the application. (user involvement)

Dependencies observed throughout the application are as follows.

- The accuracy of the System depends on the input text. Thus, it is very important to have a meaningful sentence of Sinhala or Singlish language.
- Need to have a better network connection to access the internet.
- The speed of the GIF file transfer depends on the network connection and the processing power of the mobile phone.

Furthermore, moving to the future enhancements all the regional sign languages in Sri Lanka are going to be addressed within the application. Since a less number of day to day scenarios covered in the application by now, an enhancement is done by approaching more scenarios. Implement the application by mounting all the other sign languages in order to advance the communication all around the world.

2.6. Apportioning of Requirements

The requirements described in sections 1 and 2 in this document are referred as primary specifications. Details in section 3 referred as requirements specifications. The two levels of requirements are intended to be consistent. Inconsistencies are to be logged as defects. If a requirement is stated within both primary and functional specifications, the application will be built from functional specification since it is more detailed.

Section 3 describes all the essential requirements which are going to implement in this version of "Sanwadha" application. In section 3.6 describe other requirements which contain desirable requirements and optional requirements. Desirable requirements are to be implemented in this release if possible, but are not committed to by developers. It is anticipated that they will be part of future release. Optional requirements will be implemented at the discretion of developers.
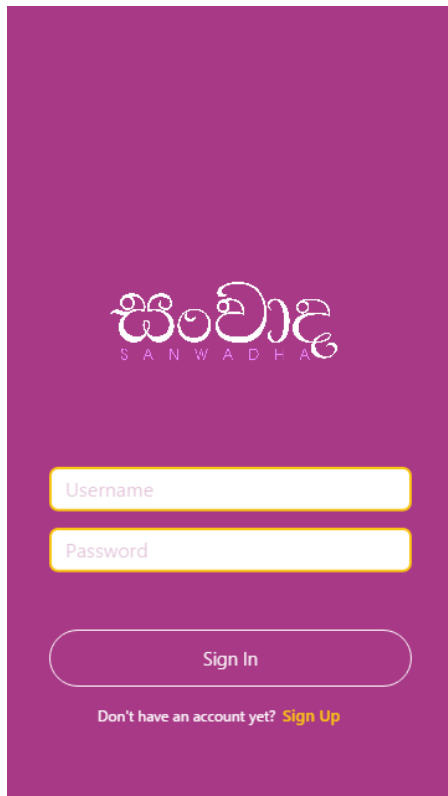
3.Specific Requirements

3.1. External Interface Requirements

3.1.1. User Interfaces
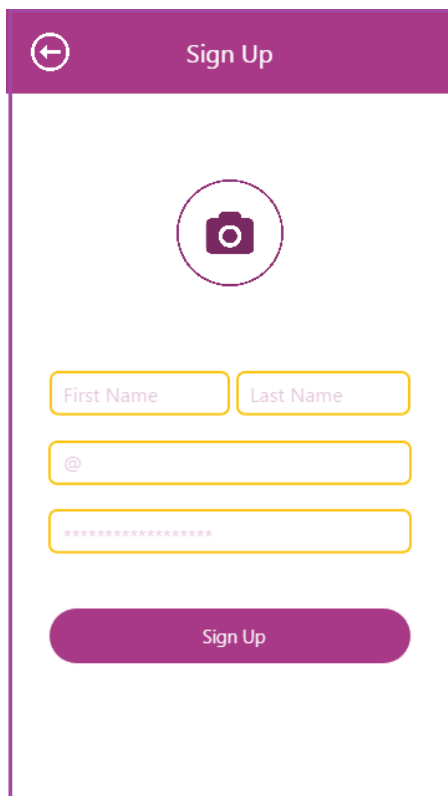
User interfaces are required to analyze the user friendliness of the application. These interfaces are the only interfaces that the user will interact with. All the functional requirements are implemented using the least number of interfaces to reduce any complexities and make the application much more user friendly.

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This interface will be appeared once the application loads successfully. Then user can enter username and password and sign in if the user is already registered

Figure 3.1.2: Sign in

Users who are not registered will be directed to this interface. They are required to fill details and press "Sign up" button to complete the registration process. After that the user is directed to the user profile window.

Figure 3.1.3: Sign up

Figure 3.1.4: Profile

This is the interface directed after user registration is completed. Here the created user profile can be viewed with relevant to user details.
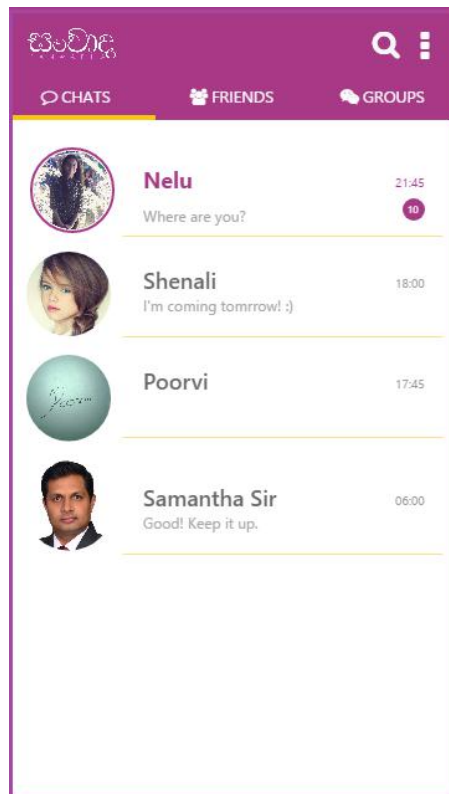

Figure 3.1.5: Friends list
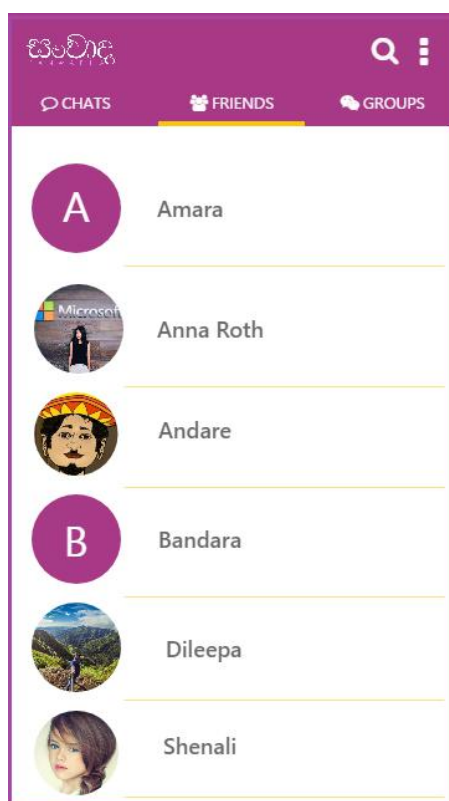
This is the interface of friends list. This allows the user to choose a friend to have a chat. Relevant user details can be viewed by clicking on the contact.

This interface implies the Chat history. User can view previous chat threads also can delete any chat thread.

Figure 3.1.6: Chat history

3.1.2. Hardware Interfaces

- Mobile Phone

This is the main hardware phone needed to use the application. There are various phones in Android platforms built by different manufacturers such as HTC, Motorola, Samsung, LG, Huawei, Sony etc. This application will need a smart phone of Android platform to use the application.

- Speaker and microphone of the mobile

Speaker and microphone of the mobile is used as the input and output streams for the application.

3.1.3. Software Interfaces

- Windows 10 Operating System
- Microsoft Visual Studio 2017 (.Net)

- Microsoft Azure

- SQLite Database

- MAYA Autodesk

- Photoshop CC

- CorelDraw X7

3.1.4. Communication Interfaces

Internet.

If user wants to perform any activity that requires internet, there should be proper internet connection.
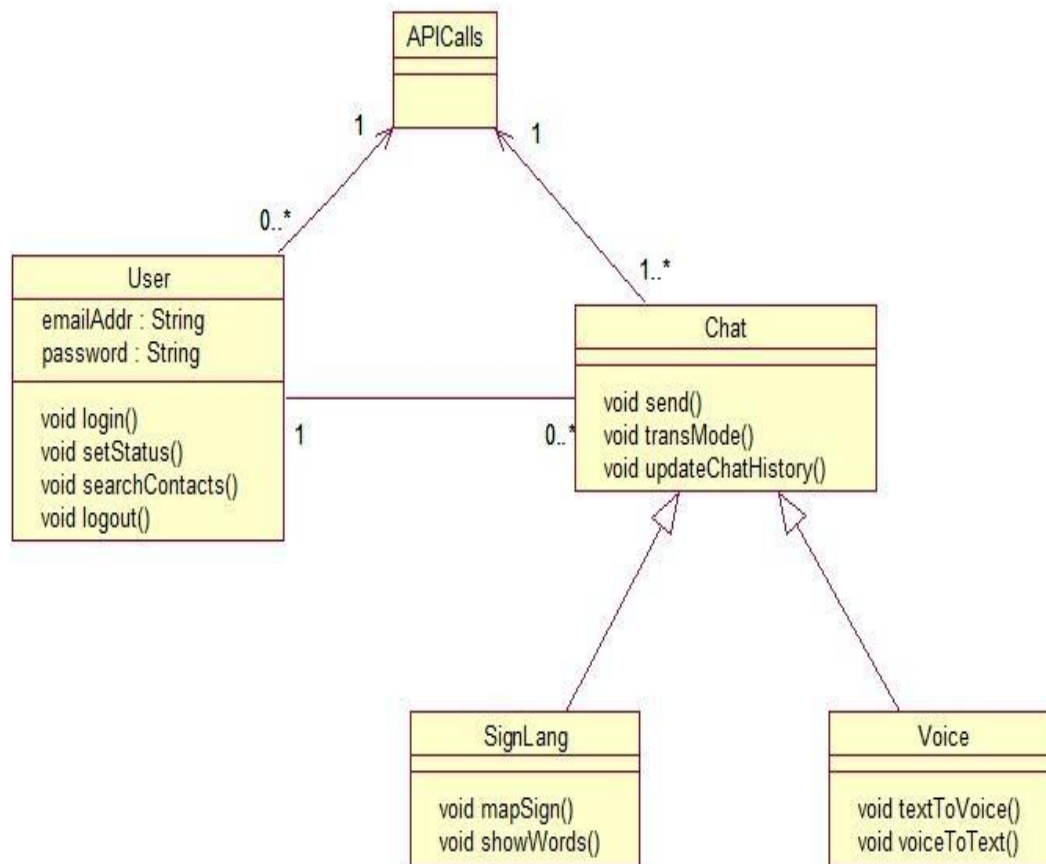
3.2. Class / Objects

Figure 3.2.1: Class diagram of the system

3.3. Performance Requirements

This application will be developed as an android application and therefore will be running on a mobile device. When compared with a desktop computer, the processing power of a mobile device is low. Due to this reason, the application should be developed in a way which it will consume minimum number of resources work efficiently.

The background sound recognizing feature will also use the same database for a fast and accurate result retrieval by comparing the background sounds with the samples in the database making it more efficient.

The main target is to make the application to run smoothly and efficiently and provide the user an accurate and quick result making it a very reliable application to use in day to day activities.

Performance requirements are required to enhance the new automated application under various circumstances. This application will be supportive to improve an effective communication between hearing-impaired people and ordinary people. Hence, using this application hearing-impairers can do their day to day goings-on easily. All the hearing-impairers and ordinary people can use this application in a straight way. All the details are deposited in the database and it will be automatically updated.

 Text and voice to sign converting application must be able to meet following performance requirements after finalizing the entire application implementation.

- Main server should be able to handle only one client at a time.
- The application must have the ability to capture text and voice.
- The application must have efficiency comparison of the sign and database stored sign.
- Accurate sign interpreted from the text.
- That translates into the voice.

3.4. Design Constraints

In system design, a design constraint refers to some limitation on the conditions, when the system is developed, or on the requirements of the system. During system design, it is as important to identify each design constraint as it is to elicit requirements since the design constraints place an overall boundary around the system design process.

- Time Factor

This will be done as a partial requirement to the degree under the guidance of SLIIT. Therefore, in dealing with projects artifacts it is strictly advised to follow the given schedules and deadlines.

Therefore, dealing with the time limitations has become one of the major concerns among the development team in the process of designing.

- Human resource factor

This module will be done as a group project. Even though the sub modules have been divided among group members it's very difficult to come to a conclusion when carrying out some work since there are many more ideas generated by the group members. Finding an appointment to have group meetings and to meet supervisor have become another problem with the busy schedules of everyone.

3.5. Software System Attributes

3.5.1. Reliability

The reliability is a critical issue in this application. This system is deployed as a voice application and the ability of a system or component to perform its required functions under stated conditions for a specified period is a critical issue of the system. Reliability is depending on some varied factors.

- Quality of the microphone – If quality is high then reliability also high
- Operating environment – If system operate on less noisy environment then reliability is high

In detail, the consistency of the system measurement, or the degree to which an instrument (e.g. microphone) measures the same way each time it is used, under the same condition, with the same subjects, is important. The system contains hard ware and software. Therefore, hardware reliability and software reliability should also be considered. The reliability of the final product should be high and quantitatively it can be specified as Mean Time to Failure (MTTF) of greater than 10000 working hours.

3.5.2. Availability

Availability of system is totally dependent on the specific system outage (System down time) and the reliability of the system equipment (e.g. microphone, Bluetooth).

3.5.3. Security

User have done the authentication when using the mobile phone. Mobile phone security plus application passwords can be used externally. All communications are open to internet so future modification should be done after integrating and launching of this version of the product.

3.5.4. Maintainability

"Sanwadha" is fully customizable solution. In future releases of "Sanwadha" will contain more functionality and will provide more flexibility for the users. Database content of words can be recognized can be updated and D2 models can be much more realistic.

3.5.5 Accuracy

Accuracy of the system is also depending on following factors

- Quality of the microphone – If quality is high then accuracy also high.
- Operating environment – If system operate on less noisy environment then accuracy is high.

3.6. Other Requirements

- Database requirement
- 2D Modelling

4.Supporting Information
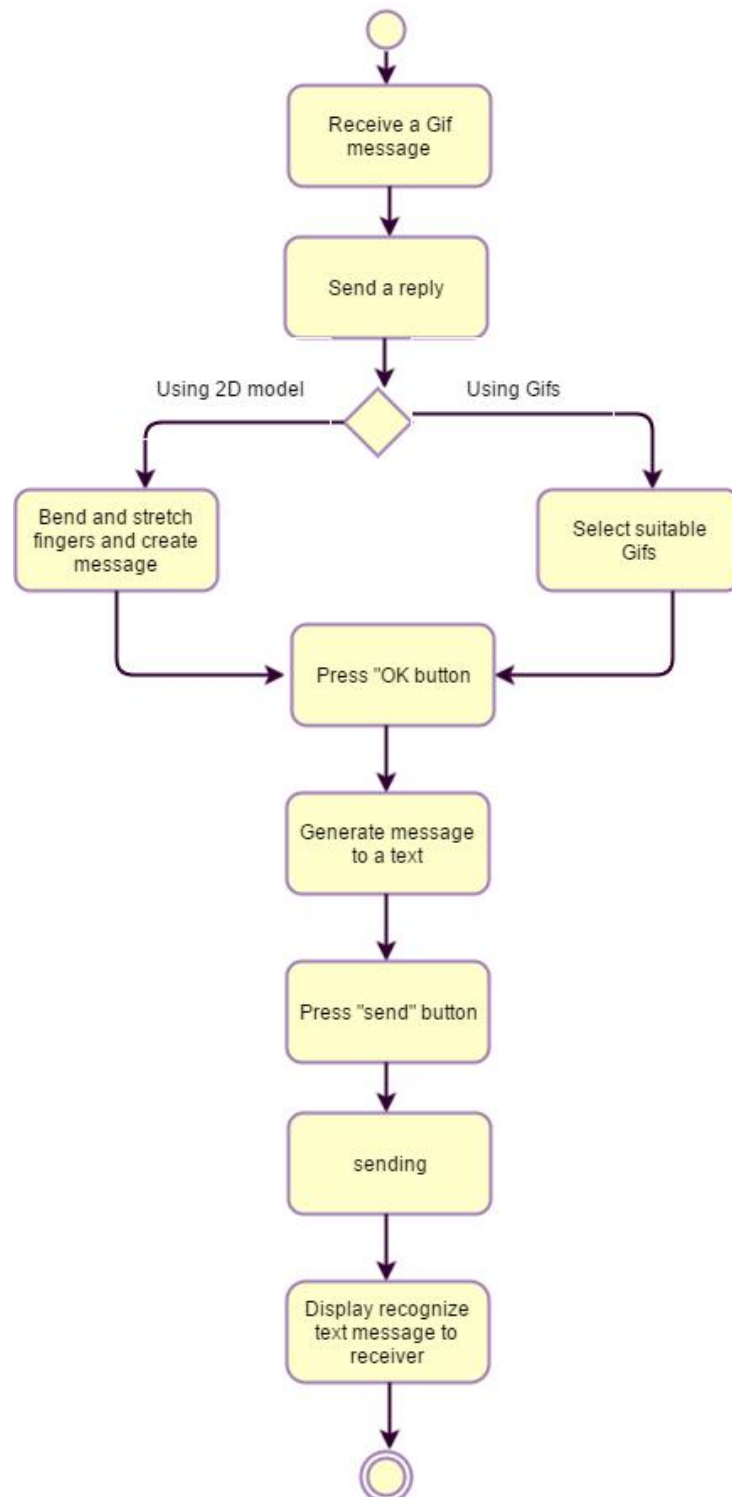
4.1. Appendices

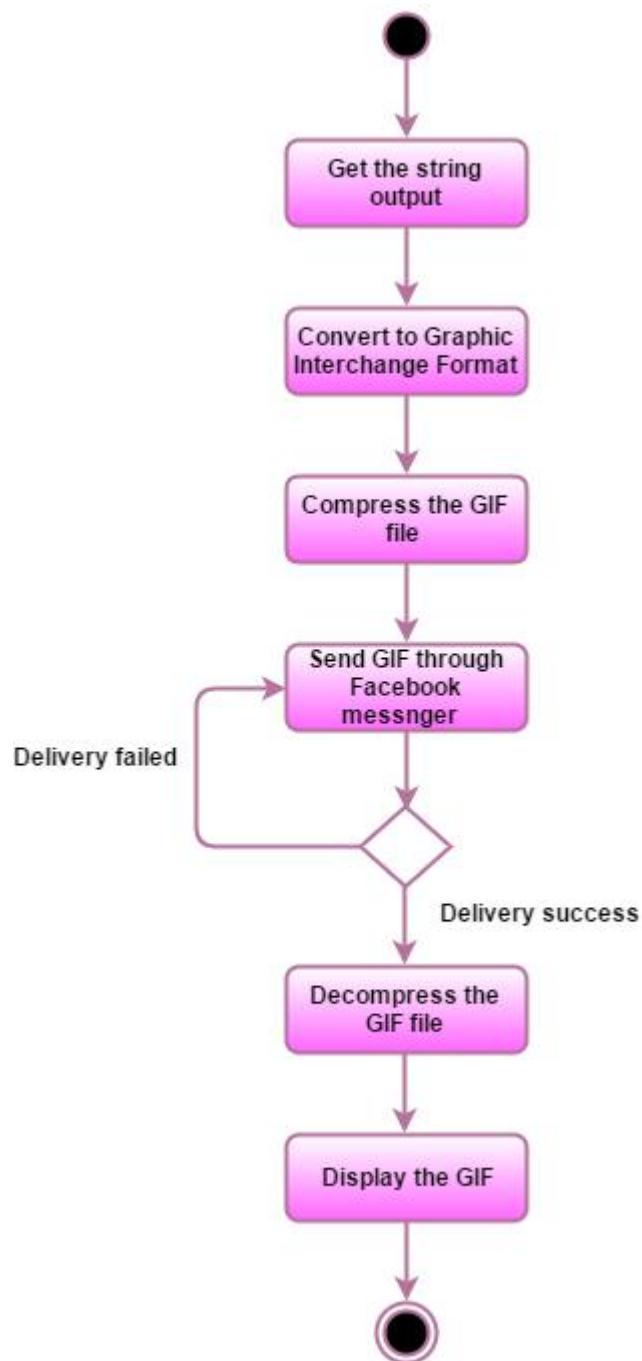Figure 4.1 : Activity diagram for convert sign to text
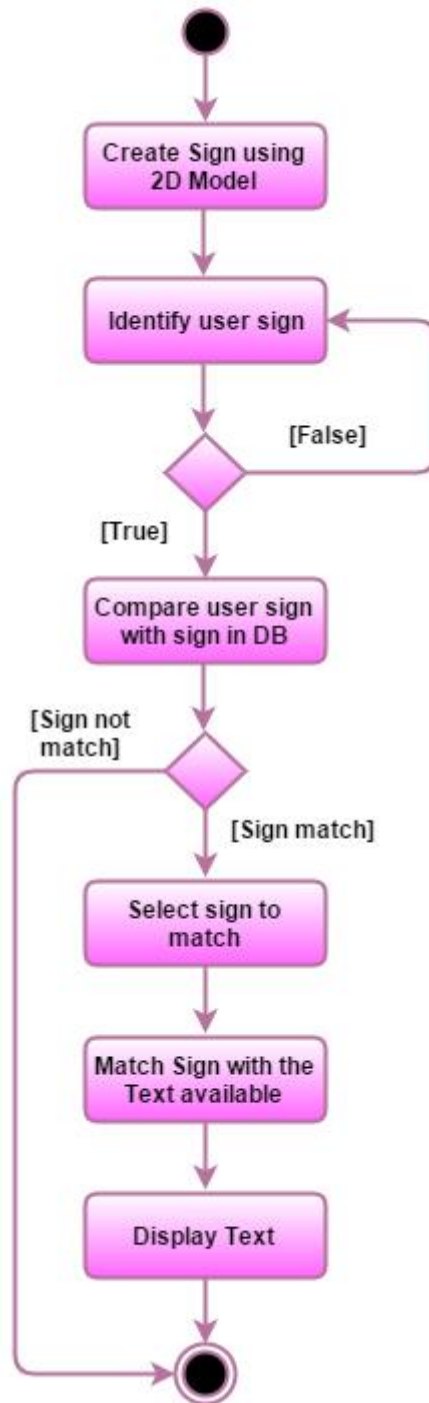
Figure 4.2: Activity diagram for GIF procedure

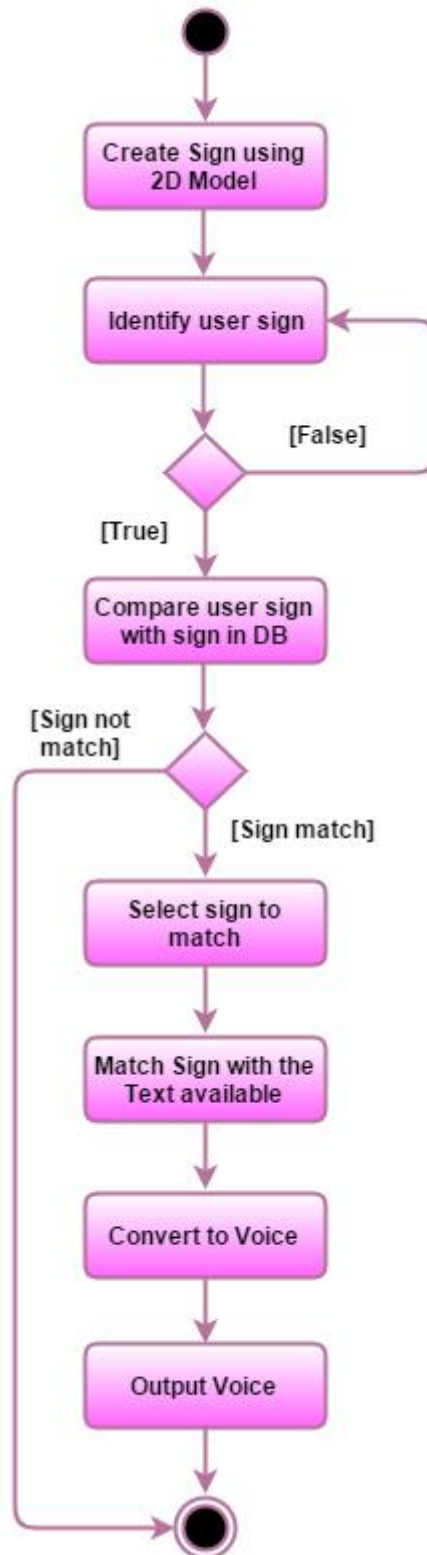Figure 4.3: Activity diagram – Sign to Text conversion

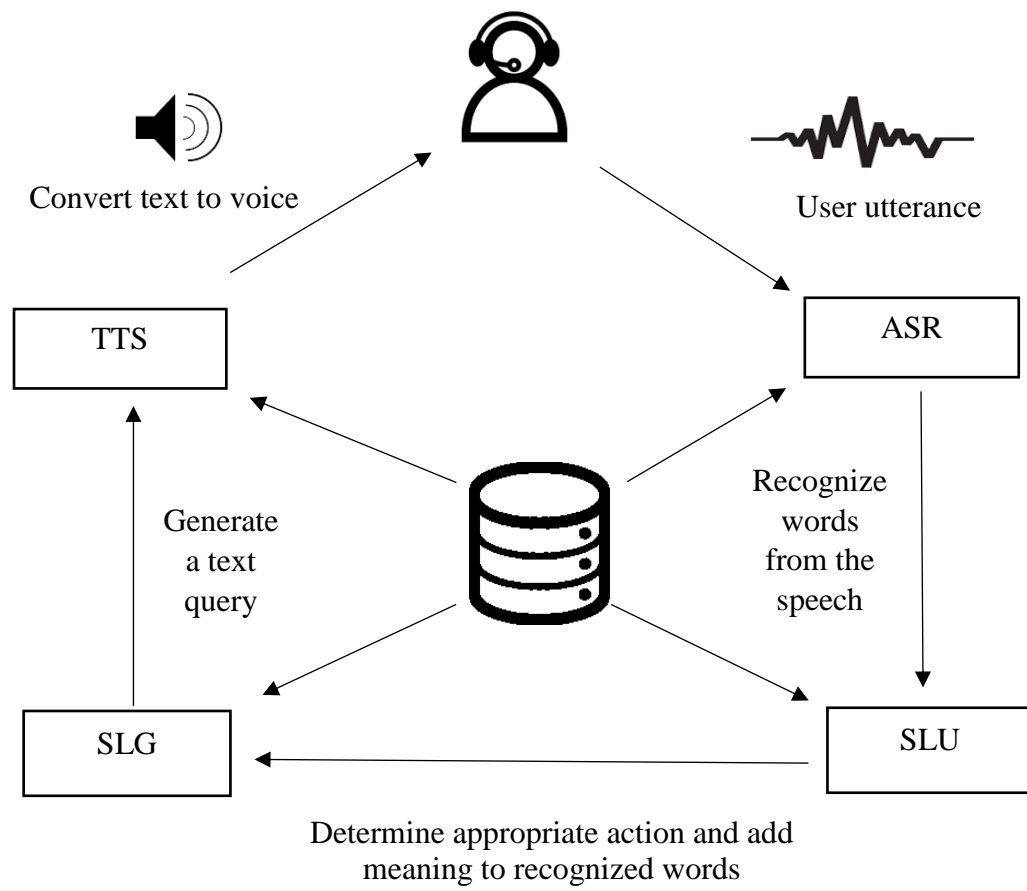Figure 4.4: Activity diagram – Sign to Voice conversion

Convert text to voice

User utterance

TTS

ASR

Generate
a text
query

Recognize
words
from the
speech

SLG

SLU

Determine appropriate action and add
meaning to recognized words

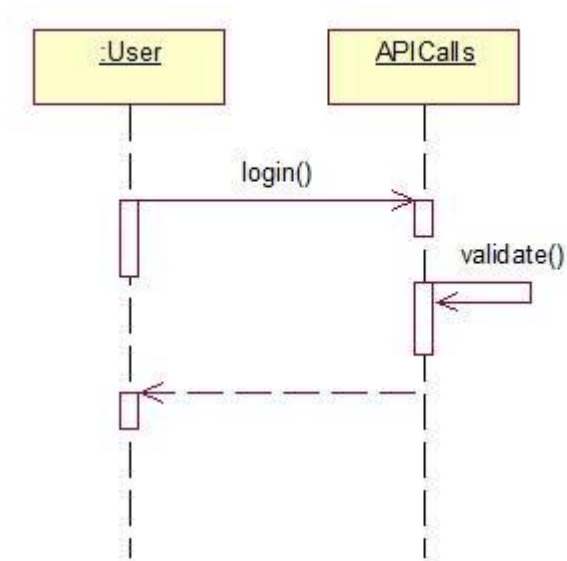Figure 4.5: Voice Dialog circle

SEQUENCE DIAGRAMS
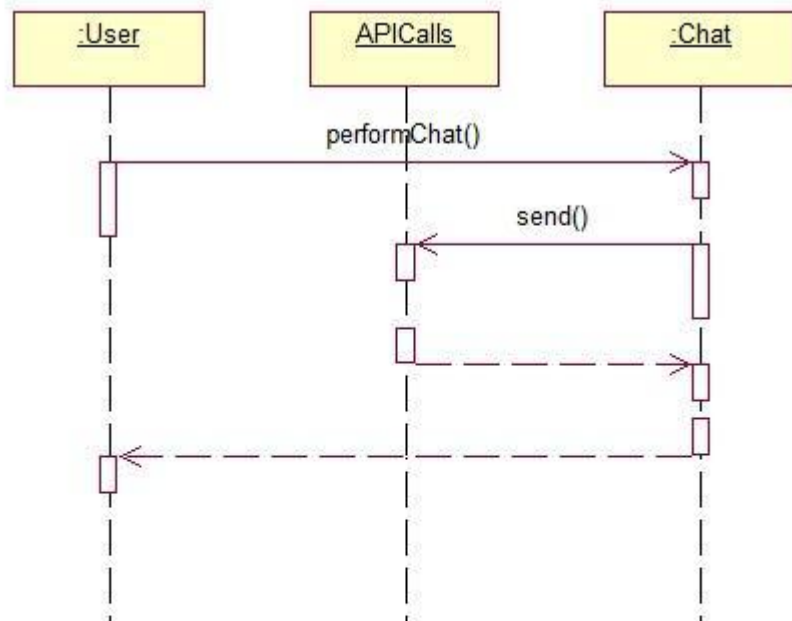

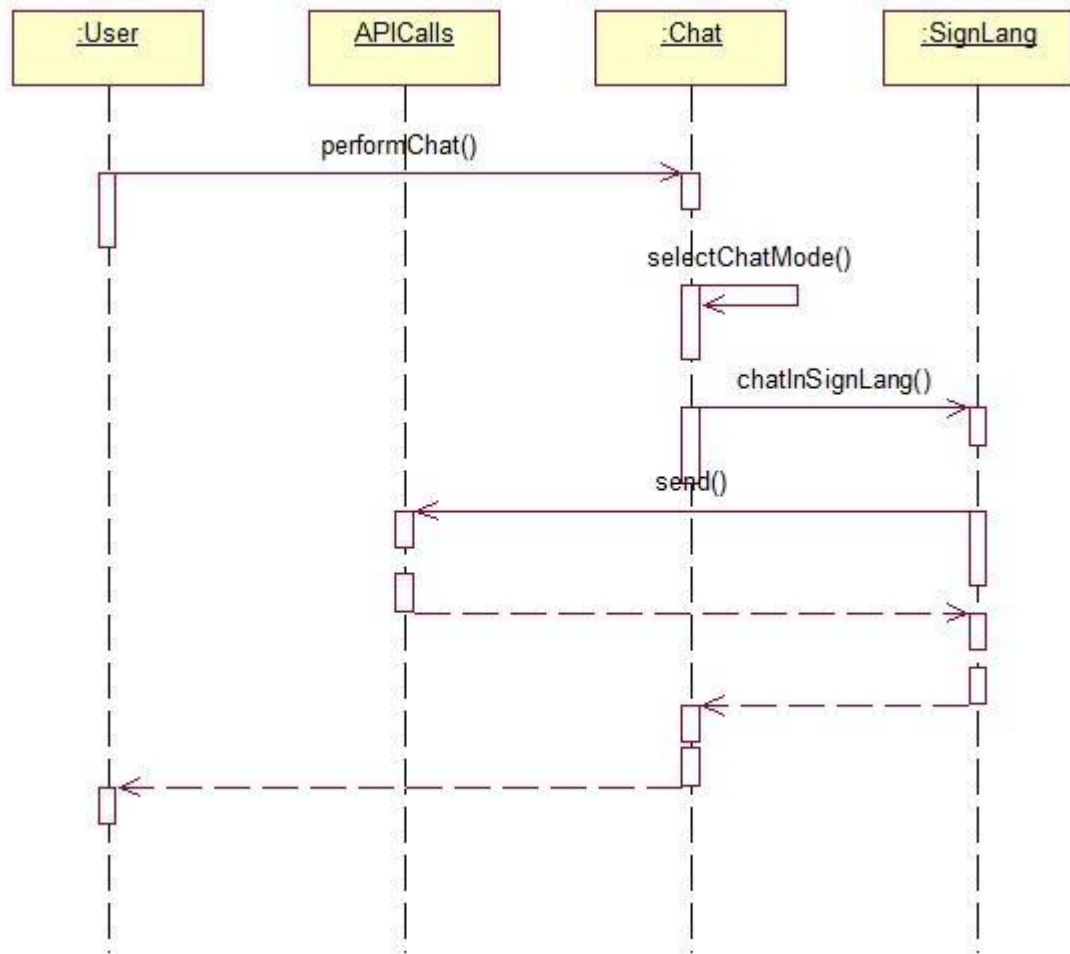Figure 4.6: User logging

Figure 4.7: Perform chat using text mode
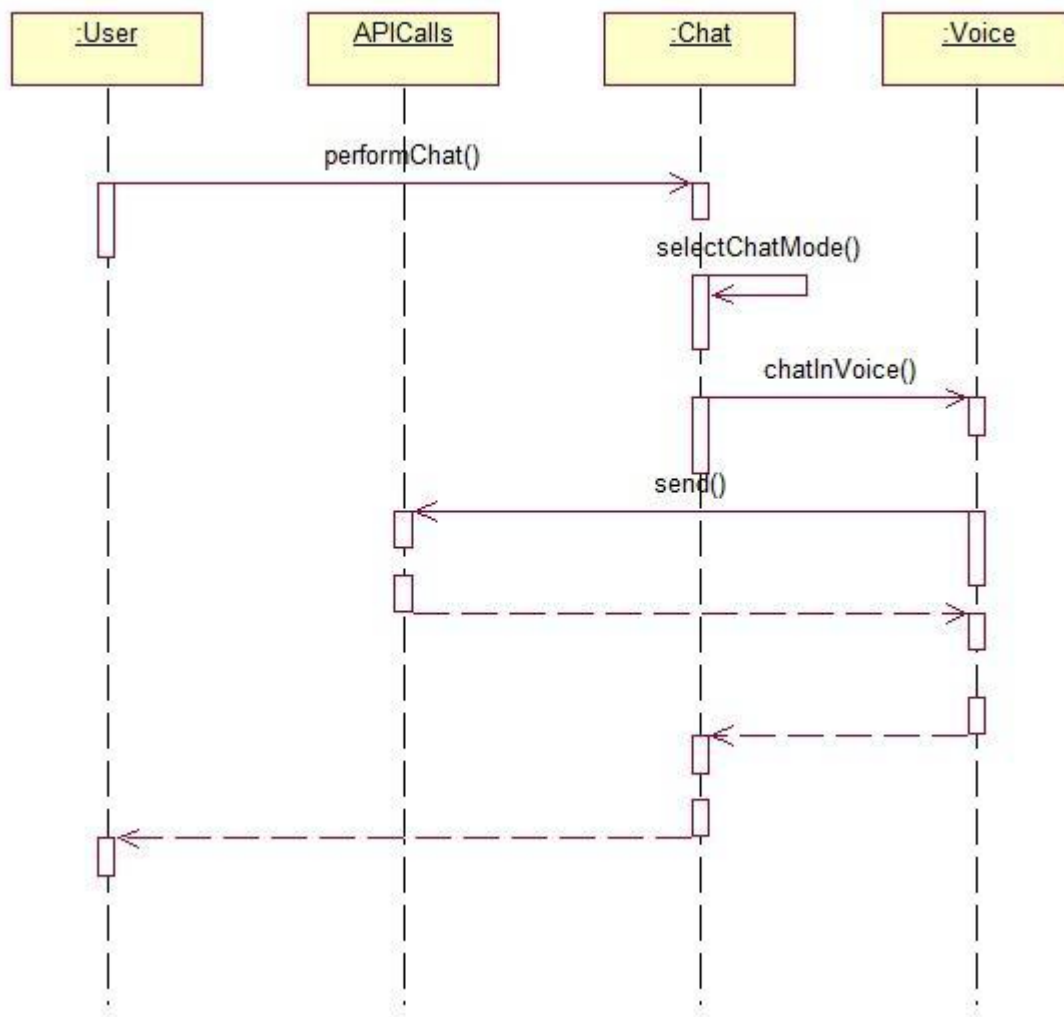
Figure 4.8: Perform chat using sign language mode
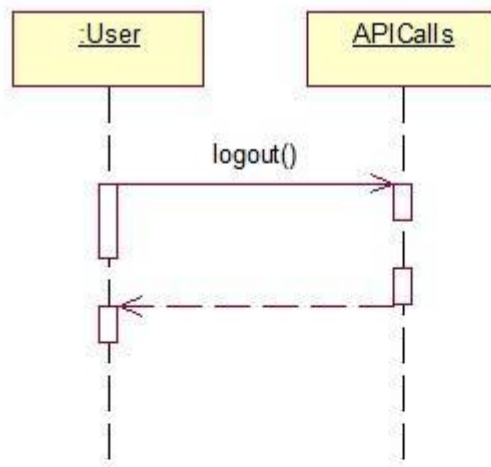
Figure 4.9: Perform chat using voice mode

Figure 4.10: Logout from the system

References

[1] Census of Population and Housing, population tables, Department of Census and Statistics, Sri Lanka, 2012. pp 2-13

[2] Anna Middleton, Working with Deaf People – a Handbook for Healthcare Professionals, CAMBRIDGE UNIVERSITY PRESS, 2010. pp 27-34

[3] M. Marschark, H. G. Lang and J. A. Albertini, Educating Deaf Students, Oxford University Press,2002. pp 2-9

[4] R. S. NICKERSON, D. N. KALIKOW, and K. N. STEVENS, A computer-based system of speech-training aids for the deaf, National Computer Conference, 1974. pp 2-4

[5] J. Siby, H. Kader and J. Jose, "Hand Gesture Recognition", (IJITR) International Journal of Innovative Technology and Research, Volume No.3, Issue No.2, February – March 2015. pp 7-11

[6] N. A. Nafis and Md. S. Hossain, "Speech to Text Conversion in Real-time" International Journal of Innovation and Scientific Research ISSN 2351-8014 Vol. 17 No. 2 Aug. 2015, pp. 271-277. [Online serial]. Available: http://www.issr-journals.org/links/papers.php?journal=ijisr&application=pdf&article=IJISR-15-139-02 [Accessed: Feb. 14, 2017]

[7] D. Metaxas, B. Liu, F. Yang, P. Yang, N. Michael and C.Neidle, "Recognition of Non-manual Markers in American Sign Language (ASL) Using Non-Parametric Adaptive 2D-3D Face Tracking" Available: http://www.thesai.org/Publications/ViewPaper?Volume=3&Issue=1&Code=IJACSA&SerialNo=1 [Accessed: March 5, 2017]

[8] Spiritually Enlightened Deaf Community through Pure Buddhism, "Ahanna (listen)", 2016 Ahanna.Org. Available: http://www.ahanna.org/en/about/ [Accessed: March 7, 2017]

[9] University of Moratuwa, "KATHANA" [Online] Available: http://lms.uom.lk/sf/shantha/Project-web-sites/2009-10/PI-33-kathana/overview.html [Accessed: March 9, 2017]

[10] Wikipedia, "Semantic Analysis" [Online] Available: https://en.wikipedia.org/wiki/Semantic_analysis_(linguistics) [Accessed: March 16,2017]

[11] Command Line Fanatic, "How LZW (GIF) Compression Works" [Online]. Available: http://commandlinefanatic.com/cgi-bin/showarticle.cgi?article=art010 [Accessed: March 10,2017]

[12] Alex Cheparev, "Easy Hand Modeling Tutorial in Maya", Nov 9, 2015.[Online]. Available: https://www.youtube.com/watch?v=vRchh9ye7TY [Accessed: March 15,2017]

[13] "Speech Recognition System by Iqbal" [Online]. Available: http://www.slideshare.net/asifmai/speech-recognition-by-iqbal-2560194 [Accessed: March 10,2017]

[14] Sneha Latha at the Dept. of Computer Science, Jamia Millia Islamia, New Delhi, "Challenges in Automatic Speech Recognition". [Online] Available: http://developeriq.in/articles/2009/jun/27/challenges-in-automatic-speech-recognition/ [Accessed March 13,2017]

[15] wikiHow, "How to Communicate with Deaf People", [Online] Available: http://www.wikihow.com/Communicate-With-Deaf-People [Accessed March 14,2017]

[16] ONLINE-CONVERT, "Convert files to GIF", [Online] Available: http://image.online-convert.com/convert-to-gif [Accessed March 14,2017]

[17]"Deaf hearing chat" [Online].Available: https://play.google.com/store/apps/details?id=g.example.android.BluetoothChat&hl=en [Accessed: March 5, 2017]

[18] "Deaf Chat" [Online].Available: http://deafunity.org/article-interview/top-10-apps-for-deaf-people/ [Accessed: March 5, 2017]