SANWADHA

Intelligent Assistant for Hearing Impairers to Interact with The Society

Software Requirement Specification Document

Comprehensive Design & Analysis Project - 2017
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Author:

Student ID	Name	Signature
IT 14106866	W.S.Tissera	

Supervisor

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Prof. Samantha Thelijjagoda

DECLARATION

I declare that this is my 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.

Author:

Student ID	Name	Signature
IT 14106866	W.S.Tissera	

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

This document clearly specifies the user requirements covered by the software application and the features included in the application. Software Requirements Specification covers product perspective and details of the designing process functionalities of an intelligent assistant for Hearing Impairers. This will be used as guideline for the development team to understand what has to be the final outcome or what the final system can do. It will clearly explain about software limitations, technological challengers which system should overcome.

This application will especially helpful for disable and normal people to discover the world on their own way. Disable people who have the difficulty of hearing and communicating, will find out share ideas is a difficult task. In order to build their confidence and raise the literacy level deaf person needs to overcome the barriers to communication [1].

By analyzing past research papers and existing techniques based on sign language, research group identified several issues which were cause for hearing impaired people's life. Major problem is the massive communication gap between deaf people and normal people. Normal people have no idea regarding sign language and the use of it. Because of that normal people avoid discourse with deaf people or build any connection with them [2],[3].

To solve above mentioned problems, proposed "Sanwadha" mobile application and this document covers all aspects in "Sanwadha" project related to Text to Sign language translation using machine learning techniques, Voice to Sign language translation using natural language processing techniques, Gif delivering using GZIP compression algorithm, creating 2D model using Maya Autodesk.

"Sanwadha" design 2D model with blueprint of the bust of a man model essential aim is focusing on the hand structure. Ordinary user can communicate with hearing impaired person without no uncertainties, using text to sign and voice to sign translation actions. Sign languages are presented in Gif format and send these Gif files using GZIP compression algorithm.

In text conversion mechanism, ordinary user can input text. Text may be sentence or assembly of sentences. Using semantic analysis recognize word by word and get the summary of these group of sentences consuming machine learning and provide string output.

1.3.Definitions, Acronyms, and Abbreviations

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.
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.
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.
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.
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.
GZIP Compression Algorithm	GZIP is a file format and a software application used for file compression and decompression.

Table 1.1: Definitions

SRS	Software Requirement Specification
GIF	Graphic Interchange Format
NLP	Natural Language Processing
ASR	Automatic Speech Recognition
SLU	Spoken Language Understanding
SLG	Spoken Language Generation
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 1.2: Acronyms and Abbreviations

1.4.Overview

The foremost outcome of this application is to achieve the higher accurate recognition of Sinhala Sign Language. By developing this application research team is willing to provide following features to users. Main objectives are list down below,

- 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 influence the Deaf community with the highest technology evolution to make hearing-impairers more comfortable in the global world.

Descriptive information about all the main objectives as well as the sub objectives of the application as follows,

- To improve the communication in-between normal people and deaf people.

Projected application will help to increase communication between normal people and hearing impaired people. Normal people will be capable to use this application when they need to communicate with hearing impairs.

- To reduce the traditional issues in learning sing language

In Sri Lanka, there is no proper application to improve communication between normal people and deaf people. Because if an individual or group of normal people need to communicate with deaf-mute ones it is must to learn sign language because there is no other way. Learning sign language is very difficult task than it seems to be. Thus, is a better response for this problem.

- 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.
- To verify that the product is reliable for Hearing-impaired community to lead to a sociable life.
- To provide flexible, reliable, accurate and available information in a suitable manner. And improve the information flow through a centralized database.
- To provide maximum benefits to the people who are going to use the application.

This SRS document contains detailed description about concluded functions of the application. It also provides product perspectives and details of the design process and covers the functionality proposed for the first release of the product.

Section 2 of this document is covering overall description which includes product perspective, functions and operation with user interfaces. And also, it contains user characteristics and constraints which can be useful to customers/potential users.

Section 3 of this document is concerning specific requirements which include interfaces and performance requirements, design constraints, software system attributes and other requirements.

Section 4 of this document is about supporting information that contain table of content, indexes and appendices.

By analyzing all the sections of the document will deliberate all necessary information with respect to the voice recognition process and also the methodologies and approaches used to result in the final goal of the research.

Users:

With the gathered information collected from different bases, research team essentially concentrated on major users in Sri Lankan Society.

- Hearing impaired people
- Ordinary people

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. So, 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.

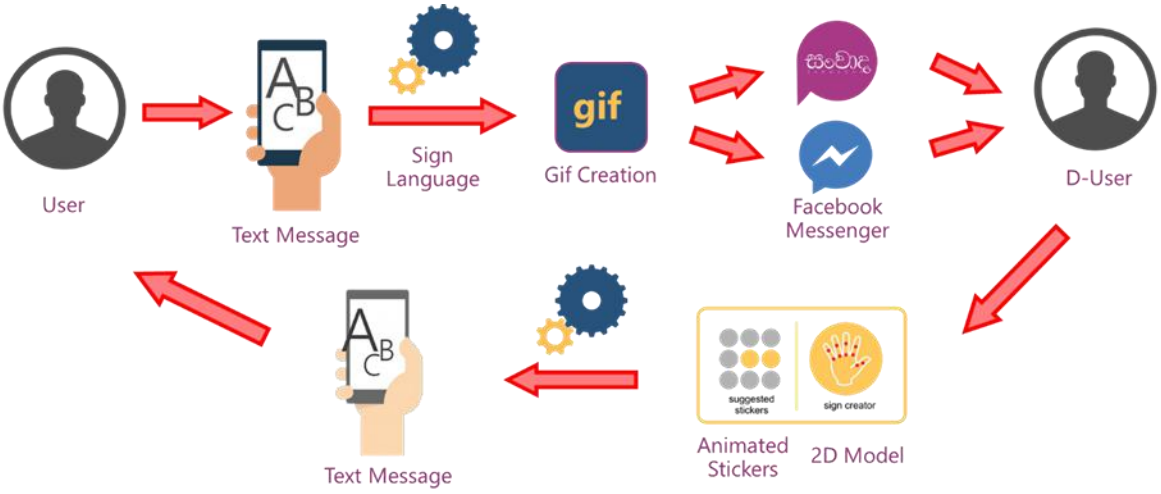


Figure 2.1: System diagram for Text conversion

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.

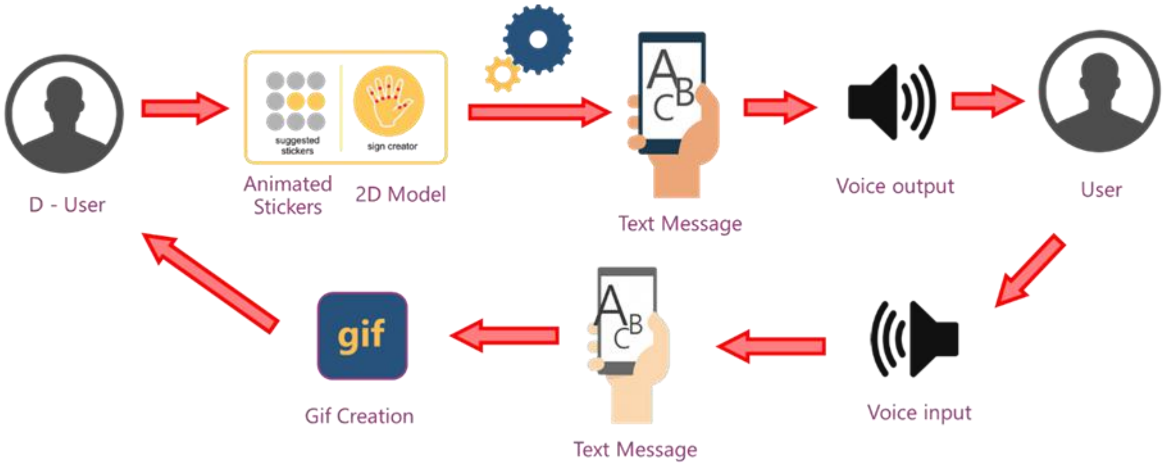


Figure 2.2: System diagram for Voice conversion

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.Product Perspective

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

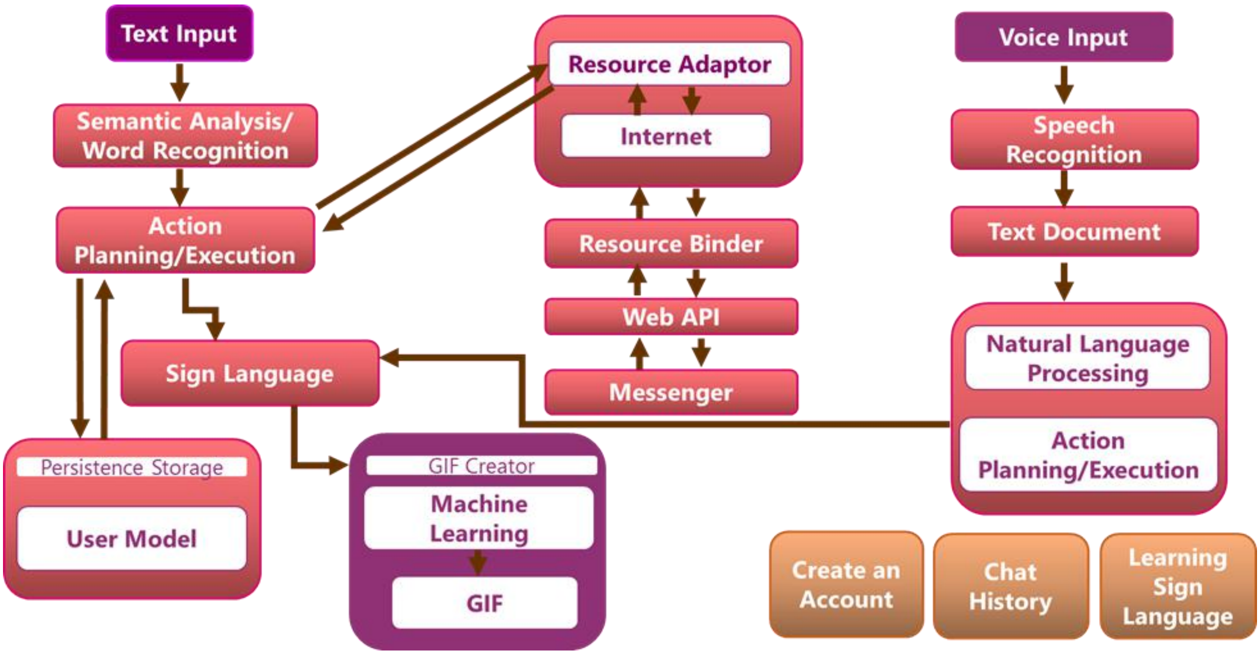


Figure 2.3: High Level diagram for overall application

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 2.4: Text Adaption)

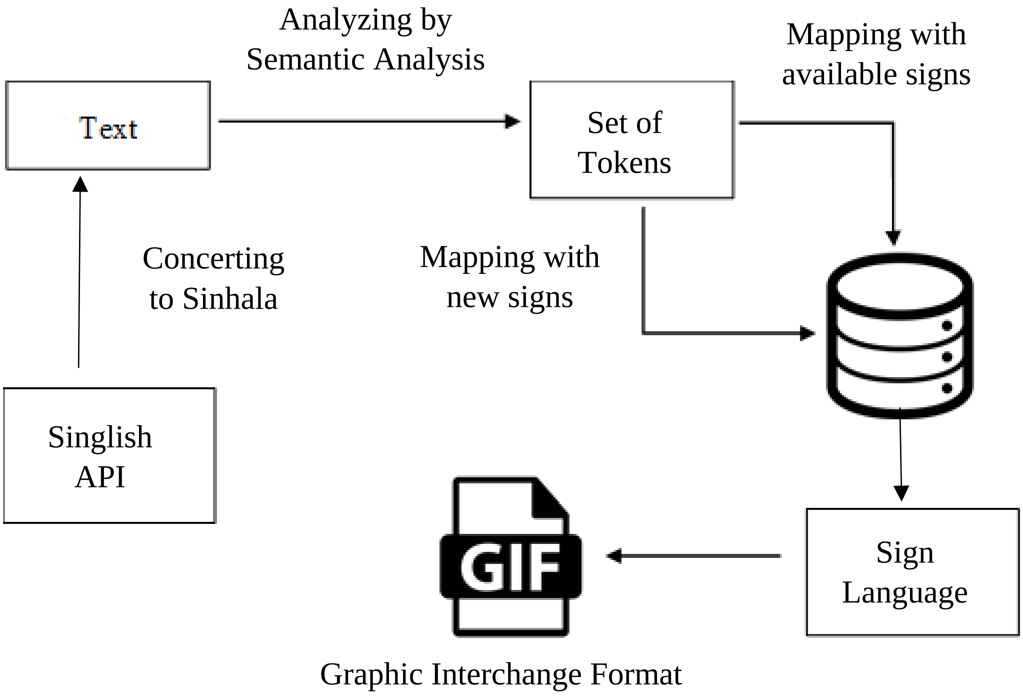


Figure 2.4: Text Adaption

The text input by the user is sent to a module which tries to recognize word by word through Semantic Analysis. Semantic Analysis concerns the procedure of involving syntactic structures, in the levels of phrases, clauses and sentences to the level of the writing as a whole, to their language independent sense. The set of tokens will be mapped by checking either available sign or new sign. Finally, the output will contract in a Graphic Interchange Format (GIF) [4], [5], [6], [7], [8].

There is very lesser amount of similar applications which are used around the world to support deaf people. But these systems have unresolved issues with it.

- Telecommunication

In order to communicate using a sign language between remote locations, deaf people use a video link through the internet, either a special-purpose videophone designed for use with sign languages or "off-the-shelf" video services designed for use on ordinary computers with webcams. The latter, though more widely available, often do not provide sufficient quality for sign language communication. The special videophones that are designed for sign language communication typically provide more frames per second than "off-the-shelf" services and may use data compression methods specifically designed to maximize the intelligibility of sign languages.

- Sign Language Interpretation

To communicate between deaf people and hearing people sign language interpreters are often used. To do the interpretation among them interpreters must have good knowledge about the sign language and they must put big effort to do this, because sign languages are distinct natural languages with their own syntax and it is different from any spoken language.

But these issues are resolved by our product and to offer flexible, reliable and accurate product for our end users. Below table clearly demonstrate in value of our product to the social order.

Features	Deaf chat	Deaf hearing chat	Nihanda	Kathana	sanwada
Speech to sign translation. (Sinhala)	✗	✗	✗	✗	✓
Text to Sign language – Sinhala & Singlish language	✗	✗	✗	✓	✓
Translated sign language to GIF	✗	✗	✗	✗	✓
Sign language using 2D modeling	✗	✓	✗	✗	✓
Price/Open source	$ 0.99	$ 2.99	FREE	FREE	--
Stickers and animated stickers	✓	✗	✗	✗	✓
Interaction with Facebook messenger	✗	✗	✗	✗	✓
Mobile application	✓	✓	✗	✗	✓

Table 2.1: Comparison with Available system

2.1.1.System Interfaces

The proposed system will interact with API’s listed below

- Facebook messenger
- Sinhala API
- 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/ Windows and iOS platforms
- 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

- 3G - 4G 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 in order 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

- 512 MB RAM and 4GB HDD space in Android mobile phone.
- 4GB RAM 500GB HDD space in Server machine.

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 application to provide.

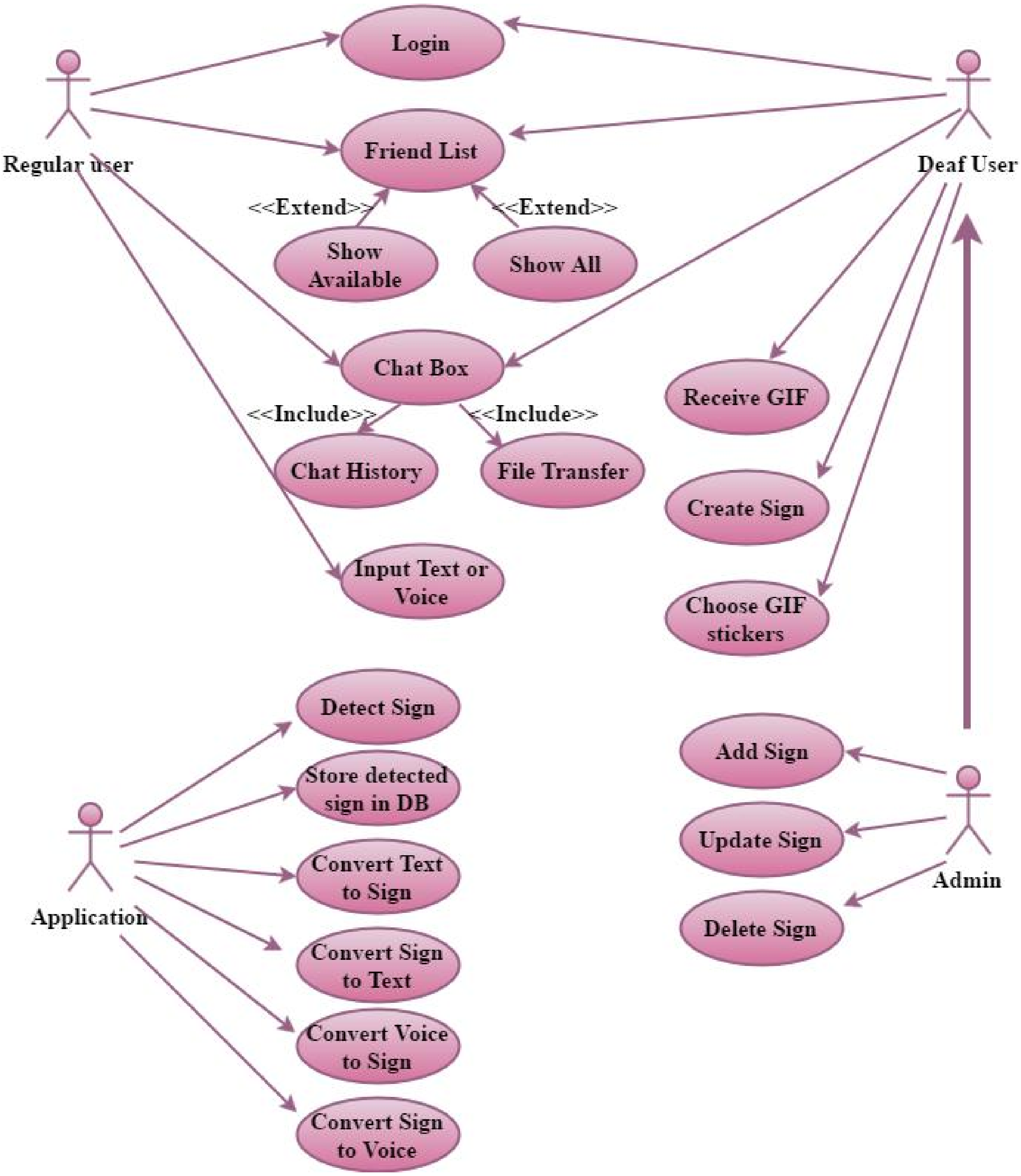


Figure 2.5: Use Case Diagram

Use Case Scenarios

Use Case Name	User Login
Actor	User
Pre-Condition	Should be a registered user in the application.
Main Flow	1. Enter Username 2. Enter Password 3. Click Login button
Extensions	1a. If the Username is invalid, application will prompt an error message and user should enter correct username again 2a. If the Password is invalid, application will prompt an error message and user should enter correct password again
Successful End Condition	Redirect to the main interface

Table 2.2: Use Case Scenario – User Login

Use Case Name	Create Signs
Actor	User
Pre-Condition	Should be a registered user in the application.
Main Flow	1. Create user's own sign using 2D model 2. Add time frame for the sign 3. Save the created sign.
Extensions	2a. If time frame is very lengthy one. application will prompt a message when transferring this sign take more time. 2a. If saved sign is not accepted by administrator, application will prompt a message created sign is not an expressive sign.
Successful End Condition	Display successful message.

Table 2.3: Use Case Scenario – Create Signs

Use Case Name	Add Signs
Actor	Administrator
Pre-Condition	Should be a registered user in the application.
Main Flow	1. Create signs using 2D model 2. Enter text for sign 3. Enter description if needed. 4. Save the created sign and detect appropriate sign.
Extensions	4a. If sign not detect correctly. application will prompt a message created sign not detected properly.
Successful End Condition	Display successful message.

Table 2.4: Use Case Scenario – Add Signs

Use Case Name	Convert Text into Sign
Actor	Application
Pre-Condition	User or Administrator Should be created signs.
Main Flow	1. Identify User input text or assembly of text. 2. Recognize word by word and get the summary. 3. Provide string output. 4. Match text with the signs are available.
Extensions	1a. If texts are not meaningful. application will prompt a message Enter meaningful texts.
Successful End Condition	Display the appropriate Text message.

Table 2.5: Use Case Scenario – Convert Text into Sign

Use Case Name	Convert sign into Text
Actor	Application
Pre-Condition	User or Administrator Should be created signs.
Main Flow	1. Identify User signs 2. Compare user sign with database signs. 3. Select sign to convert. 4. Match sign with the texts are available.
Extensions	1a. If sign not detect correctly. application will prompt a message created sign not detected properly.
Successful End Condition	Display the appropriate Text message.

Table 2.6: Use Case Scenario – Convert sign into Text

Use Case Name	Convert sign into Speech
Actor	Application
Pre-Condition	User or Administrator Should be created signs.
Main Flow	1. Identify User signs 2. Compare user sign with database signs. 3. Select sign to convert. 4. Match sign with the texts are available. 5. Identify appropriate Text or Sentences.
Extensions	1a. If sign not detect correctly. application will prompt a message created sign not detected properly.
Successful End Condition	Speak out the voice output.

Table 2.7: Use Case Scenario – Convert sign into Speech

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 also 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 the 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 [9], [11].
- 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 sight 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 application 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.

Additionally, moving to the future enhancements all the regional sign languages in Sri Lanka are going to be addressed within the application Sanwadha. Here and now our application offer less number of day to day scenarios, but upcoming developments, provide more situations. Likewise implement the application by improving 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. In the event that a requirement is stated within both primary and functional specifications, the application will be built from functional specification since it is more detailed.

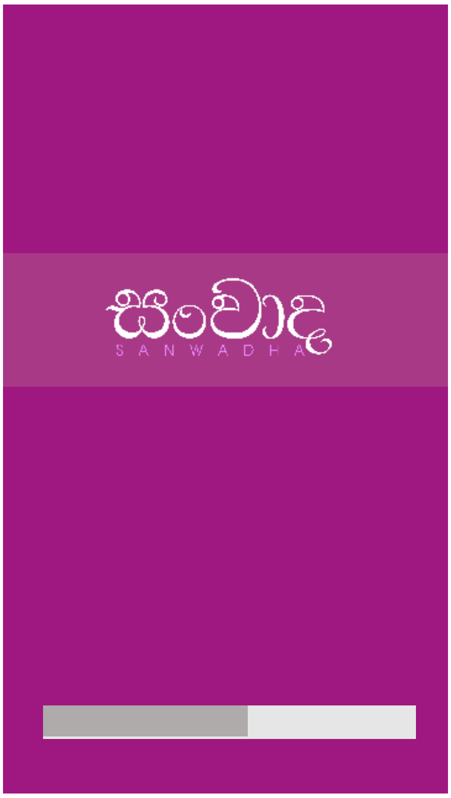
Section 3 describes all the essential requirements which are going to implement in this version of sanwadha application. In section 3.6 describe other requirements which contain desirable requirements and optional requirements. Desirable requirements are to be implemented in this release if possible, 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.



This application will be loaded when user taps on “SANWADHA” application on mobile. Then it will start loading and it will redirect to the Sign in window.

Figure 3.1: Sanwadha opening window

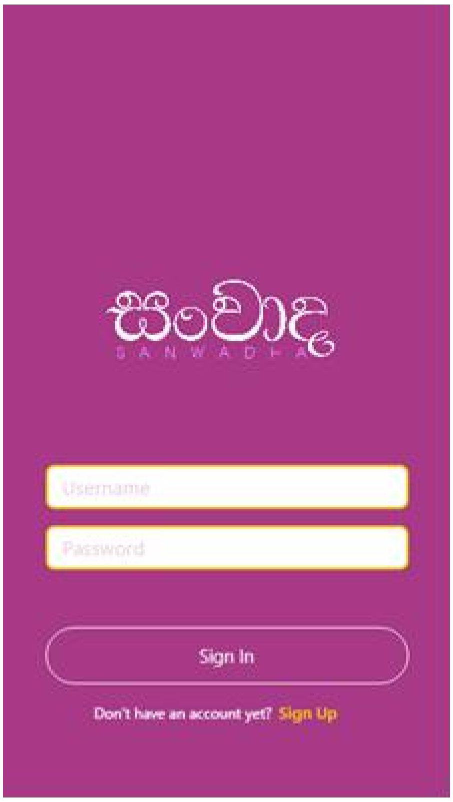


Figure 3.2: Sign In

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

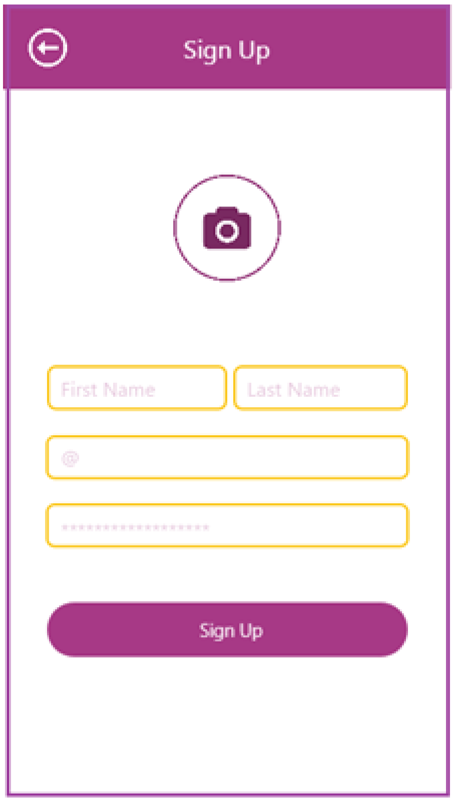
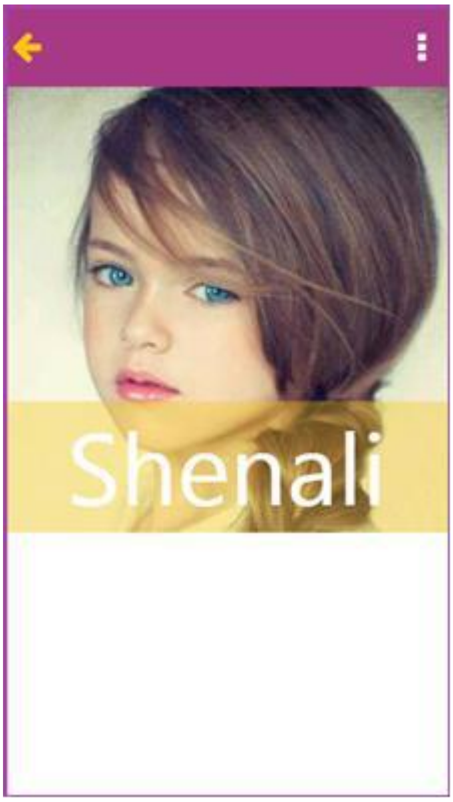


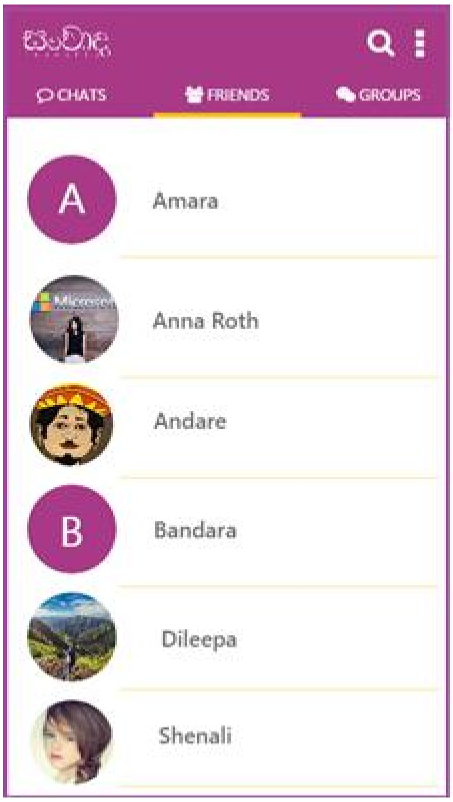
Figure 3.3: Sign Up

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.



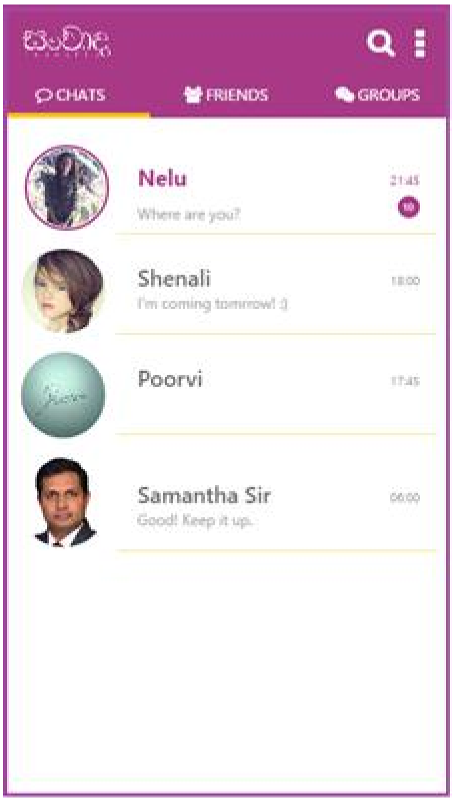
This is the interface directed after user registration is completed. Here the created user profile can be viewed with relevant to user details.

Figure 3.4: Profile



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.

Figure 3.5: Friends list



Nelu 21:45
Where are you?

Shenali 18:00
I'm coming tomrrow! :)

Poorvi 17:45

Samantha Sir 06:00
Good! Keep it up.

Figure 3.6: Chat history

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

3.1.2.Hardware Interfaces

- Mobile Phone

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

- Speaker

A speaker is needed to provide output via the TTS module

- Microphone

A good quality microphone is needed to record user input and feed into the application. A higher quality microphone will result in more accuracy.

3.1.3. Software Interfaces

- Windows 10 Operating System

Windows 10 introduces what Microsoft described as "universal apps"; expanding on Metro-style apps, these apps can be designed to run across multiple Microsoft product families with nearly identical code-including PCs, tablets, smartphones, embedded systems, Xbox One, Surface Hub and Mixed Reality. Subsequently application can perform its best, there should be that type of operating system.

- Microsoft Visual Studio 2017 (.Net)

Particularly selected Microsoft Visual Studio 2017, since it includes a code editor supporting IntelliSense (the code completion component) as well as code refactoring. The integrated debugger works both as a source-level debugger and a machine-level debugger. Other built-in tools include a code profiler, forms designer for building GUI applications, web designer, class designer, and database schema designer. It accepts plug-ins that enhance the functionality at almost every level-including adding support for source control application.

- Microsoft Azure

Microsoft Azure Machine Learning (Azure ML) service is part of Cortana Intelligence Suite that enables predictive analytics and interaction with data using natural language and speech through Cortana. Thus, using this for progress the database in the application.

Here, mainly focusing on above software interfaces. Below software interfaces are supportive tools for the application.

- SQLite Database
- MAYA Autodesk
- Photoshop CC
- CorelDraw X7

3.1.4.Communication Interfaces

- 3G - 4G 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 in order 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.

3.2.Class / Objects

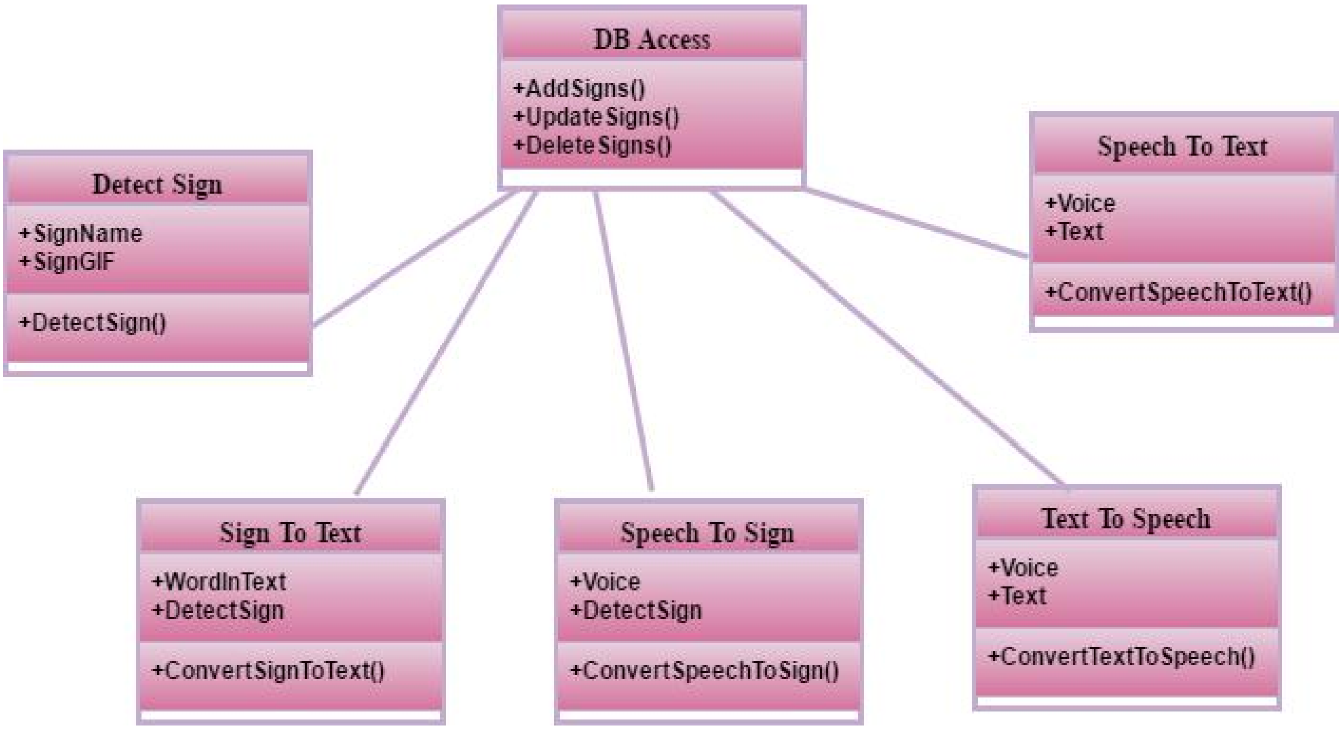


Figure 3.7: DB Accessing Class diagram for “Sanwadha”

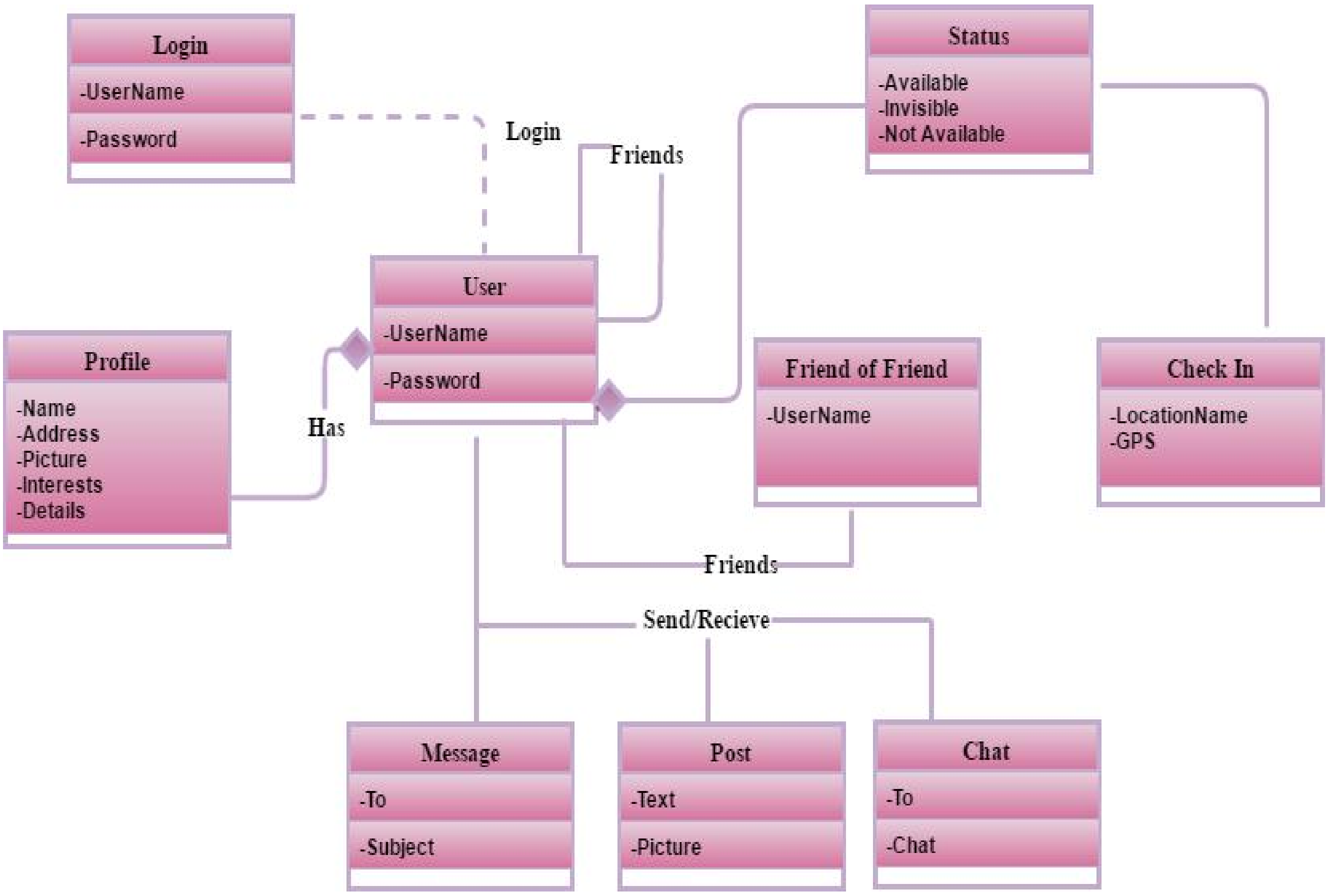


Figure 3.8: User Accessing Class diagram for “Sanwadha”

3.3.Performance requirements

Performance requirement are needed to enhance the new automated application under various circumstances. This application will be cooperative to improve a good communication between hearing impaired people and normal people. Subsequently, using this application disabled people can do their day to day activities easily. All the disabled and normal people can use this application directly. All the details are stored in the database and it will be automatically updated.

Sign to voice and text converting system must be able to meet following performance requirements after finalizing the whole application implementation.

- Main server should be able to handle only one client at a time.
- The application must have the ability to create signs in real time.
- The application must be having efficiency comparison of the user created sign and database stored sign.
- Correct sign interpreted to the text.
- That translates into the voice.

3.4.Design constraints

The program does not support each kind of operation performed in different kind of file systems, but it will be updated constantly and will support additional actions and file systems.

- The application use Microsoft Azure as the database engine.
- All programming logic, coding and processing shall be in C# using Microsoft visual studio 2017.
- Application intend to use a login facility to restrict unauthorized access.

Multi-Threading/Processing-The software requires multiple threads, i.e. a separate thread is needed to listen for user commands and another thread for the given commands to be executed, this is done because if the user wants to stop execution of a command, the user can instruct the application to do so from another thread. This will be impossible to do so if the application ran on a single thread. Hence, when adding new components, they have to be implemented in a separate thread or process.

3.5.Software system attributes

3.5.1.Reliability

Reliability is an important issue in system architecture. To be a reliable application it has to have minimum number of failures. Before releasing the final product, application must test and fix each and every possible bug incessantly. Each and every component will be tested and finally the integrated application will also be test under different conditions.

We define two operating states that relate to the application's ability to perform its function.

• Success: The application performs its function satisfactorily for a given period of time, where the criterion for success is clearly defined.

• Failure: The application fails to perform its function acceptably.

The database of the application is updated by the administrator once a day.

3.5.2.Availability

Availability is the ratio of time an application or component is functional to the total time it is required or expected to function. This can be expressed as a direct proportion (for example, 9/10 or 0.9) or as a percentage (for example, 90%).

3.5.3.Security

Improving application security is a complex task. To provide a better service we need to have a good security to the application. Consequently, to fulfill the main purpose of this application providing a good service to the users including well defined safety. This includes avoiding the unwanted problems and keep precarious details securely. Developers must implement good security features to avoid unauthorized access to the application. The development team decides to improve the application security by using following methods.

- One of the best ways to improve the application security is upgrade the application monthly.
- Give the accessible to authenticated administrators and designers.

There is an administrator to manage some processers in the application. Thus, it will be better for conducting the application continually. If everyone is able to log into the application and change the application information, that application does not have good security. Access to the information system must be limited to the authenticated administrators and designers to do the inserts update or delete data from the application.

- Give unique username, password for each member.

Application provides a logging to authenticated administrators and designers. From that we give good security. For the password, the administrators and designers should include characters and letters. The whole data stored in the database. Thus, username and password should be valid for the application and if it is not valid, the administrators and designers can't log the application. This security requirement we include to protect the application.

- Password protection

Passwords are a unique and easy way to increase computer security instantly.

3.5.4.Maintainability

Maintainable is a value that can only be applied by someone who is familiar with the code base. If that someone find it hard to work on code base, it is hard to maintain. If another system administrator or developer can't proceed with the stopping point of application then that application is hard to maintain. Sign to voice and text application will release different versions in the future. Therefore, it is a must to have well maintainable software application in this version.

The capability of the software product is to be modified. Modifications may include corrections, improvements or adaptation of the software to changes in environment, and in requirements and functional specifications. Application code base will prepare to be very simple. If any modifications or future improvements occurred then it is very easy to do those modifications. If any development team wants to make any future improvements on this application then they can easily get an idea about application code base by having a glance on the code base.

4.Supporting information

4.1.Appendicies

4.1.1. Appendix A

2D Model Creation:

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 4.1: 2D Hand Model procedure)

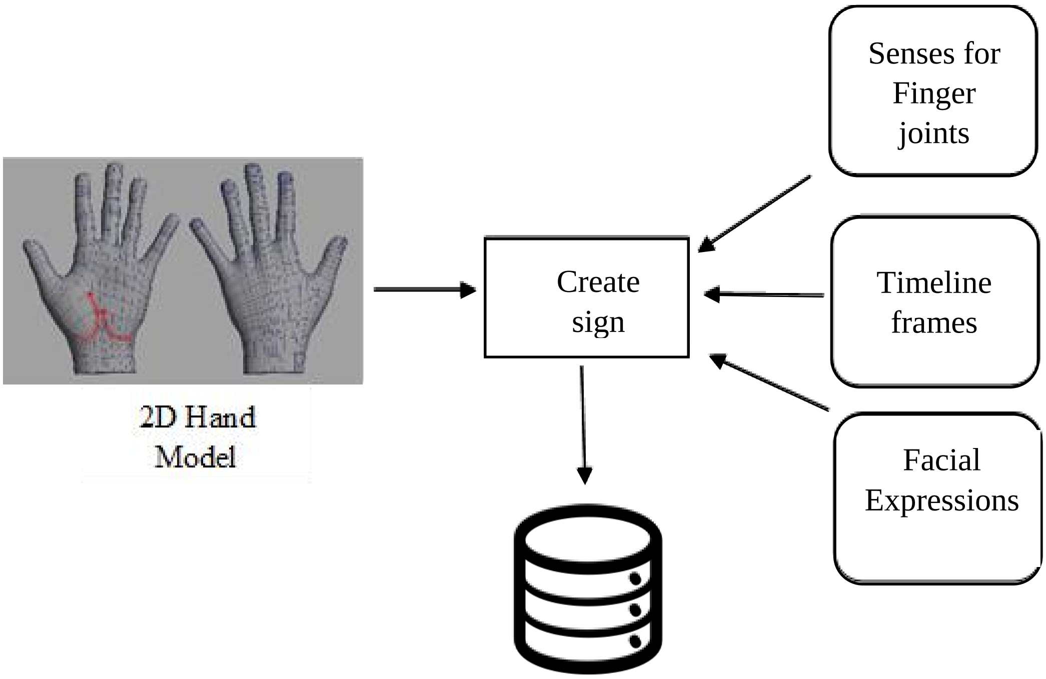


Figure 4.1: 2D Hand Model procedure

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 [10].

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

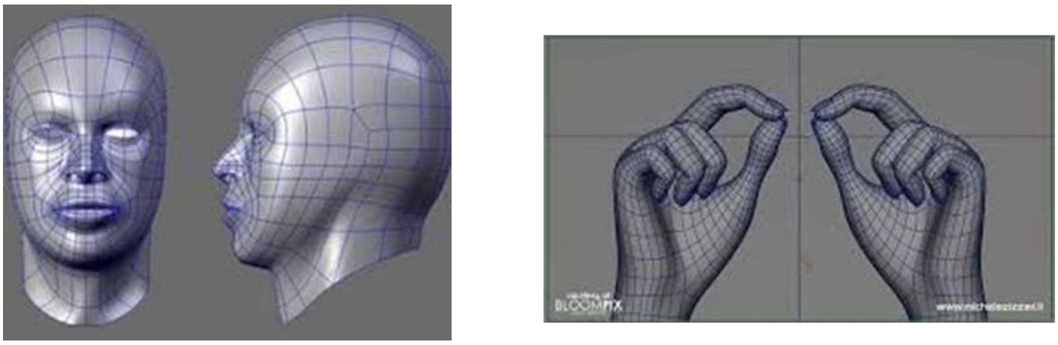


Figure 4.2: Design Models

Voice Recognition

In voice recognition, there is a cycle of events that occurs between a voice utterance and the response to that utterance from the machine. This sequence of events referred as voice dialog circle.

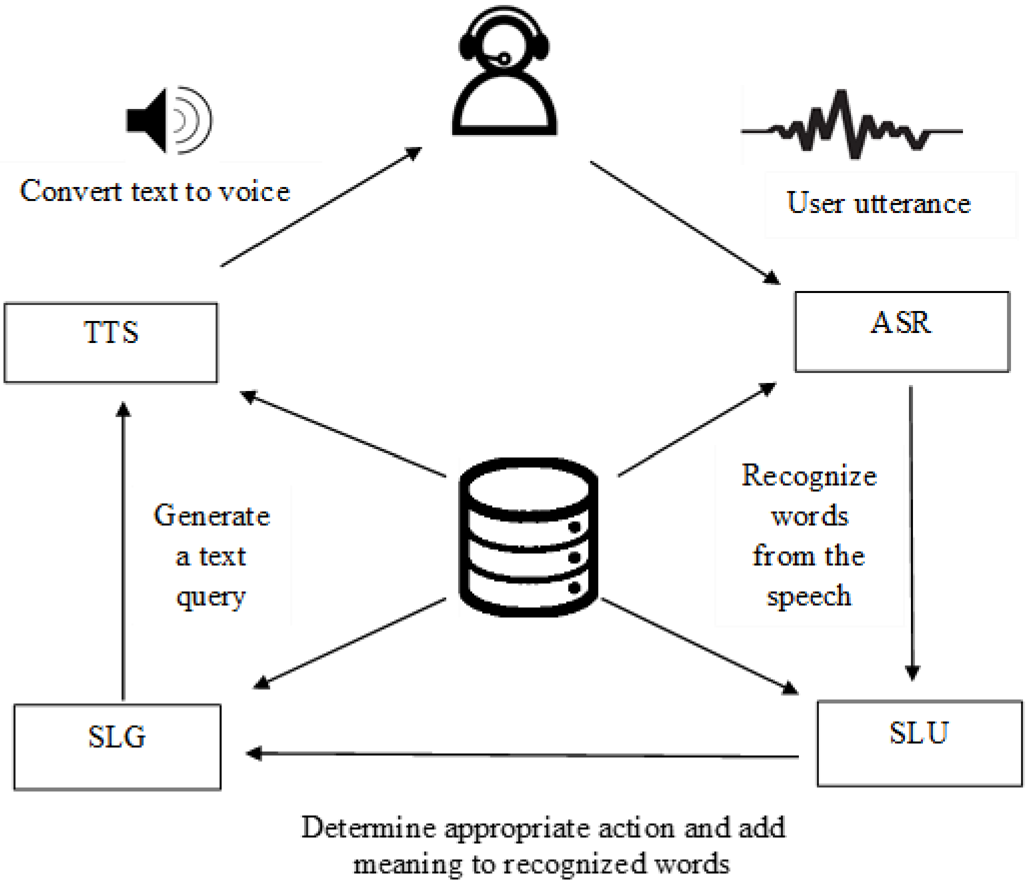

Convert text to voice
User utterance
TTS
ASR
Generate a text query
Recognize words from the speech
SLG
SLU
Determine appropriate action and add meaning to recognized words

Figure 4.3: Voice Dialog circle

The supporter (ordinary man) makes a reply by speaking that is sent to a module, which attempts to recognize, fully sentence basis, the spoken speech. The process of recognizing the words in the speech is called Automatic Speech Recognition (ASR). ASR will recognize the words from the given speech. ASR can be considered as the most important part of the voice dialog circle. To gain accurate results, the system must train to recognize factors associated with the user's voice. After this training, the user must speak in a clear and partially modified manner for his spoken words to be both recognized and correctly translated.

Next the spoken words are analyzed by a Spoken Language Understanding (SLU) module, which attempts to attribute meaning to the verify words. The meaning that is attributed is in the context of the task being handled by the voice dialog system. Once meaning has been determined, examines the state of the dialog per a prescribed operational workflow and determines the course of action that would be most appropriate to take. A text query would be generated by the Spoken Language Generation (SLG) module to clarify the meaning and help determine what to do next.

The query text is then sent to the final module, the text-to-speech synthesis (TTS) module, and then converted into intelligible and highly natural speech, which is sent to the user.

GIF file Compression and Extraction Mechanism

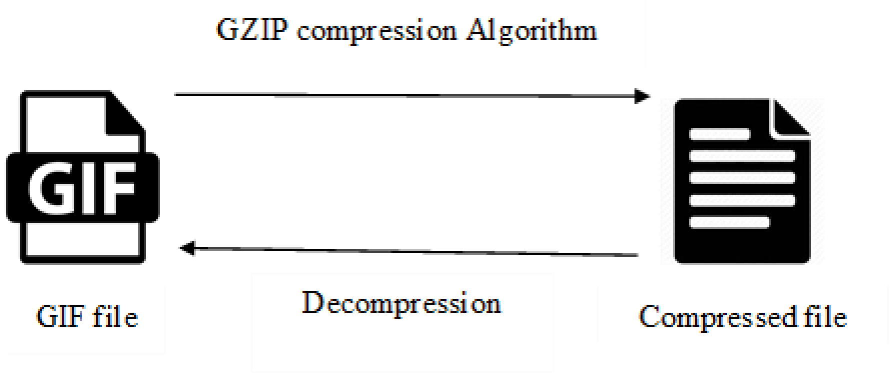


Figure 4.4: GIF Algorithm

GIF files are send through the networks by compressing. For this procedure, the "GZIP Compression Algorithm" is used where the compression can be done with less period.

GZIP Compression Algorithm is generally based on Abraham Lempel and Jacob Ziv's LZ'77 algorithm and Welch's LZW (Lempel – ZIV – Welch) algorithm.

The compressed file can be send via either Facebook messenger or proposed application “Sanwada”. The output GIF is going to be delivered under decompression.

4.1.2. Appendix B: Analysis Models

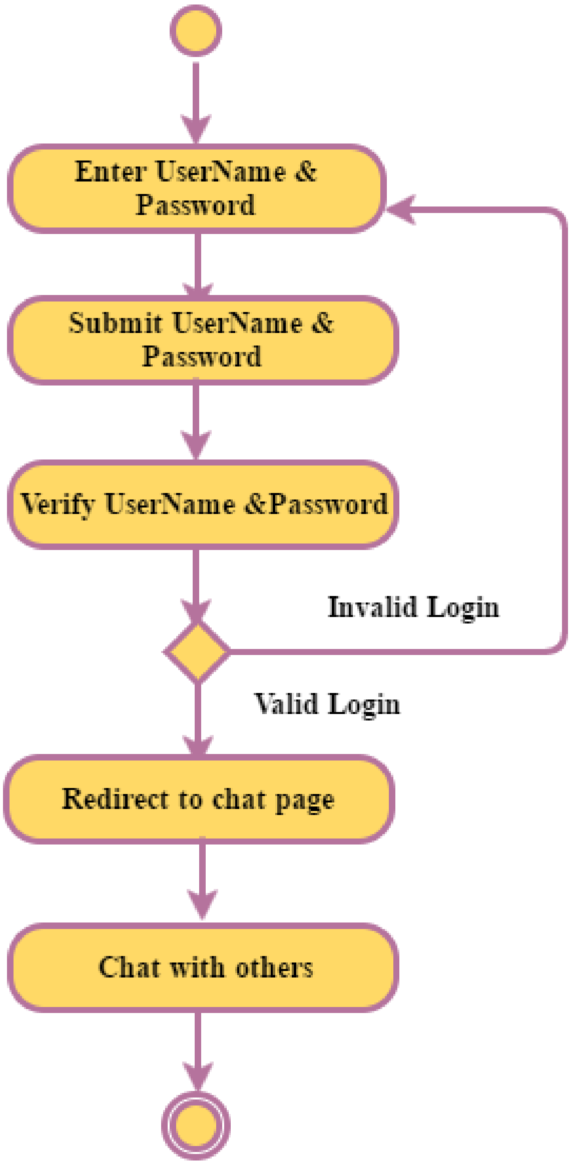

Enter UserName & Password
Submit UserName & Password
Verify UserName &Password
Invalid Login
Valid Login
Redirect to chat page
Chat with others

Figure 4.5: Activity Diagram-Start the Application

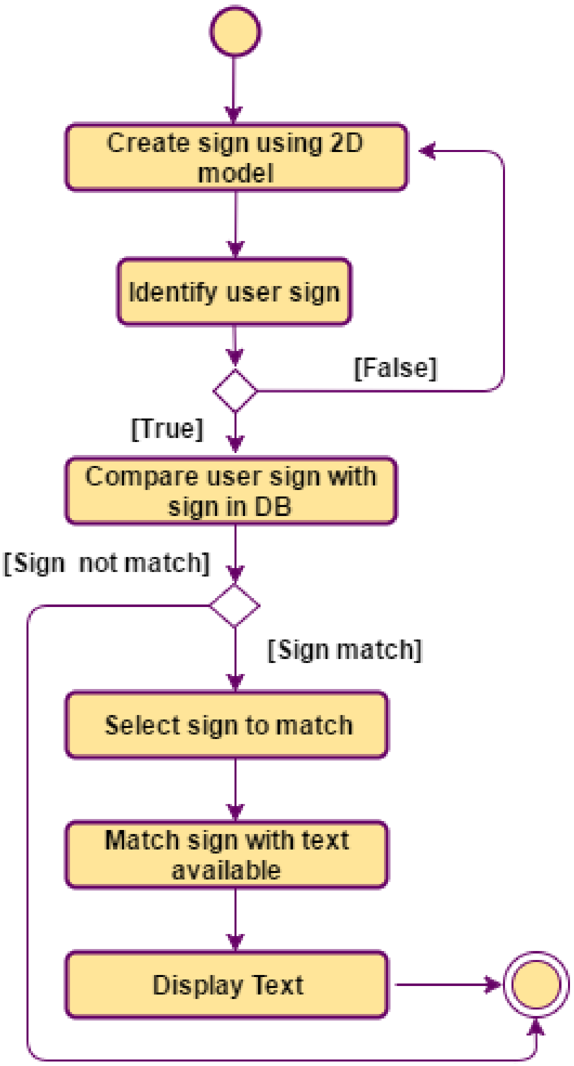


Figure 4.6:Activity Diagram- Convert Sign To Text

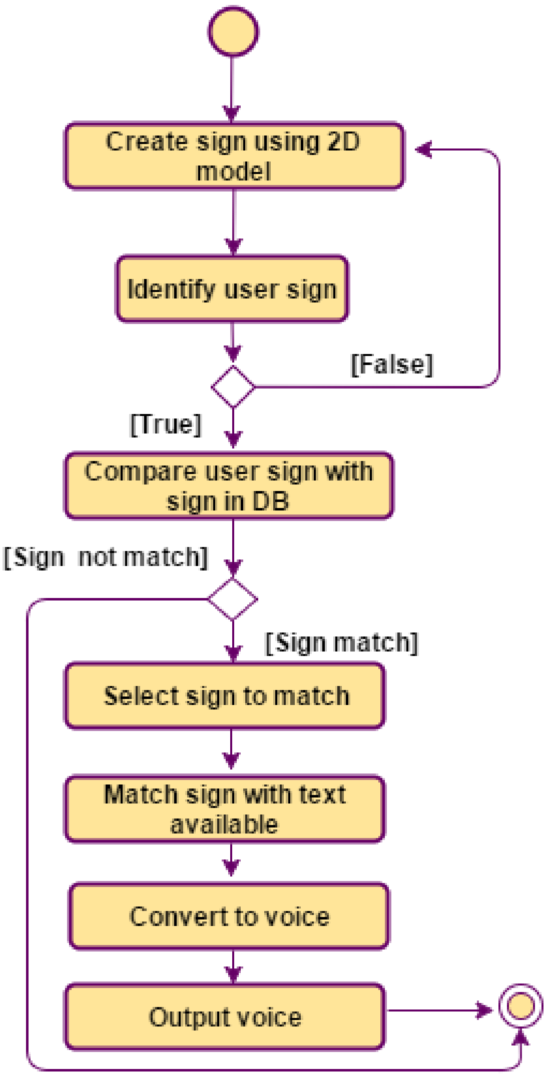


Figure 4.7: Activity Diagram-Convert Sign To Voice

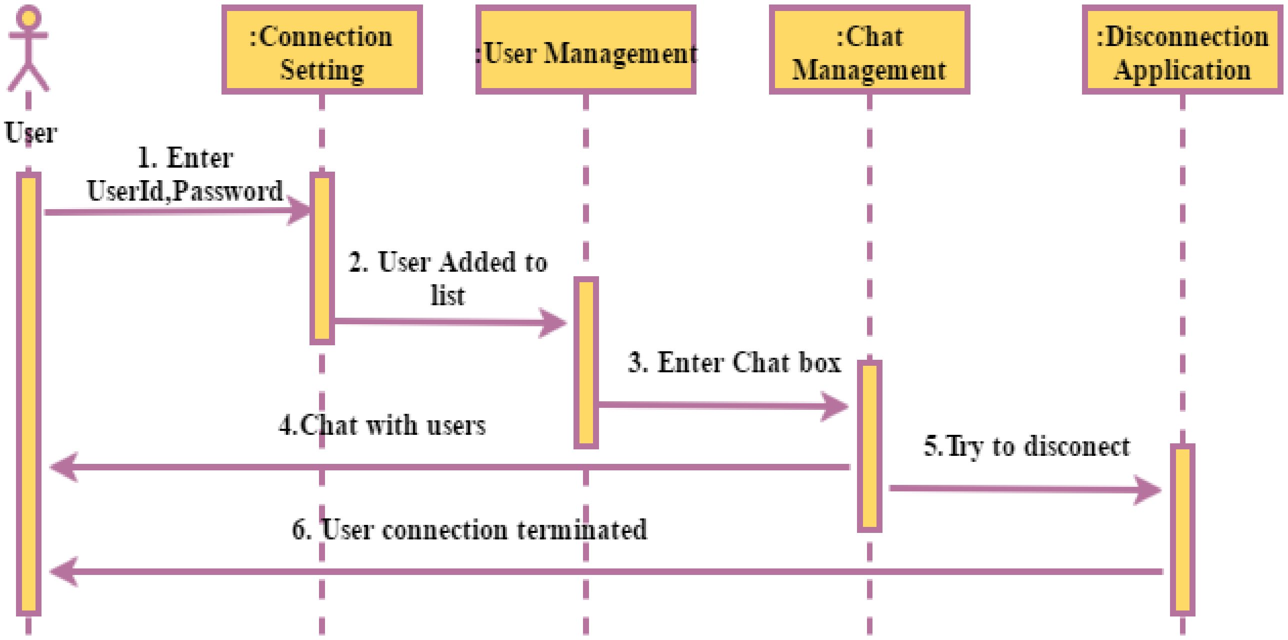


Figure 4.8: Sequence Diagram for chatting

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