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Mike – Your Personal Speech Therapist

In partial fulfilment of the requirements for the degree of
Bachelor of Science in Computer Science

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Certificate



We accept the work contained in the report titled
“MIKE – YOUR PERSONAL SPEECH THERAPIST”,

written by

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as a confirmation to the required standard for the partial fulfilment of the degree of
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June 4th, 2018

DECLARATION

We hereby declare that this project report is based on our original work except for citations and quotations which have been duly acknowledged. We also declare that it has not been previously and concurrently submitted for any other degree or award at Bahria University or other institutions.

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Specially dedicated to
my beloved mother, father and sisters
(Muhammad Johar Raza)
my beloved mother, father and siblings
(Hussain Ali Khan)

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We would like to thank everyone who had contributed to the successful completion of this project. We would like to express our gratitude to our research supervisor, Mr. Tahir Iqbal for his invaluable advice, guidance and his enormous patience throughout the development of the research.

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Muhammad Johar Raza
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MIKE – YOUR PERSONAL SPEECH THERAPIST

ABSTRACT

MIKE is a mobile application built for the community of disables who are facing problem in their everyday speech delivery. The main aim of this application is to treat people with articulation disorder and most importantly children. Our main focus is on child's speech therapy more as the speech disorders have higher chance of getting better at younger age. MIKE is created to support the cause and is therefore categorized as community support application. The application is not just a speech therapist but as our major focus is to treat children, MIKE have some interactive games that too are speech driven to increase interest. The user can download the application from app store and register the patient using our facial recognition system. Once the user is registered, MIKE will start the assessment through which each patient has to go through so that problem areas are identified. After that the dashboard will open which shows all the options including starting a session, scheduling a session, play a game or quit the application. MIKE is based on a friendly avatar which helps you learn in a better way. The main goal of MIKE is to deliver cheap speech therapy session to those individuals and parents who cannot afford taking expensive therapy sessions.

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CHAPTER 1

INTRODUCTION

1.1 Background

According to a study by US. Department of Health and Human Services nearly 1 in 12 (7.7 percent) children in the world between ages 3-17 suffer from disorders and impairments related to voice, speech and language ^[1], limiting their participation in learning activities and causing serious educational difficulties. These problems make it extremely difficult for the children to communicate and participate in numerous activities that help them to mature socially and become successful and reasonably well-adjusted adults. ^[3]

Unfortunately, the number of qualified speech therapists in Pakistan is very low as compared to the need and most of the people can't afford the expensive treatment and facilities required for speech therapy. ^[2] The gravity of this scenario requires an innovative solution that is available to everyone and be effective and efficient as well. To address this problem, we intend to develop an interactive speech therapy platform called "MIKE", which is a personal speech therapist for the children. "MIKE" is aimed to treat the speech disorders and impairments in children and improve their and language skills as well.

1.2 Problem Statement

According to a survey conducted by Dawn Newspaper, 13.75% of Pakistan's overall population (majority being children of age 3-17) have some kind of speech disorder and/or language impairment.

Fewer Specialized speech therapists available as compared to the need. Expensive treatment and facilities which made it difficult for middle-class and lower-class families to afford a qualified speech therapist. Speech Therapy Sessions are not as entertaining as they should be for the children.

Computer assisted speech training methods have been studied extensively since the early 1980's, and fall into roughly three categories: systems that present speech, and may elicit speech, but do not attempt to analyse or assess speech; systems that provide biofeedback of speech-related acoustic or physiological measures such as amplitude or fundamental frequency; and systems that provide assessment of speech and feedback on the accuracy of speech production. ^[4]

1.3 Aims and Objectives

The objectives of the thesis are shown as following:

- i. To Develop a speech therapist matching requirements of modern era of healthcare.
- ii. To Provide an efficient and cost-effective platform to children who cannot afford speech therapist.
- iii. To Create an innovative solution through which children not only learn but also enjoy the therapy session.
- iv. To Become a pioneer product maker in field of speech therapy.

- v. To Deliver a substitute of speech therapist to general public and schools/institutions.

1.4 Scope of Project

The team aims to develop an interactive speech therapy platform on top of a virtual personal assistant enhanced with artificial intelligence to treat speech disorders and language impairment in children especially with articulation disorders. We are creating speech support including English as its primary language as for therapy. Also, we planned release to be done in three versions; Personal, Professional and Special School Versions.

CHAPTER 2

Software Requirement Specification

2.1 Product Perspective

“MIKE” is a totally new product in line of speech therapy, though there are several applications available online for speech therapy but they are not more than a visual card as a kit for a speech therapist. Whereas “MIKE” is a complete replacement of a speech therapist, meaning it will be useful for Patients more than speech therapists. The figure given below shows how it works.

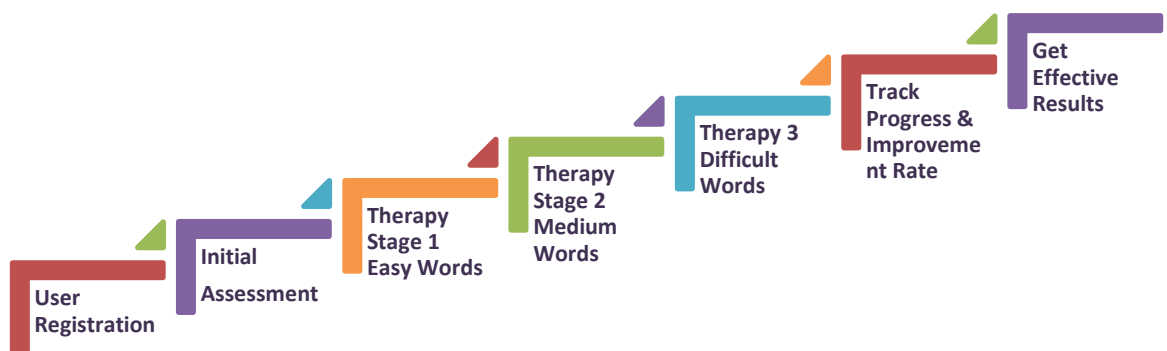


Figure 2.0 Articulation working model

2.1.1 Understanding Articulation Therapy

Articulation disorder is a part of speech disorder which can be found among children and it is a disorder which does not allow children to speak specific sound. The sounds which are treated in articulation therapy are referred as problem area and are categorised as follow; Z, S, R, L, SH, CH, TH, F, V, K, G, B, P, T, D, J, ZH, N, M, W, Y, H and R. Each Problem area has three positions. For Example: if the problem exists in P sound, we have to check on which place when P occurs in a word, the child is unable to Produce a sound. So we will take three word; Piano for initial position, Apple for middle position and Map for end position. If a child is unable to speak “PIANO” correctly, it means child has problem in producing sound P when it comes at initial position of a word.

2.1.2 MIKE’s Concept

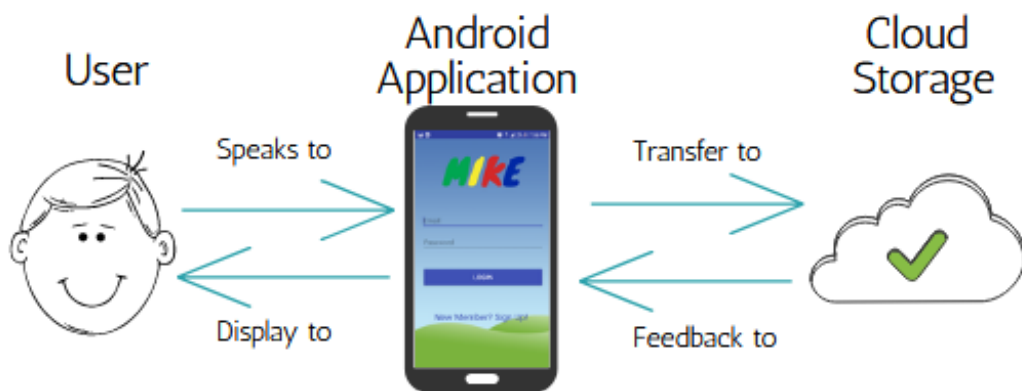


Fig. 2.1 A simple demonstration of concept behind mike

A child will repeat a word after virtual assistant, the voice will be sent to Google Speech API for comparison and will return the confidence score. After comparison, the database on cloud storage of Google Firebase will update the score of the user. Once updated, the cloud storage data will be displayed to user on the screen.

2.2 Product Functions

“MIKE” provides the following functionality to the Patient:

- a. Assessment for Patient’s current speech problems and identification of problem areas in Patient’s speech that need to be worked on in sessions.
- b. Step by step articulation speech therapy comprising three stages i.e. (Phonetic Sounds, Difficult Words, Sentences).
- c. Performance Tracking (statistics about the improvement in speech).
- d. Interactive games based on exercises designed to cure speech problems and test improvement in real-time while maintaining Patient’s interest.
- e. Interactive therapy sessions based on exercises specifically planned for each particular Patient based on their speech problems.
- f. One step registration and login process through facial recognition.

2.3 User Classes & Characteristics

2.3.1 General Public:

Anyone who has speech and language problems and wants to use Personal Version of “MIKE” for speech therapy.

2.3.2 Speech Therapists/Pathologists:

Therapists can use hardware integrated Professional Version as a tool for their therapy sessions to increase productivity and monitor progress of their Patients.

2.3.3 Students:

Students studying in various institutions can use Special School Version which is designed specially to cater their usage needs.

2.4 Operating Environment

2.4.1 Environmental Requirements:

- i. Moderately silent Room
- ii. Bright Light Availability
- iii. Headphones (Preferred Not Required)

2.4.2 Android Devices:

- i. Operating System Version 5.0 or above
- ii. Minimum Screen Resolution 480 Pixels
- iii. Front Camera
- iv. Working Microphone & Speakers
- v. 1GB RAM
- vi. 100Mb minimum disk space
- vii. Working Internet Connection

2.5 Design and Implementation Constraints

Personal Version of “MIKE” is a software application which is developed for android smartphones platform. For speech recognition it uses Google’s Speech API and is built on top of the android Platform. It is designed using a modular approach and contains various features which are accessible through a virtual assistant which is also named “MIKE”.

2.6 Assumptions and Dependencies

“MIKE” requires Internet connectivity for usage as the datasets for application are stored and maintained on the cloud and need to be updated regularly.

2.6.1 Hardware Interfaces

The hardware requirement of “MIKE” are Processor up to 1000MHz, screen with minimum resolution 720x1280 and ram of minimum 1500mb. Device should have front camera and working microphone and speaker.

2.6.2 Operating System:

MIKE requires the Android OS Version 5.0 (Lollipop) or above in order to be installed.

2.6.3 Database:

NoSQL Real-time Database provided by Google Firebase is used as the database for the application.

2.6.4 Tools & APIs:

Name	Description
Google Cloud Speech API	Google Cloud Speech provides fast and accurate speech recognition to convert audio, either from a microphone or from a file, to text in over 80 languages and variants
Google Cloud Firebase API	Google Firebase is a fully-managed database service that makes it easy to set up, maintain, manage, and administer your relational databases on Google Cloud Platform.
MPandroid Charts API	It is used for the display of statistics of the user in “Track Progress.” This API can be used to represent data and statistics in various forms of diagram.
Google Cloud Storage API	Google Cloud Storage is unified object storage for developers and enterprises,

	from live data serving to data analytics/ML to data archiving.
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2.6.5 Cloud Services:

“MIKE” uses **Google Cloud Services** for data storage, databases and speech analysis.

2.6.6 Communications Interfaces

“MIKE” requires internet access to be downloaded. Also operating and updating the application requires internet connection.

2.7 Use Cases

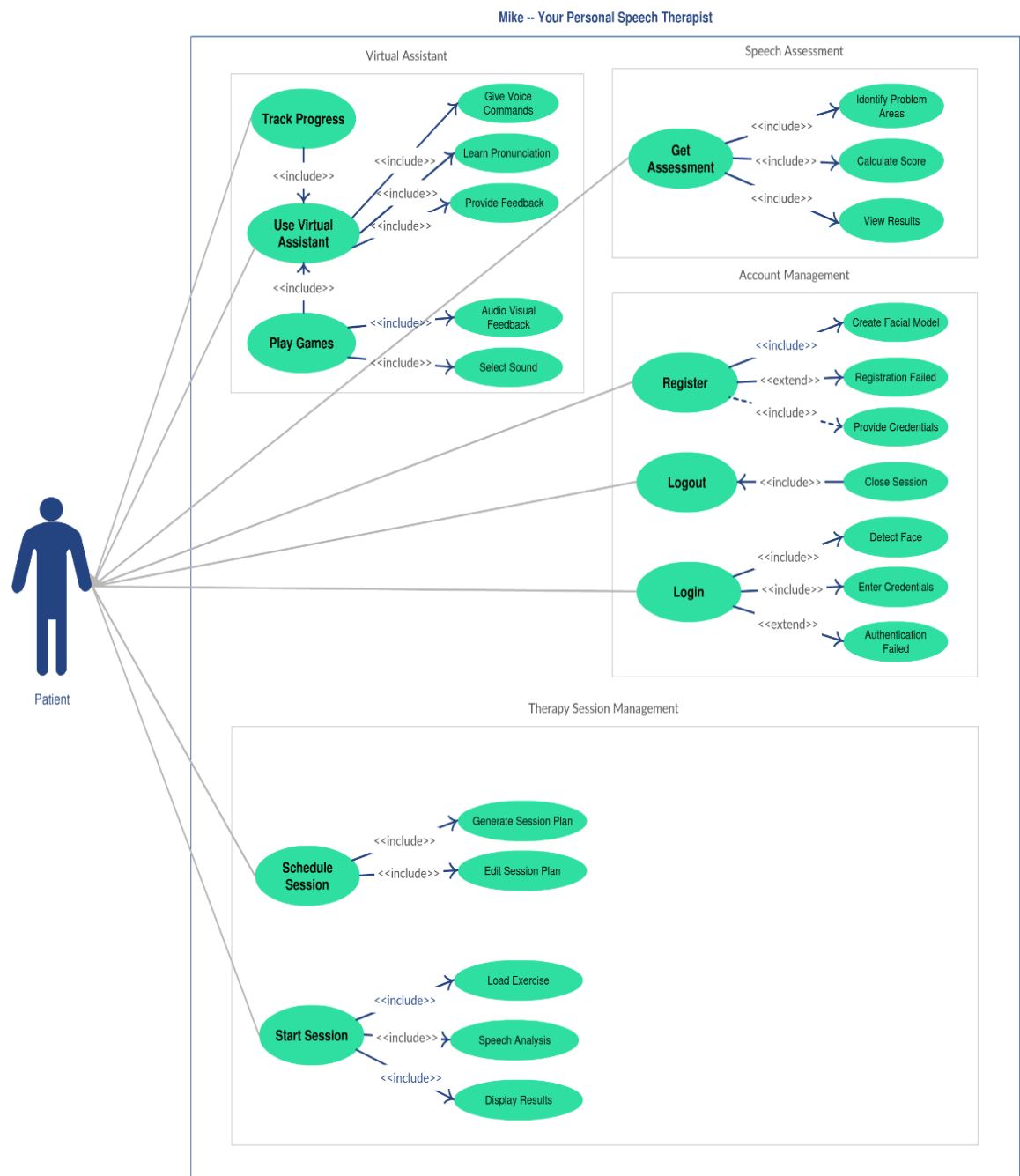


Figure 2.2 Level 1 Use Case Diagram

The Fig. 2.2 shows the level 1 use case diagram of the system “MIKE”. It contains all the components which were taken into consideration while gathering requirements from speech therapists. The level 2 diagrams of use cases can be seen inside the level 1 diagram as each component is labelled on the top.

2.7.1 Login (U1)

1. **ID** – U1
2. **Objective** – The Patient has initiated a login request. The System verifies Patient’s credentials and takes the Patient to dashboard screen after successful authentication.
3. **Priority** – High
4. **Source** – System Requirements Chart
5. **Actors** – Patient
6. **Flow of Events**
 - 6.1. **Basic Flow**

This use case starts when a Patient is not logged in to the system and selects for “Login.”

 - 6.1.1. System asks the Patient to select an option. This can be done either through a voice command or just by selecting “Login” option on screen.
 - 6.1.2. Patient selects the “Login” option on screen or says “Login”.
 - 6.1.3. System asks the Patient to provide their email and password or face the camera so that their face can be recognized.
 - 6.1.4. System authenticates the Patient’s face by facial recognition after comparing the camera input by stored facial model.
 - 6.1.5. The Patient is signed in and returned to the dashboard.
 - 6.1.6. The use case ends.
 - 6.2. **Alternative Flow 1** - At step 6.1.5 System returns a failed status, “Authentication Failed!!”
 - 6.2.1. An error message is shown to the Patient describing the reason for failed authentication.
 - 6.2.2. The System presents the Patient with suggestions for changes necessary to allow the Patient to pass authentication.
 - 6.2.3. The System prompts the Patient to re-provide the valid information.
 - 6.2.4. Return to step 6.1.5
 - 6.3. **Alternative Flow 2** – At step 6.1.4 the camera input is not available or there is a trouble in facial recognition due to dark lighting conditions.
 - 6.3.1. An error message is displayed telling the Patient they must check allow access to the camera / move to a place with better lighting condition.
 - 6.3.2. Return to step 6.1.3
 - 6.4. **Alternative Flow 3** – At any step the Patient presses “cancel”.
 - 6.4.1. System returns to the Login Screen.
 - 6.5. **Exception Flow 1** –
 - 6.5.1. Database isn’t accessible due to some technical failure on cloud end or any update issue. System prompts the Patient about the technical issue and asks them to try again later.
7. **Includes** – None
8. **Preconditions** – Patient is registered and connected to the Internet.
9. **Post conditions** – The Patient is authenticated and the system takes the Patient to dashboard screen OR the Patient is unable to log in for one or more reasons.
10. **Notes/Issues** – None

2.7.2 Register (U2)

1. **ID** – U2
2. **Objective** – The Patient wants to register an account. The system prompts the Patient to provide the required details and guides the Patient throughout the registration process and provide login details to the Patient after successful account registration.
3. **Priority** – High
4. **Source** – System Requirements Chart
5. **Actors** – Patient
6. **Flow of Events**
 - 6.1. **Basic Flow**

This use case starts when a Patient initiates a request for account registration. Patient selects the option of registering a new account.

 - 6.1.1. System takes the Patient to registration screen.
 - 6.1.2. System prompts the Patient for registration information i.e. a Name, Email, Password and to face the camera so that their facial model could be created for login.
 - 6.1.3. Patient enters the details and faces the camera.
 - 6.1.4. System creates a new account after validating the entered credentials and creating facial model of that Patient against that user Id
 - 6.1.5. System takes the Patient to login screen.
 - 6.1.6. The use case ends.
 - 6.2. **Alternative Flow 1** - At step 6.1.5 System computer returns a failed status, “Registration Failed!! Invalid Information”
 - 6.2.1. An error message is shown to the Patient to correct invalid Information.
 - 6.2.2. Return to step 6.1.4
 - 6.3. **Alternative Flow 2** – At step 6.1.5 the camera input is not available or there is a trouble in facial recognition due to dark lighting conditions.
 - 6.3.1. An error message is displayed telling the Patient they must check allow access to the camera / move to a place with better lighting condition.
 - 6.3.2. Return to step 6.1.4
 - 6.4. **Alternative Flow 3** – At any step the Patient presses “cancel”.
 - 6.4.1. System returns to the Dashboard Screen.
 - 6.4.2. The System returns the Patient to the main screen without the Patient being logged in and any information provides has been discarded.
 - 6.5. **Exception Flow 1** –
 - 6.5.1. Database isn’t accessible due to some technical failure on cloud end or any update issue. System prompts the Patient about the technical issue and asks them to try again later.
7. **Includes** – None
8. **Preconditions** – Patient is connected to the Internet.
9. **Post conditions** – The Patient’s account has been successfully created the System returns Patient to the dashboard as a Logged in Patient.
10. **Notes/Issues** – None

2.7.3 Logout (U3)

1. **ID** – U3
2. **Objective** – The Patient has initiated a logout request. System closes the current session and takes the Patient to the Login Screen.
3. **Priority** – High
4. **Source** – System Requirements Chart
5. **Actors** – Patient
6. **Flow of Events**
 - 6.1. **Basic Flow**

This use case starts when a Patient is logged in to the system and selects “Logout.”

 - 6.1.1. System asks the Patient to select an option. This can be done either through a voice command or just by selecting “Logout” option on screen.
 - 6.1.2. Patient selects the “Logout” option on screen or says “Logout”.
 - 6.1.3. System closes the current session for the Patient.
 - 6.1.4. The Patient is logged out and taken to the Main Screen.
 - 6.1.5. The use case ends.
 - 6.2. **Alternative Flow 1** – At any step the Patient presses “cancel”.
 - 6.2.1. System returns to the Dashboard Screen.
 - 6.3. **Exception Flow 1** –
 - 6.3.1. Database isn’t accessible due to some technical failure on cloud end or any update issue. System prompts the Patient about the technical issue and asks them to try again later.
7. **Includes** – None.
8. **Preconditions** – Patient is logged in and connected to the Internet.
9. **Post conditions** – The patient is taken to the Login Screen.
10. **Notes/Issues** – None

2.7.4 Get Assessment (U4)

1. **ID** – U4
2. **Objective** – The Patient has requested for an assessment of their speech and System Analyses Patient’s speech for identification of problem areas.
3. **Priority** – High
4. **Source** – System Requirements Chart
5. **Actors** – Patient
6. **Flow of Events**
 - 6.1. **Basic Flow**

This use case starts when a logged in Patient accesses the “Speech Assessment” feature of the system.

 - 6.1.1. Patient invokes the virtual assistant by saying “Hello MIKE”.
 - 6.1.2. System executes U5 (Call Virtual Assistant).
 - 6.1.3. System asks the Patient to select an option. This can be done either through a voice command or just by selecting “Speech Assessment” option on screen.
 - 6.1.4. Patient selects “Assessment” option either by saying “Assess my speech” or by selecting the same option on the screen.
 - 6.1.5. System displays the assessment module to the Patient.
 - 6.1.6. System asks the Patient to spell the Words displayed on screen one after another.
 - 6.1.7. Patient spells the Words that they were asked to spell.
 - 6.1.8. System analyses each word spoken by Patient and generates a correctness score for each assessed category and displays it to the Patient on screen.
 - 6.1.9. Once the Patient has spelled all the words/phonemes. System generates a speech therapy session plan for each day based on cumulative score in speech assessment and displays the results to the Patient.
 - 6.1.10. The use case ends.
 - 6.2. **Alternative Flow 1** - At step 6.1.7 System cannot recognize anything due to noise or unavailability, disabled access to microphone.
 - 6.2.1. An error message is shown to the Patient asking them to move to a quiet or less noisy location and to allow access to the microphone in case it is disabled.
 - 6.2.2. Return to step 6.1.5
 - 6.3. **Exception Flow 1** –
 - 6.3.1. Speech Datasets are not available due to technical failure on cloud end. System prompts the Patient about the technical issue and asks them to try again later.
7. **Includes** – U5 (Call Virtual Assistant)
8. **Preconditions** – Patient is logged in and connected to Internet.
9. **Post conditions** – Problem areas in Patient’s speech have been identified and results are displayed to the user.
10. **Notes/Issues** – None

2.7.5 Call Virtual Assistant (U5)

1. **ID** – U5
2. **Objective** – The Patient has invoked the virtual assistant. System displays different voice commands to the Patient and executes them when asked by the Patient.
3. **Priority** – High
4. **Source** – System Requirements Chart
5. **Actors** – Patient
6. **Flow of Events**
 - 6.1. **Basic Flow**

This use case starts when a logged in Patient invokes the virtual assistant by saying the keyword “Hello MIKE” on Dashboard.

 - 6.1.1. Patient invokes the virtual assistant by saying “Hello MIKE” on Dashboard.
 - 6.1.2. System displays several voice commands on screen that can be chosen to launch a particular feature of “MIKE”. Voice commands include “Assess My Speech”, “Play Games”, “Track my Progress”, “Login” and “Start Therapy”, “Show results” and “Log out”.
 - 6.1.3. System asks the Patient to select an option to execute the command.
 - 6.1.4. Patient selects the desired option by saying it to virtual Assistant.
 - 6.1.5. System executes the selected command and launches the particular feature/module associated with that command.
 - 6.1.6. The use case ends.
 - 6.2. **Alternative Flow 1** - At step 6.1.2 System cannot recognize anything due to noise or unavailability, disabled access to microphone.
 - 6.2.1. An error message is shown to the Patient asking them to move to a quiet or less noisy location and to allow access to the microphone in case it is disabled.
 - 6.2.2. Return to step 6.1.1
 - 6.3. **Alternative Flow 2** – At any step the Patient presses “cancel”.
 - 6.3.1. System returns to the dashboard.
 - 6.4. **Exception Flow 1** –
 - 6.4.1. Database not available due to technical failure on cloud end. System prompts the Patient about the technical issue and asks them to try again later.
7. **Includes** – None
8. **Preconditions** – Patient is logged in and connected to Internet.
9. **Post conditions** – The particular feature is launched as asked by the Patient or the desired task is accomplished.
10. **Notes/Issues** – None

2.7.6 Schedule Session (U6)

1. **ID** – U6
2. **Objective** – The Patient wants to schedule the therapy session. System displays different options for planning the session.
3. **Priority** – Medium
4. **Source** – System Requirements Chart
5. **Actors** – Patient
6. **Flow of Events**
 - 6.1. **Basic Flow**

This use case starts when a Patient has initiates a request of scheduling the therapy session.

 - 6.1.1. Patient invokes the virtual assistant by saying “Schedule Session”.
 - 6.1.2. System displays the options for planning the session.
 - 6.1.3. System asks the Patient to select an option to execute the command.
 - 6.1.4. Patient selects the desired option by selecting it on the screen.
 - 6.1.5. System asks the Patient to select the “Date, Time and Problem Area” of the session that they want to schedule.
 - 6.1.6. Patient selects the desired “Date and Time” on the screen.
 - 6.1.7. System displays the information about scheduled session to the Patient.
 - 6.1.8. The use case ends.
 - 6.2. **Alternative Flow 1** - At step 6.1.2 System cannot recognize anything due to noise or unavailability, disabled access to microphone.
 - 6.2.1. An error message is shown to the Patient asking them to move to a quiet or less noisy location and to allow access to the microphone in case it is disabled.
 - 6.2.2. Return to step 6.1.1
 - 6.3. **Alternative Flow 2** – At any step the Patient presses “cancel”.
 - 6.3.1. System returns to the dashboard screen.
 - 6.4. **Exception Flow 1** –
 - 6.4.1. Database not available due to technical failure on cloud end. System prompts the Patient about the technical issue and asks them to try again later.
7. **Includes** – U5 (Call Virtual Assistant)
8. **Preconditions** – Patient is logged in and connected to Internet.
9. **Post conditions** – The particular feature is launched as asked by the Patient or the desired task is accomplished.
10. **Notes/Issues** - None

2.7.7 Start Session (U7)

1. **ID** – U7
2. **Objective** – The Patient has initiated a request to start the therapy session after invoking the virtual assistant. Systems takes the Patient to the Session screen.
3. **Priority** – High
4. **Source** – System Requirements Chart
5. **Actors** – Patient
6. **Flow of Events**
 - 6.1. **Basic Flow**

This use case starts when a logged in Patient invokes the virtual assistant by saying the keyword “Start therapy”.

 - 6.1.1. Patient invokes the virtual assistant by saying “Start therapy”.
 - 6.1.2. System takes the Patient to the session screen and asks for selecting the desired exercise.
 - 6.1.3. Patient selects their desired exercise.
 - 6.1.4. System starts the particular exercise selected by the Patient.
 - 6.1.5. System asks the Patient to speak as it is displayed on the screen.
 - 6.1.6. Patient selects the desired option by saying it or by selecting the same option on the screen.
 - 6.1.7. System analyzes the response from the Patient and generates a score based on the accuracy of spoken sound.
 - 6.1.8. Steps 6.1.5 till 6.1.7 are repeated throughout this process until Patient has completed the exercise.
 - 6.1.9. System then displays the results of the therapy session to the Patient.
 - 6.1.10. The use case ends.
 - 6.2. **Alternative Flow 1** - At step 6.1.2 System cannot recognize anything due to noise or unavailability, disabled access to microphone.
 - 6.2.1. An error message is shown to the Patient asking them to move to a quiet or less noisy location and to allow access to the microphone in case it is disabled.
 - 6.2.2. Return to step 6.1.1
 - 6.3. **Alternative Flow 2** – At any step the Patient presses “cancel”.
 - 6.3.1. System returns to the dashboard screen.
 - 6.4. **Exception Flow 1** –
 - 6.4.1. Database not available due to technical failure on cloud end. System prompts the Patient about the technical issue and asks them to try again later.
7. **Includes** – U5 (Call Virtual Assistant)
8. **Preconditions** – Patient is logged in and connected to Internet.
9. **Post conditions** – The particular feature is launched as asked by the Patient or the desired task is accomplished.
10. **Notes/Issues** - None

2.7.8 Track Progress (U8)

1. **ID** – U8
2. **Objective** – The Patient has initiated a requested for tracking their progress in therapy sessions. System displays results, improvement rate and statistics of the all the therapy sessions.
3. **Priority** – Low
4. **Source** – System Requirements Chart
5. **Actors** – Patient
6. **Flow of Events**
 - 6.1. **Basic Flow**

This use case starts when a Patient invokes the Virtual Assistant by saying the keyword “Track My Progress”.

 - 6.1.1. System displays the detailed statistics and graphs for each session to the Patient including overall accuracy, wrong pronunciation and right pronunciation followed by a cumulative score and overall improvement rate after each session.
 - 6.1.2. The use case ends.
 - 6.2. **Alternative Flow 1** - At step 6.1.2 System cannot recognize anything due to noise or unavailability, disabled access to microphone.
 - 6.2.1. An error message is shown to the Patient asking them to move to a quiet or less noisy location and to allow access to the microphone in case it is disabled.
 - 6.2.2. Return to step 6.1.1
 - 6.3. **Alternative Flow 2** – At any step the Patient presses “cancel”.
 - 6.3.1. System returns to the dashboard screen.
 - 6.4. **Exception Flow 1** –
 - 6.4.1. Database not available due to technical failure on cloud end. System prompts the Patient about the technical issue and asks them to try again later.
7. **Includes** – U5 (Call Virtual Assistant)
8. **Preconditions** – Patient is logged in and connected to Internet.
9. **Post conditions** – The particular feature is launched as asked by the Patient or the desired task is accomplished.
10. **Notes/Issues** - None

2.7.9 Play Games (U9)

1. **ID** – U9
2. **Objective** – The Patient wants to play game as part of therapy. System displays different games for patient to play with.
3. **Priority** – Medium
4. **Source** – System Requirements Chart
5. **Actors** – Patient

6. Flow of Events

6.1. Basic Flow

This use case starts when a logged in Patient invokes the virtual assistant by saying the keyword “Play Games”.

- 6.1.1. Patient invokes the virtual assistant by saying “Play Games”.
- 6.1.2. System displays several voice commands on screen that can be chosen to launch a level of therapy. Voice commands include “Game 1”, “Game 2”, “Game 3”, “Cancel”, “Log out” etc. to be the few.
- 6.1.3. System asks the Patient to select a game to execute the command.
- 6.1.4. Patient selects the desired game by saying it or by selecting the same option on the screen.
- 6.1.5. System starts the game and launches the particular feature/module associated with that game.
- 6.1.6. The use case ends.

6.2. Alternative Flow 1 - At step 6.1.2 System cannot recognize anything due to noise or unavailability, disabled access to microphone.

- 6.2.1. An error message is shown to the Patient asking them to move to a quiet or less noisy location and to allow access to the microphone in case it is disabled.
- 6.2.2. Return to step 6.1.1

6.3. Alternative Flow 2 – At any step the Patient presses “cancel”.

- 6.3.1. System returns to the dashboard screen.

6.4. Exception Flow 1 –

- 6.4.1. Database not available due to technical failure on cloud end. System prompts the Patient about the technical issue and asks them to try again later.

7. **Includes** – U5 (Call Virtual Assistant)
8. **Preconditions** – Patient is logged in and connected to Internet.
9. **Post conditions** – The particular feature is launched as asked by the Patient or the desired task is accomplished.
10. **Notes/Issues** - None

2.8 Non-functional Requirements

2.8.1 Performance Requirements

“MIKE” is a cloud based mobile application and thus requires a reliable internet connection for smoothing response of the speech therapist. Moreover, “MIKE” is designed to be used on low budget smartphones and hence requires minimum specifications to run. 1GHz of processor and 1.5gb of ram is powerful enough to run “MIKE” without jitters.

2.8.2 Safety Requirements

To make sure each Patient receives the therapy sessions as per demand, the cloud services will back up the previous sessions and also track the user performance to enable for each Patient to start from where they left. Feedback email is also provided in case Patient is facing specific problem situation.

2.8.3 Security Requirements

“MIKE” uses facial recognition system to login to specific user account, so that only authorized Patient can use the system and so that each Patient could be identified individually. However, parents are highly encouraged to supervise the session.

2.8.4 Software Quality Attributes

“MIKE” comes in three variants with specific features of each variant. Due to its self-explanatory user interfaces the “MIKE” is considered user friendly to both; individuals and professionals. However, parents and professionals should have basic knowledge of articulation speech therapy.

ID	Priority	Type	Source	Use Case	Description
MIKE-REQ-01	<i>High</i>	Functional	Interviews with Speech Therapists	U1	Patient should be able to login through facial recognition.
MIKE-REQ-02	<i>High</i>	Functional	Interviews with Speech Therapists	U2	Patient's account should be registered in order for them to use "MIKE".
MIKE-REQ-03	<i>High</i>	Functional	Interviews with Speech Therapists	U4	Assessment of Patient's speech for identification of problem areas and calculating score for each assessed category and overall speech assessment.
MIKE-REQ-04	<i>High</i>	Functional	Interviews with Speech Therapists	U5	Interactive virtual assistant to guide Patient during speech therapy.
MIKE-REQ-05	<i>Medium</i>	Functional	Interviews with Speech Therapists	U4	System should generate speech therapy plan according to the problem areas identified in Patient's speech.
MIKE-REQ-06	<i>Medium</i>	Functional	Interviews with Speech Therapists	U6	Patient should be able to select and edit the desired time for their daily speech therapy session.
MIKE-REQ-07	<i>Medium</i>	Functional	Interviews with Speech Therapists	U7	Results of each exercise and the entire session should be displayed to the Patient.
MIKE-REQ-08	<i>Medium</i>	Functional	Interviews with Speech Therapists	U9	Interactive games with audio visual feedback to cure Patient's speech problems to maintain their interest.
MIKE-REQ-09	<i>Medium</i>	Functional	Interviews with Speech Therapists	None	Patient should be able to start the therapy session from where their left last time.

MIKE-REQ-010	<i>Medium</i>	Functional	Interviews with Speech Therapists	U8	Patient should be able to track progress for each session and view statistics about the rate of improvement in speech.
MIKE-REQ-011	<i>Low</i>	Functional	Interviews with Speech Therapists	None	Patient should be reminded to start the therapy session at their selected time through a push notification.
MIKE-REQ-012	<i>Low</i>	Functional	Interviews with Speech Therapists	None	Patient should receive daily notifications about their goals and achievements.
MIKE-REQ-013	<i>Low</i>	Functional	Interviews with Speech Therapists	None	“MIKE” should contain Support for Urdu Language.
MIKE-REQ-014	<i>Low</i>	Functional	Interviews with Speech Therapists	None	“MIKE” should have a feedback feature for Patient’s suggestions.
MIKE-REQ-015	<i>High</i>	Non-Functional	Interviews with Speech Therapists	None	“MIKE” should have interactive user interface so children can use with ease.
MIKE-REQ-016	<i>High</i>	Non-Functional	Interviews with Speech Therapists	None	Each patient should have separate identity.
MIKE-REQ-017	<i>High</i>	Non-Functional	Interviews with Speech Therapists	None	Limited number of user access per version downloaded or bought.
MIKE-REQ-018	<i>High</i>	Non-Functional	Interviews with Speech Therapists	None	Generate error in case of no connectivity with the internet.
MIKE-REQ-019	<i>High</i>	Non-Functional	Interviews with Speech Therapists	None	Error log should be generated in case of application failure.

MIKE-REQ-020	<i>Medium</i>	Non-Functional	Interviews with Speech Therapists	None	Session must be expired once the application is closed.
MIKE-REQ-021	<i>Low</i>	Non-Functional	Interviews with Speech Therapists	None	In case of feedback, “MIKE” should display the feedback email provided by the developers.
MIKE-REQ-022	<i>Low</i>	Non-Functional	Interviews with Speech Therapists	None	In case of data loss, the therapy session should restart.

The table above shows the functional and non-functional requirements collected to form the use cases and develop the application. The requirements were collected from a speech therapist.

CHAPTER 3

DESIGN AND METHODOLOGY

3.1 Domain Model

The table below shows the list of conceptual classes extracted from the real word entities related to the problem domain mentioned in the scope section of SRS document.

Conceptual Classes	
• Patient	• Virtual Assistant
• Facial Model	• Exercise
• Assessment	• Word
• Problem Area	• Sound
• Session	• Game
• Session Plan	• Evaluation

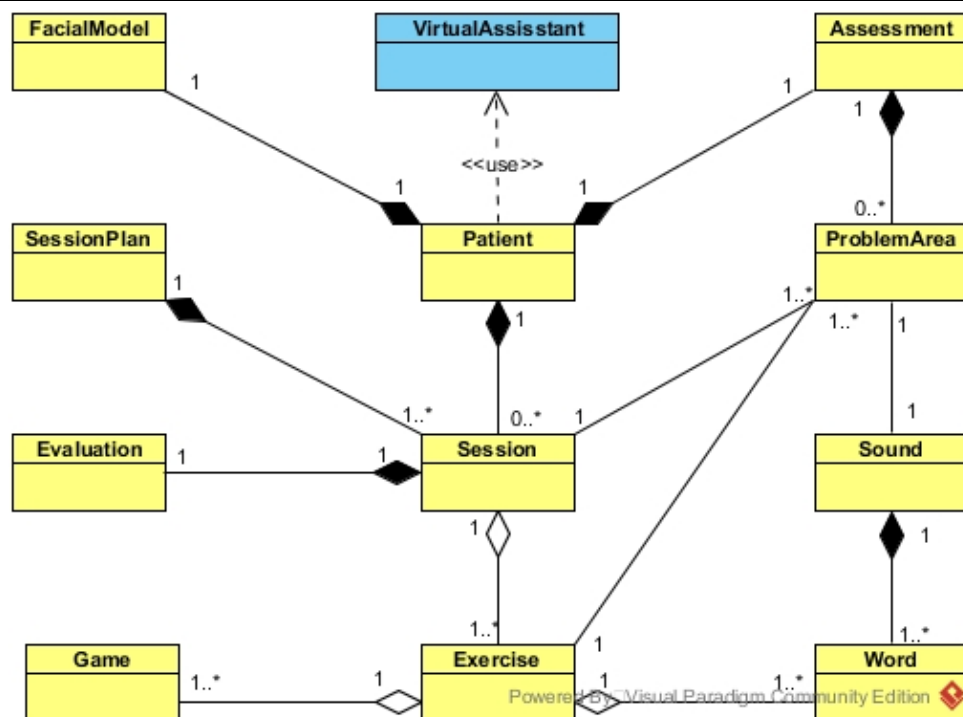


Figure 3.1 Domain Model

3.2 Sequence Diagram

Following are the sequence diagrams for critical-level use-cases of “MIKE”:

ID	Diagram
Seq-1	Patient Login Sequence
Seq-2	Patient Register Sequence
Seq-3	Call Virtual Assistant Sequence
Seq-4	Schedule Session Sequence
Seq-5	Start Session Sequence
Seq-6	Get Assessment Sequence

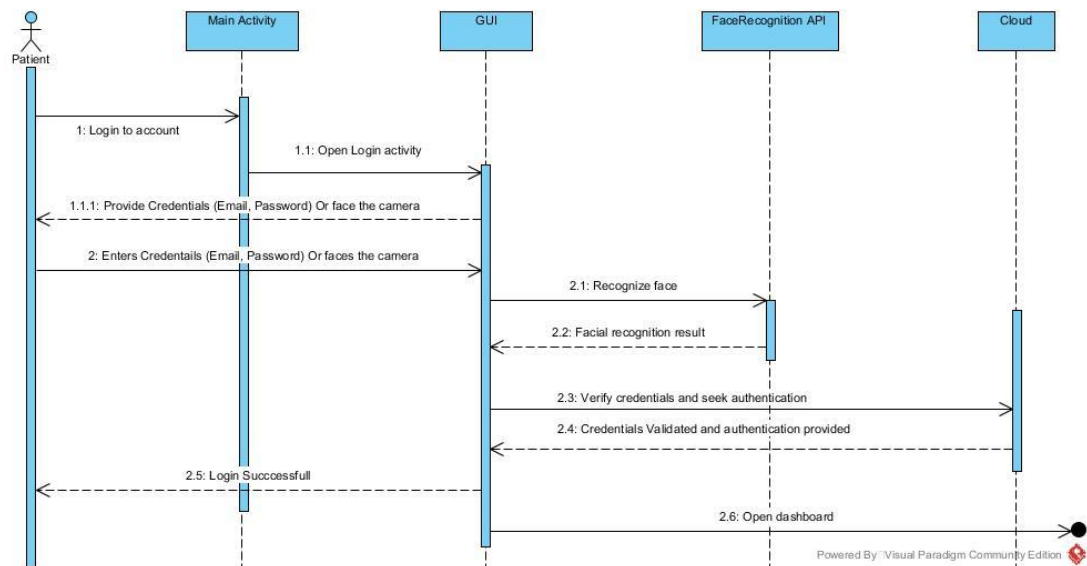


Figure 3.2 Patient Login Sequence Diagram

The Fig. 3.2 shows the sequence followed through which the patient will login to MIKE.

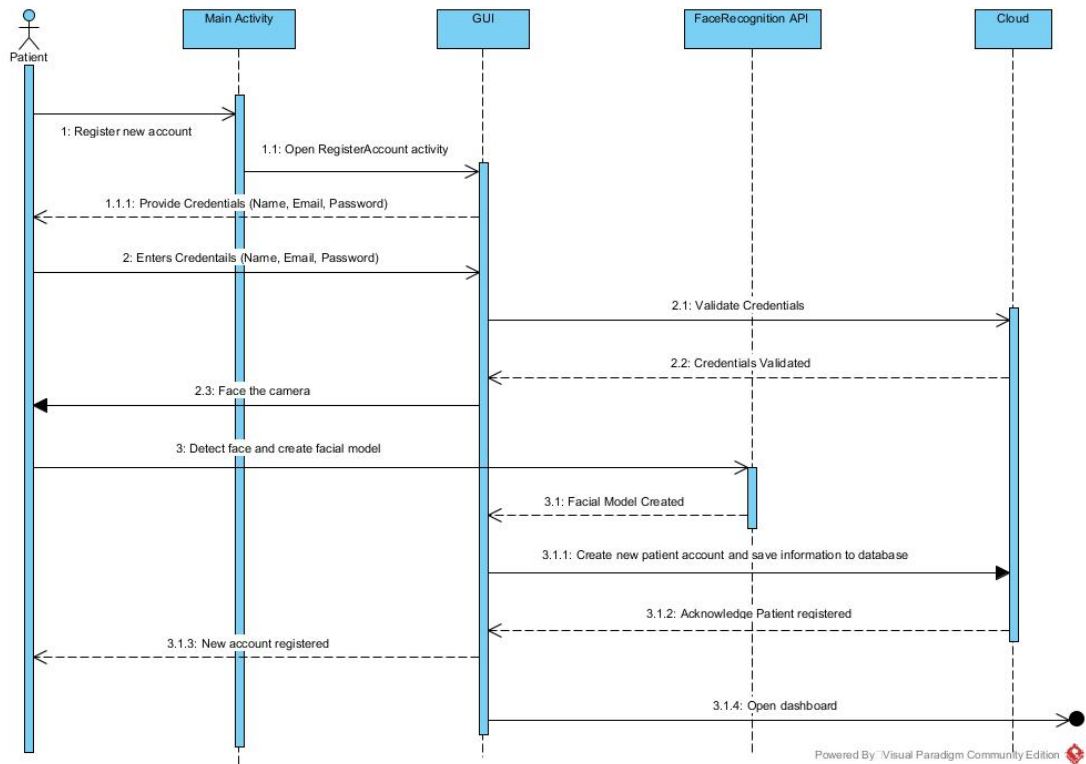


Figure 3.3 Patient Register Sequence Diagram

The Fig. 3.3 shows the sequence followed through which the patient will register to MIKE.

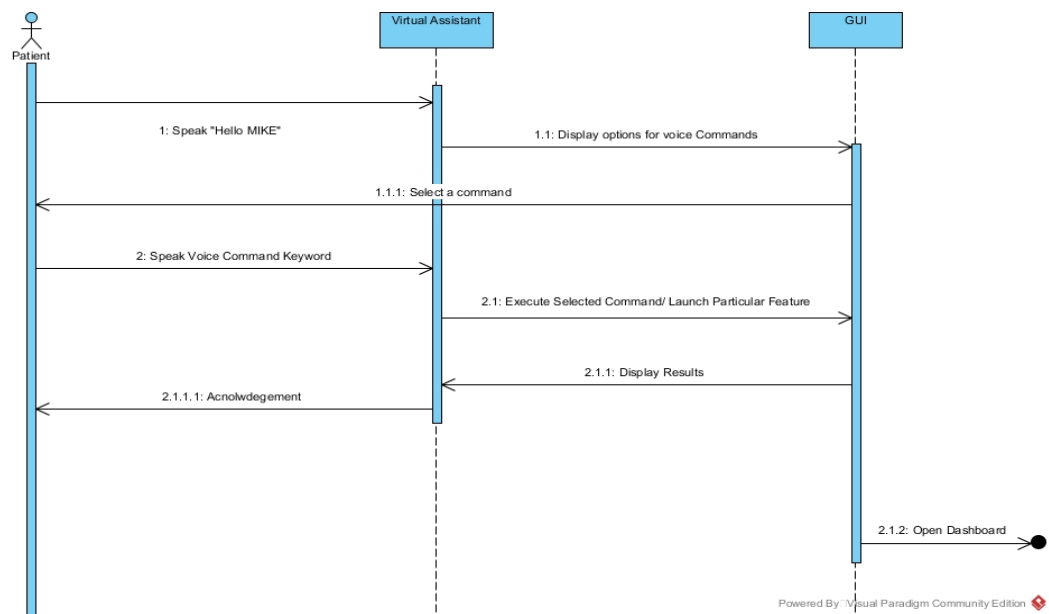


Figure 3.4 Call Virtual Assistant Sequence Diagram

The Fig. 3.4 shows the sequence followed through which the patient will call the virtual assistant.

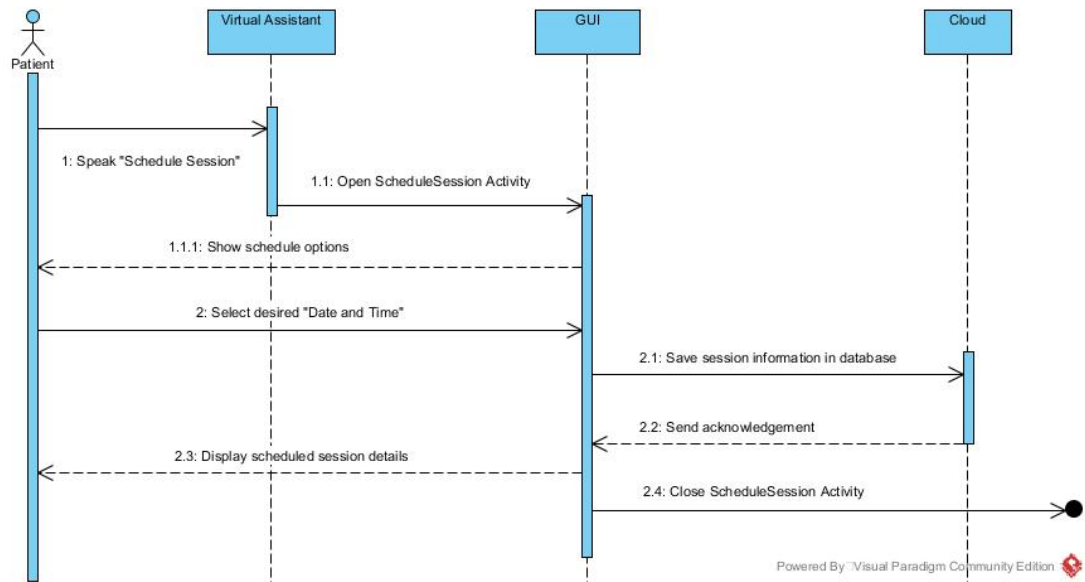


Figure 3.5 Schedule Session Sequence Diagram

The Fig. 3.5 shows the sequence followed through which the patient will schedule the session for therapy.

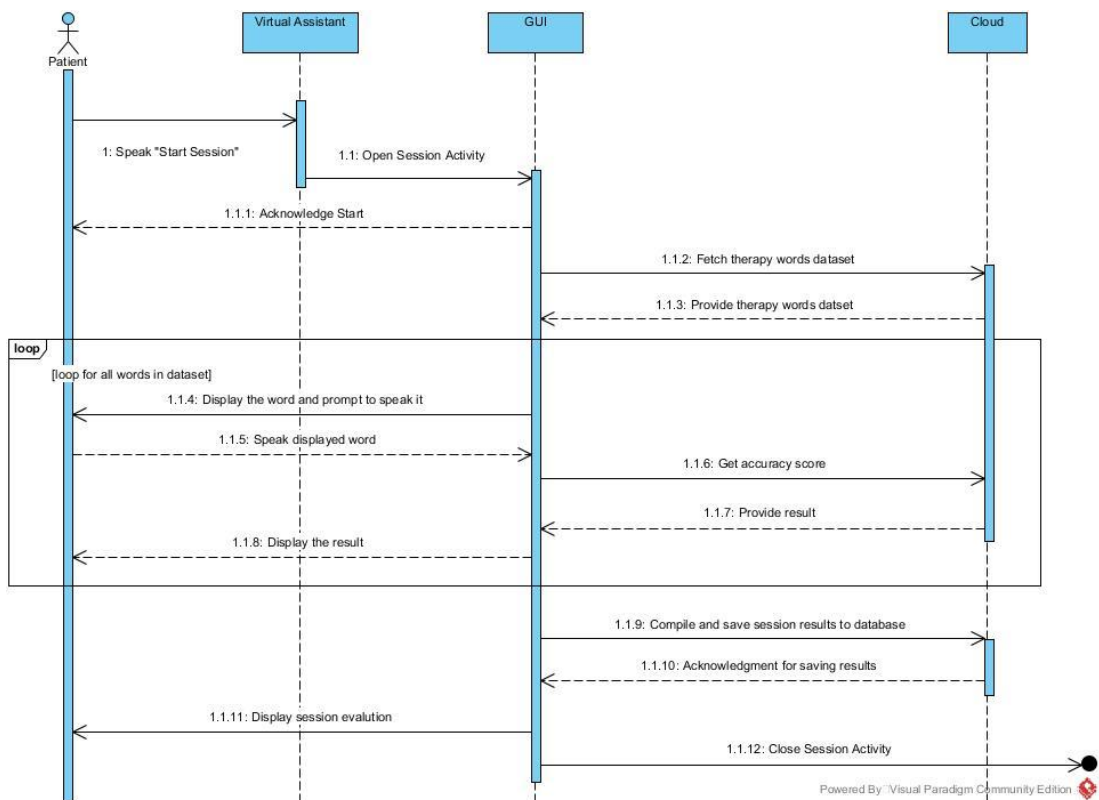


Figure 3.6 Start Session Sequence Diagram

The Fig. 3.6 shows the sequence followed through which the patient will start the session.

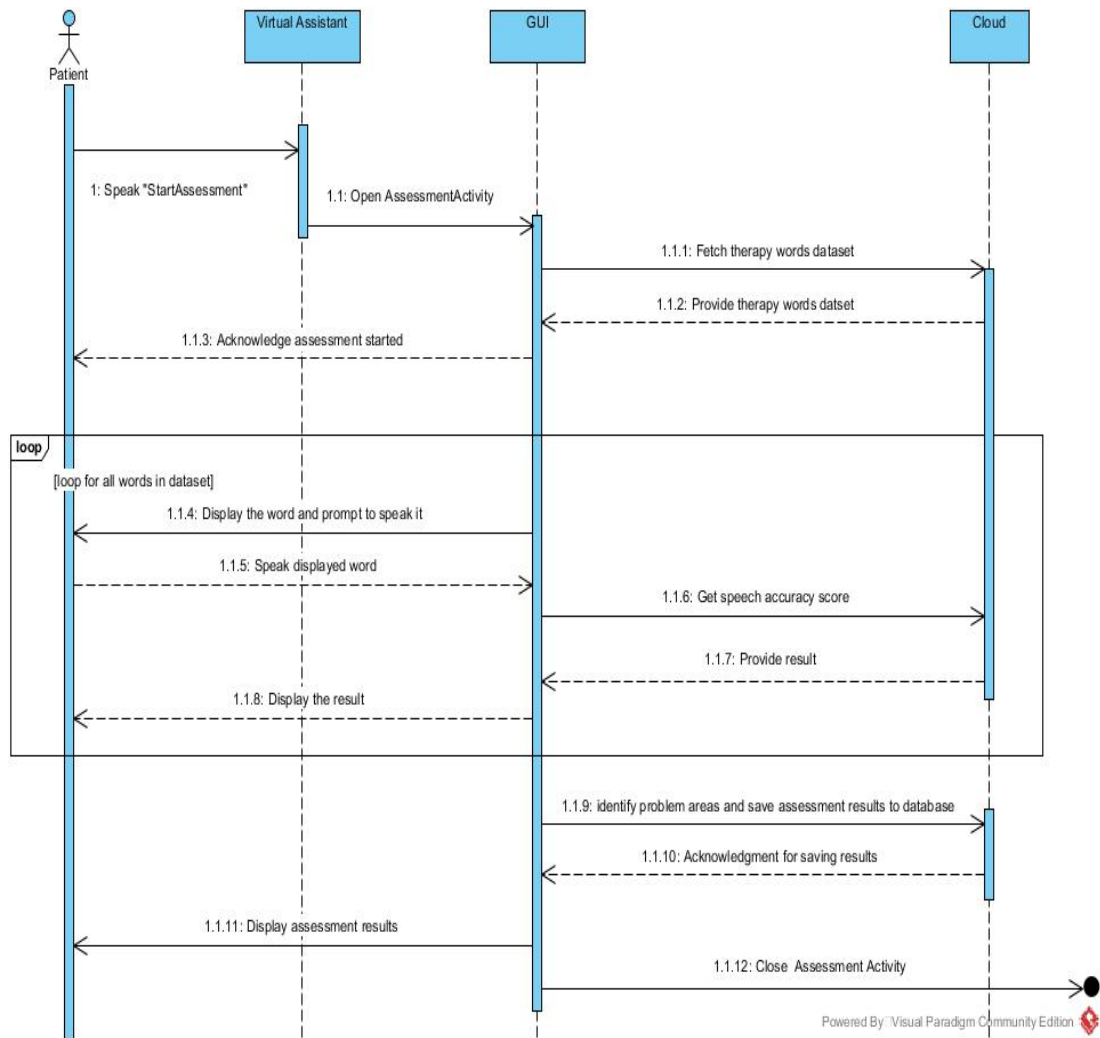


Figure 3.7 Get Assessment Sequence Diagram

The Fig. 3.7 shows the sequence followed through which the patient can get his/her assessment done.

3.3 Collaboration Diagrams

Following are the collaboration diagrams for critical level use-cases of “MIKE”:

ID	Diagram
Col-1	Patient Login Collaboration
Col-2	Patient Register Collaboration
Col-3	Call Virtual Assistant Collaboration
Col-4	Schedule Session Collaboration
Col-5	Start Session Collaboration
Col-6	Get Assessment Collaboration

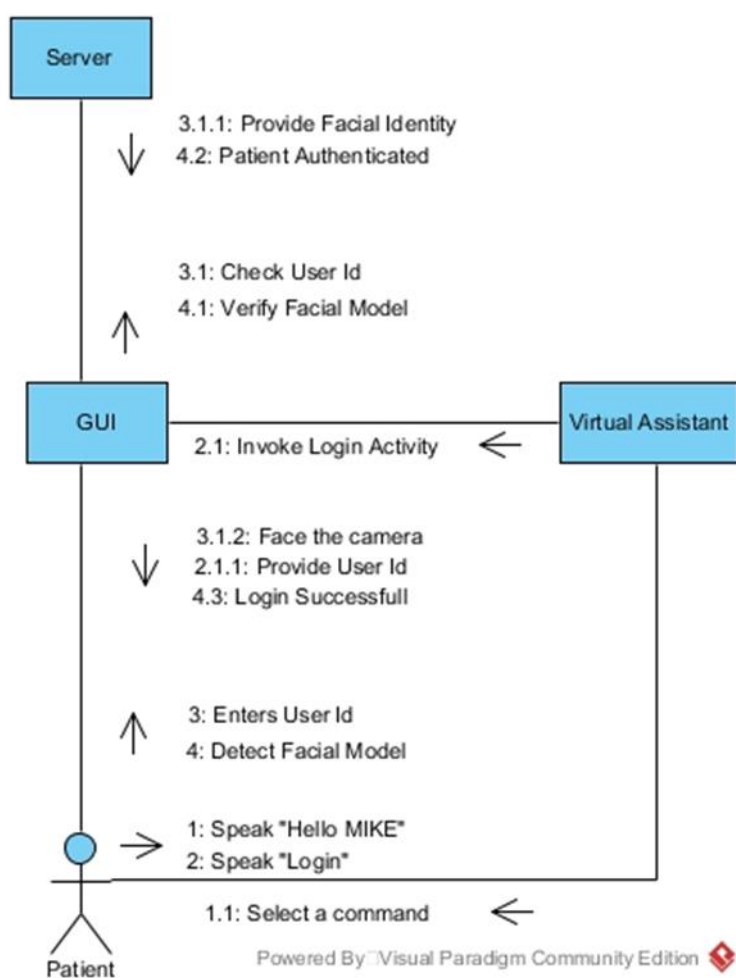


Figure 3.8 Patient Login Collaboration Diagram

The Fig. 3.8 shows the components of system involved which helps the patient login to MIKE.

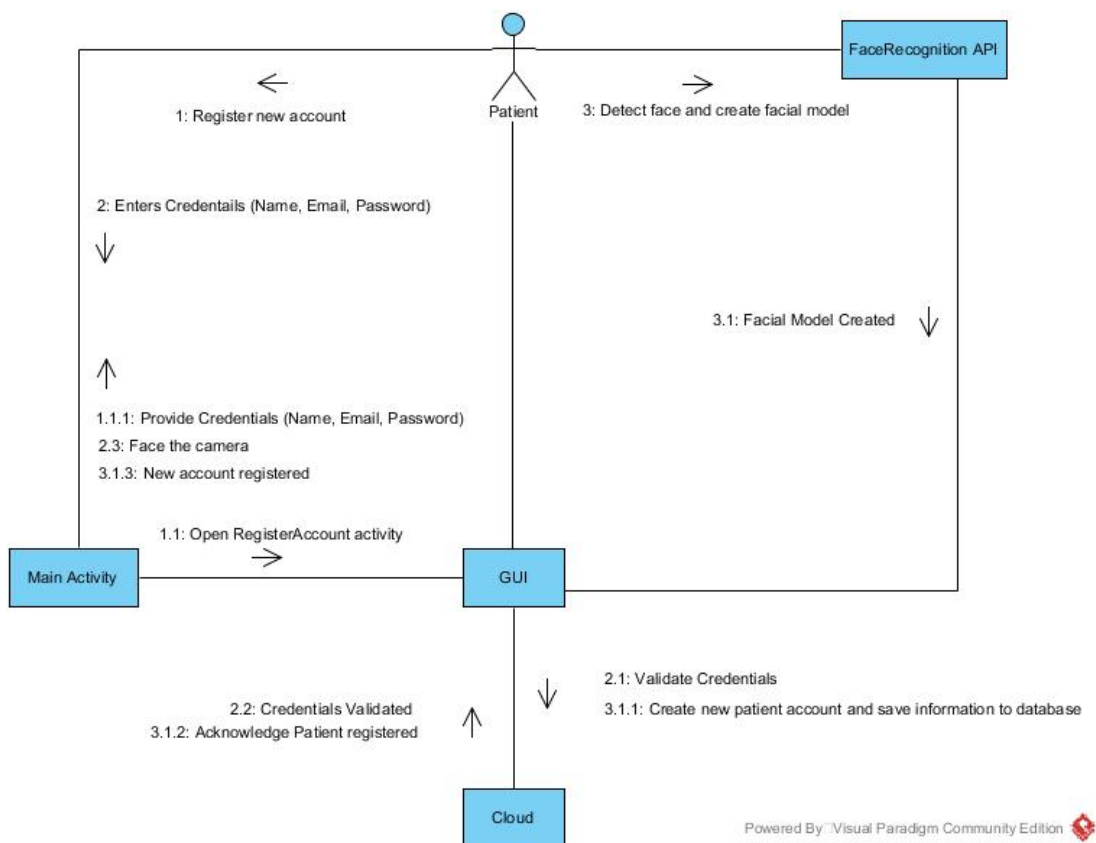


Figure 3.9 Patient Register Collaboration Diagram

The Fig. 3.9 shows the components of system involved which helps the patient to register to MIKE.

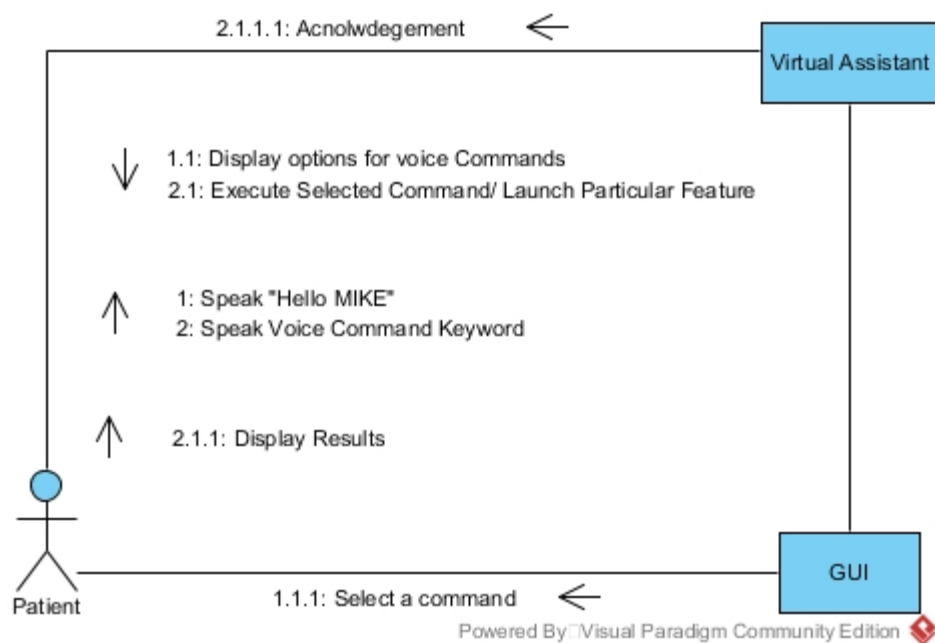


Figure 3.10 Call Virtual Assistant Collaboration Diagram

The Fig. 3.10 shows the components of system involved which helps the patient call virtual assistant.

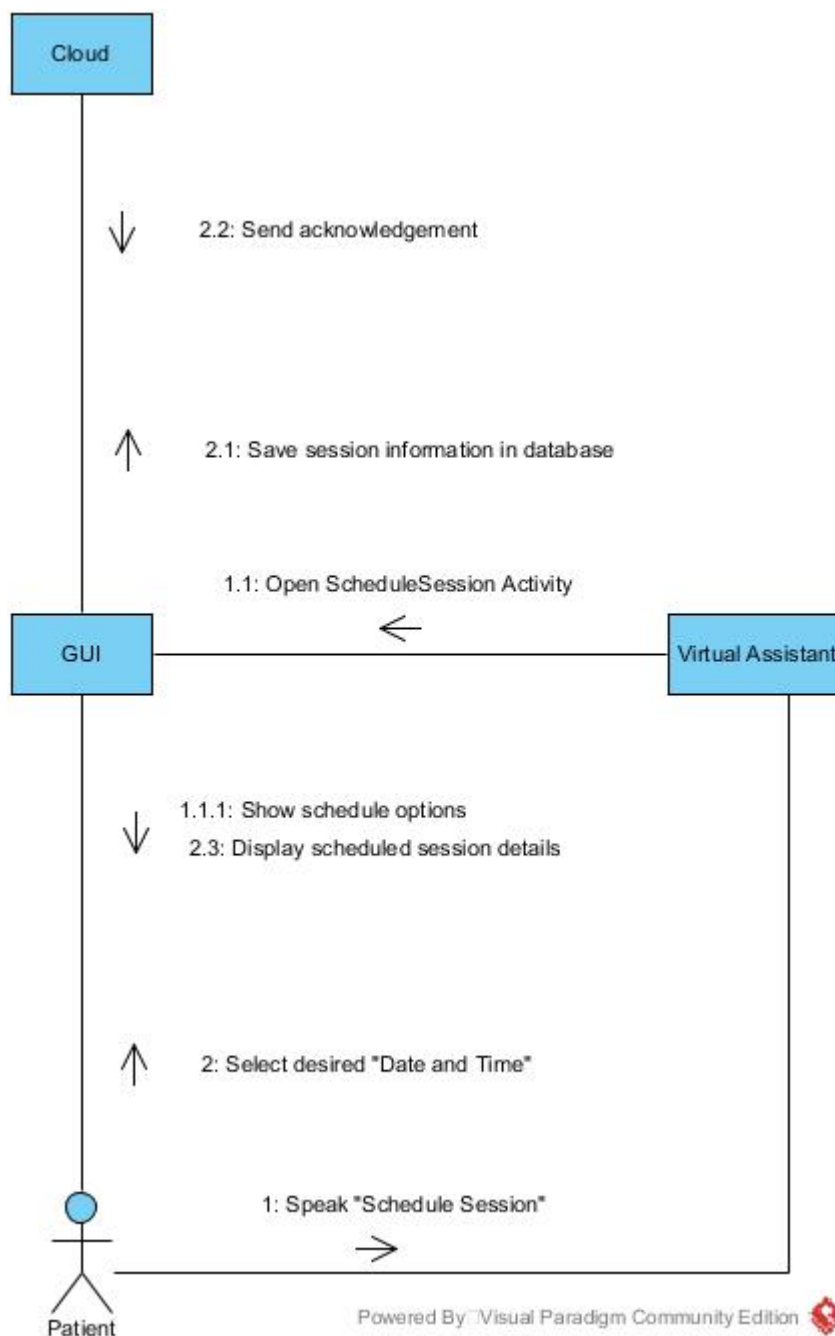


Figure 3.11 Schedule Session Collaboration Diagram

The Fig. 3.11 shows the components involved which helps the patient to schedule therapy session in MIKE.

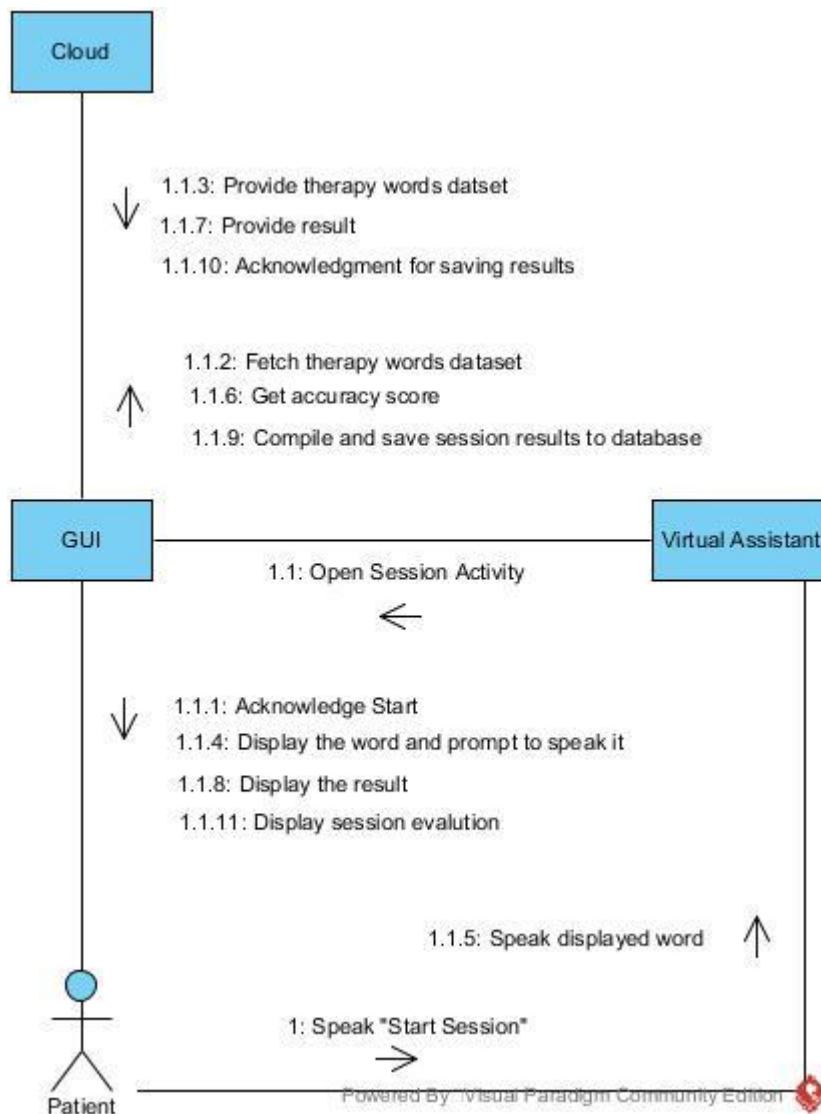


Figure 3.12 Stat Session Collaboration Diagram

The Fig. 3.12 shows the components of system involved which helps the patient to start therapy session in MIKE.

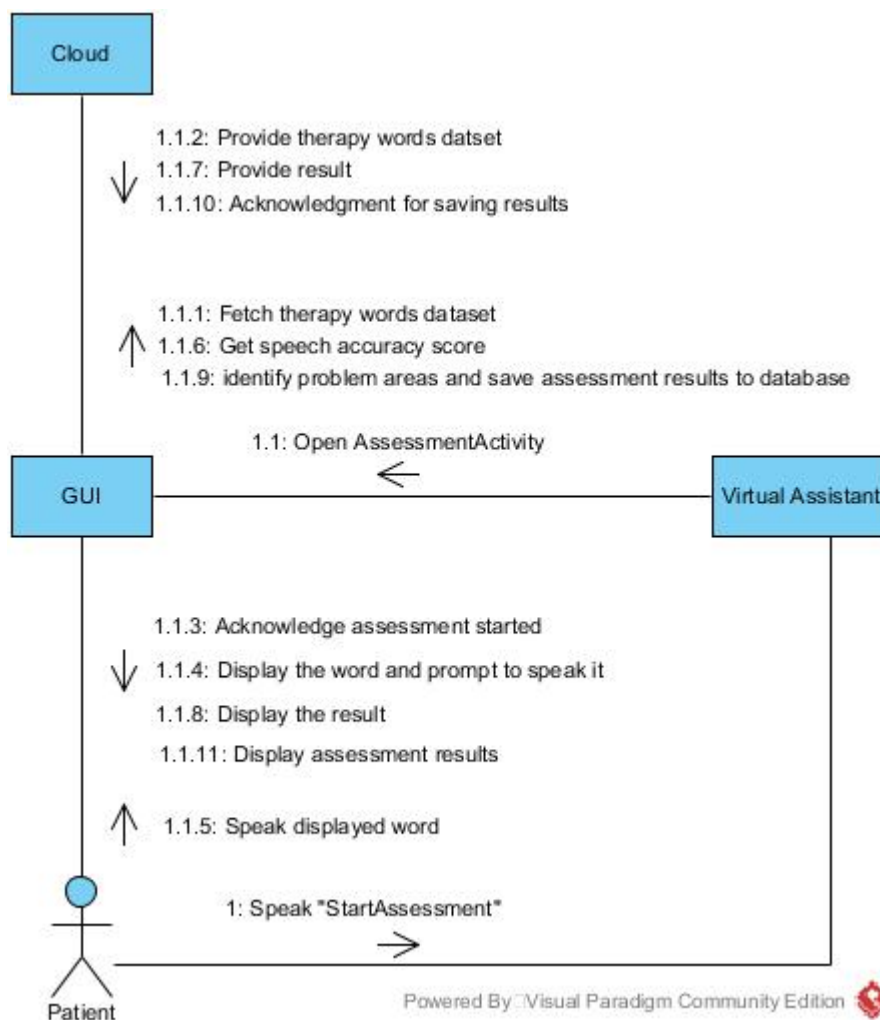


Figure 3.13 Get Assessment Collaboration Diagram

The Fig. 3.13 shows the components of the system which helps the patient to conduct assessment in MIKE.

3.4 Operation Contracts

Operation Contracts for the system are as follows:

Operation: Login(Patient_ID, FacialModel_ID)

Cross Reference: Use case: Login (U1)

Preconditions: The user has opened the application and now wants to access their dashboard. The application requires facial recognition model to open the dashboard.

Post conditions:

- A Patient instance PT is created. (instance creation)
- PT was associated with Facial model. (association formed)
- PT.FacialModel_ID became FacialModel_ID. (instance modification)

Operation: Patient(Patient_Name, Patient_Email, Patient_Type, FacialModel_link)

Cross Reference: Use case: Register (U2)

Preconditions: There is a new Patient who wants to use this application. The user will say register me and registration portal opens up.

Post conditions:

- A patient instance PT is created. (instance creation)
- A FacialModel instance FM is created. (instance creation)
- A Assessment instance ASSESS is created. (instance creation)
- PT was associated with FM. (association formed)
- PT was associated with ASSESS. (association formed)
- FM.link become FacialModel_link. (instance modification)
- PT.Patient_Type become Patient_Type. (instance modification)
- PT.Patient_Name become Patient_Name. (instance modification)
- PT.Patient_Email become Patient_Email. (instance modification)
- PT was associated with FacialModel based on Patient_Email match(association formed)

Operation: Logout(Patient_ID)

Cross Reference: Use case: Logout (U3)

Preconditions: The Patient wants to logout from the application.

Post conditions:

- A Patient instance PT was created. (instance creation)
- PT.Patient_ID became Patient_ID. (instance modification)

Operation: Assesment(Patient_ID,Assessment_ID)

Cross Reference: Use case: Get Assessment (U4)

Preconditions: There is a new Patient and application wants to assess the problem areas of their speech so assessment part pop ups.

Post conditions:

- An assessment instance A1 is created. (instance creation)
- A ProblemArea instance P1 is created. (instance creation)
- A1 was associated with Patient_ID(association formed)
- A1.ProbelmArea becomes P1 (instance modification)
- A1.Patient_ID becomes Patient_ID (instance modification)
- A1.Assessment_ID becomes Assessment_ID. (instance modification)

Operation: ScheduleSession(Patient_ID, Exercise_ID, Start_Date, End_Date, No_Of_Sessions)

Cross Reference: Use case: Schedule Session (U6)

Preconditions: Complexity level is selected and now user has to plan the session including time for therapy session.

Post conditions:

- A SessionPlan instance SP1 was created. (instance creation)
- SP1 was associated with Exercise_ID. (association formed)
- SP1.Start_Date becomes Start_Date. (instance modification)
- SP1.End_Date becomes End_Date. (instance modification)
- SP1.No_Of_Sessions becomes No_Of_Sessions. (instance modification)

Operation: StartSession(Session_ID, Evaluation_ID, Problemarea_ID, Exercise_ID, Patient_ID)

Cross Reference: Use case: Start Session (U7)

Preconditions: The Patient wants to start the therapy session..

Post conditions:

- A session instance s1 was created (instance creation)
- S1.Session_ID becomes Session_ID (instance modification)
- S1 was associated with Word (association formed)
- S1 was associated with Exercise (association formed)
- S1 was associated with Evaluation (association formed)
- S1 was associated with Patient (associated formed)

Operation: TrackProgress(Evaluation_ID, Score, Improvement, Session_ID)

Cross Reference: use case: TrackProgress (U8)

Preconditions: The Patient wants to know about his progress and now the statistics will be displayed to the Patient.

Post conditions:

- A Evaluation instance E1 was created. (instance creation)
- E1.Evaluation_ID becomes Evaluation_ID. (instance modification)
- E1 was associated with Session (association formed)
- E1.Score becomes Score(instance modification)
- E1.Improvment becomes Improvement (instance modification)

Operation: PlayGames(Game_ID ,Exercise_ID)

Cross Reference: Use case: Play Games (U10)

Preconditions: The user has given command “Play games”, and options for available games pop up.

Post conditions:

- A Game instance G1 was created. (instance creation)
- G1 was associated to exercise. (association formed)
- G1.Exercise_ID becomes Exercise_ID. (instance modification)
- G1 was associated to session based on Exercise_ID match. (association formed)

3.5 Class Diagram

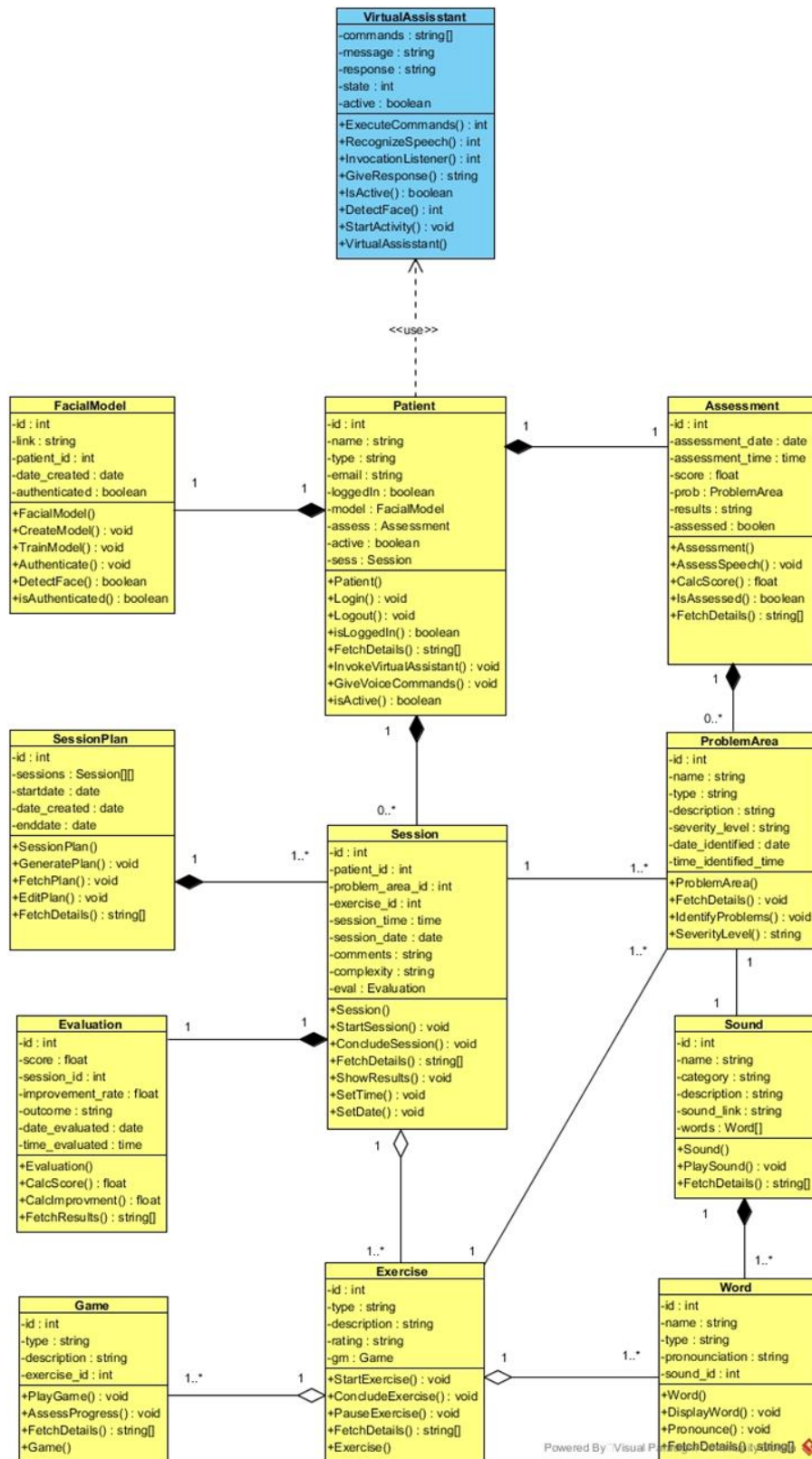


Figure 3.14 Class Diagram

The figure 3.13 shows the classes of the system involved in the database of the system. It contains all the classes, its variable and its functions.

3.6 Class Table

The table below details each of the classes used in the system and their purpose. This is a high-level description of each class to provide scope and context to the project.

Class	Purpose	Overview
VirtualAssistant	<ul style="list-style-type: none"> • Links with Chatbot • Interface for other classes • Execute commands 	The VirtualAssistant class contains all the attributes and functionality required to power the virtual assistant.
FacialModel	<ul style="list-style-type: none"> • Links with Login • Unique for Each Patient • Stores features for facial recognition • Provide authentication. 	The FacialModel class contains all the attributes and functionality required to create, store and validate facial model of a particular patient which will be used to recognize patient and link the patient to its dashboard.
Patient	<ul style="list-style-type: none"> • Container for Patient Information. • Creates Instance for each patient • Links patient to dashboard 	The Patient class contains general information of the patient as well as it is the primary class as everything related to one's therapy is linked with Patient_ID
Assessment	<ul style="list-style-type: none"> • Triggers Assessment Module • Evaluate results for therapy • Unique for each Patient. 	The Assessment class contains all the attributes and functionality essential to assess problem areas in speech of a particular Patient.
Session	<ul style="list-style-type: none"> • Store therapy session information • Trigger therapy session • Links with exercises 	The session class stores information of each speech therapy session including day, date and time.
ProblemArea	<ul style="list-style-type: none"> • Stores Patient Speech Problem Area • Fetch words of certain Problem Area 	The ProblemArea class links each patients problem area with the words used for the therapy of speech therapy session.

Word	<ul style="list-style-type: none"> • Contains words for therapy session • Link sound to the session 	The class Words is used to contain all the words used in speech therapy. As the words are used as per defined problem area the class words is link with class ProblemArea.
Sound	<ul style="list-style-type: none"> • Contain unique sounds • Sounds are linked with words 	The class Sounds contain the sound for each word and hence is the major part of the system as each word is linked with its unique sound.
Game	<ul style="list-style-type: none"> • Links Games to the dashboard • Create instance for each game to be played 	The Interactive Games class contains all the link to all interactive games as part of speech therapy.
Evaluation	<ul style="list-style-type: none"> • Create instance of result. • Initiates the score calculation for each patient after each session 	The evaluation class contains the result generated after each session. It plays the major part in calculating patients performance.
Exercise	<ul style="list-style-type: none"> • Links words and games with the session • Prioritize and customize sessions 	The Exercise class is used to customize and conduct the therapy each therapy session.

3.7 Data Model

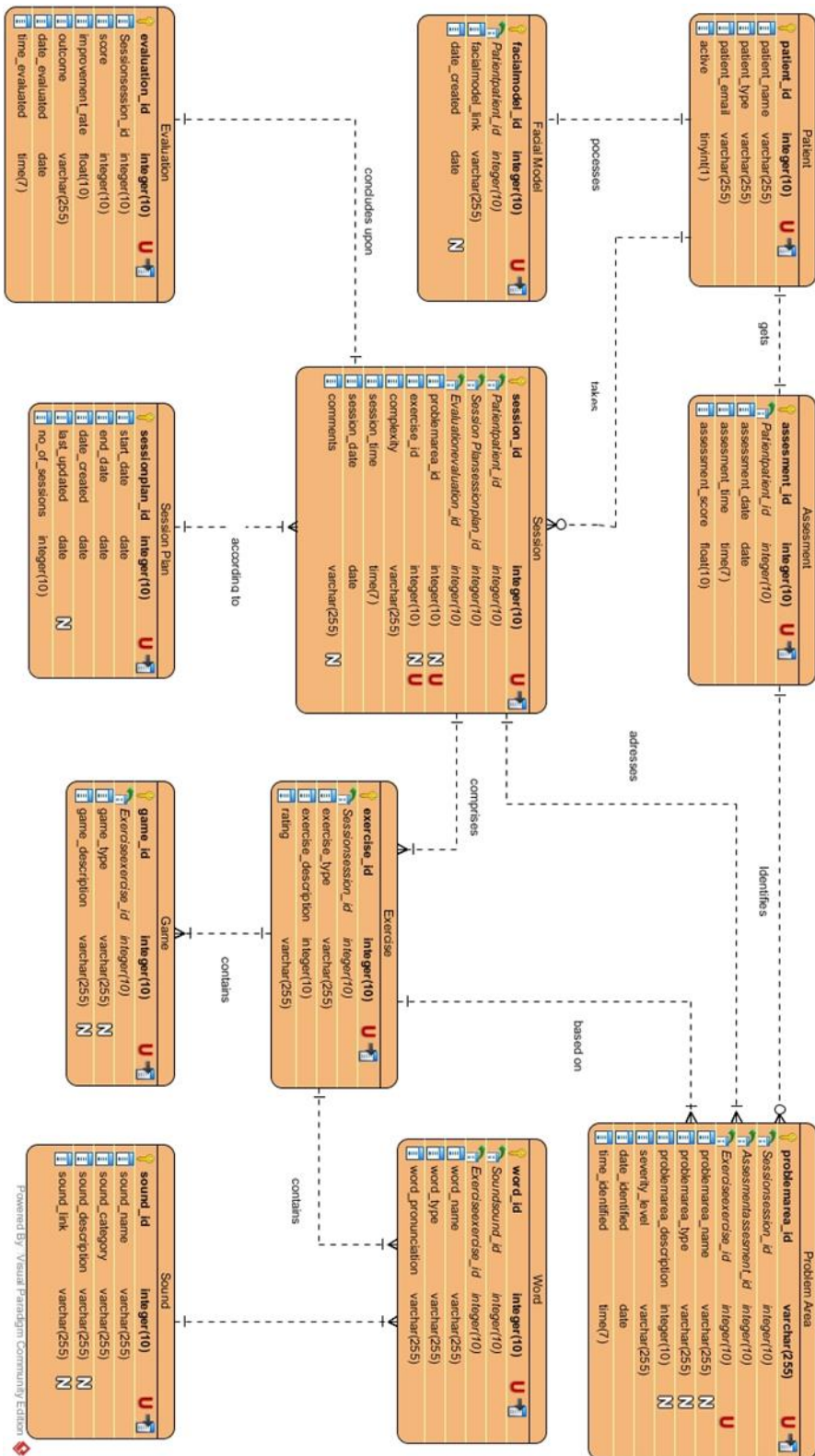


Figure 3.15 Data Model

CHAPTER 4

IMPLEMENTATION

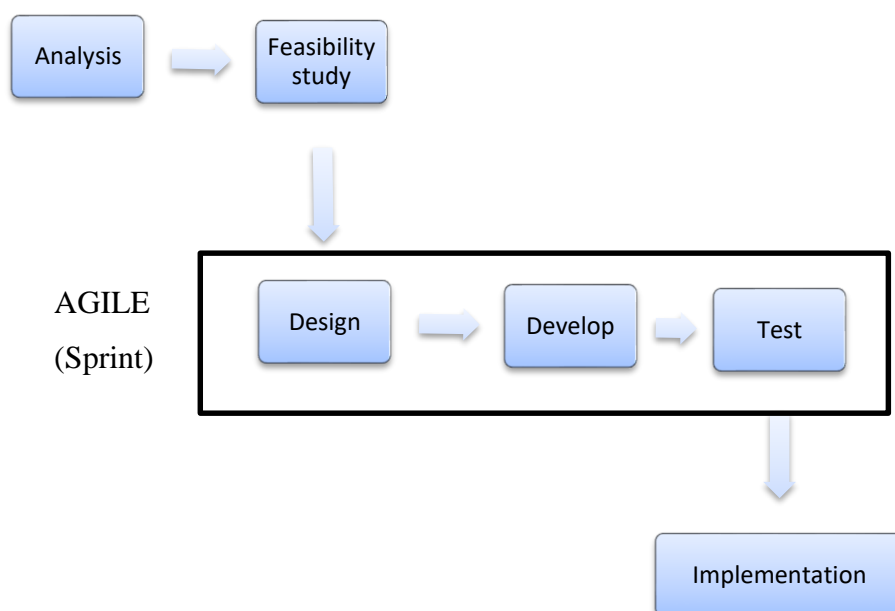
4.1 Overview

MIKE is solely android based application and thus made on android studio and have used APIs mostly provided by Google. The main programming language used in this project is JAVA however XML was used in designing the layouts of application and NoSQL is used for database.

The application was previewed after every build on Samsung galaxy S7 which is a high end smartphone and thus we have not experienced any hardware or software failure of the device as we tested MIKE on it.

4.2 Software Development Methodology

After brainstorming for quite a lot of time, we decided to build MIKE using a hybrid model (Agifall). We used this methodology as we thought gathering all the requirements at once will make the development process faster and will help us in producing the product up to the mark, fulfilling all the basic requirements.



We picked up the waterfall model and implemented agile (sprint methodology) only in design, development and testing phase. If we make a list of the phases, it is as follow:

- 1) Analysis
- 2) Feasibility Study
- 3) Design & Development (Agile)
- 4) Testing (Agile)
- 5) Implementation

4.2.1 Analysis

When the idea clicked into one of team member mind about developing the speech therapist, we were not quite sure about the working. We decided to interview a speech therapist at a nearest school for speech impaired children named Hamza Foundation and asked them about what is the possible solution and what are the requirements to develop a functional speech therapist. The speech therapist suggested that we should only cater one domain of the speech disorder which is articulation disorder and hence articulation therapist should be created.

4.2.2 Feasibility Study

After consulting speech therapist, we moved to find research papers for solution to this problem. We found that people have tried various different ways of implementing the speech therapist. Some papers were helpful in finding the framework according to which articulation therapy works but unfortunately there was no article on developing a speech therapist on mobile platform. At this stage we realized that whatever we are creating is something unique and new for the market of android application. We have also gathered datasets from different organizations including; Mommy Speech Therapy and Home Speech Home. After going through the content available over the internet, it was clear that speech therapist for articulation therapy can be implemented.

4.2.3 Design & Development

Our aim is to provide the speech therapist for articulation therapy of children. Initially, we decided the colour scheme, font style, button style and images to standardize the design of the application. After the basic design concept that we created in Adobe Photoshop CC, we divided the product into activities including; login, assessment, therapy session, progress tracking and game. Each activity is considered to be a sprint and all the tasks in each activity was divided into sprint backlogs. Following the iterative sprint methodology, we designed and developed each component and finally integrated them together.

4.2.4 Testing

As the development process was iterative, the testing was done after the completion of each component. However, we have tested the application to our maximum capacity and have included some of the test cases below. The test cases are present on the next page.

4.2.4.1 Test Case 1 - Login

Title: Login Page – Authenticate Successfully on MIKE

Description: A registered user should be able to successfully login at MIKE.

Precondition: the user must already be registered with an email address and password.

Assumption: Mobile is connected to the internet.

Test Steps:

1. Tap on MIKE icon.
2. After virtual Assistant has finished speaking, say “Login”.
3. Enter Email.
4. Enter password.
5. Click ‘Sign In’

Expected Result: An activity displaying the user’s dashboard should load.

4.2.4.2 Test Case 2 – Virtual Assistant

Title: No Command – Application Does Nothing If user is silent

Description: There should be no action performed if user is not speaking.

Precondition: the user must already be logged in to MIKE.

Assumption: Internet is connected.

Test Steps:

1. Login to Mike
2. Say “Hello Mike”.
3. Virtual Assistant Screen is popped up.
4. Press the button to speak.
5. Say nothing.

Expected Result: Virtual Assistant should not perform any task and encourage user to speak again.

4.2.4.3 Test Case 3- Wrong Word

Title: Wrong Word – To receive 0% confidence score

Description: A user should receive 0% confidence score for a wrong word spoken.

Precondition: the user must already be logged in.

Assumption: Internet is connected.

Test Steps:

1. Log in to mike
2. Open therapy session.
3. Personal Assistant will start speaking.
4. Speech dialogue will open.
5. Speak wrong word.

Expected Result: A confidence score of 0% should be displayed to user.

4.2.4.4 Test Case 4- Different Accent

Title: Different Accent – Successfully detects the word spoken

Description: Virtual assistant should detect the word correctly.

Precondition: the user must already be logged in to MIKE.

Assumption: Device is connected to working internet connection.

Test Steps:

1. Log in to the system.
2. Tap on the therapy session button.
3. Select exercise.
4. Listen to word spoken by virtual assistant.
5. Speak in your local accent.

Expected Result: Virtual Assistant will detect the accurate word and give confidence score according to accuracy.

4.2.4.5 Test Case 5- Face Detection

Title: Face Detection – Authenticate Successfully on MIKE

Description: A registered user should be able to successfully login through facial model.

Precondition: the user must already be registered with an email address and password and facial model.

Assumption: Internet is connected.

Test Steps:

1. Tap on MIKE icon.
2. After virtual Assistant has finished speaking, say “Login”.
3. Select login through Facial Model.
4. Face the camera.
5. Dashboard will pop up.

Expected Result: An activity showing user dashboard should be displayed.

4.2.5 Implementation

The application was created on Android Studio and have been tested on simulators, finally the application “apk” was generated and installed on Samsung Galaxy S7 smartphone. The application installation was successful and the application performed all the desired functions up to the satisfaction of the user.

4.3 Collection of Data Sets:

Though there is not much material available online, we managed to get good amount of vocabulary for our virtual assistant to cure the children for articulation therapy using words for problem area correction.

For the analysis of problem area and child’s assessment, we have followed the words given in a standard chart ^[5] by mommy speech therapy which is used by most of the speech therapists across the globe. For the therapy session we have taken help of dictionary provided by Home Speech Home. The link of the data set for the therapy session is given in references. ^[6]

4.4 Software and Tools Used

- Virtual Paradigm Community Version is used for architecture design.
- Android Studio 3.0.1 for application development.
- Crazy talk studio 8.0 was used to generate the avatar of personal assistant.
- Adobe Photoshop CC for designing the user interface mock-ups.

4.5 APIs Utilized

i. Google Firebase

Google firebase is used to build the backend of MIKE. Firebase authentication, firebase storage and firebase real-time database are used to power several components of MIKE that will be accessed in real time when a Patient is using the application.

ii. Google Speech

As it is the most accurate and support up to 100+ accents of English we are using google speech API to reduce the chances of voice recognition failure.

iii. OpenCV

Our login system is based on facial recognition system and hence we needed a reliable platform. After going through several tests, we finally decided to work with OpenCV as it has provided us with better results and also it is easy to integrate with Android Studio.

iv. MPAndroidChart

As we had to display the user progress in some pictorial format so that user can see a certain trend in his improvement, we have used this API as it helps in displaying graphs easily.

v. CMU PocketSphinx Android

CMU's pocketsphinx library for android has been utilized for hotword detection and continuous speech recognition.

4.6 Hardware Permissions

- i. Mobile Front Camera
- ii. Mobile Microphone
- iii. External Storage
- iv. Mount Unmount files
- v. Internet Access

CHAPTER 5

USER MANUAL

5.1 General Information

MIKE is an android application that provides solutions for the articulation which is a sub domain of speech therapy. It can be downloaded from the Google Play Store.

5.2 Overview

MIKE is a speech therapy platform created to treat people with articulation disorder. It includes a virtual assistant which help patient learn in an interactive way. It is created for android devices and best works with high end mobile phones.

5.3 Organization of the manual

The user manual consist of 5 parts; General Information, System Summary, Getting Started, Using the System and Reporting.

General Information section explains in general terms the system and the purpose for which it is intended.

System Summary section provides a general overview of the system. The summary outlines the uses of the system's hardware and software requirements, system's configuration, user access levels and system's behavior in case of any contingencies.

Getting Started section explains how to get MIKE and install it on the device. The section presents briefly system menu.

Using The System section provides a detailed description of system functions.

Reporting section describes in what way information collected by the application are presented and how to access the information.

5.4 System Summary

System Summary section provides a general overview of the system. The summary outlines the uses of the system's hardware and software requirements, system's configuration, user access levels and system's behavior in case of any contingencies.

5.5 System Configuration

MIKE operates on mobile devices that have android operating system. It can run on any device that has android operating system version 5 or above. Also, MIKE requires a working internet connection to access all the features of application.

5.5.1 User Access level

Only registered users can access the application.

5.5.2 Contingencies

The application will stop working if there is no internet connection. Also, in some mobile phones the glitches can be observed in case of insufficient space available in RAM.

5.6 Getting Started

This section explains how to download and install MIKE. Also, this section displays the main menu.

5.6.1 Installing Application

Go to Google App Store.

Search for MIKE.

Click on Download Button.

The application will download and install itself.

5.6.2 Understanding Main Menu

The picture below shows the main menu. All the possible actions are available for the user to select. All the options are touch enable and user can easily tap on the option he wants to use.

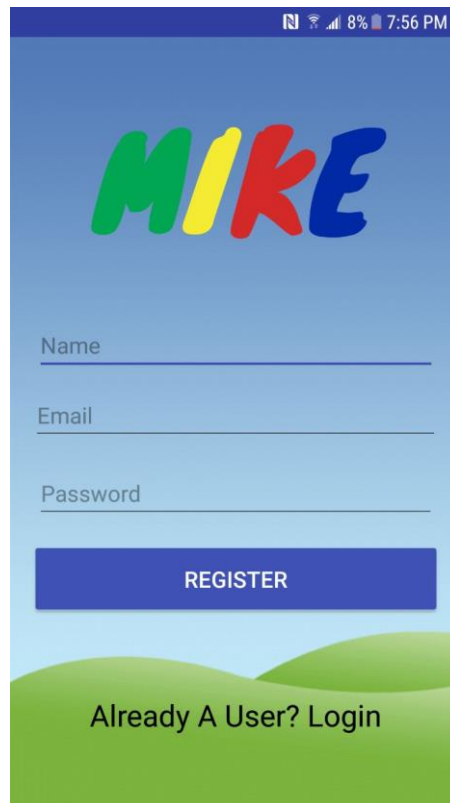


Figure 5.1 Main Menu

5.6.3 Starting Application

To start the application, just tap on the MIKE icon on your mobile application drawer. You can also add the shortcut to main screen.

5.6.4 Registration



The screenshot shows a mobile application registration screen. At the top, the status bar displays signal strength, Wi-Fi, 8% battery, and 7:56 PM. The main header features the 'MIKE' logo in large, colorful letters (M: green, I: yellow, K: red, E: blue). Below the logo are three input fields: 'Name', 'Email', and 'Password', each with a horizontal line for text entry. A prominent blue button with the text 'REGISTER' is centered below the input fields. At the bottom of the screen, the text 'Already A User? Login' is displayed in a smaller font. The background is a light blue gradient with a green hill graphic at the bottom.

Figure 5.2 Registration Screen

On main screen, tap register.

Fill in your username and password.

Tap submit.

5.6.5 Login

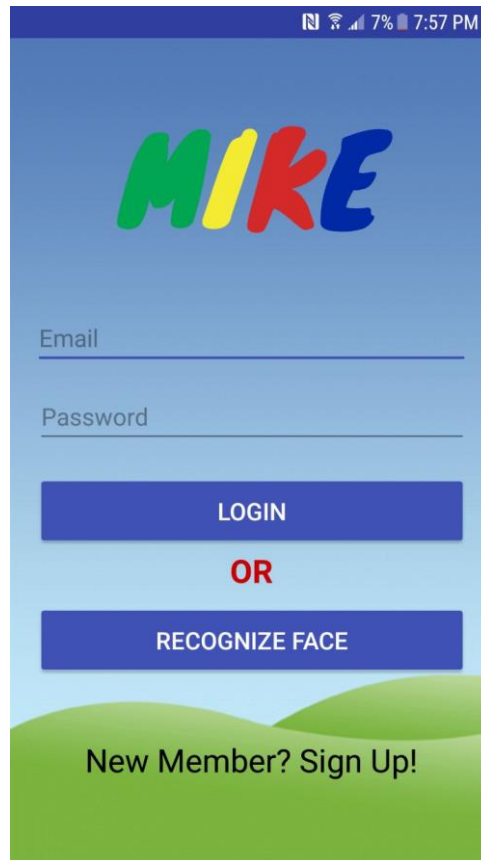


Figure 5.3 Login Screen

On main screen, tap login.

Fill in your username and password.

Tap submit.

Also you can select “recognize face” to login.

5.6.6 Assessment

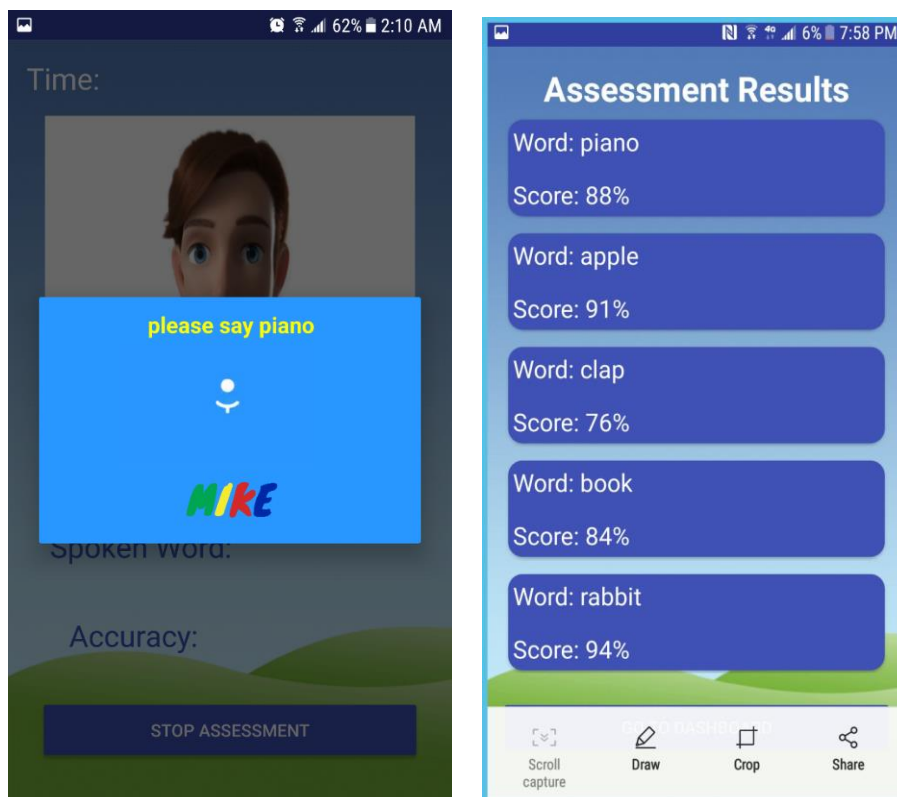


Figure 5.4 Assessment Screen

On main menu, tap assessment.

The assessment screen will pop up and session will start.

Once assessment is finished, assessment result will be displayed.

5.6.7 Therapy Session

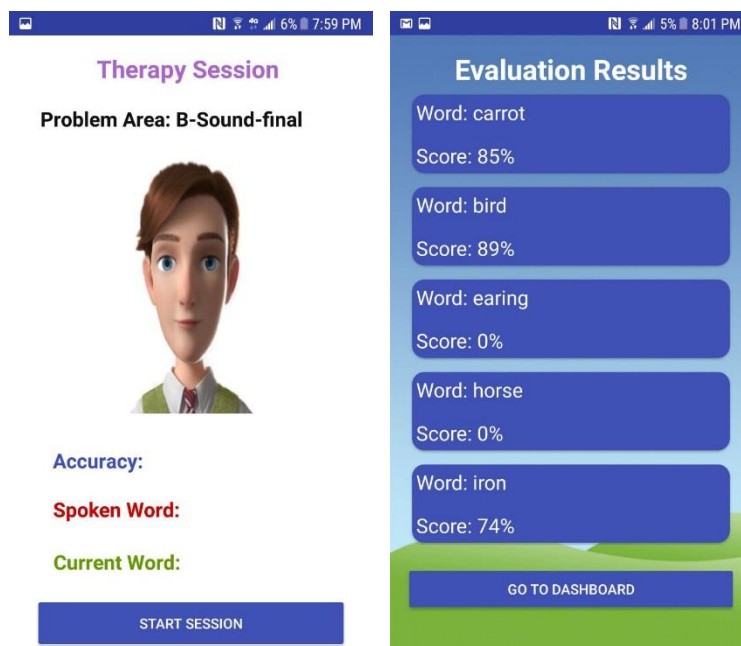


Figure 5.5 Therapy Session Screen

On main menu, tap therapy session.

The session screen will pop up and session will start.

Once the therapy session has concluded, the result is displayed.

5.6.8 Session Plan:

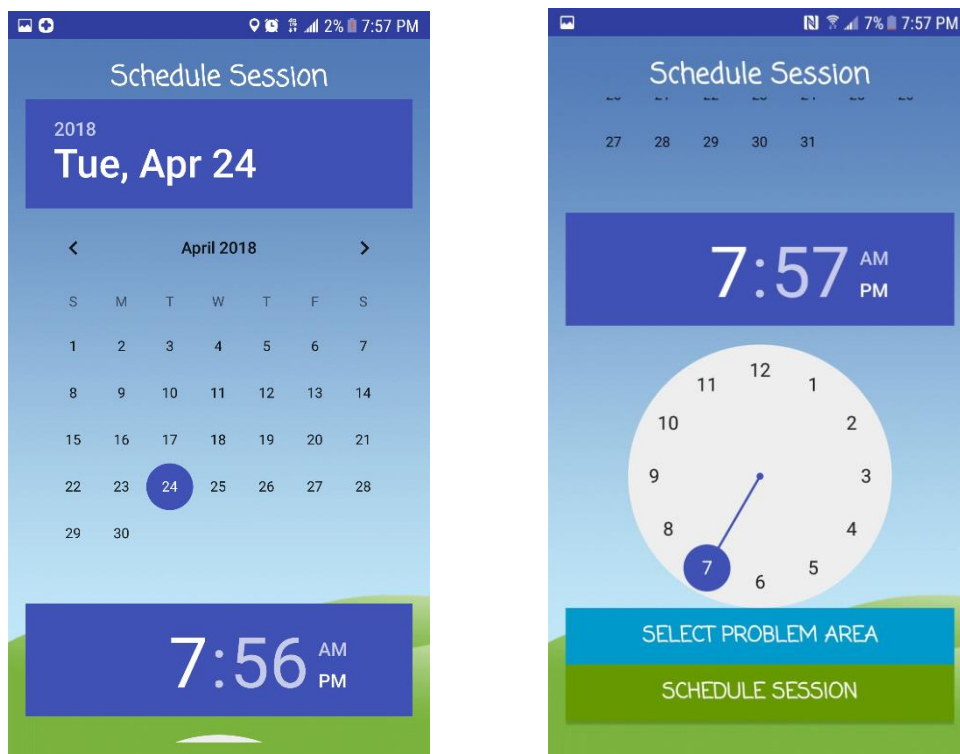


Figure 5.6 Schedule Session Screen

On main menu, tap schedule session.

Select date and time of your choice and tap select problem area.

The new activity will open.

Select problem area for which you want to conduct therapy session.

Tap Schedule Session.

The system will generate notification about session scheduling.

5.6.9 Play Game:

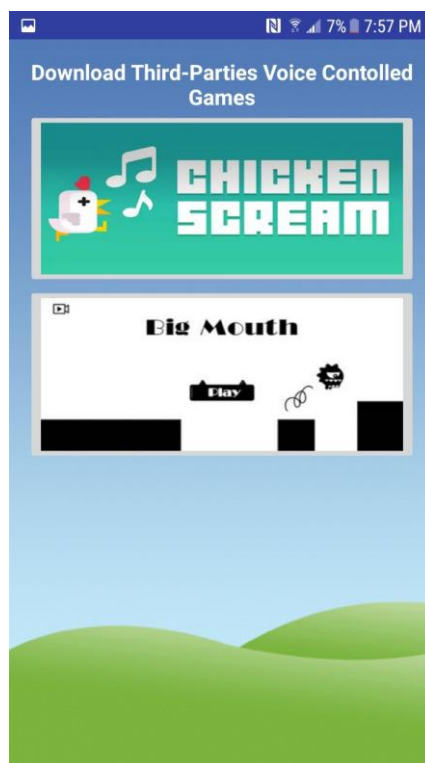


Figure 5.7 Play Games Screen

On main menu, tap play games.

The activity will show third party games available.

Click on the one you want to play.

5.6.10 Track Progress:

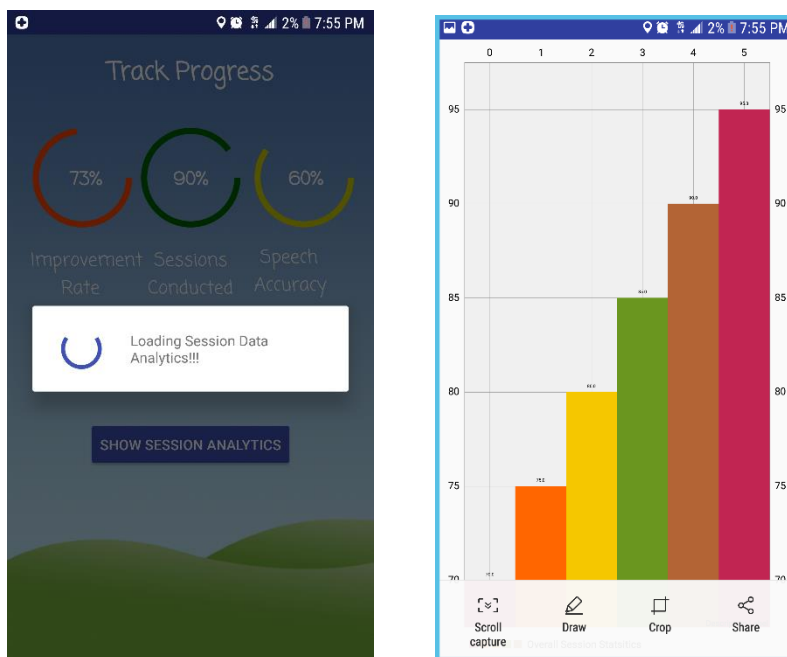


Figure 5.8 Track Progress Screen

On main menu, tap track progress.

The screen will pop up showing overall the statistics.

To see session analytics, press “Show Session analytics”.

A Bar Graph will be displayed showing the statistics of each session.

5.6.11 Closing Application

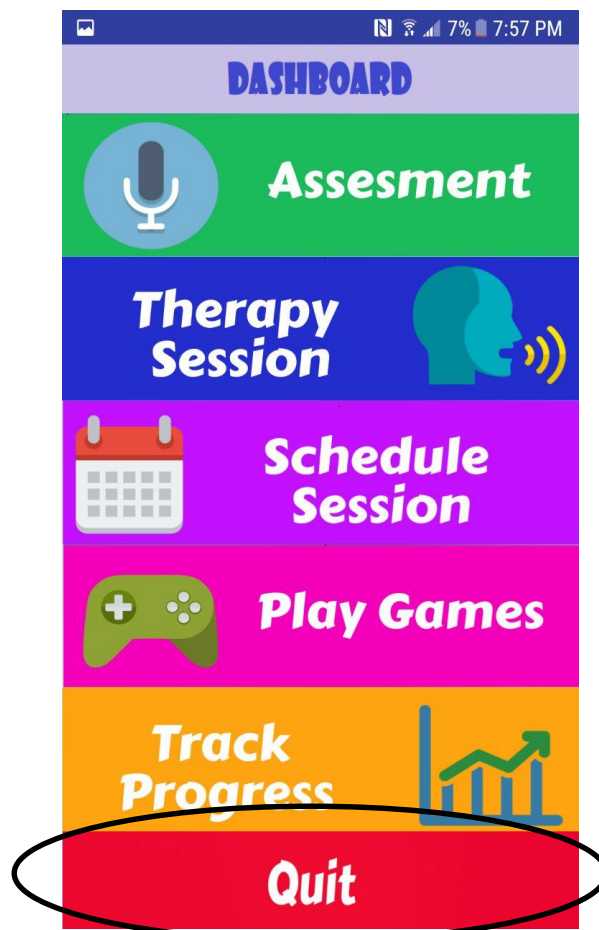


Figure 5.9 Log out Method

To close the application, tap quit button.

The application will close.

5.6.12 Speech Commands for Virtual Assistant

You can invoke the personal assistant by calling “Hello MIKE” in the main menu. After invoking, the virtual assistant will pop up, click on the “Speak to MIKE.” Once it has started listening, you can give any of the following command to give instruction to MIKE:

- i. **Start Assessment:**
This command opens up the assessment activity. If a user has already taken assessment, the command will take you to assessment’s result activity.
- ii. **Start Therapy Session**
This command opens up the therapy session activity, the user can tap on any of the exercise he wants to do in the therapy session and it will start the session.
- iii. **Schedule Session**
This command opens up the session scheduling activity, the user can then select the date and time to schedule a session. An alarm will ring to remind user about the therapy session scheduled.
- iv. **Track Progress**
This command opens up the progress tracking activity. The user can see overall progress and specific session score in the form of bar graph given.
- v. **Play Games**
This command will take you to the main menu where a user can select a game to play.
- vi. **Quit Application**
This command simply helps user to quit the application.

5.7 Reporting

The statistics of the user are saved after every therapy session and are updated on cloud. To view the stats, login and tap track progress to see the average score and determine the improvement. The pie charts are labelled with the percentage improvement and bar graph shows the accuracy percentage of each session.

5.8 Support and Feedback

We have created an email id info@SpeakwithMIKE.org for our customers to contact us in case of any query and also customers can send the feedback on the email given above. It helps us in improving our application. Also, visit our website www.Speakwithmike.org to keep yourself up to date about our latest products.

CHAPTER 6

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

As up till now MIKE is a very basic application for the area of speech therapy and it can be a very effective application for the articulation disorder and children are using it as they find it more entertaining and useful. Also as we have developed an android application which had made it feasible for most of the parents to download for free rather than paying huge amount of fee to speech therapist.

6.2 Recommendations

MIKE can be improved as we move further towards including more data sets and enhance the version to support regular sentences for the therapy.

Also we are looking forward to work with organisations who are dealing with speech disabled children so we can improve the quality of MIKE and also work towards using technology to make this world a better place.

REFERENCES

Electronic Sources from Internet:

- [1] Percentage of Children Ages 3–17 with a Communication or Swallowing Disorder in United States, CDC/NCHS, National Health Interview Survey, 2012.
- [2] Speech Language Therapy In Pakistan. Dawn Newspaper Online Scribe Publishing Platform. August 22, 2010. Contribution By College Of Speech, Language And Hearing Science, Ziaudin University, Karachi.

Research Journals Consulted:

- [3] Arshad, Hena & Khan, Muhammad & Sikander, Madiha & Ghyas, Rabia & Ain, Qurrat Ul & Shabbir, Maryam. (2013). Patterns and Risk Factors Associated with Speech Sounds and Language
- [4] Timothy Bunnell, H., (2000). STAR: Articulation Training for Young Children. *In Sixth International Conference on Spoken Language Processing*. Beijing, China, October 16-20, 2000. USA: University of Delaware, USA. 1.

Data Sets:

- [5] <http://mommyspeechtherapy.com/?p=1991>
- [6] <http://www.home-speech-home.com/speech-therapy-word-lists.html>

APPENDICES

APPENDIX A: Glossary

- **MIKE:** MIKE (Mini Interactive Kids Elocution) is an interactive speech therapy platform on top of a virtual personal assistant enhanced with artificial intelligence to treat speech disorders and language impairment in children. It refers to the intended product / system wherever mentioned.
- **Patient:** The person having speech problems or language impairment who is intended to use “MIKE”. It is used interchangeably with user.
- **System:** It refers to the end product “MIKE- Your Personal Speech Therapist” and used interchangeably with “MIKE” wherever mentioned.
- **Virtual Assistant:** An interactive feature of MIKE that understands natural language commands and executes them to launch various features and complete tasks whenever asked by the Patient.
- **Therapy Session:** Treatment of Patient’s speech problems through various exercises, during the selected time slot.
- **Assessment:** The process of assessing and evaluating the Patient’s speech for identification of problem areas.
- **Score:** The similarity between the sound of spoken phonemes/words and the actual sound stored in datasets calculated after comparison.
- **API:** API (Application Program Interface) is prebuilt set of tools used in producing a software.
- **Cloud Storage:** It refers to the storage type that is not physically present in one’s machine however is given access using internet.