



**COMSATS University Islamabad (CUI)**

## **Learning Quran**

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***Bachelor of Science in Software Engineering (2017-2021)***

**The candidate confirms that the work submitted is their own and appropriate credit has been given where reference has been made to the work of others.**



**COMSATS University Islamabad (CUI)**

## **Learning Quran**

**A project presented to  
COMSATS University Islamabad**

**In partial fulfillment  
of the requirement for the degree of**

***Bachelor of Science in Software Engineering (2017-2021)***

**By**

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# CERTIFICATE OF APPROVAL

It is to certify that the final year project of BS (CS) “Project title” was developed by **Wajeeh ul Hassan (CIIT/FA17-BSE-143)** , **M.Awais Gondal (CIIT/FA17-BSE-152)** and **M.Hamza Butt(CIIT/FA17-BSE-153)** under the supervision of “Dr. Inayat ur Rehman” and co supervisor “Dr. Saif ur Rehman” and that in their opinion; it is fully adequate, in scope and quality for the degree of Bachelors of Science in Computer Sciences.

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**Supervisor**

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**Co-Supervisor**

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**External Examiner**

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**Head of Department**  
**(Department of Computer Science)**

# Executive Summary

Nowadays, learning Quran has become difficult for children especially for those who lived in far places where there is no facility of a proper teacher (Qari) who can teach them properly. It also has become difficult due to the increase in crime rate which we hear on news. So, most of the people are afraid to send their children to any unknown person for learning Quran. Also those people who live in foreign countries where there are limited number of mosques, it is difficult for their children to learn and study Quran.

To prevent all these problems from “Learning Quran” is developed. It is an application based on android and IOS which just require a smart phone and an internet connection. People can easily read and learn Quran through this application. The mistakes of the user are also identified in this system.

**Learning Quran** is an application in which the user will learn and after learning the user will then read the words the system will evaluate his/her accuracy. By using the microphone of the smartphone of the user to take his/her voice as an input and then after applying the evaluation methodology the results will be shown to the user.

The voice of the user is sent to the server and there machine learning techniques are applied on it.

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# Acknowledgement

All praise is to Almighty Allah who bestowed upon us a minute portion of His boundless knowledge by virtue of which we were able to accomplish this challenging task.

We are greatly indebted to our project supervisor “Dr. Inayat ur Rehman” and our Co-Supervisor “Dr. Saif ur Rehman”. Without their personal supervision, advice and valuable guidance, completion of this project would have been doubtful. We are deeply indebted to them for their encouragement and continual help during this work.

And we are also thankful to our parents and family who have been a constant source of encouragement for us and brought us the values of honesty & hard work.

Student Name1

Student Name2

Student Name3

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# Abbreviations




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# 1 Introduction

Nowadays, learning Quran has become difficult for children especially for those who lived in far places where there is no facility of a proper teacher (Qari) who can teach them properly. It also has become difficult due to the increase in crime rate which we hear on news. So, most of the people are afraid to send their children to any unknown person for learning Quran. Also, those people who live in foreign countries where there are limited number of mosques, it is difficult for their children to learn and study Quran. We are designing a platform that will overcome all these problems in no time

## 1.1 Brief Overview

The application a user and a Qari sign-up. If you are a Qari and wants to add your audios so, that the users can learn from that you need to sign-up as a Qari. To learn and evaluate your skills you need to sign-up as a user. When the user sign-in he/she can either see the namaz timings, qibla direction, his/her progress, or can go to the learning phase. Here all the chapters of the noorani qaida are included the user has to start studying them from chapter 1 and so on. A user cannot study chapter 2 without studying the chapter 1. Similarly, inside a particular chapter user have to study the words in the order. After completing the learning phase user can go into the evaluation phase. Here the user will recite the words and the audio goes to the machine learning model and the model then gives the result back.

Following are the tools used.

Tools And Technologies	Tools	Version	Rationale
	Anaconda	2020.02	For machine learning/NLP libraries
	Spyder Python IDE	3.3.4	IDE
	Google Firebase	10.1.0.6	Storage
	MS Word	2015	Documentation
	MS Power Point	2015	Presentation
		2.0.5	Mockups Creation
	Android Studio	4.0	IDE for creating Android-based applications
	XCode	11.6	IDE for creating

			iOS-based applications
	<b>Technology</b>	<b>Version</b>	<b>Rationale</b>
	Python 3.4 Programming Language	6.0	Programming language
	Natural Language Toolkit (NLTK)	2013	Library/API
	Java	7.8.1	Programming Language
	Swift		Programming Language

## 1.2 Relevance to Course Modules

Learning Quran is a mobile based application that supports the android and IOS environment. It is using java language in android app which we have learned in Programming fundamentals. Also, the whole app is based on OOP (object-oriented programming). We are using AI for evaluation which we have learned in our Artificial Intelligence course. The test cases which are included in this diagram are from the course Software Testing. Gant charts, are based on Software Project Management.

## 1.3 Project Background

A mobile based application which has been built on the problems that all the people do not have the facility of a proper teacher through which they can learn the Quran properly. So, by using this application they need not to go anywhere and can easily learn the Quran just by sitting at their home. The app will also provide the Islamic calendar, Qibla direction and Namaz timings to the user.

The development of this application is done using android studio, Xcode, Google firebase and Natural Language Toolkit.

## 1.4 Literature Review

Application Name	Weakness	Proposed Project Solution
<ul style="list-style-type: none"> <li>Islam 360 [1]</li> </ul>	<ul style="list-style-type: none"> <li>This application does not have any evaluation process to identify if the user is reciting correctly or not.</li> </ul>	<ul style="list-style-type: none"> <li>In the proposed application, this problem is solved by making an evaluation process which will notify the user about their mistakes of whether they are reciting word or character correctly.</li> </ul>

<ul style="list-style-type: none"> <li>• Hafss [2]</li> </ul>	<ul style="list-style-type: none"> <li>• This application is only available on desktop.</li> </ul>	<ul style="list-style-type: none"> <li>• The proposed project will be developed for android and iOS user so that most of people can have access to it.</li> </ul>
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## 1.5 Analysis from Literature Review

### 1.5.1 Islam 30

This application does not have any evaluation process to identify if the user is reciting correctly or not. In the proposed application, this problem is solved by making an evaluation process which will notify the user about their mistakes of whether they are reciting word or character correctly.

### 1.5.2 Hafss

This application is only available on desktop. The proposed project will be developed for android and iOS user so that most of people can have access to it.

## 1.6 Methodology and Software Lifecycle for this Project

For the development of this application, the **OOP** (Object-Oriented methodology) will be used. The reason for using object-oriented methodology is that, with this approach it is easy to maintain and develop the system by dividing the work into classes, where each class is assigned a specific task.

### 1.6.1 Rationale behind the Selected Methodology

Object-Oriented Programming (OOP) helps to separate the program into smaller problems that you then can solve, one object at a time. Also, troubleshooting becomes easier using this methodology.

Incremental Software model decomposes the required product into several components depending upon functionality, each of which is designed and built separately.

## 2 Problem Definition

### 2.1 Problem Statement

In today's modern world of technology, people find very little to no time to teach and learn the Tajweed and talafuz of the Holy Quran or to go to a tutor who can teach them and guide them to the right way of reciting the Quran. Besides, the people who can get some time for the tutor, the tutor take some money for teaching them. There are some people in the world who does not even have the approach to the tutor such as the people living in non-Muslim countries. This application will help these people and solve all these problems of time, cost, place, and availability of the tutor. To the best of our knowledge, there is no smartphone application that can evaluate the recitation of user and notifies them about their mistakes. For example, there are some applications that teach users how to learn the Quranic rules, but there is no application that can perform the process of evaluation, which is able to notify the user whether he/she has committed mistakes or not. After the implementation of this project, techniques of NLP and machine learning such as pattern recognition will be learned.

### 2.2 Deliverables and Development Requirements

Learning Quran is developed to give people the facility of learning Quran just by sitting at their home without the need of a physical tutor. And along with the learning, people can also evaluate their learning skills and can see their results.

Following are the deliverables of Learning Quran.

- Scope Document
- Software Requirement Specification (SRS)
- Software Design Specification (SDS)
- Trained AI model
- Mobile App (IOS + Android)

### 2.3 Current System

**Table 3: Related System Analysis with Targeted Project Solution**

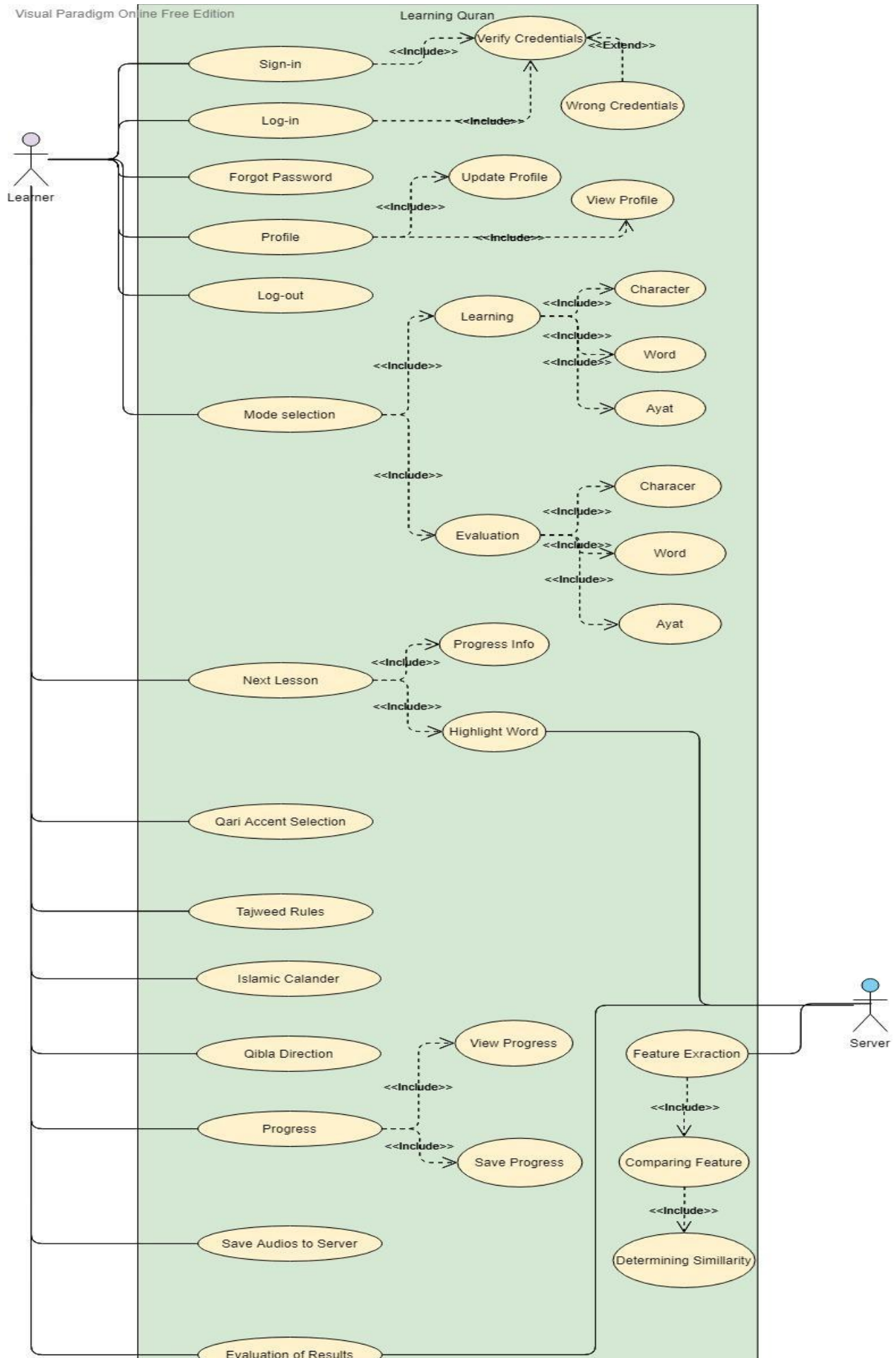
Application Name	Weakness	Proposed Project Solution
<ul style="list-style-type: none"><li>● Islam 360 [1]</li></ul>	<ul style="list-style-type: none"><li>● This application does not have any evaluation process to identify if the</li></ul>	<ul style="list-style-type: none"><li>● In the proposed application, this problem is solved by making an evaluation process which</li></ul>

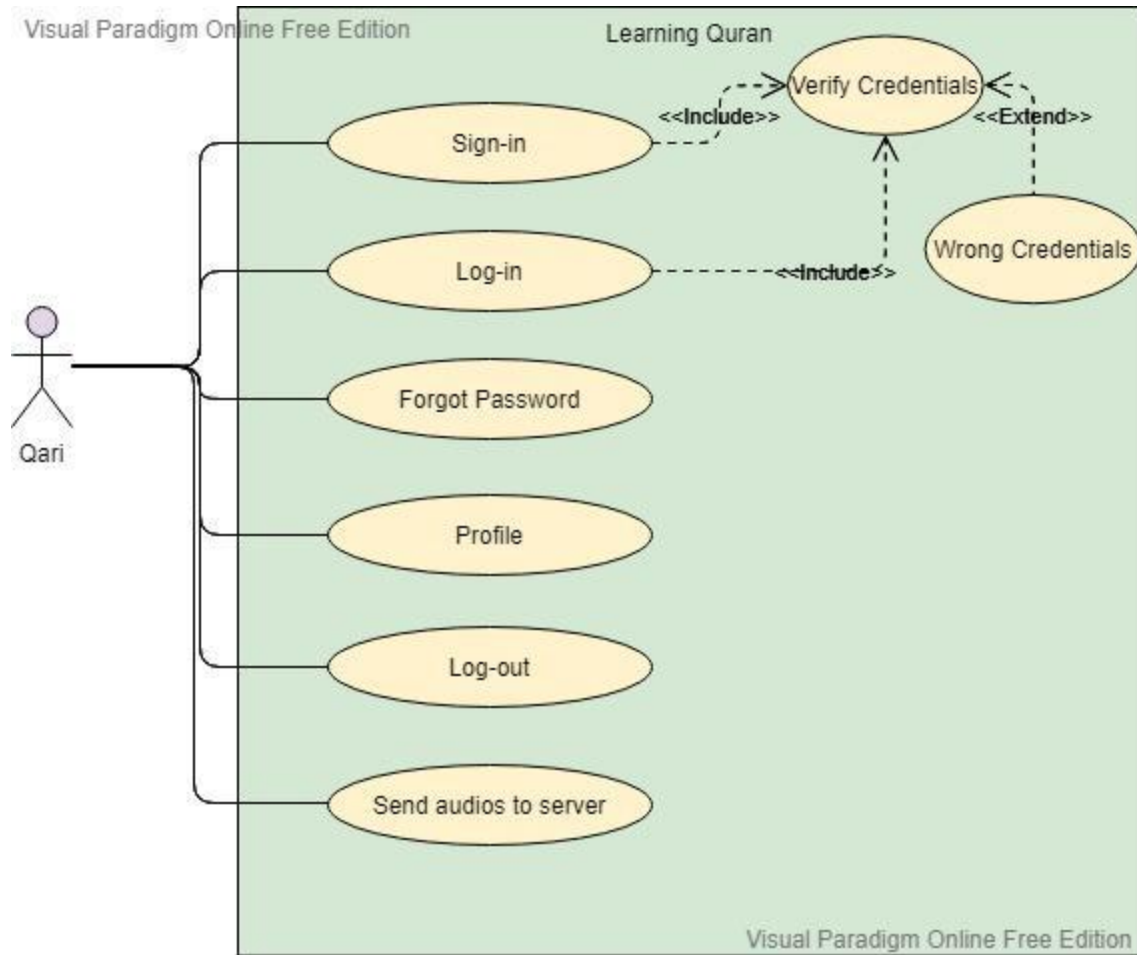
	user is reciting correctly or not.	will notify the user about their mistakes of whether they are reciting word or character correctly.
<ul style="list-style-type: none"> <li>• Hafss [2]</li> </ul>	<ul style="list-style-type: none"> <li>• This application is only available on desktop.</li> </ul>	<ul style="list-style-type: none"> <li>• The proposed project will be developed for android and iOS user so that most of people can have access to it.</li> </ul>

### 3 Requirement Analysis

#### 3.1 Use Cases Diagram(s)







### 3.2 Detailed Use Case

Following are the use cases of the software.

<b>Use Case ID:</b>	UC-1
<b>Use Case Name:</b>	User Sign Up
<b>Actors:</b>	Primary actor: User
<b>Description:</b>	The user will create their profile by providing their password, name and e-mail
<b>Trigger:</b>	This use case is triggered when the account of the user doesn't exist. So, the user will click on the sign-up button.
<b>Preconditions:</b>	PRE <sub>1</sub> : The user shouldn't already have an account through this email.

<b>Postconditions:</b>	POST <sub>1</sub> : The new account will be created, and the user will be automatically logged into the system.
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user clicks on the sign-up button.</li> <li>2. The user enters name, email, password and confirm password details.</li> <li>3. The user clicks on “sign up” button.</li> <li>4. The application will check if credentials are valid and a new account is created.</li> <li>5. The user will be logged in.</li> </ol>
<b>Alternative Flows:</b>	<ol style="list-style-type: none"> <li>1. A pop-up message will be displayed by the system if the provided email is not in the correct format.</li> <li>2. If the passwords fields do not match with each other, a pop-up message will be displayed by the system.</li> <li>3. If there exist an account against the provided email then a pop-up message will display that the account already exist.</li> </ol>
<b>Exceptions:</b>	If the user cancels the “Sign up” process, it is taken back to “Log in” screen.
<b>Business Rules</b>	N/A
<b>Assumptions:</b>	N/A

<b>Use Case ID:</b>	UC-2
<b>Use Case Name:</b>	Qari Sign Up
<b>Actors:</b>	Primary actor: Qari
<b>Description:</b>	The Qari will create their profile by providing their password, name and e-mail
<b>Trigger:</b>	This use case is triggered when the account of the qari doesn’t exist. So, the qari will click on the sign-up button.
<b>Preconditions:</b>	PRE <sub>1</sub> : The qari shouldn’t already have an account through this email.
<b>Postconditions:</b>	POST <sub>1</sub> : The new account will be created, and the qari will be automatically logged into the system.

<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. Qari clicks on the sign-up button.</li> <li>2. Qari enters name, email, password and confirm password details.</li> <li>3. Qari clicks on “sign up” button.</li> <li>4. application will check if credentials are valid and a new account is created.</li> <li>5. Qari will be logged in.</li> </ol>
<b>Alternative Flows:</b>	<ol style="list-style-type: none"> <li>1. A pop-up message will be displayed by the system if the provided email is not in the correct format.</li> <li>2. If the passwords fields do not match with each other, a pop-up message will be displayed by the system.</li> <li>3. If there exist an account against the provided email then a pop-up message will display that the account already exist.</li> </ol>
<b>Exceptions:</b>	If qari cancels the “Sign up” process, it is taken back to “Log in” screen.
<b>Business Rules</b>	N/A
<b>Assumptions:</b>	N/A

Table 3.2

<b>Use Case ID:</b>	UC-3
<b>Use Case Name:</b>	User Log In
<b>Actors:</b>	Primary actor: User
<b>Description:</b>	The user enters the logging details after opening the application.
<b>Trigger:</b>	The user clicks on “Log in” button after providing his/her credentials.
<b>Preconditions:</b>	PRE-1: The user should have registered an account. PRE-2: The user provides correct credentials.
<b>Postconditions:</b>	POST-1: user logs in successfully and taken to home screen of the app.

<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user enters correct email and password.</li> <li>2. The user clicks on log in button.</li> <li>3. The user is taken into the home screen of application after successful log in.</li> </ol>
<b>Alternative Flows:</b>	<ol style="list-style-type: none"> <li>1. If there is no email in the database, the system will inform the user that you have not registered an account with this email.</li> <li>2. If the email is correct and the password is incorrect, the system will inform that the password is incorrect.</li> </ol>
<b>Exceptions:</b>	<ol style="list-style-type: none"> <li>1. The user enters email in a wrong format, a warning is shown.</li> <li>2. The user enters wrong password, pop up message is shown.</li> </ol>
<b>Business Rules</b>	N/A
<b>Assumptions:</b>	N/A

**Table 3.2**

<b>Use Case ID:</b>	UC-4
<b>Use Case Name:</b>	Qari Log In
<b>Actors:</b>	Primary actor: Qari
<b>Description:</b>	Qari enters the logging details after opening the application.
<b>Trigger:</b>	Qari clicks on “Log in” button after providing his/her credentials.
<b>Preconditions:</b>	PRE-1: Qari should have registered an account. PRE-2: Qari provides correct credentials.
<b>Postconditions:</b>	POST-1: Qari logs in successfully and taken to home screen of the app.
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>4. Qari enters correct email and password.</li> <li>5. Qari clicks on log in button.</li> <li>6. Qari is taken into the home screen of application after successful log in.</li> </ol>

<b>Alternative Flows:</b>	3. If there is no email in the database, the system will inform the qari that you have not registered an account with this email. 4. If the email is correct and the password is incorrect, the system will inform that the password is incorrect.
<b>Exceptions:</b>	3. Qari enters email in a wrong format, a warning is shown. 4. Qari enters wrong password, pop up message is shown.
<b>Business Rules</b>	N/A
<b>Assumptions:</b>	N/A

**Table 3.3**

<b>Use Case ID:</b>	UC-5
<b>Use Case Name:</b>	Verify Credentials
<b>Actors:</b>	Primary actor: User
<b>Description:</b>	The email and password entered by the user is verified that whether they entered the correct credentials or not.
<b>Trigger:</b>	When the user clicks on the “Log-in” button the password of the user is checked from the password available in the database.
<b>Preconditions:</b>	PRE-1: The email field shouldn’t be empty. PRE-2: The email should be written in correct format. PRE-3: The password field shouldn't not empty.
<b>Postconditions:</b>	POST-1: On successful verification of the credentials the user will be logged-in to his/her account.

<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user enters email and password.</li> <li>2. The user clicks on “Log in” button.</li> <li>3. The credentials are verified.</li> </ol>
	<ol style="list-style-type: none"> <li>4. On successful verification, the learner is logged into his account.</li> </ol>
<b>Alternative Flows:</b>	<ol style="list-style-type: none"> <li>1. If the user enters wrong credentials then a dialog box will inform the learner that the credentials entered by them are wrong.</li> </ol>
<b>Exceptions:</b>	<ol style="list-style-type: none"> <li>1. The user enters email in wrong format, a warning is shown.</li> <li>2. The user enters wrong password, it shows pop up that says wrong password entered.</li> </ol>
<b>Business Rules</b>	N/A
<b>Assumptions:</b>	N/A

<b>Use Case ID:</b>	UC-6
<b>Use Case Name:</b>	Verify Credentials
<b>Actors:</b>	Primary actor: Qari
<b>Description:</b>	The email and password entered by the qari is verified that whether they entered the correct credentials or not.
<b>Trigger:</b>	When the qari clicks on the “Log-in” button the password of the qari is checked from the password available in the database.
<b>Preconditions:</b>	PRE-1: The email field shouldn’t be empty. PRE-2: The email should be written in correct format. PRE-3: The password field shouldn't not empty.
<b>Postconditions:</b>	POST-1: On successful verification of the credentials the qari will be logged-in to his/her account.
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>4. Qari enters email and password.</li> <li>5. Qari clicks on “Log in” button.</li> <li>6. Qari credentials are verified.</li> </ol>
	<ol style="list-style-type: none"> <li>4. On successful verification, Qari is logged into his account.</li> </ol>
<b>Alternative Flows:</b>	<ol style="list-style-type: none"> <li>1. Qari enters wrong credentials then a dialog box will inform the qari that the credentials entered by them are wrong.</li> </ol>

<b>Exceptions:</b>	3. Qari enters email in wrong format, a warning is shown. 4. Qari enters wrong password, it shows pop up that says wrong password entered.
<b>Business Rules</b>	N/A
<b>Assumptions:</b>	N/A

**Table 3.4**

<b>Use Case ID:</b>	UC-7
<b>Use Case Name:</b>	Warning pop-up on wrong credentials
<b>Actors:</b>	Primary actor: Learner
<b>Description:</b>	If the learner enters wrong email or password, a warning pop-up will be shown to the learner when he tries to Log in.
<b>Trigger:</b>	Learner enters wrong email or password and clicks on log-in button.
<b>Preconditions:</b>	PRE-1: Either email or password or both should be entered incorrectly. PRE-2: Learner clicks on Log in button.
<b>Postconditions:</b>	POST-1: The learner remains on same screen and not allowed to “Log-in”.
<b>Normal Flow:</b>	1. The learner enters wrong email or password. 2. The learner clicks on “Log-in” button. 3. Warning is displayed on the screen to let user know that wrong credentials have been entered.
<b>Alternative Flows:</b>	N/A.
<b>Exceptions:</b>	1. Warning is not shown if credentials are entered correctly.
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	N/A.

<b>Use Case ID:</b>	UC-8
<b>Use Case Name:</b>	Warning pop-up on wrong credentials



<b>Actors:</b>	Primary actor: Qari
<b>Description:</b>	If the Qari enters wrong email or password, a warning pop-up will be shown to the Qari when he tries to Log in.
<b>Trigger:</b>	Qari enters wrong email or password and clicks on log-in button.
<b>Preconditions:</b>	PRE-1: Either email or password or both should be entered incorrectly. PRE-2: Qari clicks on Log in button.
<b>Postconditions:</b>	POST-1: Qari remains on same screen and not allowed to “Log-in”.
<b>Normal Flow:</b>	4. Qari enters wrong email or password. 5. Qari clicks on “Log-in” button. 6. Warning is displayed on the screen to let user know that wrong credentials have been entered.
<b>Alternative Flows:</b>	N/A.
<b>Exceptions:</b>	1. Warning is not shown if credentials are entered correctly.
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	N/A.

**Table 3.5**

<b>Use Case ID:</b>	UC-9
<b>Use Case Name:</b>	Forgot Password
<b>Actors:</b>	Primary actor: User
<b>Description:</b>	If the user forgets the password, he/she can recover the password associated to their account using this option.
<b>Trigger:</b>	User clicks on “forget password” option to recover the password.
<b>Preconditions:</b>	1. Email should register previously.
<b>Postconditions:</b>	1. User is taken to “Log in” screen where he/she can log in using new password.

<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user clicks on forget password option.</li> <li>2. Email is sent to learner with a code.</li> <li>3. The user enters the code.</li> <li>4. The user enters new password.</li> <li>5. The password is changed successfully.</li> </ol>
<b>Alternative Flows:</b>	<ol style="list-style-type: none"> <li>1. If the user enters the wrong email a pop-up will display that there is no account associated with this email</li> <li>2. If the user enters a code which is different than the secret code sent through email than he/she will get a warning pop-up showing that the code entered is incorrect.</li> </ol>
<b>Exceptions:</b>	<ol style="list-style-type: none"> <li>1. If the user enters wrong email, he/she will not get code.</li> <li>2. On wrong code entry, the learner is not allowed to change password.</li> </ol>
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	N/A.

<b>Use Case ID:</b>	UC-10
<b>Use Case Name:</b>	Forgot Password
<b>Actors:</b>	Primary actor: Qari
<b>Description:</b>	If Qari forgets the password, he/she can recover the password associated to their account using this option.
<b>Trigger:</b>	Qari clicks on “forget password” option to recover the password.
<b>Preconditions:</b>	N/A.
<b>Postconditions:</b>	1. Qari is taken to “Log in” screen where he/she can log in using new password.
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>6. Qari clicks on forget password option.</li> <li>7. Email is sent to learner with a code.</li> <li>8. Qari enters the code.</li> <li>9. Qari enters new password.</li> <li>10. The password is changed successfully.</li> </ol>

<b>Alternative Flows:</b>	<ol style="list-style-type: none"> <li>1. If the user enters the wrong email a pop-up will display that there is no account associated with this email</li> <li>2. If the user enters a code which is different than the secret code sent through email than he/she will get a warning pop-up showing that the code entered is incorrect.</li> </ol>
<b>Exceptions:</b>	<ol style="list-style-type: none"> <li>3. If qari enters wrong email, he/she will not get code.</li> <li>4. On wrong code entry, the learner is not allowed to change password.</li> </ol>
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	N/A.

**Table 3.6**

<b>Use Case ID:</b>	UC-11
<b>Use Case Name:</b>	View Profile Statistics
<b>Actors:</b>	Primary actor: User
<b>Description:</b>	The user can check the overall progress of his/her skills by seeing their profile stats.
<b>Trigger:</b>	The user clicks on the tab of “profile” through menu to open the profile statistics.
<b>Preconditions:</b>	PRE-1: The user should have a profile. PRE-2: The user is logged in their profile.
<b>Postconditions:</b>	POST-1: All the stats of learner are displayed.
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user is logged in.</li> <li>2. The user clicks on menu bar.</li> <li>3. The user scrolls down to profile tab.</li> <li>4. The user clicks on profile tab and all the stats of user are displayed.</li> </ol>
<b>Alternative Flows:</b>	N/A.
<b>Exceptions:</b>	<b>1. If the user is not signed in he/she can access his/her profile stats.</b>
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	N/A.

<b>Use Case ID:</b>	UC-12
<b>Use Case Name:</b>	View Profile Statistics
<b>Actors:</b>	Primary actor: Qari
<b>Description:</b>	Qari can check the overall progress of his/her skills by seeing their profile stats.
<b>Trigger:</b>	Qari clicks on the tab of “profile” through menu to open the profile statistics.
<b>Preconditions:</b>	PRE-1: Qari should have a profile. PRE-2: Qari is logged in their profile.
<b>Postconditions:</b>	POST-1: All the stats of Qari are displayed.
<b>Normal Flow:</b>	5. Qari is logged in. 6. Qari clicks on menu bar. 7. Qari scrolls down to profile tab. 8. Qari clicks on profile tab and all the stats of user are displayed.
<b>Alternative Flows:</b>	N/A.
<b>Exceptions:</b>	1. If the qari is not signed in he/she can access his/her profile stats.
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	N/A.

Table 3.7

<b>Use Case ID:</b>	UC-13
<b>Use Case Name:</b>	Log Out
<b>Actors:</b>	Primary actor: user
<b>Description:</b>	To log out of the profile, the user will need to use this option.
<b>Trigger:</b>	The user clicks on menu, scrolls down and clicks on “Log out” tab/option.
<b>Preconditions:</b>	PRE-1: user needs to be “signed in” to log out.
<b>Postconditions:</b>	POST-1: User is taken to Log in screen where the can Log in again or create a new profile using sign up option.

<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. User is logged in.</li> <li>2. User clicks on menu bar.</li> <li>3. User scrolls down the menu.</li> <li>4. user clicks on “Log out” option.</li> <li>5. The user is successfully logged out and taken to Log in screen.</li> </ol>
<b>Alternative Flows:</b>	N/A.
<b>Exceptions:</b>	N/A.
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	1. The learner is already logged in.

<b>Use Case ID:</b>	UC-14
<b>Use Case Name:</b>	Log Out
<b>Actors:</b>	Primary actor: Qari
<b>Description:</b>	To log out of the profile, the user will need to use this option.
<b>Trigger:</b>	The user clicks on menu, scrolls down and clicks on “Log out” tab/option.
<b>Preconditions:</b>	PRE-1: user needs to be “signed in” to log out.
<b>Postconditions:</b>	POST-1: User is taken to Log in screen where the can Log in again or create a new profile using sign up option.
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. User is logged in.</li> <li>2. User clicks on menu bar.</li> <li>3. User scrolls down the menu.</li> <li>4. user clicks on “Log out” option.</li> <li>5. The user is successfully logged out and taken to Log in screen.</li> </ol>
<b>Alternative Flows:</b>	N/A.
<b>Exceptions:</b>	N/A.
<b>Business Rules</b>	

	N/A.
<b>Assumptions:</b>	1. The Qari is already logged in.

<b>Use Case ID:</b>	UC-15
<b>Use Case Name:</b>	Mode Selection
<b>Actors:</b>	Primary actor: User
<b>Description:</b>	The learner has fundamentally two choices regarding the selection of modes in the proposed application. The learner can select two modes available namely: (i) Learning, and (ii) Evaluation.

<b>Trigger:</b>	The learner clicks on either of the two buttons available depending on their choice of mode.
<b>Preconditions:</b>	PRE-1: The learner needs to log in.
<b>Postconditions:</b>	POST-1: The learner has selected the mode successfully and is taken to the screen of lesson selection.
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The learner is Logged in.</li> <li>2. The learner selects either of the two options (i)Teaching (ii)Evaluation</li> <li>3. Mode selected successfully.</li> </ol>
<b>Alternative Flows:</b>	N/A.
<b>Exceptions:</b>	N/A.
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	The user is already logged in.

<b>Use Case ID:</b>	UC-16
<b>Use Case Name:</b>	Lesson Selection.
<b>Actors:</b>	Primary actor: User
<b>Description:</b>	Different lessons will be displayed, and the user will click the specific lesson which he/she wants to study

<b>Trigger:</b>	The user clicks on “Learning” option and a new screen opens where he/she can select the lesson.
<b>Preconditions:</b>	PRE-1: The user needs to Log in.
<b>Postconditions:</b>	POST-1: The user is taken to screen where corresponding Arabic words/letters are shown depending upon option selected.
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user is logged in.</li> <li>2. The learner selects a mode.</li> <li>3. The learner clicks on a lesson.</li> <li>4. The system displays screen to learner from which he/she can learn words/letters/</li> </ol>
<b>Alternative Flows:</b>	
	N/A.
<b>Exceptions:</b>	N/A.
<b>Business Rules</b>	
	N/A.
<b>Assumptions:</b>	1. The learner is already logged in.

Table 3.10

<b>Use Case ID:</b>	UC-17
<b>Use Case Name:</b>	Selection of Qari
<b>Actors:</b>	Primary actor: User
<b>Description:</b>	The user can select the voice of Qari in which he/she wishes to listen to the recitation.
<b>Trigger:</b>	The user clicks on the name of Qari available in the list.
<b>Preconditions:</b>	PRE-1: The user is in the “Teaching” mode of the application.
<b>Postconditions:</b>	POST-1: The learner will be able to listen the Arabic words in a specific accent of the Qari the selected.
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user is logged in the application.</li> <li>2. The user selects “Teaching” mode from the home screen.</li> <li>3. The user selects the accent of the Qari.</li> <li>4. The user can listen Arabic words in that specific accent of Qari.</li> </ol>

<b>Alternative Flows:</b>	N/A.
<b>Exceptions:</b>	1. If the user selects “Evaluation” mode in the application, he/she will not be able to select any Qari accent.
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	1. The user is already logged in.

**Table 3.21**

<b>Use Case ID:</b>	UC-18
<b>Use Case Name:</b>	Next Lesson.
<b>Actors:</b>	Primary actor: user
<b>Description:</b>	Once the level is completed, the user is taken into the next level.
<b>Trigger:</b>	Once the user clicks on the next button, the use case is initiated.
<b>Preconditions:</b>	PRE <sub>1</sub> : The user has completed the current lesson.
<b>Postconditions:</b>	POST <sub>1</sub> : The user is taken onto the next lesson.
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user logs into the application.</li> <li>2. The user selects the “Teaching” mode of the application.</li> <li>3. The user completes a lesson and clicks on the next button.</li> <li>4. The user is taken onto the next lesson.</li> </ol>
<b>Alternative Flows:</b>	1. N/A
<b>Exceptions:</b>	If the user selects “Evaluation” mode in the application, he/she will not be able to select any Qari accent.
<b>Business Rules</b>	N/A
<b>Assumptions:</b>	N/A

**Table 3.32**

<b>Use Case ID:</b>	UC-19
<b>Use Case Name:</b>	Sounds of words.
<b>Actors:</b>	Primary actor: User
<b>Description:</b>	This use case will play the sound of word or ayat the user wants to listen.



<b>Trigger:</b>	The user clicks on the play button.
<b>Preconditions:</b>	PRE-1: The user is in teaching mode of application. PRE-2: The user has selected the accent of the Qari.
<b>Postconditions:</b>	POST-1: The sound stops so the learner can practice pronunciation conveniently.
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user is logged in.</li> <li>2. The user selects “Teaching” mode from the menu.</li> <li>3. The user selects lesson.</li> <li>4. The user selects the accent of the Qari.</li> <li>5. The user clicks on the play button.</li> </ol>
<b>Alternative Flows:</b>	N/A.
<b>Exceptions:</b>	If the user selects “Evaluation” mode in the application, he/she will not be able to select any Qari accent.
<b>Business Rules</b>	
	N/A.
<b>Assumptions:</b>	<ol style="list-style-type: none"> <li>1. The user has logged in.</li> <li>2. The user has selected “Teaching” mode</li> </ol>

**Table 3.43**

<b>Use Case ID:</b>	UC-20
<b>Use Case Name:</b>	Progress tracking.
<b>Actors:</b>	Primary actor: User
<b>Description:</b>	The user is notified of his/her progress once a level is completed. This is an indirect use case executed every time a level is completed.
<b>Trigger:</b>	Once the user completes a level and clicks on “Next” button.
<b>Preconditions:</b>	PRE-1: The user has to complete a level.
<b>Postconditions:</b>	POST-1: Progress of the user is now updated.

<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user is logged in.</li> <li>2. The user selects “Teaching” mode of application.</li> <li>3. The user selects the lesson.</li> <li>4. The user selects the accent of Qari.</li> <li>5. The user clicks on the play button.</li> <li>6. The user completes the whole level by listening/practicing all words and ayat correctly.</li> </ol>
<b>Alternative Flows:</b>	N/A.
<b>Exceptions:</b>	<ol style="list-style-type: none"> <li>1. If the user does not listen to all the words/ayat, he/she will not be able to move onto next level and the progress will not be shown.</li> <li>2. <b>If the learner is not connected to internet, he/she will not be able to see</b></li> </ol>
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	N/A.

**Table 3.54**

<b>Use Case ID:</b>	UC-21
<b>Use Case Name:</b>	Highlighted words
<b>Actors:</b>	Primary actor: User
<b>Description:</b>	During each learning level, the words/ayat already listened by the user will be highlighted with green color, the remaining are highlighted by white color.
<b>Trigger:</b>	The user listened words/ayats and clicks on the next button.
<b>Preconditions:</b>	PRE-1: The user is logged in. PRE-2: Learner has selected mode and accent of Qari.
<b>Postconditions:</b>	POST-1: All the words/ayat which were listened by the user will be highlighted.

<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user is logged in.</li> <li>2. The user selects “Teaching” mode of application.</li> <li>3. The user selects lesson.</li> <li>4. The user selects accent of Qari.</li> <li>5. The user clicks on the play button.</li> </ol>
<b>Alternative Flows:</b>	
<b>Exceptions:</b>	N/A.
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	1. The user has selected “Teaching mode”

Table 3.15

<b>Use Case ID:</b>	UC-22
<b>Use Case Name:</b>	Tajweed rules
<b>Actors:</b>	Primary actor: user
<b>Description:</b>	<b>The user will be able to see all the tajweed rules related to Quran recitation. This way they will</b>
<b>Trigger:</b>	The learner clicks on “tajweed rules” menu item of the main menu.
<b>Preconditions:</b>	PRE-1: The learner is logged in. PRE-2: The learner is at home screen.
<b>Postconditions:</b>	POST-1: The learner is presented with all rules of “Tajweed”.
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The learner is logged in.</li> <li>2. The learner clicks on menu icon.</li> </ol>
	<ol style="list-style-type: none"> <li>3. The learner clicks on menu item “Tajweed rules”</li> <li>4. System shows all the tajweed rules.</li> </ol>
<b>Alternative Flows:</b>	N/A
<b>Exceptions:</b>	1. If the learner is not connected to internet, he/she will not be able to see “Tajweed rules.”
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	N/A.

<b>Use Case ID:</b>	UC-23
<b>Use Case Name:</b>	Hijri Calendar
<b>Actors:</b>	User
<b>Description:</b>	Here the user will be able to open the hijri calendar and will be check the Islamic dates.
<b>Trigger:</b>	The user can open this simply, by clicking the button hijri calendar.
<b>Preconditions:</b>	PRE-1: The user is logged in. PRE-2: The user must click on the button
<b>Postconditions:</b>	POST-1: The Islamic calendar should be displayed
<b>Normal Flow:</b>	3. The user is logged in. 4. The user must click on the calendar button
<b>Alternative Flows:</b>	N/A
<b>Exceptions:</b>	N/A
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	N/A.

<b>Table 3.17</b>	
<b>Use Case ID:</b> <b>UC-24 Use Case:</b> <b>Save Poggess</b>	
<b>Actors:</b>	User
<b>Description:</b>	Here the user can save his/her progress.
<b>Trigger:</b>	Save progress by pressing the “Save” button in menu

<b>Preconditions:</b>	PR- 1 At least any of the lecture is completed E :
<b>Postconditions:</b>	POS- 1 Completed lectures will be updated T :
<b>Normal Flow:</b>	1 Th Learner “Logs-in” to account 2 At least one new lecture completed 3 Click on save button
<b>Alternative Flow</b>	The progress will be automatically updated when the application is closed
<b>Exceptions:</b>	N
<b>Business Rules</b>	N
<b>Assumptions:</b>	N

A

Table 3.18

<b>Use Case ID:</b>	UC-25
<b>Use Case Name:</b>	Qari’s Accent Selection
<b>Actors:</b>	Primary actor: User
<b>Description:</b>	The user can learn the Arabic letters and/or words in an accent of a selected Qari.
<b>Trigger:</b>	The user can click on any of the limited number of the accent available.
<b>Preconditions:</b>	PRE-1: The user is in the “Learning” mode.
<b>Postconditions:</b>	POST-1: The user will learn the Arabic letters/words in that specific accent which they have selected.
<b>Normal Flow:</b>	5. The user is logged in. 6. The user selects “Learning” mode. 7. The user selects Qari accent of their choice. 8. The user can learn Arabic words/characters in that specific accent.
<b>Alternative Flows:</b>	N/A.
<b>Exceptions:</b>	2. The user will not be allowed to select any qari accent if he/she has selected the “Evaluation” mode
<b>Business Rules</b>	N/A.
<b>Assumptions:</b>	2. The user is already logged in.

Table 3.19

<b>Use Case ID:</b>	UC-26
<b>Use Case Name:</b>	<b>Sending Recorded audio to server</b>
<b>Actors:</b>	User
<b>Description:</b>	User will record the audio using microphone to be send to server for further processing which includes recognition of character/word and feature extraction.
<b>Trigger:</b>	When the user releases the recording button.
<b>Preconditions:</b>	PRE-1: Audio must be recorded for validation.
<b>Postconditions:</b>	POST-1: Audio will be uploaded to server.
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user “Logs in” to account</li> <li>2. Listen new lecture</li> <li>3. During quiz, audio will be recorded</li> <li>4. Audio will be uploaded to server</li> </ol>
<b>Alternative Flows:</b>	NA
<b>Exceptions:</b>	Releasing the recording button without speaking, nothing will be uploaded
<b>Business Rules</b>	NA
<b>Assumptions:</b>	NA

Table 3.20

<b>Use Case ID:</b>	UC-27
<b>Use Case Name:</b>	Extracting features
<b>Actors:</b>	Primary actor: Extracting & Comparing Engine
<b>Description:</b>	Features like Amplitude, Frequency and Time will be extracted from audio. Waveform of the voice of the users will be compared with the average waveform of all data sets.
<b>Trigger:</b>	When audio is uploaded to server

<b>Preconditions:</b>	PRE-1: User is in Evaluation mode PRE-2: Uploaded audio
<b>Postconditions:</b>	POST-1: Features will be extracted which will be used for validation
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>2. The User “Logs in” to account</li> <li>3. Listen new lecture</li> <li>4. During quiz audio will be recorded</li> <li>5. Audio will be uploaded to server</li> <li>1. 6. Features will be extracted from audio</li> </ol>
<b>Alternative Flows:</b>	NA
<b>Exceptions:</b>	The features will not give actual values if noise cancellation is not done. The user is not connected to the internet.
<b>Business Rules</b>	NA
<b>Assumptions:</b>	NA

**Table 3.21**

<b>Use Case ID:</b>	UC-28
<b>Use Case Name:</b>	Comparing features
<b>Actors:</b>	Primary actor: Extracting & Comparing Engine
<b>Description:</b>	The system will recognize each character of the voice of the learner with the data available in the datasets that whether he/she spoke right or wrong .
<b>Trigger:</b>	When features are extracted
<b>Preconditions:</b>	PRE-1: User is in Evaluation mode PRE-2: Uploaded audio PRE-3: Server will provide extracted features
<b>Postconditions:</b>	POST-1: Result of comparison will be provided by server
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user “Logs in” to account</li> <li>2. Listen new lecture</li> <li>3. During Evaluation audio will be recorded</li> <li>4. Audio will be uploaded to server</li> <li>5. Features will be extracted from audio</li> <li>6. Comparison of features will be done</li> </ol>
<b>Alternative Flows:</b>	NA
<b>Exceptions:</b>	NA

<b>Business Rules</b>	NA
<b>Assumptions:</b>	NA

**Table 3.22**

<b>Use Case ID:</b>	UC-29
<b>Use Case</b>	Audio's Similarity Computation
<b>Actors:</b>	Primary actor: Extracting & Comparing Engine
<b>Description:</b>	The evaluation will be done and if any of the word/character is right/wrong then that will be displayed as green/red respectively
<b>Trigger:</b>	When comparison is done and calculated.
<b>Preconditions:</b>	PRE-1: Distance value is calculated
<b>Postconditions:</b>	POST-1: According to threshold value system will validate the recorded audio.
<b>Normal Flow:</b>	1. The User "Logs in" to account 2.Listen new lecture 3.During evaluation audio will be recorded 4.Audio will be uploaded to server 5.Features will be extracted from audio 6.Comparison of features will be done 7.With the help of the threshold value system will validate the recorded audio
<b>Alternative Flow</b>	N/A
<b>Exception:</b>	N/A
<b>Business Rule</b>	N/A
<b>Assumption:</b>	N/A

<b>Use Case ID:</b>	UC-30
<b>Use Case</b>	Highlight the letter/words
<b>Actors:</b>	Primary actor: Learner, Secondary actor: Extracting & Comparing Engine
<b>Description:</b>	During the evaluation process the right/wrong words or characters will be displayed as green/red respectively



<b>Trigger:</b>	When evaluation is done.
<b>Preconditions:</b>	PRE-1: The user has completed the lesson
<b>Postconditions:</b>	POST-1: Result will be displayed with the highlighted colours
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user “Logs in” to account</li> <li>2. Listen new lecture</li> <li>3. During audio will be recorded</li> <li>4. Audio will be uploaded to server</li> <li>5. Features will be extracted from audio</li> <li>6. Comparison of features will be done</li> <li>7. With the help of threshold value system will validate the recorded audio</li> </ol>
<b>Alternative Flow</b>	N/A
<b>Exception:</b>	N/A
<b>Business Rule</b>	N/A
<b>Assumption:</b>	N/A

<b>Use Case ID:</b>	UC-31
<b>Use Case Name:</b>	Evaluation Result Statistics
<b>Actors:</b>	Primary actor: User

<b>Description:</b>	When evaluation is done then the result will be displayed to the user <ol style="list-style-type: none"> <li>1. Whole accuracy</li> <li>2. Lectures completed</li> <li>3. Lectures remaining</li> </ol>
<b>Trigger:</b>	When the evaluation is completed
<b>Preconditions:</b>	PRE-1: The user has completed the quiz
<b>Postconditions:</b>	POST-1: Result card will be displayed
<b>Normal Flow:</b>	<ol style="list-style-type: none"> <li>1. The user “logs in” to an account</li> <li>2. Listen to new lecture</li> <li>3. During evaluation, audio will be recorded</li> <li>4. Audio will be uploaded to the server</li> <li>5. Features will be extracted from the audio</li> <li>6. Comparison of features will be done</li> <li>7. With the help of threshold value system will validate the recorded audio</li> <li>8. According to distance value, letter/word will be highlighted</li> <li>9. Result will be displayed</li> </ol>
<b>Alternative Flows:</b>	NA
<b>Exceptions:</b>	NA
<b>Business Rules</b>	NA
<b>Assumptions:</b>	NA

### 3.3 Functional Requirements

Following are the functional requirements of the software.

<b>Identifier</b>	FR-1
<b>Title</b>	Email validation
<b>Requirement</b>	The system should show a warning pop-up sign if user enters the email in wrong format and describe the correct format.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To show the user that he/she needs to enter email in correct format in order to sign up.
<b>Business Rule (if required)</b>	N/A

<b>Dependencies</b>	N/A
<b>Priority</b>	Low

**Table 4.2**

<b>Identifier</b>	FR-2
<b>Title</b>	Password validation
<b>Requirement</b>	The system should show a warning pop-up that says “Passwords do not match” and also inform user about the format of password.
<b>Source</b>	Developer #1
<b>Rationale</b>	To inform the user that password do not match.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	Low

**Table 4.3**

<b>Identifier</b>	FR-3
<b>Title</b>	Email Authentication.
<b>Requirement</b>	The system should inform the user that an account already exists with the email he/she entered.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To show the user that he/she needs to enter email that doesn't exist in the database.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	High

Table 4.4

<b>Identifier</b>	FR-4
<b>Title</b>	Email Verification
<b>Requirement</b>	The system should check that the email entered by the user is in correct format.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To show the user that he/she needs to enter email in the correct format.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	Medium

Table 4.5

<b>Identifier</b>	FR-5
<b>Title</b>	Password Verification
<b>Requirement</b>	The system shall check that the password is entered in correct format.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To show the user that he/she needs to enter password in the correct format.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	Medium

Table 4.6

<b>Identifier</b>	FR-6
<b>Title</b>	Email authentication
<b>Requirement</b>	The system will verify that the email entered by the user is correct.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To make sure that the email entered by the user is correct

<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	high

Table 4.7

<b>Identifier</b>	FR-7
<b>Title</b>	Password Authentication
<b>Requirement</b>	The password entered by the user should be associated with some email account.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To make sure that the user logs into his/her own account.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	high

Table 4.8

<b>Identifier</b>	FR-8
<b>Title</b>	Warning pop-up
<b>Requirement</b>	The system will inform the user that the credentials entered by them are wrong in the form of pop up message.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To authenticate the login process.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	high

Table 4.13

<b>Identifier</b>	FR-9
-------------------	------

<b>Title</b>	Change password
<b>Requirement</b>	To change the password, the user needs to enter the confirmation password received through email.
<b>Source</b>	Mohsin Ali Farhat
<b>Rationale</b>	To allow the learner to change the password if he/she forgets it.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	High

Table 4.9

<b>Identifier</b>	FR-10
<b>Title</b>	Email verification
<b>Requirement</b>	The learner will be able to change password by entering their email.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To make sure the email entered by the learner is correct.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	Medium

Table 4.10

<b>Identifier</b>	FR-11
<b>Title</b>	Email a code
<b>Requirement</b>	The learner will receive a secret code through email, using which he/she would be able to change password
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To allow the user to change the password of their account.
<b>Business Rule (if required)</b>	N/A

<b>Dependencies</b>	N/A
<b>Priority</b>	Medium

Table 4.11

<b>Identifier</b>	FR-6.1
<b>Title</b>	Account Name
<b>Requirement</b>	Each User will have his/her name displayed on profile.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To let the user know which they are using.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	Low

Table 4.12

<b>Identifier</b>	FR-12
<b>Title</b>	Progress (Learning)
<b>Requirement</b>	The user will know how many levels in learning mode they have completed.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	The user should know their progress.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	Medium

Table 4.13

<b>Identifier</b>	FR-13
<b>Title</b>	Progress (Evaluation)
<b>Requirement</b>	The user will know how many levels in evaluation mode they have completed.

<b>Source</b>	M Awais Gondal
<b>Rationale</b>	The user should know their progress.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	Medium

Table 4.14

<b>Identifier</b>	FR-14
<b>Title</b>	Log Out pop up
<b>Requirement</b>	The system will show a confirmation pop up message to user when he/she presses the log out button.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To make sure the wants to log out.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	Low

Table 4.15

<b>Identifier</b>	FR-15
<b>Title</b>	Log in screen
<b>Requirement</b>	The system will take the user to Log in screen once they are logged out.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To allow the user to log in again or to create a new account.
<b>Business Rule (if required)</b>	N/A



<b>Dependencies</b>	N/A
<b>Priority</b>	Low

**Table 4.16**

<b>Identifier</b>	FR-16
<b>Title</b>	Learning Mode
<b>Requirement</b>	The user will be able to select learning mode from the menu.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	In learning mode user can learn Quranic words and Ayats.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	High

**Table 4.17**

<b>Identifier</b>	FR-17
<b>Title</b>	Evaluation Mode
<b>Requirement</b>	The learner will be able to select Evaluation mode from the menu.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	In evaluation mode user can evaluate their recitation skills.
<b>Business Rule (if Rule required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	High

**Table 4.18**

<b>Identifier</b>	FR-18
<b>Title</b>	Learning Arabic Characters

<b>Requirement</b>	The user will be able to select the character part from the lesson mode.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	The user should be able to learn the Arabic characters.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	8.1
<b>Priority</b>	High

Table 4.19

<b>Identifier</b>	FR-19
<b>Title</b>	Learning Arabic Characters with Diacritics
<b>Requirement</b>	the user will be able to select Arabic characters with diacritics in lesson mode.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	The user should be able to learn the Arabic characters with diacritics.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	8.1
<b>Priority</b>	High

Table4.20

<b>Identifier</b>	FR-20
<b>Title</b>	Learning Arabic Words with Diacritic
<b>Requirement</b>	The user will be able to select Arabic words with diacritics in lesson mode.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	The user should be able to learn the Arabic words with diacritics.
<b>Business Rule (if required)</b>	N/A

<b>Dependencies</b>	8.1
<b>Priority</b>	High

Table 4.21

<b>Identifier</b>	FR-21
<b>Title</b>	Accent Selection
<b>Requirement</b>	The user will be able to select accent of Qari.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	The user should be able to learn in their desired accent. .
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	Medium

Table 4.22

<b>Identifier</b>	FR-22
<b>Title</b>	Level selection screen
<b>Requirement</b>	The user will be able to move back to level selection screen from accent selection
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	The user can change the level they selected.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	Medium

Table 4.23

<b>Identifier</b>	FR-23
<b>Title</b>	Next/previous lesson

<b>Requirement</b>	The user will be able to move ahead or back to any word/character.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	The user should be able to listen a single word/character multiple times.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	High

Table 4.24

<b>Identifier</b>	FR-24
<b>Title</b>	Quit
<b>Requirement</b>	If the user should be able to quit a specific lesson.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To allow the user to quite a lesson.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	High

Table 4.25

<b>Identifier</b>	FR-25
<b>Title</b>	Saving progress
<b>Requirement</b>	When the user quite a lesson, the system will save their progress.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	The user can come back to the same lesson after quitig.
<b>Business Rule (if required)</b>	N/A

<b>Dependencies</b>	N/A
<b>Priority</b>	Low

Table 4.26

<b>Identifier</b>	FR-26
<b>Title</b>	Next level
<b>Requirement</b>	The user will be able to see the level number of next level and will be able to move to it while clicking on the button
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	The user should be able to move to next level.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	Medium

Table 4.27

<b>Identifier</b>	FR-27
<b>Title</b>	Show levels completed/Remaining
<b>Requirement</b>	The user will be able to see how many levels they have completed and how many are remaining remaining.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To let the user, know about their overall progress.
<b>Business Rule (if required)</b>	N/A
<b>Dependencies</b>	N/A
<b>Priority</b>	Low

Table 4.28

<b>Identifier</b>	FR-28
<b>Title</b>	Highlighted Words
<b>Requirement</b>	To lesson will be highlighted once they are completed

<b>Source</b>	M Awais Gondal
<b>Rationale</b>	During each learning level, the words/ayat already listened by the user will be highlighted with green color, the remaining are highlighted by white color.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	NA
<b>Priority</b>	High

Table 4.29

<b>Identifier</b>	FR-29
<b>Title</b>	Tajweed rules
<b>Requirement</b>	The user will be able to see the tajweed rules by clicking on “Tajweed rules” in the menu.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	The let the user learn the Tajweed rules.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	NA
<b>Priority</b>	High

Table 4.30

<b>Identifier</b>	FR-30
<b>Title</b>	Zoom
<b>Requirement</b>	The user can change the aspect ratio of the screen by magnifying the screen to see clearly.
<b>Source</b>	M Awais Gondal

<b>Rationale</b>	To provide the ease of reading to user.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	14.1
<b>Priority</b>	High

Table 4.36

<b>Identifier</b>	FR-31
<b>Title</b>	Islamic Calendar.
<b>Requirement</b>	The user can see the Islamic calendar and current Islamic date.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	The user can update him/her regarding Islamic date.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	NA
<b>Priority</b>	High

Table 4.37

<b>Identifier</b>	FR-32
<b>Title</b>	Calendar Background Color
<b>Requirement</b>	A bright color should be used for Calendar background so text becomes easy to read.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	Calendar should be clearly visible.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	NA
<b>Priority</b>	Low

Table 4.38

<b>Identifier</b>	FR-33
<b>Title</b>	Color of Current Date
<b>Requirement</b>	Current date should be highlighted with a separate color.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	So user can easily see the current date.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	NA
<b>Priority</b>	Low

Table 4.39

<b>Identifier</b>	FR-34
<b>Title</b>	Progress tracking.
<b>Requirement</b>	Progress of user will be saved once they quit the application
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To keep the user updates about their progress
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	NA
<b>Priority</b>	High

Table 4.40

<b>Identifier</b>	FR-35
<b>Title</b>	No progress is saved
<b>Requirement</b>	If the user does not complete a new lesson than no progress will be saved.
<b>Source</b>	Dr. Inayat ur Rehman
<b>Rationale</b>	There is no need to save if no new lectures are covered.



<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	NA
<b>Priority</b>	High

Table 4.41

<b>Identifier</b>	FR-36
<b>Title</b>	Voice Recording
<b>Requirement</b>	The user will press and hold the recording button to record audio.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	User will record their voice for evaluation.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	NA
<b>Priority</b>	High

Table 4.42

<b>Identifier</b>	FR-37
<b>Title</b>	Send Recorded Audio to Server
<b>Requirement</b>	The audio will be uploaded to server for validation and processing.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	Processing is done at server side to make no working load at client side.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	18.1

<b>Priority</b>	High
-----------------	------

Table 4.4

<b>Identifier</b>	FR-38
<b>Title</b>	Extracting Data from Audios
<b>Requirement</b>	Features like Amplitude, Frequency and Time will be extracted from audios.
<b>Source</b>	Dr. Inayat ur Rehman
<b>Rationale</b>	To Validate recorded audio, it is compared with features of pre-recorded audio.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	18.1
<b>Priority</b>	High

Table 4.44

<b>Identifier</b>	FR-39
<b>Title</b>	Sending features to Engine
<b>Requirement</b>	Extracted features from the audio will be send to comparing Engine for validation.
<b>Source</b>	Dr. Inayat ur Rehman
<b>Rationale</b>	To Validate recorded audio its features will be provided to Comparing Engine.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	18.1
<b>Priority</b>	High

Table 4.45

<b>Identifier</b>	FR-40
<b>Title</b>	Comparing Data of Audios

<b>Requirement</b>	Features of datasets of audio and user audio will be compared for the verification process.
<b>Source</b>	Dr. Inayat ur Rehman
<b>Rationale</b>	To validate that learner spoke correct word or not, features of audios will be compared.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	18.1
<b>Priority</b>	High

Table 4.46

<b>Identifier</b>	FR-41
<b>Title</b>	Verifying similarity
<b>Requirement</b>	Similarity between datasets and user audio is determined with the help of waveform graph.
<b>Source</b>	Dr. Inayat ur Rehman
<b>Rationale</b>	After calculation If distance is <b>zero</b> it means both audios are same, Threshold value will be specified for equivalence.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	18.1
<b>Priority</b>	High

Table 4.47

<b>Identifier</b>	FR-42
<b>Title</b>	Color Scheme for Evaluation Result.
<b>Requirement</b>	After validation, letter/word will be highlighted by different colors to describe the skills of learner.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To describe skills of user graphically.

<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	21.2
<b>Priority</b>	Medium

Table 4.48

<b>Identifier</b>	FR-43
<b>Title</b>	Highlight by Red Color
<b>Requirement</b>	If user does not recite correctly, it will be shown by red color.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To describe skills of the user graphically.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	21.2
<b>Priority</b>	Medium

Table 4.49

<b>Identifier</b>	FR-44
<b>Title</b>	Highlight by Green Color
<b>Requirement</b>	If user recites correctly, it will be shown by green color.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To describe skills of the user graphically.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	21.2
<b>Priority</b>	Medium

Table 4.50

<b>Identifier</b>	FR-45
<b>Title</b>	Highlight by Orange Color
<b>Requirement</b>	If user recites the words/ayat on average then it will be highlighted by orange color .
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To describe skills of the user graphically.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	21.2
<b>Priority</b>	Medium

Table 4.51

<b>Identifier</b>	FR-46
<b>Title</b>	Results After Evaluation
<b>Requirement</b>	The user will be informed by their result after completing a lesson.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	To let the user know about their recitation skills.
<b>Business Rule (if required)</b>	NA
<b>Dependencies</b>	21.2
<b>Priority</b>	Medium

Table 4.52

<b>Identifier</b>	FR-47
<b>Title</b>	Remaining Lectures
<b>Requirement</b>	After completed a lesson the user will be informed by the remaining lesson.
<b>Source</b>	M Awais Gondal
<b>Rationale</b>	The learner should know about their progress.
<b>Business Rule (if required)</b>	NA

<b>Dependencies</b>	21.2
<b>Priority</b>	Medium

### **3.4 Non-Functional Requirements**

Following are the non-functional requirements of the software.

#### **3.4.1 Usability**

USE-1: The menu bar of the proposed application will consist all the available functionalities of the application.

USE-2: The proposed application will highlight the mistakes and correct pronunciation with separate colors which will help the users to check their mistakes easily.

USE-3: The application will save the progress of user once they complete a level.

#### **3.4.2 Performance**

PER-1: The proposed application will only use 150-200MB of memory (RAM) while running.

PER-2: The proposed application will drain 10-19% battery of a smartphone/mobile each hour.

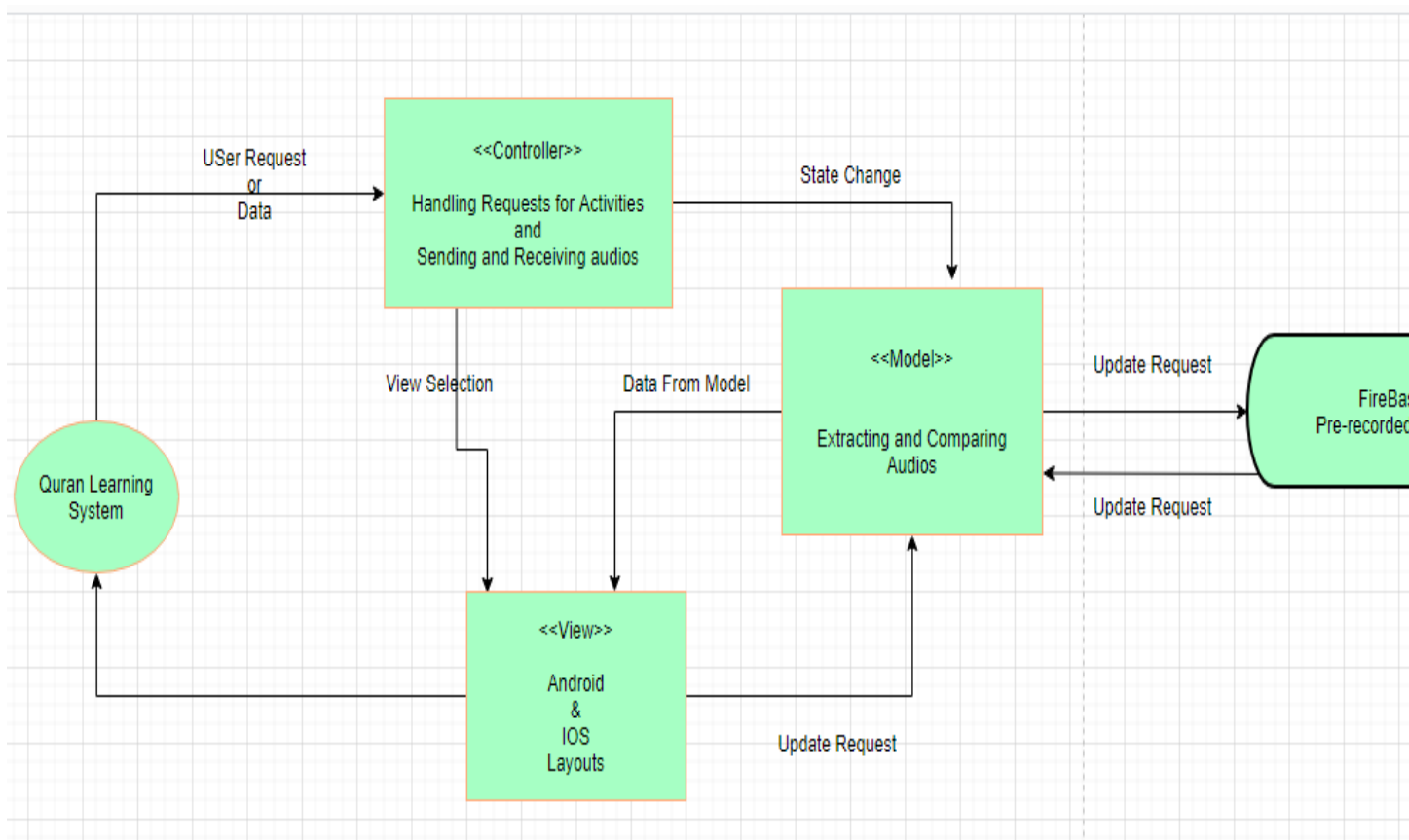
PER-3: The proposed application will take up 80MB of space in the smartphone after installation.

PER-4: The proposed application will use 16-21% of CPU of mobile.

## 4 Design and Architecture

### 4.1 System Architecture

The system architecture defines the major components or modules of a system, their connection and how they communicate with each other. The architecture which we are using in our system is 2-tier architecture which contains a presentation layer and a data layer (client and server). Here the front-end of the system lies in presentation layer and the database and the server of the system lies in the data layer. The learning part is in the presentation layer and the evaluation part lies in the data layer or we should say in the server. Client directly interacts with the server.



### 4.2 Data Representation

#### 4.2.1 Learner

```
const mongoose = require("mongoose");
```

```
var Schema = mongoose.Schema;
```

```

var learnerSchema = new Schema(
  {
    id: Schema.ObjectId,
    firstname: {
      type: String,
      unique: true
      default: null
    },
    lastname: {
      type: String,
      default: null
    },
    password:
    {
      type: String,
      default: null
    },
    email: {
      type: String,
      unique: true,
      required: true
    }
  });

```

```

module.exports = mongoose.model("Learner", learnerSchema);

```

#### 4.2.2 Profile

```

const mongoose = require("mongoose");

var Schema = mongoose.Schema;

var profileSchema = new Schema(
  {
    id: learner_id,

    levels_completed: {
      type: int,
      unique:true
      default: null
    },
    Pending_lectures: {
      type: int,

```



```

        default: null
      },
      Accuracy_rate:
      {
        type: float,
        default: null
      }
    });
module.exports = mongoose.model("Profile", profileSchema);

```

### 4.2.3 Characters

```

const mongoose = require("mongoose");

var Schema = mongoose.Schema;

var charactersSchema = new Schema(
  {
    id: Schema.ObjectId,

    character_name:

    {
      type: String,
      default: null
    },

    Character_audio {
      type: audio,
      default: null
    },

    Qari_id {
      type: int,
      default: null
    }
  }
);

module.exports = mongoose.model("Characters", charactersSchema);

```

### 4.2.4 Characters\_with\_diacritics

```

const mongoose = require("mongoose");

```

```

var Schema = mongoose.Schema;

var characters_with_diacritics_Schema = new Schema(
  {
    id: Schema.ObjectId,

    character_with_diarictics_name:

    {
      type: String,
      default: null
    },

    character_with_diarictics_audio {
      type: audio,
      default: null
    },

    Qari_id {
      type: int,
      default: null
    }
  });

module.exports =

mongoose.model("Characters_with_diacritics", characters_with_diacritics_Schema);

```

#### 4.4.5 Words

```

const mongoose = require("mongoose");

var Schema = mongoose.Schema;

var wordsSchema = new Schema(
  {
    id: Schema.ObjectId,

    word_name:

    {
      type: String,
      default: null
    },
  },

```

```

    word_audio {
      type: audio,
      default: null
    },

    Qari_id {
      type: int,
      default: null
    }
  });

```

```

module.exports = mongoose.model("Words", wordsSchema);

```

#### 4.4.6 Levels

```

const mongoose = require("mongoose");

var Schema = mongoose.Schema;

var levelSchema = new Schema(
  {
    id: Schema.ObjectId,

    level_name:

    {
      type: String,
      default: null
    }
  });

module.exports = mongoose.model("level", levelSchema);

```

#### 4.4.7 Accuracy\_characters

```

const mongoose = require("mongoose");

var Schema = mongoose.Schema;

var accuracy_charactersSchema = new Schema(
  {

```

```

    learner_id:
      {
        type: String,
        default: null
      },
    Character_id {
      type: int,
      default: null
    },
    accuracy {
      type: float,
      default: null
    }
  });

module.exports = mongoose.model("Accuracy_characters", accuracy_charactersSchema);

```

#### 4.4.8 Accuracy\_characters\_diacritics

```

const mongoose = require("mongoose");

var Schema = mongoose.Schema;

var accuracy_characters_diacriticsSchema = new Schema(
  {

    learner_id:

      {
        type: int,
        default: null
      },

    Character_diacritic_id {
      type: int,
      default: null
    }, accuracy {
      type: float,
      default: null
    }
  });

```

```
module.exports = mongoose.model("Accuracy_characters_diacritics",
accuracy_characters_diacriticsSchema);
```

#### **4.4.9 Accuracy\_words**

```
const mongoose = require("mongoose");

var Schema = mongoose.Schema;

var QariSchema = new Schema(
  {

    learner_id:

    {
      type: int,
      default: null
    },

    word_id {
      type: int,
      default: null
    },

    accuracy {
      type: float,
      default: null
    }
  });

module.exports = mongoose.model("Accuracy_words", accuracy_wordsSchema);
```

#### **4.4.10 Qari**

```
const mongoose = require("mongoose");

var Schema = mongoose.Schema;

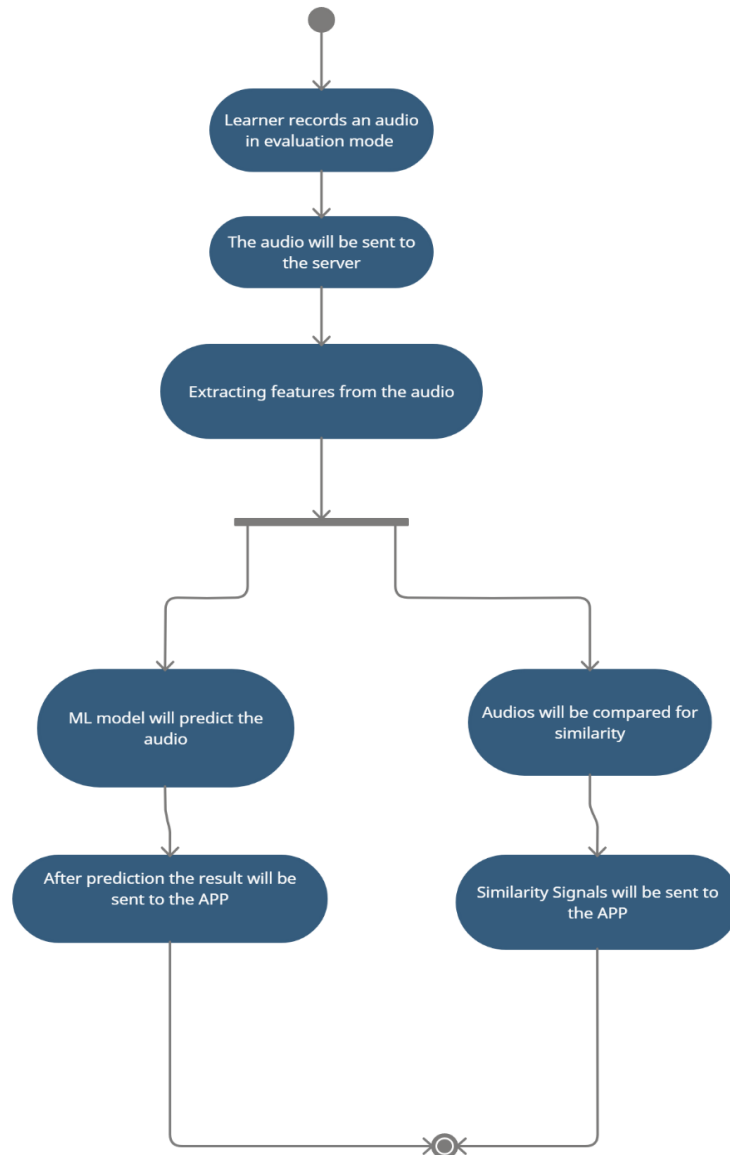
var qari_Schema = new Schema(
  {
    id: Schema.ObjectId,
```

```
    qari_name {  
      type: String,  
      default: null  
    }  
  }  
};  
  
module.exports = mongoose.model("Qari", qari_Schema);
```

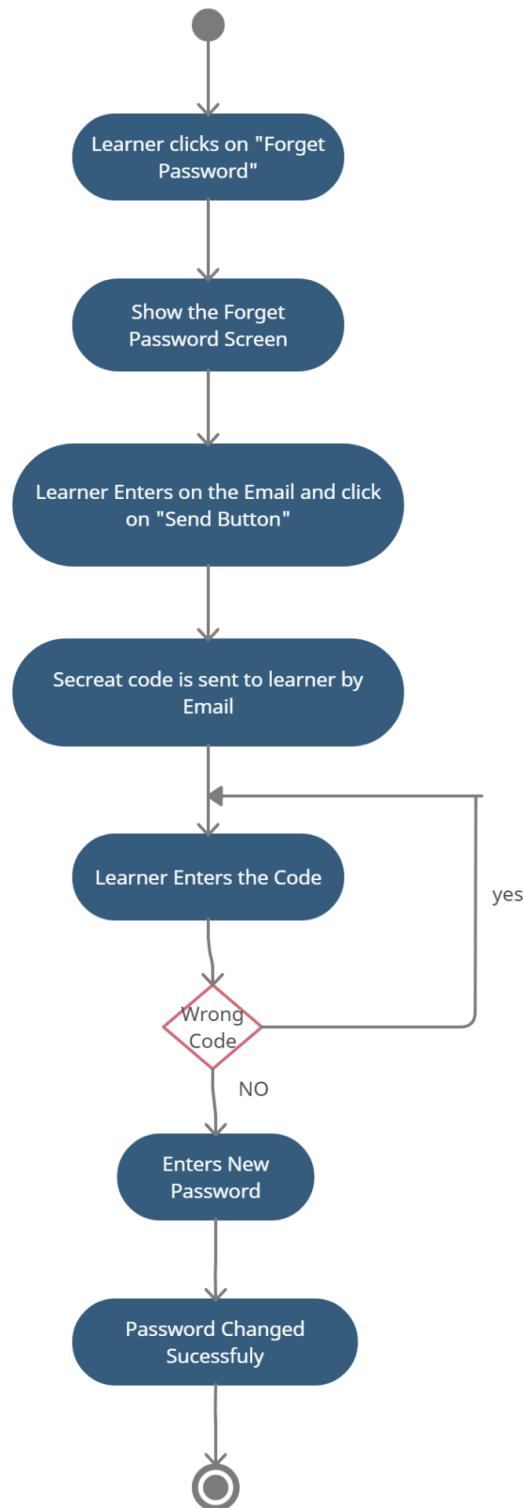
## **4.5 Process Flow/Representation**

### **4.5.5 Activity Diagram**

**Activity Diagram 1 : Evaluation of Learner based on recorded audio**

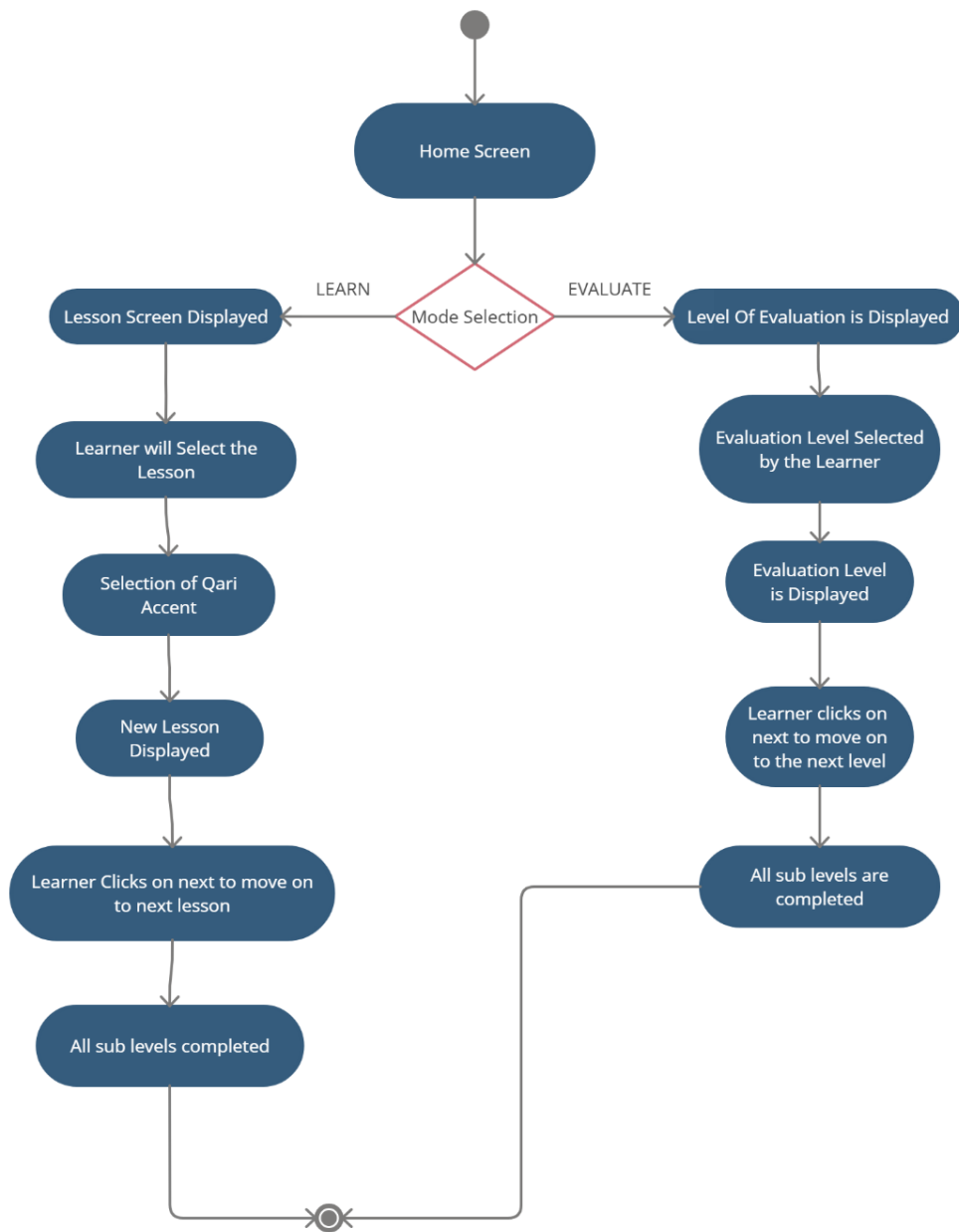


**Activity Diagram 2 : Password retrieval using ‘Forgot Password’**

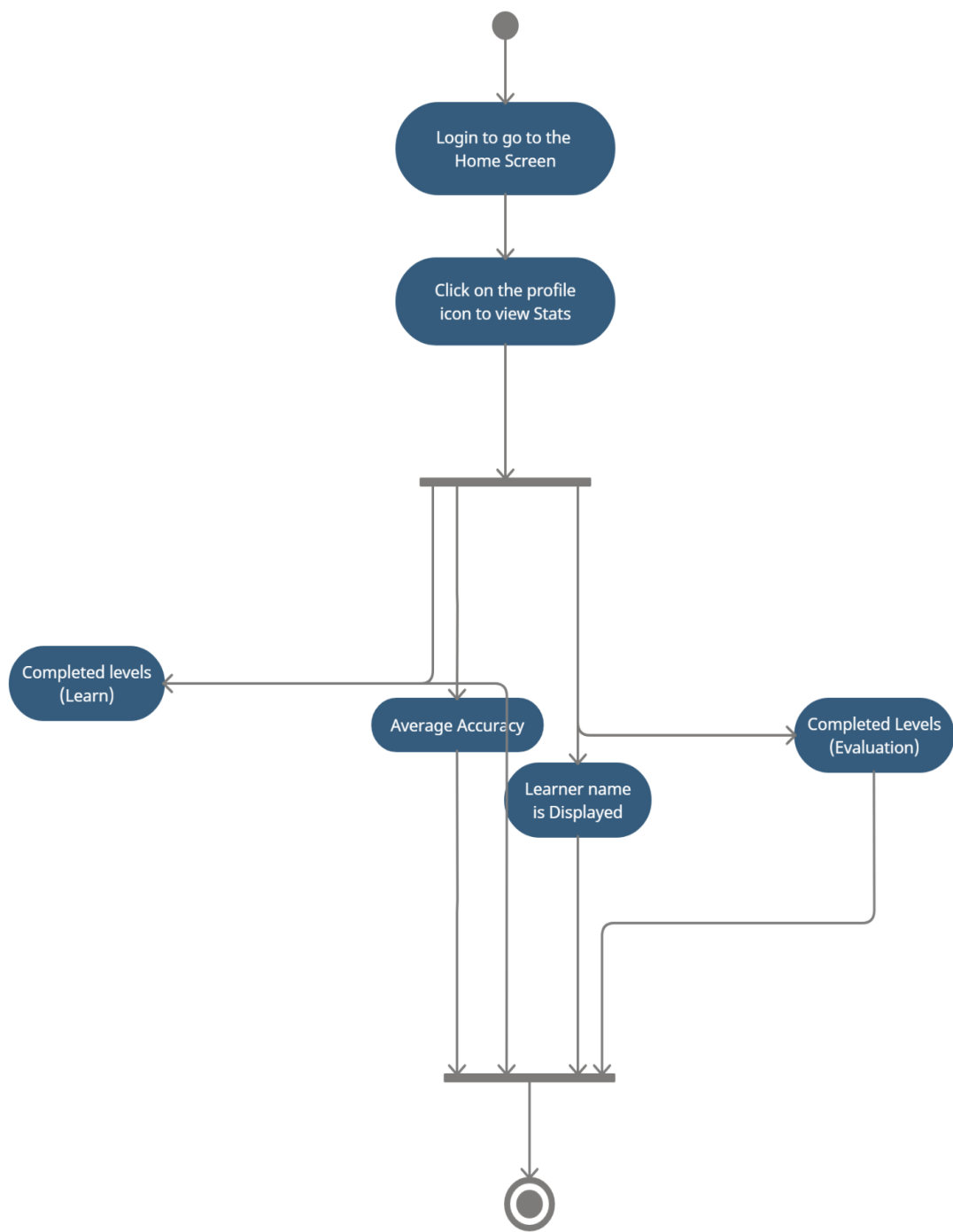


**Activity Diagram 3 : Mode Selection along with levels**



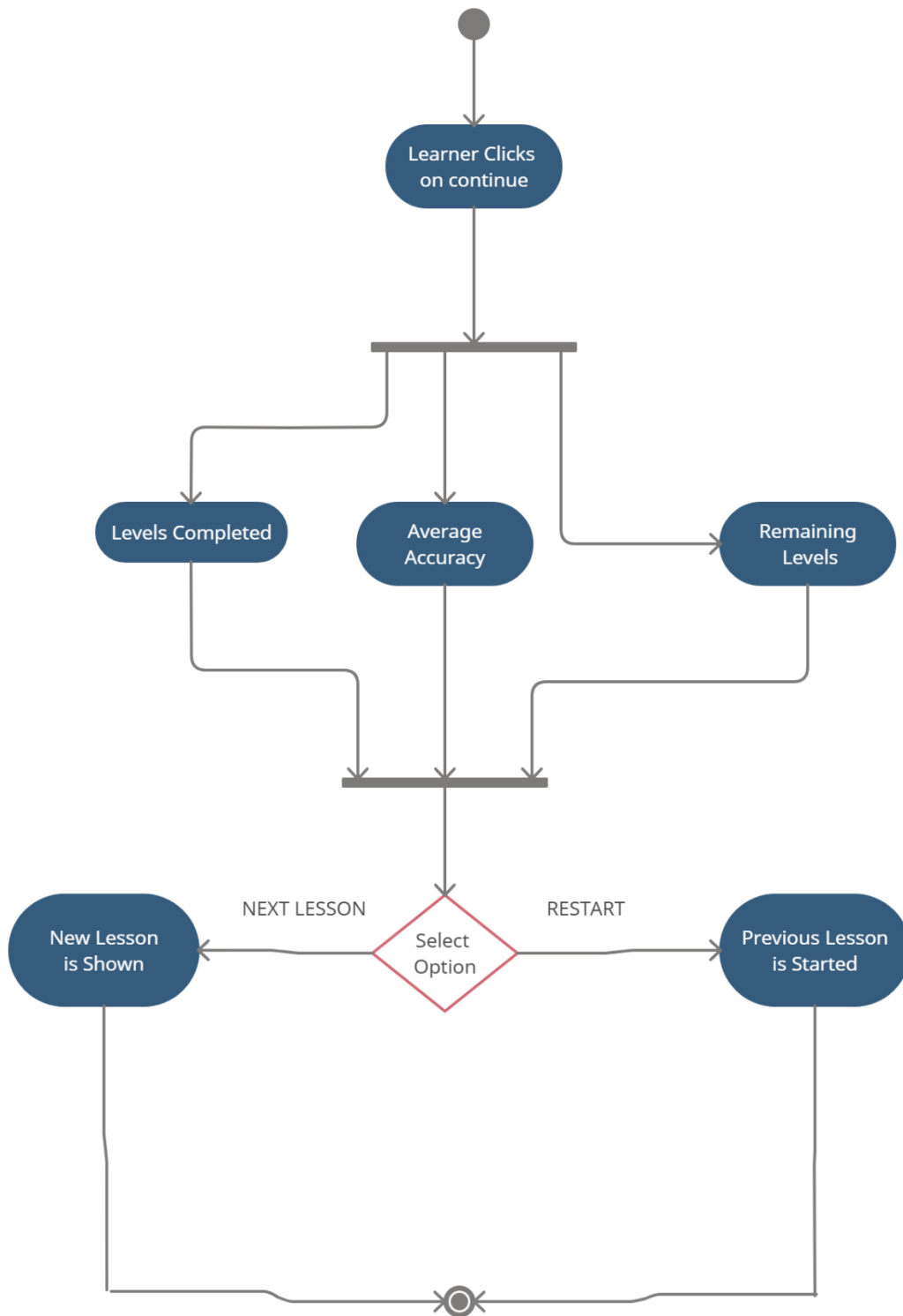


**Activity Diagram 4 : Profile Statistics**

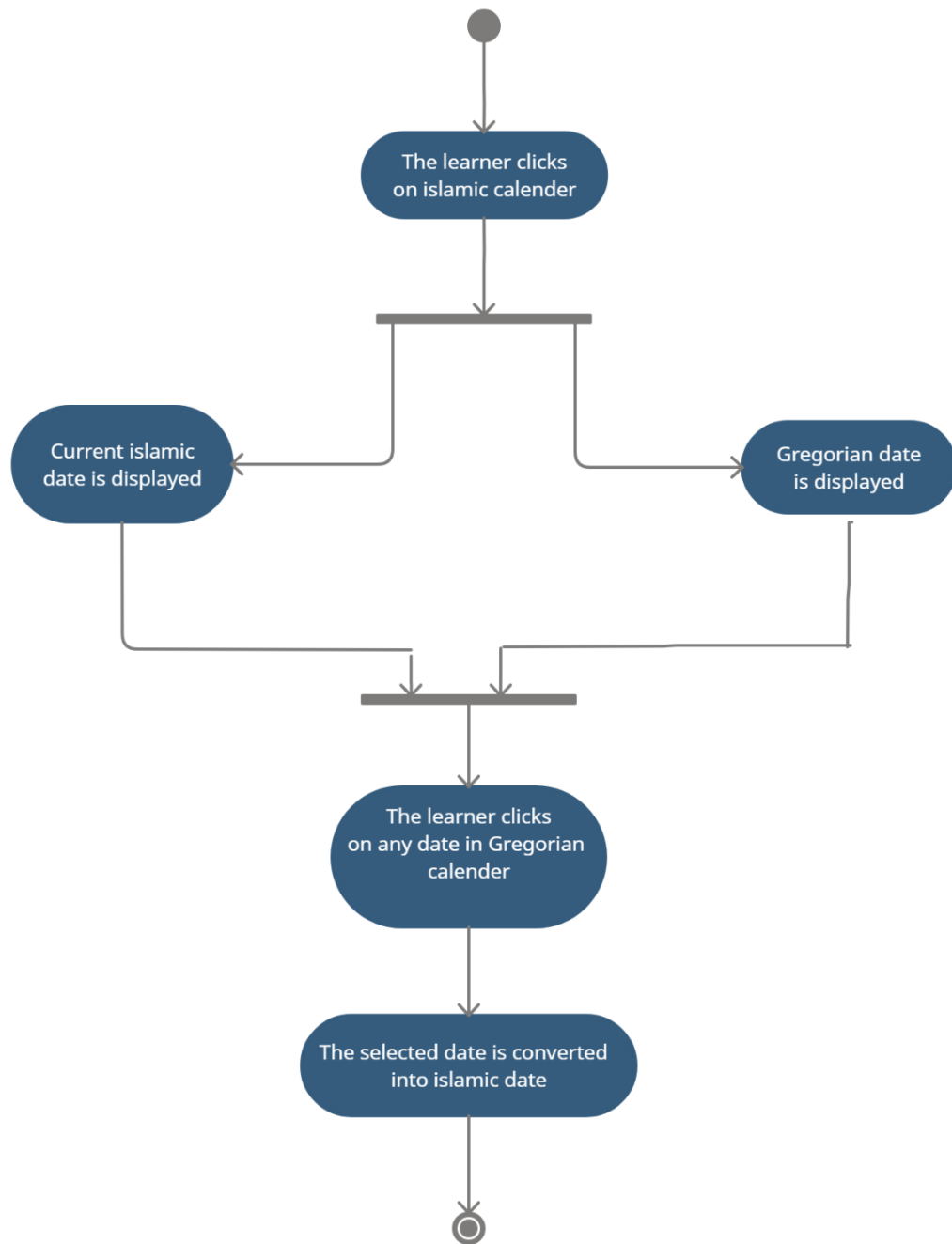


**Activity**

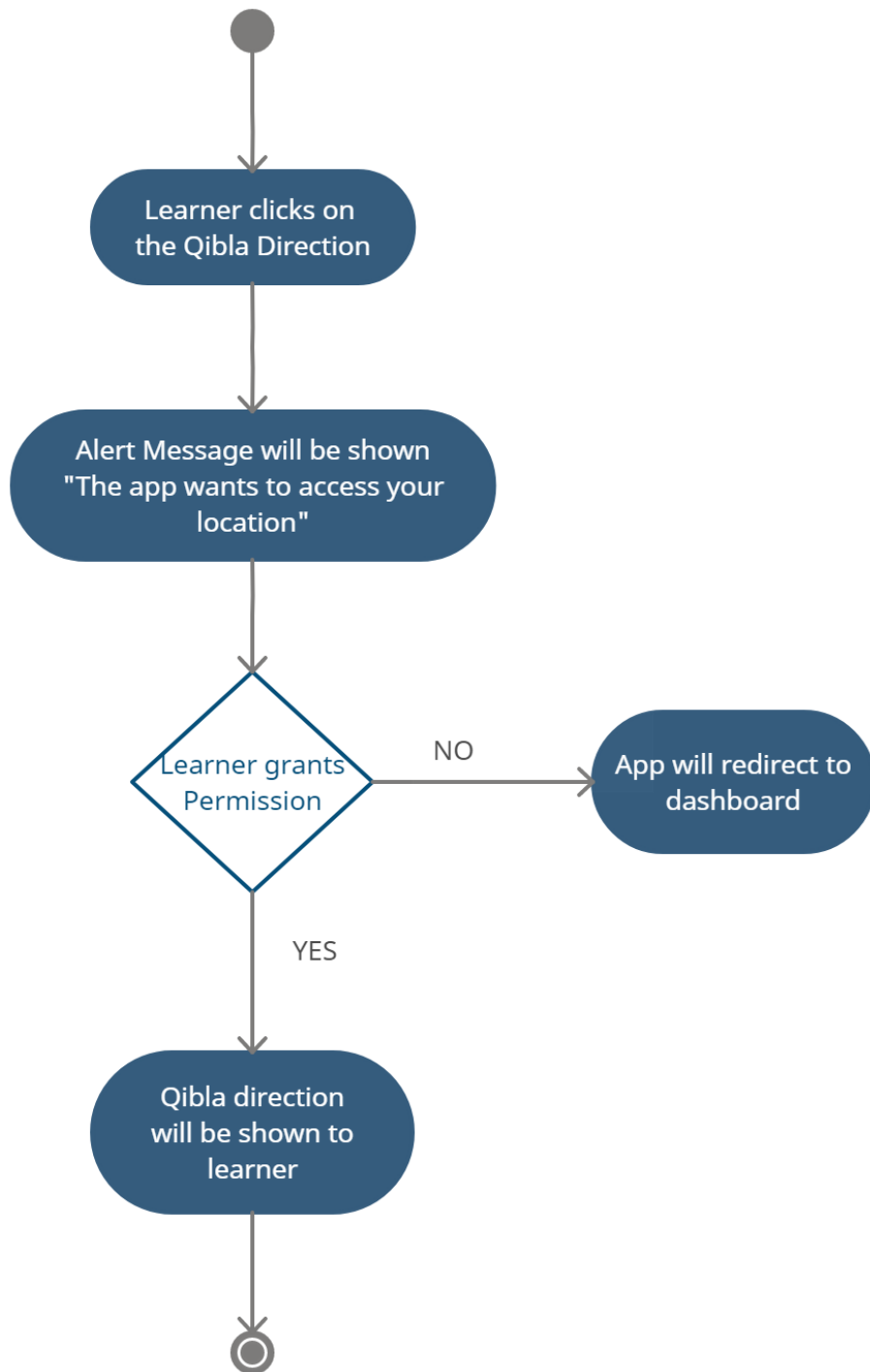
**Diagram 5: Progress Information**



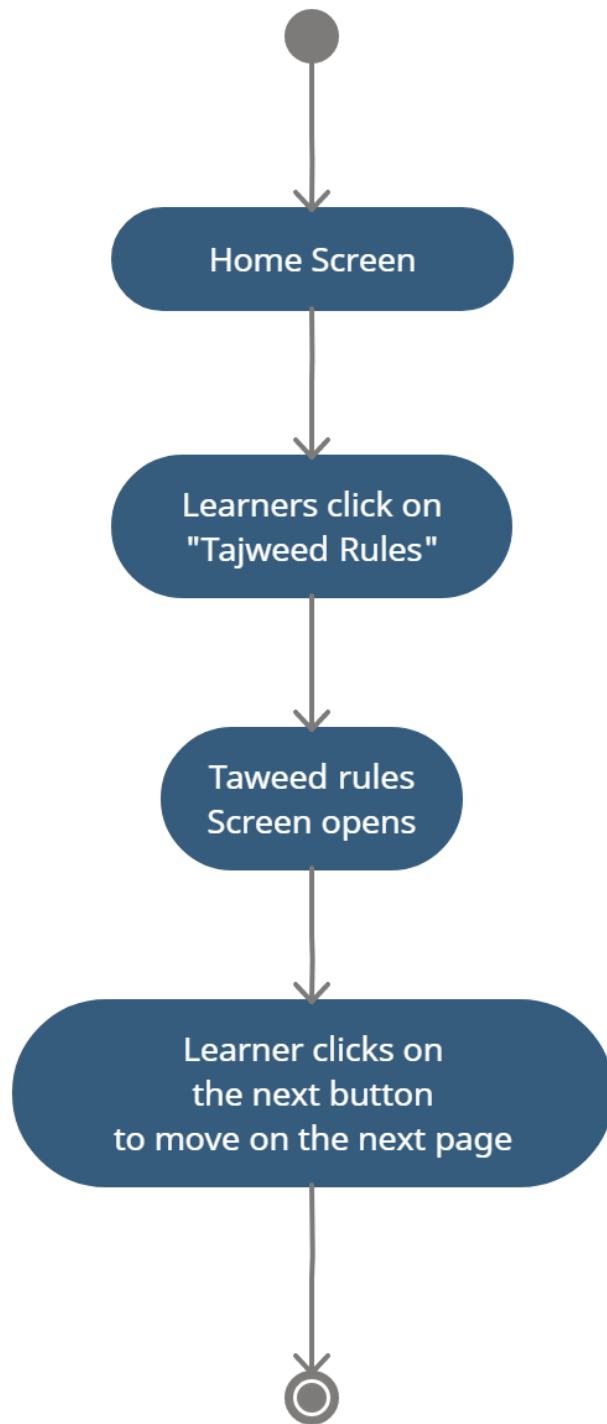
**Activity Diagram 6: Islamic Calendar**



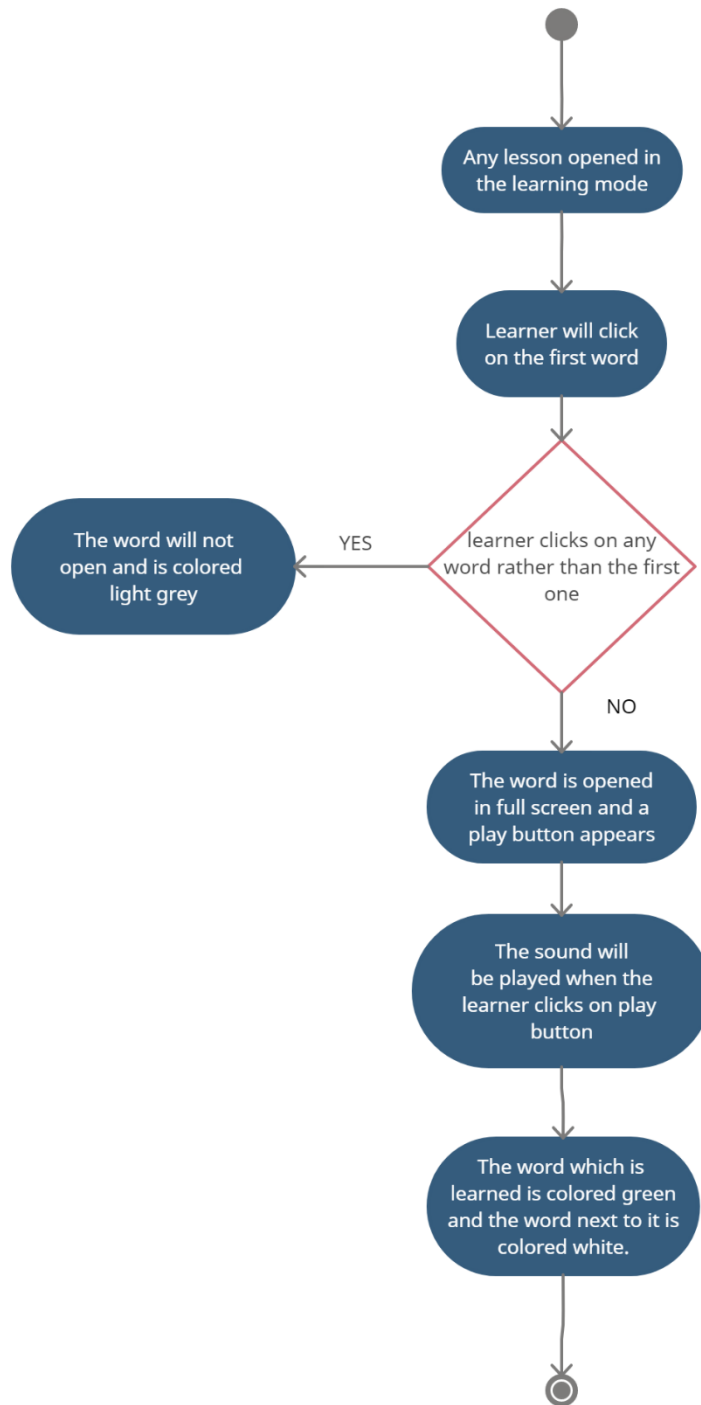
**Activity Diagram 7: Qibla Direction**



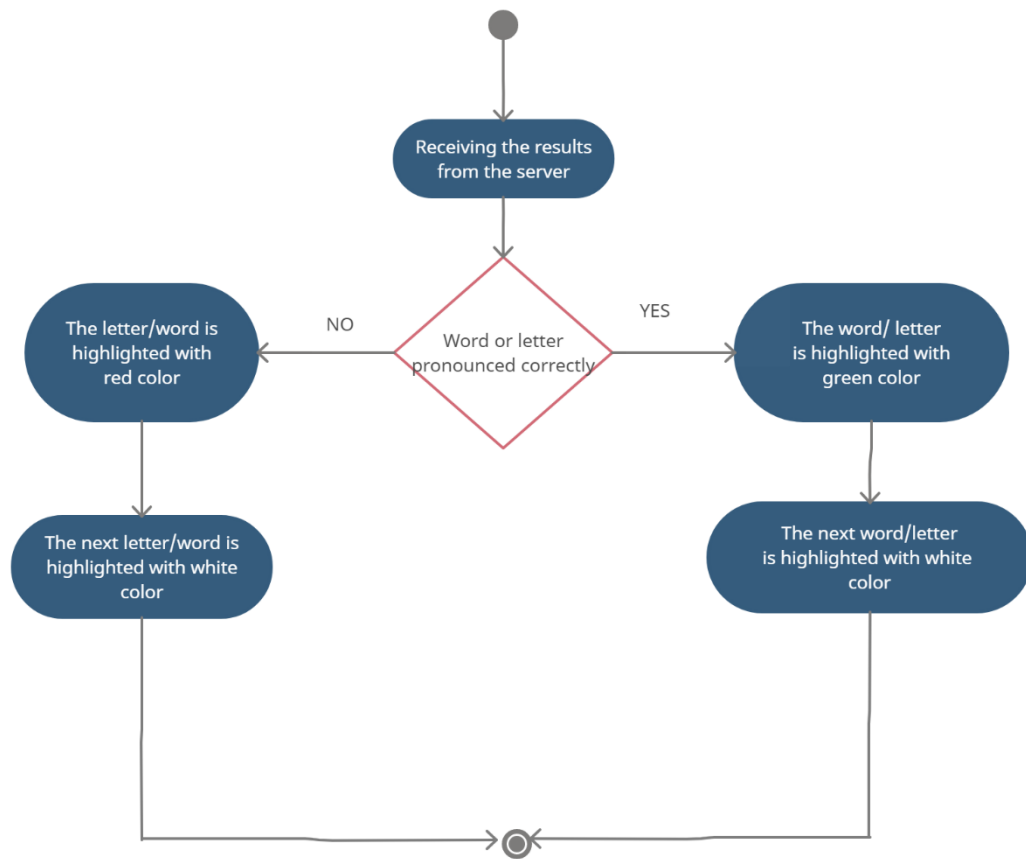
**Activity Diagram 8: Tajweed Rules**



**Activity Diagram 9: Words Highlighting (Learning)**



**Activity Diagram 10: Words Highlighting (Evaluation)**

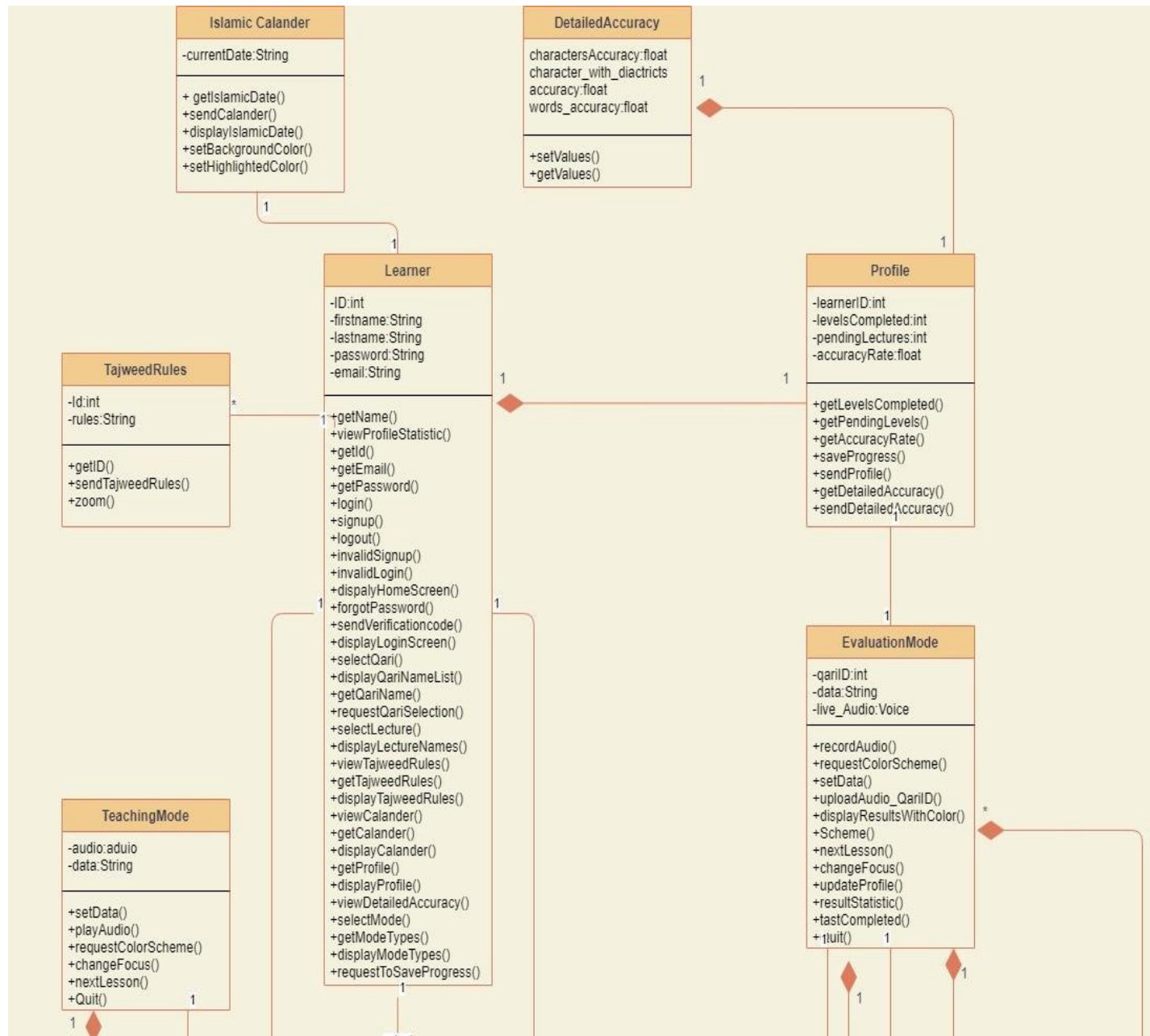


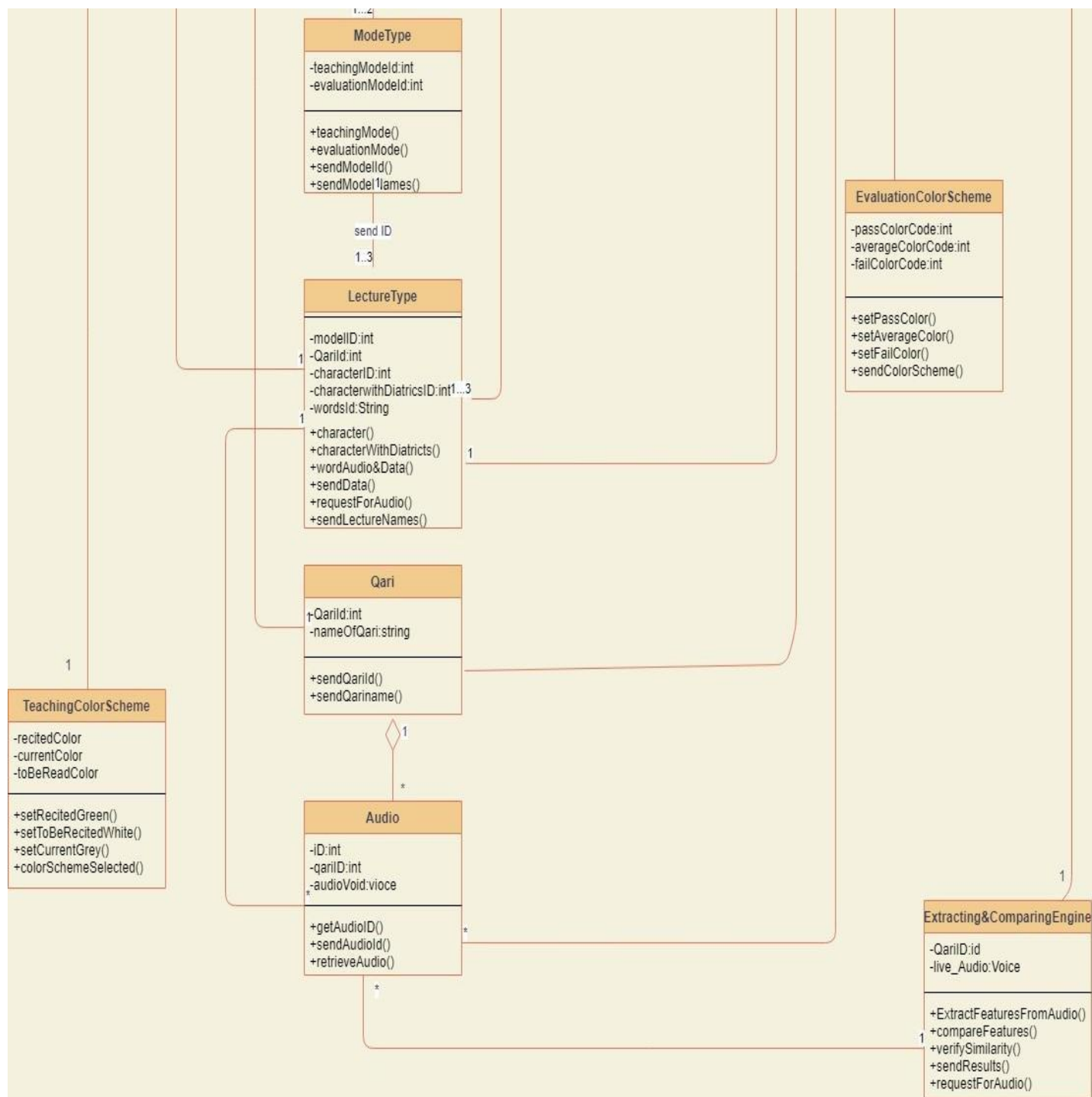


## 4.6 Design Models

### 4.6.5 Structural Diagrams

#### 4.6.5.1 Class diagram

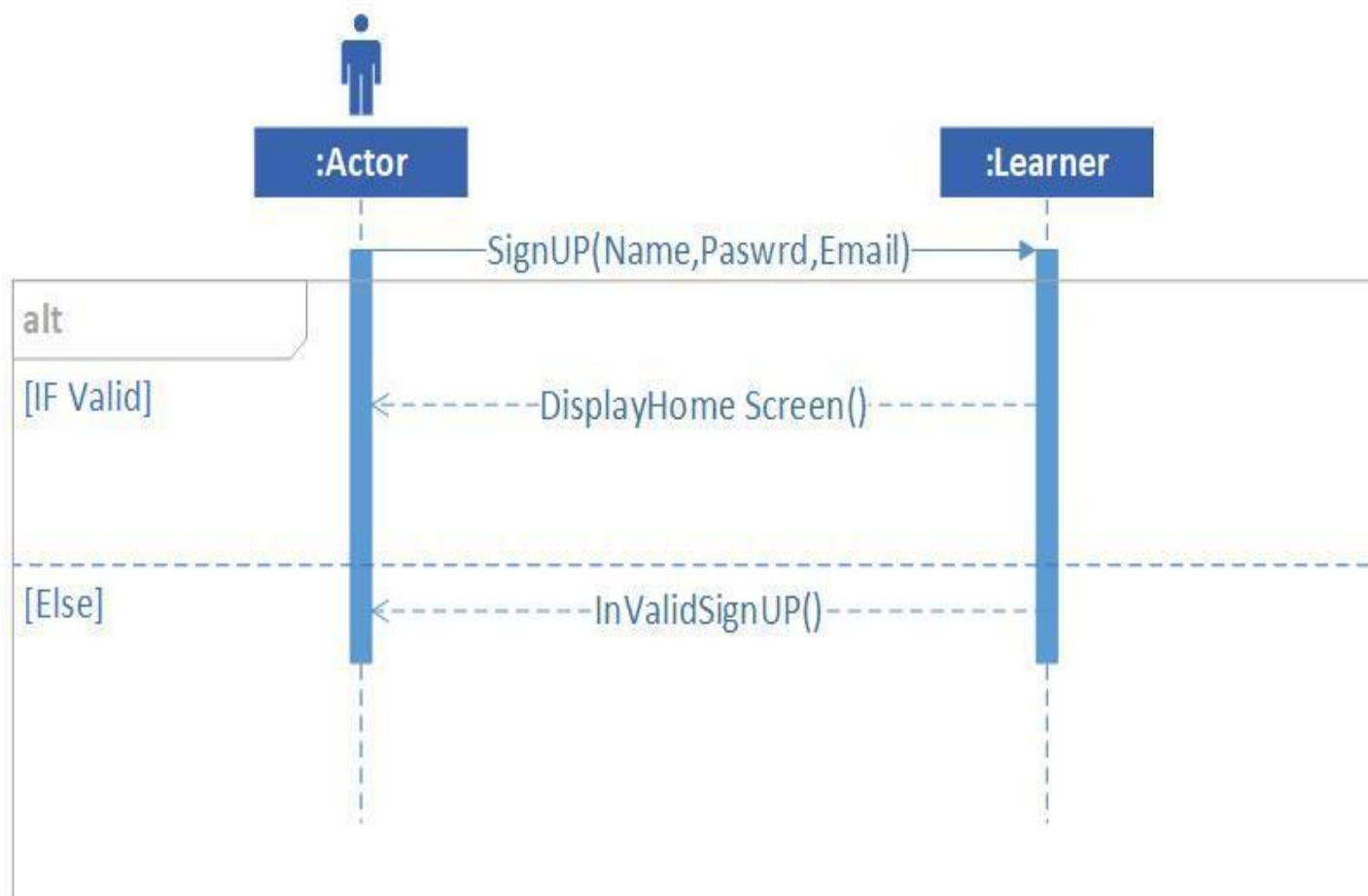




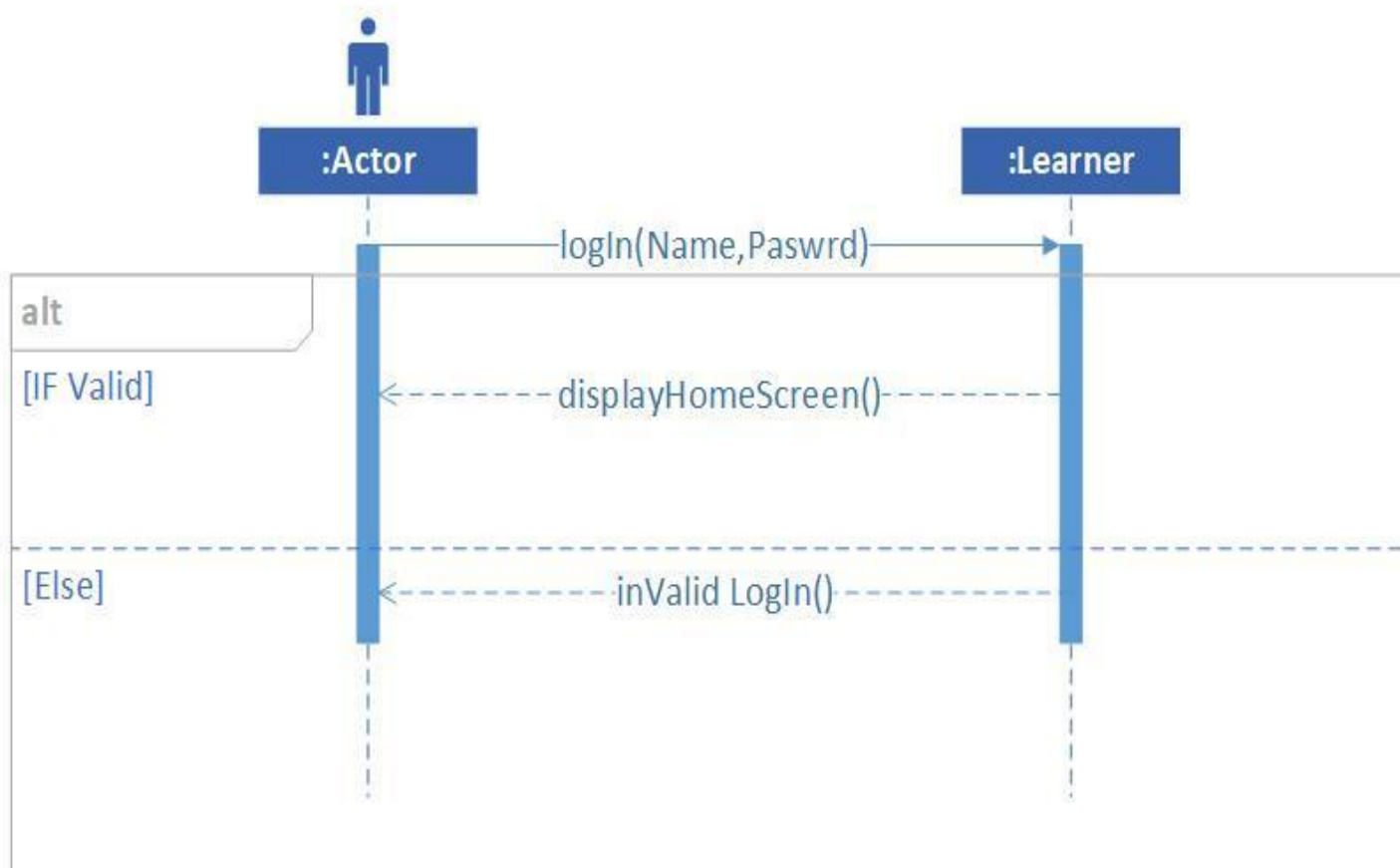
## 4.6.6 Behavioral Diagrams

### 4.6.6.1 Sequence Diagram

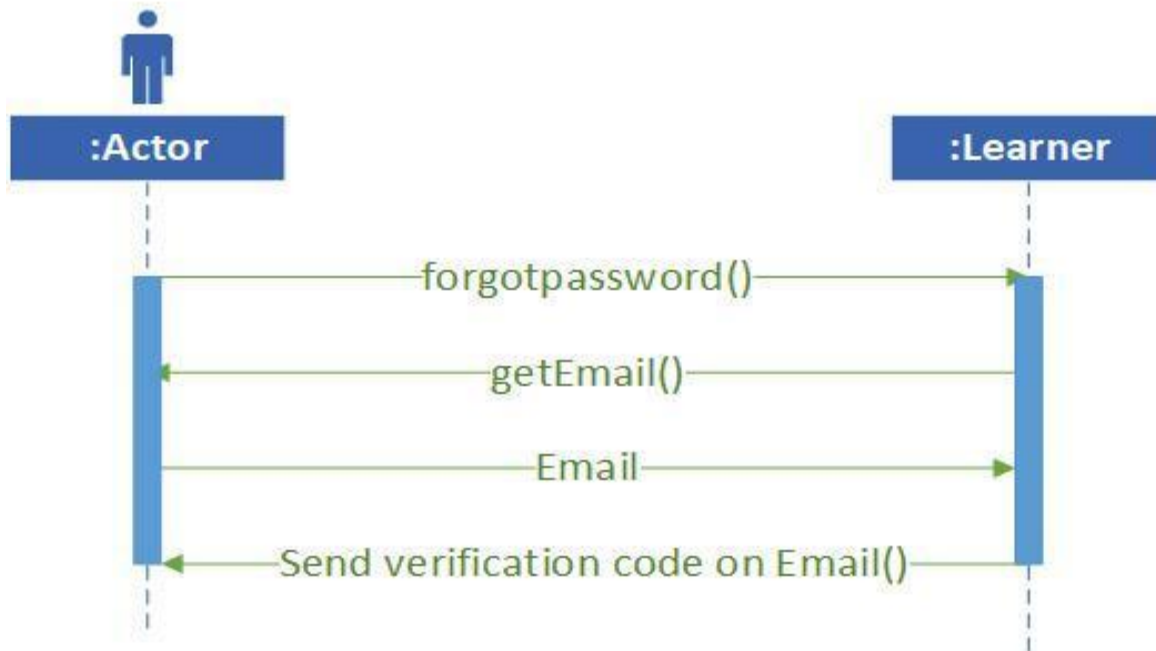
Sequence Diagram-1:Sign Up



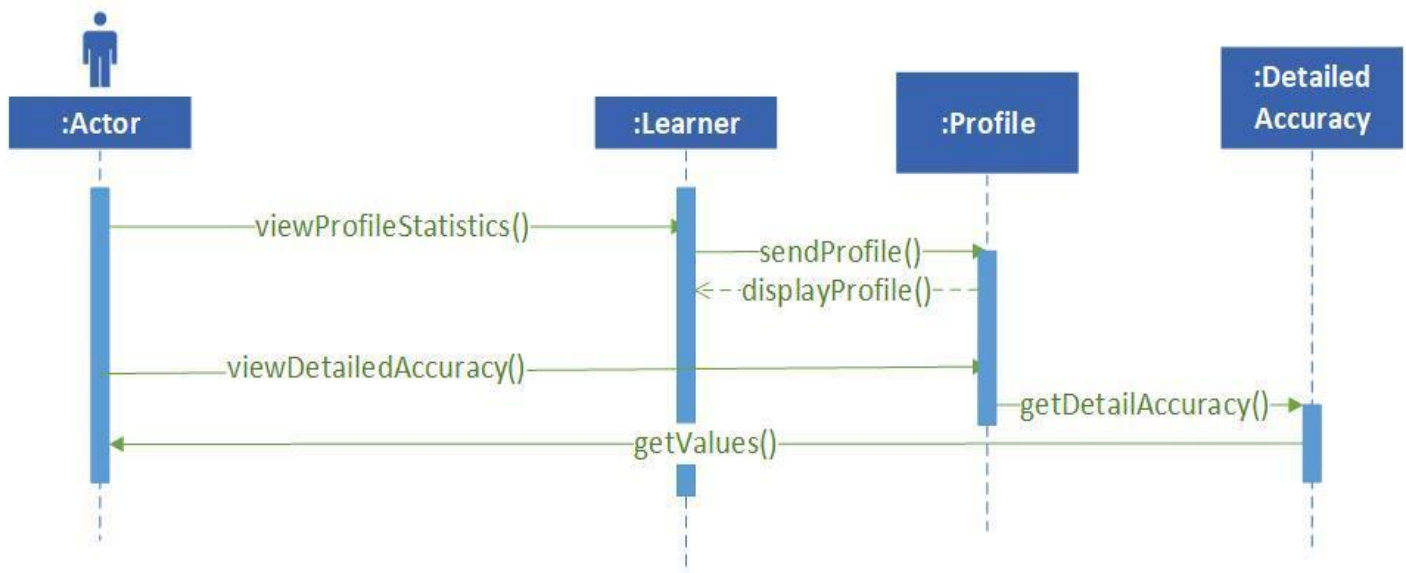
Sequence Diagram-2:Login



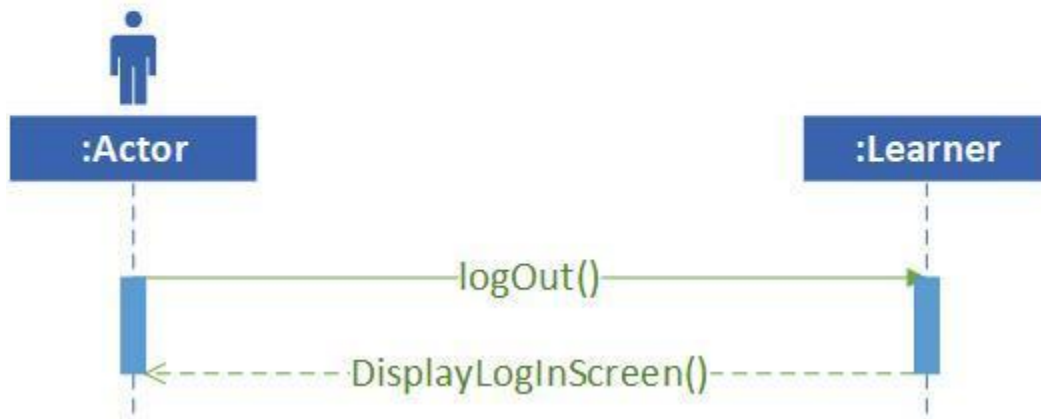
Sequence Diagram-3: Forgot Password



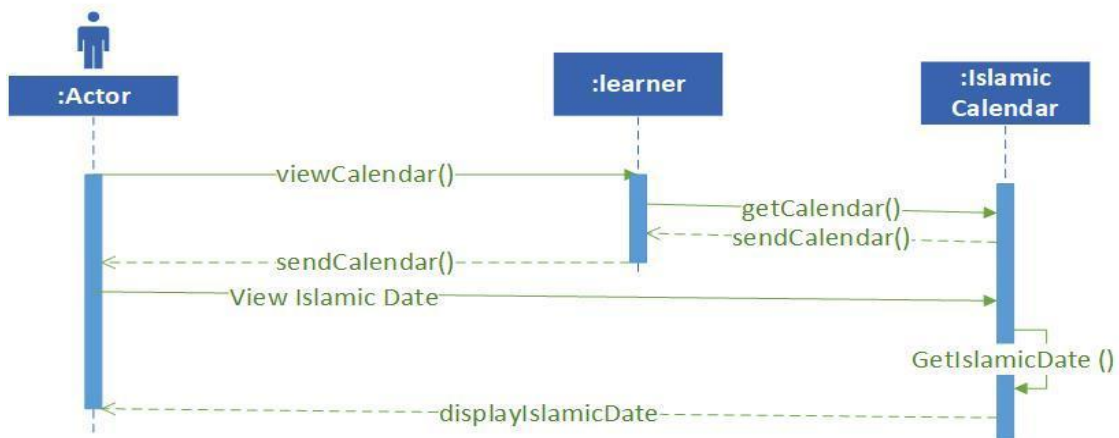
Sequence Diagram-4: View Profile Statistics



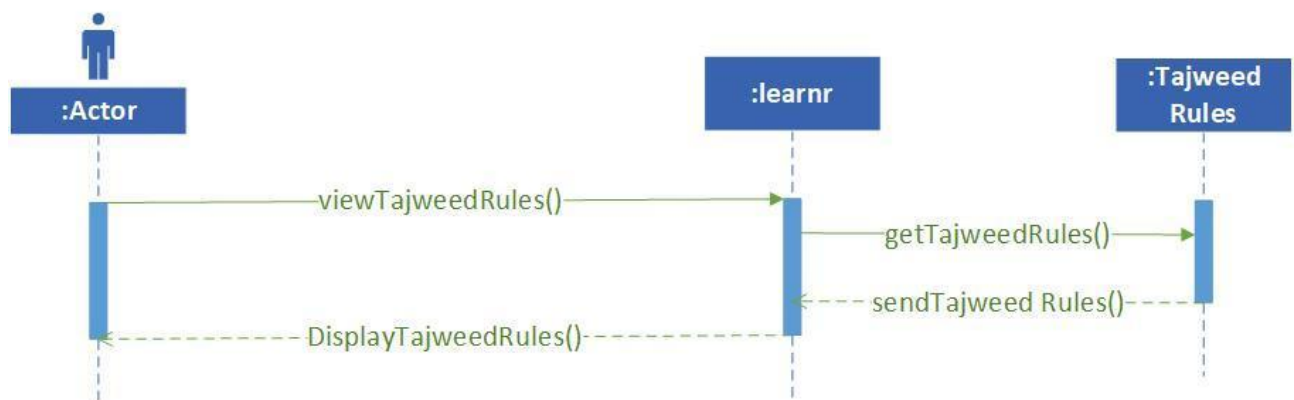
Sequence Diagram-5: Log Out



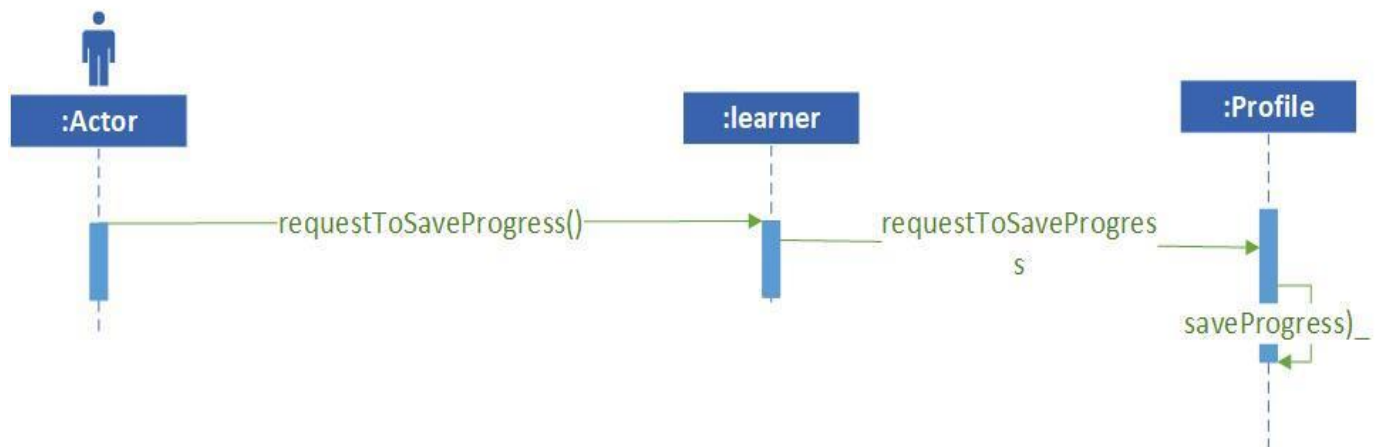
Sequence Diagram-6: Islamic Calendar



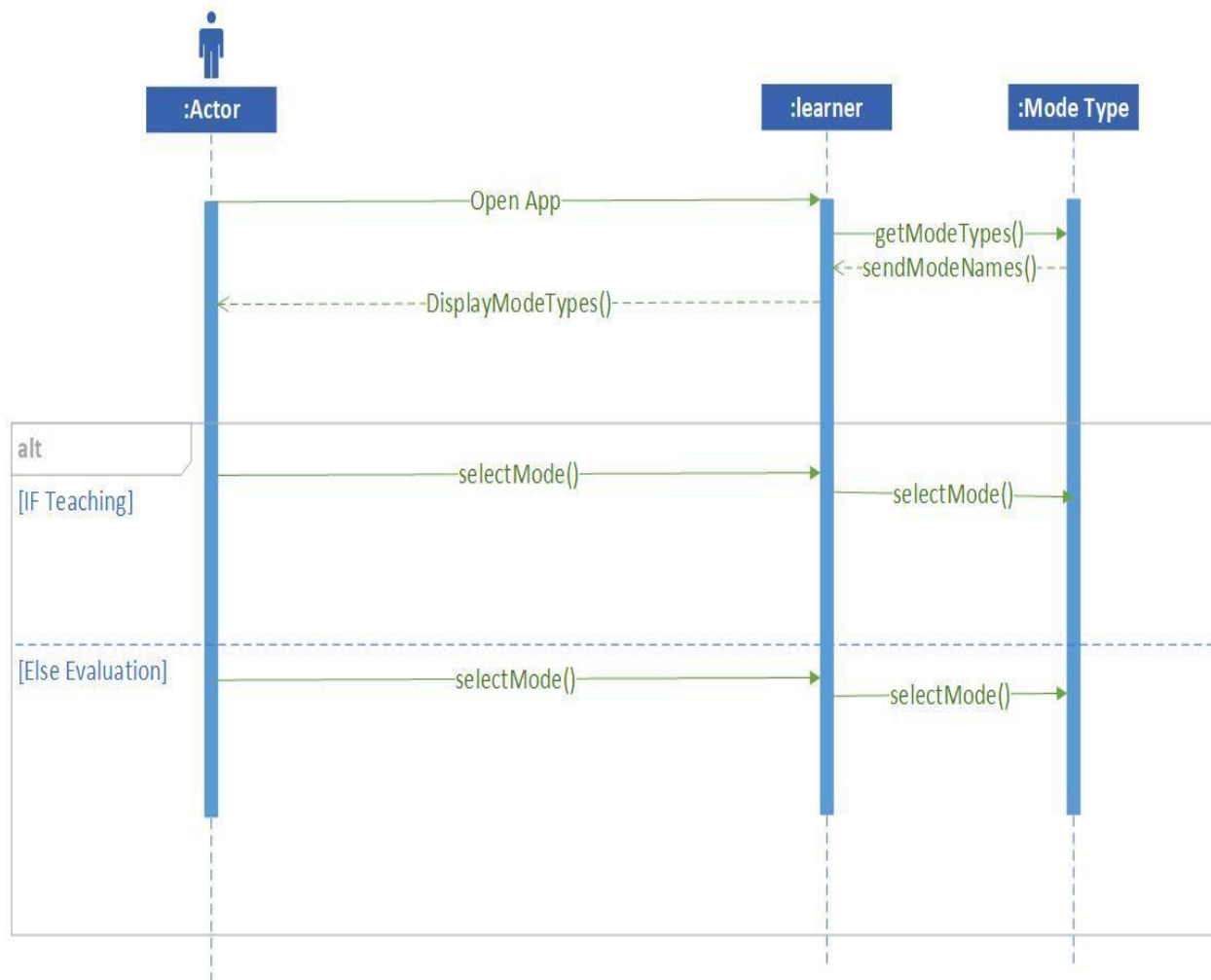
Sequence Diagram-7: Tajweed Rules



Sequence Diagram- 8: Save Progress

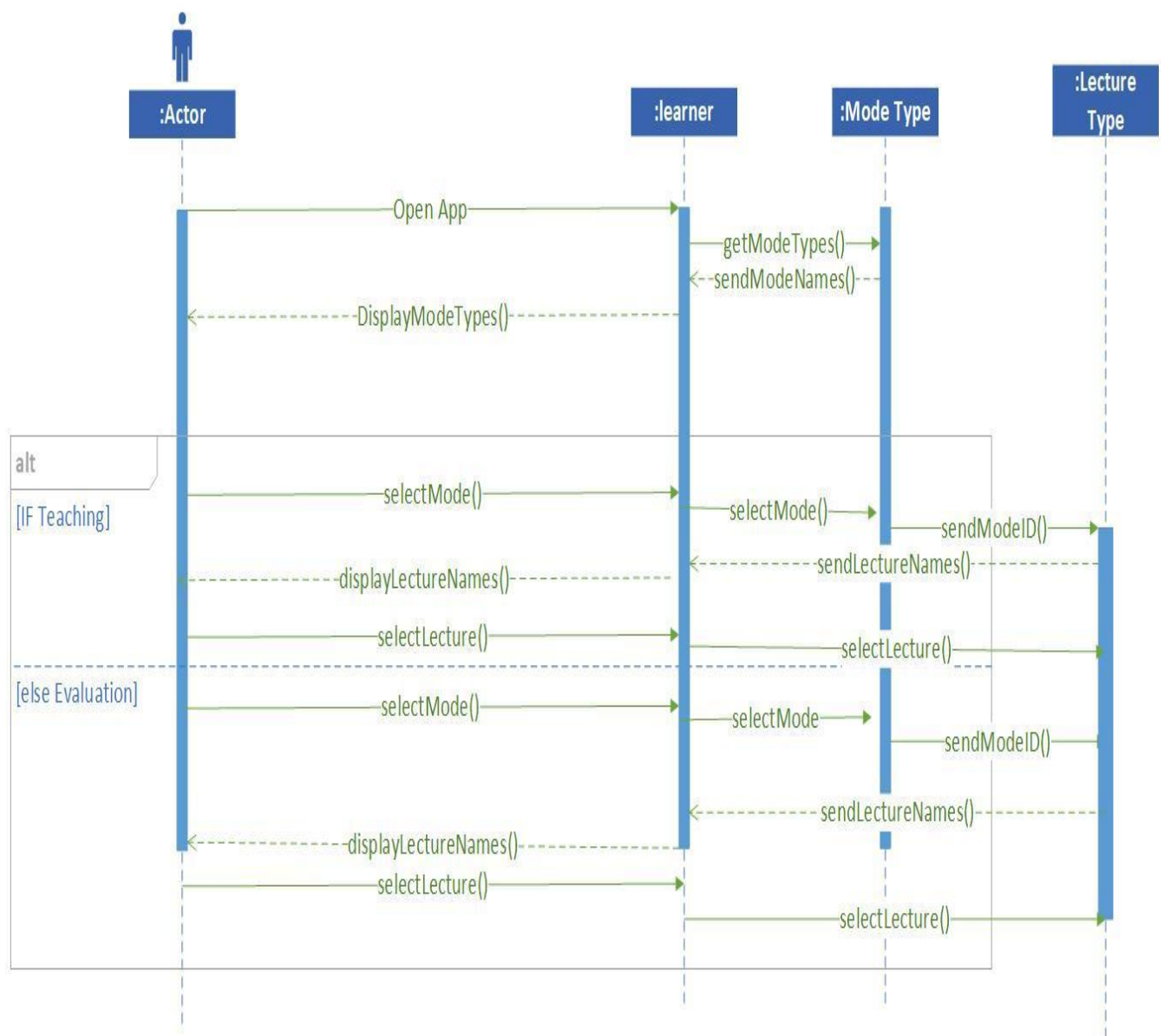


Sequence Diagram-10:Mode Selection



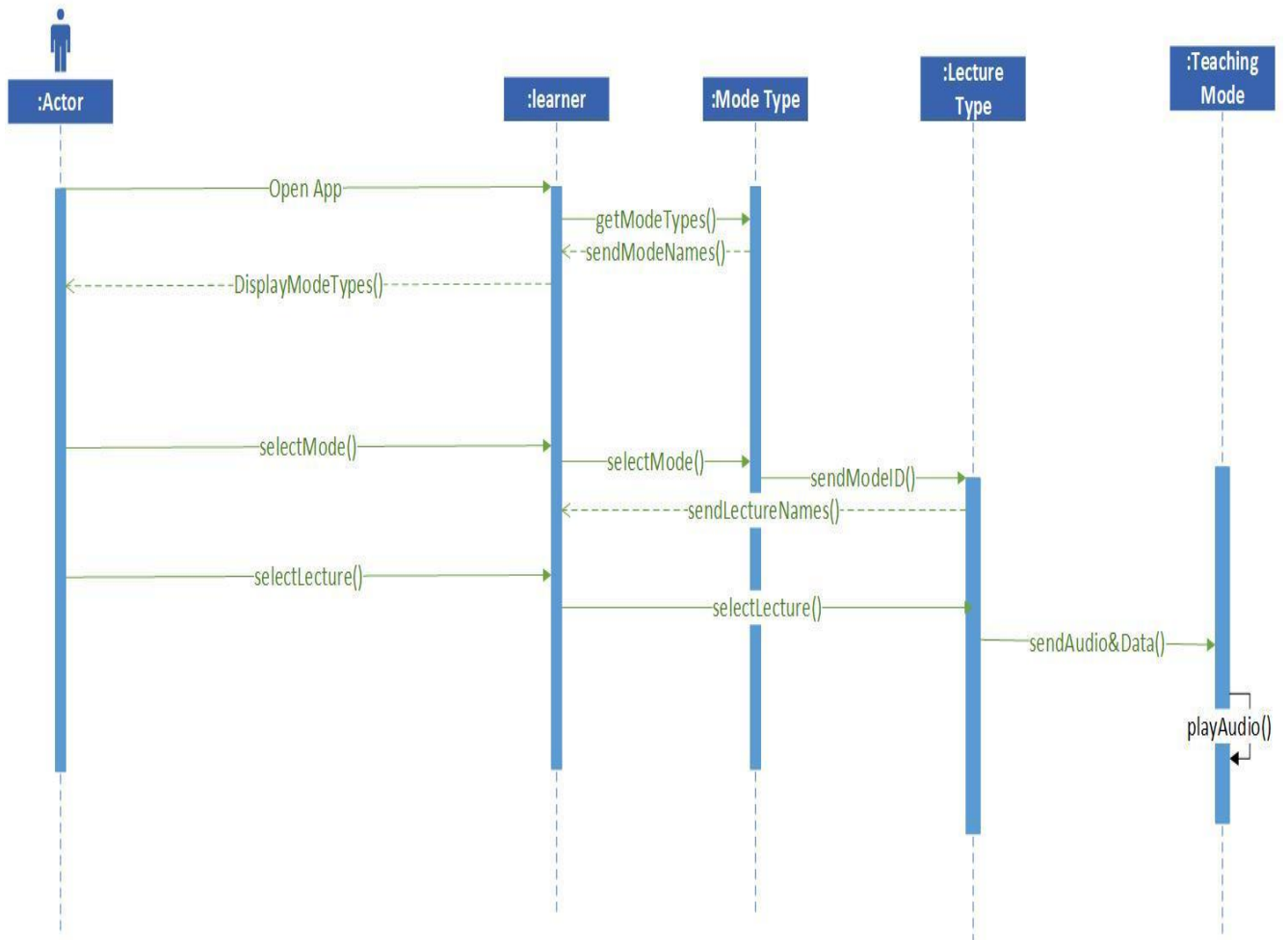


Sequence Diagram-11: Lesson Selection





Sequence Diagram-12:Play Audio



## 4. Implementation

### 4.7 Algorithm

#### 4.7.5 Learning

1. Click on the learning mode.
2. As the user learns his/her progress keep on modifying.
3. The same progress is updated in local memory and also on the server.
4. The user can learn *kalmas*, *namaz* and can also look on the *Qibla Direction*, *tajweed rules*.
5. When the user enter the noorani qaida to learn the chapters he/she has always has to start learning from the start i.e cannot learn chap 4 before learning the chap 1,2,3.
6. Open chapter 1
  - 6.1 All the words are colored grey.
  - 6.2 Words which are available for learning are colored white (here only the first word is available).
  - 6.3 The word learned are colored green.
7. The word clicked is pronounced.
8. The progress is updated each time.

#### 4.7.6 Evaluation

1. Click on the evaluation mode.
2. The user records his/her audio for evaluation.
3. The word is displayed to user and the user speaks the word.
4. The result is displayed to the user according to the accuracy of the word being spoken.

#### 4.5.3 Qari

1. After clicking on qari portal the qari gets log-in.
2. Here the qari records the audio and the audios are stored to the server.
3. The audios are to be used to train the evaluation model

## 4.8 External APIs

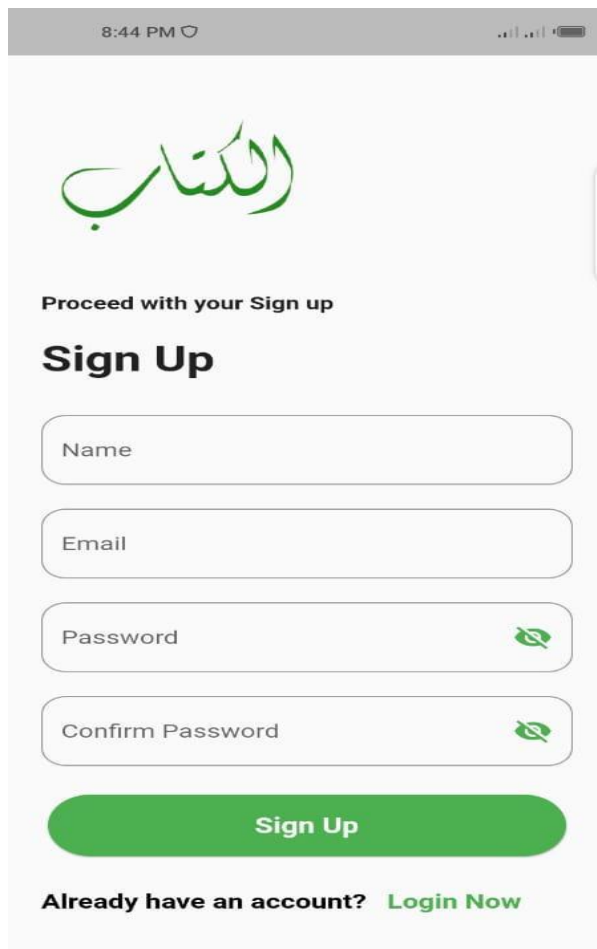
Describe the APIs used in the following table.

**Table 5.1: Details of APIs used in the Project**

<b>Name of API</b>	<b>Description of API</b>	<b>Purpose of Usage</b>	<b>List down the function/class name in which it is used</b>
<b>FireBase</b>	a platform developed by Google for creating mobile and web applications. It was originally an independent company founded in 2011. In 2014, Google acquired the platform and it is now their flagship offering for app development.	To save data	Login, sign-up, forget password
<b>Firestore</b>	<b>a flexible, scalable database for mobile, web, and server development from Firebase and Google Cloud. Like Firebase Realtime Database, it keeps your data in sync across client apps through realtime listeners and offers offline support for mobile and web so you can build responsive apps that work regardless of network latency or Internet connectivity.</b>	To store user data	learning, evaluation and qari portal.

## 4.9 User Interface

Details about user interface with descriptions will be presented in this section.



The image shows a mobile application interface for signing up. At the top, there is a status bar with the time 8:44 PM and battery level. Below the status bar is a green logo with Arabic calligraphy. The main heading is "Proceed with your Sign up" followed by "Sign Up" in a larger font. There are four input fields: "Name", "Email", "Password", and "Confirm Password". The "Password" and "Confirm Password" fields have a green eye icon to toggle visibility. Below the input fields is a large green button labeled "Sign Up". At the bottom, there is a link that says "Already have an account? Login Now".

8:44 PM

الكتاب

Proceed with your Sign up

### Sign Up

Name

Email

Password

Confirm Password

Sign Up

Already have an account? [Login Now](#)



Proceed with your

## Login



Login

[Forget Password](#)

Don't have an account? [Register Now](#)

8:44 PM

← Forget Password

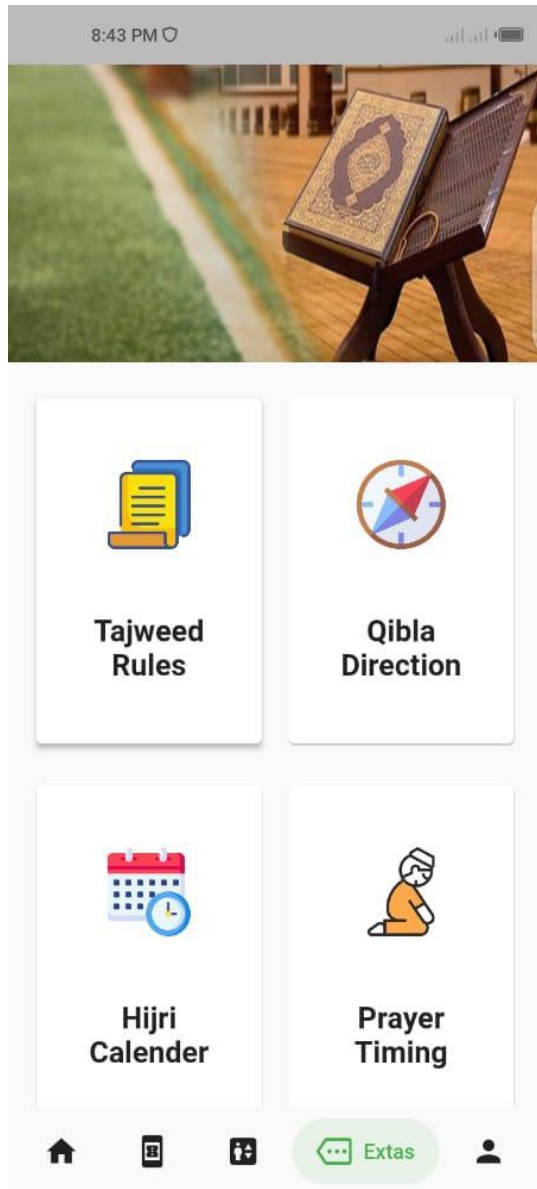
الكتاب

Enter Your Email Address

Email

Forget Password







**Quran**



**Prayer**

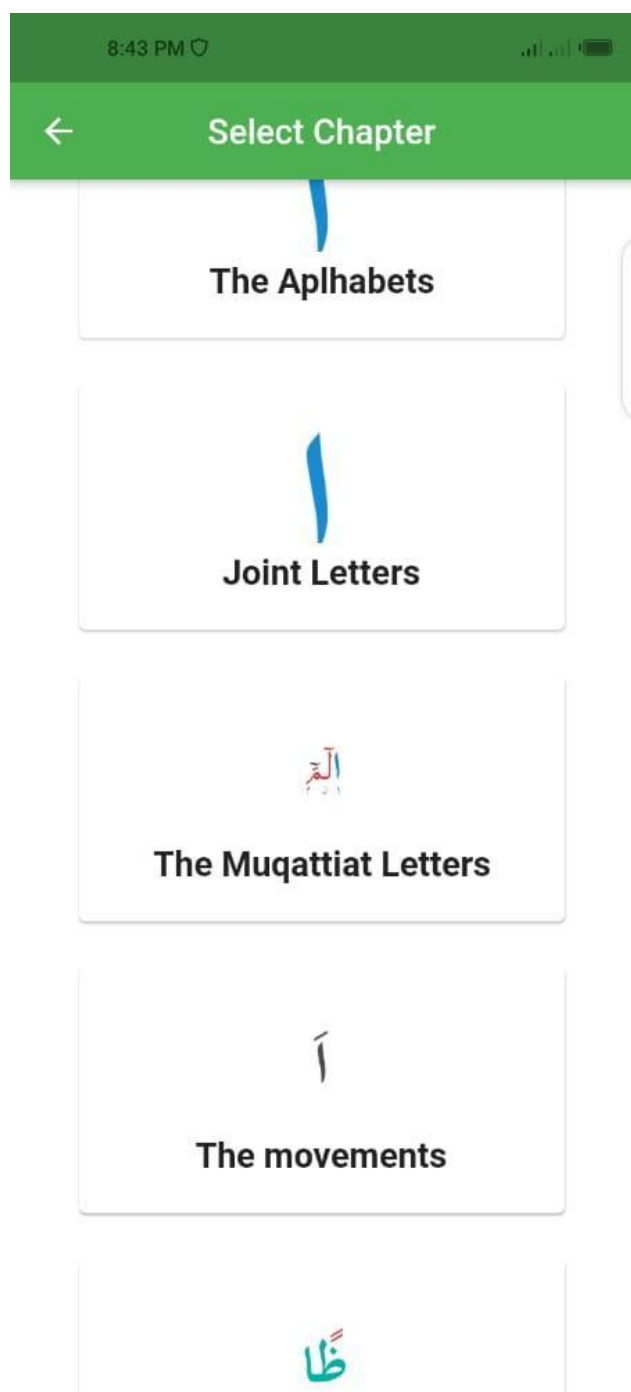


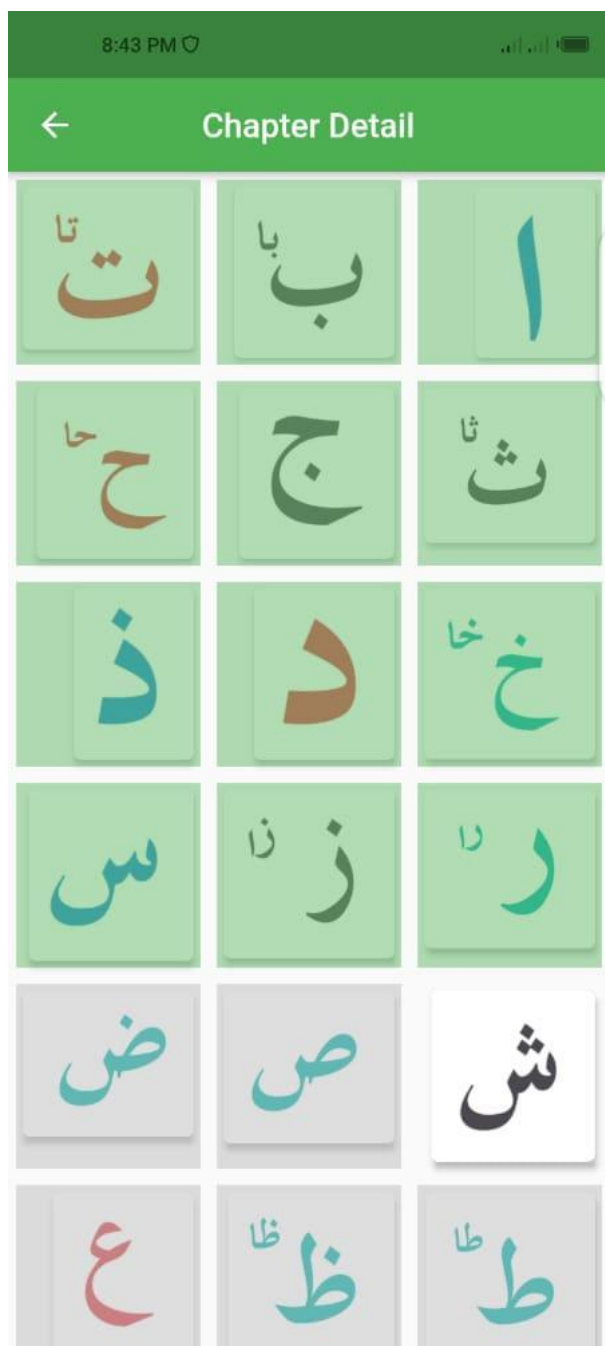
**Qalma**

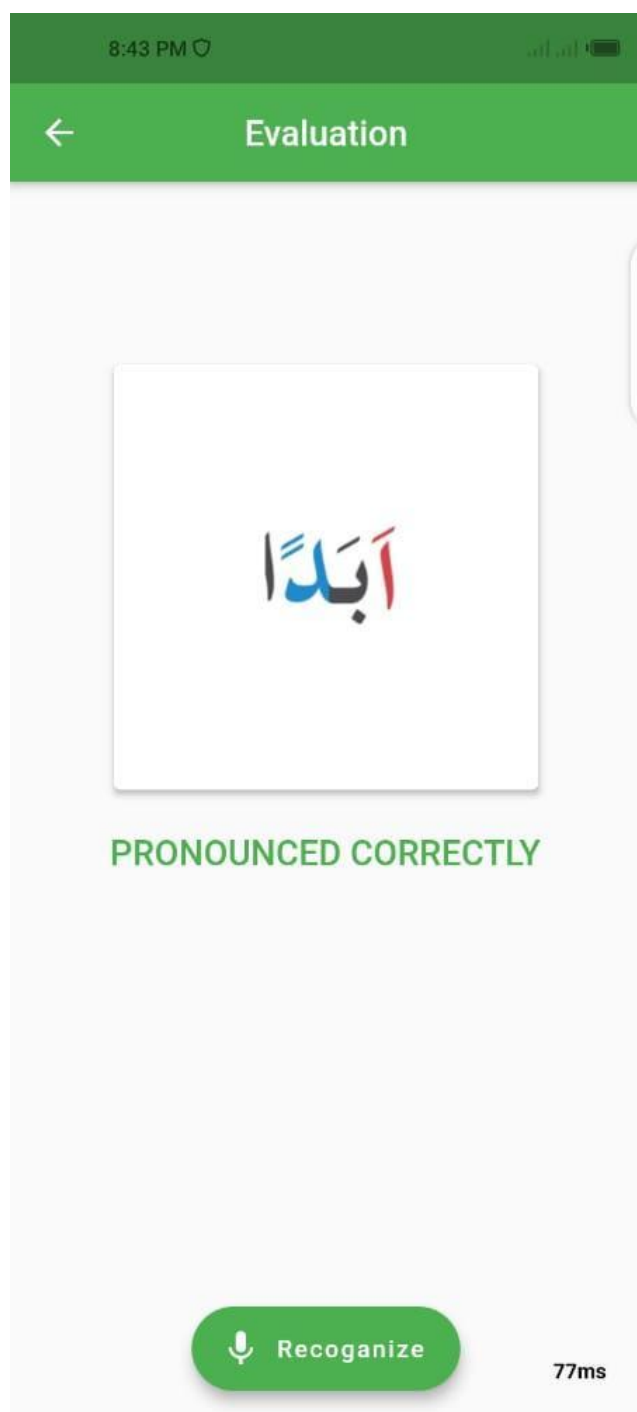


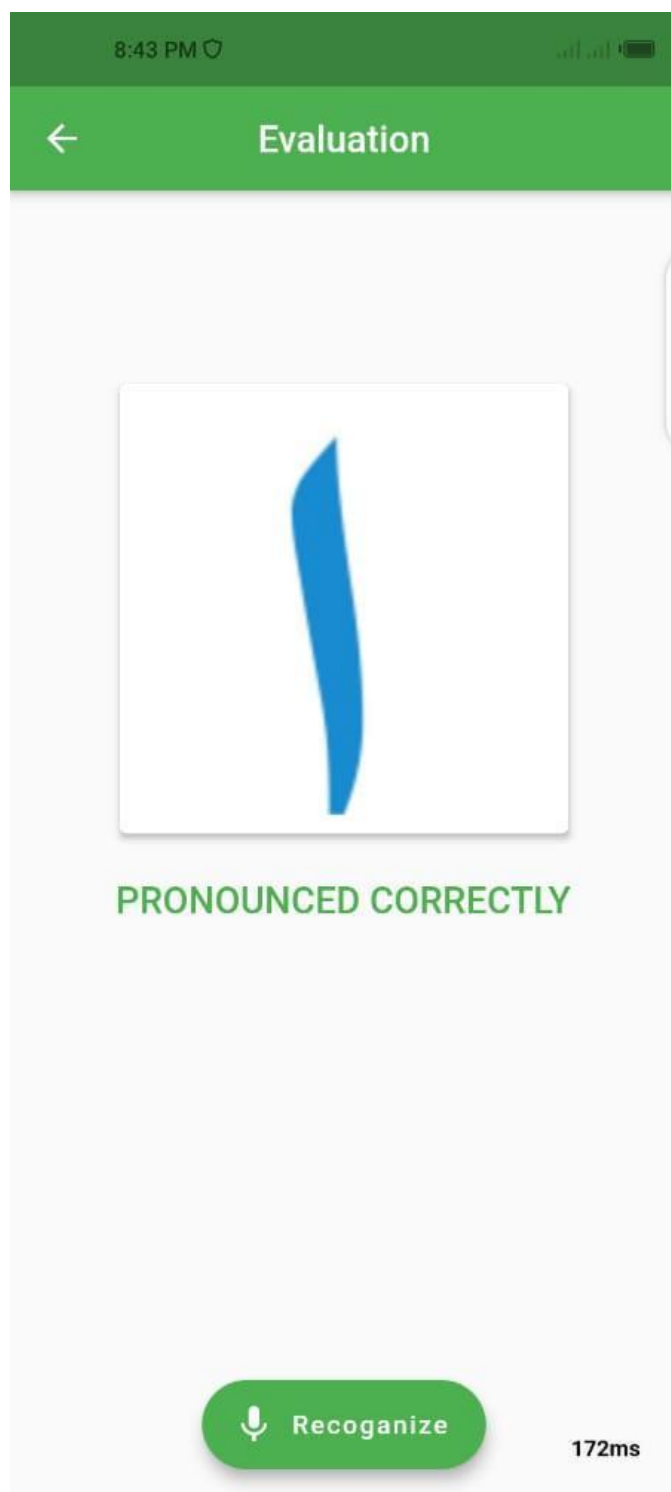
**Learn**

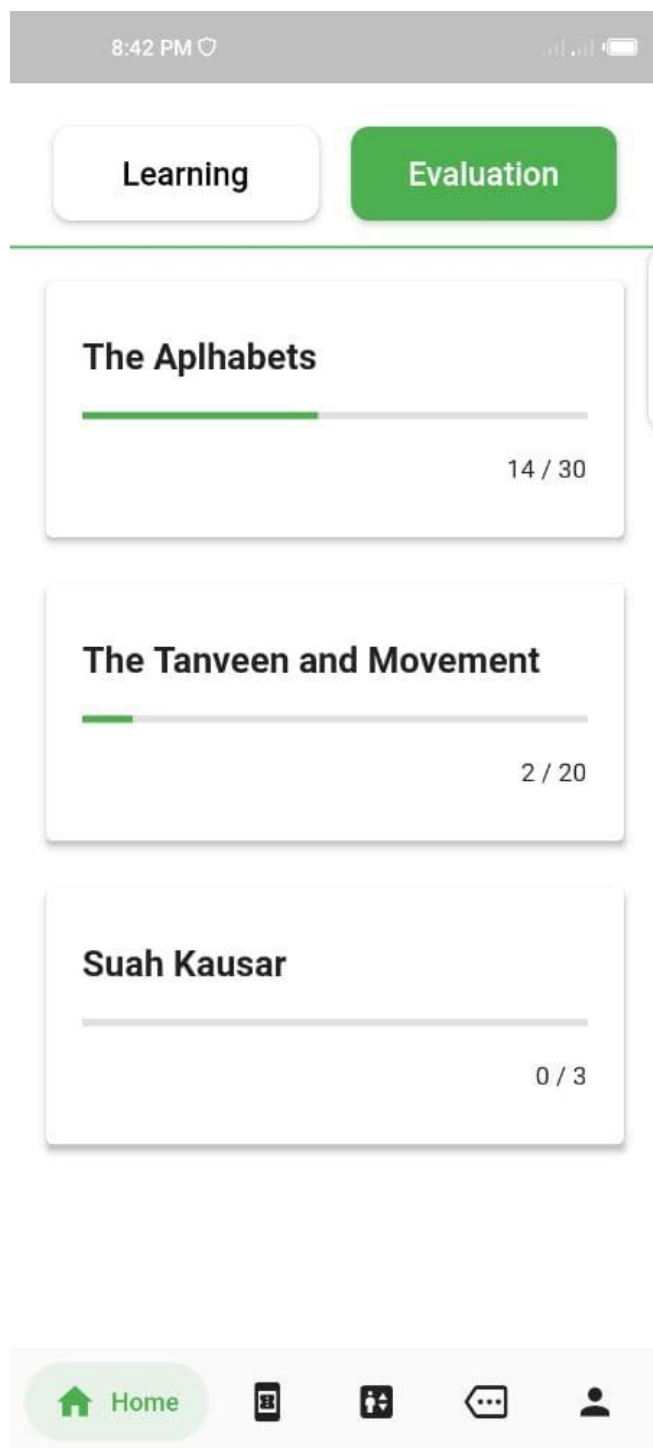












8:42 PM

Learning

Evaluation

The Aplhabets

Qari 1

12 / 30

Qari 2

0 / 30

Joint Letters

Qari 1

0 / 50

Qari 2

0 / 50

The Muqattiat Letters

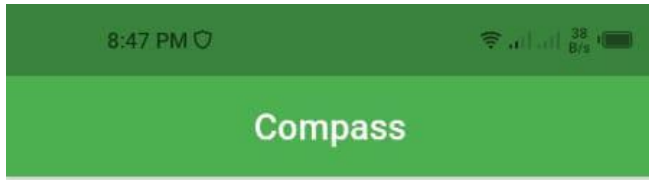
Qari 1

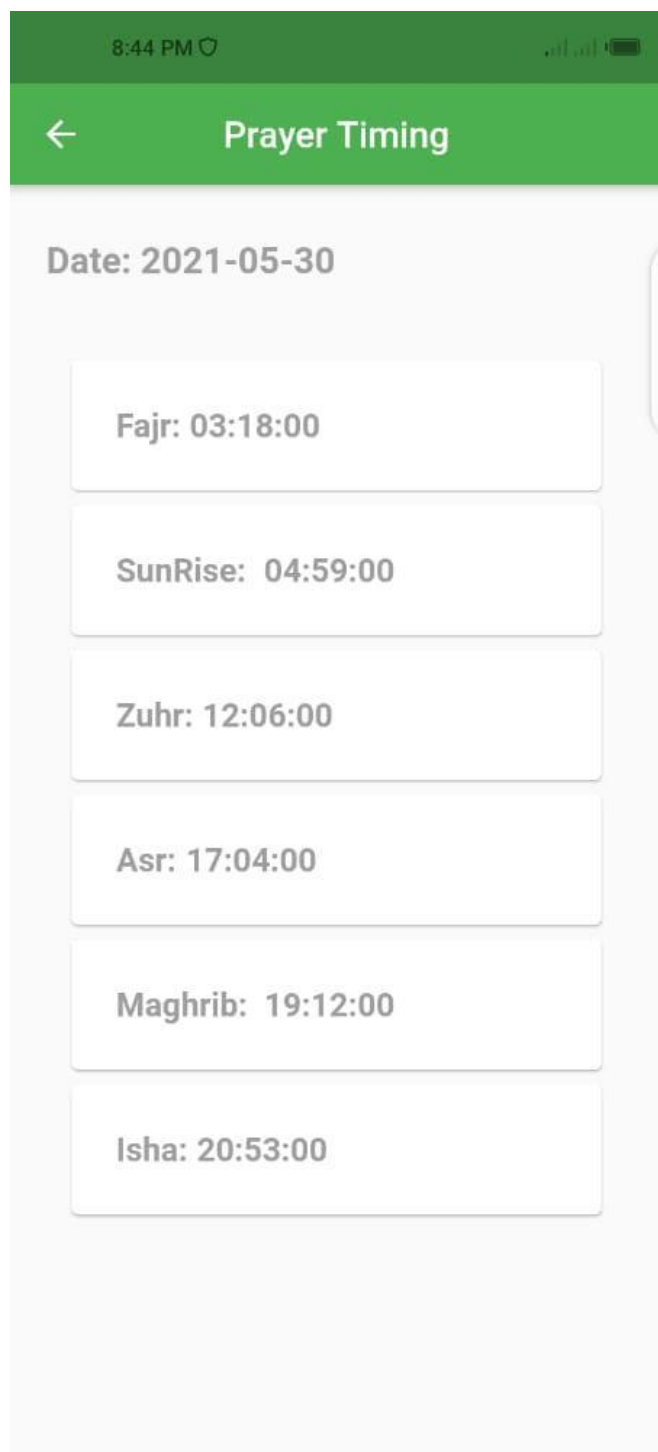
0 / 14

Qari 2

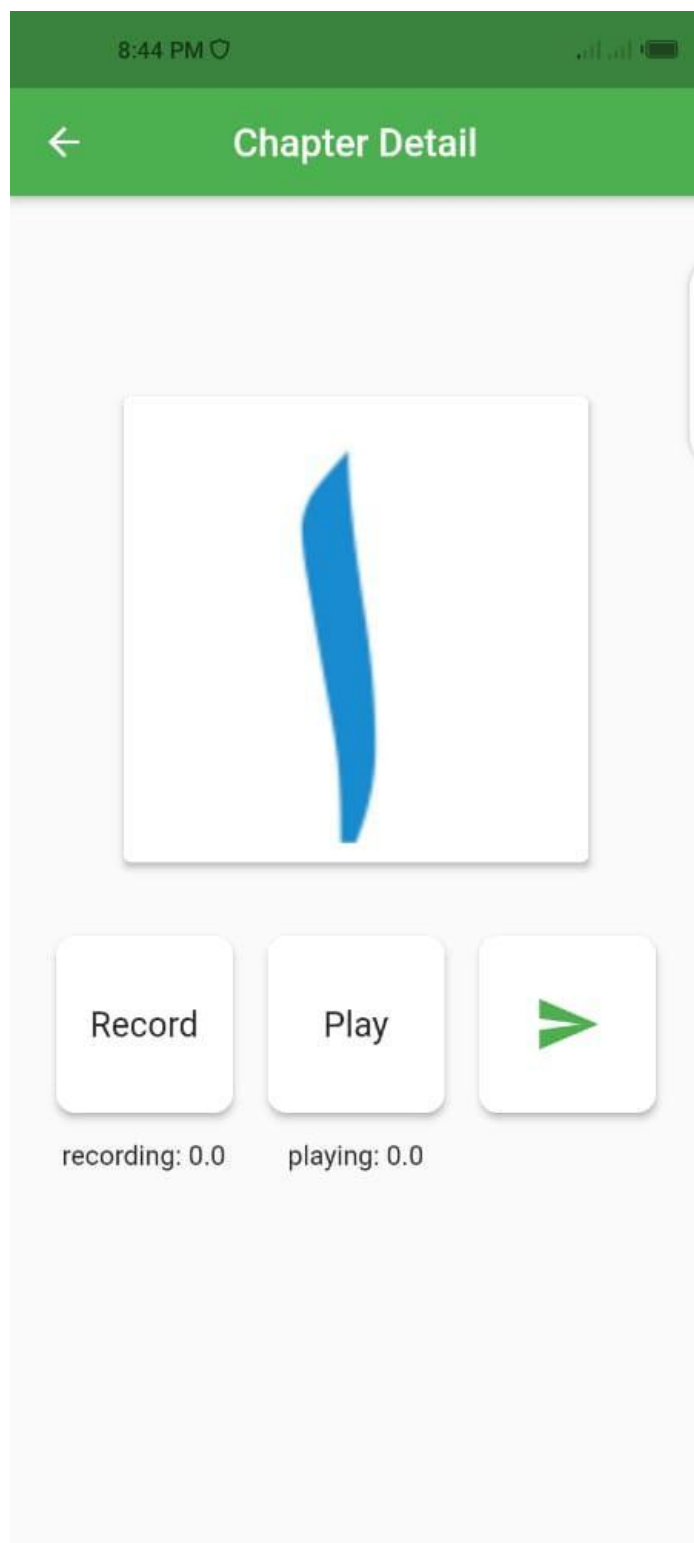
Home

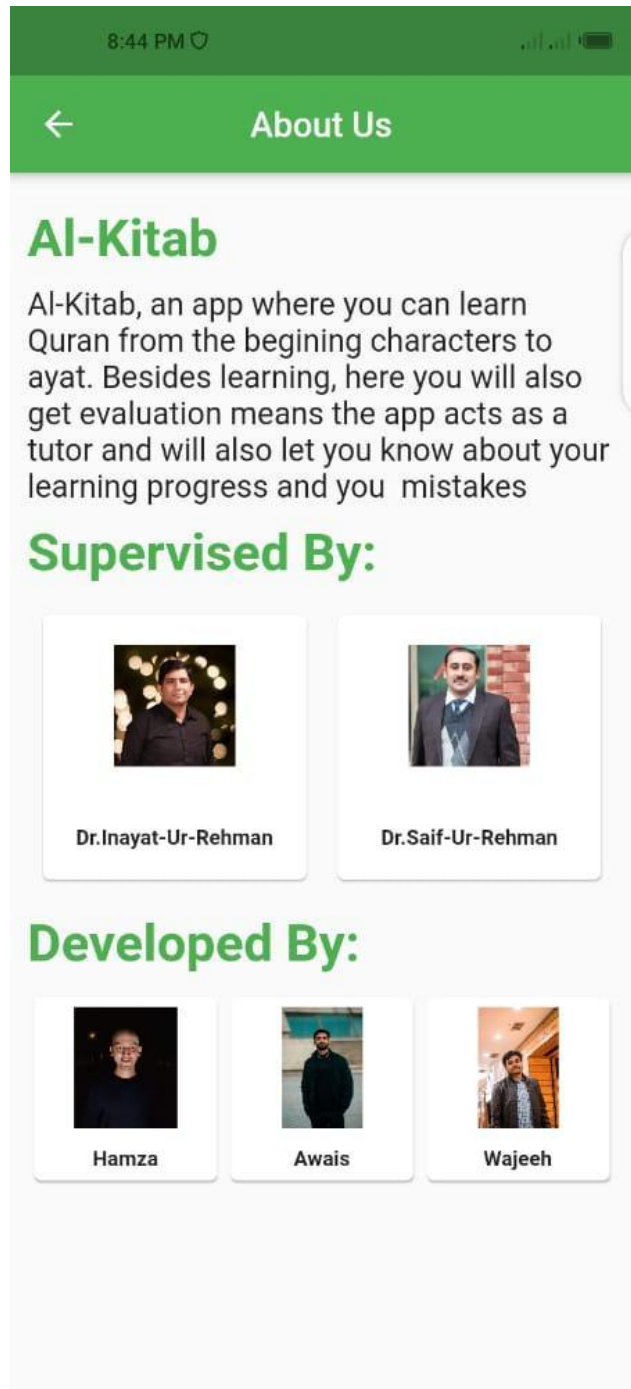












## 5 Testing and Evaluation

### 5.4 Manual Testing

#### 5.4.5 Unit Testing

##### Unit Testing 1: Signup

**Testing Objective:** To ensure the signup form is working correctly.

**Test Case Id:** U\_001

**Test Case Description:** Test the signup functionality.

**Test Scenario:** Verify on entering valid details, the user can sign up.

**Table 6.1: Test Cases for Sign Up**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify user sign up after click on the 'Sign Up' button with correct input data	<b>Username:</b> Awais <b>Email:</b> Agondal62@gmail.com <b>Password:</b> 12345678 <b>Confirm Password:</b> 12345678	Successfully sign up into the system as new user	As Expected	Pass
2.	Verify user sign up after click on the 'Sign Up' button with incorrect input data	<b>Email:</b> Agondal62@gmail.com <b>Password:</b> 12345678 <b>Confirm Password:</b> 12345678	Please enter a valid username	Error	Fail
3.	Verify user sign up after click on the 'Sign Up' button with incorrect input data	<b>Name:</b> a1234 Agondal62@gmail.com <b>Password:</b> 12345678 <b>Confirm Password:</b> 12345678	Please enter name in correct format.	Error	Fail

4.	Verify user sign up after click on the 'Sign Up' button with incorrect input data	<b>Username:</b> Awais <b>Email:</b> Agondal62@gmail <b>Password:</b> 12345678 <b>Confirm Password:</b> 12345678	Please enter a valid email	Error	Fail
5.	Verify user sign up after click on the 'Sign Up' button with incorrect input data.	<b>Username:</b> Awais <b>Email:</b> Agondal62@gmail.com <b>Password:</b> 12345 <b>Confirm Password:</b> 12345678	Password must of length 8	Error	Fail
6.	Verify user sign up after click on the 'Sign Up' button with incorrect input data.	<b>Username:</b> Awais <b>Email:</b> Agondal62@gmail.com <b>Password:</b> 12345678 <b>Confirm Password:</b> 125678	Password and confirmed password should match.	Error	Fail

## Unit Testing 2: Login

**Testing Objective:** To ensure the login form is working properly.

**Test Case Id:** U\_002

**Test Case Description:** Test the login functionality.

**Test Scenario:** Verify on entering valid email and password, the user can login

**Table 6.2: Test Cases for Login**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
------	-----------------------	-----------	-----------------	---------------	----------------------------------

1.	Verify user login in after click on the 'Sign In' button with correct input data	<b>Email:</b> Agondal62@gmail.com <b>Password:</b> 12345678	Successfully log into the main page of the application	As Expected	Pass
2.	Verify user sign in after click on the 'Sign In' button with incorrect input data	<b>Email:</b> Agondal62@gmail.com <b>Password:</b> 12345678	Email or password is not correct	Error	Fail
3	Verify user sign in after click on the 'Sign In' button with incorrect input data	<b>Email:</b> Agondal62@gmail.com <b>Password:</b> 123458	Email or password is not correct	Error	fail

### Unit Testing 3: Learning

**Testing Objective:** To ensure the learning section is working properly.

**Test Case Id:** U\_003

**Test Case Description:** Test the learning module.

**Test Scenario:**

**Table 6.3: Test Cases for Learning**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify that that learning audio is playing on tapping a character or word.		Successfully play the audio	As Expected	Pass
2.	Verify that the next character		Successfully unlocked.	As expected	Pass



	or word gets unlock.				
3	Verify that nothing happens on tapping a locked character or word.		No action occurred.	As expected	Pass
4	Verify that the color of tapped character or word changes to green.		Successfully changed the color.	As expected	pass
5	Verify that the color of unlocked character or word is white		The color is white.	As expected	pass
6	Verify that the color of locked character or word is grey.		The color is grey.	As expected	Pass

#### **Unit Testing 4:** Forget Password

**Testing Objective:** To check that the forget password works correctly

**Test Case Id:** BU\_004

**Test Case Description:** Test the forget password

**Test Scenario:** Verify on checking the link sent on email address

**Table 6.4: Test Cases for Forget Password**

No.	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify user can retrieve password by clicking on forget password button	<b>Email:</b> hamza@gmail.com	Successfully entered and can now have a new password	As Expected,	Pass
2.	Verify user can retrieve password by clicking on forget password button	<b>Email:</b> Hamza1122@gmail.com	The email entered is incorrect		Fail

**Unit Testing 4: Progress**

**Testing Objective:** To ensure the login form is working properly.

**Test Case Id:** U\_004

**Test Case Description:** Test the progress of user.

**Test Scenario:** Verify that the progress is visible on home screen.

**Table 6.4: Test Cases for Progress**

No.	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify that the progress is visible to the user.		Progress is visible on home screen.	As Expected	Pass

**Unit Testing 5: Prayer**

**Testing Objective:** To ensure that the prayer method is visible to user.

**Test Case Id:** U\_005

**Test Case Description:** Test the prayer method visibility to user.

**Test Scenario:** Verify that the prayer method is visible on prayer screen.

**Table 6.5: Test Cases for Prayer**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify that the prayer method is visible to the user.		Prayer method is visible on prayer screen.	As Expected	Pass

**Unit Testing 6:** Kalimas

**Testing Objective:** To ensure that the Kalimas are visible to user.

**Test Case Id:** U\_006

**Test Case Description:** Test the Kalimas visibility to user.

**Test Scenario:**

**Table 6.6: Test Cases for Kalimas**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify that the Kalimas are visible to the user.		Kalimas are visible.	As Expected	Pass
2.	Verify that the user can play to Kalima on tapping the play button.		The audio will be played.	As Expected	Pass.

**Unit Testing 7:** Qibla direction

**Testing Objective:** To ensure that the user is getting correct direction of qibla.

**Test Case Id:** U\_007

**Test Case Description:** Test that the user is getting correct direction of the qibla.

**Test Scenario:**

**Table 6.7: Test Cases for Qibla direction**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	verify that the user is getting correct direction of the qibla.	Current location of user	The direction to qibla will be displayed.	As Expected	Pass

**Unit Testing 8:** Prayer Timing

**Testing Objective:** To ensure that the user is getting correct Timings of prayer.

**Test Case Id:** U\_008

**Test Case Description:** Test that the user is getting correct timings of the prayers.

**Test Scenario:**

**Table 6.8: Test Cases for Prayer Timing**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	verify that the user is getting correct timings of the prayer.	Current location of user	The timing of the prayers will be displayed.	As Expected	Pass

**Unit Testing 9:** Islamic calendar

**Testing Objective:** To ensure that the Islamic calendar is displayed to user.

**Test Case Id:** U\_009

**Test Case Description:** Test that the user is getting correct Islamic date.

**Test Scenario:**

**Table 6.9: Test Cases for Islamic calendar**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify that the user is getting correct Islamic date.		The calendar will be displayed	As Expected	Pass

**Unit Testing 10:** Tajweed rules

**Testing Objective:** To ensure that the user can see the tajweed rules.

**Test Case Id:** U\_010

**Test Case Description:** Test that the user can see the tajweed rules.

**Test Scenario:**

**Table 6.10: Test Cases for : Tajweed rules**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	verify that the user can see the tajweed rules.		Tajweed rules will be showed to user.	As Expected	Pass

**Unit Testing 11:** Qari portal

**Testing Objective:** To ensure that the user can access the qari portal

**Test Case Id:** U\_011

**Test Case Description:** Test that the user can access the qari portal.

**Test Scenario:** The user will record the audio and send it to server

**Table 6.11: Test Cases for Progress**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify that the user can access the qari portal		The user will be able to switch to qari portal from user.	As Expected	Pass
2.	Verify that the user can record the audio.	The audio recorded from mobile's microphone.	The user will be able to record the audio.	As expected.	Pass
3.	Verify that the user can play the recorded the audio.	The audio recorded from microphone.	The user will be able to play the audio.	As expected.	Pass.
4.	Verify that the user can send the recorded audio to the server.	The audio recorded from microphone.	The user will be able to send the audio to server.	As expected.	Pass

#### **Unit Testing 12: Logout**

**Testing Objective:** To ensure that the user can log out of the application.

**Test Case Id:** U\_012

**Test Case Description:** Test that the user can logout.

**Test Scenario:**

**Table 6.12: Test Cases for Progress**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Test that the user can logout.		The user will be logged out of the application.	As Expected	Pass

**Unit Testing 13: Evaluation**

**Testing Objective:** To ensure the evaluation section is working properly.

**Test Case Id:** U\_013

**Test Case Description:** Test the evaluation module.

**Test Scenario:**

**Table 6.13: Test Cases for Evaluation**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify that the user can record the audio.	The audio recorded from mobile's microphone.	Successfully play the audio	As Expected	Pass
2.	Verify that the next character or word gets unlock.		Successfully unlocked.	As expected	Pass
3	Verify that nothing happens on tapping a locked		No action occurred.	As expected	Pass

	character or word.				
4	Verify that the color of evaluated character or word changes to green.		Successfully changed the color.	As expected	pass
5	Verify that the color of unlocked character or word is white		The color is white.	As expected .	pass
6	Verify that the color of locked character or word is grey.		The color is grey.	As expected .	Pass

#### Unit Testing 7: Selecting the Mode

**Testing Objective:** To check the the user can select the mode

**Test Case Id:** BU\_007

**Test Case Description:** Test that user can select the mode

**Test Scenario:** Verify on selecting the mode.

**Table 6.7: Test Cases for View Statistics**

No.	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
-----	-----------------------	-----------	-----------------	---------------	----------------------------------



1.	Verify that the user can select the mode	The user selects on the learning mode	The user has successfully entered in the learning mode	As Expected,	Pass
2.	Verify that the user can select the mode	The user clicks on the evaluation mode	The user has successfully entered in the Evaluation mode		Pass

#### Unit Testing 8: Selecting the Lesson

**Testing Objective:** To check the the user can select the lesson

**Test Case Id:** BU\_008

**Test Case Description:** Test that user can select the lesson

**Test Scenario:** Verify on selecting the lesson.

**Table 6.8: Test Cases for Selecting the lesson**

No.	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
-----	-----------------------	-----------	-----------------	---------------	----------------------------------

1.	Verify that the user can select the lesson	The user selects the first lesson	The user has successfully entered in the first lesson for learning	As Expected,	Pass
2.	Verify that the user can select the word in a specific lesson.	The user has entered in the first lesson at first time and selects any word expect the first word	The user cannot select any word except the first word.		Fail
3	Verify that the user can select the lesson	The user has not learned the first lesson and is trying to open the lesson 2	The user cannot open the lesson 2 because he/she has not learned the lesson 1		Fail

### Unit Testing 9: Selecting the Qari

**Testing Objective:** To check the the user can select the Qari

**Test Case Id:** BU\_009

**Test Case Description:** Test that user can select the Qari

**Test Scenario:** Verify on selection of the Qari

**Table 6.8: Test Cases for Selecting the Qari**

No.	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify that the user can select the Qari	The user is in the Learning Mode	The user has successfully selected the Qari of his/her own choice	As Expected,	Pass
2.	Verify that the user can select the Qari	The user is in Evaluation mode	The user cannot select Qari because he/she is in evaluation mode		Fail

**Unit Testing 11: Highlighted Words**

**Testing Objective:** The words are highlighted with different colors

**Test Case Id:** BU\_011

**Test Case Description:** Test that user can see the colors

**Test Scenario:**

**Table 6.11: Test Cases for Highlighted Words**

No.	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
-----	-----------------------	-----------	-----------------	---------------	----------------------------------

1.	Verify that the proper colors are shown when he clicks on the next button	The user has listened a word	The color of the word is green	As Expected,	Pass
2.	Verify that the proper colors are shown when he clicks on the next button .	The user has not listened some of the words	All these words are colored white		Pass

#### Unit Testing 16: Extracting Features

**Testing Objective:** Features are to be extracted for comparison

**Test Case Id:** BU\_016

**Test Case Description:** Test that features are being extracted

**Test Scenario:**

**Table 6.16: Test Cases for Feature Extraction**

No.	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
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1.	Verify that the Features like Amplitude, Frequency and Time will be extracted from audio. Waveform of the voice of the users will be compared with the average waveform of all data sets.	Audio has been uploaded	Features are extracted	As Expected,	Pass
2	Verify that the Features like Amplitude, Frequency and Time will be extracted from audio. Waveform of the voice of the users will be compared with the average waveform of all data sets.	Audio is not uploaded	Features will not be extracted		Fail

#### 5.4.6 Functional Testing

### Functional Testing 1: Sign up

**Test Objective:** To ensure that the sign-up form working correctly.

**Test Case Id:** FT\_001

**Test Case Description:** Test that a user can sign-up successfully

**Test Scenario:** Verify that the user can be able to sign-up

**Table 6.14: Test Cases for Signup**

No.	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify user sign up after click on the 'Sign Up' button with correct input data	<b>Username:</b> Awais <b>Email:</b> Agondal62@gmail.com <b>Password:</b> 12345678	Successfully sign up into the application as new user	As Expected,	Pass
2.	Verify user sign up after click on the 'Sign Up' button with incorrect input data	<b>Email:</b> Agondal62@gmail.com <b>Password:</b> 1234	Please enter a valid username	As Expected,	Fail
3.	Verify that the user is added to server.	<b>Username:</b> Awais <b>Email:</b> Agondal62@gmail.com <b>Password:</b> 12345678	User successfully added to server.	As expected	Pass

### Functional Testing 2: Login

**Test Objective:** To ensure that the correct page with the correct screen loaded.

**Test Case Id:** FT\_002

**Test Case Description:** Test that a user can login successfully, after sign up with his

**Test Scenario:** Verify that the user can be able to sign in with his desired role

**Table 6.15: Test Cases for Login with different Roles**

No.	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify user sign in after click on the 'Log In' button with correct input data	<b>Email:</b> Agondal62@gmail.com <b>Password:</b> 12345678	Successfully log into the main screen of the application	As Expected	Pass
2.	Verify user sign in after click on the 'Log In' button with incorrect input data	<b>Email:</b> Agondal62@gmail.com <b>Password:</b> 12345678	Error message	Please enter a valid password	Fail

**Functional Testing 3:** Learning

**Test Objective:** To ensure that the learning module is working correctly.

**Test Case Id:** FT\_003

**Test Case Description:** Test that the learning module is performing its functionality correctly

**Test Scenario:**

**Table 6.16: Test Cases for Learning**

No.	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify that that learning audio is playing on tapping a character or word.		Successfully play the audio	As Expected	Pass

2.	Verify that the next character or word gets unlock.		Successfully unlocked.	As expected	Pass
3	Verify that nothing happens on tapping a locked character or word.		No action occurred.	As expected	Pass
4	Verify that the color of tapped character or word changes to green.		Successfully changed the color.	As expected	pass
5	Verify that the color of unlocked character or word is white		The color is white.	As expected	pass
6	Verify that the color of locked character or word is grey.		The color is grey.	As expected	Pass
7.	Verify that only one audio is being played at one time		Only one audio will be played	As expected	pass
8.	Verify that progress is uploaded to local storage on pressing a character or word.	The data of the character or word.	The progress will be saved in local storage.	As expected	pass
9.	Verify that the progress is uploaded on server.	The data of the character word.	The progress will be saved on server.	As expected	Pass

#### Functional Testing 4: Evaluation



**Testing Objective:** To ensure the evaluation section is working properly.

**Test Case Id:** FT\_004

**Test Case Description:** Test the evaluation module.

**Test Scenario:**

**Table 6.17: Test Cases for Evaluation**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify that the user can record the audio.	The audio recorded from mobile's microphone.	Successfully play the audio	As Expected	Pass
2.	Verify that the next character or word gets unlock.		Successfully unlocked.	As expected	Pass
3	Verify that nothing happens on tapping a locked character or word.		No action occurred.	As expected	Pass
4	Verify that the color of evaluated character or word changes to green.		Successfully changed the color.	As expected	pass
5	Verify that the color of unlocked character or word is white		The color is white.	As expected .	Pass
6	Verify that the color of locked character or word is grey.		The color is grey.	As expected .	Pass
7.	Verify that the model is successfully	Machine learning model of TensorFlow lite.	The application will load the model.	As expected	Pass

	loaded into application				
8.	Verify that the labels of the model are correctly loaded into application.	Labels from the model.	The application will load the labels into the application.	As expected	Pass
9.	Verify that the recorded audio is passed to model.	Recorded audio from mobile's microphone.	The recorded audio will be passed to model	As expected	Pass
10.	Verify that the model is returning the result.	Recorded audio from mobile's microphone.	The model will return the result.	As expected	Pass
11.	Verify that the returned result from the model is shown to user.	Result returned from model.	The result will be shown to user.	As expected	Pass
12.	Verify that progress is uploaded to local storage on pronouncing correctly.	The data of the character or word.	The progress will be saved in local storage.	As expected	pass
13.	Verify that the progress is uploaded on server.	The data of the character word.	The progress will be saved on server.	As expected	pass

#### **Functional Testing 5: Model training**

**Test Objective:** To ensure that the model is training correctly..

**Test Case Id:** FT\_005

**Test Case Description:** Test that the model is trained according to requirements

**Test Scenario:**

**Table 6.18: Test Cases for Login with different Roles**

No.	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify that the model is getting correct dataset	<b>Dataset in the form of audios</b>	The model is loading correct dataset	As Expected	Pass
2.	Verify that the model is getting correct labels.	<b>Labels of the audios</b>	The model is loading correct labels.	As expected	pass
3.	Verify that the model is extracting features using MFCC from the dataset	<b>Dataset in the form of audios</b>	Model is extracting features.	As expected	pass
4.	Verify that the model is training.		Trained model	As expected	Pass
5.					

#### Functional Testing 06: Model training

**Test Objective:** To ensure that the model is training correctly..

**Test Case Id:** FT\_006

**Test Case Description:** Test that the model is trained according to requirements

**Test Scenario:**

**Table 6.19: Test Cases for Progress**

No.	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify that the progress is saving on local storage	Data from learning and evaluation.	Progress is saved.	As Expected	Pass
2.	Verify that the progress is loaded from the server.	Data from learning and evaluation.	Progress is saved.	As expected	pass

#### Functional Testing 07: Qibla direction

**Testing Objective:** To ensure that the user is getting correct direction of qibla.

**Test Case Id:** FT\_007

**Test Case Description:** Test that the user is getting correct direction of the qibla.

**Test Scenario:**

**Table 6.20: Test Cases for Qibla direction**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	verify that the user is getting correct direction of the qibla.	Current location of user	The direction to qibla will be displayed.	As Expected	Pass

**Functional Testing 8: Prayer Timing**

**Testing Objective:** To ensure that the user is getting correct Timings of prayer.

**Test Case Id:** FT\_008

**Test Case Description:** Test that the user is getting correct timings of the prayers.

**Test Scenario:**

**Table 6.21: Test Cases for Prayer Timing**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	verify that the user is getting correct	Current location of user	The timing of the prayers will be displayed.	As Expected	Pass

	timings of the prayer.				
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#### **functional Testing 9: Islamic calendar**

**Testing Objective:** To ensure that the Islamic calendar is displayed to user.

**Test Case Id:** FT\_009

**Test Case Description:** Test that the user is getting correct Islamic date.

**Test Scenario:**

**Table 6.22: Test Cases for Islamic calendar**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Verify that the user is getting correct Islamic date.		The calendar will be displayed	As Expected	Pass

#### **Functional Testing 10: Qari portal**

**Testing Objective:** To ensure that the user can access the qari portal

**Test Case Id:** FT\_010

**Test Case Description:** Test that the user can access the qari portal.

**Test Scenario:** The user will record the audio and send it to server

**Table 6.23: Test Cases for Progress**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
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1.	Verify that the user can access the qari portal		The user will be able to switch to qari portal from user.	As Expected	Pass
2.	Verify that the user can record the audio.	The audio recorded from mobile's microphone.	The user will be able to record the audio.	As expected.	Pass
3.	Verify that the user can play the recorded the audio.	The audio recorded from microphone.	The user will be able to play the audio.	As expected.	Pass.
4.	Verify that the user can send the recorded audio to the server.	The audio recorded from microphone.	The user will be able to send the audio to server.	As expected.	Pass

### 5.4.7 Integration Testing

#### Integration Testing 1: User Sign up

**Testing Objective:** Check the interface link between the sign up and login

**Test Case Id:** IT\_001

**Test Case Description:** Test the login functionality.

**Test Scenario:** User wants to switch from sign up to login screen.

**Table 6.24: Test Cases for Integration Testing of User Login**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	verify the interface link between the sign up and login screen	<b>Username:</b> Awais <b>Email:</b> Agondal62@gmail.com <b>Password:</b> 12345678 <b>Confirm Password:</b> 12345678	to be directed to login screen	As Expected	Pass
2.	Verify the interface link between login and sign up		To be directed to sign up screen from login	As expected	pass

#### Integration Testing 2: User login

**Testing Objective:** Check the interface link between the login and Home screen

**Test Case Id:** IT\_001

**Test Case Description:** Test the login functionality.

**Test Scenario:** User wants to switch from sign up to login screen.

**Table 6.25: Test Cases for Integration Testing of User Login**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	verify the interface link between the login and home screen.	<b>Email:</b> Agondal62@gmail.com <b>Password:</b> 12345678	To be directed to home screen after successfully logging	As Expected	Pass

			into the application.		
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### Integration Testing 3: logout

**Testing Objective:** Check the interface link between the logout and login screen

**Test Case Id:** IT\_003

**Test Case Description:** Test the logout functionality.

**Test Scenario:** User wants to logout of application

**Table 6.25: Test Cases for Integration Testing of User Login**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Check the interface link between the logout and login screen		To be directed to login screen after logging out of application.	As Expected	Pass

### Integration Testing 3: Home screen

**Testing Objective:** Check the interface link of the home screen

**Test Case Id:** IT\_003

**Test Case Description:** Test the home screen

**Test Scenario:** User wants to navigate into the application.

**Table 6.25: Test Cases for Integration Testing of User Login**

No .	Test Case/Test Script	Test Data	Expected Result	Actual Result	Pass/Fail/Not Executed/Suspended
1.	Check the interface link of learning progress and evaluation progress on home screen.		To be directed back and fourth on progress of learning and evaluation module.	As Expected	Pass
2.	Check the interface link between		To be directed to learning	As expected	pass



	home screen and learning module		module of the application		
3.	Check the passing of data from learning module to home screen	Detail of the data being passed	Updated progress on home screen.	As expected	pass
4.	Check the interface link between home screen and evaluation module		To be directed to evaluation module of the application	As expected	pass
5.	Check the passing of data from evaluation module to home screen	Detail of the data being passed	Updated progress on home screen.	As expected	pass
6.	Check the interface link between home screen and Tajweed rules		To be directed to tajweed rules section of the application	As expected	pass
7.	Check the interface link between home screen and qibla direction		To be directed to qibla direction section of the application	As expected	pass
8.	Check the interface link between		To be directed to hijrji calendar	As expected	pass

	home screen and hirji calendar		of the application		
9.	Check the interface link between home screen and prayer timing		To be directed to prayer timing of the application	As expected	pass
10.	Check the interface link between home screen and Qari portal		To be directed to Qari portal	As expected	Pass

#### 5.4.8 System Testing

Learning Quran is developed and the testing was performed manually using unit testing, functional testing and integration testing by the project individuals. The functional testing was carried out using different roles. Then, after all the individual modules were integrated, integration testing was performed. Finally, the whole system testing was carried out and aligned with the functional requirements and almost all the results were as expected.

## **6 Conclusion and Future Work**

### **6.4 Conclusion**

Learning Quran is an application that is designed for the users who live where there is no tutor available. There is no app available till now which provide the facility of evaluation. Qari portal which provide the facility to people who can record their audios so that the audios can be further use for evaluation. Users can learn quran anytime when they want

### **6.5 Future Work**

Till now the application is covered for the entire Noorani Qaida and some of the verses of the holy Quran and we tend to work to make this application for the entire quran in future when we have enough skills and experience to work on that.

## **7 References**

1. <https://theislam360.com/>
2. <https://ieeexplore.ieee.org/document/7549454>
3. <https://machinelearningmastery.com/introduction-python-deep-learning-library-tensorflow/>

4. <https://www.intechopen.com/books/from-natural-to-artificial-intelligence-algorithms-and-applications/some-commonly-used-speech-feature-extraction-algorithms>
5. <https://github.com/librosa/librosa>