An-Najah National University

Faculty of Engineering and Information Technology

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FOOTBALL FANBOOK

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Dedication

First and foremost, to God be all the praise. We have reached this point in our educational path thanks to his heavenly guidance.

To the person whose wisdom and advice have consistently inspired us. Our Master Muhammad, may God bless him and grant him peace.

To the souls of our brave martyrs. Whose sacrifices have taught us the true meaning patience and motivated us to continue pursuing dreams on behalf of many of them.

To those whose prayers and supplications were the secret of our success. To all those who believed in us, enveloped us with love and encouragement, lifted our spirits, and extended a hand when we felt on the brink of giving up our dear family, friends, and teacher thank you from the depths of our hearts for being an inseparable part of this journey.

Here stands this modest effort, a proof of the love and support that have driven us along the way.

Acknowledgment

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Disclaimer Statement

This report was written by ***Najat Mansour*** and ***Mohammad Alawneh*** at the Computer Engineering Department, Faculty of Engineering, An-Najah National University. It has not been altered or corrected, other than editorial corrections, as a result of assessment and it may contain language as well as content errors. The views expressed in it together with any outcomes and recommendations are solely those of *Najat Mansour* and *Mohammad Alawneh*. An-Najah National University accepts no responsibility or liability for the consequences of this report being used for a purpose other than the purpose for which it was commissioned.

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Abstract

Football is often viewed as the most important thing of trivial ones. While it may not be essential for everyone, it continues to serve as an indispensable escape for those looking to take a break from the fundamental matters of everyday living. Lately, there has been a marked rise in the number of football tournaments, leading to more matches being played. This surge is largely driven by economic factors. Consequently, fan enthusiasm has waned due to the oversaturation of games, causing many to feel bored and skip watching several matches. Furthermore, new technologies have been implemented, some designed to aid referees and others aimed at improving players' performance. As a result, in this software we attempted to use the technology in a different way to decrease the feeling of boredom in football.

One of the most important features that the application supports is **Match Prediction**, where user can make predictions of any today's matches. It's important to note that this isn't a typical prediction based on a final score; instead, users can score points based on their predictions for a variety of events, including home goals, away goals, goal difference, first team to score, first player to score and more, knowing that a user can get “Underdog bonus” to his points in case he predicts an exact score that less than percent of users predicted it. Another creative and new feature that will be implemented is **Live Show** which concludes that a user can pick any 3 players earlier than a match started and he's going to get points during the live match based on the overall performance of the chosen players positivity and negatively, for instance, the user's score will increase if the selected player scores a goal or makes an assist; conversely, the user's score will decrease if the player gets a yellow or red card. The third main feature is a **Quiz System**, this feature gives the user the opportunity to create his own quiz or complete the ones that already exist. The quiz consists of ten multiple-choice questions (10 seconds each) with four possible answers. So, the user's quiz can be solved and rated by other users in the application. Additionally, there’re **Rooms and Chats** where the user can create and join video conferences or have a chat with the other users. Last but not least there’s **Statistics** zone which displays tables and charts about the user’s usage of the application.

In order to implement this software application, we used *JavaScript / Node.js* frameworks and Libraries to develop this application as *Express.js* back-end framework and *React Native* front-end library. *A.I.* was be used for providing a recommended prediction for the match, auto-generated questions and verifying the quiz content before publishing it.

1 Introduction

Arrigo Sacchi, a shoe salesman who later became one of the most famous football coaches in its history spanning more than one hundred and sixty years and one of the founders of what is called modern football, says that "football is the most important of the unimportant things" (*Jacob Steinberg, 2014*). This saying may be used to belittle the most popular sport in the world, but at that time it would not have come from Sacchi, as he here truly emphasizes its importance.

With the many personal and public problems in this world, this sport always remains an outlet that is incomparable to any other option. With its excitement, the beauty of its different scenarios, the high competitiveness, and the mixed feelings it always carries, it may be something unimportant, but it is the refuge that no one ever refuses from all the important things in his life.

Since the beginning of the last millennium, many changes have begun to occur in football, and the economic aspect of it has begun to grow little by little (*Inside the business of football, 2020*), followed by pressure from sponsoring companies to increase the number of tournaments and matches, which may lead to a feeling of fullness from the richness of the dish presented and its diversity. In this context, in 2019, Adidas CEO (Chef Executive Officer) Kasper Rørsted warned of the growing boredom among football fans, citing the fact that he himself had missed watching the UEFA (Union of European Football Associations) Nations League final that same year, and he is a huge fan of the game (*Too much soccer is too much of a good thing, Adidas boss warns, 2019*).

Among the recent changes introduced to football is the increased use of technology in several areas (*Technology in Football, n.d.*), perhaps the most prominent of which are goal-line technology, VAR (Video-Assisted Refereeing) technology, and automated offside technology. This is in addition to its use in analyzing and enhancing player performance.

In this project, we tried to link the last two paragraphs by using technology to increase the enjoyment of football and reduce the feeling of boredom through the application we developed and its various features by allowing the users to provide their predictions for the final score of the matches as well as the performance of the players. Also, the users can challenge themselves by creating and publishing their own quizzes and solving and rating the other ones. The users can communicate with each other using the video conferences or the chats system and they have a section for the statistical charts and numbers of their usage of the application.

In Chapter 2, we will discuss the related and previous work. Chapter 3 will address the methodology. In Chapter 4, we will present the results and analysis, and Chapter 5 will provide a discussion of the findings. Finally, Chapter 6 will conclude with our conclusions, recommendations and future work.

2 Related Work

There are many football-related apps available, but we focus on those that provide predictions and live match updates, rather than just displaying scores, stats, and details. However, our app still covers game outcomes, player stats, and tournament information. Some of the most popular apps in this category are:

SofaScore (*Sofascore, n.d.*) is a well-known app for sports that offers real-time scores, statistics, match details, and updates for various sports. It also allows users to share their match predictions, but with a simple approach, focusing only on the winning team and which team will score first. Naturally, there are other factors to be considered in the prediction, such as forecasting the total goals each team will score and the goal difference that the match will end on.

Primer League Fantasy (*Primer League Fantasy, n.d.*) A very popular app that enables users to choose their starting lineup and earn points according to each player's weekly performance in every English Premier League round. While highly favored, this app is limited to the English Premier League, which is just one of many football tournaments. In addition, you have to wait until the end of the round to find out how many points you have earned.

Football Quiz-Soccer Trivia (*Football Quiz – Soccer Trivia, n.d.*) is a mobile app made to evaluate and improve your knowledge of football. It provides football lovers with an enjoyable and interesting method to test their knowledge of the game by asking themselves and others a wide range of questions. This application was selected to represent the growing category of football-related question apps, although it does not offer the option for users to generate their own quizzes or see their scores.

Applications related to football have increased significantly in quantity in recent years. But these apps might be lacking in some areas, like testing, and they don't yet cover every aspect of the most beloved sport in the world.

This app is a must-have for every true football fan, as it was created by individuals who have used similar apps before and are familiar with their strengths and weaknesses. They have worked to enhance the strengths and implemented additional functionalities to overcome any weaknesses.

The main reason for developing this software was to make football more enjoyable due to the numerous tournaments and matches that can occasionally result in boredom with the sport, as discussed in the introduction section.

3 Methodology

3.1 Main Frameworks / Libraries, Tools and Technologies

3.1.1 Main Frameworks / Libraries

- **Front-End**
  - ✓ React Native library (*React Native, n.d.*) for the mobile application.
  - ✓ React library (*React, n.d.*) for the website.

- **Back-End**
  - ✓ **Express.js framework** (*Express.js, n.d.*): To build a complete back-end REST (Representation State Transfer) API (Application Programming Interface) to serve both the mobile application and the website.
  - ✓ **node-cron** (*node-cron, n.d.*) module: Tasks / Events scheduler module, it's used in the application to run procedures every time period:
    - Calculate the users' scores.
    - Notify the users about their favorite team matches.
    - Reset User's X2Booster counter to 5 every week (will be explained later on the Discussion chapter).

    To implement the calculation part of the back-end there are multiple alternatives to choose between them:
    - Allow the admins to enter the scores and the events of the matches and this will result in management application without the most amazing part of it "The automation of the calculation process".
    - Re-calculate the scores each time a user required his / her score and this will make the other users see in-correct score for a user who doesn't require his / her score.
    - Use tasks / events scheduler such as node-cron to re-calculate the scores every time period with some customization to avoid re-calculating the scores of a "finished and already calculated" match.

3.1.2 Tools

- **Workspace Tools**
  - ✓ **Visual Studio Code (VS Code)**: Very popular code editor that can be customized with multiple extensions to support any programming language and saves time and effort.

  - ✓ **Android Studio**: Very popular IDE (Integrated Development Environment) in mobile development, we use it to create virtual devices to build and test the mobile application on them.

- ✓ **Expo Go**: Mobile application for testing the mobile apps written in React Native without building them on physical or virtual devices.

- ✓ **Git / GitHub**:
  - Git: Open-source version control system to deal with cloud-based platforms such as GitHub and GitLab.

  - GitHub: Cloud-based platform for saving and sharing codes.

- ✓ **MySQL Workbench**: Desktop application to manage local or remote MySQL databases.

- ✓ **Postman**: Desktop application (Provides also a website and VS Code extension) to test the back-end APIs and generate documentations for their usage.

- **Development Tools**
  - ✓ **Node.js run-environment** (*Node.js, n.d.*): In order to use React and React Native libraries on the front-end side and Express.js framework on the back-end one.

  - ✓ **Expo** (*Expo, n.d.*): Production-grade framework that provides helping tools and libraries for making mobile application using React Native library.

  - ✓ **Tailwind CSS (Cascading Style Sheets)** (*Tailwind CSS, n.d.*): CSS framework for quickly styling websites and mobile applications.

3.1.3 Technologies

- **Cloud Services**
  - ✓ **AWS (Amazon Web Service)** (*AWS, n.d.*) **MySQL RDS (Relational Database Service)**: Creating a database on AWS Cloud will ease the process of the development between the team members rather than using a local database.

  - ✓ **AWS S3**: AWS service to store the files on the cloud, and it can be helpful in:
    - Reduce the server-side storage; Comparing with the other methods of storing the images either in a folder in the server side or as BLOB (Binary Large Object) in the database itself, using AWS S3 will be better for getting smaller storage size.

- Provide Signing URLs (The URL is changed every small time (15 min – 7 days) based on the user configuration and this will enhance the security.

✓ **Meta For Developers Login Service** (*Meta for Developers, n.d.*): To provide "Login by Facebook" as an example of third-party login. It's important to say that "Login by Facebook" isn't implemented using Firebase authentication services.

✓ **Google Cloud Translation** (*Google Cloud, n.d.*): One of the challenges in this application is to provide acceptable translation for the dynamic content (especially the teams and players names). So, we used two main technologies, one of them is google cloud translation service.

✓ **Zego Cloud** (*Zego Cloud, n.d.*): Cloud platform that provides video calls, video conferences, streaming, etc. services. It's used to implement video conferences feature in the mobile application.

✓ **Firebase** (*Firebase, n.d.*): Cloud platform that provides several services for the web and mobile applications. It's used to implement:
- Chat system between the users.
- Notification system.

- **External APIs Integration**

✓ **API-Football API** (*API-Football, n.d.*): The implementation of the main two features of this application is based on this API, the application used API-Football API to fetch:
- Today matches
- History matches
  - Last Matches for a team
  - Two teams' head-to-head matches
- Match events and information
  - Goals, penalties, missed penalties and own goals
  - Red and yellow cards
  - Lineup: The starting XI for each team and their formation (positions on the playground).
  - Substitutions
  - Match facts for each team (Total shots, shots on goal, fouls, corner kicks, offsides, ball possession, total passes, pass accuracy, etc.)
  - Penalties shootout (if any)
  - Competition details
    - Top Scorers

        - Top Assists
        - Standing -if any-
        - Team facts in the competition
      - Coaches
      - Stadium
      - Referee
    - Team players
    - Player statistics in the last three seasons (club, position, number of played games, number of games in starting XI, number of minutes, number of in / out substitutions, total shots, goals, saves if he is a goalkeeper, total passes, key passes, assists, passes accuracy, tackles, etc.)

- ✓ **DeepL Translation API** (*DeepL Translation API, n.d.*): To provide dynamic-content translation as Google Cloud Translation Service.

- ✓ **Gmail API** (*Gmail API, n.d.*): To send emails for the users in Email Verification or Forget Password cases.

- ✓ **OpenAI API** (*OpenAI, n.d.*): We used "GPT-4o mini" API for two main features:
  - Generating new questions in user created quizzes.
  - Verifying the quiz to make sure its questions are related to football and have correct answers.

- **Main Local Services**
  - ✓ **Localization using i18next**: To provide translation for the static textual content of the application.

  - ✓ **Expo Local Authentication**: To access the mobile authentication such as password, PIN code, fingerprint to verify the identity of the user before doing critical actions.

  - ✓ **Expo Text to Voice**: To provide text to speech button for each question / option when the user solves a quiz.

  - ✓ **Voice to Text using "react-native-community/voice" module**: To provide speech to text button for each question / option when the user creates a quiz.

  - ✓ **Screenshots and Share using "expo-sharing" and "react-native-view-shot"**: To allow the user to capture and share his / her statistics.

3.2 Database Design

After the first view on the application requirement, anyone could think that a NoSQL database will be the best schema to be used since the application depends on data from external APIs, but after analyzing the requirement we can easily identify the entities and the relations between them.

- **Tables**
  - **Users**
    - ✓ ID [Primary Key]: Either a generated id using "uuidv4" module or Facebook id.
    - ✓ Username
    - ✓ Email
    - ✓ Password
    - ✓ First name
    - ✓ Last name
    - ✓ Image status: Indicates whether the user have an image stored on AWS S3 or not.
    - ✓ Favorite national team
    - ✓ Favorite club
    - ✓ App rating: Number between 1 – 5 will be picked from star rating front-end component.
    - ✓ Notification status: Indicates whether the user want to be notified about his/her favorite teams matches or not.
    - ✓ X2BoosterCounter: Contains the number of remaining X2Boosters that remains for the user. [Each user can play up to 5 X2Boosters every week).

  - **Created Quizzes**
    - ✓ Quiz ID [Primary Key]: generated id using "uuidv4" module.
    - ✓ Quiz Data: JSON (JavaScript Object Notation) object contains the questions and each one options and correct answer.
    - ✓ Status: Indicates whether the quiz is saved or published (ready to be solved by the other users).
    - ✓ Contains AI: Indicates whether the quiz contains questions generated by A.I. or not.
    - ✓ Author ID: Foreign key refers to ID in "users" table.

  - **Solved Quizzes**
    - ✓ Quiz ID: Foreign key refers to Quiz ID in "created quizzes" table.
    - ✓ User ID: Foreign key refers to ID in "users" table.
    - ✓ Answers: JSON object contains the answers of the user for a quiz.
    - ✓ Score: The score of the user in the quiz.

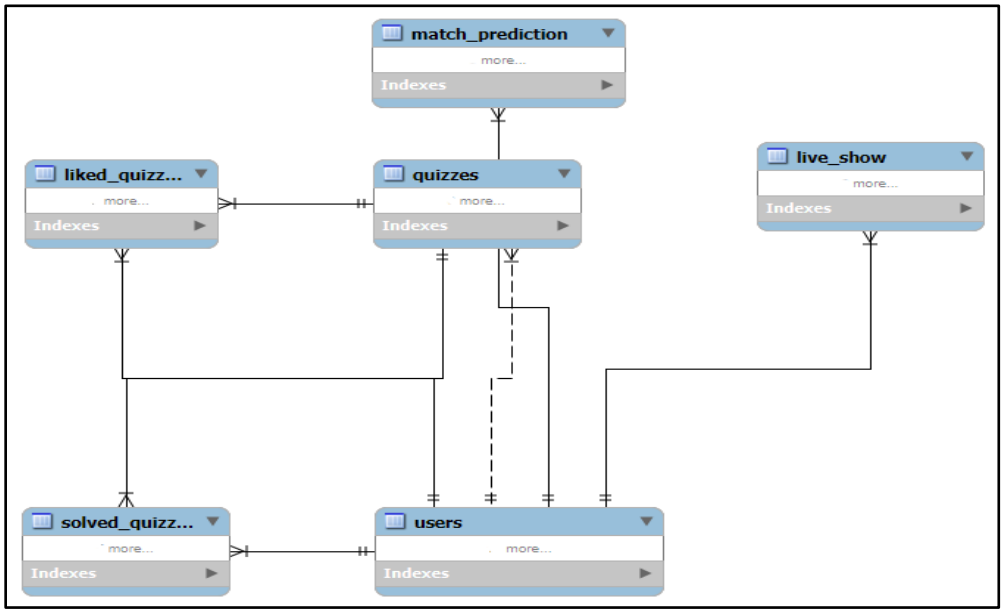
- ✓ Rating: Number between 1 – 5 will be picked from star rating front-end component represents the user rating of the solved quiz.
  NOTE: The primary key of this table is combined key from Quiz ID and User ID.

- **Liked Quizzes**
  - ✓ Quiz ID: Foreign key refers to Quiz ID in "created quizzes" table.
  - ✓ User ID: Foreign key refers to ID in "users" table.
    NOTE: The primary key of this table is a combined key from Quiz ID and User ID.

- **Match Prediction**
  - ✓ Match ID: The id of the match as it fetched from the external API (API-Football).
  - ✓ Match Status: Indicates the status of the match to determine whether the score of the match needs to be re-calculated or not. The match status can be:
    - **TBD**: To be Determined
    - **FT**: Finished
    - **NS**: Not Started
    - **AET**: Extra Time
    - **PEN**: Penalties Shootout
    - **PST**: Post Ponded
    - **SUSP**: Suspended
    - **1H**: First Half (In Play)
    - **HT**: Half Time (In Play)
    - **2H**: Second Half (In Play)
    - **ET**: Extra Time (In Play)
    - **BT**: Break Time (In Play)
    - **P**: Penalties in progress (In Play)
  - ✓ User ID: Foreign key refers to ID in "users" table.
  - ✓ X2Booster: Indicates whether the user wants to double his / her score of this match or not.
  - ✓ Home Goals: The predicted goals of the home team.
  - ✓ Away Goals: The predicted goals of the away team.
  - ✓ First team to score: The name of the first team to score in the match.
  - ✓ Underdog Bonus: The earned points if the user predicts a correct score that less than 5% of the users predict it.
  - ✓ Score: The user score in the match.
    NOTE: The primary key of this table is a combined key from Match ID and User ID.

- **Live Show**
  - ✓ Match ID, Match Status, User ID, X2Booster and Score similar to Match Prediction.
  - ✓ Selected Players: JSON object contains the three players selected by the user and their information.
  - ✓ Player One Score: The score earned from the first player.
  - ✓ Player Two Score: The score earned from the second player.
  - ✓ Player Three Score: The score earned from the third player.
    NOTE: The primary key of this table is a combined key from Match ID and User ID.

- **Diagram**



Database UML

3.3 Project Architecture

A headless approach was used in this project, by providing signal back-end application that runs on a server and serve multiple front-end ones (Mobile application and Website).

3.3.1 Back-End Architecture

The back-end is followed the REST guidelines and structured using a variation of MVC (Model View Controller) architecture which divides the back-end code into:

- **Models**: To deal with the database and perform the CRUD (Create-Read-Update-Delete) operations.

- **Controller**: To validate the request, add the core-business logic and perform and calling to a third-party library or service.

- **Routers**: To define the end-points and their corresponding controllers' methods.

- **Other folders and sub-packages** such as Enums, Errors, Middleware, Services, Helpers, etc.

3.3.2 Front-End Organization

The project structure contains basically:

- **APIs**: To separate the APIs calls from the views.
- **Components**: To be created once and used many times.
- **Screens** (Mobile) / **Pages** (Website)
- **Other folders and sub-packages** such as: Enums, Services, Utilities, etc.

3.3.3 Authentication and Authorization Mechanism between Client-Server

The authentication and authorization will be done using JWT (JSON Web Token) because of its security and compact size comparing with the Sessions.

3.3.4 Distribution of API-Football External API resources across the Front-End and Back-End

Putting all the API-Football resources in the back-end will increase the latency due to the size of the data and many of them aren't needed by any calculation process. So, we integrated any resource that isn't needed directly by the back-end on the front-end side to reduce the number of the requests and enhance the performance.

3.4 A.I. in Providing Recommended Result

A multi-layer neural network regression model implemented using "**@tensorflow/tfjs**" library in JavaScript with training data from the head-to-head matches between the two teams and contains two features: Home and away goals.

3.5 Standards and Constraints

3.5.1 Standards

- RESTful APIs standards -RESTful itself isn't a standard-:
  - ✓ HTTPS (Hyper-Text Transfer Protocol Secure) [RFC 2818].
  - ✓ URI (Uniform Resource Identifier) [RFC 3986].

- ✓ JSON [RFC 8259].
- ✓ JWT [RFC 7512]: For authentication and authorization as it described in 3.3.3.

- SQL (Structured Query Language) [ISO/IEC 9075].
- Gmail API [RFC 8621]: Used to send emails to the users as it described in 3.1.3.
- CSS [W3C Standard].

3.5.2 Constraints

- **Resources Constraints**
  - ✓ Restricted to use only one Football Data API (API-Football) which provides multiple resources but difficult to be integrated with the other Football Data APIs due to different data IDs and keys.

  - ✓ API-Football API provides the data only in English language. So, we need to use translation services and APIs such as Google Translation Service or DeepL Translate API which may result in in-accurate translation in some extreme cases.

  - ✓ Number of daily available requests of the external APIs especially in the case of API-Football which provides 7500 request per day in the first paid plan that cannot serve large number of users.

- **Quality Constraints**
  - ✓ Limited features of the input dataset for matches that used to train the A.I. model to provide recommended result of a match, it contains only home and away goals, but the match can depend on other factors like the injuries, weather, stadium, competition and so on.

4 Results

In this software, we tried to include the features that we thought it's important to have in other similar applications, as discussed in the literature review. This was done as being users before being developers due to our passion for this sport.

The app we created includes five primary functions. The first feature is match prediction, allowing users to make daily match predictions in major tournaments and earn points based on their accuracy. The primary feature of this forecasting is that it considers other elements rather than the final result, such as goal differential, the team that will score first, and the unexpected prediction—underdog.

The second event is the live show, where users can choose three players from any of both teams and earn points according to their performance in a real-time game.

Third, the Quiz section allows users to create, publish, and track other user's scores on solved quizzes. We have improved this feature by integrating voice-to-text for quiz creation, text-to-speech for quiz solving, and artificial intelligence for suggesting questions, verifying that quiz topics are related to football, and confirming correct responses.

Fourth, rooms and chats that allow users to start or join a video conference or communicate with other users by exchanging messages through them.

The fifth section is statistics; it provides users with statistics and graphs showing their overall app usage or usage by specific categories.

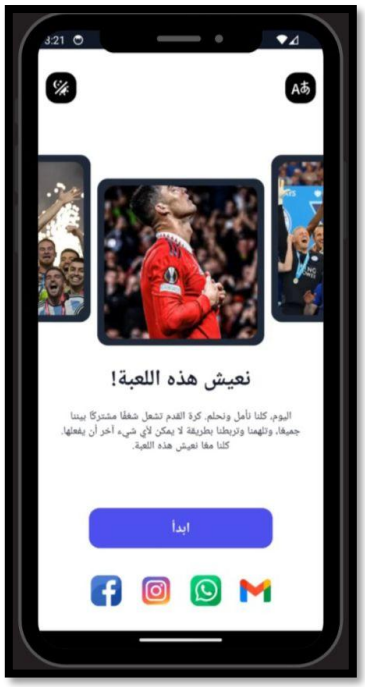
Shortly, the app is made up of five parts that include improvements to already-presented features in related applications as well as new additions to enhance user experience and increase enjoyment of both the app and football in general.

5 Discussion

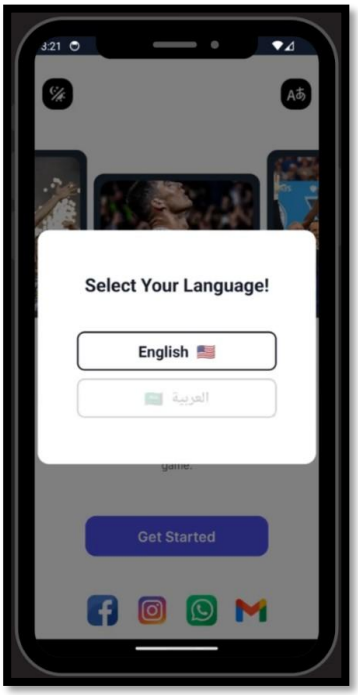
4.1 Mobile Application

The mobile application supports both English and Arabic languages for both static and dynamic content. Also, it has dark and light modes (color themes).

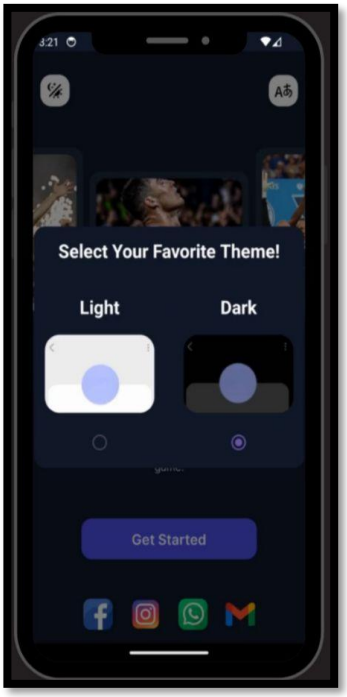
- **Welcome Screen**
  It contains the following:
  - Three images that there order is changed every 10 seconds.
  - Main button to navigate to either the login screen or the home screen if the user is already logged in.
  - Social media icons to access the developers accounts on Facebook, Instagram, WhatsApp and Gmail.
  - 2Two icon buttons to change the language and the mode (color theme).



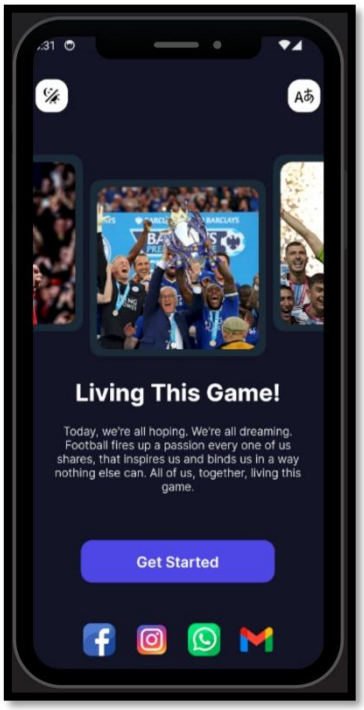
Welcome-1



Welcome-2

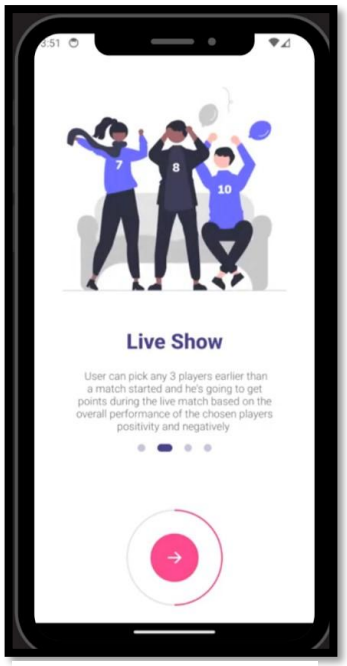


Welcome-3

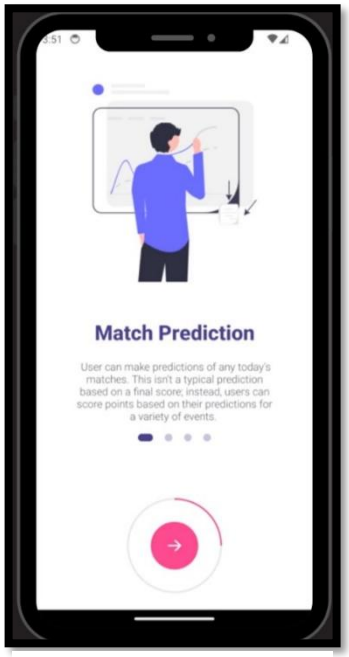


Welcome-4

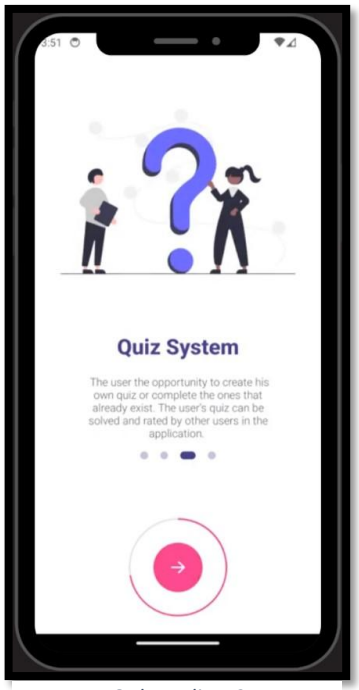
- **Onboarding**
  It contains a description for the main four features of this application which are “Match Prediction”, “Live Show”, “Quiz Zone” and “Rooms and Chats”. This screen is visible only for the first time the user uses the application on its mobile device, this is done by storing a value in the Async Storage.



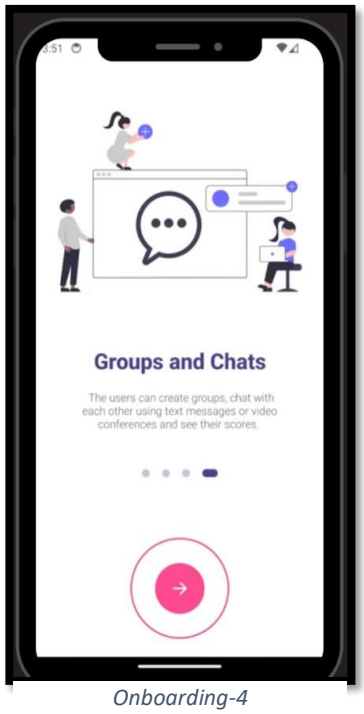
Onboarding-1



Onboarding-2



Onboarding-3



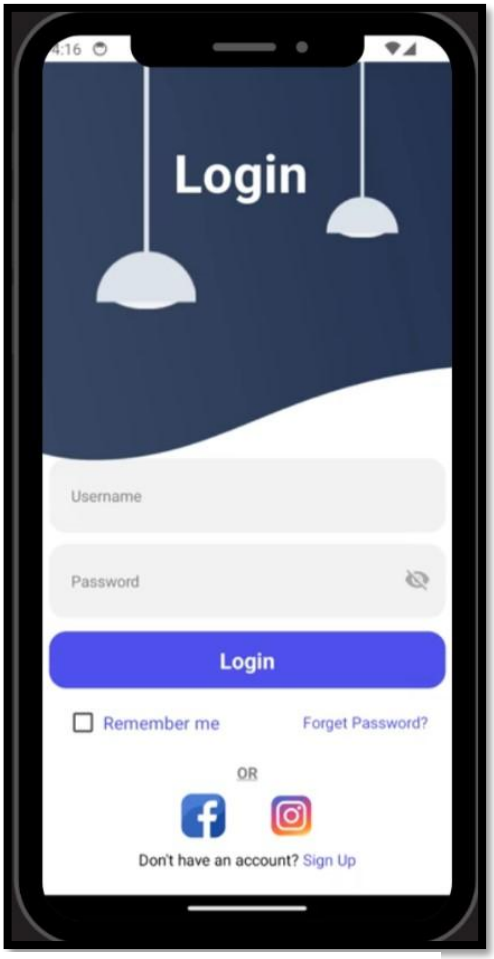
Onboarding-4

- **Login**

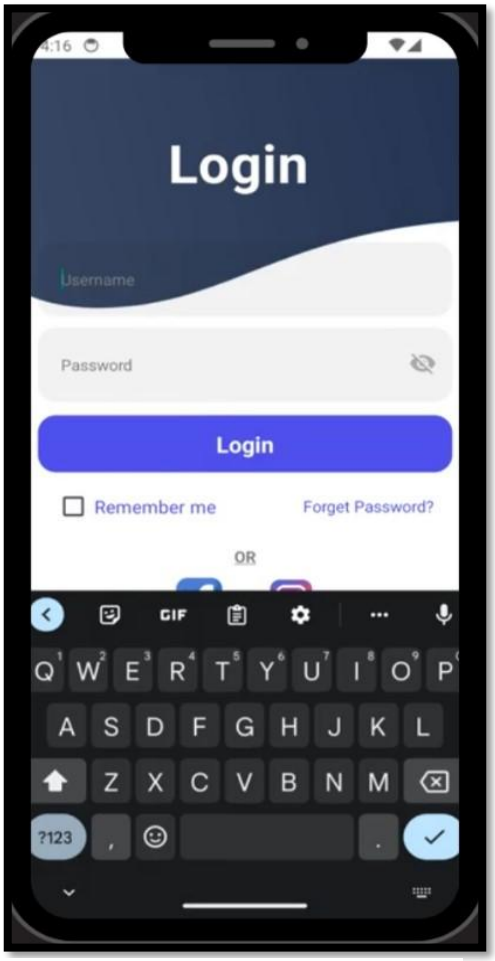
  It allows the user to enter his / her credentials or using third party login as Facebook or Instagram, and do some relevant actions such as:

  - **Remember me**: Remember the password associated with a username for faster login in the next times. It's important to say that once a user is logged in, he / she doesn't need to login again until 14 days.
  - **Forget password**: If the user forgot his / her password, an email is sent to the email that is associated with the user's account.
  - **Navigate to sign up**: If the user wants to create a new account.

  The UI (User Interface) of the login screen in the light mode is relatively different from the dark mode; In the light mode it contains an entering animation for two lamps, but in the dark mode it contains a flipped card with a popular quote on each side of it.

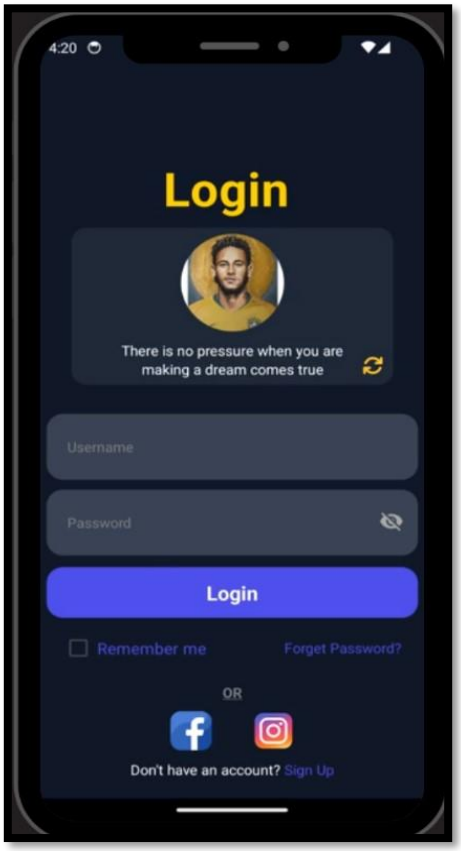


Login-1
light mode

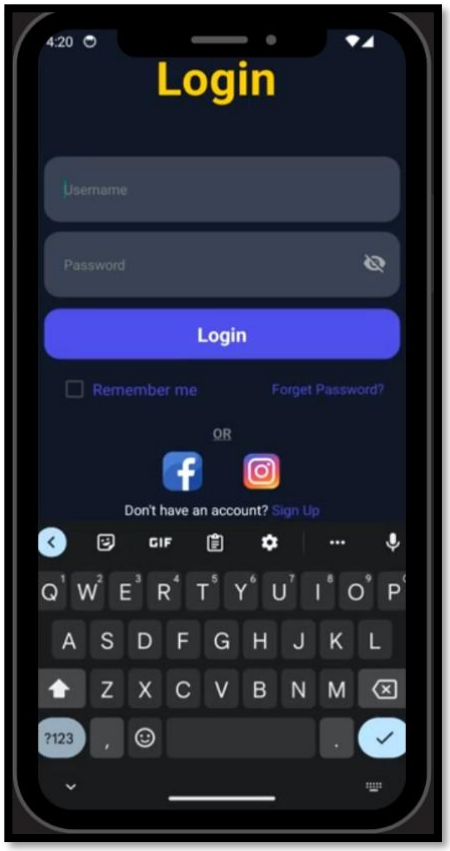


Login-2
light mode

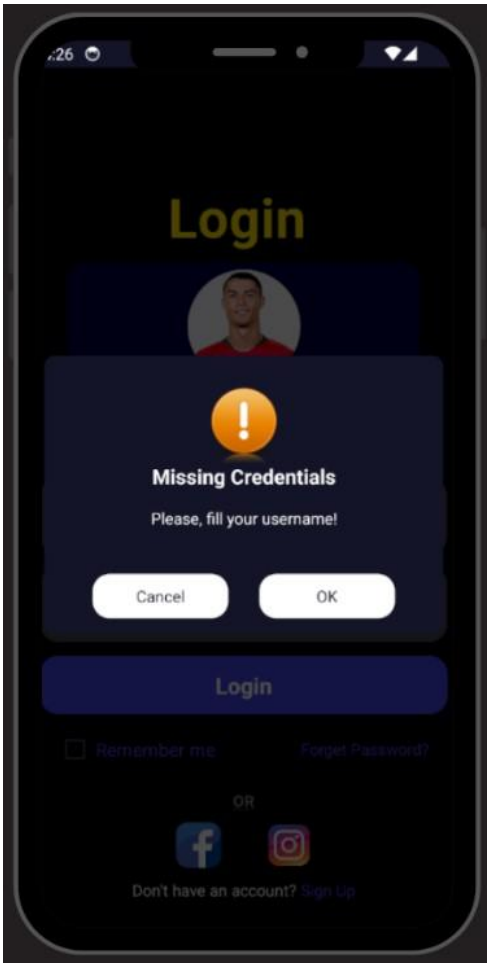
Login-3
dark mode



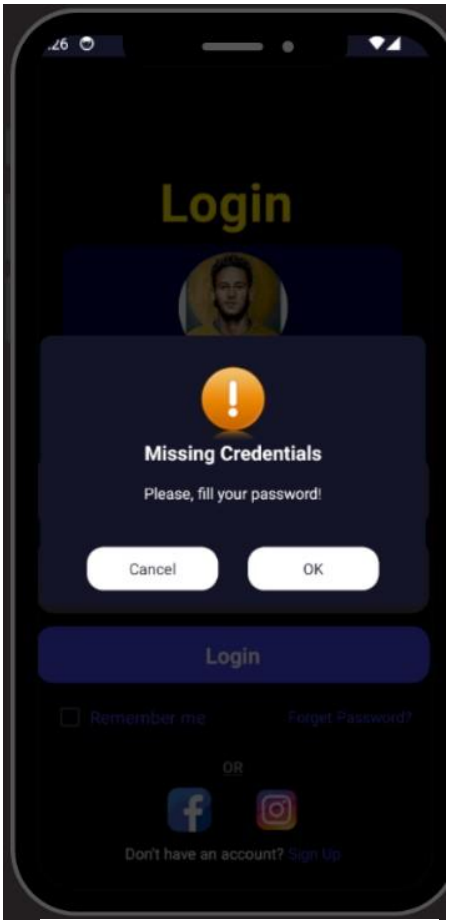
Login-4
dark mode



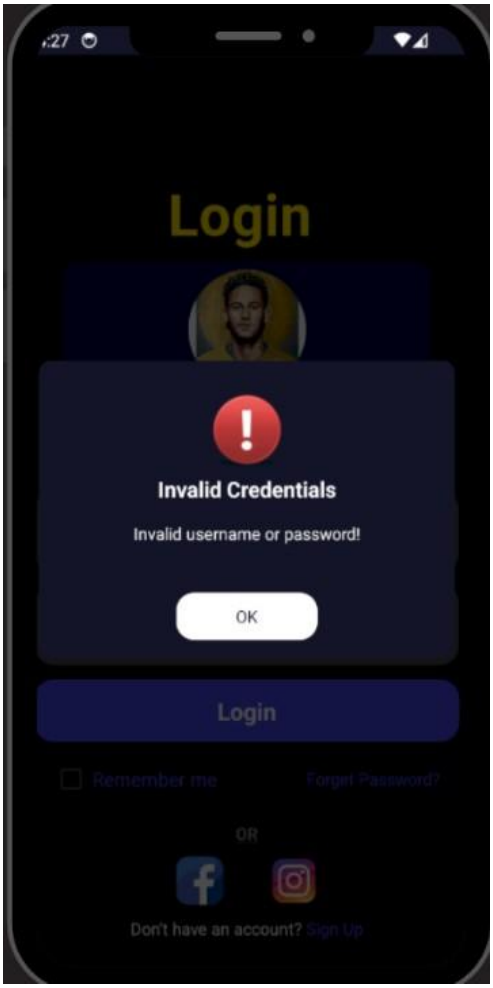
Login-5
dark mode



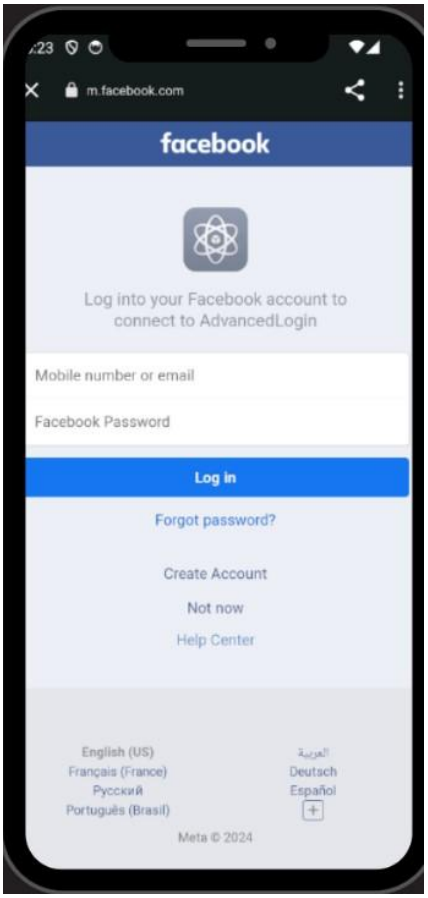
Login-6



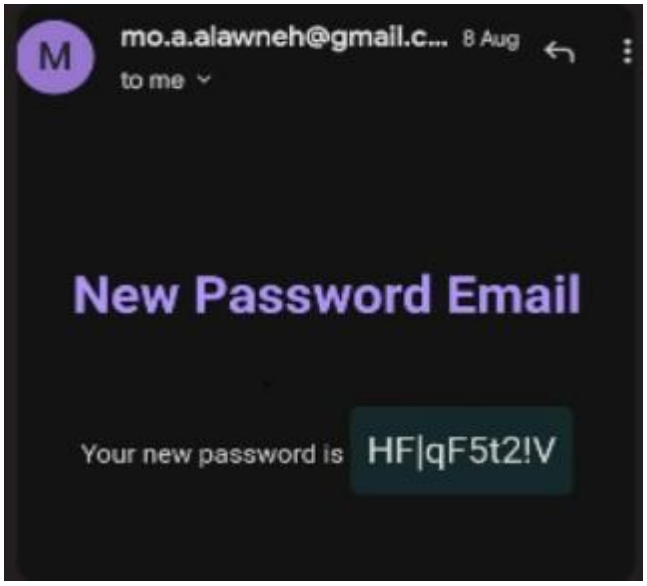
Login-7



Login-8



Login-9
login using Facebook



Login-10
Forget password option and getting new one via email

- **Sign Up**
  It allows the user to create a new account by entering his / her details in multiple screens as the following:

- **First Screen**: Collecting the username and email and the user confirmation for the terms, conditions and privacy rules of the application.

- **Second Screen**: Collecting the password and allow the user to confirm it. The user can monitor the status of password strength by a progress bar with red and green ones, the color will be green and the progress will be 1 (Password is accepted) if it capital and small letters, numbers, special characters and has a length more than 8. The user also can see the status of each password condition by a modal after pressing the info icon.

- **Third Screen**: Collecting the user first and last name as well as the user personal image using an image picker.

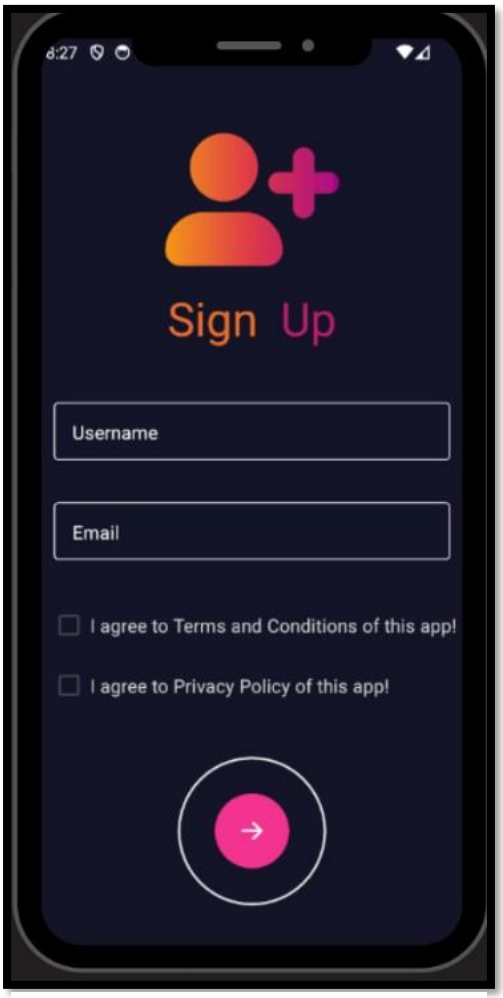
- **Fourth Screen**: Verifying the email by entering a code that is sent to the user email address. If the entered code matches the sent code the verification process is success and the user can continue the registration.

- **Fifth Screen**: Collecting the user favorite national team, the list contains all the countries using "country-list" and "react-native-country-flag" modules.

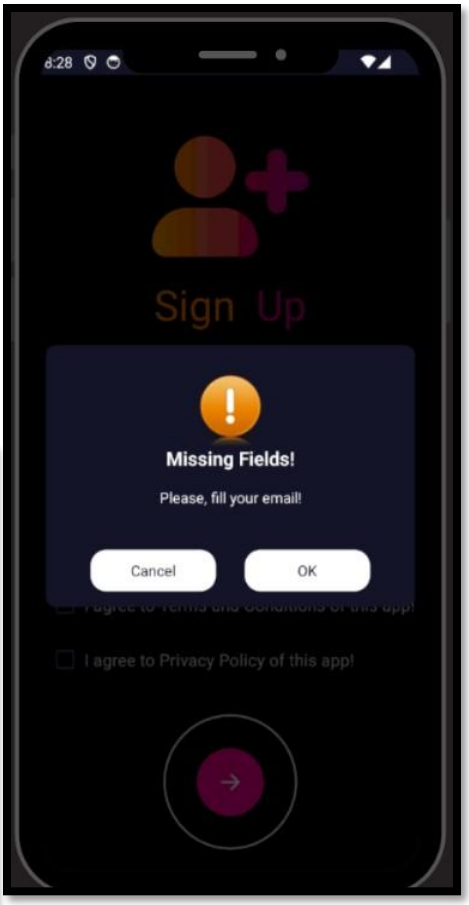
- **Sixth Screen**: Collecting the user favorite club, the list contains the following teams:
    - **Top five leagues**
        - ✓ English Primer League
        - ✓ Spain LA Liga
        - ✓ Italy Serie A
        - ✓ Germany Bundesliga
        - ✓ Frame Ligue 1

    - **Popular Arabic clubs**
        - ✓ Al Hilal SFC
        - ✓ Al-Nasser FC
        - ✓ Al-Ittihad Club
        - ✓ Al-Ahli Saudi FC
        - ✓ Al Ahly FC
        - ✓ Zamalek SC

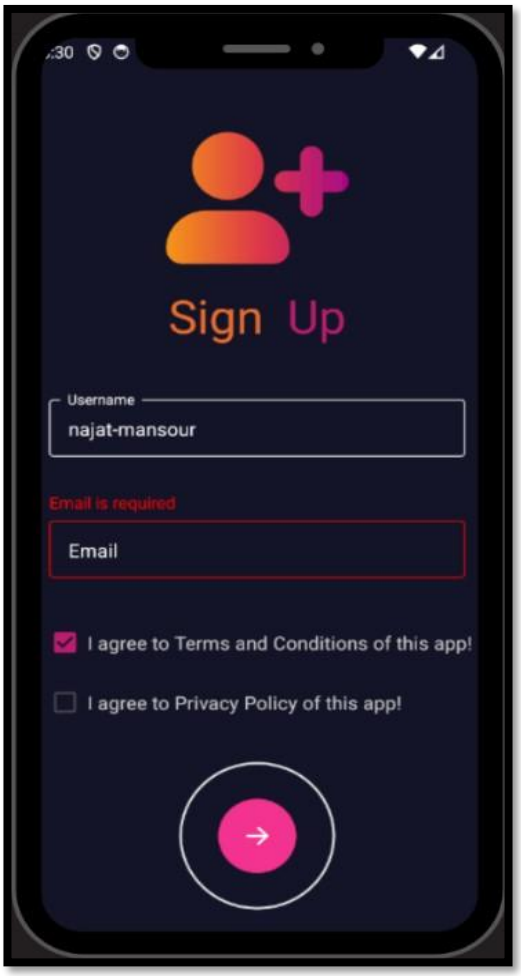
    We cached the fetched clubs in the Async Storage until the next season teams are ready (On the beginning of July).



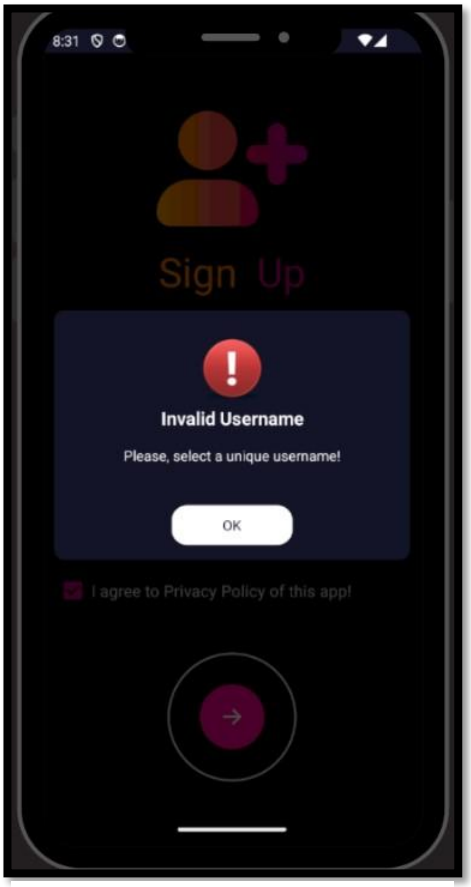
Sign Up-1
1st screen



Sign Up-2
1st screen

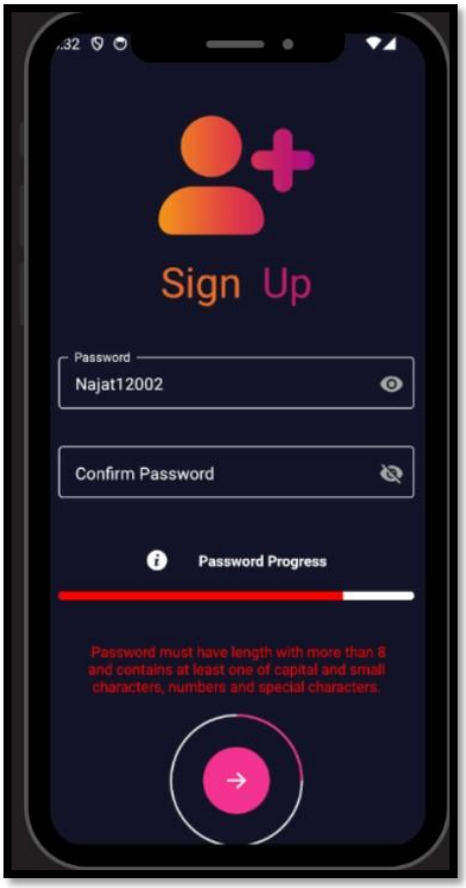


Sign Up-3
1st screen

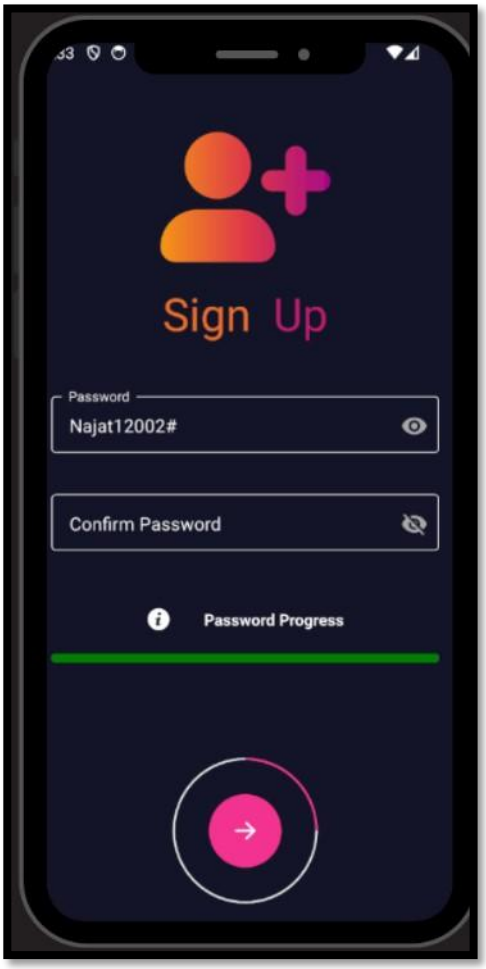


Sign Up-4
2nd screen

Sign Up-5
2nd screen

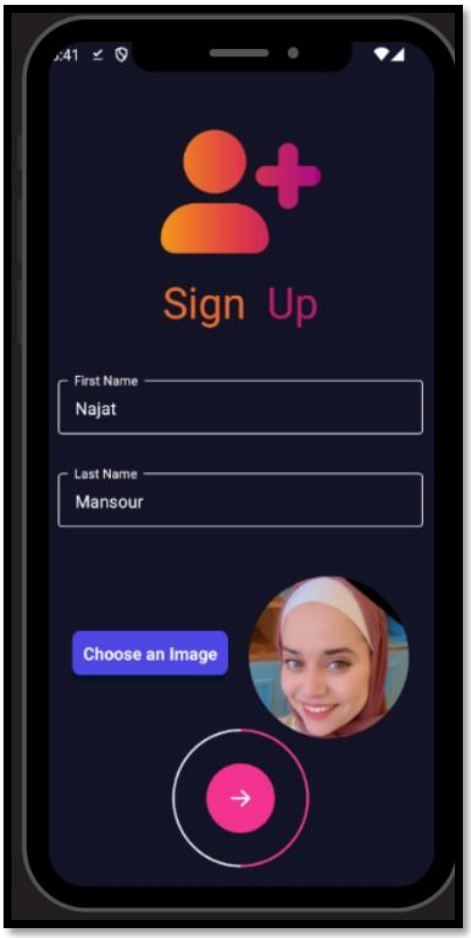


Sign Up-6
2nd screen

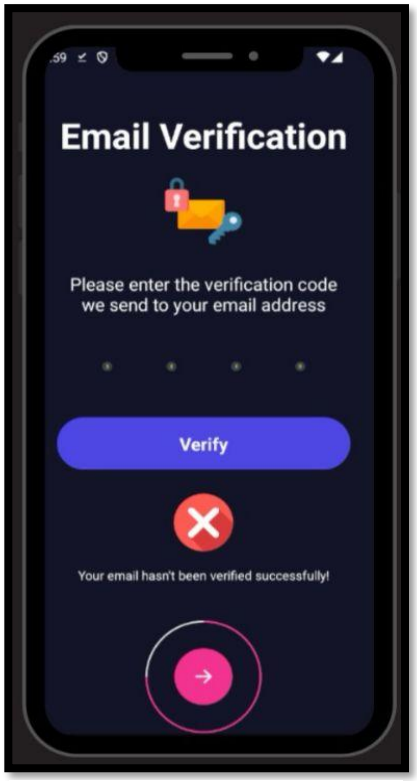


Sign Up-7
3rd screen

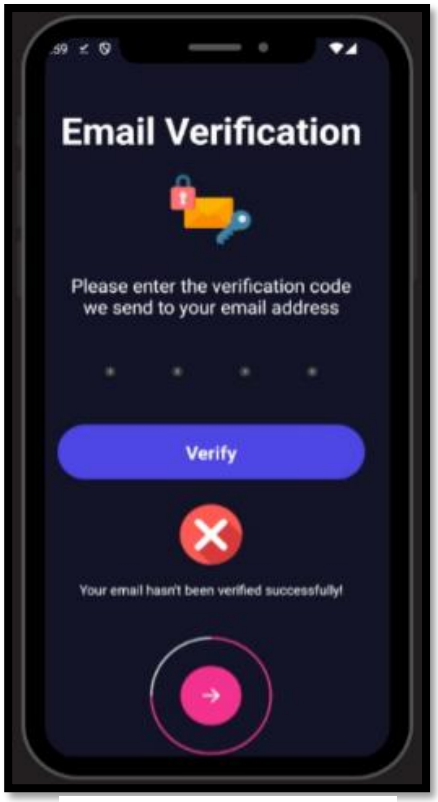
Sign Up-8
3rd screen



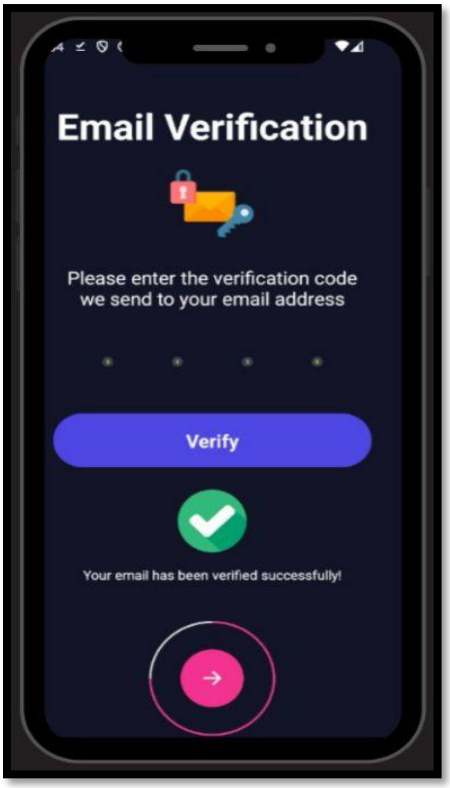
Sign Up-9
3rd screen



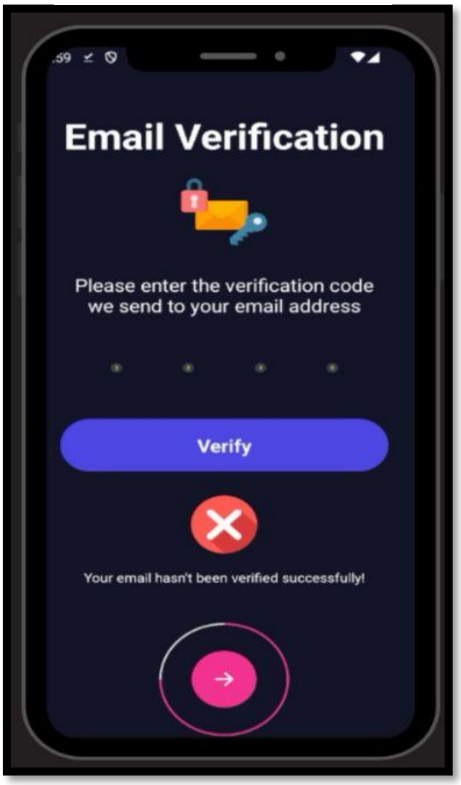
Sign Up-10
4th screen



Sign Up-11
4th screen



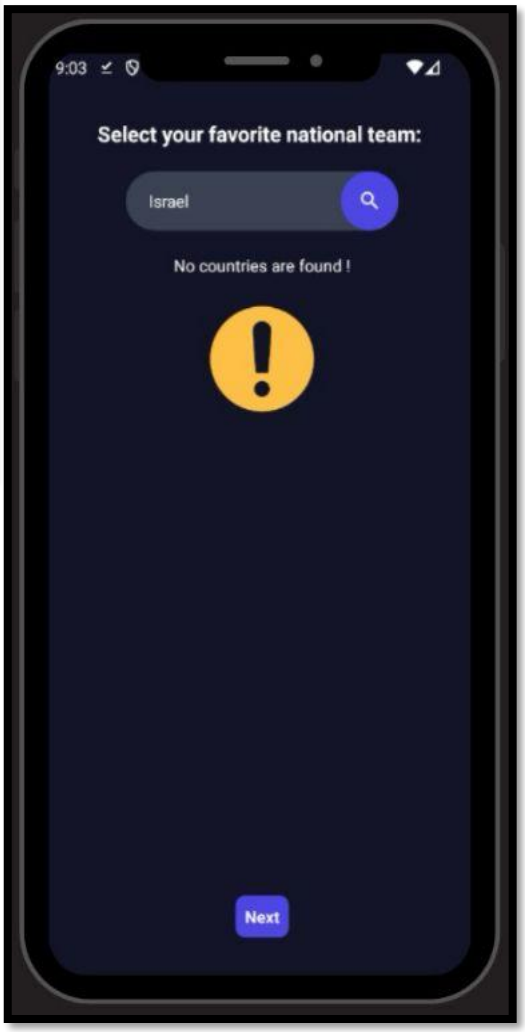
Sign Up-12
4th screen



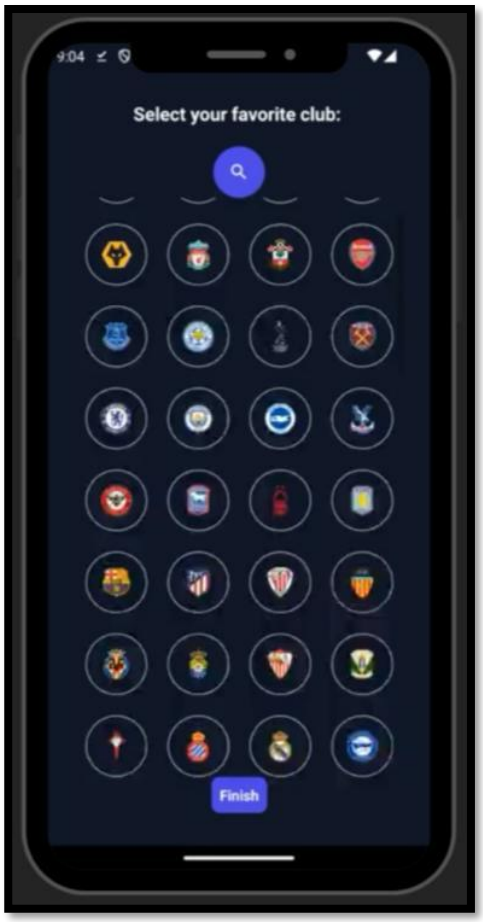
Sign Up-13
4th screen

Sign Up-14
5th screen

Sign Up-15
5th screen



Sign Up-16
5th screen



Sign Up-17
6th screen

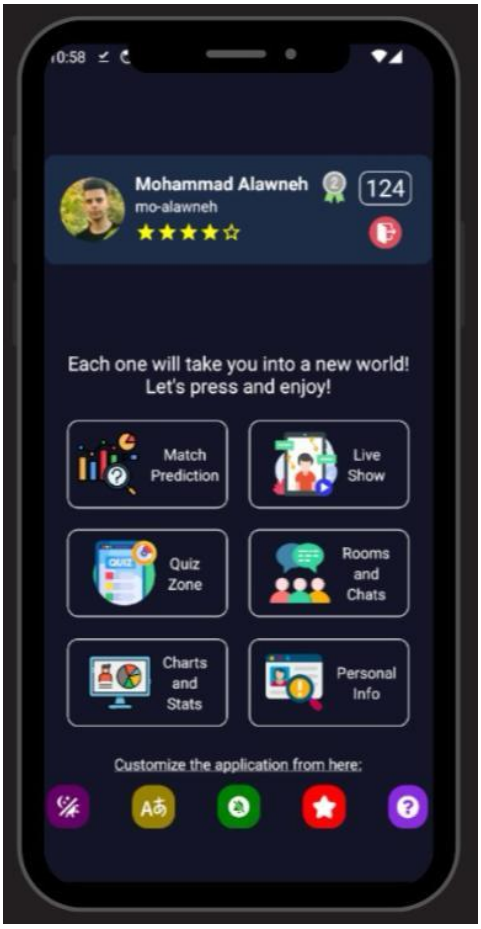
Sign Up-18
6th screen

Sign Up-19
6th screen

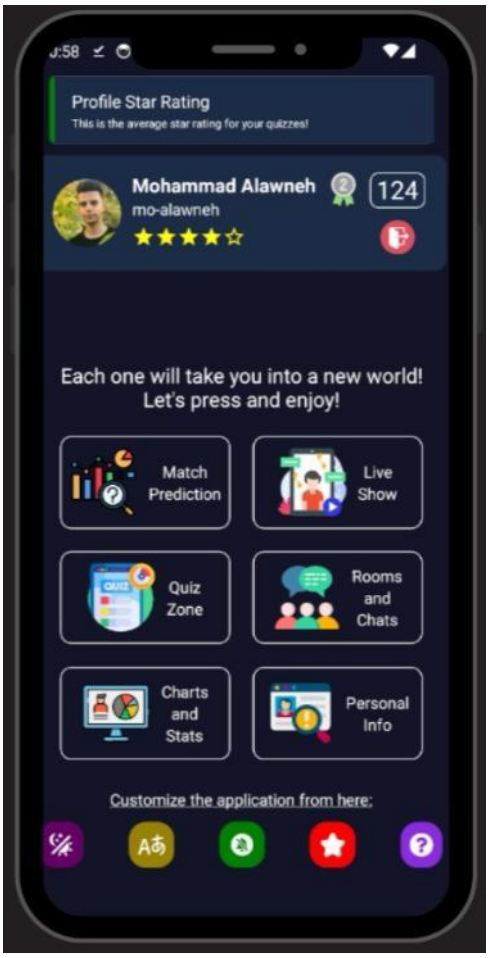
- **Home**

  It contains the following:

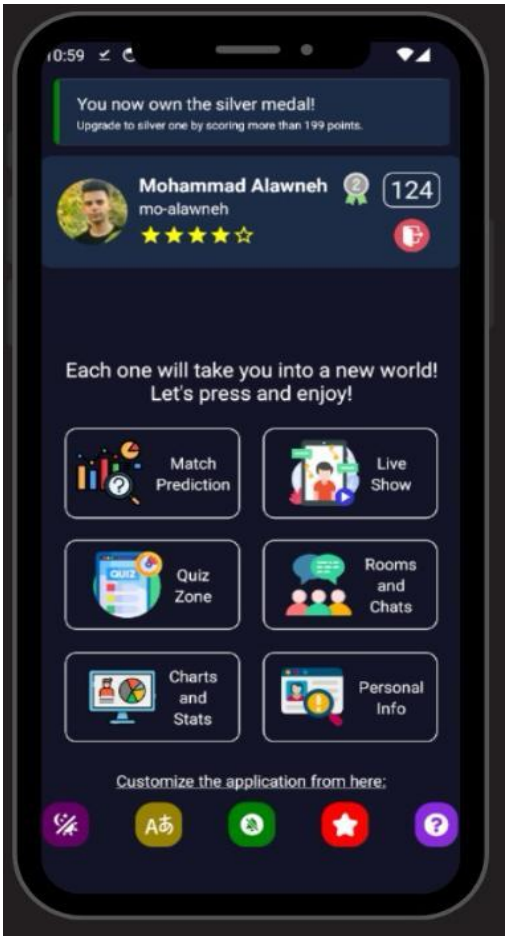
  - Horizontal bar contains the user details (First name, last name, personal image, average rating of the user created quizzes, user's total score and the medal.
    - Bronze Medal if the user's score is less than 100.
    - Silver Medal if the user's score is between 100 and 199.
    - Gold Medal if the user's score is more than 200.
  - Logout button.
  - Helper toast (alert) messages to tell the user about the numbers on the horizontal bar.
  - If the user has level upgrade or downgrade, a modal with success or fail sound effect will appear.
  - Main six buttons in order to navigate to the main screens of the application.
    - Match Prediction
    - Live Show
    - Quiz Zone
    - Rooms and Chats
    - Statistics
    - Edit Your Info
  - Five icon buttons in order to see some important modals.
    - Turn ON / OFF the notifications.
    - Change the language.
    - Change the mode (color theme).
    - Rate the application out of 5 stars.
    - See FAQs (Frequently Asked Questions).



Home-1

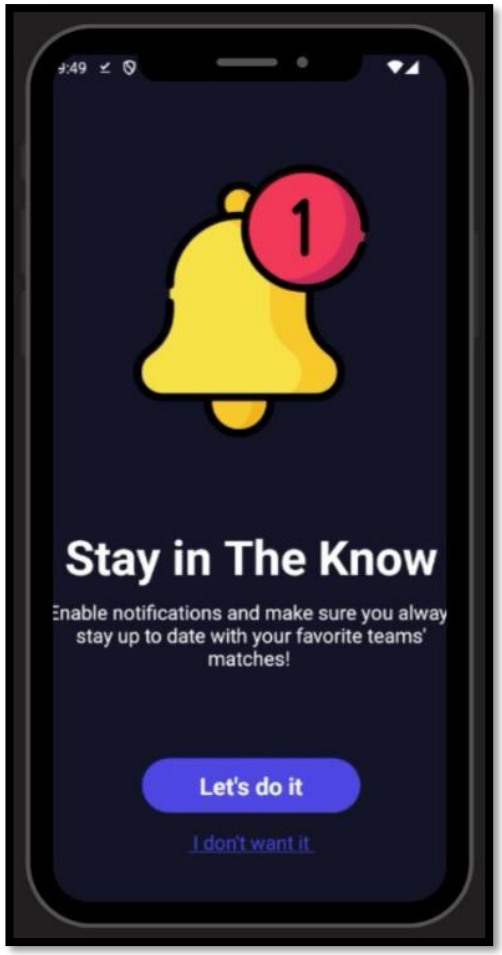


Home-2

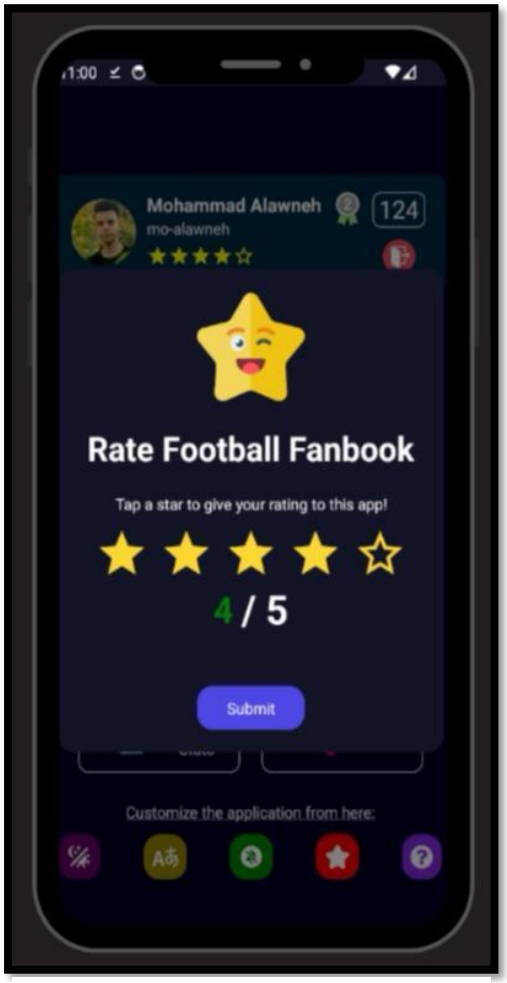


Home-3

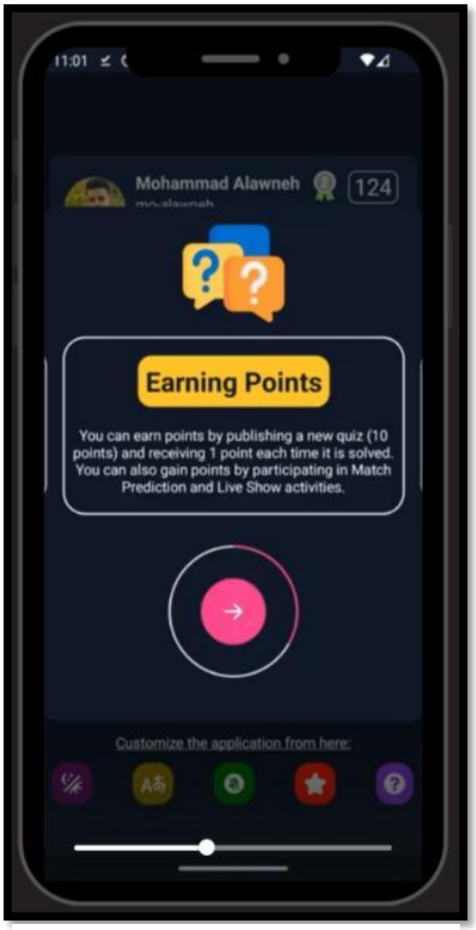
Home-4



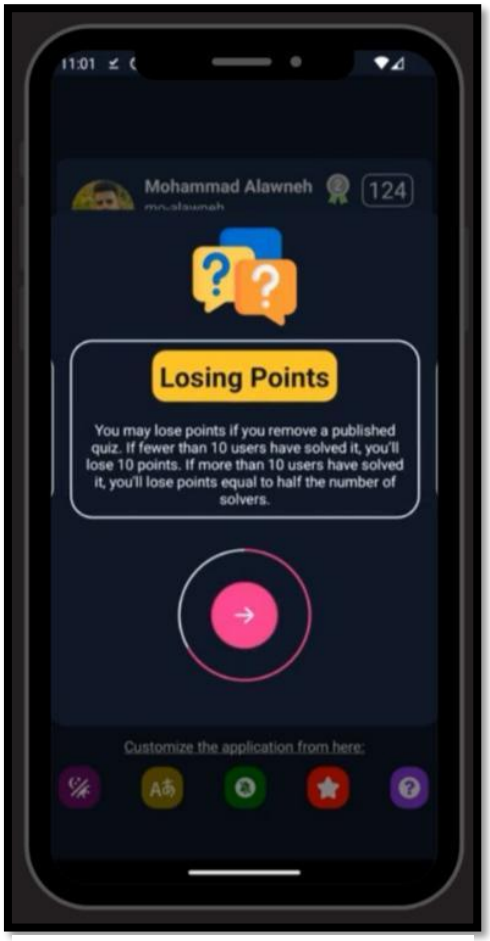
Home-5



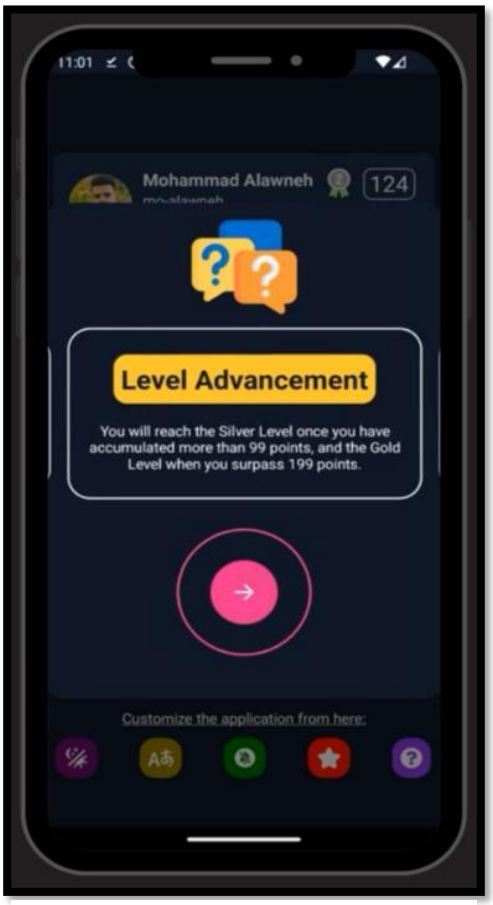
Home-6



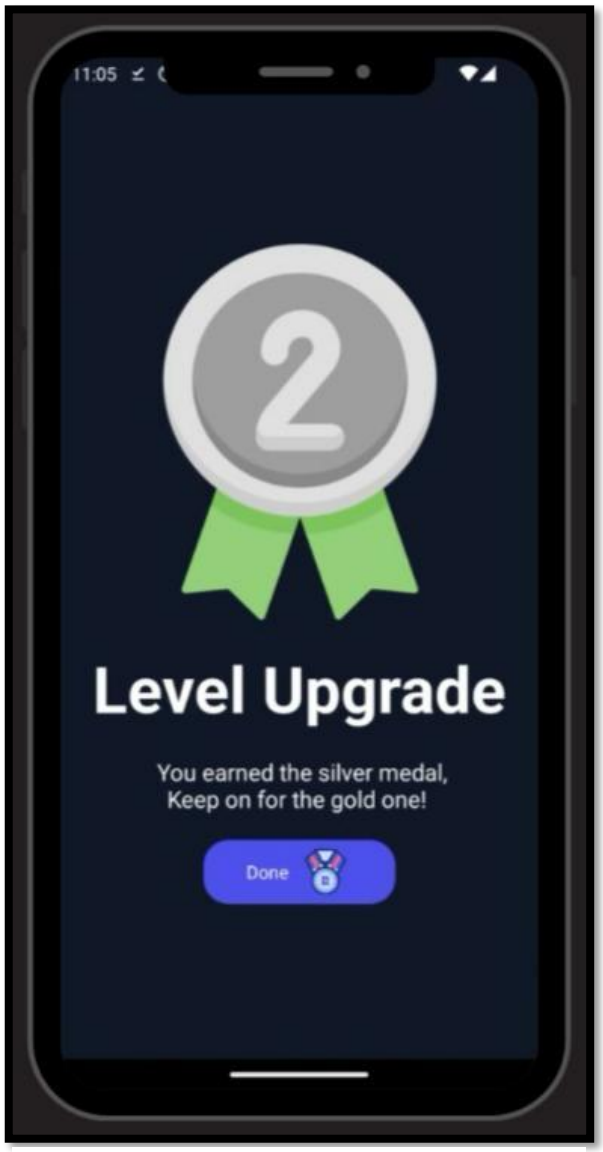
Home-7



Home-8



Home-9



Home-10

Home-11

- **Edit Your Info**

  The user can edit any of his / her information:

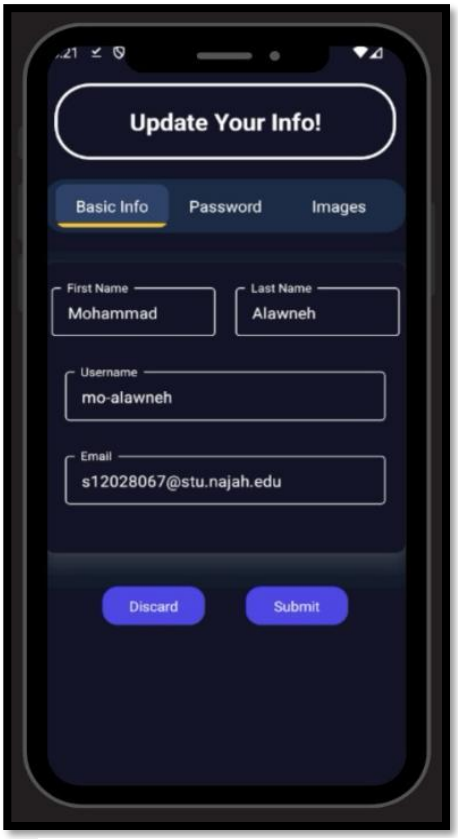
  - First name
  - Last name
  - Username (Requires a unique new username)
  - Email address (Requires verification of the new email address)
  - Password (Requires a strong password as it's described in Sign Up screen and the user can monitor the password strength via progress bar and a modal appears after pressing the info icon)
  - Personal Image
  - Favorite national team
  - Favorite club

  The screen divides the information into three taps as the following:

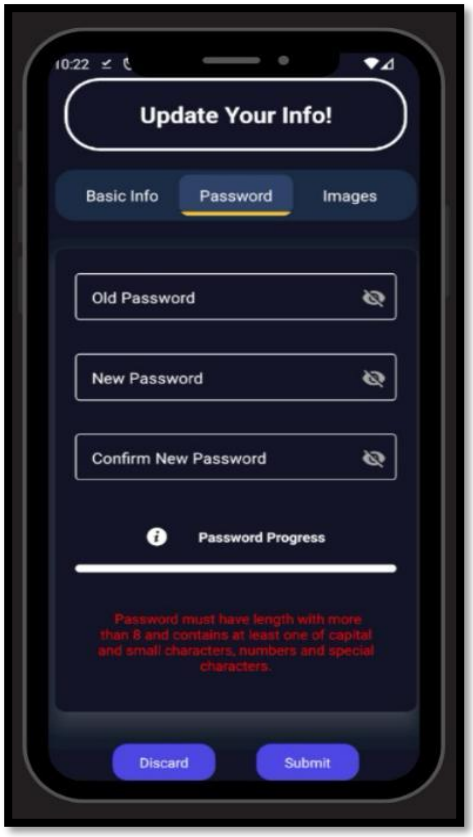
  - **Basic**: Contains the first name, last name, username and email address.
  - **Password**: Contains the password, confirm password, password strength progress bar and an icon button to show the modal that contains the password conditions status
  - **Images**: Contains the personal image, favorite national team and favorite club.

  The screen contains two buttons:

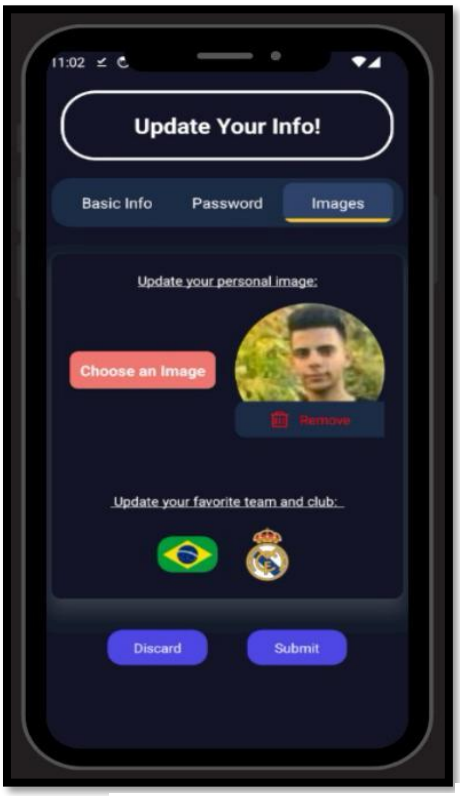
  - **Discard**: To discard the changes and retrieve the original information, and a warning will appear before discarding the data.
  - **Submit**: To submit the changes, and a screen to ask the user to enter its mobile local authentication -password, PIN (Personal Identifier Number) code, fingerprint- will appear to complete the submission.



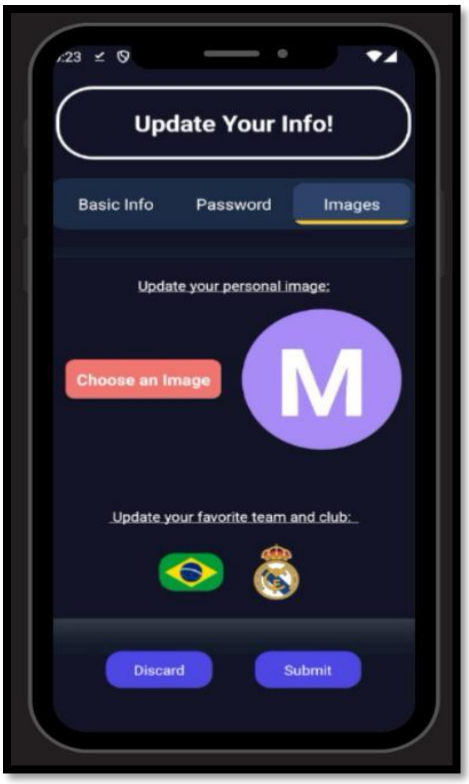
Personal info-1



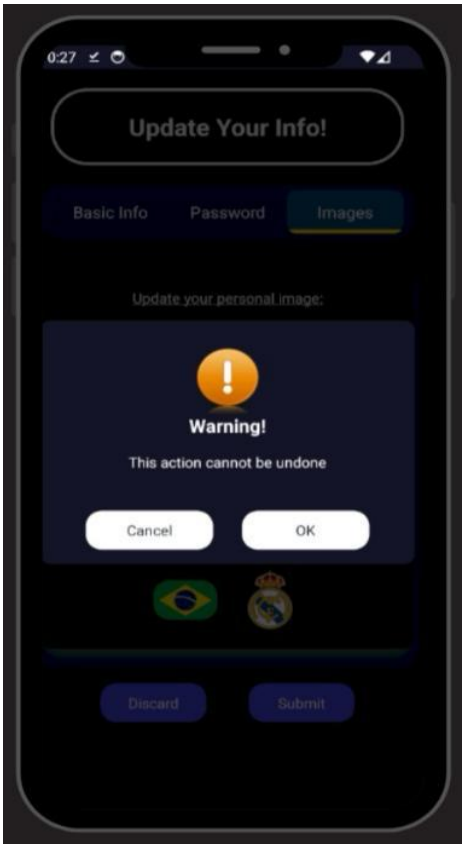
Personal info-2



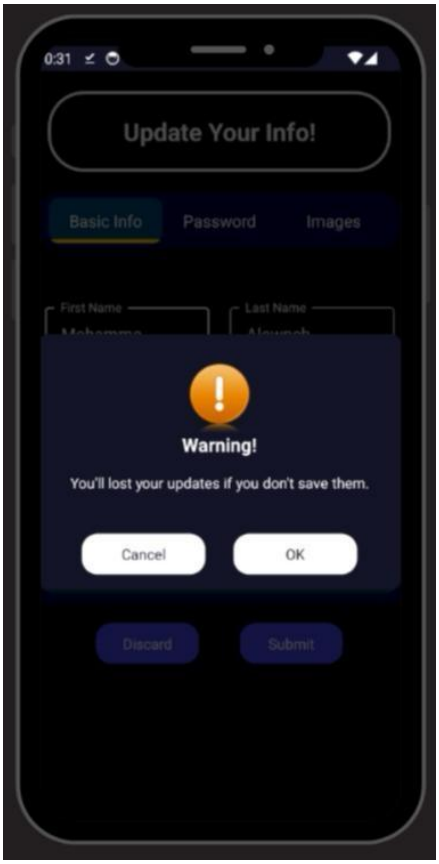
Personal info-3



Personal info-4

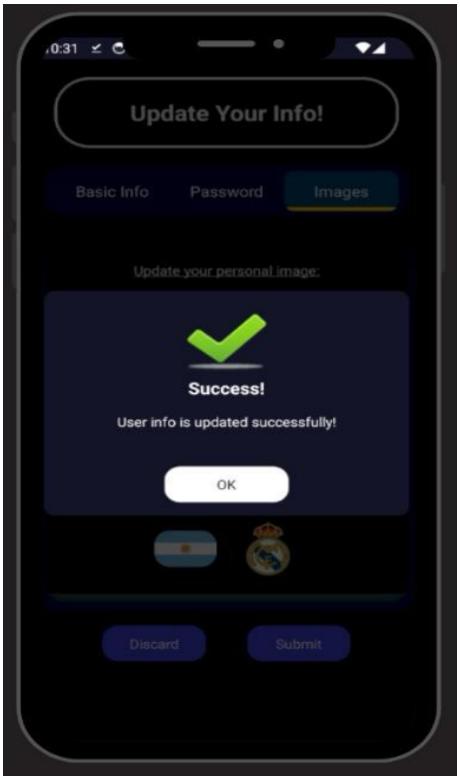


Personal info-5



Personal info-6

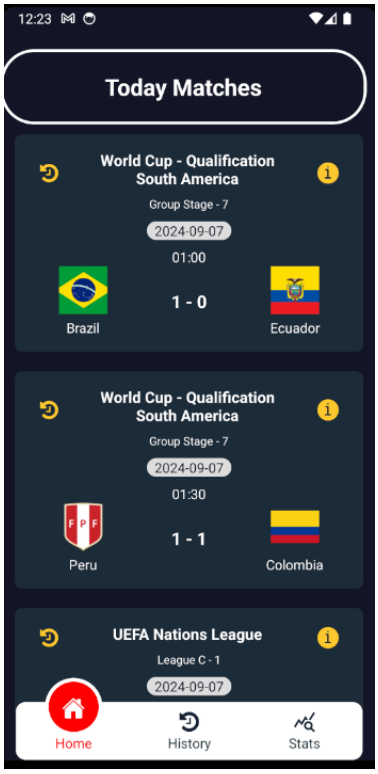
Personal info-7



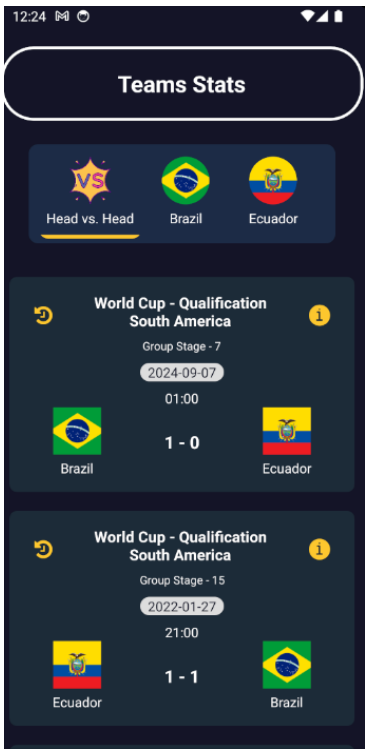
Personal info-8

- **Match Prediction**
  - Browse Today's Matches
    The today's matches will appear as cards each card contains the match information such as:
    - Competition name
    - Round
    - Teams' logos and names
    - Match score (Even there is penalties shootout)
    - Match elapsed time if the match is in progress (in play)
    - History icon button: Navigate to screen to see the last five matches for each team and the last five head-to-head matches -if any- between them.
    - Info icon button: Open a modal to see the match events and their corresponding minutes as the following:
      - Goals, own goals
      - Penalties, missed penalties
      - Red cards

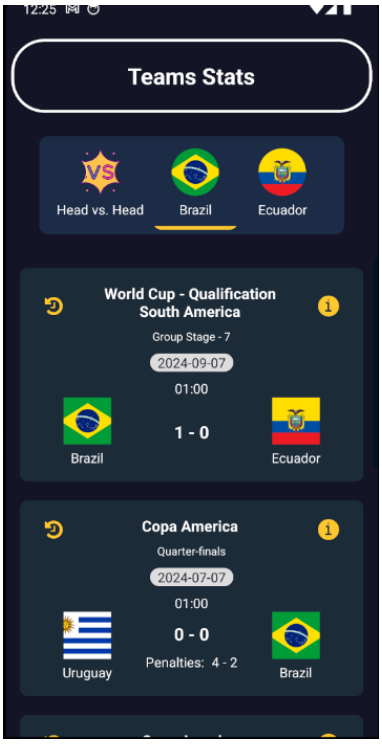
      The user can press on the event to see its details (Assist if it's a goal for example). Also, the opened modal contains icon buttons to see more information as the following:
      - Yellow cards
      - Substitutions
      - Lineup: The starting XI players for each team and their formation on the playground, and the lineup will display if there is a cards or substitution relevant to each player.
      - Match facts (statistics)
      - Penalties shootout details (if any)
      - Other details as the following:
        - ✓ Coaches of the two teams
        - ✓ Referee
        - ✓ Stadium name, location and image
      - In competition details: Navigate to a screen contains information about the two teams in the competition of the match as the following:
        - ✓ Last five matches for each team in the competition (Not in all the competitions)
        - ✓ Standing (If it's a league -not a cup-)
        - ✓ Statistics of each team in the competition
        - ✓ Top scorers in the competition
        - ✓ Top assists in the competition



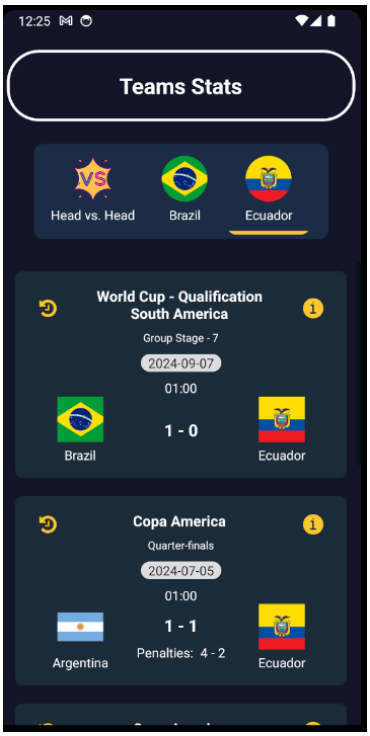
Today Matches - Browse



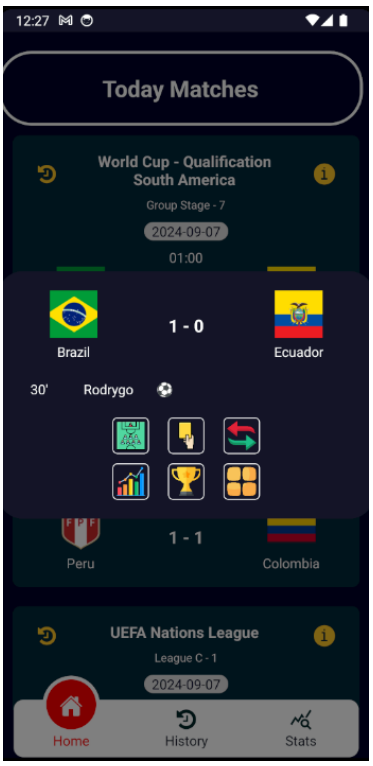
Today Matches - History Matches - Head-to-Head



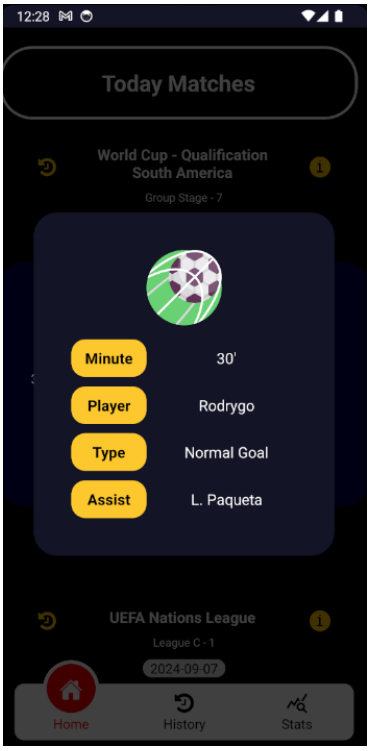
Today Matches - History Matches - Home Team



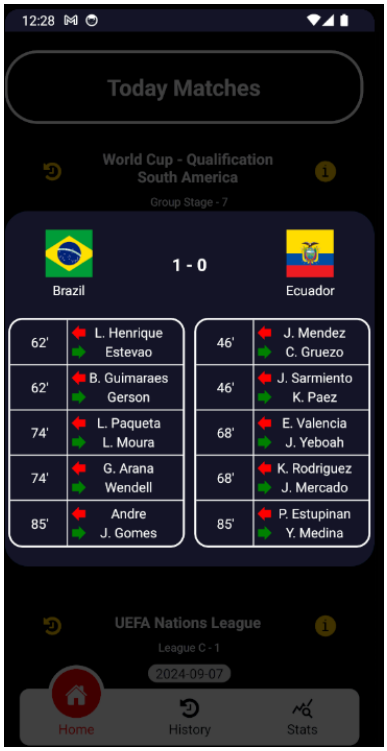
Today Matches - History Matches - Away Team



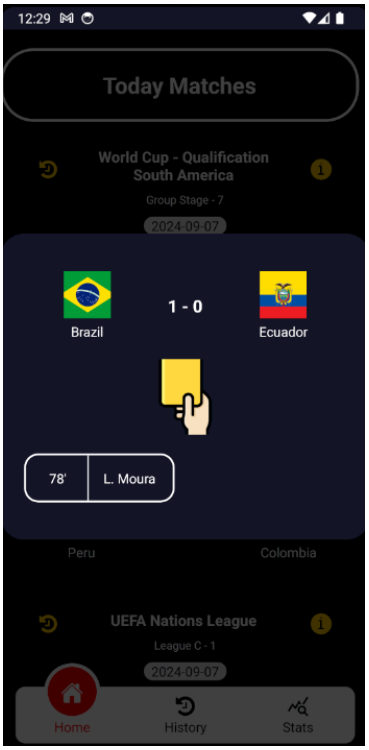
Match Events Modal



Event Details Modal

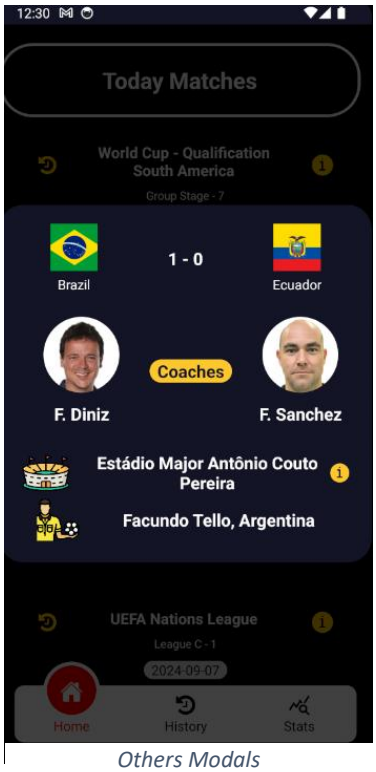


Substitutions Modal



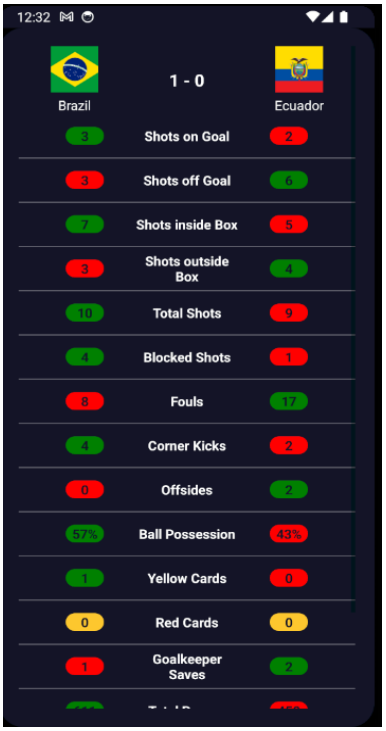
Yellow Cards Modal

Lineup Modal

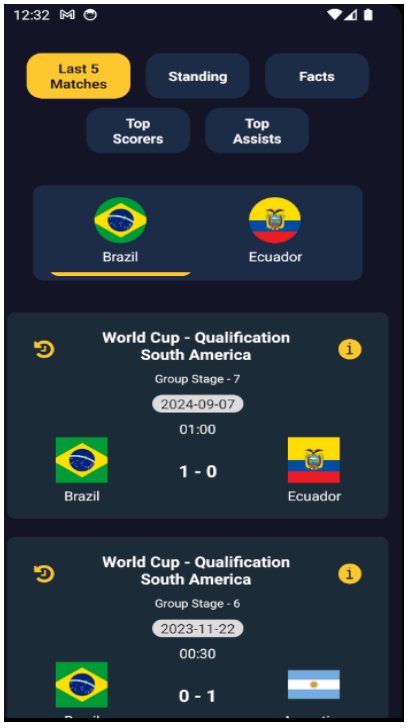


Others Modals
(Coaches, Stadium, Referee)

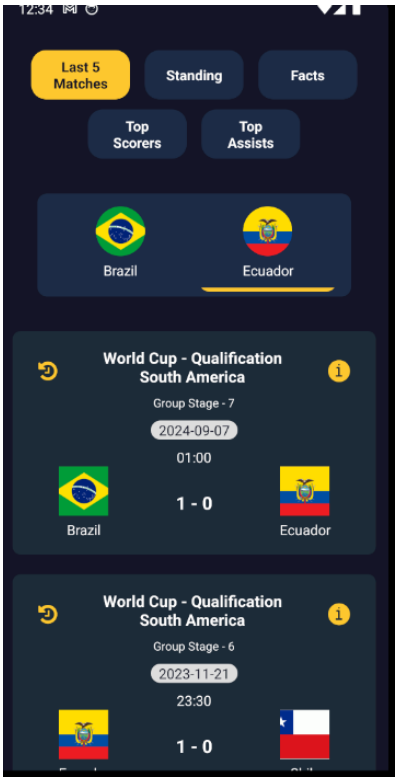
Stadium Details



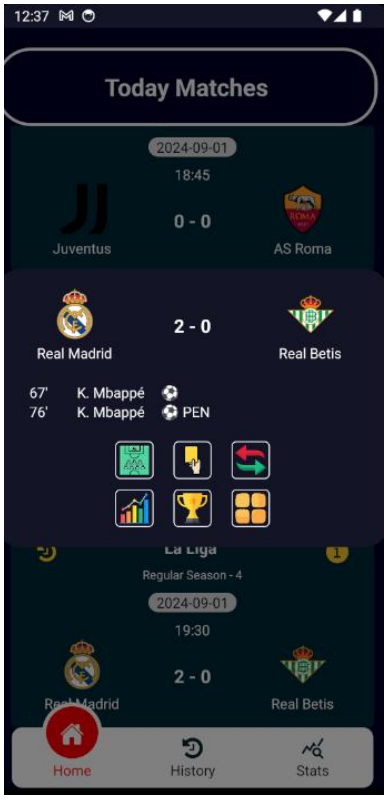
Match Facts



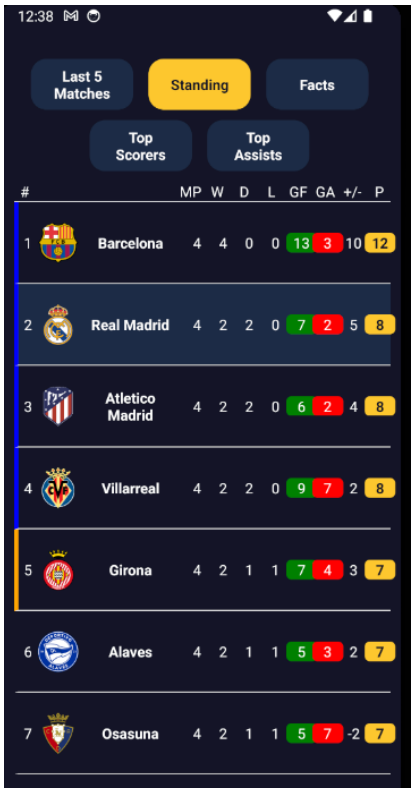
Competition Details - Last Five Matches - Home Team



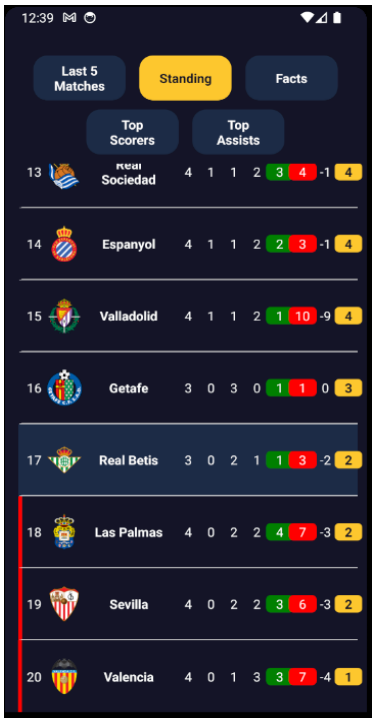
Competition Details - Last Five Matches - Away Team



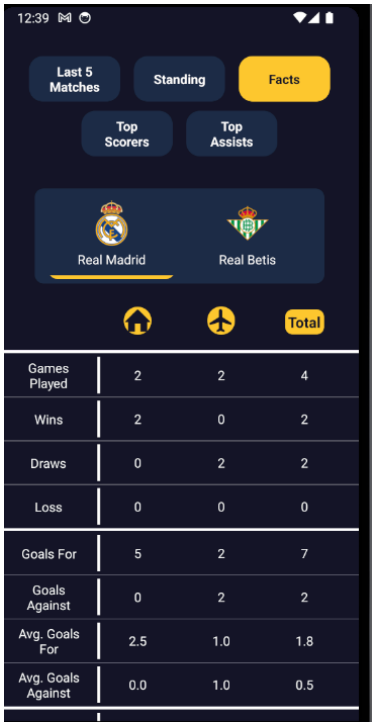
Match Events - Penalty Includes



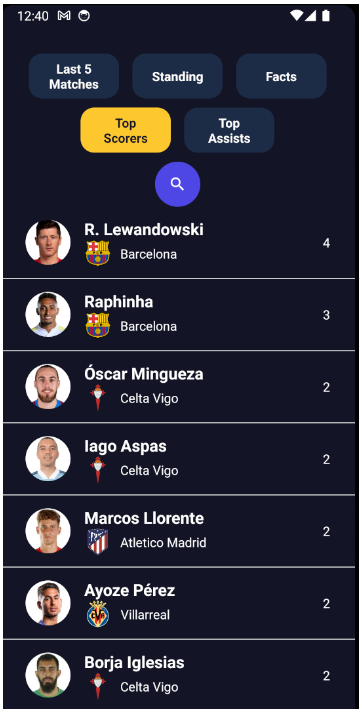
Competition Details – Standing (Shows also the UEFA competitions' qualified teams)



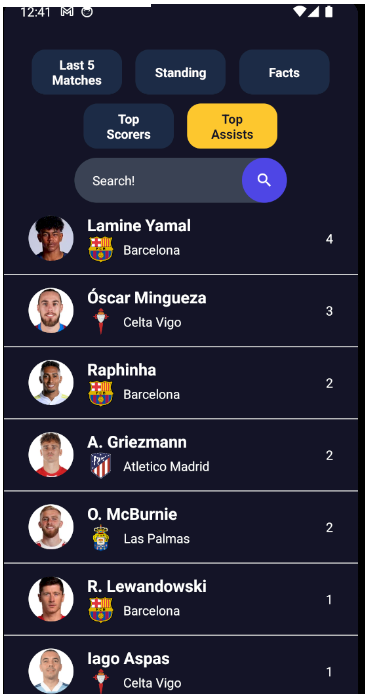
Competition Details - Standing (shows also the falling teams)



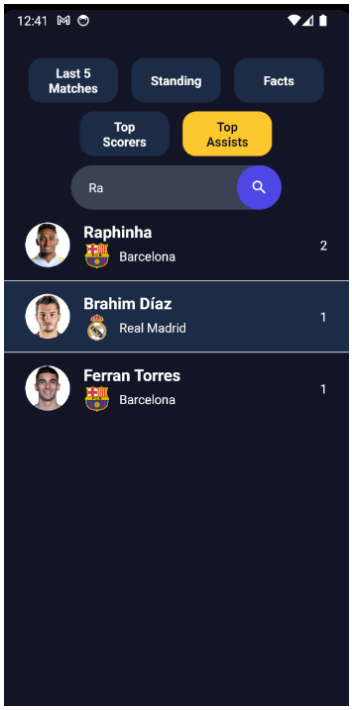
Competition Details - Team Facts



Competition Details- Top Scorers

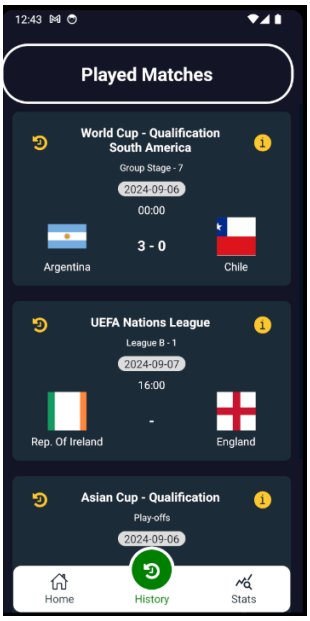


Competition Details - Top Assists



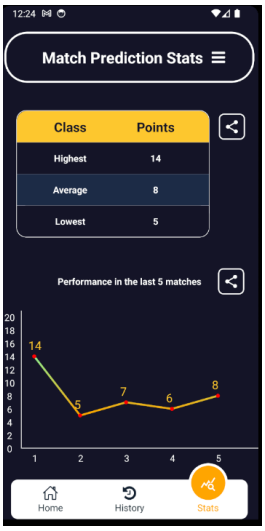
Competition Details – Top Assists (with filtering)

- See Played Matches



Played Matches

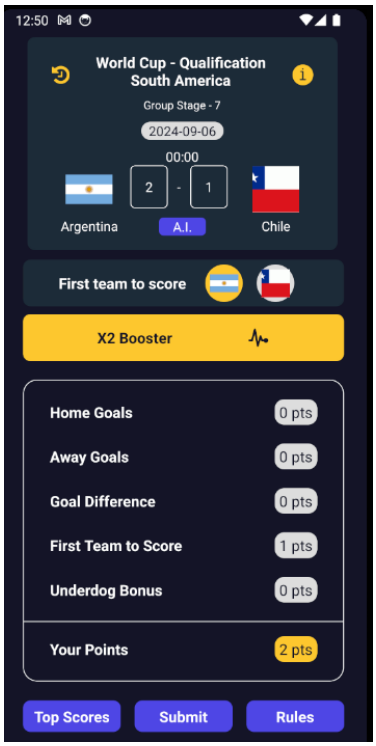
- See Match Prediction Statistics (Will be described again in Statistics):
    - Table showing the highest score, lowest one and the average score across all the matches.
    - Line chart shows the scores across the last five played matches.



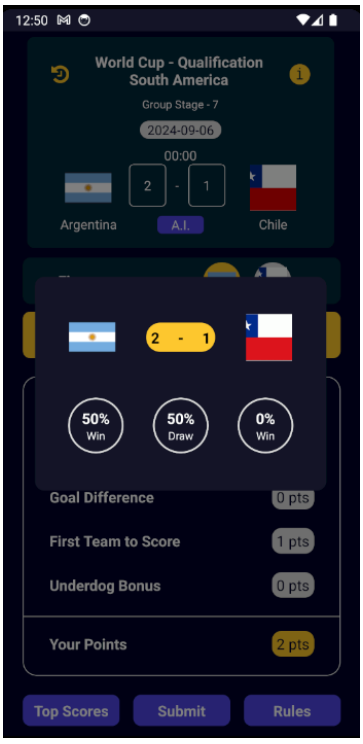
Match Prediction Stats

- Play Match Prediction:
  - The user can fill his / her prediction as the following:
    - Entering the predicted final score.
    - Determining the first team to score (if any).
    - Playing X2Booster or not.

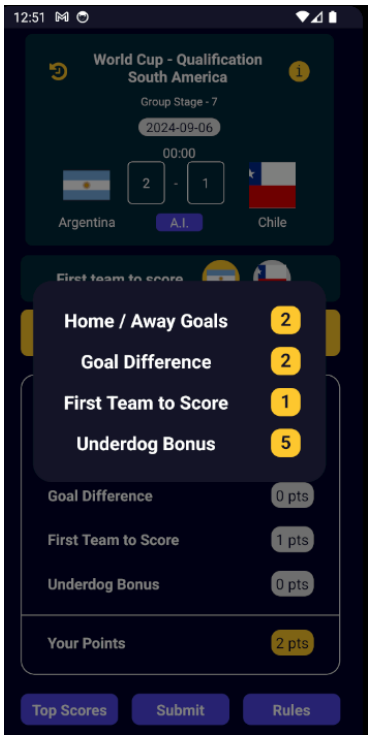
  - See the A.I. recommended result and the win / draw / lose percentages.
  - See the user earned points details.
  - See the rules of the match prediction.
  - See the scores of the other users and filter them using a search field.



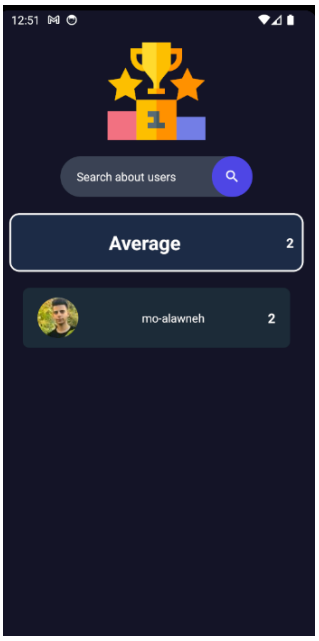
Play Match Prediction - 1



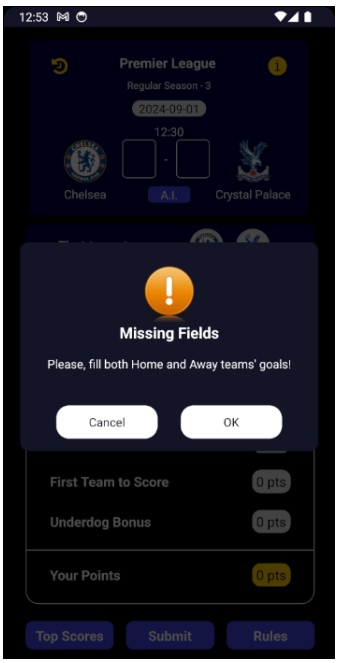
Play Match Prediction - 2 - A.I. Prediction



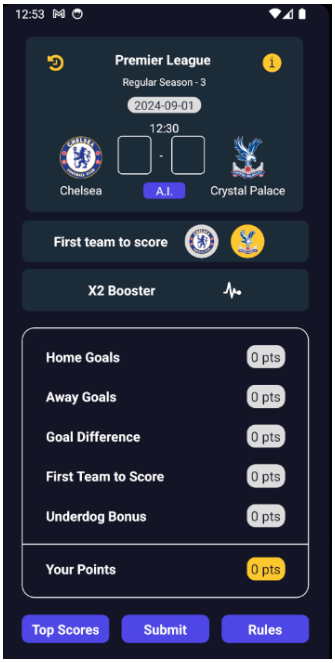
Play Match Prediction - 3 - Rules



Play Match Prediction - 4 - Top Scorers

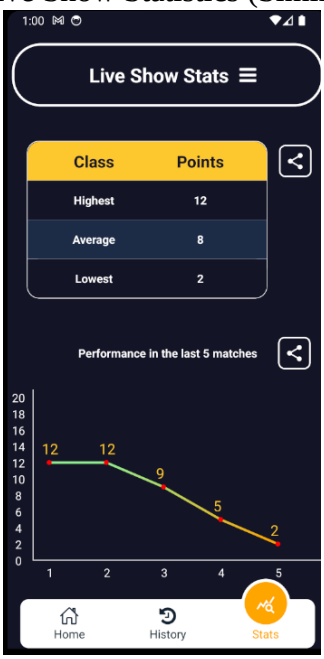


Play Match Prediction - 5 - Validation



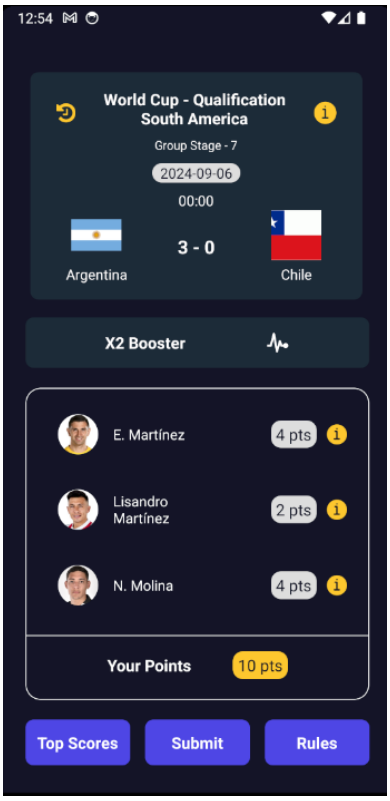
Play Match Prediction - 6

- **Live Show**
  - Browse Today's Matches
  - See Played Matches
  - See Live Show Statistics (Similar to Match Prediction statistics).

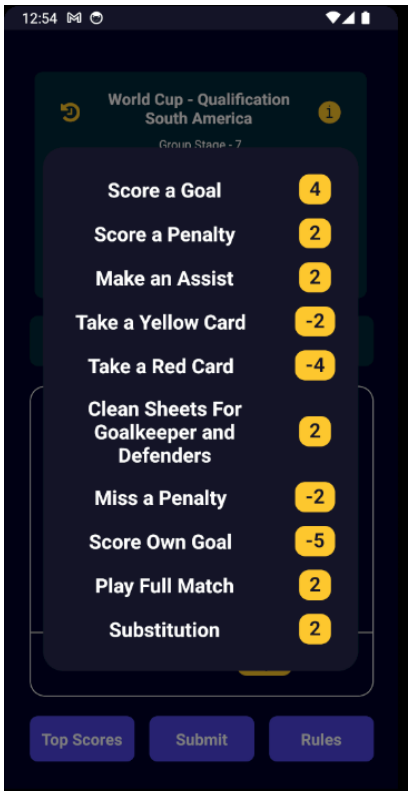


Live Show Stats

- Play Live Show
    - The user can fill his / her prediction by selecting three players from the two teams. A warning mark will appear next to the player's image if the team's lineup is ready and the player isn't a part of it and the user can see the player statistics in the last three seasons by performing long press on the player's image.
    - See each player points and their details by pressing the info icon.
    - See the rules of the match prediction.
    - See the scores of the other users and filter them using a search field.

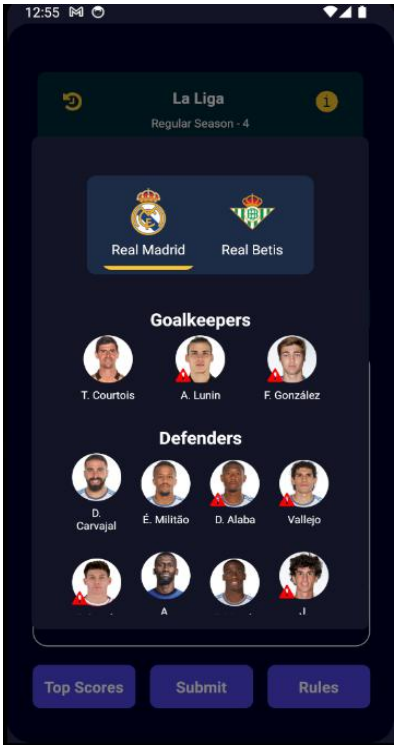


Play Live Show - 1

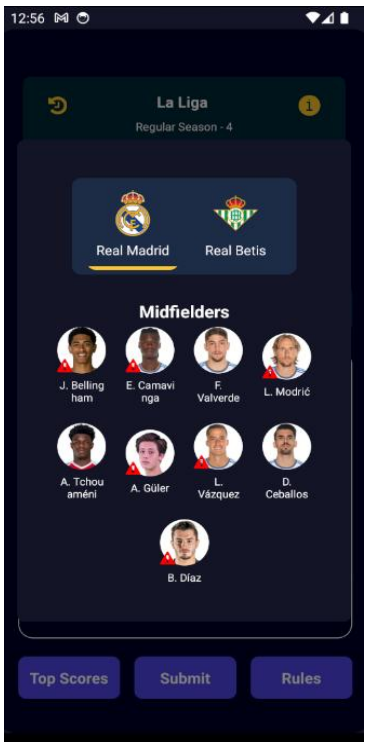


Play Live Show - 2 - Rules

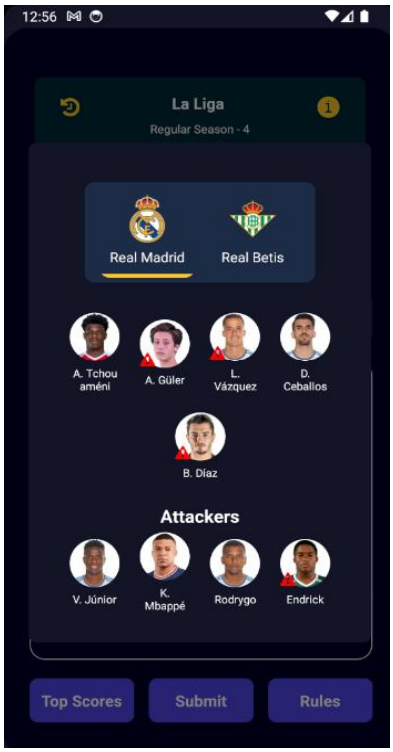
Play Live Show - 3 - Player Points Details



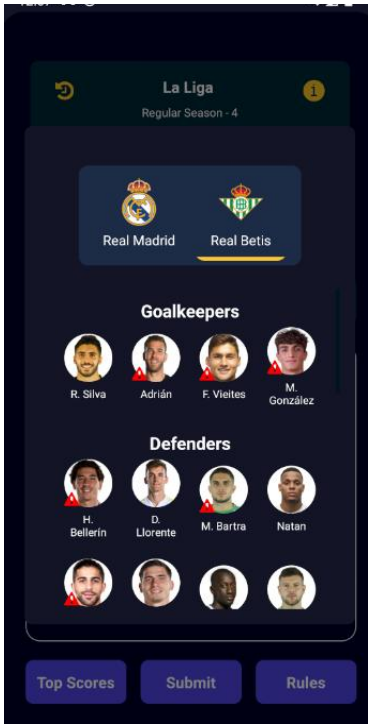
Play Live Show - 4 - Player Selection (1)



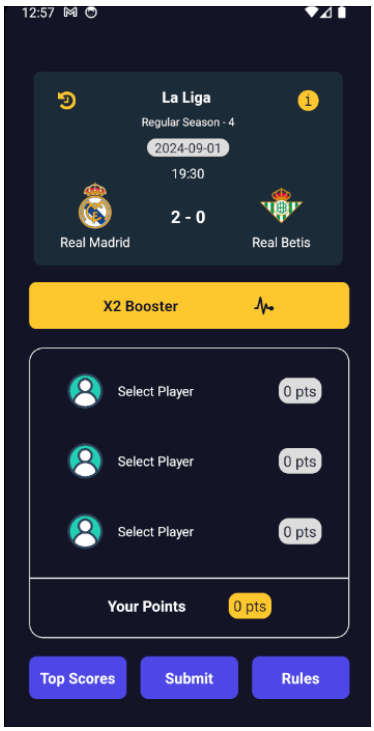
Play Live Show - 5 - Player Selection (2)



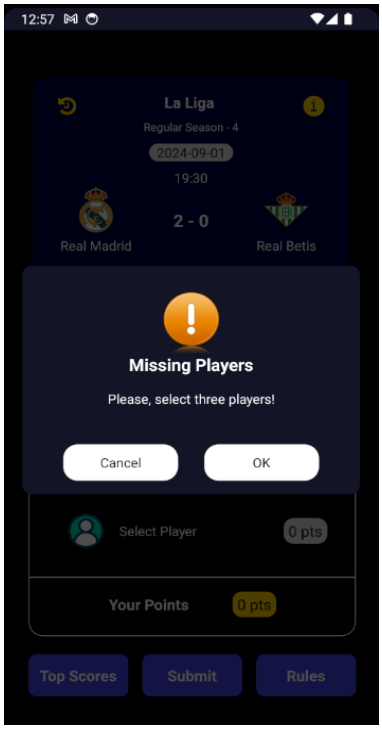
Play Live Show - 6 - Player Selection (3)



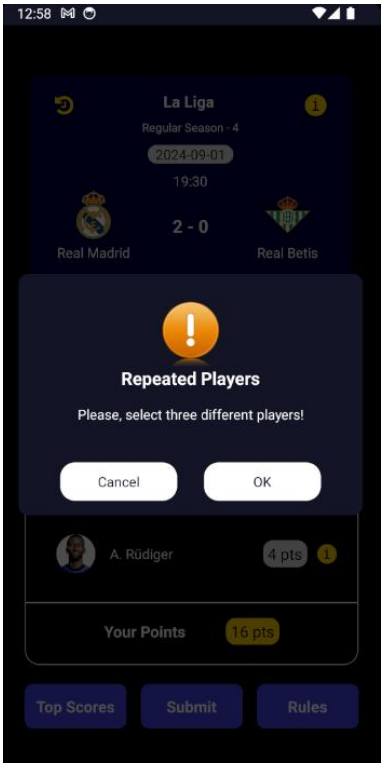
Play Live Show - 7 - Player Selection (4)



Play Live Show - 8



Play Live Show – 9 – Validation (1)



Play Live Show - 10 - Validation (2)

Play Live Show - 11 - Player Points - New Sample (1)

Play Live Show - 12 - Player Points - New Sample (2)

- **Quiz Zone**
  - **Main Screen**: The user can browse the quizzes under three main categories:
    - Created Quizzes
    - Solved Quizzes
    - Others (Available Quizzes)

    The quizzes appear as cards and each one holds information such as:
    - The author details:
      - ✓ Image
      - ✓ username
      - ✓ name
    - The quiz details:
      - ✓ The date
      - ✓ The number of views (users who solved the quiz)
      - ✓ The average rating
      - ✓ The average score
    - Like button: To add the quiz to the favorite

- Delete button: To delete the quiz if it's under the created quizzes category and this required entering the local authentication credentials of the mobile.
- Info button: To navigate to the details of the quiz if it's under the created quiz category.

Pressing the card itself will navigate the user to solve the quiz, review it if it's already solved by the user or update it if it's under the user created quizzes category.
The user can filter the quizzes in a category either by a search filed based on the author details or the quiz date, or using the favorite button to get only the liked quizzes.

- **Create a New Quiz**:
  Allows the user to create a new quiz by providing filling the question and options text fields and selecting the checkbox of the correct option.

  Each question contains the following buttons:
  - Delete button: To delete the question.
  - Copy button: To copy the content of the question and its options once to the clipboard.
  - Drag and drop button: To change the order of the questions.
  - Record button: To record the question instead of writing it (Voice to Text).

  Each option contains the following features:
  - Record button: To record the option instead of writing it (Voice to Text).
  - Drag and drop hidden button (By long pressing on the option): To change the order of the options of question.

  The screen itself contains the following buttons:
  - Add question button: To add an empty question to the list of the questions.
  - Try A.I. button: To add an A.I. generated question (with its options and correct answer) to the list of the questions.
  - Save button: To save the quiz to the user created quizzes (The other users still cannot see it).
  - Publish button: To publish the quiz and allow the other users to solve it. When the user publishes a quiz, the quiz will be validated using the A.I. to ensure that all the questions are related to football and answered correctly.

After the user publish a quiz, he / she can still update it except adding a new question either manually or using the A.I., After the re-publish button is pressed, the quiz will be verified again using the A.I. and all the scores will be re-calculated.

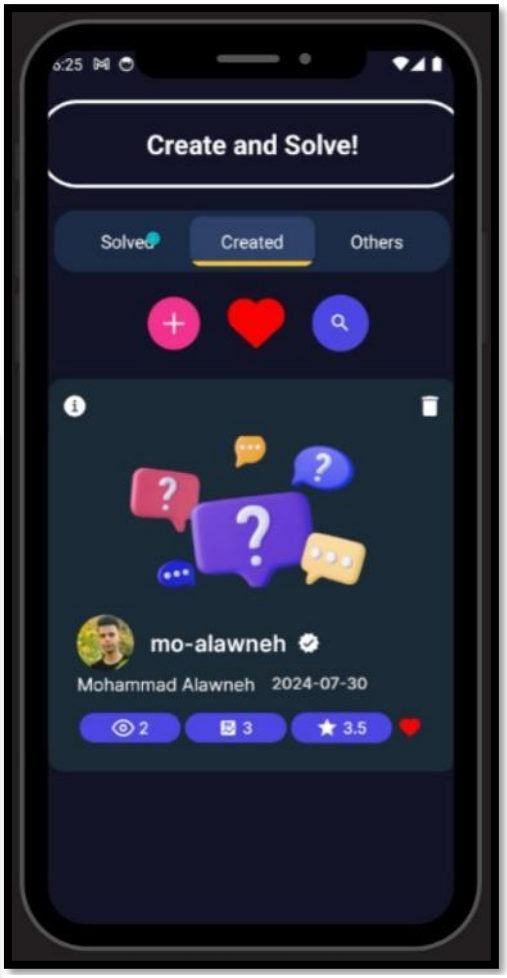
A modal contains indicates that the quiz is created successfully will be shown. Otherwise, a dialog contains the error will be shown.

- **Solve a Quiz**:
  The user can see one question at each screen within only 10 seconds. After answering the question or the available time is finished, the user answer will be validated and (X) and (✓) marks will appear.

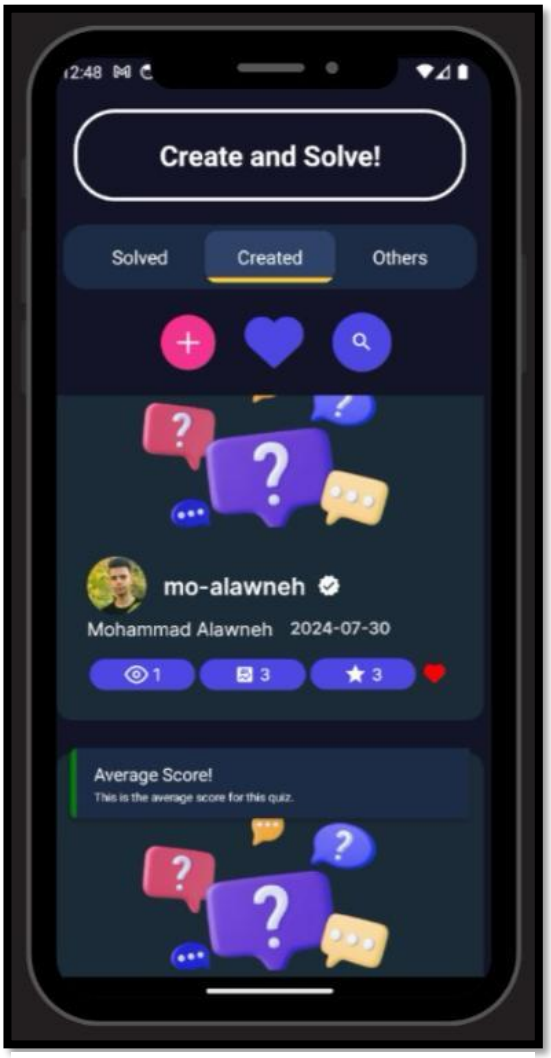
  The U.I. is enhanced by the following:
  - A progress bar and a label will be used to monitor the number of solved questions.
  - A timer will display the remaining time with two colors (Green >= 6) and (Red <= 5).

  After finishing the quiz, a rating modal will be visible in order to rate the quiz out of five stars. It's important to say that the user can re-rate the solved quiz even he / she in the review mode and already rated it in the first time.

- **Created Quiz Statistics**:
  The author of the quiz can monitor the results of the others who solved the quiz by:
  - Pie chart contains the distribution of the users' scores in the quiz in these categories [0 – 49%, 50 – 59%, 60 – 69%, 70 – 79%, 80 – 89% and 90 – 100%].
  - Bar chart contains the number of users who solved each question correctly.
  - Table contains the users' details (Image, username, rating and the score) as well as the average raring and the average score. The pressing on the details of any user will navigate the author to his / her answers.

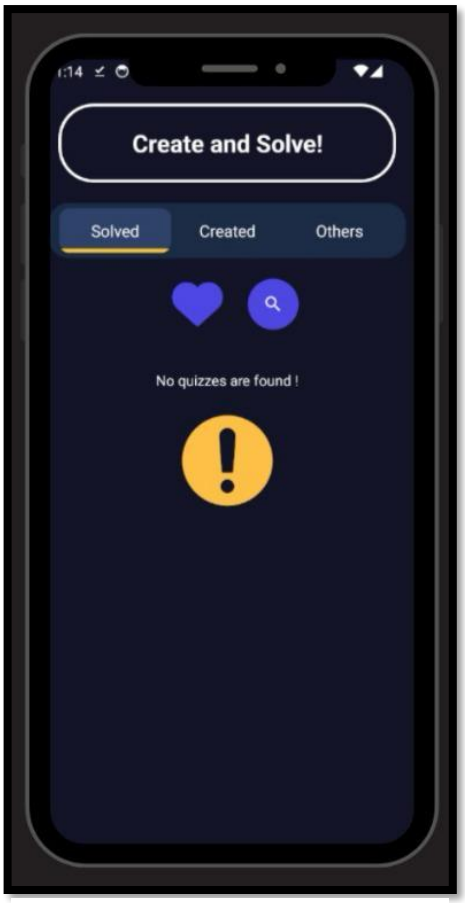


Quiz-1
main page

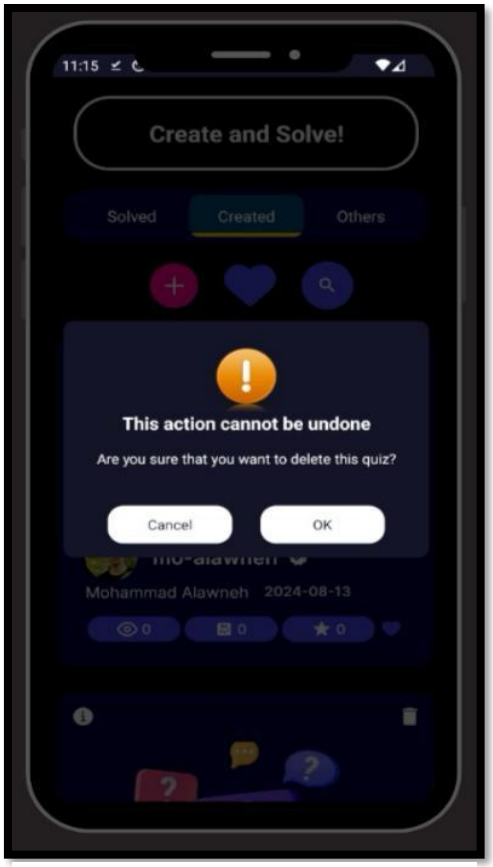


Quiz-2
main page

Quiz-3
main page

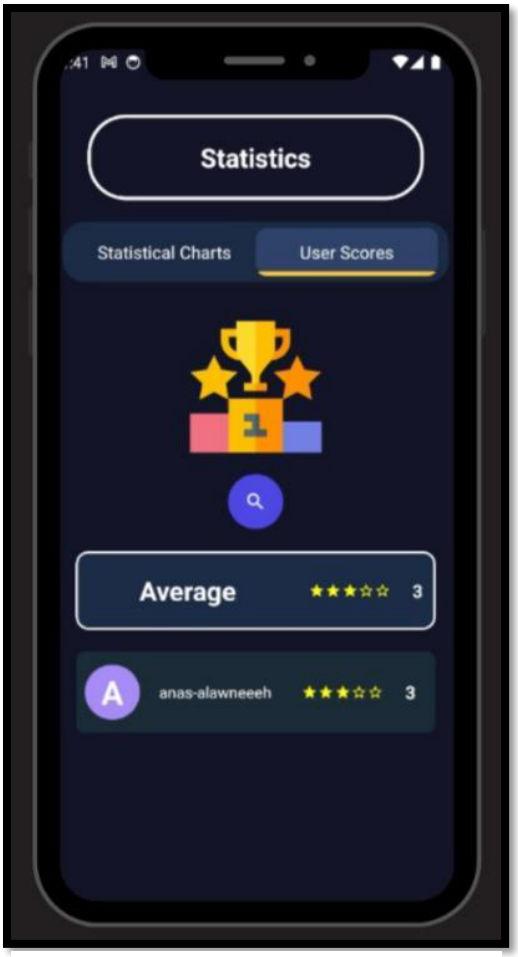


Quiz-4



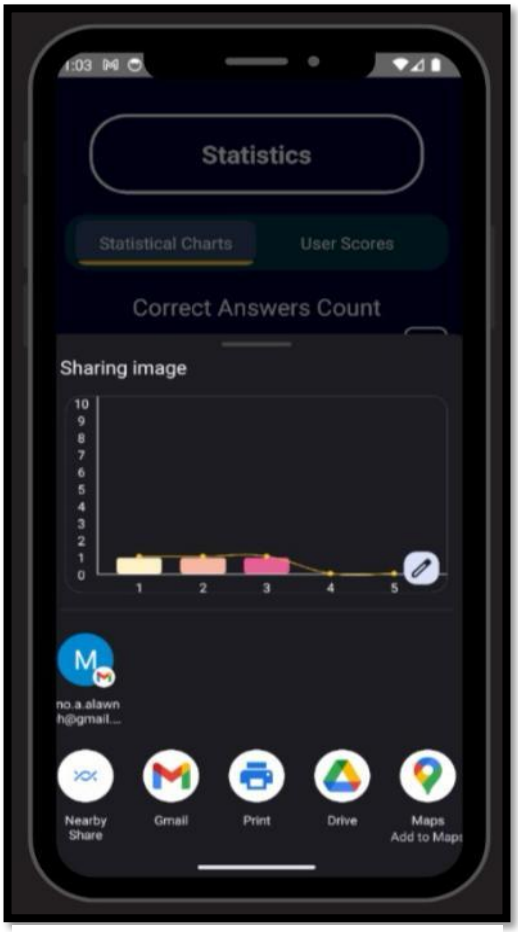
Quiz-5

Quiz-6

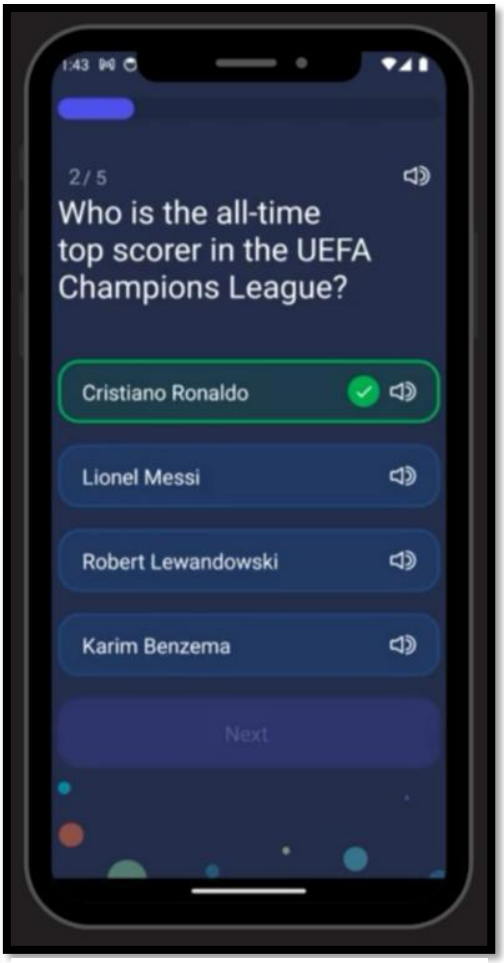


Quiz-8
statistics

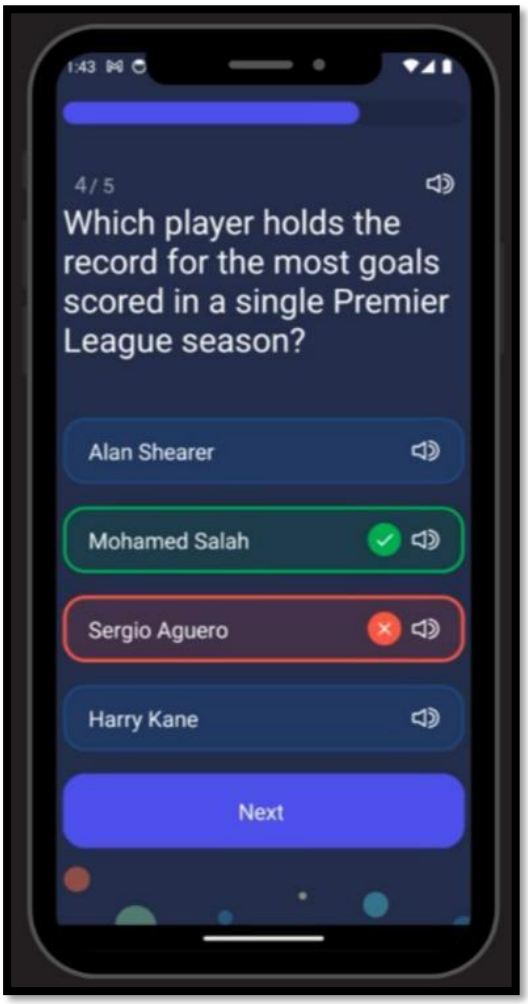
Quiz-7
statistics



Quiz-9
statistics

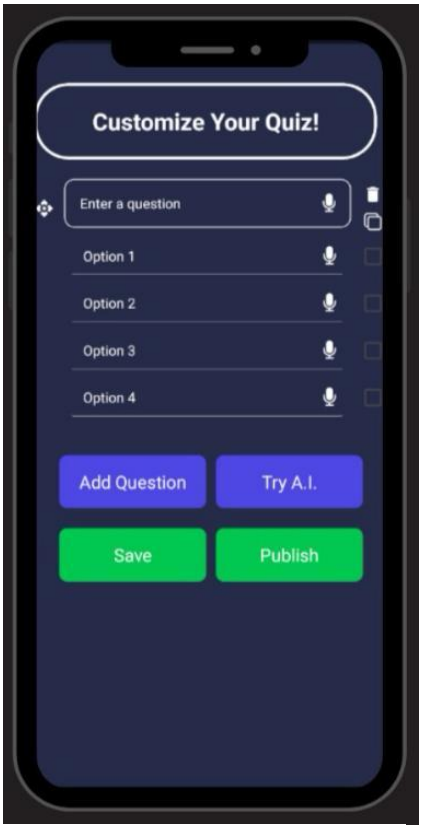


Quiz-11
User's answers

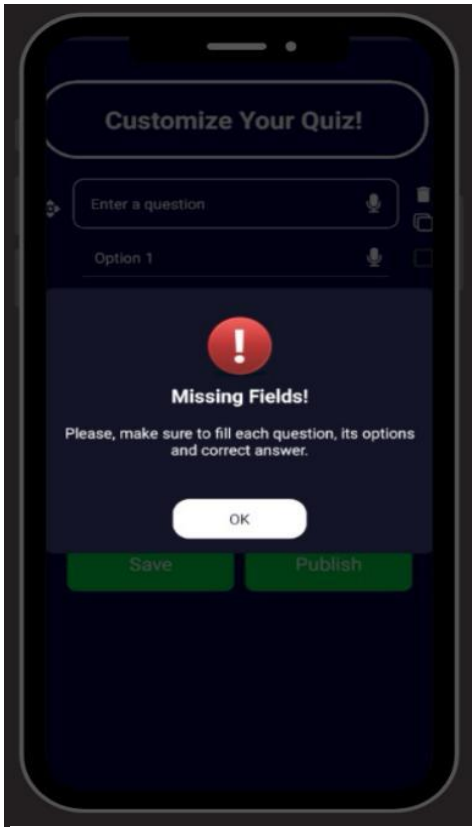


Quiz-10
User's answers

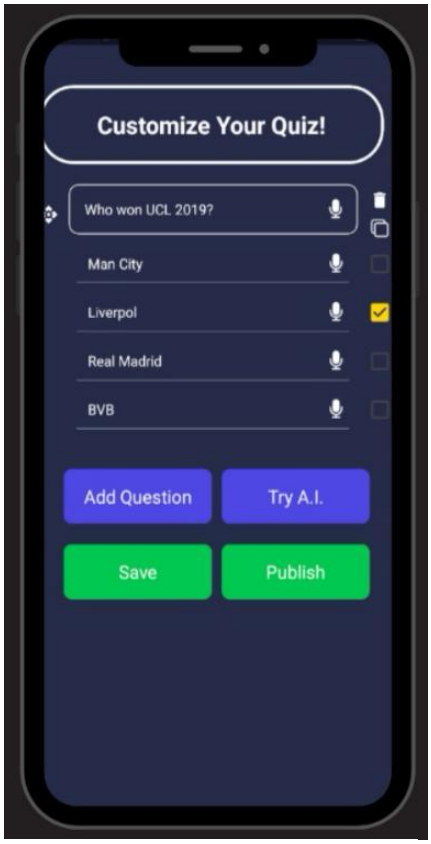
Quiz-12
User's answers



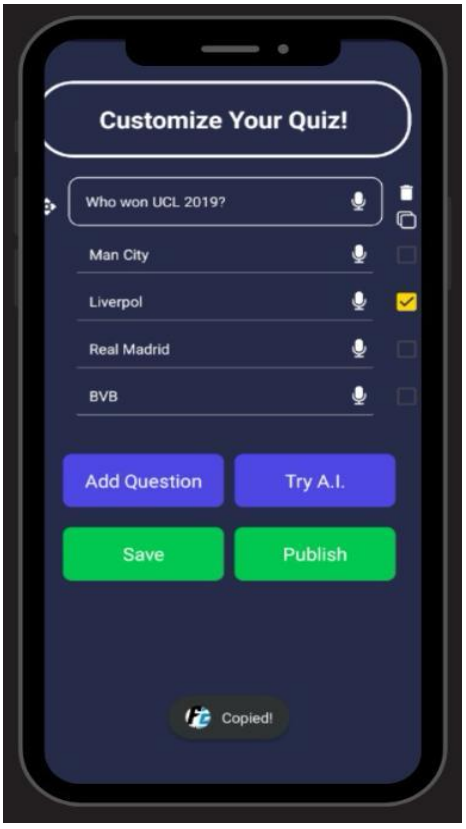
Quiz-13



Quiz-14

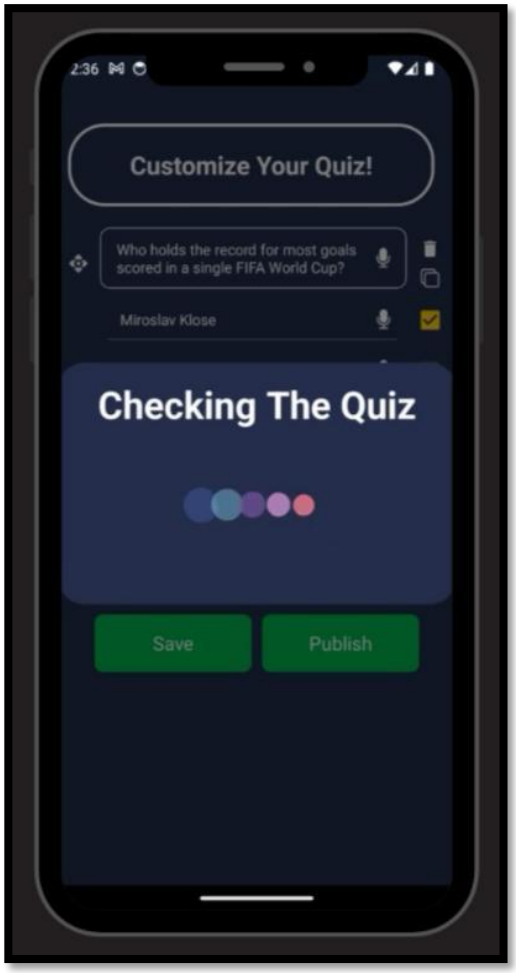


Quiz-15



Quiz-16

Quiz-17



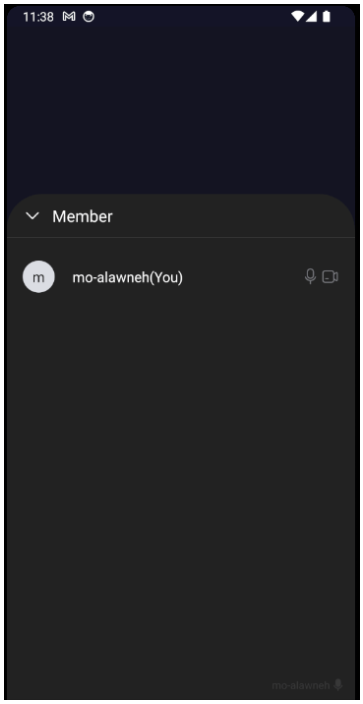
Quiz-18

Quiz-19

- **Rooms and Chats**
  The user can start or join to a video conference by using a meeting ID or make a chat with any user in the application.

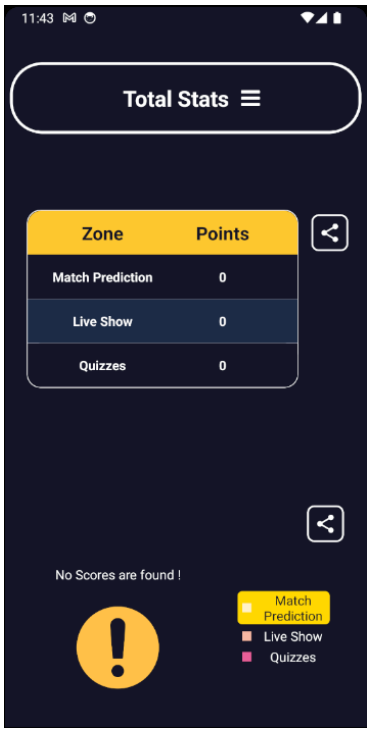
Rooms and Chats - 1

Rooms and Chats - 2

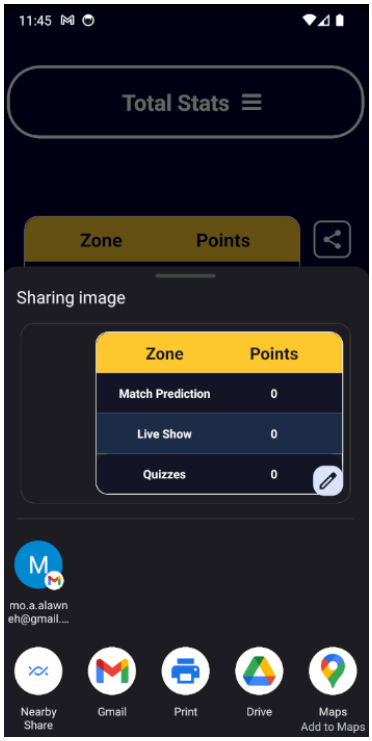


Rooms and Chats - 3

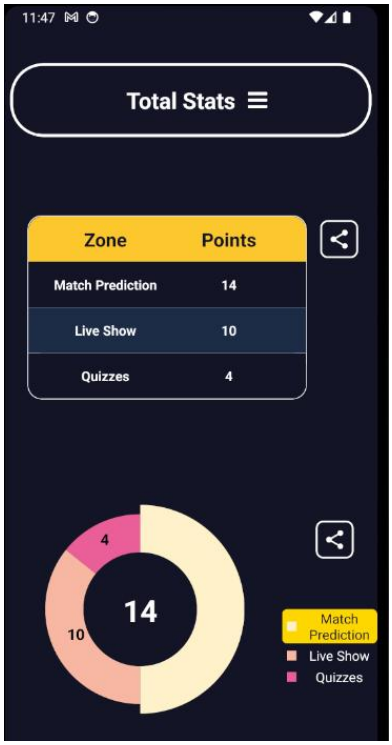
- **Statistics**
  The user can see statistics about his / her app usage divided into these categories:
  - **Overall**
    - The points earned from each feature.
    - Pie chart shows the distribution of the points across the features.



Total Stats - 1

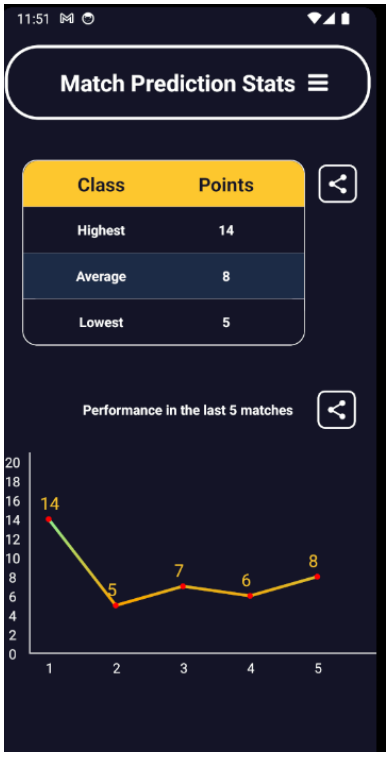


Total Stats - 2



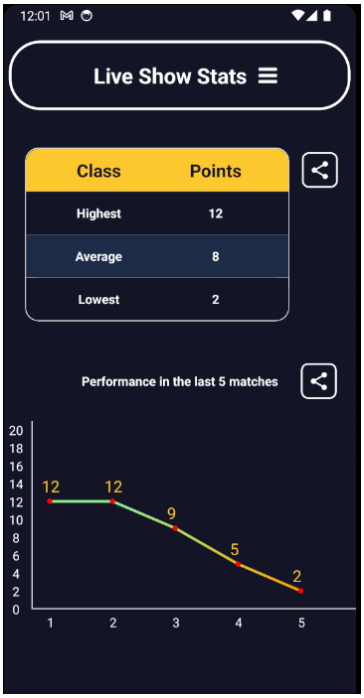
Total Stats - 3

- **Match Prediction**
  - Table showing the highest score, lowest one and the average score across all the matches.
  - Line chart shows the scores across the last five played matches.



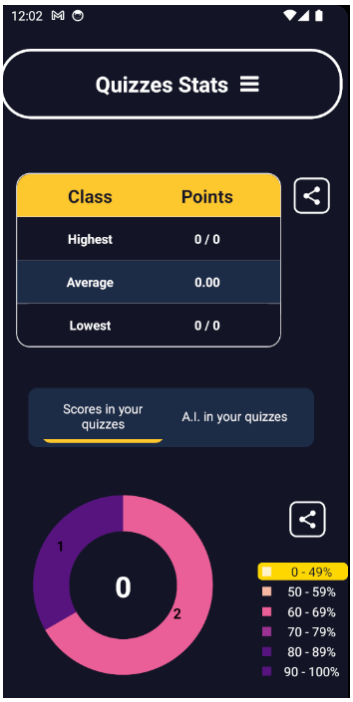
Match Prediction Stats - 1

- **Live Show**
  - Similar to Match Prediction.

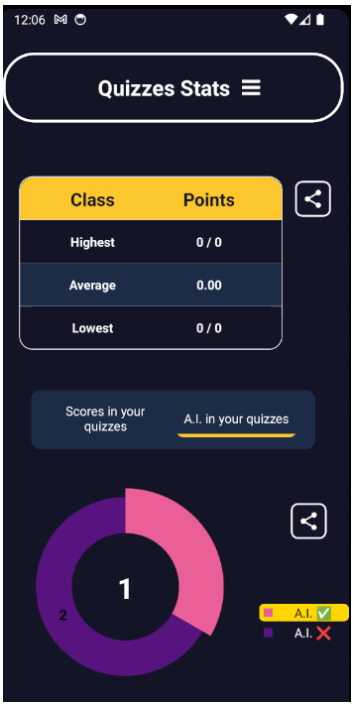


Live Show Stats - 1

- **Quiz Zone**
  - Table showing the highest score, lowest one and the average score across all the quizzes.
  - Line chart shows the scores across the last five solved quizzes.
  - Pie chart showing the distribution of the user created quizzes according to the use of the A.I. in them.

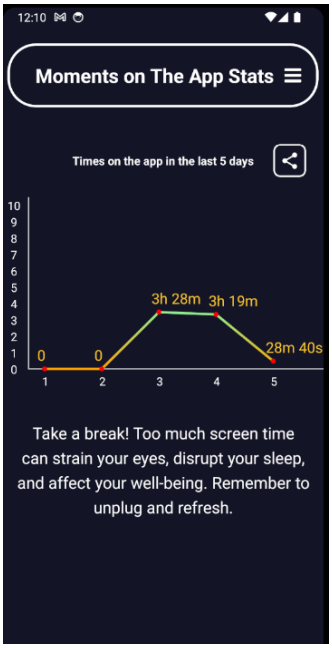


Quiz Zone Stats - 1



Quiz Zone Stats - 2

- **App Usage Time**
  - Line chart showing the usage time of the app in the last five days.
  - Animated text to tell the user to avoid using the mobile phone in general and this application in particular too much.

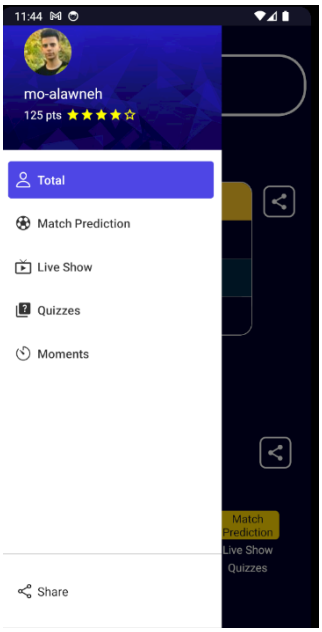


Moments on The App Stats

The navigation between the categories can be easily done using a drawer contains at the top of it the user's information and at the bottom of it two buttons:

- Share: To share the user's information on the social media.
- Logout button

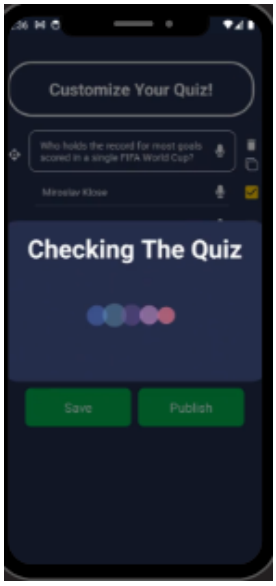
It's important to say that the user can share any table or chart using a share button.



Navigation between stats

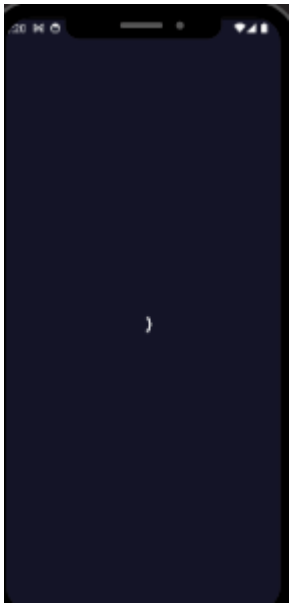
- **Loading Handling**
  Since the applications depends on cloud services, local and external APIs, there are multiple loading screens in the application. So, we use multiple methods to show the loading:
    - Skeleton loading
    - Lottie and GIF
    - Activity indicator

Loading GUI - 1



Loading GUI - 2

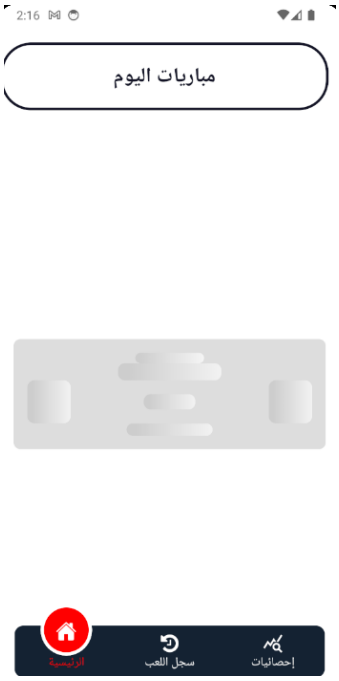
Loading GUI - 3



Loading GUI - 4

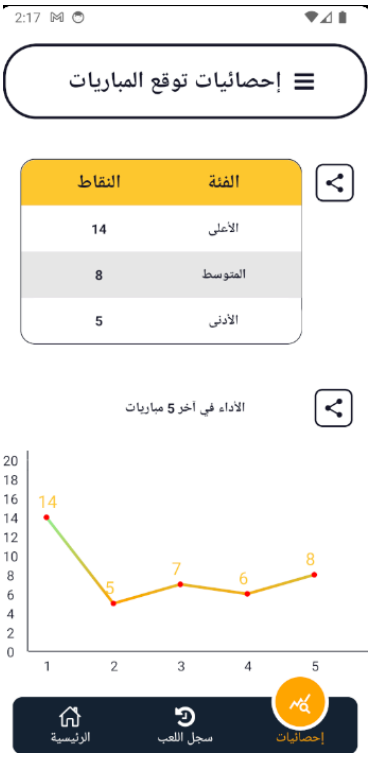
4.2 Screenshots from Light Mode and Arabic Language

Arabic & Light screenshots - 1



Arabic & Light screenshots - 2

Arabic & Light screenshots - 3

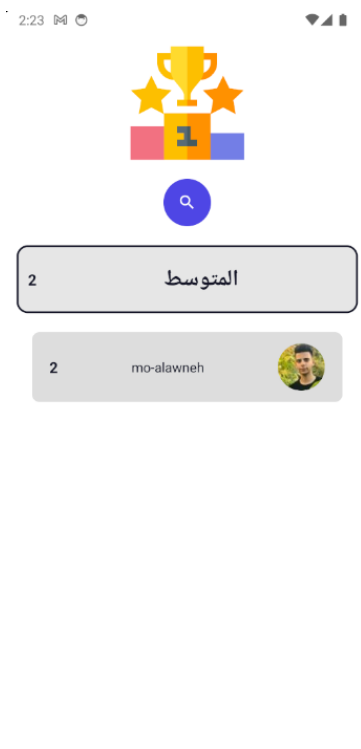


Arabic & Light screenshots - 4

Arabic & Light screenshots - 5

Arabic & Light screenshots - 6

Arabic & Light screenshots - 7



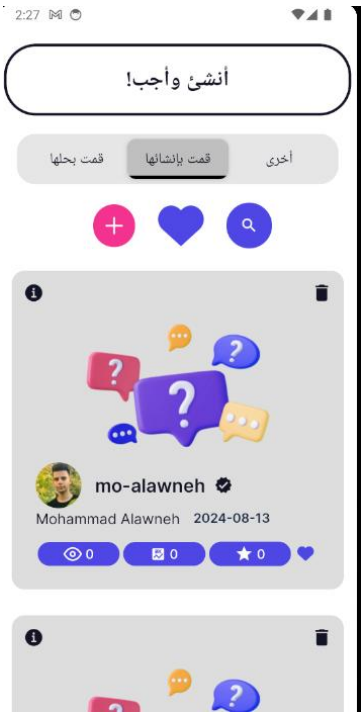
Arabic & Light screenshots - 8

Arabic & Light screenshots - 9

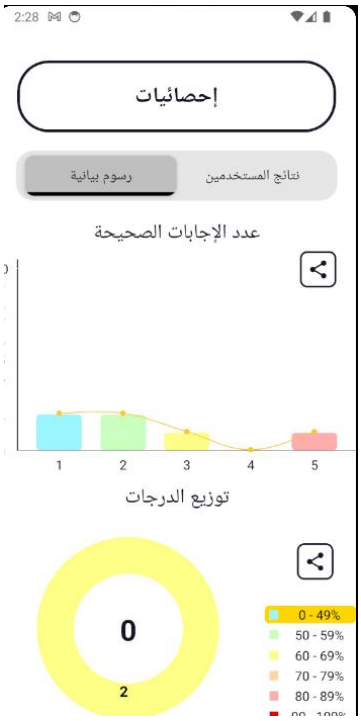
Arabic & Light screenshots - 10

Arabic & Light screenshots - 11

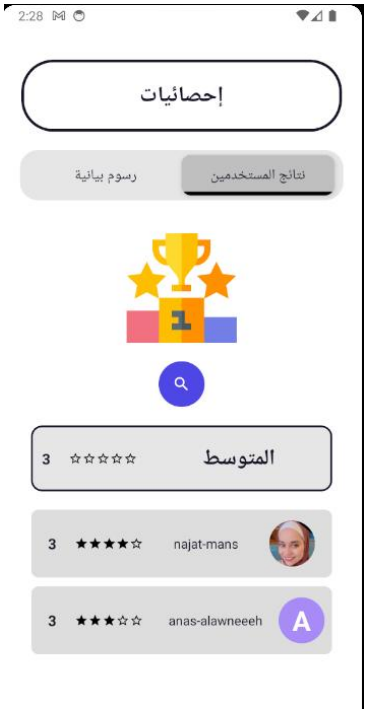
Arabic & Light screenshots - 12



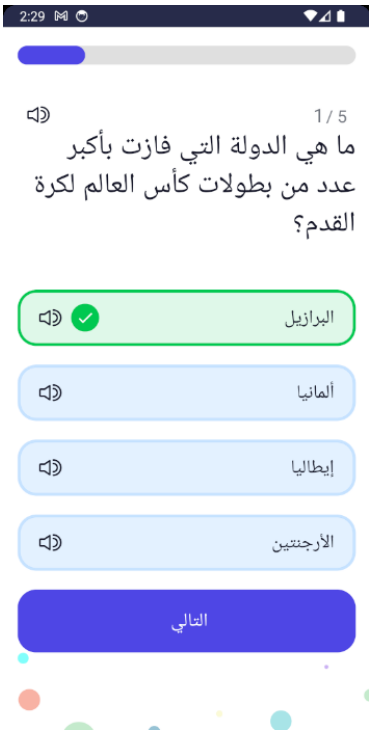
Arabic & Light screenshots - 13



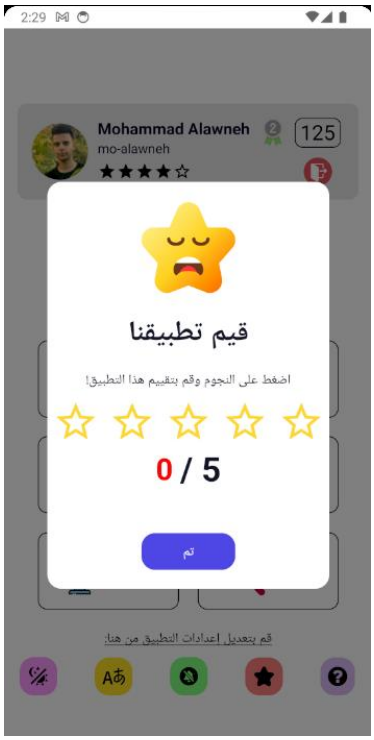
Arabic & Light screenshots - 14



Arabic & Light screenshots - 15



Arabic & Light screenshots - 16



Arabic & Light screenshots - 17

Arabic & Light screenshots - 18

Arabic & Light screenshots - 19

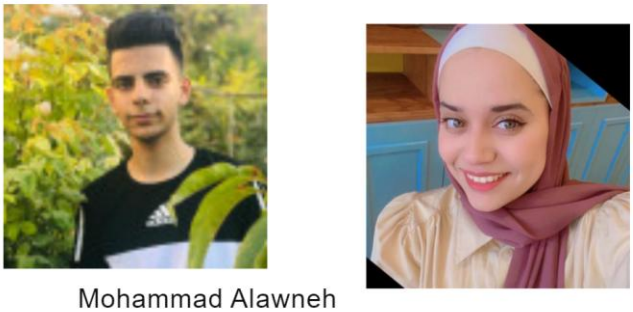
Arabic & Light screenshots - 20

Arabic & Light screenshots - 21

4.3 Website

- **Main Page**
  - See the developers and their contact details.
  - Navigate to test our public API or login as an admin.

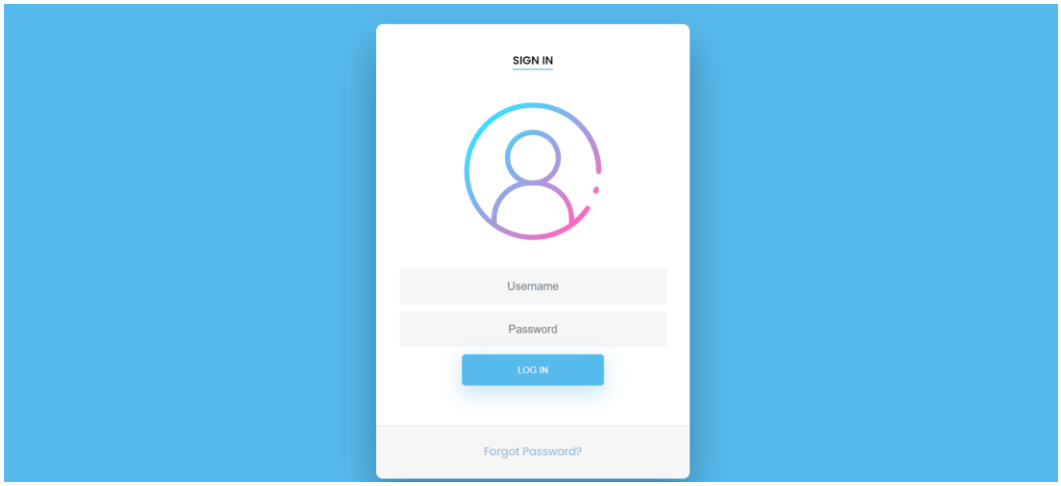
Home Page - 1



Home Page - 2

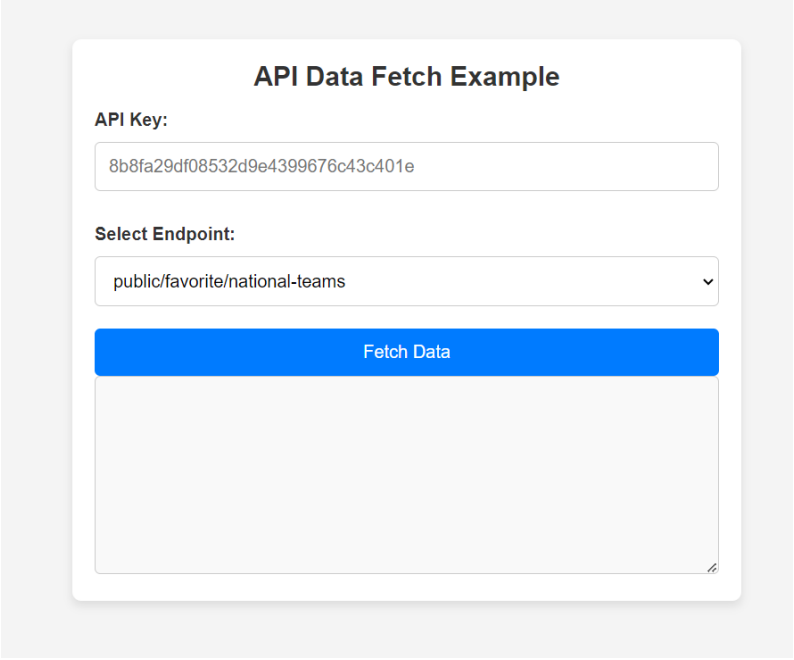
Home Page – 3

- **Login as admin**
  - Allow the admin to login into his / her dashboard.

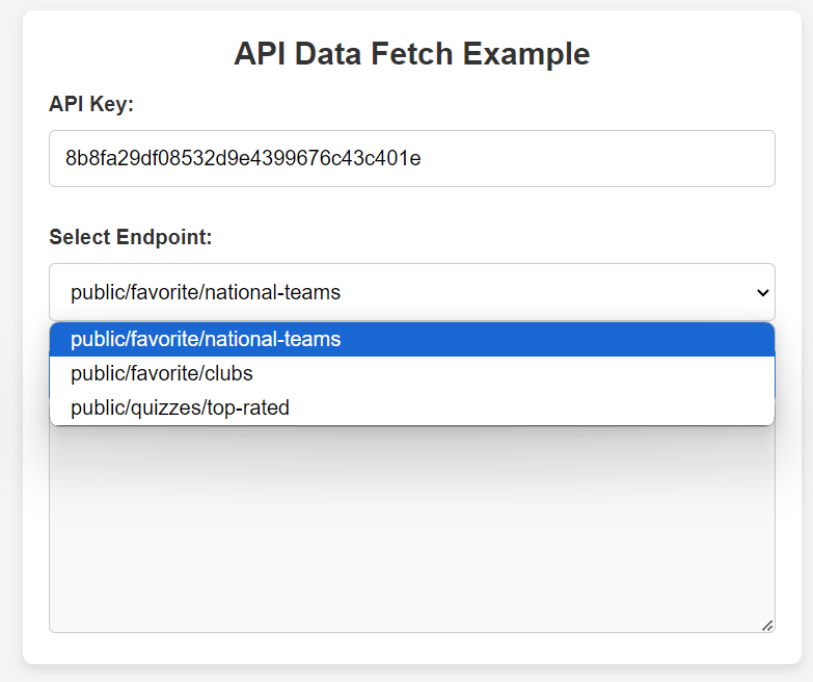


Login Page

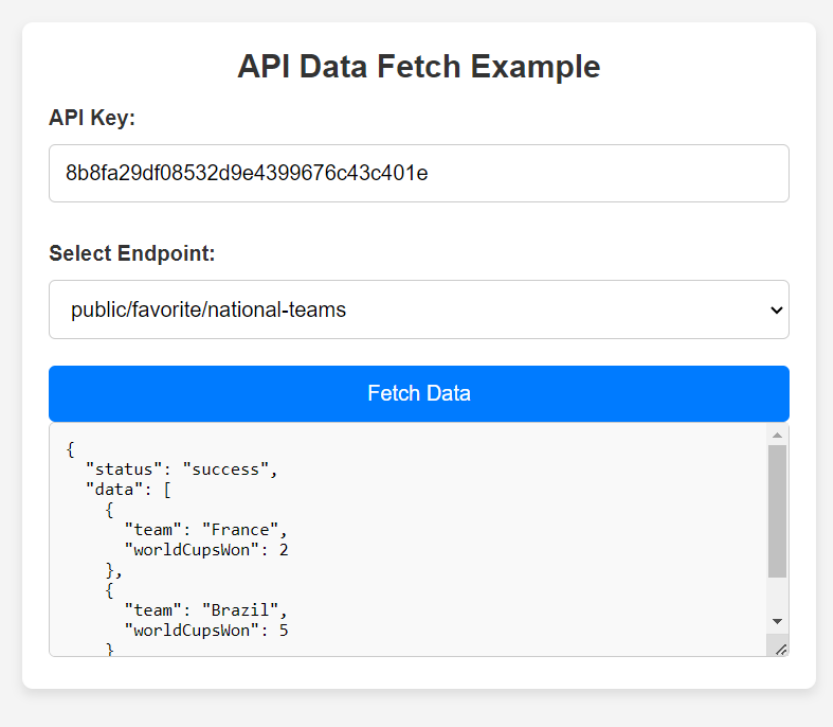
- **Test Our Public API**
  - The user can test our public API before use it in their applications and try these resources:
    - ✓ Get the most five selected national teams as favorite ones.
    - ✓ Get the most five selected clubs as favorite ones.
    - ✓ Get the content of the most five solved quizzes.
    - ✓ Get the content of the most five quizzes based on the average rating.



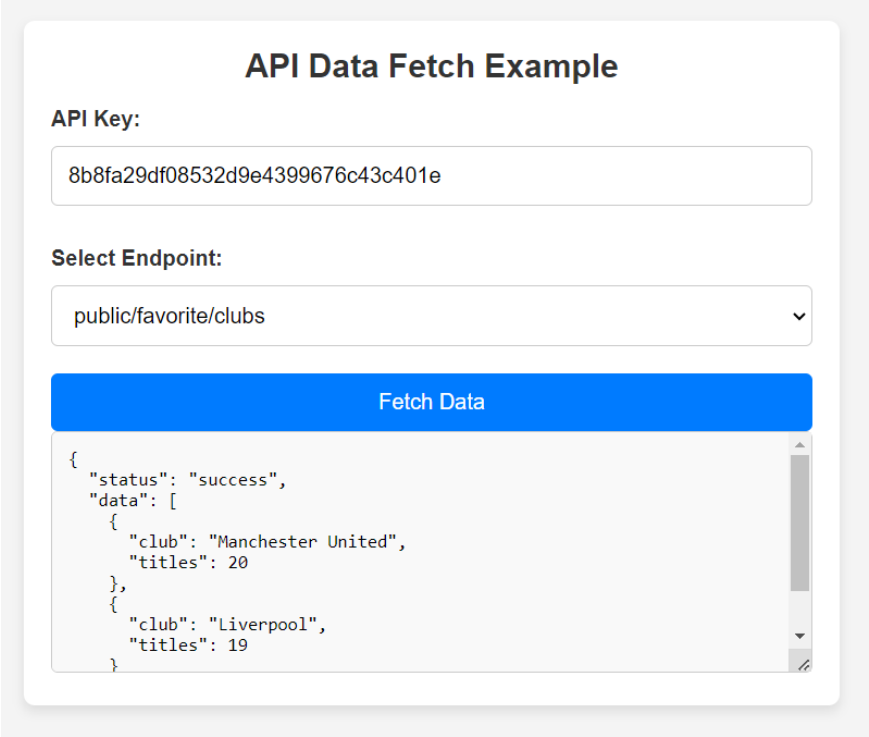
Try API Page – 1



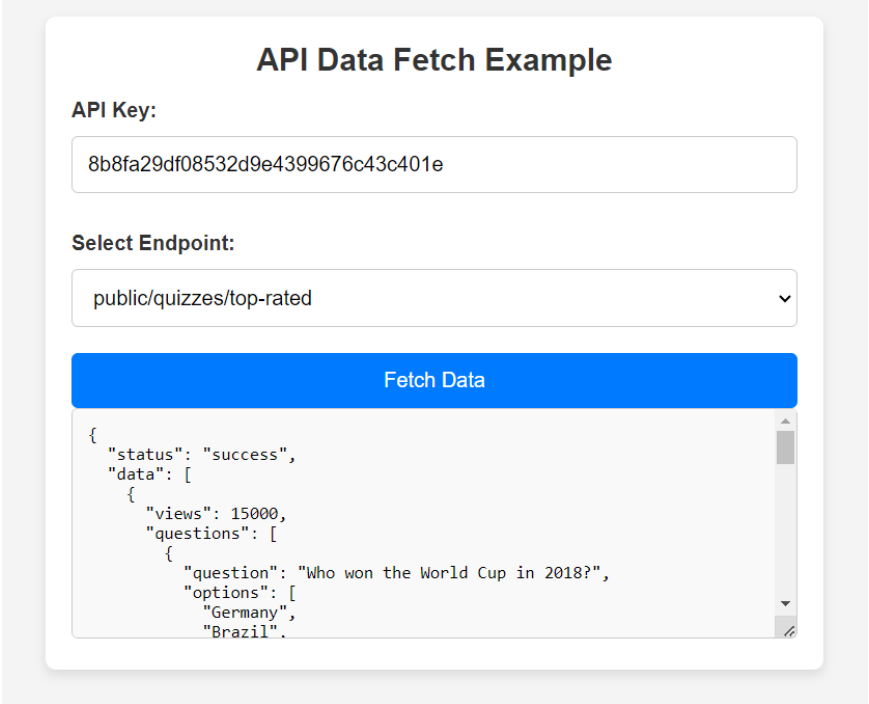
Try API Page – 2



Try API Page – 3

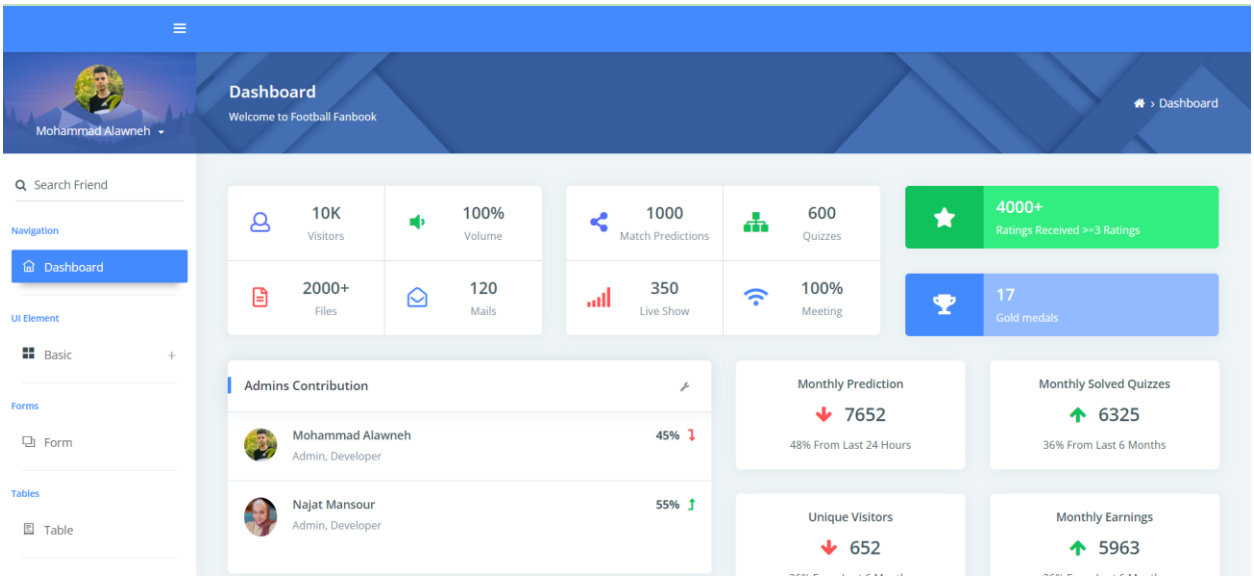


Try API Page – 4

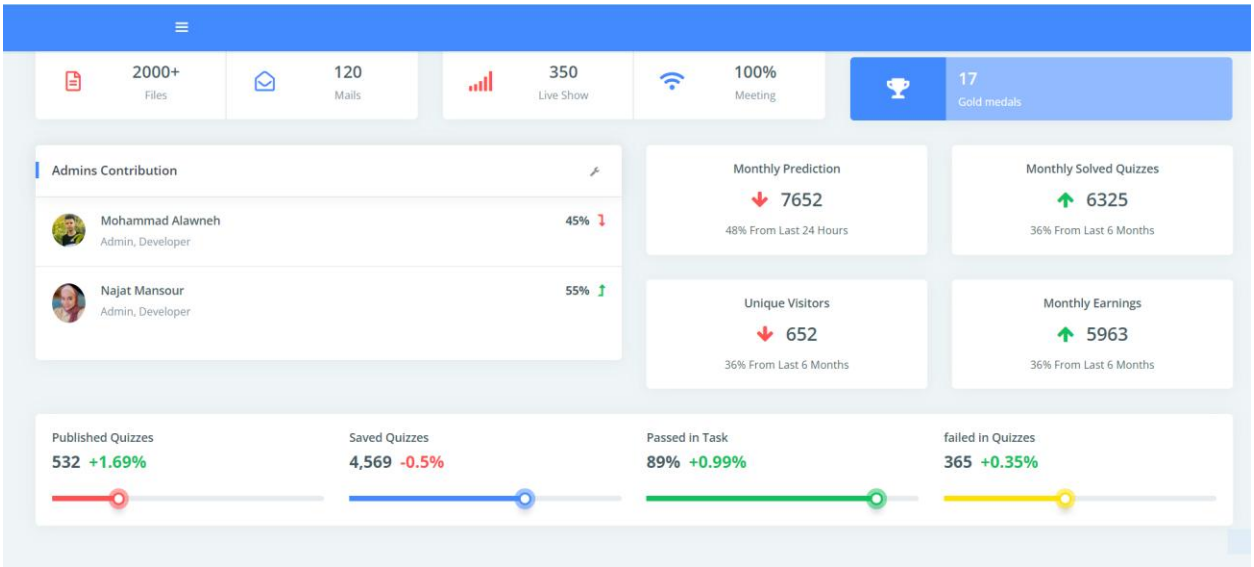


Try API Page - 5

- **Admin Dashboard**
  - Contains statistics about the application as it appears in the image below.



Admin Dashboard - 1



Admin Dashboard - 2

6 Conclusion, Recommendations and Future Work

We created this app to enhance the excitement of football and introduce some excitement to regular viewing. The app includes five functions: Match Prediction and Live Show events to allow the user to predict the matches and the players' performance. Quizzes section where the user can create his / her own quizzes or solve and rate ones created by the others. Rooms and Chats to add some communication channels between the users. Finally, Statistics to analyze the user's usage of the application and provide statistical tables and charts.

We recommend that developers study and analyze the external APIs based on the resources they provide, the number of daily requests allowed, and the ability to integrate with other APIs before relying on them, especially if it is as extensive as it is in this application. Also, we recommend to prefer the APIs that provide the resources in different languages instead of relying on translation APIs and services and this will be extremely important if the data contains multiple names for countries, leagues, teams, players, etc. Finally, we recommend to build A.I. NLP (Natural Language Processing) models to verify the contents (such as the created quizzes in our case) instead of using OpenAI API in order to have better customization and flexibility for the domain and datasets as well as reducing the dependency and improving the performance by using some patterns and conditions.

Future work focuses on four main areas: First, increasing user engagement by adding more features such as allowing users to create their own leagues and compete with friends and adding the ability to play a "wild card" during the match if the user have the highest score in the room to make a substitution for one player in the Live Show. Second, improve quality by optimizing operations to manage large data from different sources and improve translation accuracy to provide the program in multiple languages which makes the application more popular. Third, allow the user to dynamically add the competitions and leagues that he / she want to monitor and predict as well as the ones that the app support by default. Finally, enhancing the chat -even it isn't an essential part of our application- by adding "Block", "Reactions" and "Delete messages" features.

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