AR Pocket Trainer

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COMSATS UNIVERSITY ISLAMABAD,

ATTOCK CAMPUS – PAKISTAN

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UNDERTAKING

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FINAL APPROVAL

Certified that we have read this project report submitted by Muhammad Ahsan and Rizwan Amjad and it is, in our judgment, of sufficient standard to warrant its acceptance by the Department of Computer Science, COMSATS University Islamabad, Attock Campus, for the BSSE degree.

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DEDICATION

To our Loving Parents and Teachers

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. Yasir Ali Shah”. Without his personal supervision, advice, and valuable guidance, the completion of this project would have been doubtful. We are deeply indebted to him for his encouragement and continual help during this work.

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.

PROJECT BRIEF

PROJECT NAME	AR_FITNESS TRAINER
ORGANIZATION NAME	COMSATS
OBJECTIVE	MAKING FITNESS TRAINING EASY AND AFFORDABLE
UNDERTAKEN BY	MALIK MUNEEB SHAHID JUNAID AHMED
SUPERVISED BY	MR WAQAS AHMED LECTURER CS COMSATS UNIVERSITY ISLAMABAD
STARTED ON	01/04/2021
COMPLETED ON	TODO
COMPUTER USED	MACBOOK PRO 2015 LENOVO THINKPAD X240
SOURCE LANGUAGE	JAVASCRIPT, PYTHON
OPERATING SYSTEM	WINDOWS 10
TOOLS USED	GIT & GITHUB, VSCODE, PYCHARM, FIREBASE, DEEPMOTION.

ABSTRACT

Working out on your own can be a struggle especially, if you are a beginner and don't know where to start because there are tons of workout plans out there and each with a million exercises stacked for you to go through and that just makes you lose hope unless you hire a personal trainer who can help you get through the endless jungle called "fitness journey" but the problem is personal trainers are not so "pocket friendly" thereby to tackle this problem and to get you that pack of six, we are going to develop an AR (Augmented Reality) fitness app which will guide you along your journey to become fit and fine.

Our app will start off by calculating your BMI and analyzing your body structure (using Computer Vision) following which will be a diet plan provided to you either calorie deficit or calorie surplus once done with that you will then be directed to workout plan where our app will guide you throughout your workout using Augmented Reality and as you deal with that stuff our app will automatically be keeping track of your progress using Artificial Intelligence and real time body movements recognition and also provide you with analytics that will help you track your progress easily so that you can focus on one and only one goal (yep, you guessed it right) of getting fit.

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LIST OF ABBREVIATIONS

API	Application Programming Interface
AP	Access Point
HTTP	Hypertext Transfer Protocol
IoT	Internet of Things
IP	Internet Protocol
MQTT	Message Queuing Telemetry Transport
MAC	Medium Access Control
REST	Representational State Transfer
Wi-Fi	Wireless Fidelity

Chapter 1

Introduction

1.1 Introduction:

"If you look good you feel good"

We all agree that fitness is important right? And to help us achieve it a lot of efforts have already been made, there are hundreds of apps available on the internet but what we have noticed is none of them is using augmented reality to guide the user. They are either a well-organized collection of fitness videos or a bunch of exercise plans, not denying the impact they have (technology always has anyway) but we are talking about doubling the magnitude of that impact by giving it a dip in Artificial Intelligence, Augmented Reality and Machine learning.

So, our user will start off by creating his/her account after which they will go through a short body physique inspection with the help of computer vision and for more accuracy we will use body BMI. So, then user will be provided with information of their current state and a matching diet plan after which they will be shown a few introductory videos about what fitness really means and a bit of motivation, phase one ends here. The next step is about bringing things to ground reality where our application will find a suitable workout plan for them, as the user is performing his exercise his body posture and steps will be monitored and recorded, the app will notify him wherever he is doing a mistake and will not count that repetition. There will also be a weekly examination of his body and app will compare his current stats with the ones that were recorded on day one and tell him how much he has achieved since day one along with that he will also be provided with the weekly report of his workout so he can better analyze his track record.

1.2 Problem Statement:

Working out on your own can be a struggle especially, if you are a beginner and don't know where to start because there are tons of workout plans out there and each with a million exercises stacked for you to go through and that just makes you lose hope unless you hire a personal trainer who can help you get through the endless jungle called "fitness journey" but the problem is personal trainers are not so "pocket friendly". This is the main reason most people get demotivated during their journey and ultimately quit.

1.3 Proposed Solution:

AR Fitness trainer will start off by calculating your BMI and analyzing your body structure (using Computer Vision) following which will be a diet plan provided to you either calorie deficit or calorie surplus once done with that you will then be directed to workout plan where our app will guide you throughout your workout using Augmented Reality and as you deal with that stuff our app will automatically be keeping track of your progress using Artificial Intelligence and real time body movements recognition and also provide you with analytics that will help you track your progress easily so that you can focus on one and only one goal (yep, you guessed it right) of getting fit.

1.4 Motivation:

Our primary driving force behind building this project is to help those peoples who want an effective workout and diet plan but cannot afford professional trainer because of less financial resources. Helping these type of peoples using modern technology is our primary concern for the development of this application.

That way everyone would be able to lead a healthy life and feel good about how they look. We believe that this application can be also used to fight off psychological conditions like body complex and lack of self confidence due to physical appearence. This application will give people to change their lives if they put a little bit of effort and will power in it.

1.5 Tools:

- Visual Studio Code
- Pycharm Professional
- Pycharm Community Edition
- Deep Motion.
- Firebase.
- Expo Cli.

1.6 Frameworks:

- React Na

1.7 Goals and Objetives:

- To create a fitness solution using power of computer vision and AI inorder to help a user perform his workout in an efficient manner.
- To ease the process of weight gain/loss for user.
- To maximize the user's focus on his workout and diet routine by minimizing the effort in side tasks.
- To inspire users to become the best version of themselves.
- To provide a balanced diet to user.

Chapter 2

Literature Review

2.1 Introduction:

In this session we are going to discuss some already available projects/applications that resemble our solution. We will be comparing them all with each other on the basis of their pros and cons. In the latter session we are going to take an in depth look at our solution and finally we are going to compare our system with all of the above discussed applications which will provide us with a clear view about why our solution is much optimized version of all the available solutions.

2.2 Available Systems:

There are variety of different fitness software abailable to us today and all of them have their own uniquenesses and limitations. We will be looking at these applications in detail below:

Pro-Fitness:

The PRO-Fitness app is designed specifically for fitness trainers who lead personalized workouts.This application allows its users to:

- keep a training schedule
- customer base
- create customized workouts
- create custom exercises
- share exercises with other trainers

in addition the application has certain other features like:

- timer
- measurements and their dynamics
- customer profile with basic information
- muscle groups

Limitations:

- Does not support body recognition using computer vision.
- Does not monitor exercises using computer vision.

- Does not propose diet plan for the user to follow on the basis of his BMI and body analytics.
- Does not provide Provide user with progress tracking reports.
- Does not contain BMI calculator
- Does not have Augmented reality based exercise guidence plan.

30 Days Fitness:

30 Day Fit Challenge Workout increases exercise intensity step by step, so you can easily stick daily workouts. Don't need to go to gym, just use your body weight and take a few minutes a day, 30 Day Fit Challenge Workout will greatly help you keep fitness and lose weight effectively. It has 360 degrees exercise tutorials for 30 days fitness

Limitations:

- Does not support body recognition using computer vision.
- Does not monitor exercises using computer vision.
- Does not propose diet plan for the user to follow on the basis of his BMI and body analytics.
- Does not provide Provide user with progress tracking reports.
- Does not contain BMI calculator
- Does not have Augmented reality based exercise guidence plan.

JEFIT – Gym workout and plan and log tracker:

Jefit has an execise libarary with vast number of execises and workout plans .With a built in rest timer and an intuitive exercise logging system it allows users to to create his/her own workout plan manually with flexibilty and vastness.

Limitations:

- Does not support body recognition using computer vision.
- Does not monitor exercises using computer vision.

- Does not propose diet plan for the user to follow on the basis of his BMI and body analytics.
- Does not provide Provide user with progress tracking reports.
- Does not contain BMI calculator
- Does not have Augmented reality based exercise guidence plan.

7 Minute Workout:

The app consists of only 12 exercises to be done for 30 seconds, with 10 second breaks between each exercise. All a user needs is a chair and a wall. Repeat 2-3 circuits depending on how much time you have. It allows user to perform exercises easily at home or at office.

Features contain:

- Google Fit support
- Voice guidance
- Adjustable circuit time
- Adjustable rest time
- Character and UI design
- Workout log shows your complete workout time

Limitations:

- Does not support body recognition using computer vision.
- Does not monitor exercises using computer vision.
- Does not propose diet plan for the user to follow on the basis of his BMI and body analytics.
- Does not provide Provide user with progress tracking reports.
- Does not contain BMI calculator

2.3 Proposed System:

Our proposed system will be a complete package comprising of all the neceassary tools required to help a user with hir/her fitness routine. From body analysis using computer vision to BMI canculation to diet plan suggestions to workout plan to exercise monitoring. Every thing will be available to the user under the ruberic of AR Fitness Trainer.

Our system will be majorly made up of four components. Details about these components are discussed below:

2.3.1 USER INTERFACE – using React Native:

UI will be interactive mobile app that will allow the user to interact with the system. Through UI user will be able to manage his plans and check monthly/reports. Moreover he will also be able to navigate between different screens as per requirements. For instance : if our user wants to activate camera for exercise recognition, he will be able to do it with the help of the virtual buttons given on the sreen.Similarly other operations like reports, AR guide etc will all be accessable to the user using system UI.

2.3.2 Machine Learning Model:

Machine learning model will be working side by side with the rest of our system to ensure he is performing all the reps accurately and utilizing the full potential of his body to perform that specific exercise. In addition it will also :

- Recoginze body type using computer vision.
- Suggest a diet plan to user, either, calorie surplus or calorie deficit.
- Suggest a workout plan for the user.
- Count number of reps of an exercise performed correctly.
- Monitor exercise accuracy in real time.

2.3.3 FireBase for Database Integration:

The users data has to go somewhere right? So we will be using firebase for the data storage. There are two benefits of using firebase.

- Our application will not clutch user's physical storage on the device.
- In case users mobile phone is lost/destroyed he can still have access to his records and start right where he left.

2.3.4 Sensors and actuators:

Our system will be utilizing the following resources of a cell phone to perform smoothly:

1. Camera
2. Speaker

Camera will be used to track user's exercise progress and to monitor his performance during an exercise. Speakers on the other hand will be used to notify the user if he exceeds the thresh-hold of wrongly performed reps of an exercise exercise.

2.4 Comparison:

Functionalities	Proposed	Pro Fitness	Workout plan	30 Days fitness challenge	7 Minute workout
AR Trainer	✓	✕	✕	✕	✕
Body Physique Recognition	✓	✕	✕	✕	✕
Workout Reminder	✓	✕	✕	✓	✕
Diet Plan	✓	✕	✕	✕	✕
Video Recommendations	✓	✕	✕	✕	✕
Progress tracker	✓	✓	✕	✕	✓
Weekly comparison	✓	✕	✕	✕	✕
Exercises	✓	✓	✓	✓	✓

Chapter 3

Requirement Analysis

3.1 Introduction

In the following chapter, we will go through the requirements of our system. These Include the:

1. Functional Requirements
2. Non Functional Requirements

We will be looking at functional requirements in first section and non functional requirements in second section.

3.2 Functional Requirements

Listed below are the functional requirements of AR Pocket Trainer.

- The application shall run on both android and iOS platforms.
- The user shall be able to create account.
- The user shall be able to log into the system.
- The application shall be able to determine user's body type using computer vision.
- The application shall be able to propose a diet plan according to user's BMI and body type either calorie deficit or calorie surplus.
- The application shall be able to propose a a workout plan to user on the basis of his body type and BMI.
- The application shall be able to recognize exercise that the user is performing.
- The application shall be able to prompt user if he performs a rep incorrectly.
- The user shall be able to check his progress via monthly or weekly reports.
- The application shall be able to remind user about his workout time.

3.3 Functional Requirements Analysis:

Table 3.1 Cross-platform support

Identifier	**FR-1**
Title	Cross platform support
Requirement	The Mobile App should run on both Android and iOS.
Source	Users
Rationale	--
Restrictions and Risk	--
Dependencies	--
Priorities	Low

Table 3.2 Account Creation

Identifier	**FR-2**
Title	Account Creation
Requirement	The user shall be able to create his account.
Source	Users
Rationale	The application requires authorization of the user to access and store his data.
Restrictions and Risk	The user must have a unique and valid email.
Dependencies	--
Priorities	High

Table 3.3 Log-in Functionality

Identifier	**FR-3**
Title	Log-in functionality
Requirement	The registered user shall be able to log into the app.
Source	Users
Rationale	To allow user access to his data and to store his future data.
Restrictions and Risk	The user must already have an existing account on our application.
Dependencies	--
Priorities	High

Table 3.4 Physique Recognition

Identifier	**FR-4**
Title	Physique Recognition
Requirement	The application shall recognize user's body physique using computer vision.
Source	Users
Rationale	To determine user's body type.
Restrictions and Risk	The device must have a camera
Dependencies	--
Priorities	High

Table 3.5 Diet Plan Suggestion

Identifier	**FR-5**
Title	Diet Plan Suggestion
Requirement	The application shall propose a calorie surplus or calorie deficit diet plan to user.
Source	Users
Rationale	To propose a suitable diet plan to user for his fitness routine
Restrictions and Risk	The user must have calculated his BMI previously.
Dependencies	FR-4
Priorities	Medium

Table 3.6 Propose workout plan

Identifier	**FR-6**
Title	Proposing Workout Plan
Requirement	The application shall provide user with a suitable workout plan.
Source	Users
Rationale	To provide user with a suitable diet plan.
Restrictions and Risk	The user must already have a diet plan.
Dependencies	FR5
Priorities	Medium

Table 3.7 Exercise Recognition

Identifier	**FR-7**
Title	Exercise Recognition
Requirement	The application shall recognize the exercise that user is performing.
Source	Users
Rationale	To determine the exercise user is performing.
Restrictions and Risk	The user must have a camera in his device
Dependencies	--
Priorities	High

Table 3.8 Incorrect Exercise Prompt

Identifier	**FR-8**
Title	Incorrect exercise prompt
Requirement	The application shall promtp user if they perform wrong exercise rep.
Source	Users
Rationale	To prevent user from performing wrong exercise.
Restrictions and Risk	--
Dependencies	FR-7
Priorities	High

Table 3.9 Progress Reports

Identifier	**FR-9**
Title	Progress Reports
Requirement	The application shall provide user with monthly or weekly progress reports.
Source	Users
Rationale	To help user track his progress.
Restrictions and Risk	--
Dependencies	--
Priorities	Medium

Table 3.10 Workout Reminder

Identifier	**FR-10**
Title	Workout Reminder
Requirement	The application shall remind user about his workout time.
Source	Users
Rationale	To prompt user about his workout time.
Restrictions and Risk	--
Dependencies	--
Priorities	Medium

3.4 Non Functional Requirement

3.4.1: Performance:

- The application shall provide optimal performance since it has to perform realtime functionalities. So if the performance decreases the user wont be able to know about his mistakes in due time.

3.4.2: Recoverability:

- The application shall be able to recover user data in case the user misplaces his device due to any reason.

3.4.3: Scalablity:

- The system shall allow user to add more workout remiders if the wish.

3.4.4: Usability:

- The system must be easily usable by primary user persona even if they don’t have extensive knowledge of technology.

3.4.5: Reliability:

- The systme must identify user’s exercise coreectness with accuracy of 90%.

3.4.6: Availability:

- The application must be available to user 24/7 so that he can perform his workout anytime and anywhere he want.

Chapter 4

System Design

4.1 Introduction:

In this chaper we are going to take a look at the detailed working of our application using visual representation. The first section of this chapter will deal with UML use case behavioral diagrams by explaining complete working of the system and showing how the system will deal with different events.

In latter section we will be explaining the structural details of our system using UML structural diagrams. This section will also represent the overall architecture of our application and discuss the details of sub-system (if any).

4.2 Use Case Diagram:

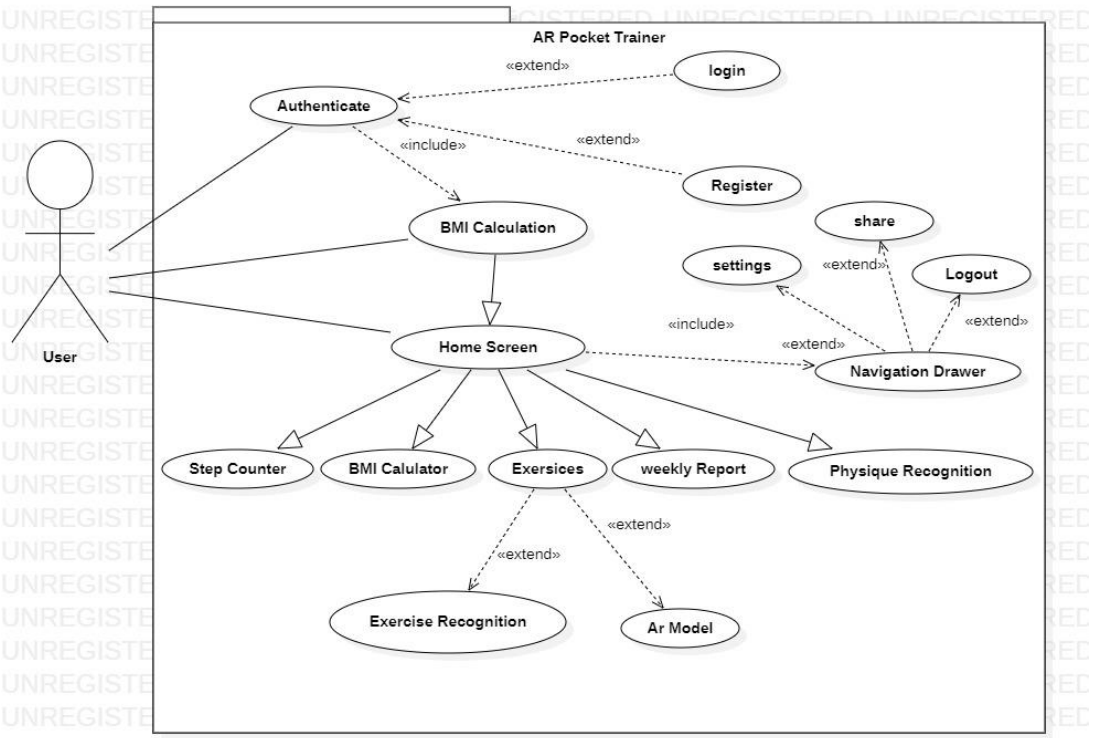


Figure 4.1: System Use Case Diagram

Figure 4.1 represents use case diagram of the complete system. Details about the use case are given below in Table 4.1.

Table 4.1 : System Use Case Description

Use Case	**Description**
Authentication	Users can create a new account and login into the system from the mobile app. Without the account, the user cannot access the system.
BMI Calculation	Users can calculate its BMI which is used for Exercises and recommending steps.
Physique Recognition	User can calculate its BMI using Physique recognition. Which actually tells BMI on basis of height and width.
Step Counter	Users can Track record of its steps using steps counter also it tells how much calories you burn.
Home screen	Users should be able to Navigate to all the screens from home screen of app.
Navigation Drawer	Users should be able to navigate to all screen form navigation drawer and also go to setting and do logout.
Exercise	Users should be record reps of defined exercises with correction using Ar Model.
Ar Model	User should be able to check how to perform specific steps from Augmented reality character

Figure 4.2: Log in/Sign up Use Case Diagram

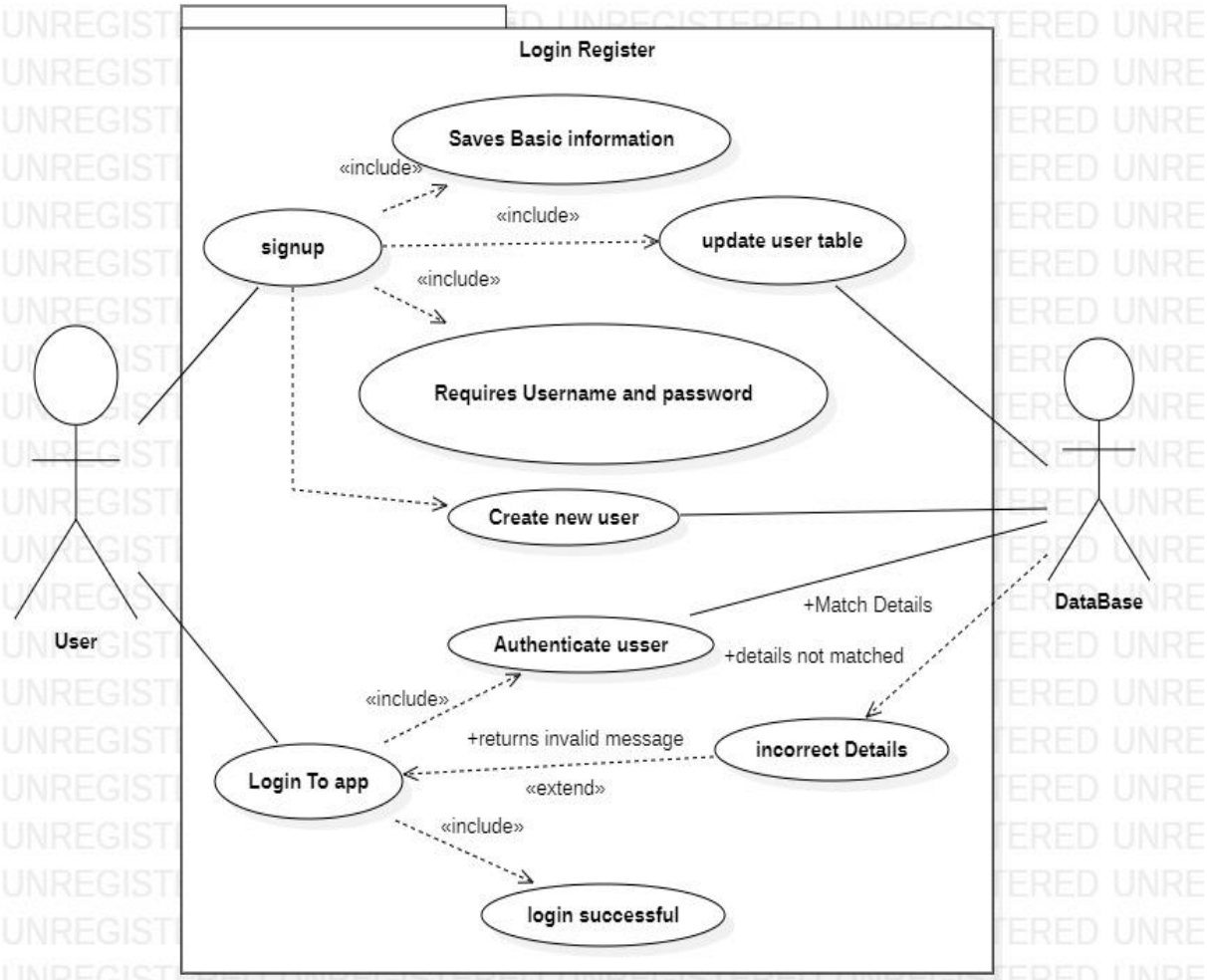


Table 4.2: Log in/Sign Up Use Case Description

Use Case	**Description**
Sign up	Users can create a new account and login into the system from the mobile app. Without the account, the user cannot access the system.
Login	If user is already registered; then he/she will be able to use the system by entering valid username and password.
Update user table	App will update the database table with user information.
Invalid details	If user information is wrong then pop-up shows up with the message that invalid username password.
Login successful	Users should be able to view the home screen after this message.

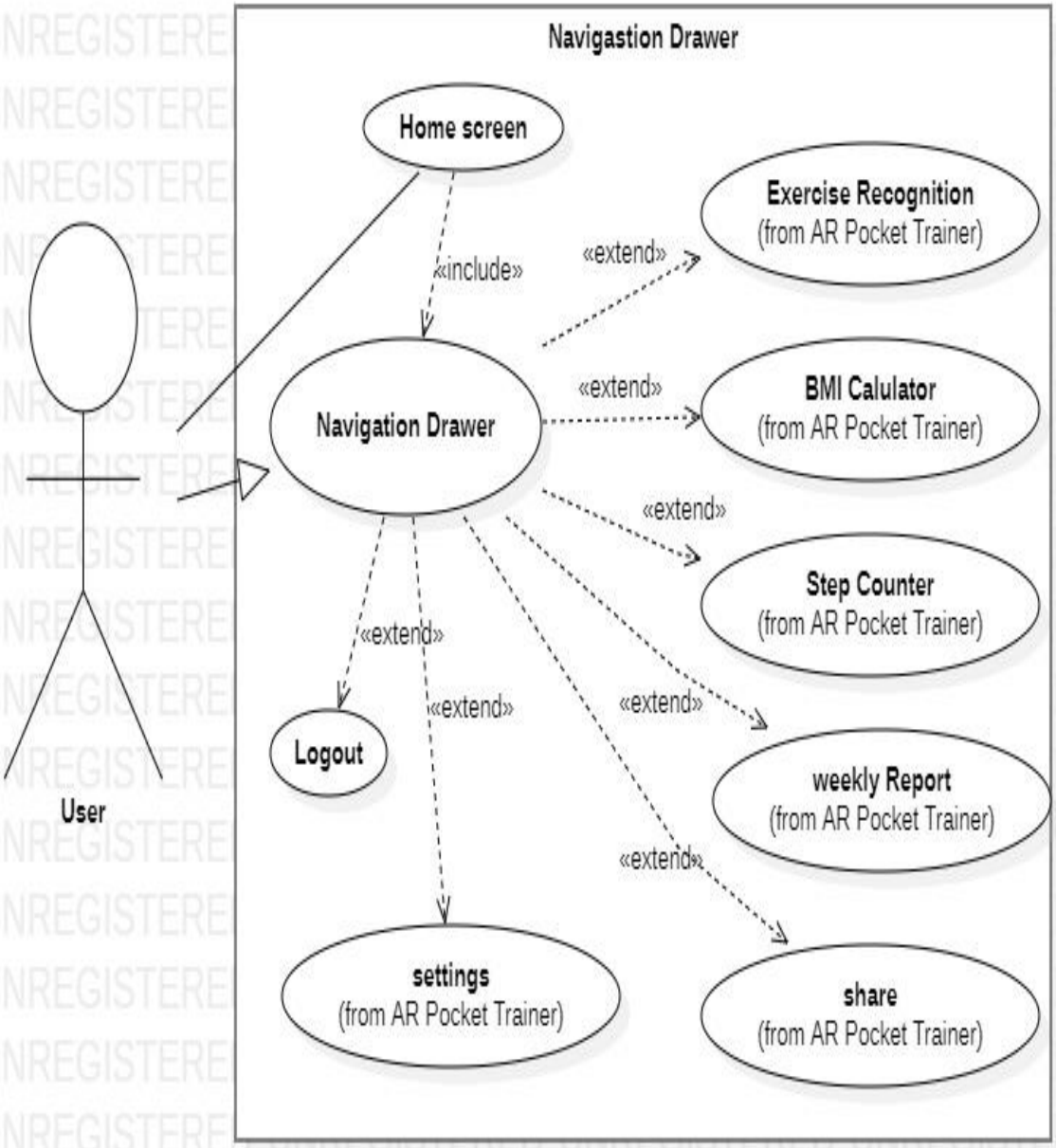


Figure 4.3: Navigation Drawer Use Case Diagram

Table 4.3: Navigation Drawer Use Case Description

Home screen	Users can go to the Navigation Drawer using home screen .
All the screens	User should be able to navigate to all the screens using navigation drawer.
Logout	User should be able to logout from account using navigation drawer.
Share	User can share app using app link.
settings	User should be able to access app settings using navigation drawer.

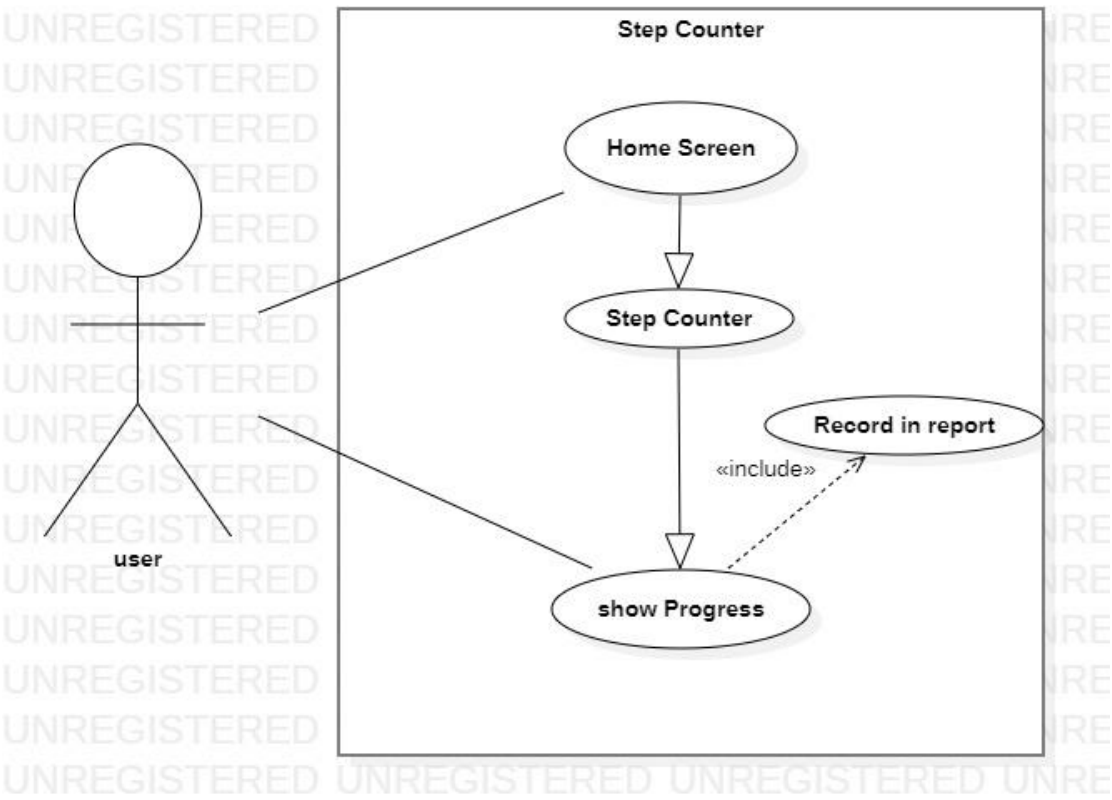


Figure 4.4: Step Counter Use Case Diagram

Table 4.4: Step Counter Use Case Description

Use Case	**Description**
Home screen	Users can goto the step counter screen using home screen .
Step Counter	Users can check its todays steps from progress bar on step counter screen.
Record in reports	App record all the progress to generate reports.

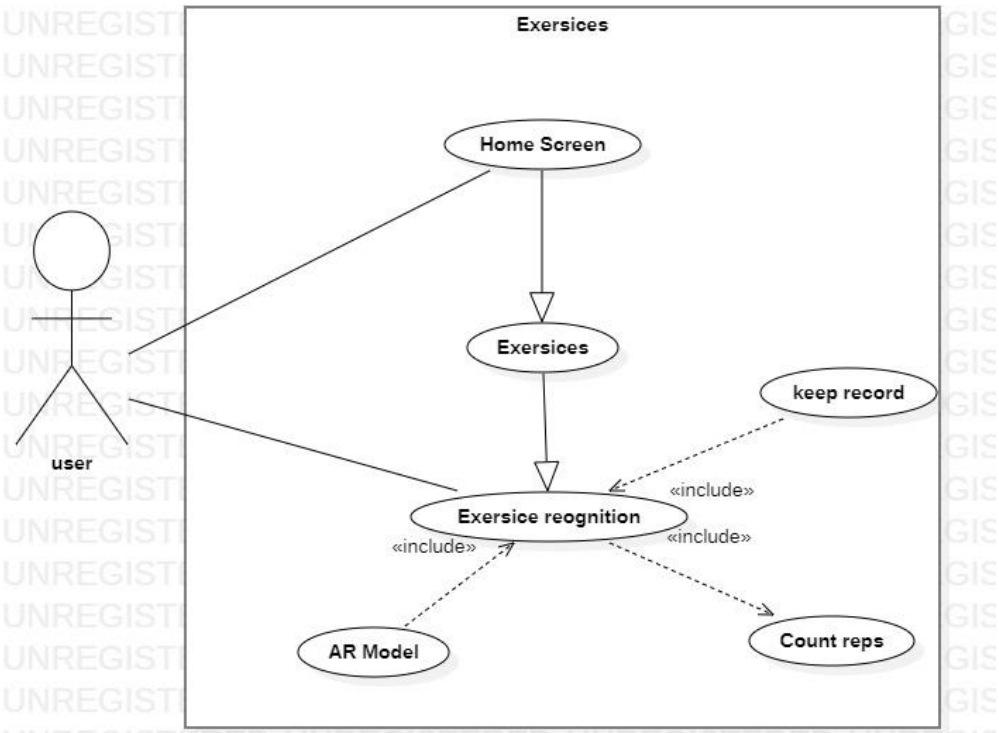


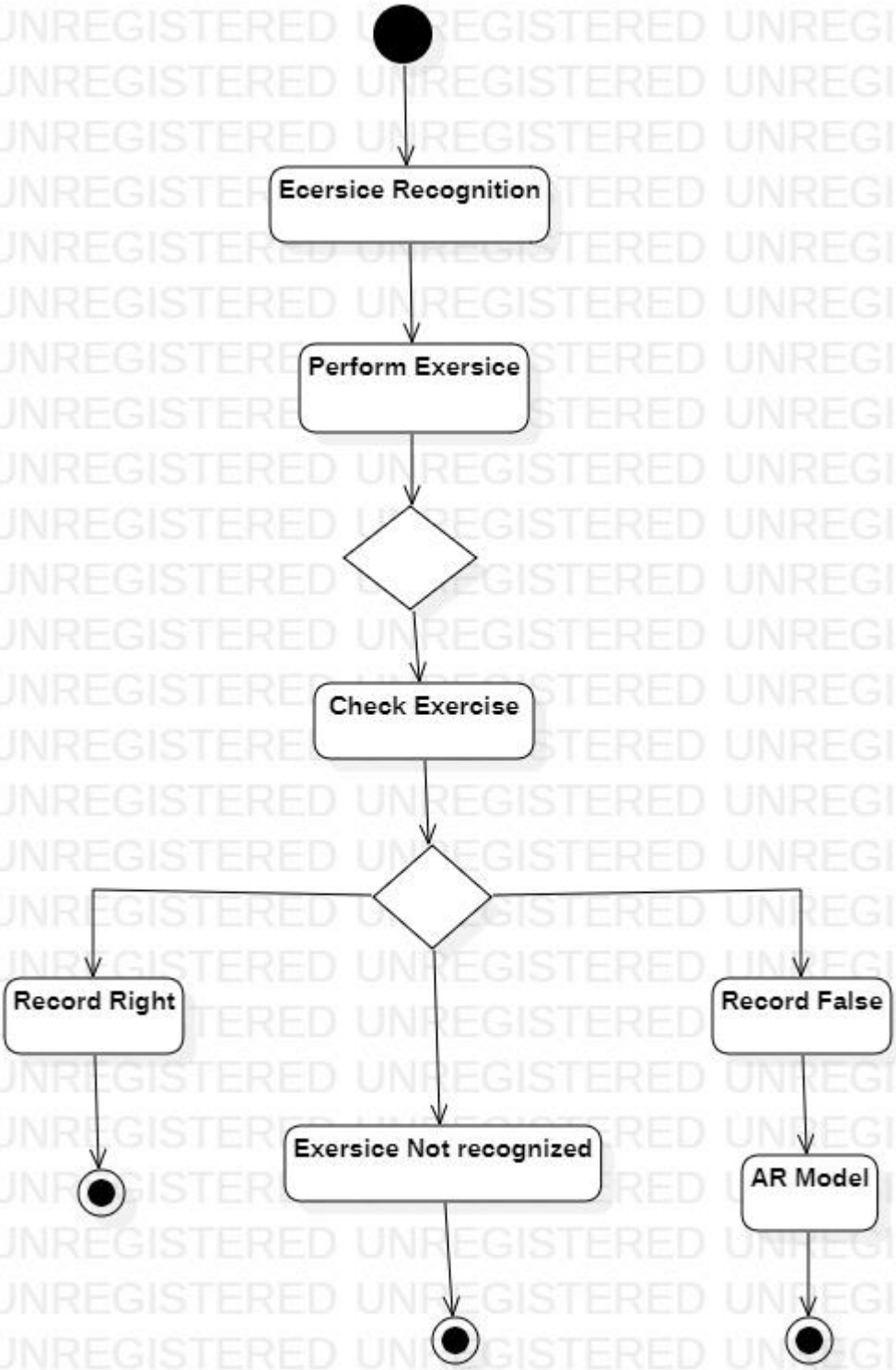
Figure 4.5: Exercise Recognition Use Case Diagram

Table 4.5: Exercise Recognition Use Case Description

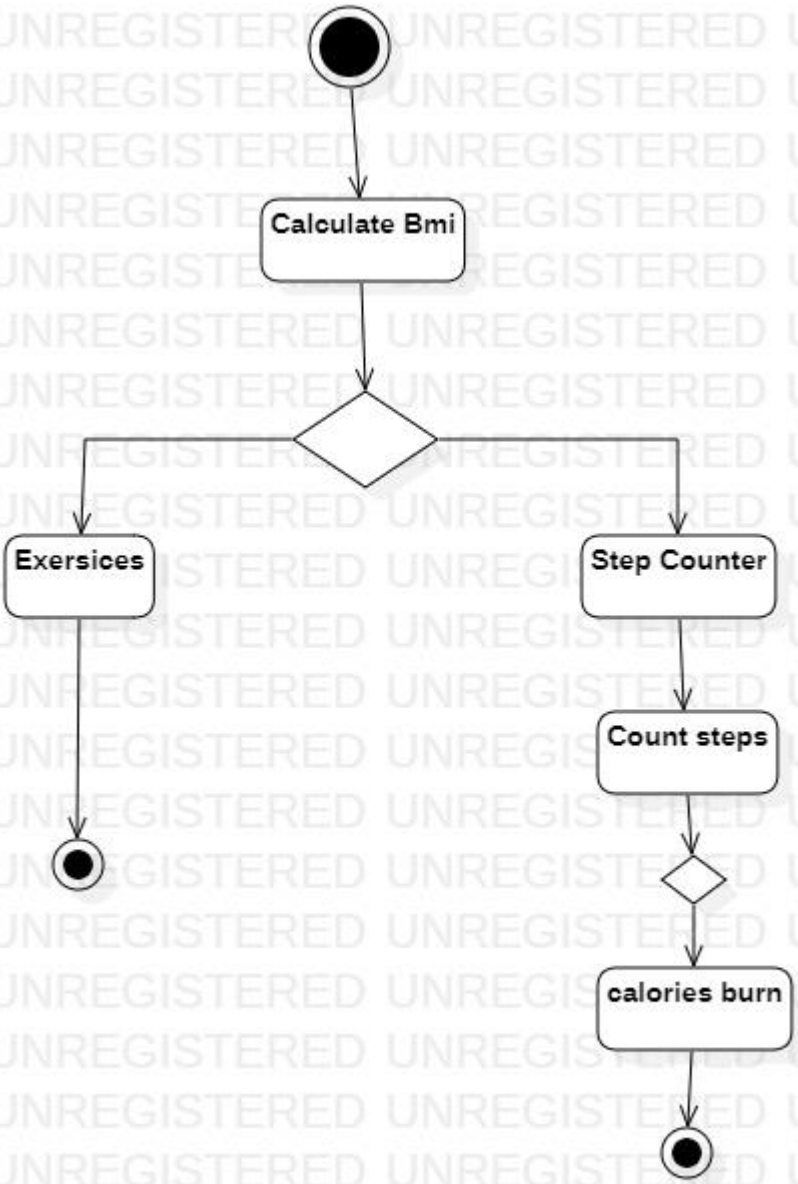
Use Case	**Description**
Home screen	Users can go to the Exercises screen using home screen .
Exercise Screen	User should be able to select exercises.
Exercise Recognition	This can record user reps of particular exercise in right and wrong manner.

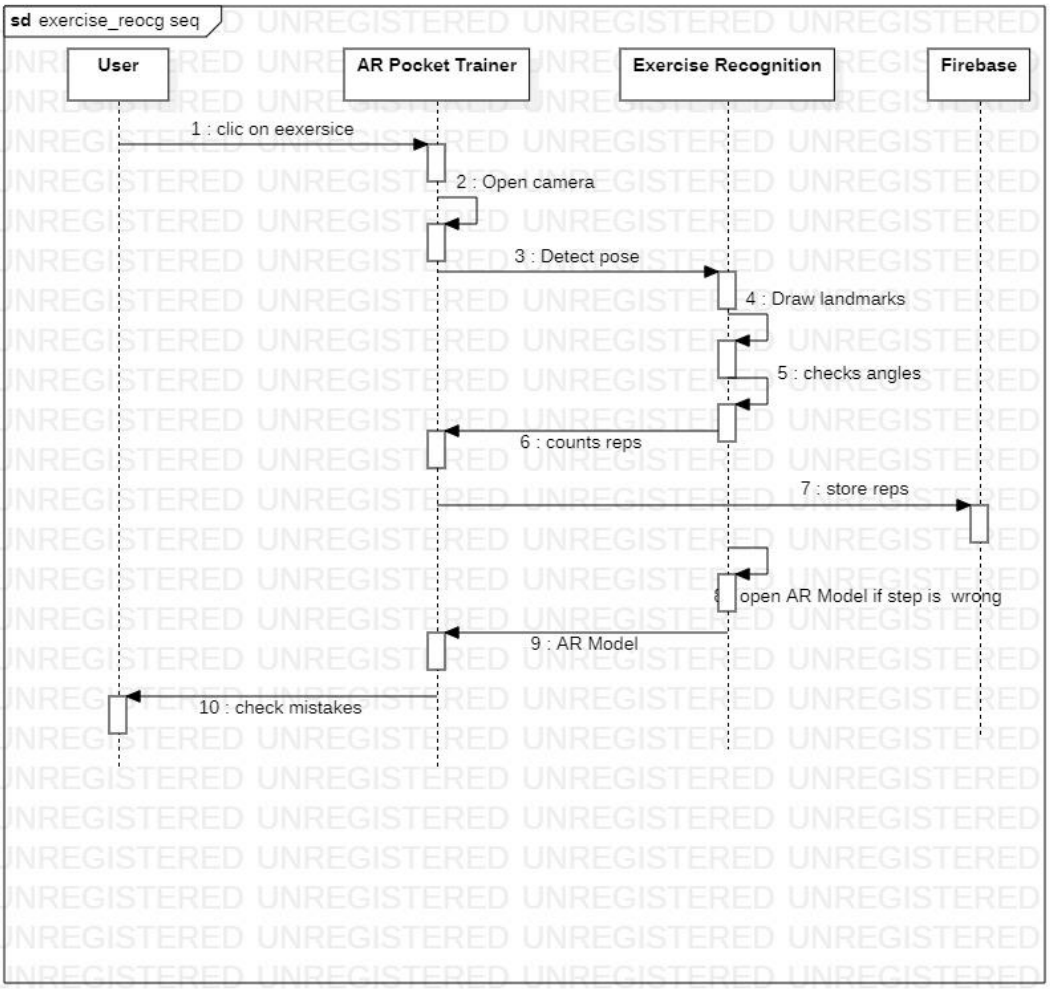
4.3 Activity Diagram:

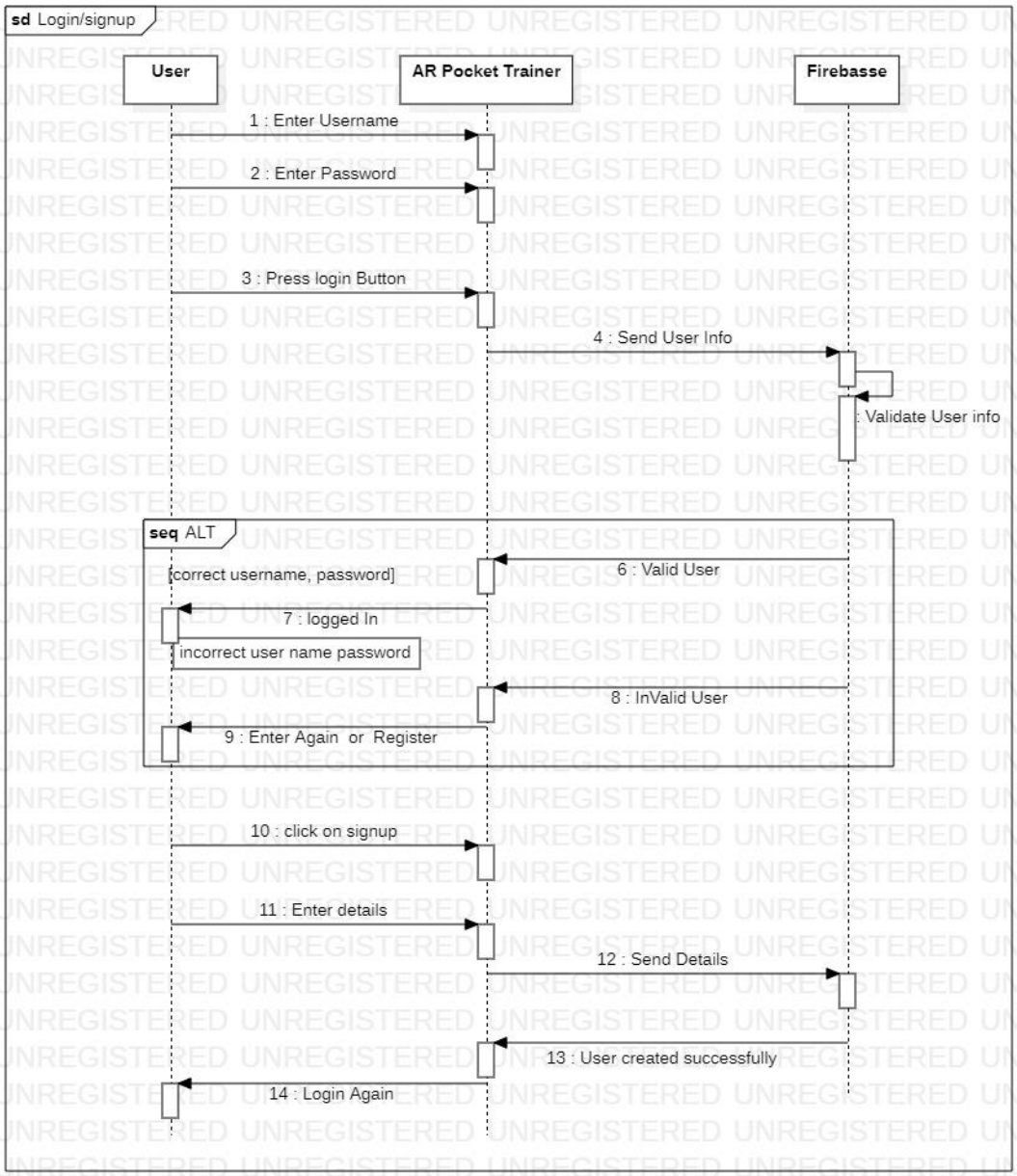
4.3.1: Exercise Recognition, Activity Diagram

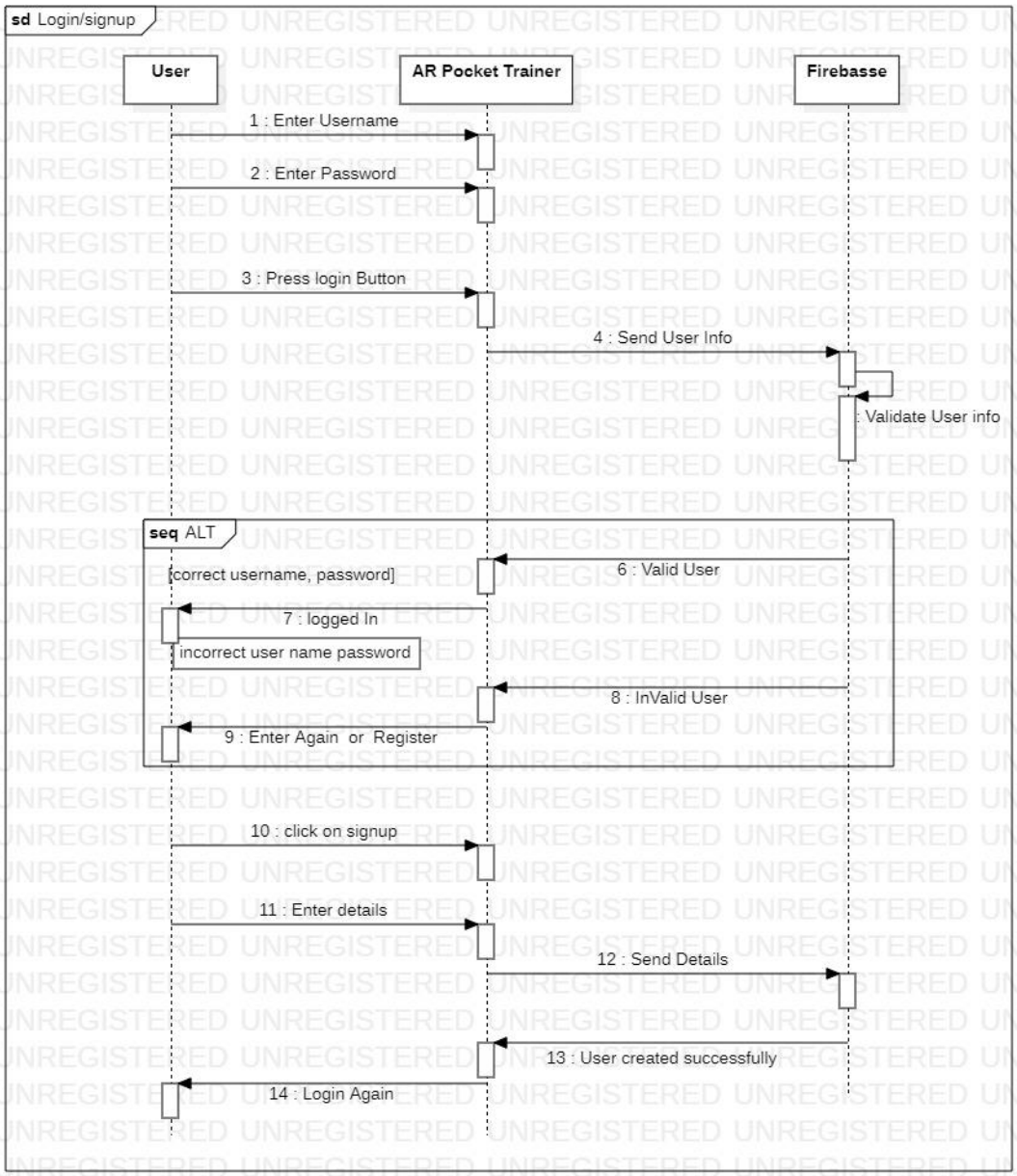


UNREGISTERED UNREGISTERED UNREGISTE


Calculate Bmi
Exersices
Step Counter
Count steps
calories burn


sd exercise_reocg seq
User
AR Pocket Trainer
Exercise Recognition
Firebase
1 : clic on eexersice
2 : Open camera
3 : Detect pose
4 : Draw landmarks
5 : checks angles
6 : counts reps
7 : store reps
open AR Model if step is wrong
9 : AR Model
10 : check mistakes


sd Login/signup
User
AR Pocket Trainer
Firebasse
1 : Enter Username
2 : Enter Password
3 : Press login Button
4 : Send User Info
: Validate User info
seq ALT
[correct username, password]
6 : Valid User
7 : logged In
incorrect user name password
8 : InValid User
9 : Enter Again or Register
10 : click on signup
11 : Enter details
12 : Send Details
13 : User created successfully
14 : Login Again


sd Login/signup
User
AR Pocket Trainer
Firebasse
1 : Enter Username
2 : Enter Password
3 : Press login Button
4 : Send User Info
: Validate User info
seq ALT
[correct username, password]
6 : Valid User
7 : logged In
incorrect user name password
8 : InValid User
9 : Enter Again or Register
10 : click on signup
11 : Enter details
12 : Send Details
13 : User created successfully
14 : Login Again