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Fit Mitra - A.I. Fitness Trainer

"FITMITRA an A.I. fitness training app"

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Abstract : Fitness solutions have exploded in popularity over the last 5 years as people look to become healthier. The collaboration of Artificial Intelligence with Healthcare has drastically increased in recent years. Every individual has become health-conscious in recent times and their concern over personal health and fitness has a big uptrend. Even after that, injuries due to improper exercise technique remains one of the biggest problems in the fitness industry. The existing solutions include hiring personal trainers, which can cost a lot to use workout-related applications, some of which do not work as expected and some which are available only on specific platforms like iOS. This system aims to reduce their need of hiring personal trainers by providing an interface in the Android OS to the users which will guide them with proper exercise techniques along with other exercise tracking tools.

I. INTRODUCTION

Over the years, the lifestyle of the population has changed drastically. Everything is becoming more and more digital, and the need to do physical work to accomplish tasks is getting less. This includes delivery of food, medicines, groceries and more. After the Covid-19 pandemic, more jobs are having a shift towards the "Remote working" culture [1]. The Covid 19 pandemic has brought with it awareness about physical health. People are now looking for new and innovative ways of keeping themselves fit. People are also searching for alternatives to gym equipment for their fitness activities[2].

With this new wave of fitness enthusiasts, we also need to look at this age-old problem related to exercise and sports. Fitness related injuries due to improper workout technique[3]. Sports and exercise-related injuries due to improper workout technique has always been one of the most common problems related to the fitness industry. These injuries can be prevented by proper knowledge and guidance. But since the Covid-19 pandemic, people have started to shift toward other forms of fitness than going to the gym. More people now prefer to exercise at home. This increases the risk of Injuries due to lack of guidance.

We propose to make a system which will reduce the need for personal trainers and gym memberships, and will reduce the risk of injuries due to improper exercise techniques. The system will also provide other tools to help in the fitness journey like exercise tracking and keeping track of exercise history.

II. SYSTEM DEVELOPMENT

2.1 System Architecture

This app gives users the ability to track their daily workouts. Along with tracking the exercises, this app also gives the users live feedback on a set of exercises. The Process is very simple and intuitive. It involves just 3 steps. Selecting the exercise, placing the phone camera as instructed and tracking the workout. For live tracking, each frame from the camera input is fed to an ML model, which detects 33 different joints of the body. This joint information is then passed for processing, where different factors such as relative positioning of joints, the angle between body parts, etc are calculated. A skeleton highlighting the relevant joints and body parts is displayed, along with errors in the exercise(if any). The users can track their workouts without live feedback as well. This involves manually inputting the number of repetitions per exercise set. The users can later view their exercise history.

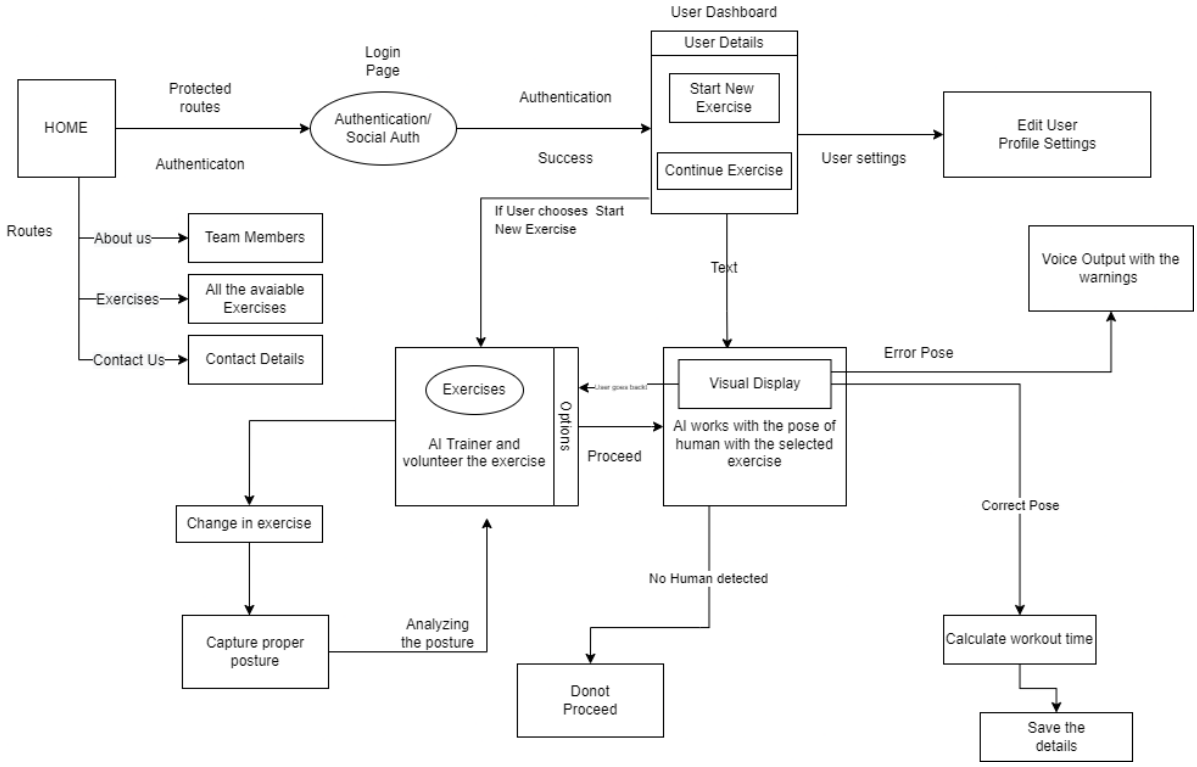

Fig 1. Live Exercise Module

Fig 1 depicts the System Architecture of the proposed system i.e. Fit Mitra. It gives a short idea about the flow of the application and corresponding modules.

2.2 Live Exercise Module

The main objective of this module is to process the image input data fetched from the camera stream and Display it on the screen. This module deals with getting the input data from the camera stream, passing it to the ML-Model and finding the key points of 33 human joints from it, calculating required angles between joints from that data, and performing the necessary calculations for analyzing particular exercises.

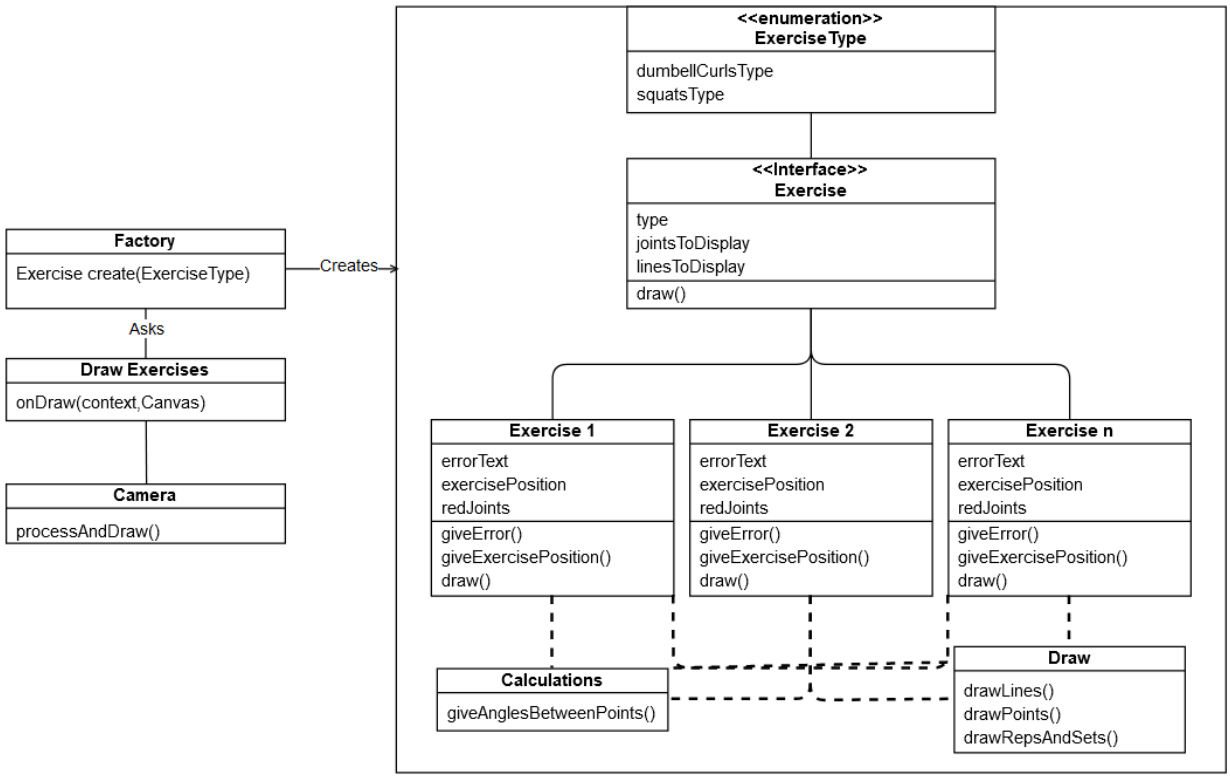

Fig 2. Live Exercise Module

2.3 Authentication Module

The main objective of this module is to authenticate the user so that the security of an app is maintained. So for the authentication module, the app uses MongoDB. An authentication module is a plug-in that collects information from the principal requesting access to a protected resource and checks the information against entries in a data store. If the information provided meets the authentication criteria, the user is validated. If the information provided does not meet the authentication criteria, the user is denied validation. OpenSSO Enterprise provides several authentication modules. You instantiate an authentication module before accessing it for a simple authentication process or adding it to an authentication chain.

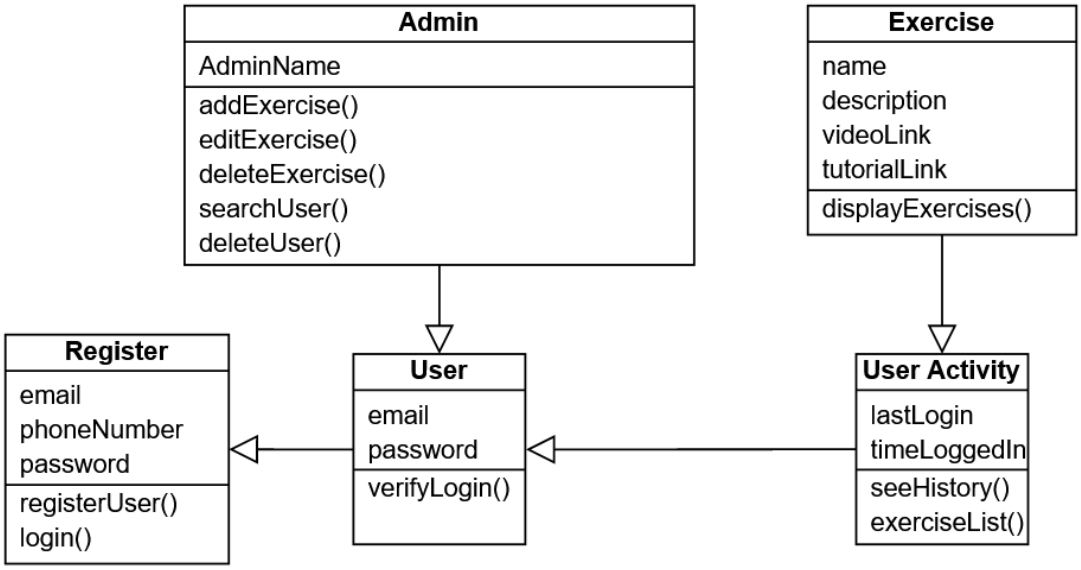

Fig 3. Authentication Module

2.4 Class Model

This is the architecture of the project which is intended for the Class Model and the Schema of the Database we are using. We must distinguish these two terms individually. The database schema is the skeleton of the database. It is designed when the database doesn't exist at all. A database schema does not contain any data or information.

A database instance is a state of operational database with data at any given time. It contains a snapshot of the database. Database instances tend to change with time. A DBMS ensures that every instance (state) is in a valid state, by diligently following all the validations, constraints, and conditions that the database designers have imposed.

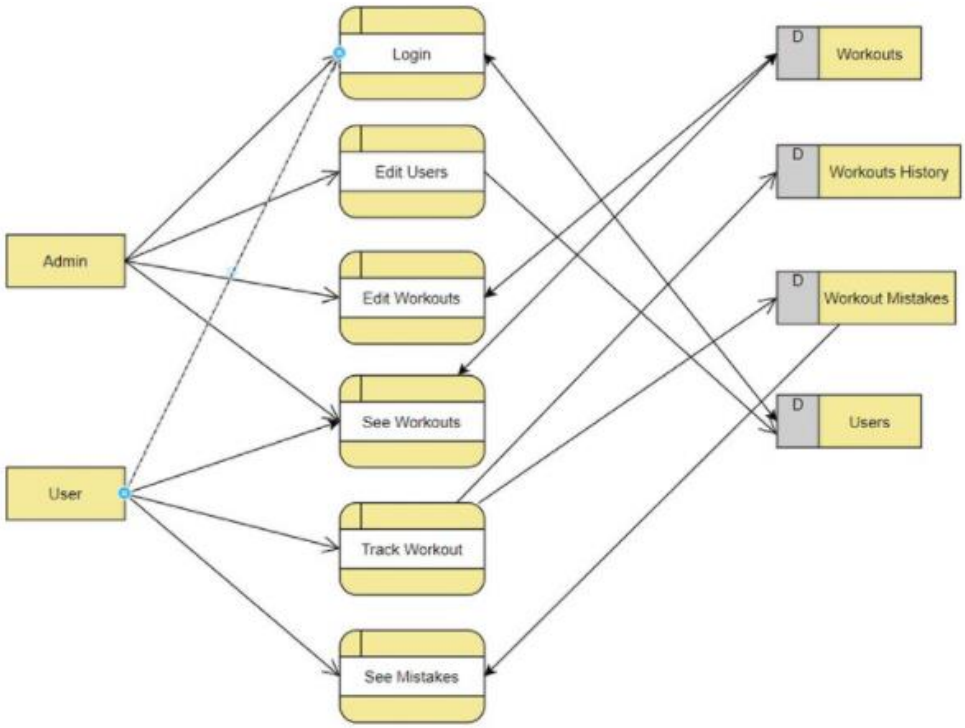

Fig 4. Class Model

2.5 Software Tools and Technologies

Android Studio IDE is used for App development. The modules and the app are written in Kotlin and Java.
Firebase is used for web services like Database and authentication.
Multiple external libraries are used for different tasks such as Retrofit for authenticating and interacting with APIs and sending network requests with OkHttp, CameraX for accessing the device's native camera, mlKitPoseDetection for loading the ml model and image processing, and more.

III. FEATURES

3.1 Authentication

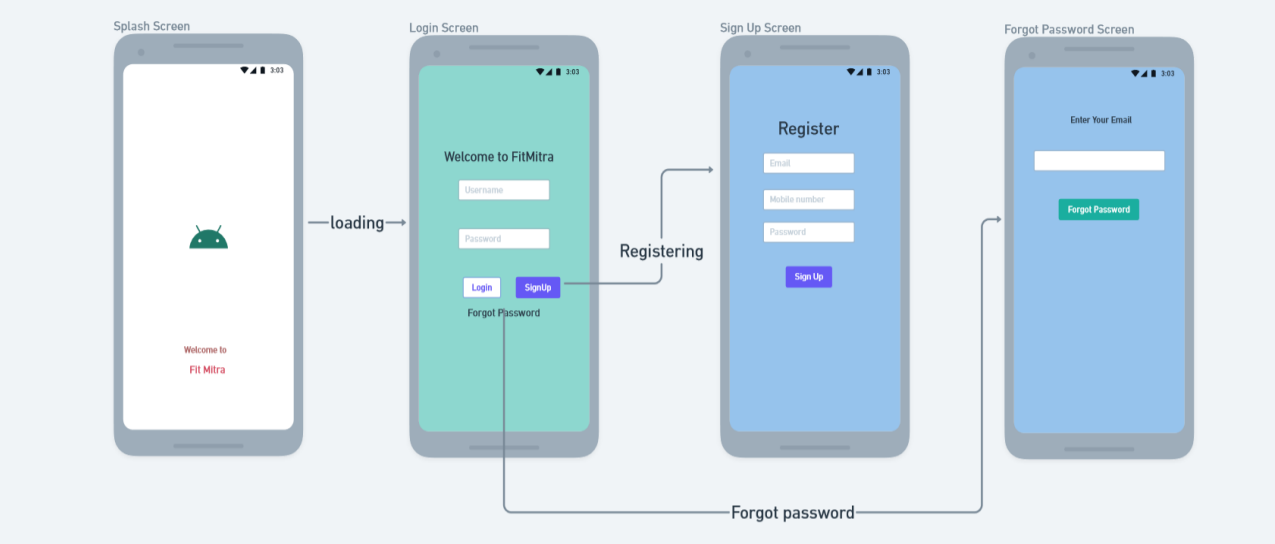

Fig 5. Fit Mitra : Authentication

Authentication is the first step for this system . The user is Welcomed with a splash screen . After that the user has the option to login, sign up or to restore password via the forgot password screen.

3.2 User Navigation

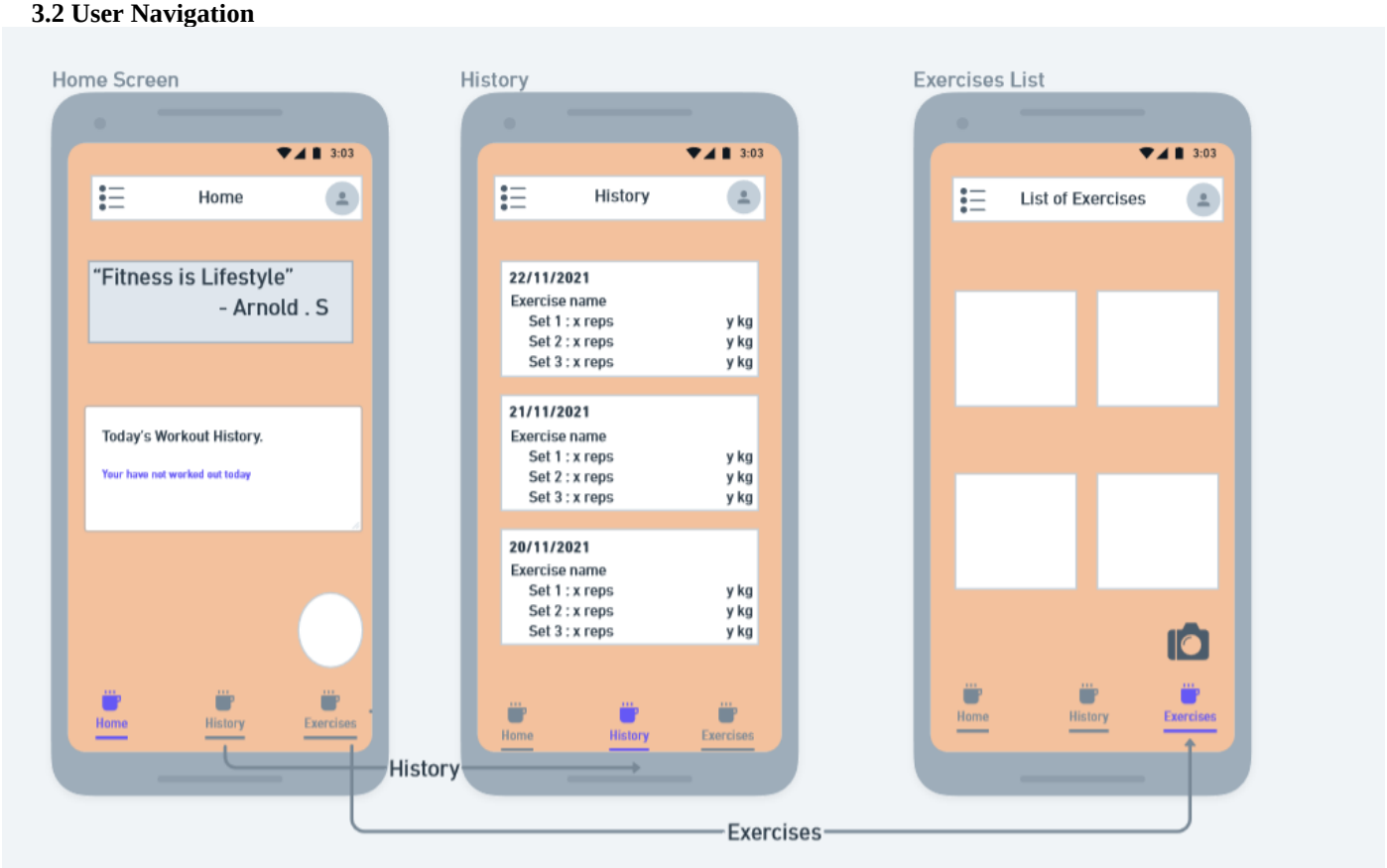

Fig 6. Fit Mitra : User Navigation

The user can navigate to three main screens. Home Screen, History Screen and Exercises Screen. In the home screen , the user is welcomed with a motivating quote and their workout history. In the History Screen, the users exercise history for each day is displayed. The The exercise screen , there are different exercises that the user can choose from.

3.3 Manual Tracking

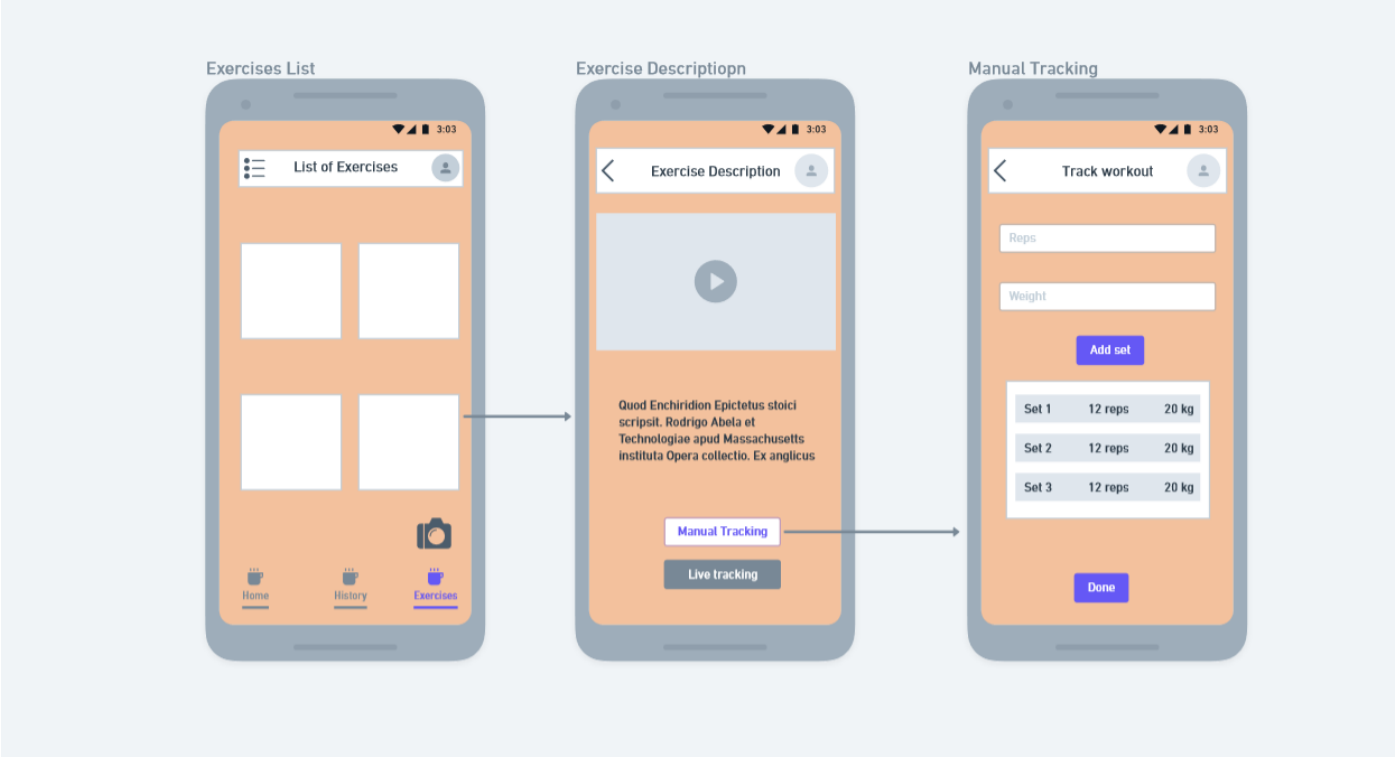

Fig 7. Fit Mitra : Manual Tracking

The user can do manual tracking for all the exercises. Clicking the manual tracking button takes them to the manual tracking screen, where they can enter the number of reparations and weights for each set of the exercise. When they click add set, that set gets added to the list, which is displayed on the screen. On clicking the done button, the exercise history is sent to the remote database and is saved.

3.4 Live Tracking

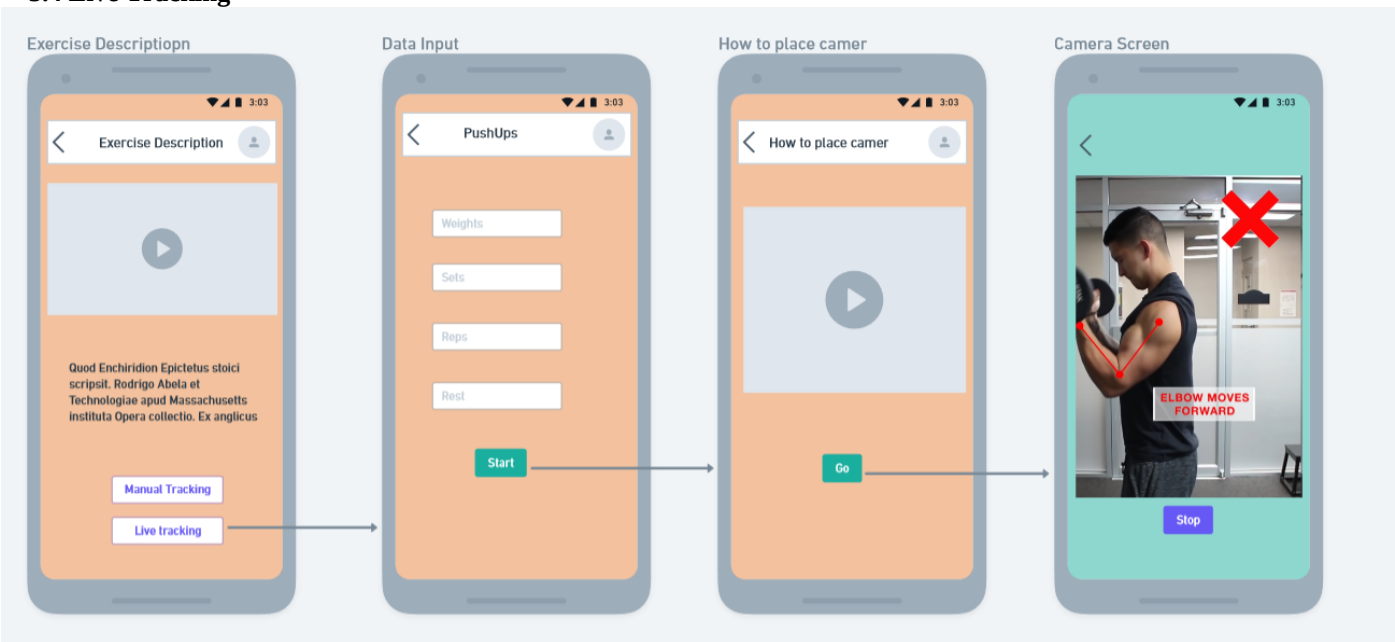

Fig 8. Fit Mitra : Live Tracking

The user can do live tracking for some of the exercises available. The live tracking button is enabled, the user can click on that. After entering the details like the number of sets, reps and weights that the user wants to do the exercise with, they are shown a tutorial video of how to place the camera, and then the live tracking starts with live feedback.

3.5 Admin: Add, Modify and Delete Exercises

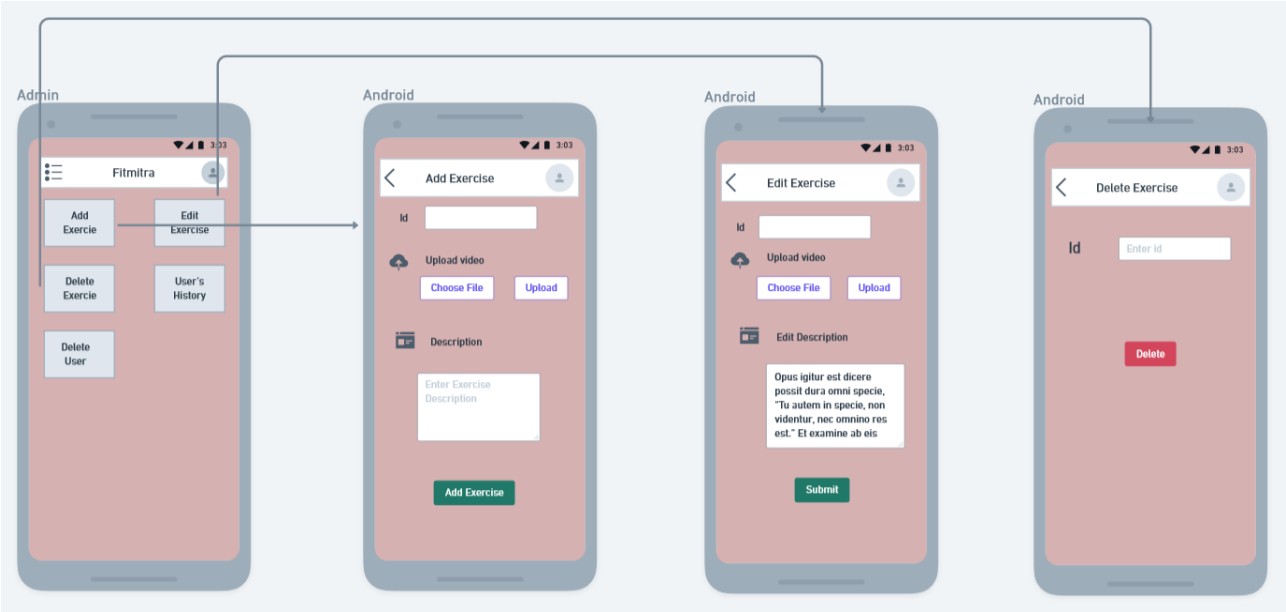

Fig 9. Fit Mitra : Admin : Add, Modify and Delete Exercises

Upon login, the admin is welcomed with a home screen with multiple options like addExercise, ModifyExercise and Delete Exercise. The Admin can go to the respective screens and add, delete and modify the exercises.

3.6 Admin : Delete User and View User's History.

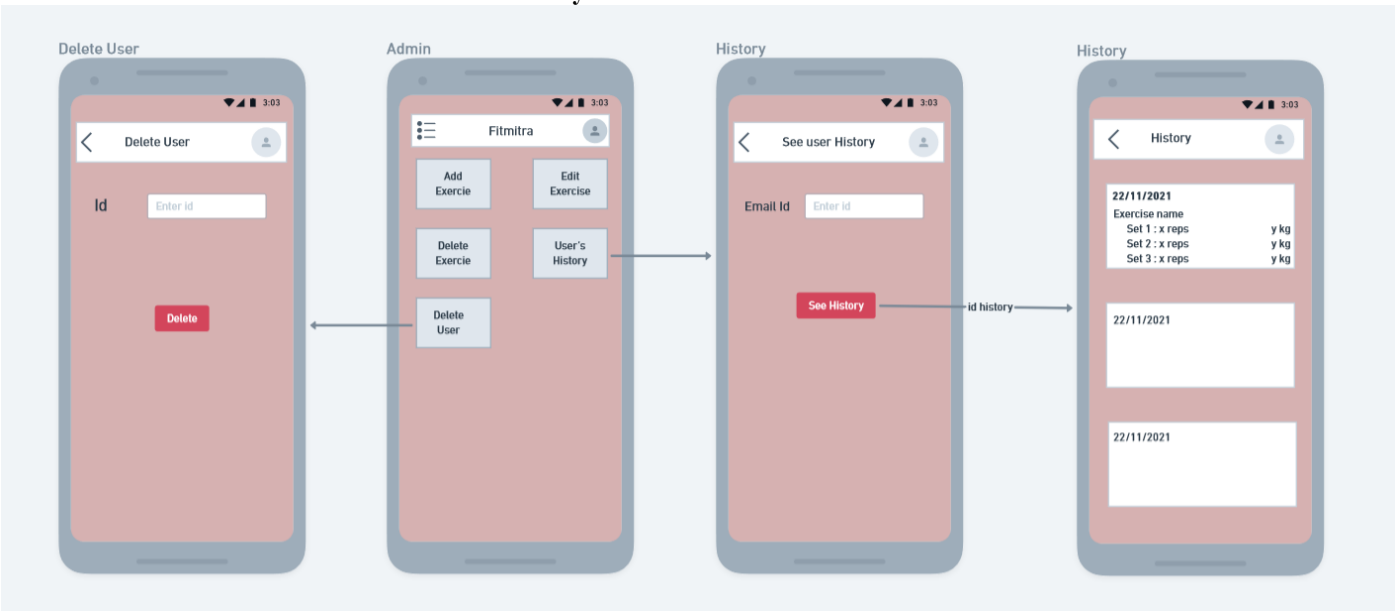

Fig 10. Admin : Delete User and View User's History.

The admin also has the option to delete a user and see User History. The admin can navigate to the respective screens and do the necessary functions.

IV. SCOPE AND LIMITATIONS

Fit Mitra currently focuses on developing an Android application that provides assistance to working out and reduces the risk of injuries. It is suitable for beginners and intermediate lifters, but in its current state, might not be very useful to advanced lifters as advanced lifters already have the knowledge of exercises.

Fit Mitra also supports live feedback for some of the workouts, which can be improved in the future, along with the accuracy of the pose detection software.

V. CONCLUSION

In this review, recognition of pose while doing regular exercises in modern gyms or at HOME is assessed by applying different machine learning algorithms and deep learning models. Among machine learning models, decision trees, linear SVM and Naive Bayes with Gaussian kernel perform best with a maximum accuracy of 80 per cent. Furthermore, we proposed a deep neural network for our exercise recognition (DER) consisting of three hidden layers with each hidden layer having 150 LSTM cells. DER outperformed traditional machine learning techniques with a maximum accuracy of 92 per cent. Additionally, we made the collected dataset for our evaluation publicly available to support and encourage further research.

Most important is conducting larger experiments to perform a more robust evaluation. This includes experiments with not only more people, but also more women and different levels of athletics (professional and non-professional participants). This work could be further extended by incorporating more sensors (e.g. heart rate sensor) or by examining the effects of changes to the location of sensors on the exerciser's body. In the same way, participant-specific attributes, such as height, weight, age, or gender, can be fit into the models to assess if these kinds of physical information per participant lead to higher recognition accuracy.

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