Module Code & Module Title

CS6P05NI Project

Interim Report

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Credit: 30 Credit Year Long Module

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External Supervisor: Mr. Srawan Shrestha

I confirm that I understand my coursework needs to be submitted online via MST Classroom under the relevant module page before the deadline for my assignment to be accepted and marked. I am fully aware that late submissions will be treated as non-submission and a mark of zero will be awarded.

Acknowledgement

I would like to express my sincere gratitude to the academic staff of Islington College for their continuous support, guidance, and encouragement throughout my academic journey. Their dedication to creating a positive and engaging learning environment has greatly contributed to my growth as a student. Their expertise and commitment to academic excellence have inspired me to push my boundaries and pursue this project with confidence and enthusiasm.

I would like to extend my heartfelt appreciation to my supervisors, Mr. Srawan Shrestha and Ms. Astha Sharma, for their invaluable mentorship and constructive feedback throughout the development of this project. Their consistent guidance, timely suggestions and technical insights have shaped this research in meaningful ways. Their encouragement during challenging phases of the project kept me motivated and helped me refine my ideas into practical and achievable solution.

I am also thankful to the entire Islington College community for providing the necessary resources and academic support essential for the successful initiation of this project.

Abstract

The rapid rise of home-based fitness solutions has highlighted the need for intelligence, personalized workouts assistance that ensures proper exercise form and minimizes the risk for injuries specially for beginners. KasRrat is a mobile application designed to address this need by utilizing real-time human pose estimation and computer vision techniques to analyse user posture and offer corrective feedback during workouts. By leveraging TensorFlow Lite and MediaPipe pose estimation models, the system detects and tracks the user's body movements through the device camera, evaluates posture accuracy using joint-angles calculations, and provides instant audio feedbacks to improve the user's performance.

In addition to real-time posture correction, the application features and animated workout instructor (bot) that demonstrates exercises clearly, enabling users to follow guided routines without external supervision. The platform aims to enhance workout quality, reduce injuries risks, and create a more interactive and effective exercise experience. The project follows the Agile Scrum methodology to ensure iterative development, continues testing, and steady progress toward a functional prototype. Ultimately, KasRrat seeks to bridge the gap between technology and fitness by offering a smart, accessible, and engaging solution for individuals seeking structured workouts with proper beginner guided assistance.

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1. Introduction

1.1 Current Scenario

Physical activity is beneficial to health and well-being and conversely, physical inactivity increases risk for noncommunicable diseases (NCDs) and other poor health outcomes. Together, physical inactivity and sedentary behaviours are contributing to the rise in NCDs and placing a burden on healthcare systems. Improving levels of physical activity benefits and contributes to attainment of global NCD targets and a number of sustainable development goals. People who are insufficiently active have a 20% to 30% increased risk of death compared to people who are sufficiently active (World Health Organization, 2024).

Digital fitness platforms are a powerful force driving fitness industry growth, nowadays with innovations like virtual fitness solutions, wearable technology, and AI-driven personalization, workouts can be done in new ways. As the industry recovers from the disruptions caused by the COVID-19 pandemic, it is clear that digital fitness will remain a big part of the future (Ashley Miller, 2024).

The global fitness industry has proven its resilience, with significant recovery post-pandemic. In 2022, the global market was valued at $104.05 billion and is projected to reach $202.78 billion by 2030, reflecting a robust compound annual growth rate (CAGR) of 8.4% (Alexandra, 2025).

1.2 Problem Statement

Engaging in physical activity with poor posture can put undue stress on specific muscles and joints, leading to various problems and cause problems such as muscle pain, joint pain, and can restrict blood flow and circulation, leading to fatigue and potentially affecting healing and recovery. Bad posture harms the body and affects performance. Proper posture helps maintain balance and coordination, which is critical in doing exercises correctly and without risking well-being (ghpnews, 2024, September 24).

Developing an exercise habit is hard enough without having to guess what exercises are good as a beginner. We are all beginners at one time or another there is no shame in that. The sheer amount of content available online can make it even more difficult to get started. The biggest problem with tagging videos as beginners is that often the exercises are demonstrated but the proper form and technique to perform those exercises are not shown (Bradbury, December 30, 2022).

Many people spend tons and tons of money on personal trainers especially as a beginner which cost them a lot, and existing fitness apps offer general workout guidance but lack the ability to:

- Correct the user’s form in real-time
- Detect and track actual body movements
- Give instant audio feedbacks
- Provide an interactive AI trainer that dynamically responds to user actions

Incorrect posture during exercise can lead to injuries, reduced effectiveness, and long-term health issues. Users who exercise at home without supervision are especially vulnerable to performing movements incorrectly.

1.3 Project as a solution

In the age of digital transformation, fitness tracking has evolved from simple pedometers to systems which are capable of analysing movement, posture, and performance in real-time. Computer vision a ground-breaking technology that enables machines to interpret and analyse visual data. With the use of advance algorithms and machine learning techniques to analyse visual data captured through cameras enables system to identify, monitor, and evaluate human movements, providing detailed insights into physical activities, posture, and performance (Meegle, 2025).

MediaPipe being used as a framework used in computer vision to access and solve several real-life problems through pose-estimation and joint angle calculation provide feedback on exercise form as well as expanded rep count. This application employs an unique method by using dynamic angle thresholds and joint distance computation to provide precise feedback about user posture assisting users in maintaining proper form and tracking their workout progress (IEEE, 2024).

KasRrat will be a mobile app that uses computer vision technology to track the user’s body joints in real-time, analyse posture accuracy, and provide instant corrective feedback. The app will also feature an animated virtual bot that demonstrates the proper form of the exercise so the user could follow the proper exercise form side-by-side along with the virtual bot.

1.4 Aims and Objectives

1.4.1 Aims

The project aims to design and develop a mobile fitness application that enables the users to perform guided exercises safely by providing real-time posture tracking features and real-time audio feedbacks through AI-driven computer vision.

1.4.2 Objectives

The major objectives of the project are listed below:

1. Develop a Flutter mobile application that tracks 17 body key points in real-time and calculate joints angles for posture analysis.
2. Achieve at least 80% accuracy in form correction across 4 core exercises featuring animated guides and audio feedback.
3. Leverage integrated Flutter packages (TFLite, TTS, Camera) and Mixamo assets to ensure a high-performance, functional prototype.
4. Enhance home-workout safety by providing real-time corrective guidance to prevent exercise related injuries.
5. Complete all development, testing, and project documentation within the allocated academic semester timeline.

1.5 Report Structure

The Interim report is split and organized into sections to present the progress, design, and development status of the KasRrat fitness application in a clear structured order. Each section focuses on a specific aspect of the project to ensure logical flow and understanding of the application.

Section 1: Introduces the project by discussing the current scenario in the fitness domain in terms of technology, identifying the problem statement, presenting the proposed solution, and defining the aim and objectives of the project and also outlines the overall structure of the report to guide the reader through the sections.

Section 2: Provides background information and a literature review related to the project discussing the target end users, explains the core concepts behind the system, reviews similar existing applications, and presents a comparative analysis highlighting the uniqueness of the proposed solution.

Section 3: Describes the development methodology for the project. It outlines the methodologies considered, justifies the selection of the Agile Scrum methodology, and presents the work breakdown structure and Gantt chart used to manage and track project progress effectively.

Section 4: Focuses on the development work completed to date. It includes the system architecture diagrams, UML diagrams, flowcharts, wireframes, UI designs, and evidence of implementation progress, demonstrating the practical development of the system.

Section 5: Analyses the overall progress of the project. It reviews completed tasks, presents a progress table, and outlines an action plan for addressing remaining work and potential challenges the system could face during the development process.

Section 6: Discusses the future work planned for the project, additional features, improvements, and enhancements that may be implemented in the later stages of development.

Section 7: Concludes the report by summarizing the progress made so far and reaffirming the project’s objectives and direction.

Section 8: Lists all references used throughout the report.

2. Background and Literature Review

The KasRrat application aims to help people start their fitness journey minimizing injury factors as a beginner. This section provides information related to similar applications, that used AI-based fitness guidance and posture analysis to help understand the problem domain, identifying existing solutions, analysing their limitations, and justify the need of the proposed system.

2.1 About the End User/Client

The primary end users of KasRrat are individuals who engage in physical exercises, particularly beginners and intermediate users who perform workouts at home without proper professional supervision. Users who often reply on online videos to guide their exercises however, such resources usually lack real-time feedback and posture correction.

Many beginners face challenges such as performing exercises with incorrect form, and lacking motivation due to the absence of personal trainer. Incorrect posture during the workouts can lead to reduced effectiveness and, in some cases, serious injuries as well. Additionally, hiring a professional trainer may not be practical for everyone, especially students and home-based fitness enthusiasts.

KasRrat aims to serve these users by providing an intelligent mobile-based fitness assistant that offers real-time posture analysis, corrective feedback, and visual guidance through an animated instructor to improve users workout quality and consistency without requiring external supervision.

2.2 Understanding the project

KasRrat is an AI-based fitness coaching application that uses the device camera to analyse the use's body movements during exercise. The system leverages computer vision and pose estimation techniques to identify key body landmarks, track movements patterns, and evaluate posture correctness in real time.

The application integrates technologies such as Flutter for cross-platform mobile development and MediaPipe and TensorFlow Lite for efficient on-device pose detection. MediaPipe Pose provides a lightweight yet accurate solutions for detecting human body joints, making it suitable for real-time mobile applications. TensorFlow Lite enables the execution of machine learning models directly on the device, reducing dependency on internet connectivity and improving performance.

The core functionality of KasRrat includes real-time posture analysis, audio and visual feedbacks, and an animated virtual instructor demonstrating correct exercise form. By combining these features, the system aims to provide an interactive and engaging workout experience that bridges the gap between traditional fitness application and personal training sessions.

2.3 Review of Similar Projects

To understand the major unique features of KasRrat, several existing similar applications were reviewed:

2.3.1 Project 1: Fitform

Fitform is a mobile application that utilizes camera-based pose detection to analyse a user's exercise for in real time, focusing on specific exercises such as squats and push-ups and provides immediate feedback when incorrect posture is detected.

It is an application that supports real-time posture analysis, which closely aligns with the core objective of the KasRrat application. It helps users reduce the risk of injury by identifying incorrect exercise forms. It focuses on a limited set of exercises and provides feedbacks.

Some of the features inspired from Fitform for my application KasRrat are:

- Camera-based pose detection
- Feedback generator

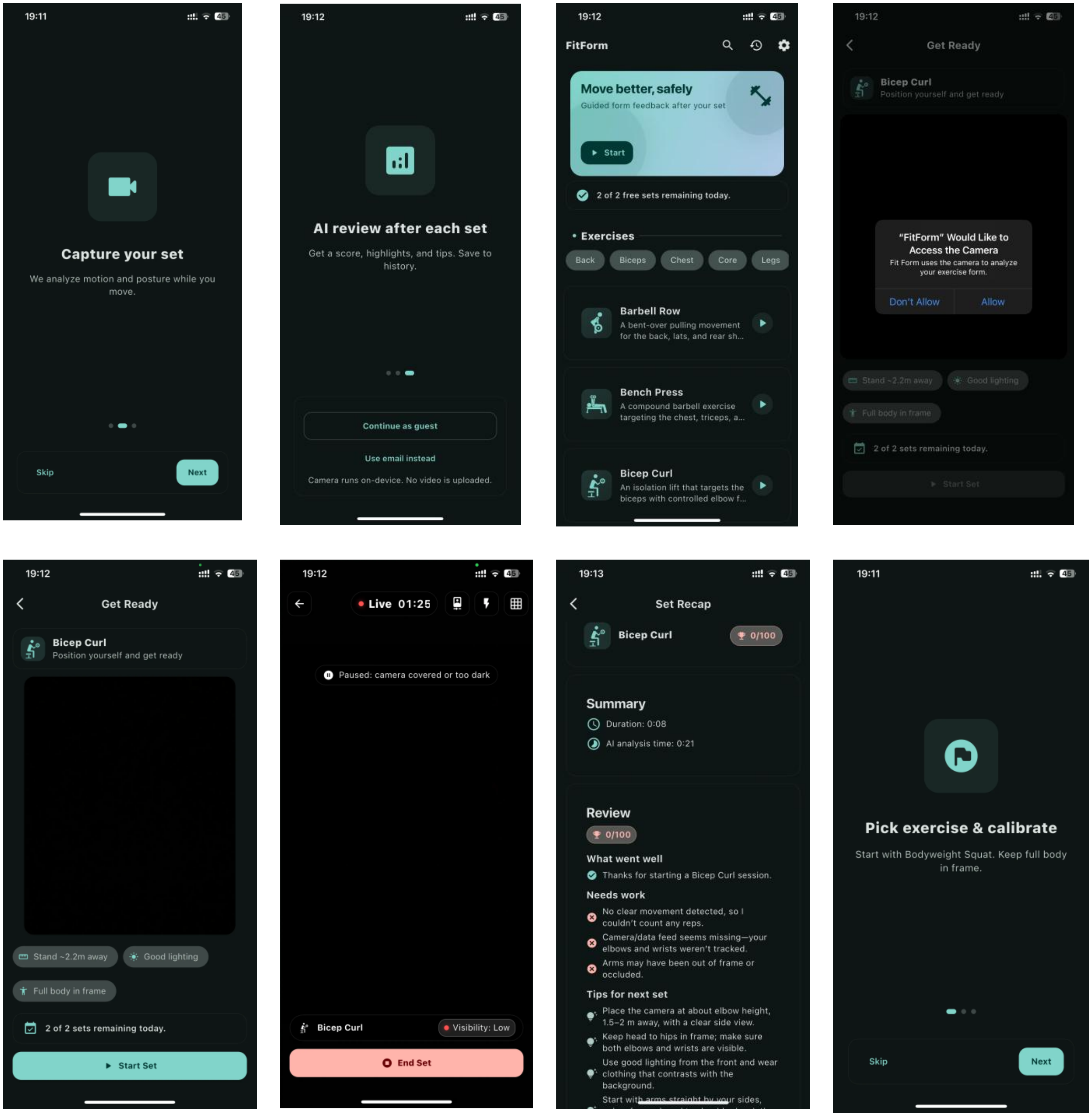

Figure 1: Fitform Application

2.3.2 Project 2: Freeletics

Freeletics is a popular fitness application focused on bodyweight training and personalized workout plans. The app adapts training intensity based on user performance and feedbacks, making it suitable for users with different fitness levels.

This application aims to provide a personalized digital training experience for users. It combines structured workout plans, adaptive coaching, and a large exercise library to help individual achieve their fitness goals through flexible and guided routines.

Some of the features inspired from Freeletics for my application KasRrat are:

- Structured workout plans
- Exercise library for users

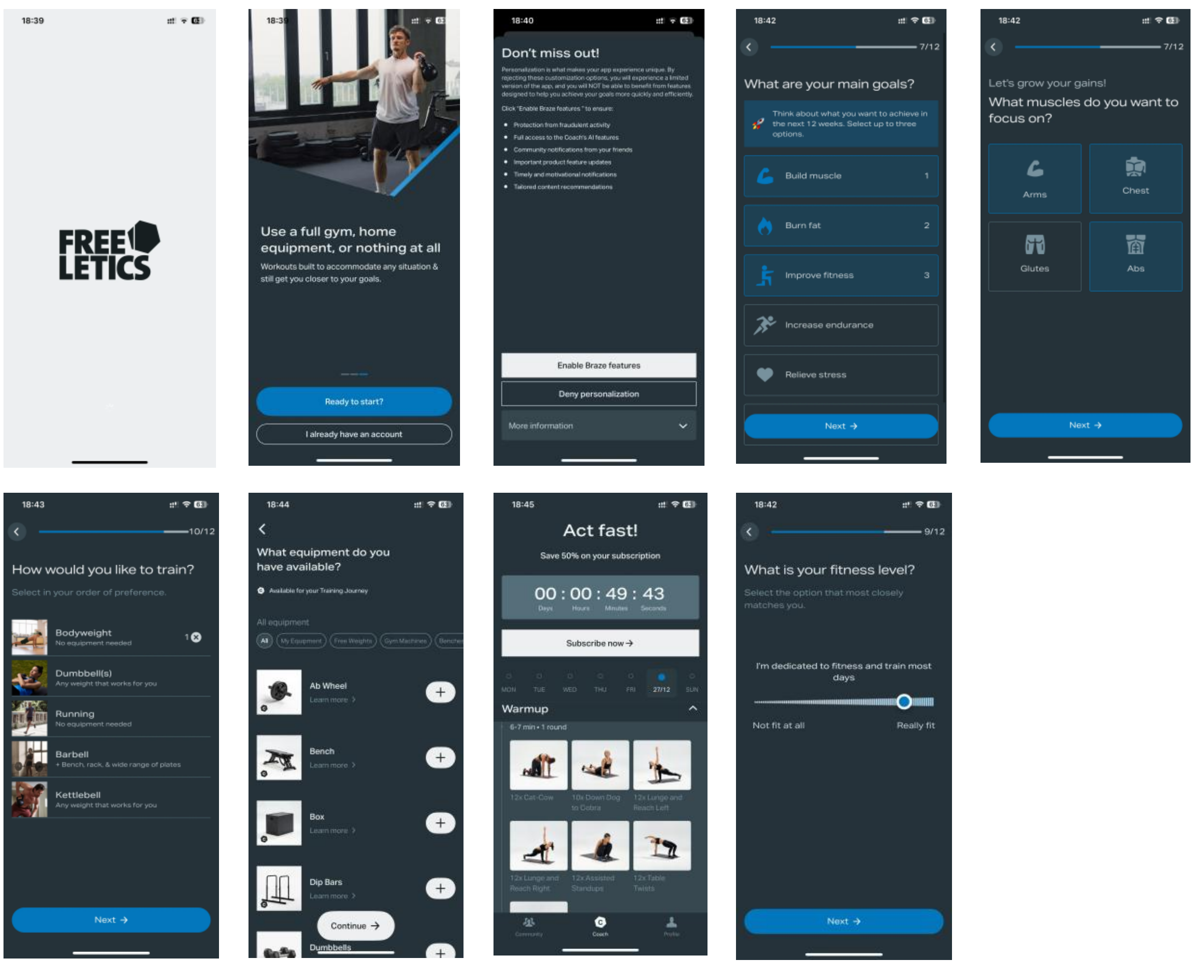

Figure 2: Freeletics Application

2.3.3 Project 3: Gymshark Training and Fitness

Gymshark Training and Fitness is a free mobile fitness application designed to provide users with workouts and personalized training plans. The app includes thousands of instructional videos and supports both gym-based and home training courses.The app also allows users to track workout progress, including sets, repetitions, and completed sessions.

Some of the features inspired from Nike Training Club for my application KasRrat are:

- Workout plans
- Instructional guidance videos

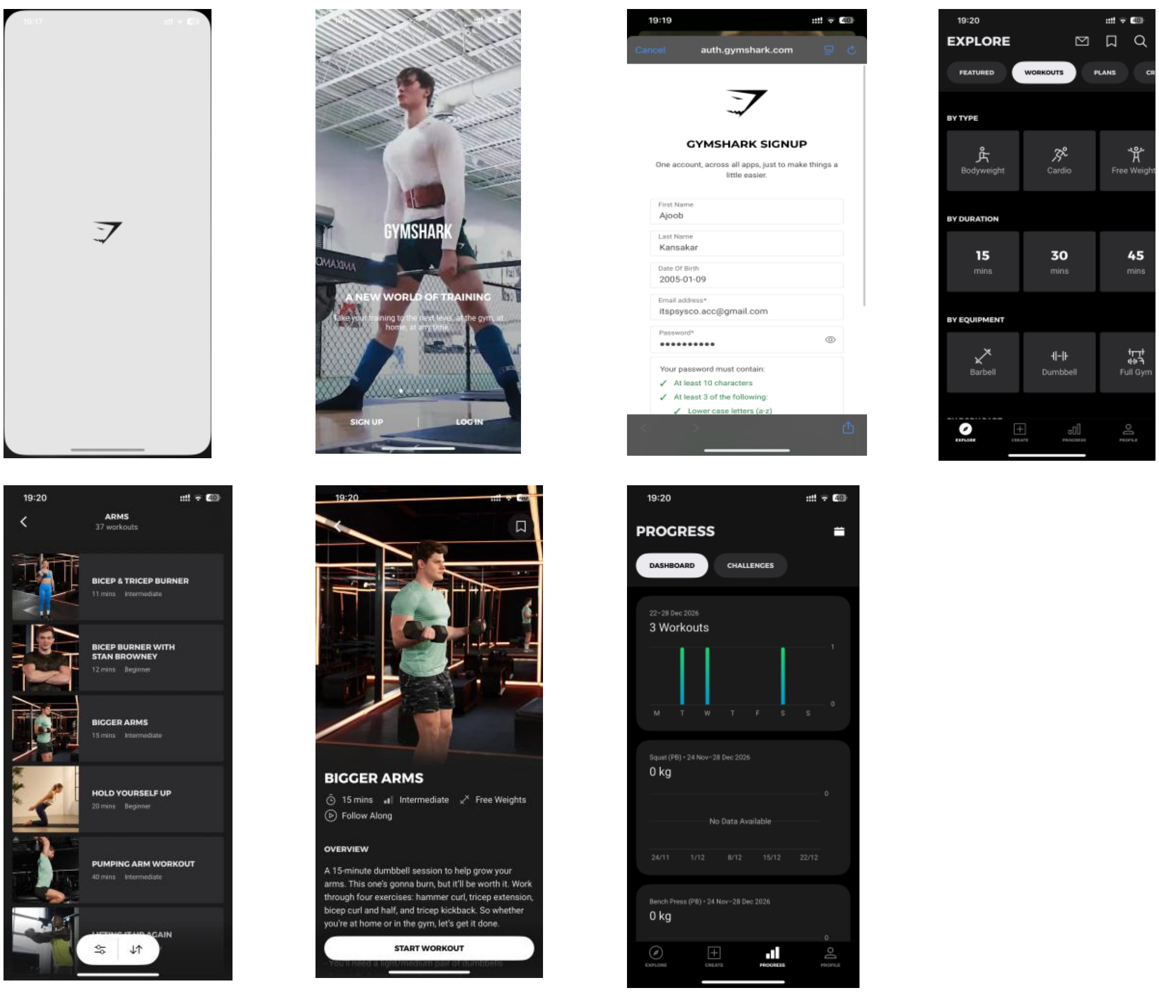

Figure 3: Gymshark Application

2.4 Comparison Table of Similar Projects

Table 1: Comparison Table of Similar Projects

No.	Features	Fitform	Freeletics	Gymshark	KasRrat
1.	**Real-time Camera based tracking**	✓	✗	✗	✓
2.	**AI-based pose detection**	✓	✗	✗	✓
3.	**Real-time posture feedback**	✓	✗	✗	✓
4.	**Animated virtual instructor**	✗	✗	✗	✓
5.	**Workout planning**	✗	✓	✓	✓
6.	**Posture Analysis**	✓	✗	✗	✓
7.	**Beginner-friendly**	✓	✗	✓	✓
8.	**Structured workout flow**	✗	✓	✓	✓
9.	**Mobile app availability**	✓	✓	✓	✓
10.	**Offline user capability**	✗	✓	✗	✓

2.5 Comparison Analysis of Similar Projects

Comparative analysis of existing fitness platform such as Fitform, Freeletics, and Gymshark Training reveals a significant limitation that KasRrat aims to address. Applications like Freeletics and Gymshark Training primarily focus on structured workout programs, training plans, and motivational content, offering users guided routines and professional exercise demonstrations. However, these platforms largely reply on static video-based instructions and assume that users perform exercises correctly, but no real-time validation of posture and form. Similarly, Fitform attempts to improve exercise accuracy but remains limited in terms of personalized feedback, real-time corrective guidance. This creates a high risk of incorrect form, which can lead to physical injuries.

KasRrat solves these issues by directly addressing these limitations through the integration of real-time posture detection and corrective feedback mechanisms. Unlike existing applications, KasRrat actively analyses user movements using camera-based pose estimation to detect incorrect posture during workouts and provides immediate visual and audio feedbacks which ensures that users not only follow workout routines but also perform exercises safely and correctly, reducing the risk of injury. Furthermore, KasRrat emphasizes personalized fitness experiences by adapting feedback based on individual performances, maintaining detailed progress tracking, and offering workouts with guidance for beginners. By combining posture analysis with feedback and progress monitoring, KasRrat provides a more comprehensive and beginner friendly fitness solution that solves the existing application limitations.

The primary features of KasRrat lies in its feedback system by providing immediate audio and visual corrections supported by a side-by-side animated virtual instructor. KasRrat effectively lowers the risk of injury and empowers users with the highest level of engagement and safety, offering level of interactive guidance that is currently missing in fitness applications.

3. Development Methodology:

3.1 Considered Methodology

a. Prototype:

An iterative model focused on building a preliminary version of software to visualize requirements and refine user feedback before the development.

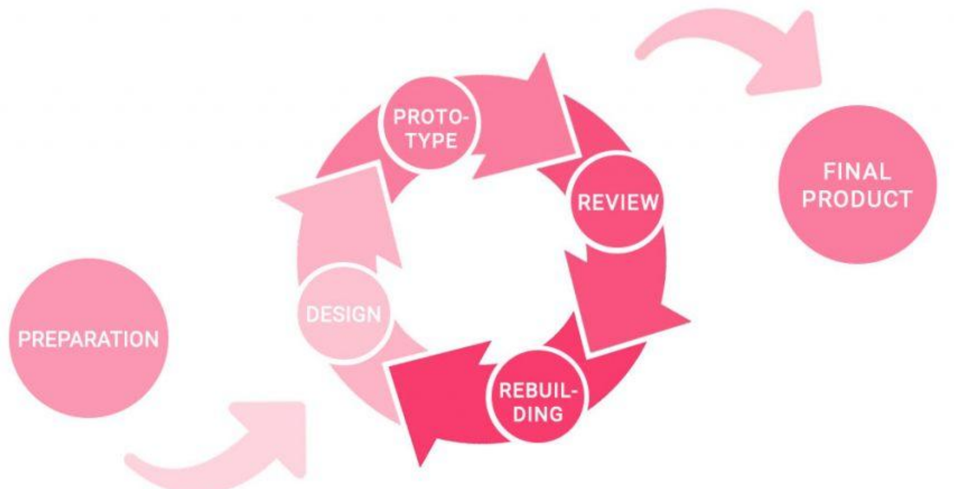

Figure 4: Workflow of Prototype Methodology

Prototype methodology is not suitable for this project because prototyping takes time, and with limited time for the project submission, creating and revising prototypes could slow things down. It also does not support the complexity involved in building an AI-driven fitness application that requires real-time pose detection, machine learning integration, and continuous performance testing.

b. XP (Extreme Programming):

An Agile framework emphasizing technical excellence, frequent small releases, and continuous feedback to ensure high software development.

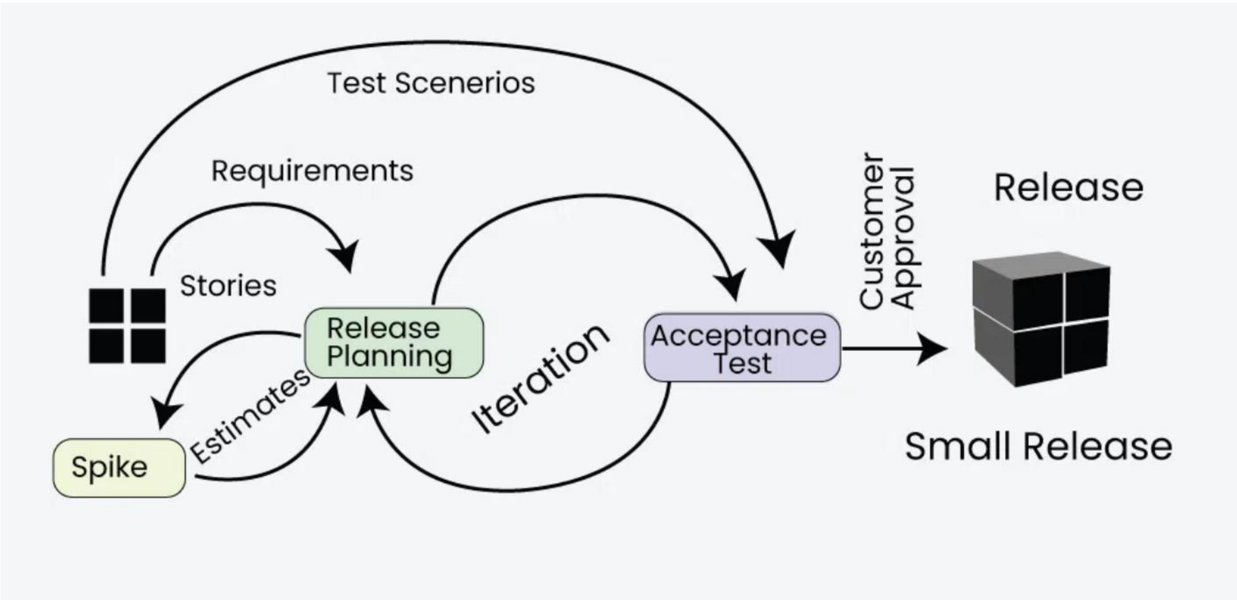

Figure 5: Workflow of Extreme Programming

Extreme Programming (XP) is not suitable for this project because it is designed for fast-paced software development environments where continuous coding, pair programming, and rapid incremental releases are required due to its complexity, team-oriented practices, and lack of alignment with AI-centric development, XP is not an appropriate methodology for this project.

c. Spiral:

A risk-driven process model that combines iterative development with systematic risk analysis and evaluation across multiple evolutionary cycles.

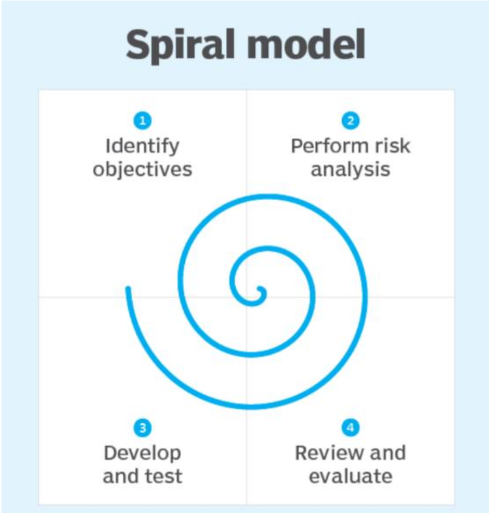

Figure 6: Workflow of Spiral Model

The spiral methodology is not suitable for this project because it is designed for large-scale, high-risk, and high-budget systems that require extensive risk assessment and multiple iterative cycles. Because of its complexity, documentation load, and unsuitability for small-scale projects, the spiral model is not suitable to develop an AI-based mobile fitness application.

3.2 Selected Methodology

Scrum Methodology is a widely used framework for managing complex projects, in the realm of software development. It operates on the principle of iteration and continuous improvement. In Scrum, work is organized into short iterations known as sprints, during each sprint a small, tangible piece of the overall project is delivered, known as a increment. Scrum aims to fulfil all the requirements through transparent communication, and a commitment to ongoing improvement. It prioritizes list of features known as the product backlog that aligns with the project goals (S, April 2, 2025).

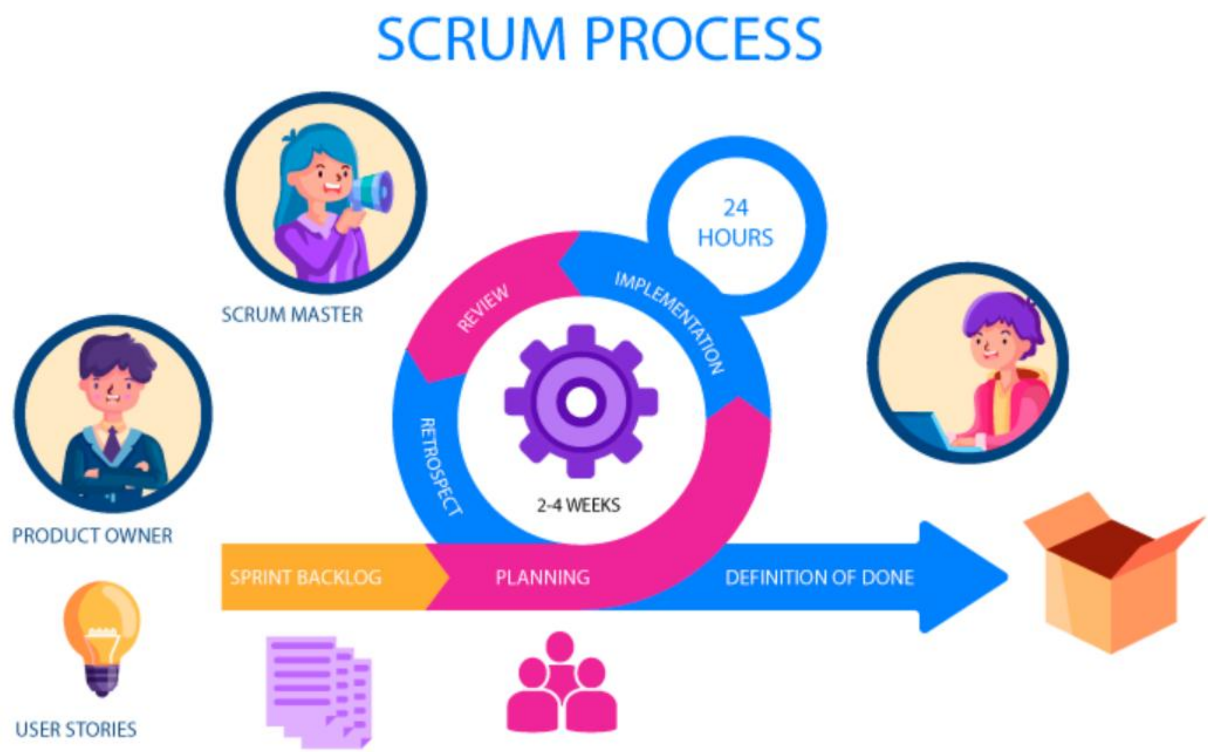

Figure 7: Workflow of Scrum Methodology

3.3 Work Breakdown Structure

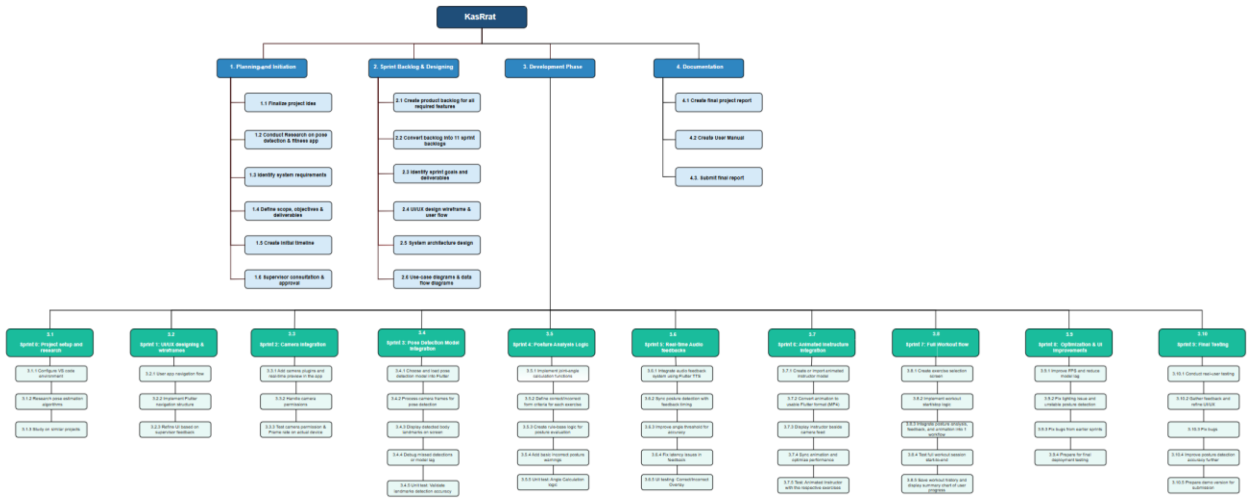

Figure 8: Work Breakdown Structure of KasRrat

Click Here for clearer view of WBS

3.4 Project Gantt Chart

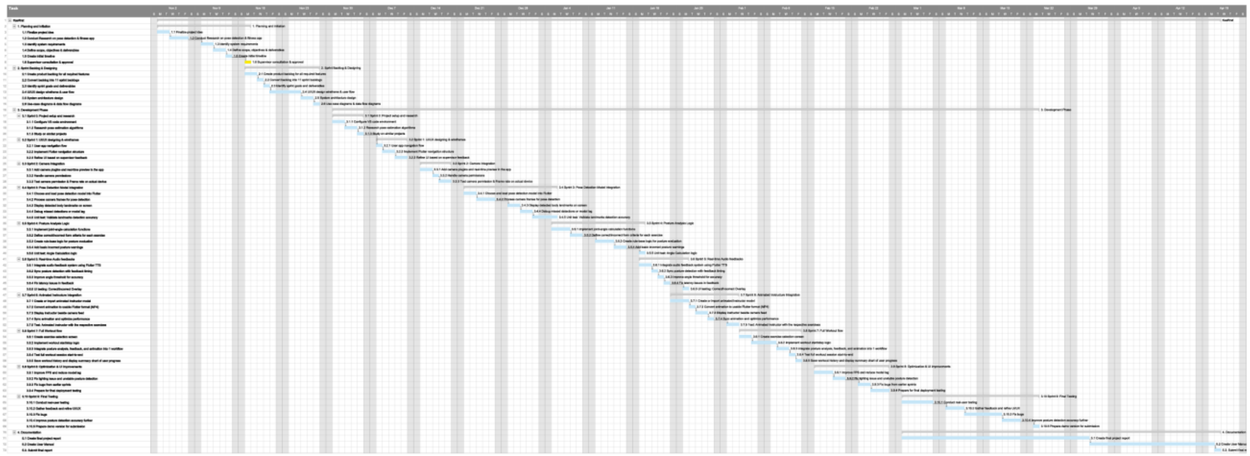

Figure 9: Gantt Chart of KasRrat

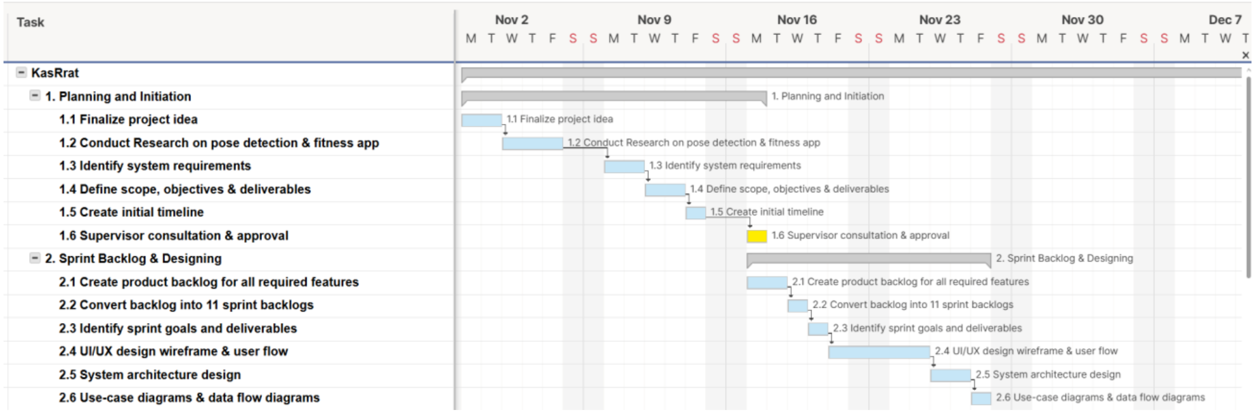

Figure 10: Planning and Backlogs

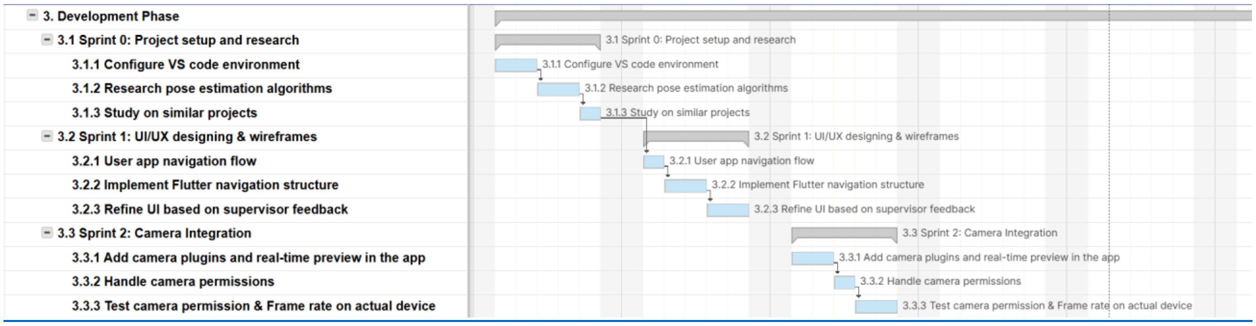

Figure 11: Development Phase: Sprint 0-2

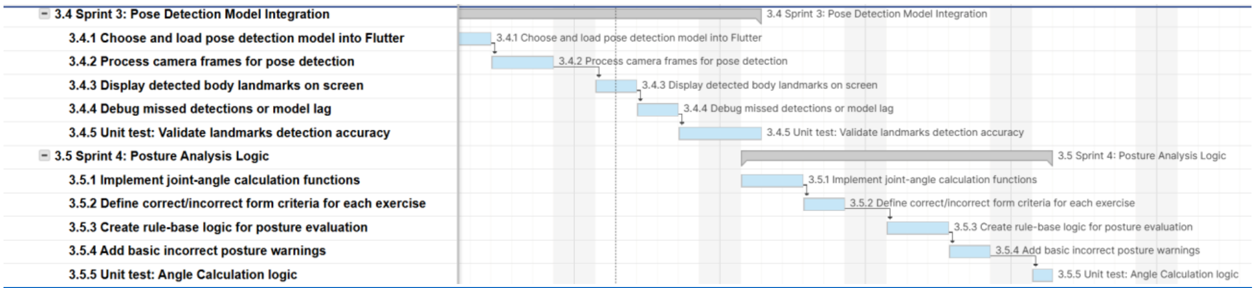

Figure 12: Development Phase: Sprint 3-4

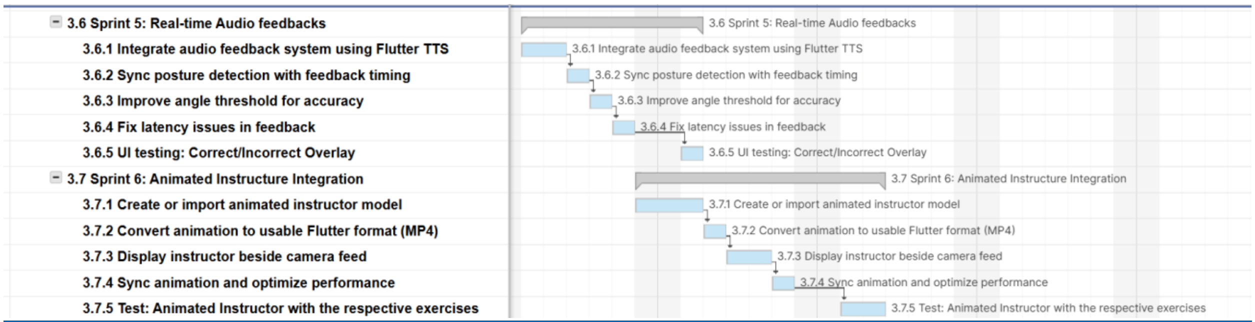

Figure 13: Development Phase: Sprint 5-6

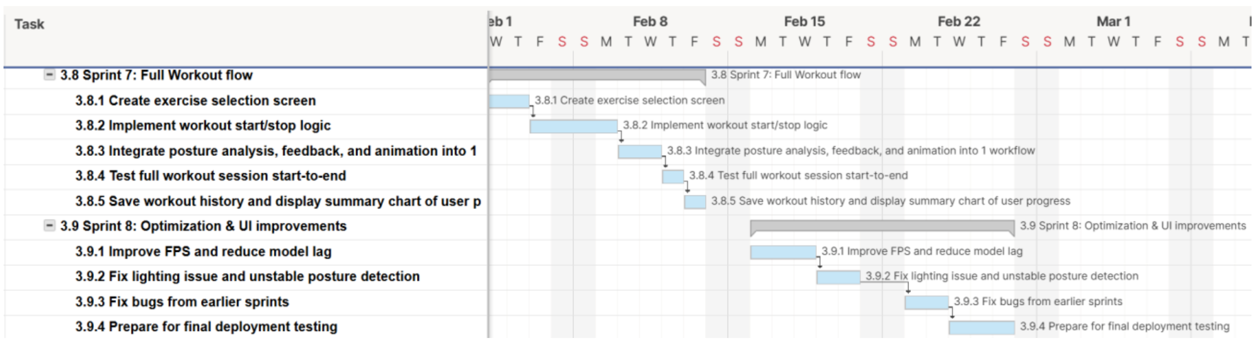

Figure 14: Development Phase: Sprint 7-8

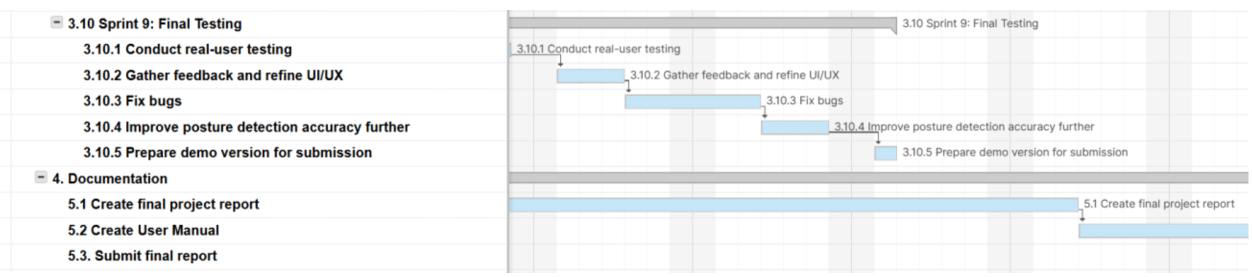

Figure 15: Development Phase: Sprint 9 and documentation

[Click Here](#) for a clearer view of Gantt chart

4. Development till Date

4.1 System Architecture Diagram

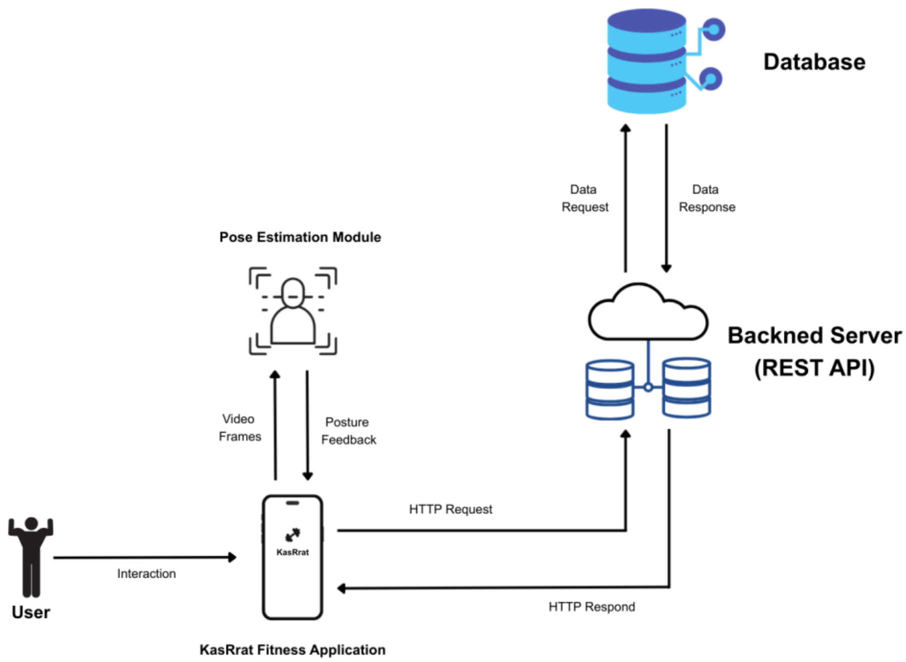

Figure 16: System Architecture Diagram

4.2 Use Case Diagram

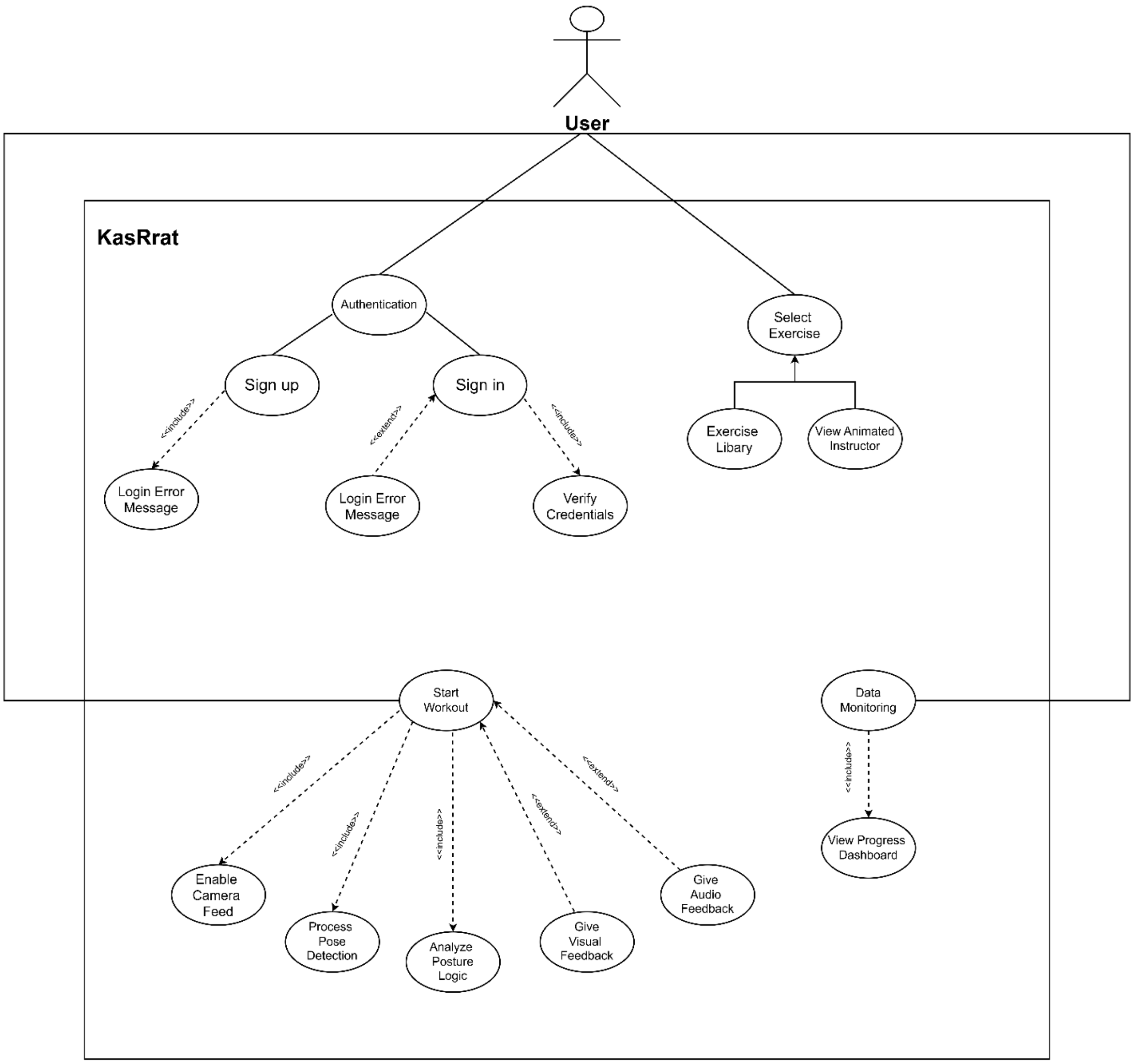

Figure 17: Use Case Diagram

4.3 Activity Diagram

4.3.1 User Login & Workout Selection

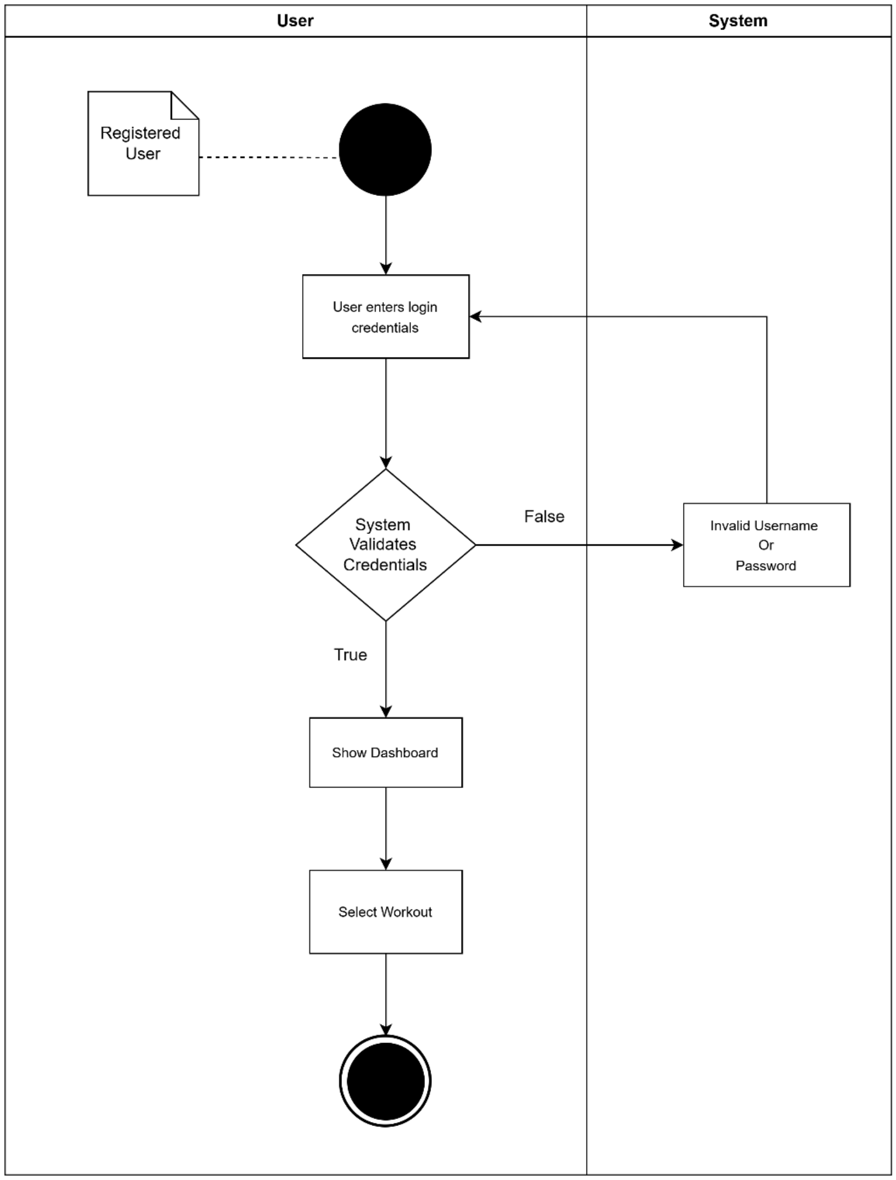

Figure 18: Activity Diagram: User Login & Workout selection

4.3.2 Real-time Movement Detection

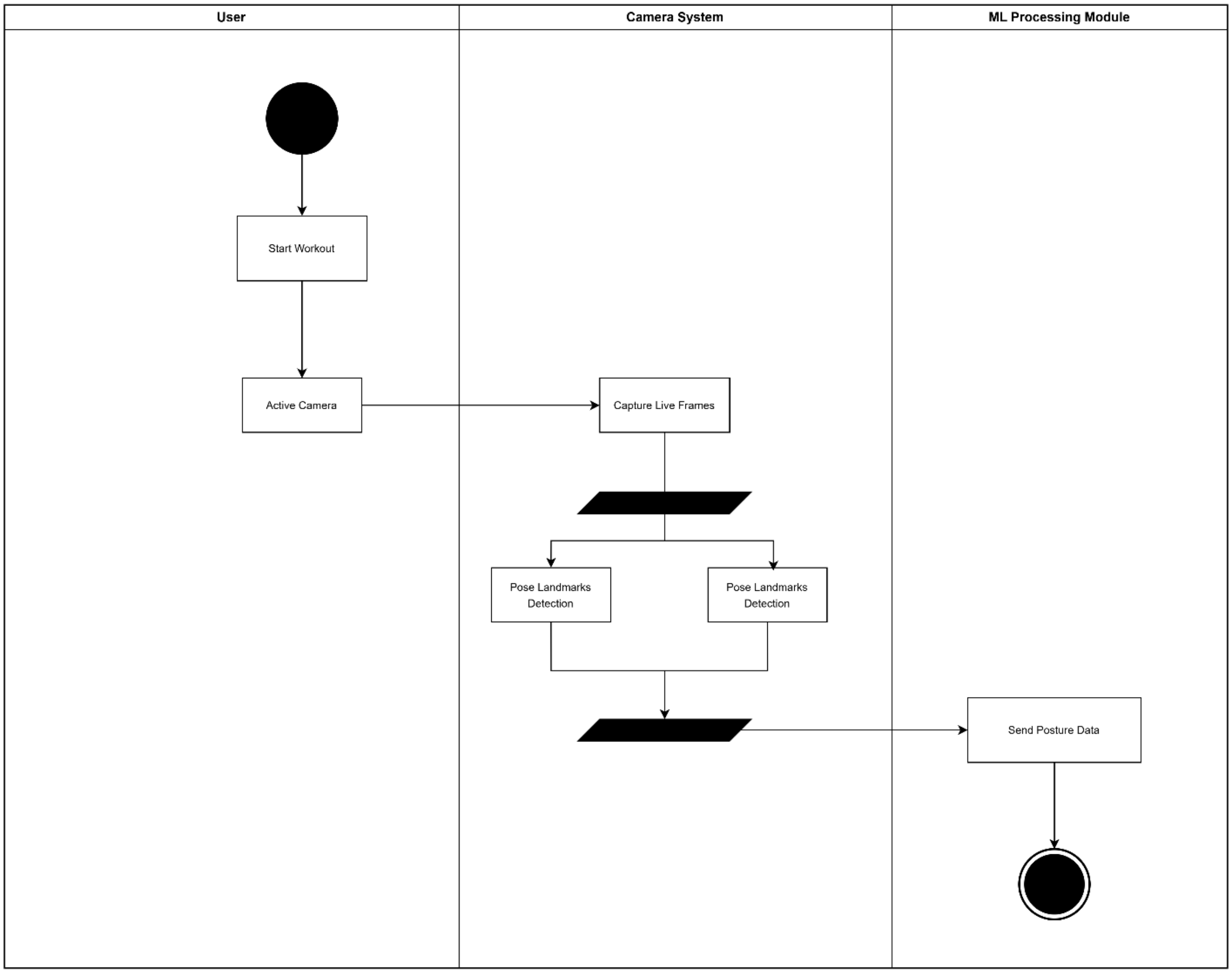

Figure 19: Activity Diagram: Real-time Detection

4.3.3 Posture Analysis & Feedback

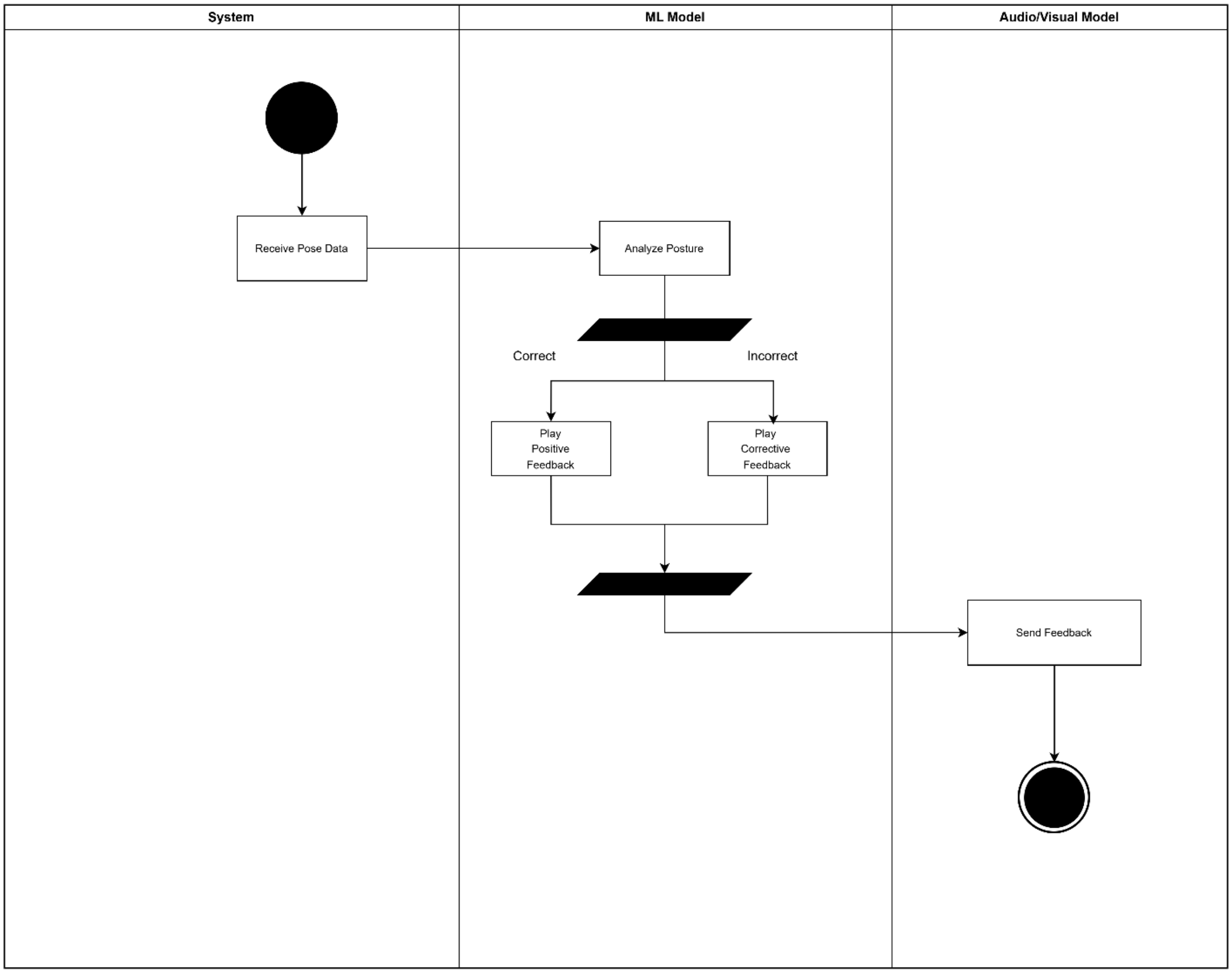

Figure 20: Activity Diagram: Posture Analysis & Feedback

4.3.4 Animated Instructor Guidance

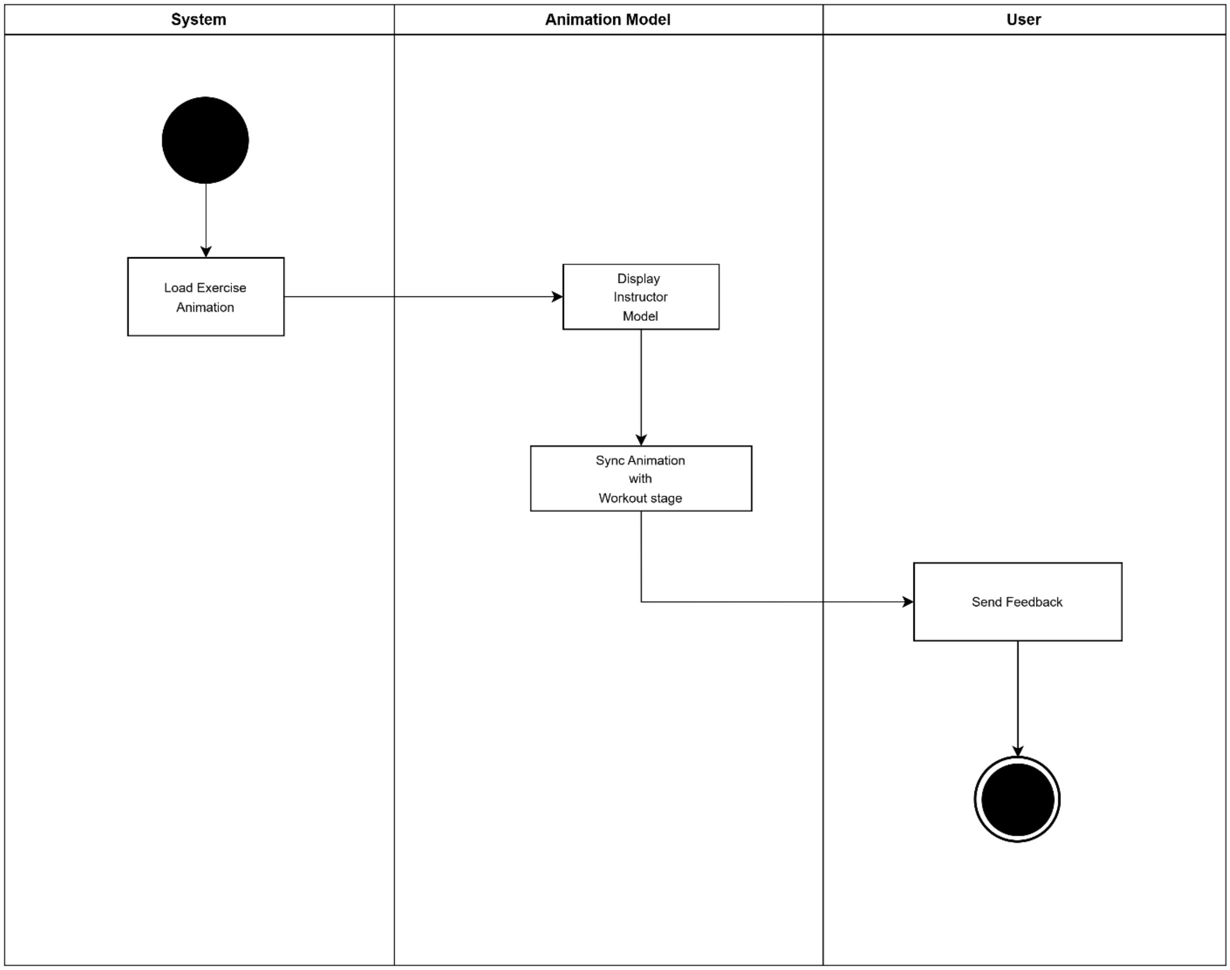

Figure 21: Activity Diagram: Animated Instructor Guidance

4.3.5 Progress Tracking & Session Report

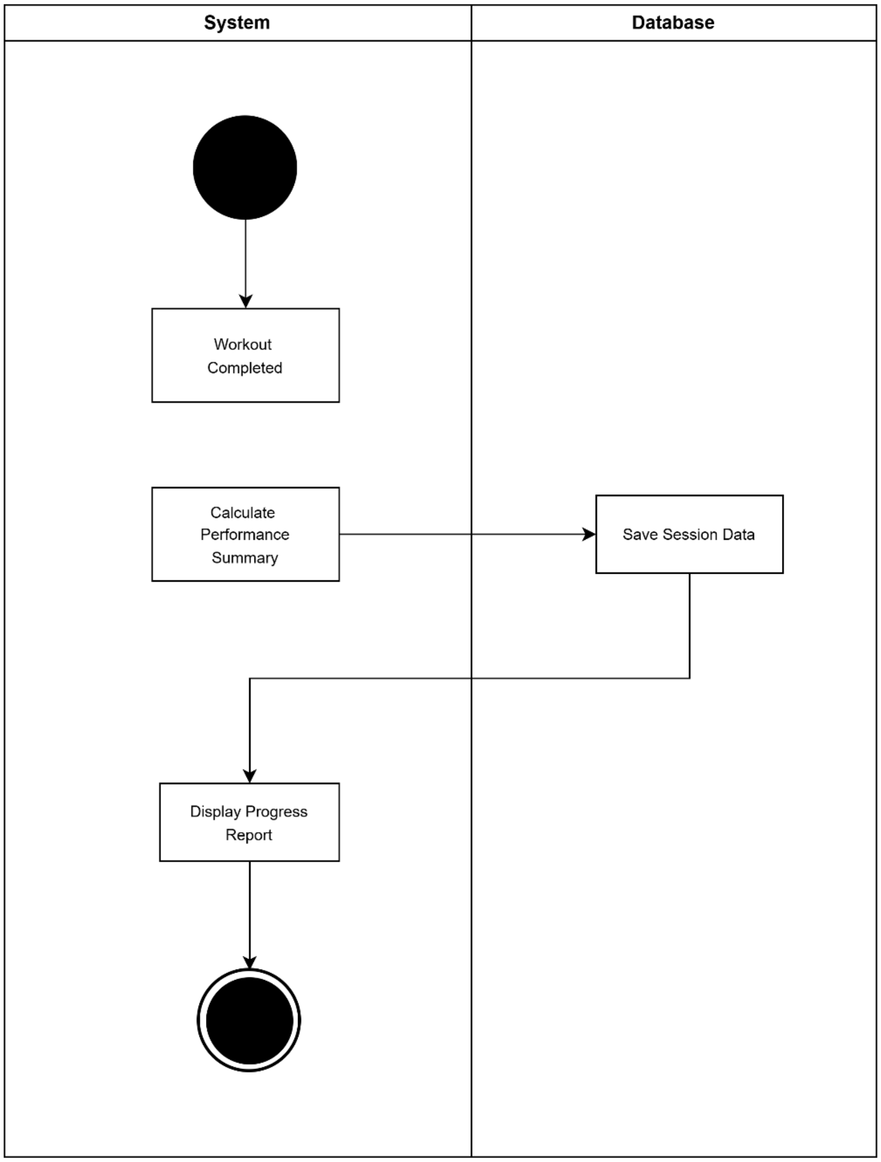

Figure 22: Activity Diagram: Progress Tracking & Session Report

4.4 Entity Relationship Diagram

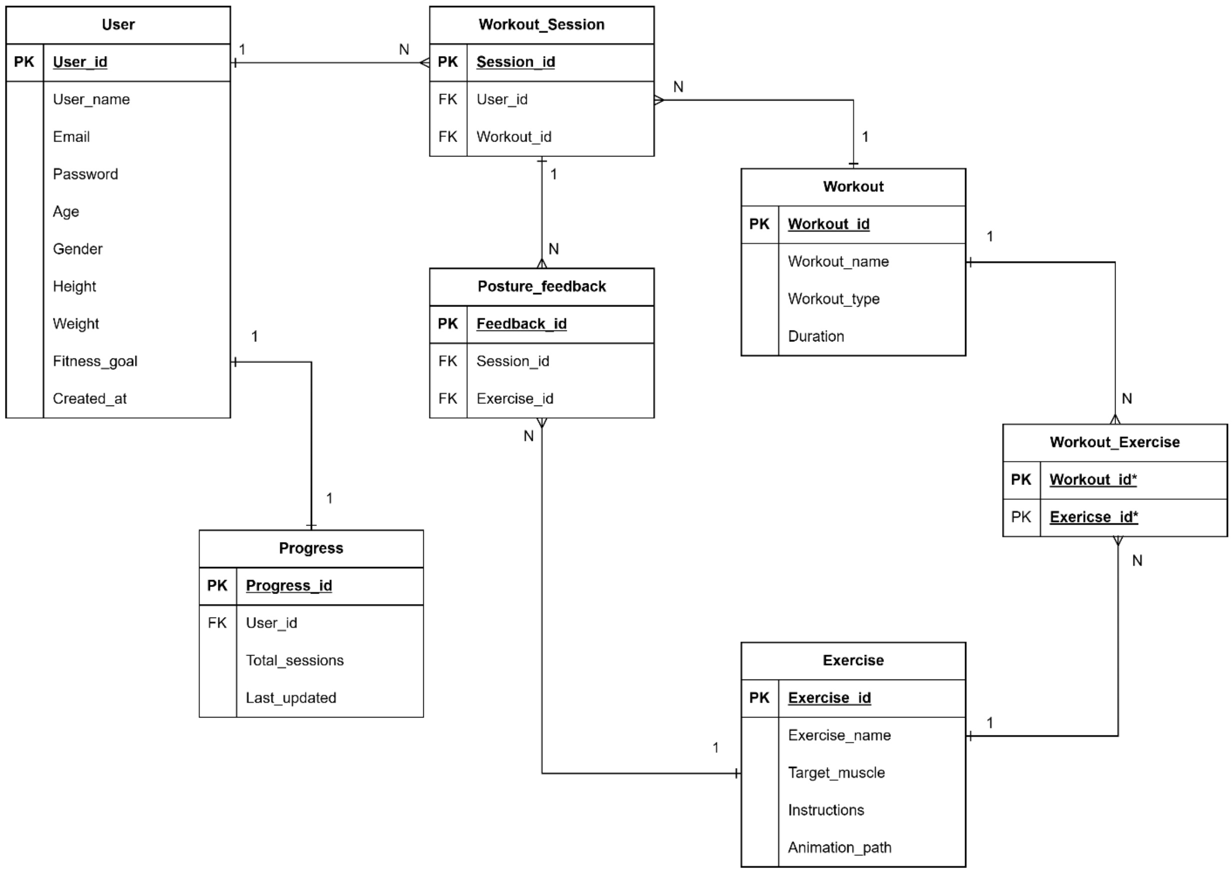

Figure 23: KasRrat: Entity Relation Diagram

4.5 Data Flow Diagram

DFD Level 0:

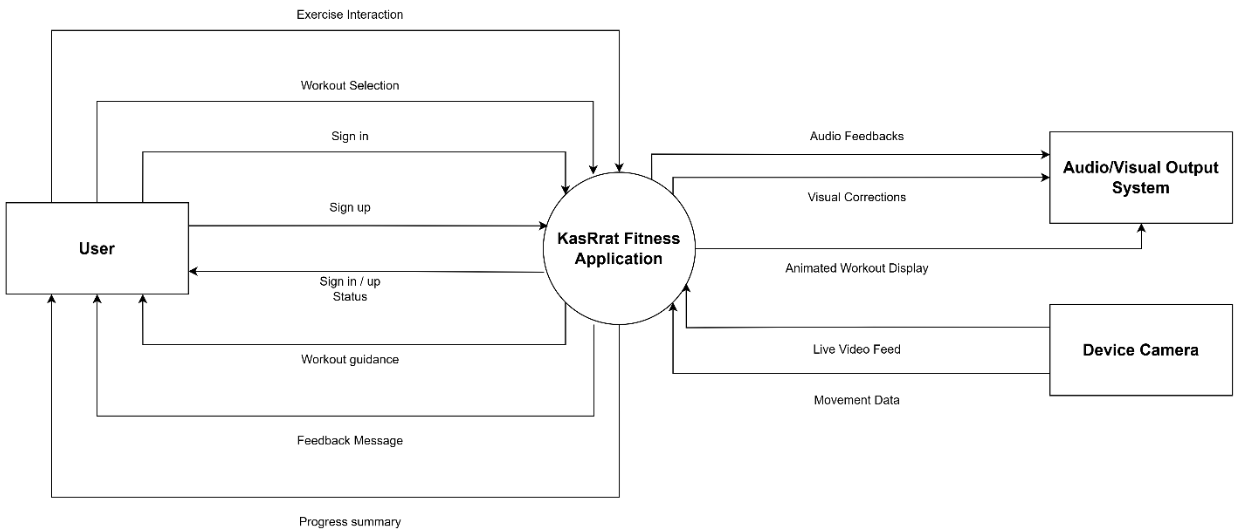

Figure 24: DFD level 0

4.6 Sequence Diagram

4.6.1 User Login

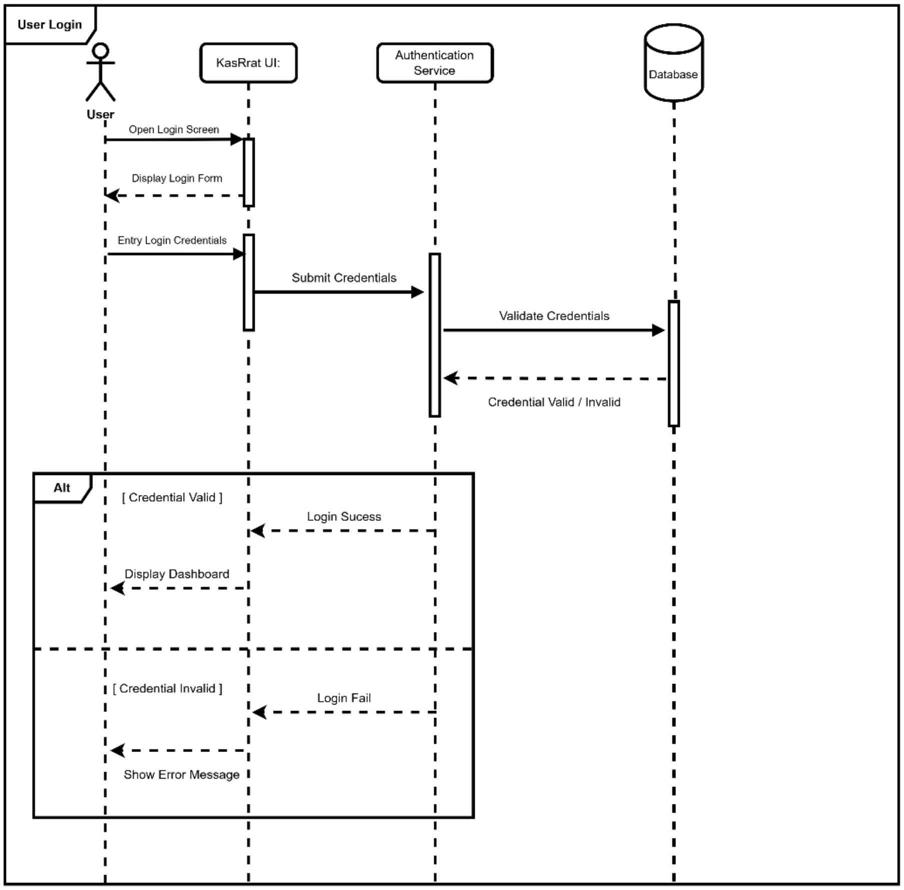

Figure 25: Sequence Diagram: User Login

4.6.2 Workout Session and Camera Activation

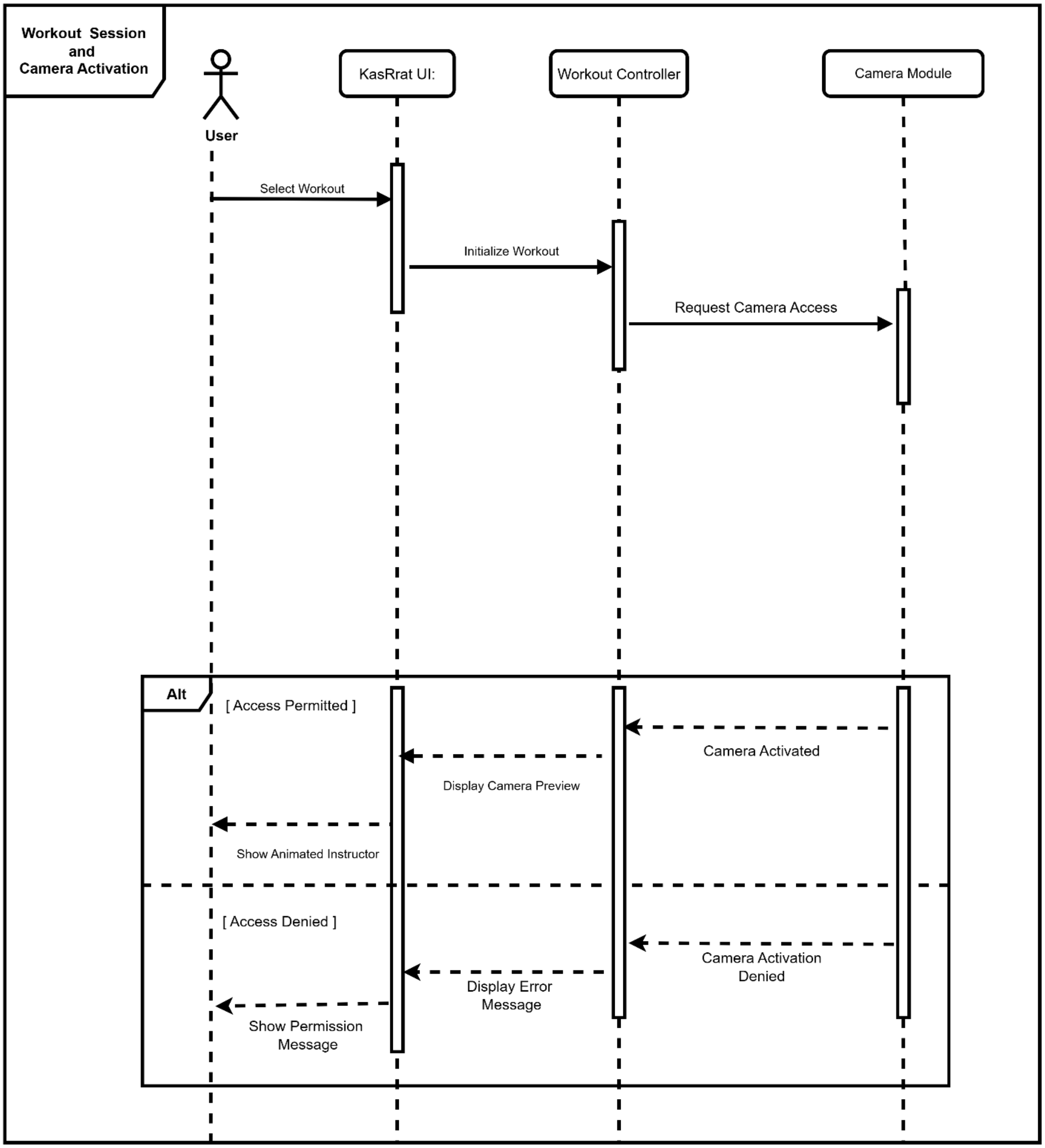

Figure 26: Sequence Diagram: Workout Session and Camera Activation

4.6.3 Pose Detection and Feedback

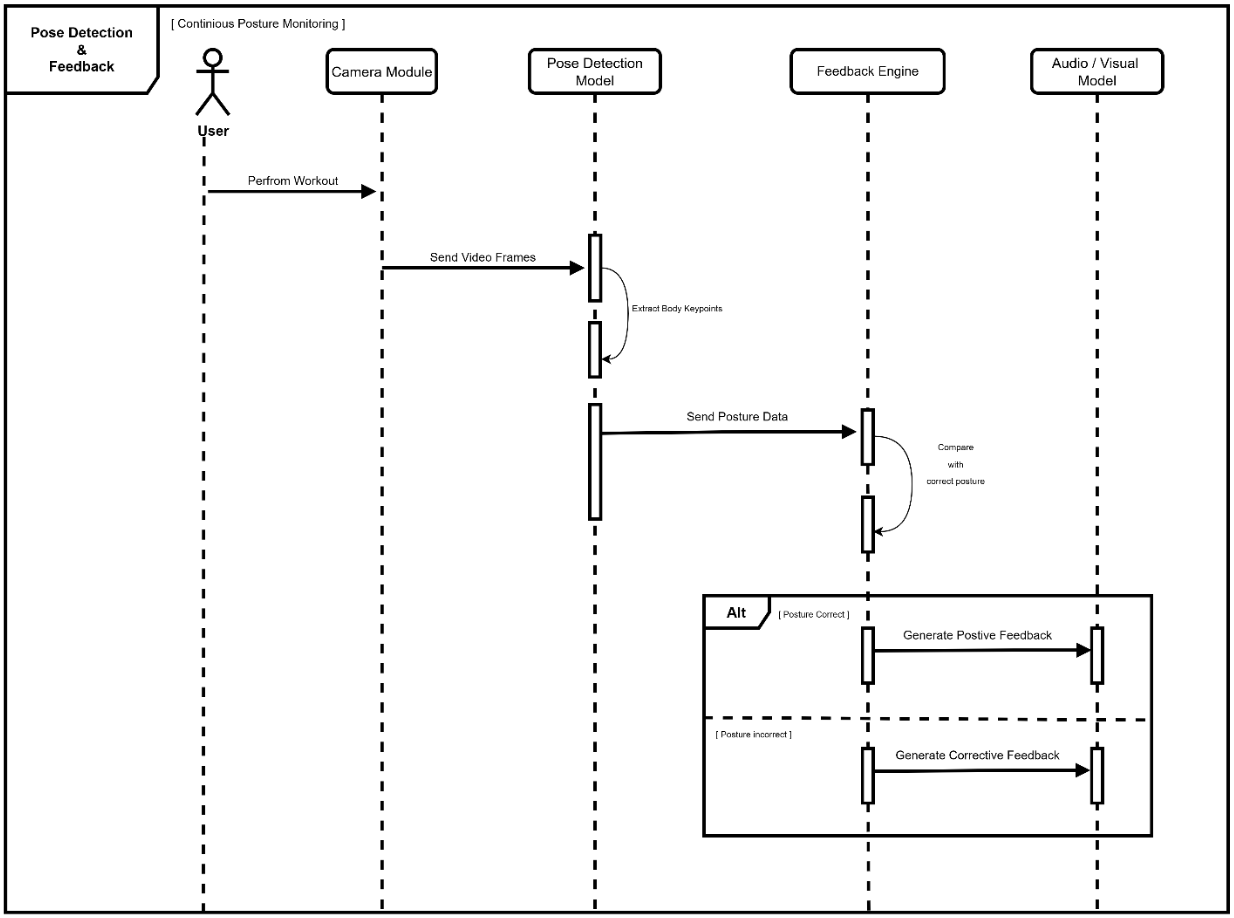

Figure 27: Sequence Diagram: Pose Detection and Feedback

4.7 Flowchart

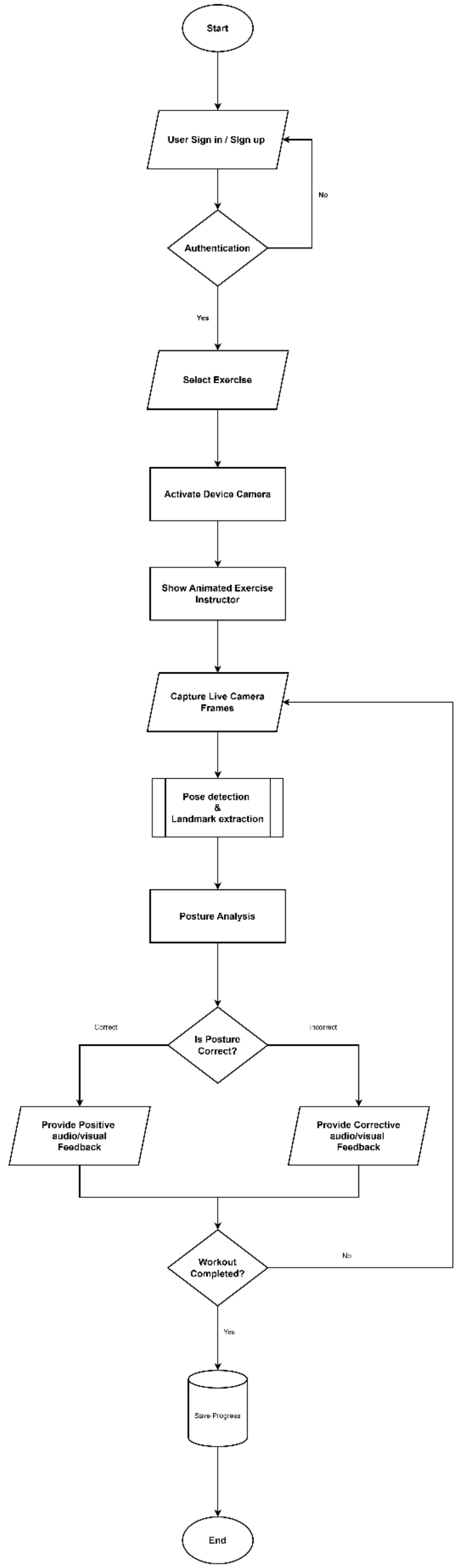

Figure 28: Flowchart

4.8 Wireframes

4.8.1 Sign in/ Sign up

Figure 29: Wireframe: Sign in/Sign up

4.8.2 User Information

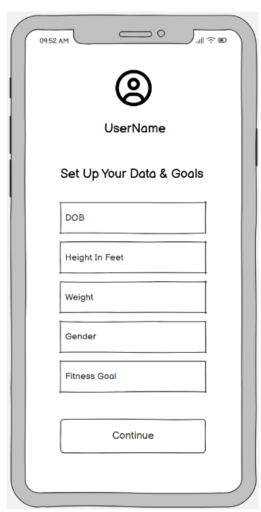

Figure 30: Wireframe: User Information

4.8.3 Home Page

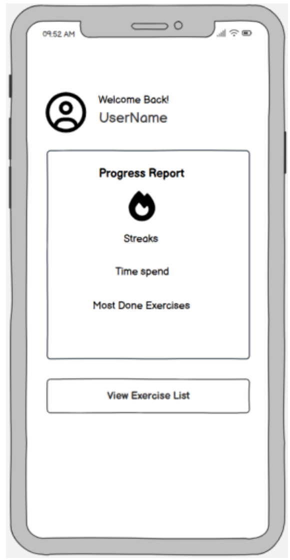

Figure 31: Wireframe: Home Page

4.8.4 Exercise List

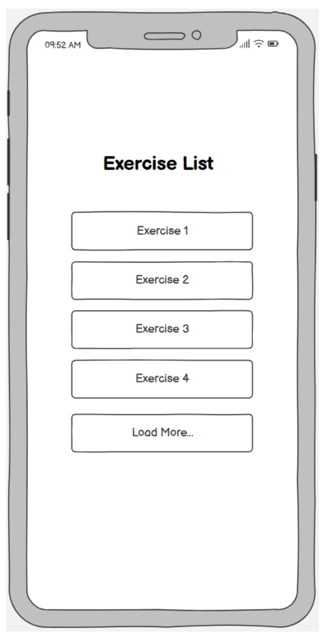

Figure 32: Wireframe: Exercise list

4.8.5 Workout Screen

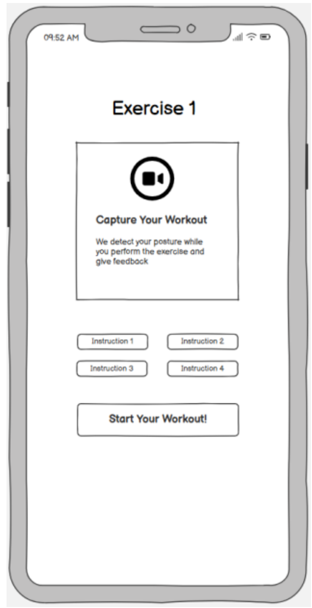

Figure 33: Wireframe: Workout Screen

4.8.6 Camera Access

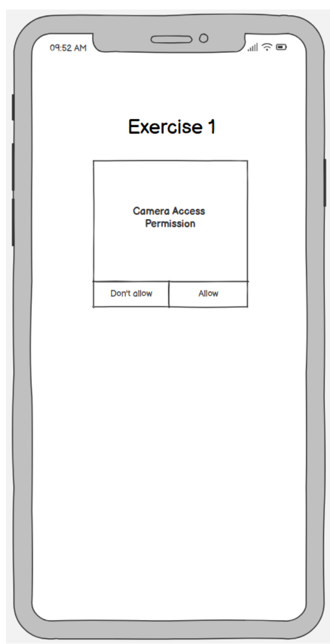

Figure 34: Wireframe: Camera Access

4.8.7 Workout Display

Figure 35: Wireframe: Workout Display

4.8.8 Workout Summary

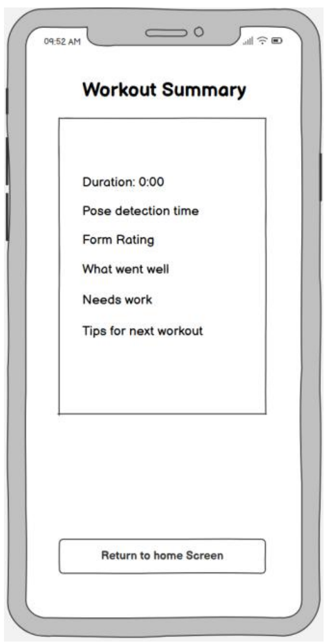

Figure 36: Wireframe: Workout Summary

4.9 UI Designs

4.9.1 Welcome Screen

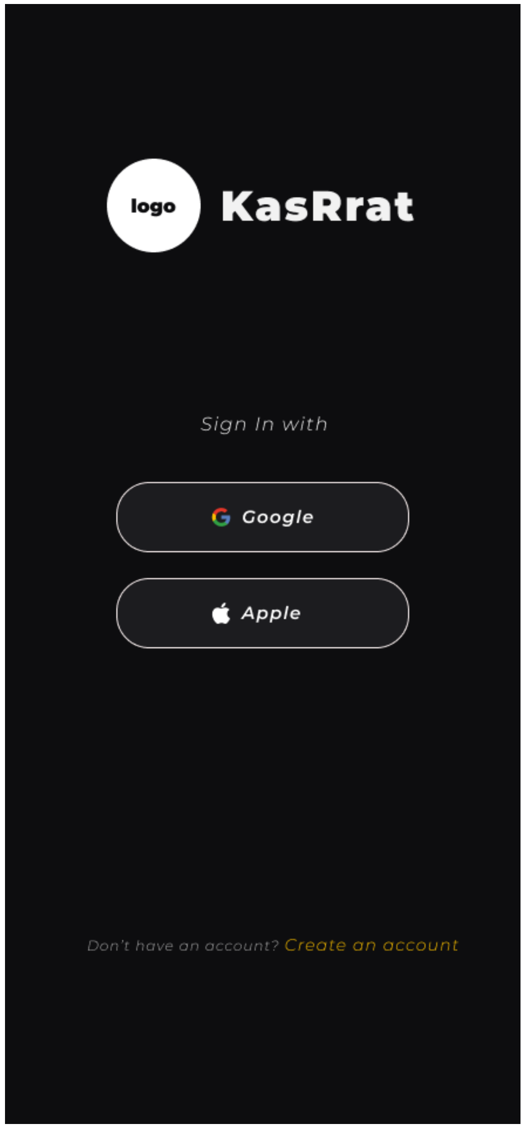

Figure 37: UI Design: Welcome Screen

4.9.2 Sign in / Sign up Screen

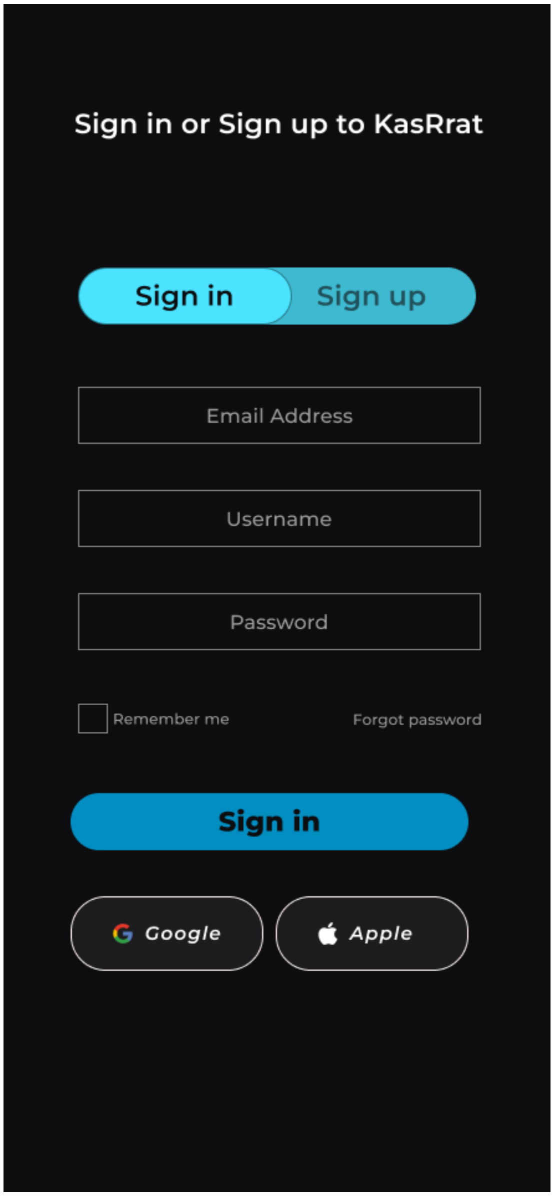

Figure 39: UI Design: Sign in

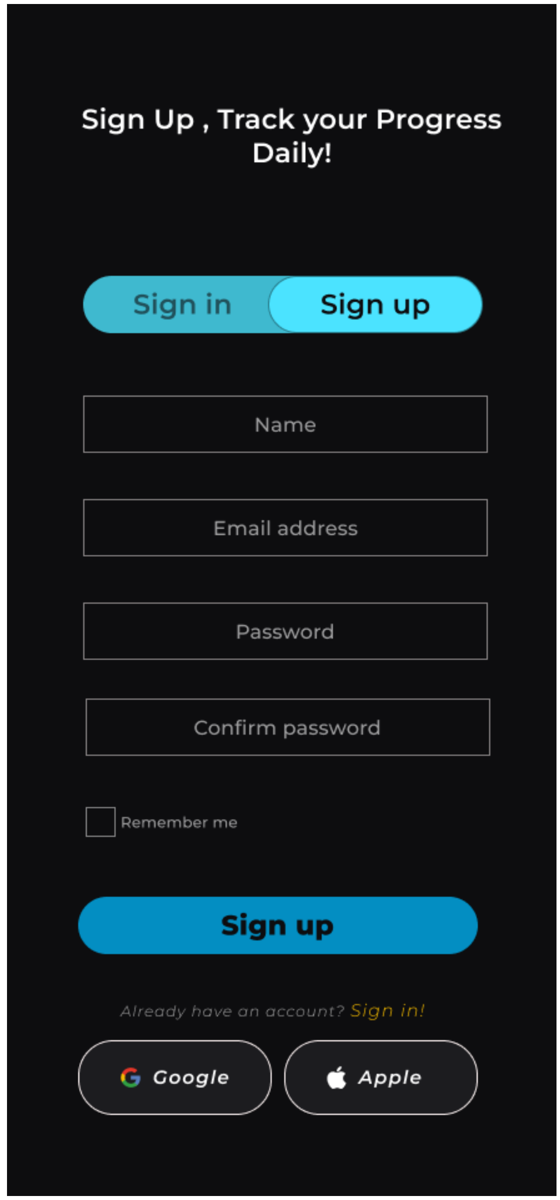

Figure 38: UI Design: Sign up

4.9.3 User Information Screen

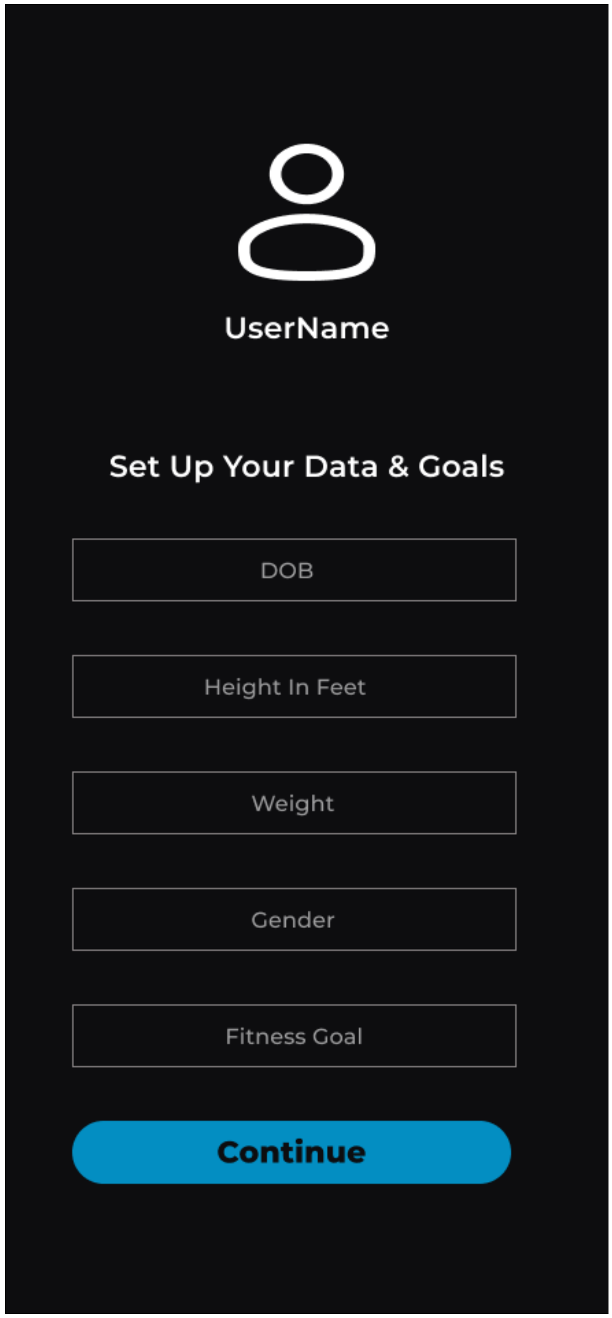

Figure 40: UI design: User Information

4.10 Development status with Evidence

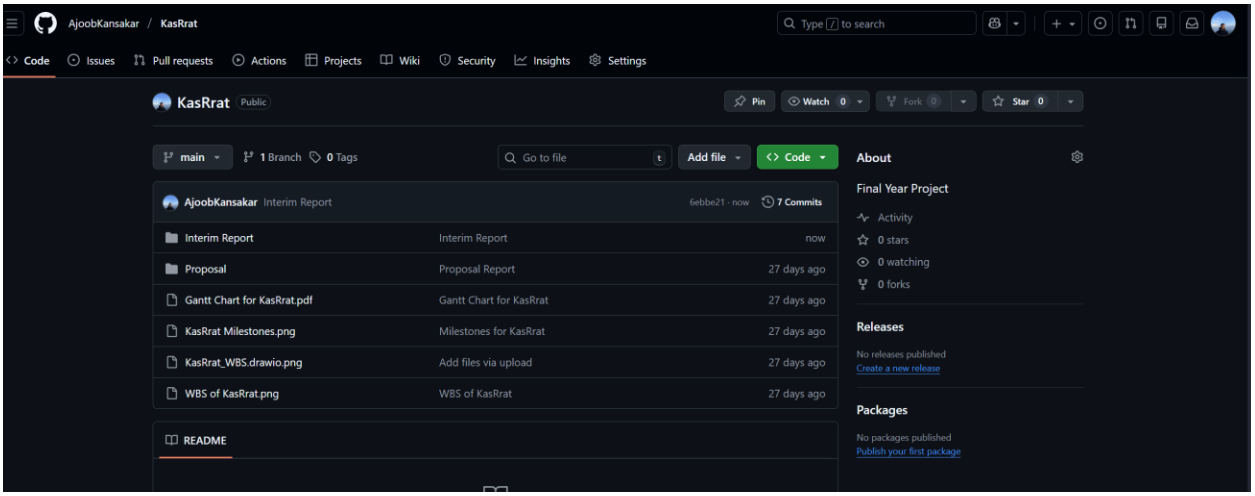

Figure 41: Git hub Repository

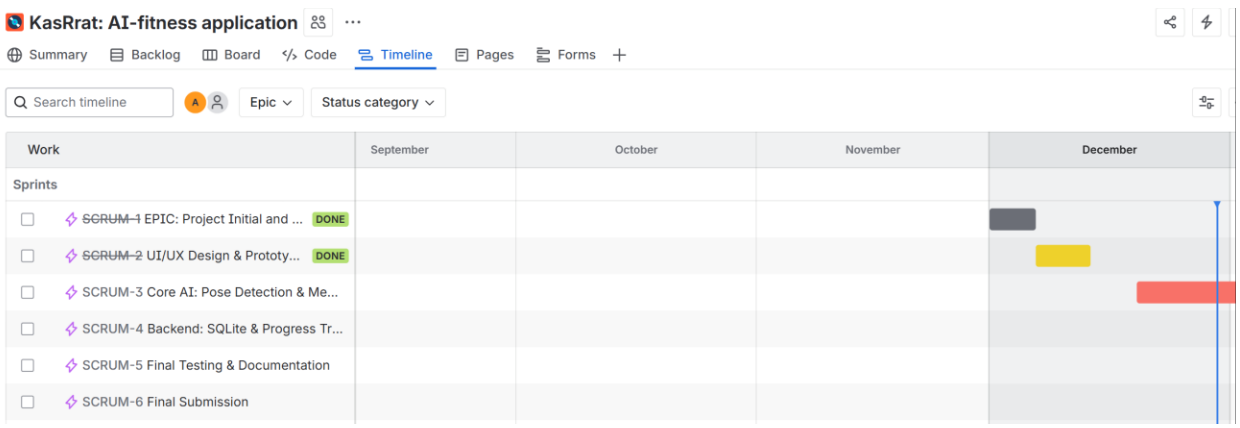

Figure 42: Jira Tracking

5. Analysis of Progress

5.1 Progress Review

The KasRrat application has been developed using the Agile Scrum methodology. Due to technical complexity involving real-time computer vision and pose estimation Scrum methodology was selected as the Software Development Life Cycle (SDLC) framework. The progress has been tracked through defined sprints.

Sprint 0: Project Setup and Research

December 1st – December 13th

During this initial sprint, the project scope was defined, focusing on the selection of a suitable tech stack, identifying functional and non-functional requirements, and conducting a literature review on posture detection, fitness applications, and real-time feedback systems. Extensive research was conducted into Flutter for cross-platform development and MediaPipe/TensorFlow Lite for on-device pose estimation. Additionally, initial system architecture planning and tool selection were completed. This sprint provided a strong conceptual and technical base for my project.

Sprint 1: UI/UX Designing and Wireframes

December 14th – December 20th

During this sprint, the primary focus was on user interface and user experience design entirely devoted to the design phase. Wireframes for core application screens such as login, workout selection, camera view, feedback display, and progress tracking were designed. By the end of this sprint, the core UI components were finalized, providing a blueprint for the implementation phase.

5.4 Progress Table

Table 2: Progress Table

No.	Tasks	Status	Progress
1.	Topic Selection	Completed	100%
2.	Literature Review	Completed	100%
3.	Similar Project Research	Completed	100%
4.	Feasibility Study	Completed	100%
5.	Proposal Submission	Completed	100%
6.	System Requirement Specification (SRS)	Completed	100%
7.	Develop System Architecture Diagram	Completed	100%
8.	Develop UML Diagrams (Use Case, Activity diagram, Sequence diagram, Data Flow diagram)	Completed	100%
9.	Develop Flow Chart	Completed	100%
10.	Develop Entity Relationship Diagram (ERD)	Completed	100%
11.	Wireframes Creation	Completed	100%
12.	UI design	Completed	100%
13.	Selection of Tools and Technologies	Completed	100%
14.	Pose Detection Research	In Progress	50%
15.	Camera Integration Prototype	Not Started	0%
16.	Real-Time Posture Analysis Logic	Not Started	0%
17.	Audio/Visual Feedback Implementation	Not Started	0%
18.	Animated Instructor Integration	Not Started	0%
19.	Jira Setup and Sprint Tracking	Completed	100%
20.	Sprint 0: Project setup and research	In Progress	90%
21.	Sprint 1: UI/UX designing & wireframes	Completed	100%
22.	Sprint 2: Camera Integration	Not Started	0%
23.	Sprint 3: Pose Detection Model Integration	Not Started	0%
24.	Sprint 4: Posture Analysis Logic	Not Started	0%

25.	Sprint 5: Real-time Audio feedbacks	Not Started	0%
26.	Sprint 6: Animated Instructure Integration	Not Started	0%
27.	Sprint 7: Full Workout flow	Not Started	0%
28.	Sprint 8: Optimization & UI improvements	Not Started	0%
29.	Sprint 9: Final Testing	Not Started	0%
30.	Interim Report	In Progress	80%

5.5 Action Plan

The action plan for the KasRrat project involves completing camera integration, pose detection, and real-time feedback implementation in upcoming sprints. This will be followed by animated instructor integration, system optimization, and final testing to ensure the application meets its functional and non-functional requirements before submission.

6. Future Work

The remaining development work for the KasRrat application will be carried out through the following upcoming sprints:

Sprint 2: Camera Integration

- Focuses on implementing the Flutter camera controller to access the device's hardware to ensure a high-frame-rate (FPS) preview while minimizing battery consumption.

Sprint 3: Pose Detection Model integration

- Pose detection model will be integrated into the application using suitable machine learning libraries. And AI model to extract 17 key body landmarks in real-time.

Sprint 4: Posture Analysis Logic

- To develop the algorithms to calculate angles between specific joints. The core mathematical phase of the project. Logic will be implemented to compare live user data against predefined "correct form" thresholds to determine posture accuracy.

Sprint 5: Real-time Audio Feedbacks

- Implementing real-time audio feedback Text-to-Speech (TTS) module. The sprint involves logic that triggers specific audio cues when joint angles deviate from the correct form.

Sprint 6: Animated Instructor Integration

- An animated instructor will be integrated into the application that visually demonstrate correct exercise movements and synchronize with the workout flow to assist users in maintaining proper form.

Sprint 7: Full workout flow

- Linking all the modules together to create a continuous session from exercise selection to saving the final results in the local database.

Sprint 8: Optimization and UI Improvements

- Focuses on optimizing system performance and refining the user interface.

Sprint 9: Final Testing

- Involve comprehensive system testing, including functional testing, performance testing, and usability testing, and fixing any remaining bugs before the final submission.

Final documentation

- Documenting the entire development process for the final report submission.

7. Conclusion

The KasRrat Application demonstrates a structured and research-driven approach to developing an AI-assisted fitness coaching application. At the interim stage, significant progress has been made in project planning, requirement analysis, system design, and user interface development. Core conceptual foundations such as system architecture, UML diagrams, wireframes, and development methodology have been successfully established, providing a strong framework for the upcoming implementation phases. The project continues to focus on delivering an intuitive workout experience supported by real-time posture analysis, animated exercise guidance, and audio feedback mechanisms.

Since, the proposal phase, KasRrat has made steady progress through the completion of the research, requirement analysis, and UI design sprints. The project has successfully demonstrated that the initial objectives are achievable within the allocated timeline. Now the ultimate goal is to deliver a smart, accessible, and posture-corrective fitness solution for beginners.

Overall, the interim report confirms that KasRrat is on track to achieve its intended objectives. The completed design and research phases validate the feasibility of integrating mobile application development with real-time pose detection technologies. The remaining development work will focus on implementing and integrating the core functional features, followed by testing and optimization, upon completion, KasRrat aims to demonstrate how AI-driven mobile solutions can enhance personal fitness experiences by improving exercise accuracy, user engagement, and overall workout effectiveness.

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9. Appendix

9.1 Software Requirements Specification (SRS)

SRS is a formal document that clearly describes the functional and non-functional requirements of a software system necessary to build a real-time AI-powered Fitness application. With the help of these requirements, the application ensures structured development, and alignment with academic standards.

For the application KasRrat, the SRS outlines the requirements of a mobile-based AI fitness system that uses real-time camera input to analyse user posture, provide feedback, and guide workouts through an animated instructor.

9.1.1 Functional Requirements

It showcases the specific features and behaviours of the KasRrat application.

a. **User Registration and Authentication**
    - The system shall allow users to register and log in using secure authentication mechanisms.

b. **Workout Selection**
    - The system shall allow users to select predefined workouts based on fitness goals.

c. **Camera Activation**
    - The system shall activate the mobile device camera to capture the user's movements during workouts.

d. **Real-Time Movement Detection**
    - The system shall detect and track the user's body movements in real time using the device camera.

e. **Posture Analysis**
    - The system shall analyse the user's posture whole performing the exercises by the user using pose detection techniques.

f. **Feedback Generation**
   - The system shall provide real-time feedback indicating whether the user’s posture is correct or incorrect.

g. **Audio Feedback**
   - The system shall deliver real-time audio feedback to guide the user during workouts.

h. **Animated Instructor Display**
   - The system shall display an animated instructor demonstrating the correct exercise posture alongside the user.

i. **Workout Session Management**
   - The system shall record workout sessions including duration and exercise completion status.

j. **Progress Tracking**
   - The system shall store and display user progress data for completed workout sessions.

9.1.2 Non-functional Requirements

It describes the quality attributes and performance constraints of KasRrat.

a. **Performance**
   - The system shall process posture analysis and feedback in real time with minimal delay.

b. **Usability**
   - The system shall provide a user-friendly and intuitive interface suitable for users with minimal technical knowledge.

c. **Reliability**
   - The system shall function consistently during workout sessions without crashes or data loss.

d. **Scalability**

- The system shall support future expansion such as additional workouts and advanced analytics.

e. Security

- The system shall securely store user credentials and personal data using encryption techniques.

f. Compatibility

- The system shall be compatible with modern Android and iOS mobile devices.

g. Maintainability

- The system shall be modular and easy to update and maintain.

h. Availability

- The system shall be accessible to users at any time, except during scheduled maintenance.

9.2 Core features

- Real-Time Movement Tracking
- Uses device’s camera and TensorFlow Lite pose model to detect user joints.
- Real-Time Posture Analysis
- Measures joint angles, posture alignment, and checks form correctness.
- Live Audio Feedbacks
- Provides feedbacks to the user with text-to-speech instructions to guide the user during the workout.
- Animated Workout Instructor
- A Mixamo-based animated character demonstrates exercises on screen.

KasRrat a mobile application aims to address this limitation by integrating real-time pose detection, computer vision, and audio feedbacks, enabling users to train safely and effectively without needing a physical trainer. The system will use the device camera to detect full-body movements, analyse posture using machine learning models, and guide the users through animated exercise demonstrations so that the user could easily follow the bot and perform the exercises in a simple easy way.

9.3 Project risks, threats and contingency plans

9.3.1 Project risks and threats

Developing an AI-powered mobile fitness application involves several technical and project-management risks, and with identifying such risk early ensures better planning and higher project success.

The following are the list of some of the risks and threats that the project may face:

a. Technical Risks

1. Pose detection performance issue:
   - Pose detection may not perform well on all the devices as the real-time pose detection model may run slowly on certain mobile devices due to low FPS issues.
2. Posture detection accuracy:
   - Posture detection accuracy may be incorrect due to angle miscalculations or inconsistent joint detection
3. Animation integration complexity:
   - 3D/2D animated instructor may not render smoothly or may cause UI performance issues.
4. Audio feedback delays or fail to trigger:
   - User may experience, misleading instructions or no instructions at all if the cameras could not detect the joint angles properly.

b. Project management Risks

1. Time Management issue:
   - Missing milestones due to academic, personal, or technical challenges.
2. Insufficient testing:
   - Real-time posture evaluation requires multiple body types and environments.
3. Feature overload:
   - Attempting to add too many features may compromise app stability.

c. Tool Risks

1. Device storage or Camera Permission denied:
   - If the app cannot access camera then it's a major blocker for the project.
2. Library or Plugin Compatibility Issues:
   - Flutter plugins (camera, TFLite) may conflict with certain android versions.
3. Hardware Limitations:
   - Some user devices may not support real-time pose detection.

d. External Risks:

1. Dependency on AI models:
   - Pre-trained models or documentations may be updated.

e. Ethical and Security Risks:

1. Privacy Concerns with camera usage:
   - User distrust if camera footage is mishandled.

9.3.2 Contingency Plans

a. **Technical Risks**

1. Pose detection performance issue:
   - Reduce camera resolutions when FPS drops.
2. Posture detection accuracy:
   - Start with simple exercises (push ups, pull ups, squats, and lunges) and calibrate joint-angles thresholds using test users.
3. Animation integration complexity:
   - Use Mixamo animations converted to MP4 and test animations playback.
4. Audio feedback delays or fail to trigger:
   - Preload audio prompts to avoid runtime delays and text various text-to-speech engines.

b. **Project management Risks**

1. Time Management issue:
   - Follow the defined Agile sprints and weekly check-ins with supervisors for progress validation and prioritize core features first such as pose detection, posture analysis, audio feedbacks
2. Insufficient testing:
   - Conduct testing with minimum 5 real users of different body types and test in various lighting conditions.
3. Feature overload:
   - Limit MVP to 4 basic exercises and add additional features only if time remains.

c. Tool Risks

1. Device storage or Camera Permission denied:
   - Display permission dialog with explanation and redirect user to Settings if access denied.
2. Library or Plugin Compatibility Issues:
   - Use stable plugin versions only and target Android API 28+ for consistency.
3. Hardware Limitations:
   - Include optional low-performance mode with reduced camera resolutions and clearly specify required device specifications in the documentation.

d. External Risks:

1. Dependency on AI models:
   - Download and store offline copies of MoveNet, BlazePose models and use TensorFlow Lite version control.

e. Ethical and Security Risks:

1. Privacy Concerns with camera usage:
   - Clearly state that no video is saved or uploaded and all processing occurs on-device only.

Table 3: Risks, Threats, and Contingency plans

Risks	Threats	Contingency Plans
1. Pose detection Performance	Low FPS on specific devices may cause the application to lag.	Reduce camera resolutions dynamically when FPS drops to maintain performance.
2. Posture Detection Accuracy	Due to inconsistent joint detection or angle miscalculation incorrect feedback provided to the user.	Start with simple exercises and calibrate joint-angle thresholds using real test users.
3. Animation Integration	Rendering issues may occur if the animation is too complex for the device.	Use Mixamo animations converted to MP4 format instead of live rendering to ensure smooth playback.
4. Audio Feedback Failure	Misleading instructions or silence when the user needs guidance, causing confusion during the workouts.	Preload audio prompts to avoid runtime delays and test various text-to-speech engines for reliability.
5. Insufficient Testing	System failure in real-world scenarios if the model cannot recognize different body types or lighting.	Conduct testing with a minimum of 5 real users of different body types and test in various lighting conditions.
6. Camera permissions denied	Major blocker where the app functions become completely inaccessible.	Display a permission dialog with a clear explanation and redirect the user to Settings if access is initially denied.

9.4 Expected Outcomes and Deliverables

By the end of the project, the following outcomes are expected:

- A fully functional app that detects user movements in real-time.
- An accurate posture evaluation system based on joint-angle measurement.
- Real-time corrective feedback.
- Integrated animated exercise instructor.
- A user-friendly UI suitable for fitness beginners.
- Project documentation and testing results.

9.5 Resource Requirements

Basic requirements to complete this project are:

9.5.1 Hardware Requirements

a. Computer: Personal laptop to run development tools and applications.
b. Good internet connection to ensure that the project runs smoothly.

9.5.2 Software Requirements

a. IDE: Visual Studio Code
b. App development: Flutter
c. Machine learning frameworks: MediaPipe/ TensorFlow Lite MoveNet
d. Animation Tools: Mixamo/ Blender MP4 for renderer inside Flutter
e. Backend Requirements: SQLite
f. Version control: GitHub

9.6 Benefits of using Scrum Methodology

1) Supports iterative and flexible development structure, which is essential for handling technical challenges associated with machine learning and pose estimation.
2) Breaks down the project to manageable sprints, enabling to focus on small, achievable goals while continuously refining application based on testing and feedback.
3) Encourages continuous improvement, making it ideal for project that requires testing of AI models.
4) Focuses on delivering minimum viable product (MVP) early in the development cycle, reducing risk and providing a foundation for more advance features such as animated workout guidance.
5) Provides balance of structure, adaptability, and continues improvement while developing an application.

9.7 Milestones

Figure 43: Milestones of KasRrat

Click here for clearer view of the milestones

9.8 KasRrat Survey Report

1. How often do you currently exercise or work out?

50 responses

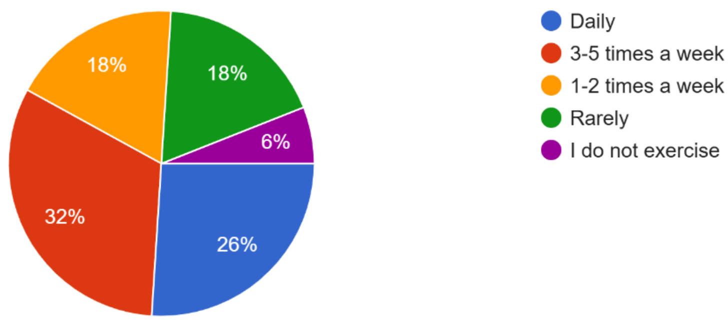

Figure 44: Survey Question 1

2. What type of workout do you usually prefer?

50 responses

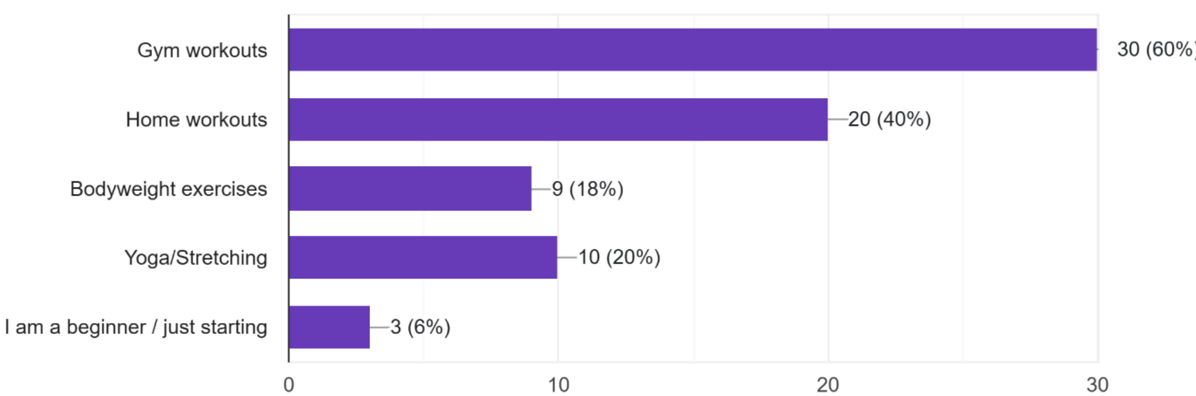

Figure 45: Survey Question 2

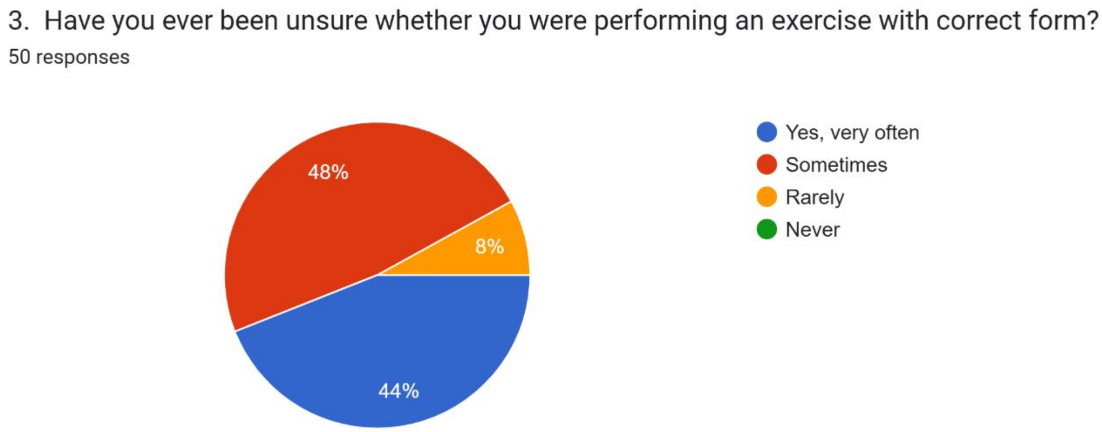

Figure 46: Survey Question 3

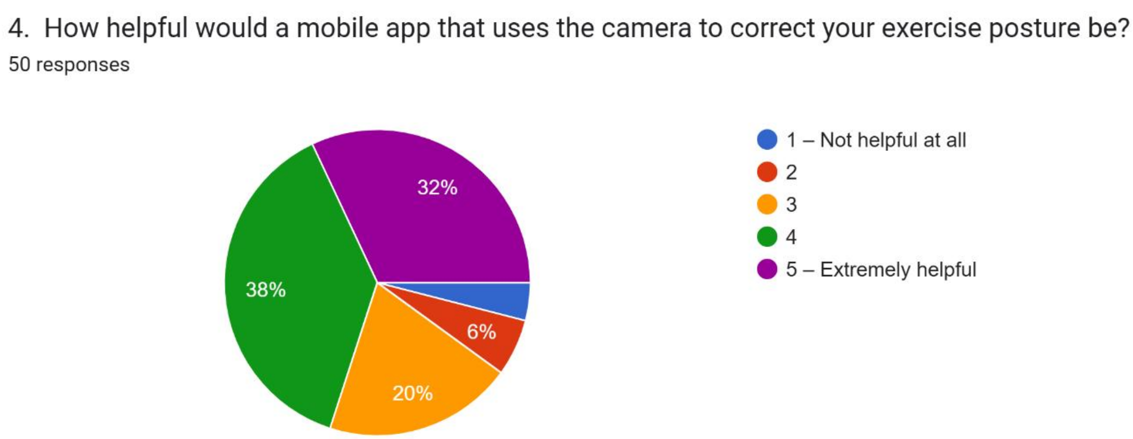

Figure 47: Survey Question 4

5. Would you feel comfortable allowing a fitness app to access your device camera during workouts?

50 responses

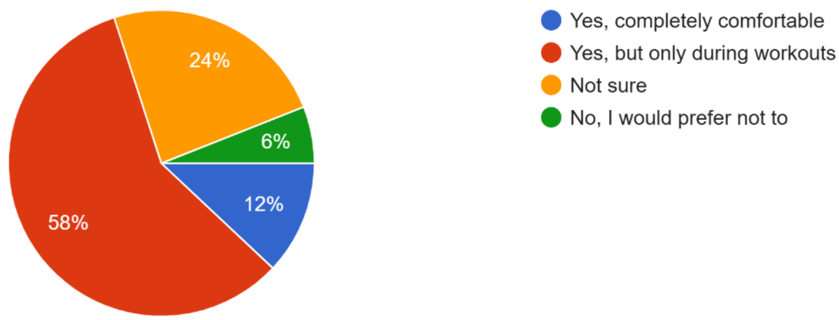

Figure 48: Survey Question 5

6. Which feature would you find MOST useful in a fitness app like KasRrat?

48 responses

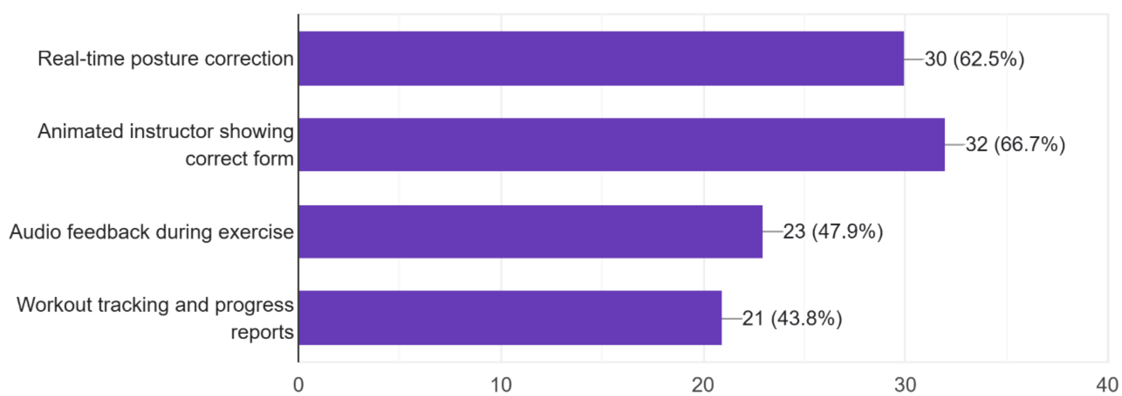

Figure 49: Survey Question 6

Figure 50: Survey Question 7

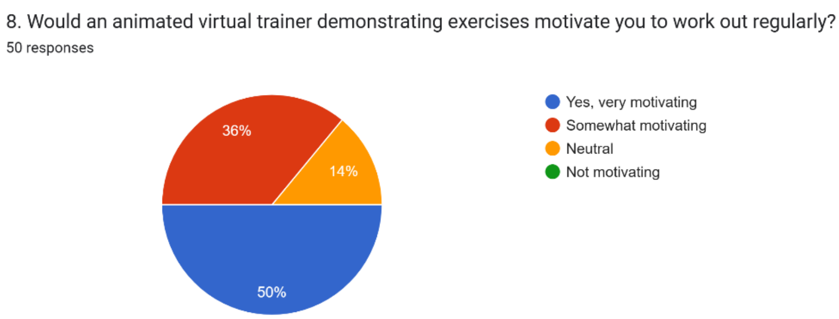

Figure 51: Survey Question 8

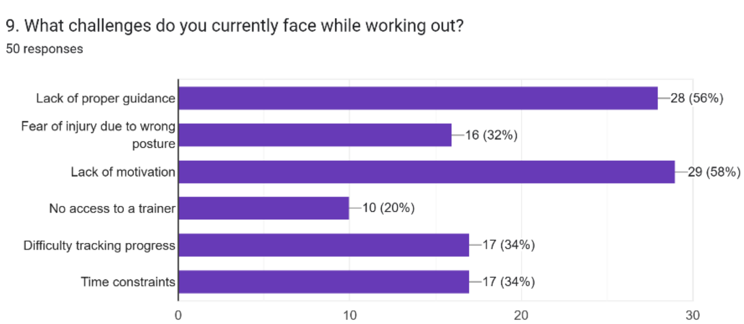

Figure 52: Survey Question 9