Project Report On

Activity Monitoring System

Submitted By

Kalpak Nemade	22120044
Shreyas Borakhadikar	22010450
Arya Yedekar	22120268
Om Hambire	22120085

Under the Guidance of
Prof Ashwini Ranjit
Nawadkar

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Certificate

This is to certify that the project report entitles

“ACTIVITY MONITORING SYSTEM”

Submitted by

Kalpak Nemade	**22120044**
Shreyas Borakhadikar	**22010450**
Arya Yedekar	**22120268**
Om Hambire	**22120085**

is a bonafide work in partial fulfillment of the award of Bachelor of Technology in Artificial Intelligence and Data Science, Savitribai Phule Pune University, Pune, during the year 2023-24. The project report has been approved as it satisfies the academic requirements in respect of the project work prescribed for the Bachelor of Technology Degree.

Prof Ashwini Ranjit Nawadkar
Project Guide

Dr. P. N.Mahalle
Head, AInDS Department

Prof.Vivek. Deshpande
Director, VIIT, Pune

Date:

Examiners: 1. . . . . 2. . . . . .

Place: Pune

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Kalpak Nemade 22120044
Shreyas Borakhadikar 22010450
Arya Yedekar 22120268
Om Hambire 2212008

ABSTRACT

This innovative project introduces an Activity Monitoring System focused on holistic health management. Through an Android app utilizing the device's pedometer sensor, it meticulously tracks steps, calculates calories, and logs dietary intake. The robust backend infrastructure powered by Firebase ensures secure data storage, authentication, and database management, prioritizing user privacy. The project's core objective is to empower users by offering real-time activity tracking and insightful dietary analysis, fostering a proactive approach to personal health. The Android app acts as a central hub, providing users with comprehensive insights into their daily energy expenditure. Firebase's features bolster security, creating a seamless and trustworthy environment for users to manage their health effectively. Overall, this project seamlessly integrates technology to offer a comprehensive solution for personal health and well-being.

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Chapter 1

Introduction

1.1 Motivation

The impetus behind this project is deeply rooted in the recognition of the burgeoning health challenges that individuals face in today's fast-paced and technologically driven world. Sedentary lifestyles, poor dietary habits, and a lack of awareness about personal health contribute to the rise in chronic diseases. The motivation to embark on this endeavor stems from a collective concern for the well-being of individuals and a commitment to leveraging technology to address these health challenges.

The ubiquity of smartphones and the increasing adoption of wearable devices offer a unique opportunity to integrate technology seamlessly into individuals' daily lives for health monitoring. Our motivation is grounded in the belief that a holistic approach, encompassing both physical activity tracking and dietary analysis, can empower individuals to take charge of their health. By providing users with real-time insights and personalized recommendations, we aim to bridge the gap between intention and action, inspiring healthier lifestyle choices.

The prevalence of lifestyle-related diseases, such as obesity, diabetes, and cardiovascular conditions, underscores the urgency of adopting preventive measures. Recognizing that technology can be a catalyst for positive change, our project strives to create a user-centric platform that not only monitors activities but also educates and guides users toward healthier habits. The motivation is to shift the paradigm from reactive healthcare to proactive health management, encouraging individuals to make informed decisions that contribute to long-term well-being.

Moreover, the integration of Firebase and Python technologies adds a layer of sophistication to the project, addressing the need for secure data management and predictive modeling. The motivation to incorporate Firebase lies in its versatility, providing a robust backend infrastructure for seamless data storage, user authentication, and database management. Python's role in predictive modeling stems from the desire to offer users more than just retrospective data – we aspire to empower them with forward-looking insights into their health through personalized predictions.

In essence, the motivation behind our project is deeply intertwined with a commitment to enhancing the quality of life for individuals. By amalgamating technological advancements with health science, we aim to create a dynamic and user-friendly system that transcends conventional health monitoring. The aspiration is to empower users not merely with data but with actionable insights that propel them

towards sustained and meaningful health improvements. As we delve into the intricacies of the "Activity Health Monitoring System," our motivation remains steadfast – fostering a healthier, more informed, and resilient society.

1.2 Need of Activity Monitoring System

In the contemporary landscape of hectic schedules, sedentary occupations, and an increasing reliance on technology, the need for an Activity Monitoring System has become imperative. This section delves into the multifaceted requirements and societal exigencies that underscore the significance of a comprehensive health monitoring solution.

1. Sedentary Lifestyles and Health Implications:
The pervasive nature of sedentary lifestyles has become a global concern, with individuals spending prolonged hours in front of screens and engaged in desk-bound occupations. The repercussions of such sedentary behavior are profound, contributing to a surge in lifestyle-related health issues, including obesity, cardiovascular diseases, and musculoskeletal disorders. The Activity Monitoring System emerges as a response to combat the adverse effects of sedentary living, encouraging individuals to be cognizant of their activity levels and make informed choices for a healthier lifestyle.

2. Rising Health Awareness:
As awareness about the importance of physical activity and a balanced diet grows, individuals seek tools that provide real-time insights into their health. The need for an Activity Monitoring System arises from the desire of people to have a holistic view of their well-being. By amalgamating activity tracking with dietary analysis, the system caters to the evolving health consciousness, offering a comprehensive solution for those committed to making informed decisions about their lifestyle.

3. Preventive Healthcare and Proactive Well-being:
In the realm of healthcare, there is a paradigm shift from traditional reactive approaches to preventive and proactive measures. The Activity Monitoring System aligns with this shift by empowering individuals to take preemptive actions toward maintaining good health. By proactively monitoring physical activities, caloric expenditure, and dietary intake, users gain the tools to make timely adjustments, preventing the onset of health issues rather than merely addressing them after they emerge.

4. Technological Integration in Health Management:
The ubiquity of smartphones and wearable devices has created an unprecedented opportunity to

integrate technology seamlessly into health management. The need for an Activity Monitoring System is fueled by the expectation that technology can be a catalyst for positive change. The system leverages the capabilities of smartphones, utilizing inbuilt sensors and intelligent algorithms to provide users with a user-friendly platform for holistic health tracking.

5. Individualized Health Insights and Predictive Analysis:
Generic health advice often falls short in addressing the unique needs of individuals. The Activity Monitoring System addresses this by incorporating predictive analysis using Python. By analyzing historical data, the system offers personalized insights and predictions, taking into account the user's activity patterns, dietary habits, and health goals. This individualization is a crucial need, as it empowers users with actionable information that aligns with their specific health aspirations.

6. Data Security and Accessibility:
The need for secure data management in health applications cannot be overstated. With Firebase integration, the Activity Monitoring System ensures that user data is stored securely in the cloud. Firebase provides a reliable infrastructure for data storage, authentication, and database management, addressing the growing concerns about data security and accessibility in health-related applications.

1.3 Brief Introduction Activity Monitoring System

The Activity Monitoring System is a cutting-edge health management solution designed to empower individuals with comprehensive insights into their physical activities and dietary habits. Rooted in the convergence of modern technology and health science, this system aims to address the burgeoning challenges of sedentary lifestyles and rising health concerns.

At its core, the system revolves around an intuitive Android application that utilizes the built-in pedometer sensor to monitor and record users' daily step counts. This information serves as the foundation for calculating calories burned, offering users real-time feedback on their physical activity levels. The application seamlessly integrates with Firebase, a robust cloud-based platform, to ensure secure data storage, user authentication, and efficient database management.

Beyond basic activity tracking, the system goes a step further by incorporating a dietary record feature. Users can log details of their food intake, enabling the application to maintain a comprehensive record of consumed calories. This holistic approach provides users with a unified view of their health, encompassing both physical activity and nutritional aspects.

One of the standout features of the Activity Monitoring System lies in its predictive analysis capabilities. Leveraging Python for machine learning, the system analyzes historical data to generate personalized predictions for users' daily caloric intake. This forward-looking insight empowers users to make informed decisions about their dietary choices, aligning with their health goals.

Moreover, the system features a built-in assistant that enhances user convenience by offering real-time guidance and suggestions based on activity levels, dietary preferences, and health objectives. This virtual guide adds a dynamic and interactive element to the user experience, fostering motivation and accountability.

In summary, the Activity Monitoring System represents a modern, user-centric approach to health management. By amalgamating activity tracking, dietary analysis, and predictive modeling, the system aspires to be a proactive tool for individuals seeking to enhance their well-being. The integration of Android, Firebase, and Python technologies ensures a seamless and secure user experience, marking a significant stride towards a healthier and more informed lifestyle.

1.4 Reason behind Activity Monitoring System

1. Health Awareness: The Activity Monitoring System arises from the growing awareness of the pivotal role that physical activity and dietary choices play in overall health. It serves as a tool to educate individuals about their habits and empower them to make healthier choices.

2. Combatting Sedentary Lifestyles: Sedentary lifestyles have become pervasive, contributing to various health issues. The Activity Monitoring System addresses this by encouraging users to be mindful of their activity levels, providing a proactive solution to counteract the negative effects of sedentary living.

3. Preventive Health Management: The system aligns with the paradigm shift towards preventive healthcare, enabling users to monitor their health in real-time. By providing insights into physical activity and dietary patterns, it facilitates early interventions and preventive measures.

4. Technology Integration: Leveraging the ubiquity of smartphones and wearable devices, the system integrates technology seamlessly into health management. It capitalizes on the capabilities of these devices to offer a user-friendly platform for continuous health tracking.

5. Individualized Insights: Recognizing the uniqueness of each individual, the system employs predictive modeling to offer personalized insights. This individualization goes beyond generic health

advice, providing tailored recommendations based on users' specific activity levels, dietary habits, and health goals.

6. Motivation and Accountability: The system serves as a motivational tool by offering real-time feedback and suggestions. The built-in assistant enhances user accountability, fostering a sense of responsibility towards maintaining a healthy lifestyle.

7. Comprehensive Health Tracking: With features encompassing activity monitoring and dietary analysis, the system provides a holistic view of users' health. This comprehensive approach allows individuals to understand the intricate interplay between their physical activities and nutritional intake.

8. Data Security: In an era of increasing concerns about data privacy, the integration of Firebase ensures secure data storage and authentication. This addresses the need for a trustworthy platform where users can confidently store and access their health-related information.

9. User Convenience: The Activity Monitoring System is designed for user convenience, offering an intuitive interface and real-time guidance. This ensures that users can seamlessly incorporate health monitoring into their daily routines.

10. Empowerment Through Information: Ultimately, the system aims to empower users with information. By providing insights into their health, it equips individuals with the knowledge needed to take control of their well-being, fostering a proactive and informed approach to health management.

1.5 Application of the Activity Monitoring System

The Activity Monitoring System finds versatile applications across various domains, bringing tangible benefits to individuals, healthcare professionals, and the broader community. The system's adaptability and functionality make it a valuable tool in several contexts:

1. Individual Health and Wellness:

- Personal Health Tracking: Individuals can use the system to monitor their daily physical activities, track calorie expenditure, and maintain a record of dietary intake. This promotes self-awareness and helps users make informed decisions for a healthier lifestyle.
- Goal Setting and Achievement: Users can set personalized health goals, such as daily step targets or calorie intake limits. The system provides real-time feedback, motivating users to achieve and surpass their health objectives.

2. Healthcare Industry:

- Remote Patient Monitoring: Healthcare professionals can leverage the system for remote patient monitoring. Patients with chronic conditions or those recovering from surgery can be monitored in real-time, allowing for timely interventions and reducing the need for frequent hospital visits.
- Health Data Analysis: Aggregate and anonymized data collected by the system can be analyzed to identify health trends, contributing to epidemiological studies and public health initiatives.

3. Fitness and Sports:

- Athlete Performance Monitoring: Coaches and athletes can utilize the system to monitor training sessions, track performance metrics, and tailor training programs based on individualized data. This enhances athletic performance and reduces the risk of injuries.
- Fitness Challenges and Community Engagement: The system can facilitate fitness challenges and community engagement, encouraging social interaction and friendly competition among users striving to achieve common health and fitness goals.

4. Corporate Wellness Programs:

- Employee Health Initiatives: Companies can integrate the system into corporate wellness programs to encourage employee well-being. This promotes a healthy workplace culture, reduces absenteeism, and enhances overall productivity.

5. Educational Institutions:

- Physical Education and Health Education: The system can be incorporated into educational curricula to teach students about the importance of physical activity and nutrition. It provides a practical and interactive tool for promoting healthy habits from a young age.

Chapter 2

Literature Survey

2.1 Literature Review

Table No 2.1: Comparison table of pros and cons of activity monitoring system

activity monitoring system	Advantages	Disadvantages
1.	Comprehensive Health Tracking:- The system offers a holistic view of users' health by seamlessly integrating activity monitoring and dietary analysis.	Privacy Concerns Users may have concerns about the security and privacy of their health data, especially if it involves sensitive information
2.	Individualized Insights: -Utilizing predictive modeling with Python, the system provides personalized predictions for users' daily caloric intake.	Dependency on Technology
3.	Motivation and Accountability - The built-in assistant enhances user motivation by offering real-time feedback and suggestions.	Accuracy of Sensors
4.	Remote Patient Monitoring - In healthcare settings, the system facilitates remote patient monitoring, allowing healthcare professionals to track patients' activity levels and dietary habits..	User Engagement and Adoption

2.2 Review of existing System

In the realm of health monitoring and activity tracking, various existing systems have paved the way for advancements in personal well-being. This section presents a concise review of some notable systems, shedding light on their features, strengths, and limitations.

1. Fitbit:

- Features: Fitbit is a widely adopted wearable device that combines activity tracking, heart rate monitoring, and sleep analysis. It syncs with a user's smartphone to provide real-time data and offers a comprehensive app for in-depth health insights.
- Strengths: Fitbit excels in user-friendly interfaces, diverse device options, and a strong emphasis on social engagement through challenges and community features.
- Limitations: Some users report discrepancies in step count accuracy, and while it provides robust physical activity tracking, its dietary analysis features are relatively basic.

2. MyFitnessPal:

- Features: MyFitnessPal is a popular mobile app that focuses on dietary tracking and calorie counting. It includes a vast food database, barcode scanning for easy input, and integration with various fitness trackers.
- Strengths: MyFitnessPal stands out for its extensive food database, community support, and integration capabilities with other health and fitness platforms.
- Limitations: While strong in dietary tracking, it may lack the depth of physical activity monitoring compared to dedicated fitness trackers.

3. Google Fit:

- Features: Google Fit is an Android-based health tracking platform that integrates with a wide range of wearables. It focuses on activity tracking, providing insights into steps, heart points, and other fitness metrics.
- Strengths: Seamless integration with Android devices, compatibility with various third-party apps and devices, and a user-friendly interface make Google Fit accessible to a broad audience.
- Limitations: Some users find the depth of analysis and insights to be less extensive compared to specialized health platforms.

4. Apple Health:

- Features: Apple Health is an integrated health app for iOS devices, offering a comprehensive platform for tracking various health metrics, including activity, sleep, and nutrition. It aggregates data from various apps and wearables.
- Strengths: Integration with the Apple ecosystem, a diverse set of health metrics, and a user-friendly interface contribute to the popularity of Apple Health.
- Limitations: Limited compatibility with non-Apple devices and some users express the need for more advanced features, especially in predictive health analytics.

5. Samsung Health:

- Features: Samsung Health is a health and wellness app for Samsung devices, encompassing activity tracking, sleep analysis, and nutrition tracking. It syncs with various wearables and devices.
- Strengths: Integration with Samsung devices, a comprehensive set of features, and compatibility with third-party devices contribute to its appeal.
- Limitations: Similar to other integrated platforms, Samsung Health may face challenges in providing in-depth analysis compared to specialized health and fitness apps.

2.2.1 System Functions

1. Activity Tracking:

- Description: The system utilizes the built-in pedometer sensor of Android devices to monitor and record users' daily physical activities. It accurately tracks step counts, providing a fundamental metric for assessing overall activity levels.
- Importance: Accurate activity tracking serves as the foundation for various health-related analyses, such as calculating calories burned and establishing baseline activity patterns.

2. Caloric Expenditure Calculation:

- Description: Based on the recorded step counts and activity data, the system calculates the calories burned by the user throughout the day. This function provides valuable insights into the user's energy expenditure during different activities.
- Importance: Understanding caloric expenditure is crucial for individuals aiming to manage their weight, set fitness goals, or make informed dietary choices.

3. Dietary Intake Recording:

- Description: Users can input details of their dietary intake, including meals, snacks, and

beverages, into the system. The application maintains a comprehensive record of consumed calories and nutritional information.

- Importance: Recording dietary intake allows users to create a holistic view of their health by considering both physical activity and nutritional habits. It facilitates informed decision-making regarding dietary choices.

4. Firebase Integration:

- Description: The system seamlessly integrates with Firebase, a cloud-based platform, for secure data storage, authentication, and database management. Firebase ensures that user data is stored safely and can be accessed from various devices.
- Importance: Firebase integration enhances the system's reliability and scalability, addressing concerns about data security and providing a seamless experience for users across multiple platforms.

5. Predictive Caloric Intake Analysis

- Description: Leveraging Python for predictive modeling, the system analyzes historical data, including activity levels and dietary habits, to generate personalized predictions for users' daily caloric intake.
- Importance: Predictive analysis empowers users with forward-looking insights, assisting them in making proactive decisions about their dietary choices and contributing to long-term health goals.

6. User Authentication and Account Management

- Description: The system incorporates user authentication features through Firebase, ensuring secure access to individual accounts. Users can manage their profiles, preferences, and health-related data within the application.
- Importance: User authentication safeguards personal health information and ensures that individuals have exclusive access to their data, contributing to the overall privacy and security of the system.

Chapter 3

Project Statement

3.1 Purpose behind the Project

The purpose of the "Activity Monitoring System with Predictive Caloric Intake Analysis" project is to address the contemporary health challenges stemming from sedentary lifestyles and inadequate health awareness. The project aims to provide individuals with a powerful yet user-friendly tool to actively manage and enhance their well-being through real-time activity tracking, dietary analysis, and predictive modeling.

In an era where technology is omnipresent, the project recognizes the potential for leveraging smartphones and wearables to create a seamless and integrated health monitoring experience. The purpose is to empower users with comprehensive insights into their physical activities, caloric expenditure, and dietary habits. By amalgamating accurate activity tracking with advanced predictive modeling, the project seeks to go beyond conventional health monitoring systems, offering personalized recommendations for users to make informed decisions about their health.

The overarching purpose is to instill a proactive mindset towards health management, fostering a culture where individuals are not merely reactive to health issues but are equipped with the knowledge and tools to prevent them. The integration of Firebase ensures data security, and the built-in assistant adds a dynamic layer of user engagement, making the project a holistic solution for those committed to achieving and sustaining a healthier lifestyle. Ultimately, the purpose is to contribute to a paradigm shift in how individuals perceive and manage their health in the modern, technology-driven age.

3.2 Decision of Scope

The decision of the project scope is rooted in a commitment to developing a robust and user-centric health monitoring system while acknowledging practical constraints. The scope encompasses precise activity tracking, caloric expenditure calculation, dietary intake recording, and predictive modeling for personalized health insights. To ensure feasibility and efficiency, the scope is limited to Android devices, leveraging the inbuilt pedometer sensor. The decision prioritizes the seamless integration of Firebase for secure data management and authentication. This focused scope aims to deliver a high-quality, functional system that addresses key health aspects, ensuring a practical and impactful solution for users within the project's constraints.

3.3 Methodology for solving this proposed theme

The methodology for developing the "Activity Monitoring System" involves a systematic and iterative process. Initial stages include a thorough literature review of existing health monitoring systems, enabling the identification of best practices and potential areas for innovation. Following this, a comprehensive requirement analysis is conducted to define user needs and system functionalities.

The development methodology incorporates an Agile approach, allowing for iterative cycles of design, implementation, and testing. This agile methodology ensures flexibility in adapting to evolving requirements and facilitates continuous user feedback throughout the development process.

3.3.1 Proposed system Architecture

Activity Monitoring System based on the pedometer sensor, which is in-built into mobile devices, and now a days having a mobile device is very common. The system is developed for the Android mobile operating system in the Java programming language, The app is designed to run on Android devices with a minimum API level of 17. For real-time database and file storage, Firebase is used. The user has to sign up into the system. The system provides two ways to login: one using Google, and another using email and password, which will be authenticated by Firebase authentication. After signing up, the user must fill out profile information, which includes name, height, weight, gender, and age, which is used further for the prediction.

After that, the user is directed to the dashboard, where they can monitor the steps count. This service can be battery-consuming, so there is an option to turn it off. When the user is steady, he can off-step count.

Also, the system has a page that contains predictions of calorie intake and a list of diets that users consume. There is an option where users can add a dish, and the calories that dish contains are added to the total calorie intake.

The two primary components of the system are the diet monitoring module, which predicts caloric intake, and the step counting module, which uses a pedometer sensor.

A. utilizing the built-in pedometer sensor to count steps

The system makes use of a pedometer sensor, which enables us to retrieve data on the steps that users have taken. To detect changes in acceleration, we use an accelerometer sensor. The accelerometer on

our mobile device detects changes in acceleration when we walk as a result of our hand and leg movements, alerting the system to the situation. The program now counts the steps the user takes while walking by using these signals.

Using a step count, the device also determines how many calories the user burns while walking. Calculating calories burned depends on many factors, like the number of steps, stride length, weight of the user, and calories cost per mile.

Calories burn = number of steps * stride length* weight* calories cost per mile

Where:

- Number of steps is total number of step user walk.
- Stride length is distance covered in one step by the user ideally it is 0.75 meter.
- Weight us weight of the user.
- Calories cost per mile represents the energy cost of walking or running a mile. It is based on our intensity of activity. For walking, the ideal calorie cost per mile is 0.58, while for running, it is around 1.03 calories.

The system saves this data in the app's local database, and it is reflected in the Firebase real-time database when the device is connected to the internet or after a certain amount of time, which can be used to track activity in the future.

B. Diet monitoring according to calories intake prediction.

By adding up all of the calories consumed in a day, the system keeps track of the user's diet and recommends how many calories they should consume daily. We employ a machine learning model to estimate calorie consumption based on several user parameters, such as age, gender, height, and weight.

Utilizing an ensemble learning model with a weighted average to forecast calories. This model is a blend of several models, including support vector, gradient boosting, decision tree, linear regression, and random forest. Following each model's estimate, we calculate the weighted average of the outcomes. We hosted this model on PythonAnywhere.com for the Android system in order to create API endpoints.

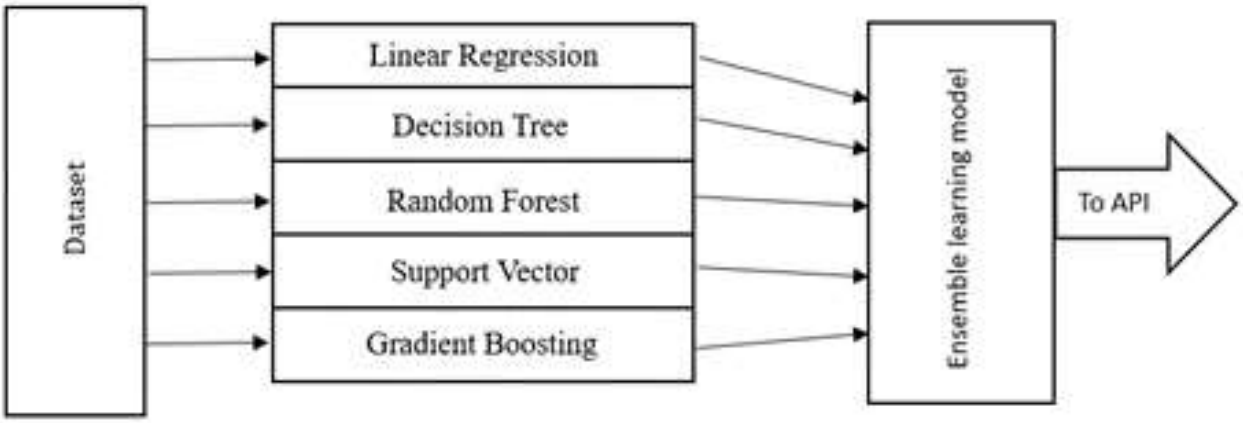


Fig. 1. block diagram of the ensemble learning model used in system

A machine learning method called ensemble learning combines the predictions of several models to enhance performance. You are describing an ensemble model in this instance that consists of decision trees, random forests, gradient boosting, support vector machines, and linear regression. The goal is to combine the forecasts from these several models in order to improve the anticipated calorie values' accuracy and resilience.

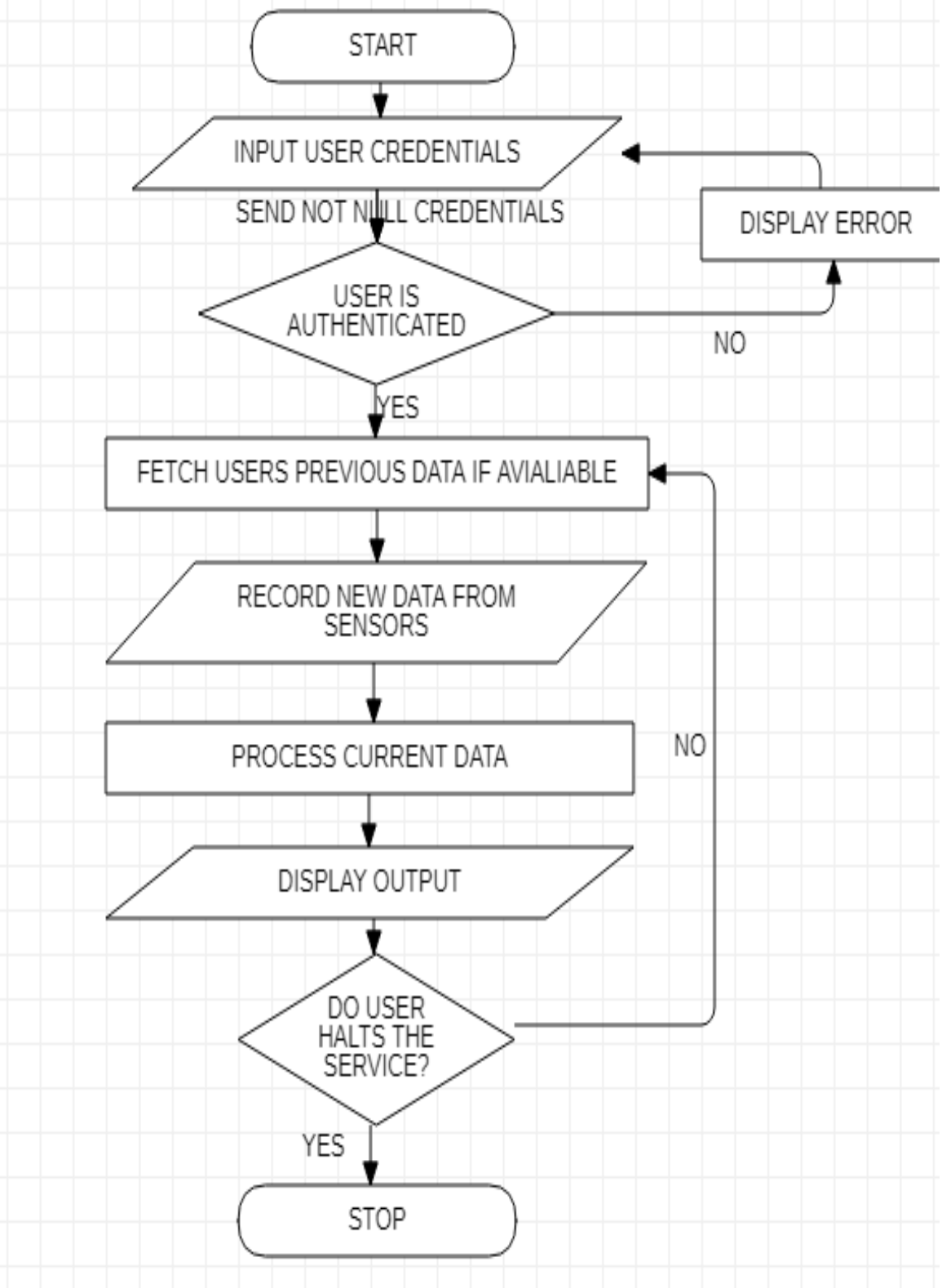
The weighted average technique entails giving each model's predictions a distinct weight. The weights correspond to each base model's perceived level of skill or dependability.

For this system, we need two datasets: one on calorie intake depending on weight, height, gender, and age, and a second on food and their calorie dataset.

The system keeps track of a user's diet by rounding up all the calories they add to it. Users can enter their diet through the Android application's extensive food list, which includes a wide variety of foods and dishes. We are constantly expanding our dataset to include more dishes, and users can even add their own dishes and their corresponding calories to the system for use in the future.

Users can enter their daily diet, and the system will alert them if they exceed the amount of calories they are expected to consume. Since it is quite difficult to add food and constantly check their activities, we have included an assistant bot to help us communicate with the system.

3.3.2 Flowchart of System



Chapter 4

System requirement and specification

4.1 Software requirements specifications:

4.1.1 Introduction

The System Requirements and Specifications outline the fundamental parameters and functionalities that define the "Activity Monitoring System." This section provides a detailed overview of the project's scope, objectives, and the technical specifications that guide the development process, ensuring a cohesive and effective solution for users' health monitoring needs.

4.1.2 User Classes and Characteristics

There are three users in the system:

The Activity Monitoring System caters to diverse user classes, each with specific characteristics and needs:

1. End Users
    - Characteristics: Individuals seeking a holistic health monitoring solution.
    - Needs: Seamless interface, personalized insights, and user-friendly features for effective self-health management.

2. Healthcare Professionals
    - Characteristics: Medical professionals utilizing the system for remote patient monitoring.
    - Needs: Access to comprehensive patient data, secure communication channels, and real-time health insights.

3. Fitness Enthusiasts
    - Characteristics: Individuals focused on optimizing physical fitness.
    - Needs: Advanced activity metrics, goal tracking, and integration with fitness routines.

4. Researchers
    - Characteristics: Academic or healthcare researchers leveraging system data for studies.
    - Needs: Aggregated and anonymized data, exportable datasets, and analytics tools.

Understanding these user classes ensure that the system addresses a broad spectrum of user requirements, enhancing its usability and impact.

4.1.3 Operating Environment

The Activity Monitoring System operates within the Android environment. It is optimized for Android devices, utilizing the inherent capabilities of the platform, including the inbuilt pedometer sensor, to deliver seamless and efficient health monitoring experiences for users.

4.1.4 External Interface Requirements

The Activity Monitoring System interfaces with external elements to ensure seamless functionality:

1. Android Platform:
   - Purpose: Utilizes Android OS features for activity tracking.
   - Requirements: Compatibility with Android versions 6.0 and above.

2. Firebase Cloud Services
   - Purpose: Ensures secure data storage and authentication.
   - Requirements: Integration with Firebase Authentication and Realtime Database services.

3. Python for Predictive Modeling
   - Purpose: Provides personalized predictions for caloric intake.
   - Requirements: Compatibility with Python scripts for machine learning algorithms.

4. User Devices
   - Purpose: Interaction with smartphones and wearables.
   - Requirements: Compatibility with a range of Android devices for optimal user experience.

These external interfaces facilitate the system's functionality, ensuring a cohesive and integrated health monitoring solution.

4.1.5 Functional Requirement

1. Activity Tracking:

Description: Accurately record and monitor users' daily physical activities using the Android device's inbuilt pedometer sensor.

Features: Real-time step count, distance traveled, and active minutes tracking.

2. Caloric Expenditure Calculation:
Description: Calculate and display the calories burned by users based on recorded step counts and activity data.
Features: Accurate caloric expenditure metrics for various activities.

3. Dietary Intake Recording:
Description: Enable users to input details of their dietary intake, including meals and snacks, to maintain a comprehensive record.
Features: Food logging, calorie tracking, and nutritional information.

4. Firebase Integration:
Description: Seamlessly integrate with Firebase for secure user authentication, data storage, and real-time database management.
Features: User account management and secure cloud-based data storage.

4.1.6 Other Non-functional Requirements

1. Performance:
Requirement: The system should exhibit minimal latency in processing and presenting real-time data to ensure a responsive user experience.
Benchmark: Achieve a response time of less than one second for user interactions.

2. Scalability:
Requirement: The system should be scalable to accommodate a growing user base and increasing data volume.
Benchmark: Support a minimum of 10,000 simultaneous users without compromising performance.

3. Reliability:
Requirement: Ensure high system reliability to minimize downtime and interruptions in health monitoring.
Benchmark: Achieve a system uptime of 99.9% over a specified period.

4. Security:
Requirement: Implement robust security measures to protect user data and ensure secure authentication.

Benchmark: Adherence to industry-standard encryption protocols, and regular security audits to identify and address vulnerabilities.

5. Usability:
Requirement: Provide an intuitive and user-friendly interface to enhance user adoption and engagement.
Benchmark: Attain a user satisfaction rating of at least 85% based on usability surveys.

6. Compatibility:
Requirement: Ensure compatibility with a diverse range of Android devices, minimizing issues related to device specifications.
Benchmark: Support Android devices with OS versions 6.0 and above, covering at least 90% of the user base.

7. Data Privacy:
Requirement: Safeguard user privacy by implementing stringent data protection measures, adhering to relevant data privacy regulations.
Benchmark: Receive no reported breaches or unauthorized access to user data.

These non-functional requirements are essential for ensuring the effectiveness, reliability, and security of the Activity Monitoring System, contributing to a positive user experience and sustained system performance.

4.1.7 Product Perspective

The Activity Monitoring System exists as a comprehensive and integrated health management solution within the broader context of digital health and well-being. It interacts with various elements:

1. User Devices:
Description: The system operates on Android devices, utilizing inbuilt sensors for activity tracking and interacting with users through a dedicated mobile application.

2. Firebase Cloud Services:
Description: The system seamlessly integrates with Firebase, leveraging cloud-based services for secure user authentication, data storage, and real-time database management.

3. External Platforms and Apps:

Description: The system may interface with external platforms and apps for additional functionalities, such as fitness challenges, community engagement, or third-party health services.

4. Healthcare Ecosystem:

Description: In scenarios involving healthcare professionals, the system may be part of a broader healthcare ecosystem, facilitating remote patient monitoring and data sharing for medical analysis.

5. Research and Analytics Tools:

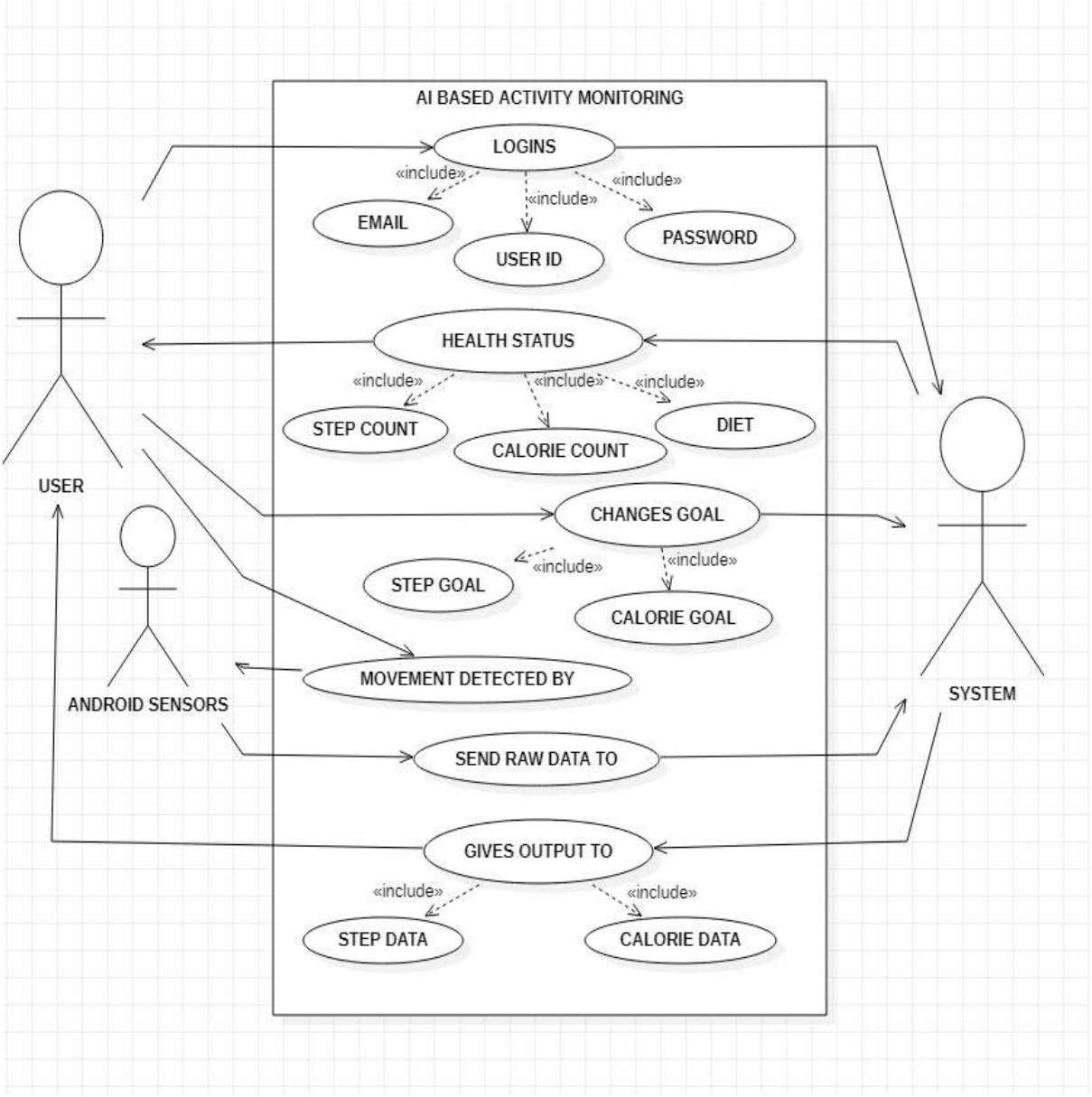
Description: The system's data may be utilized by researchers and analysts for health-related studies, contributing to advancements in personalized medicine and preventive healthcare.

In this product perspective, the Activity Monitoring System serves as a central component, interacting with various elements to deliver a seamless and effective health monitoring experience for end-users, healthcare professionals, researchers, and the broader community.

Chapter 5

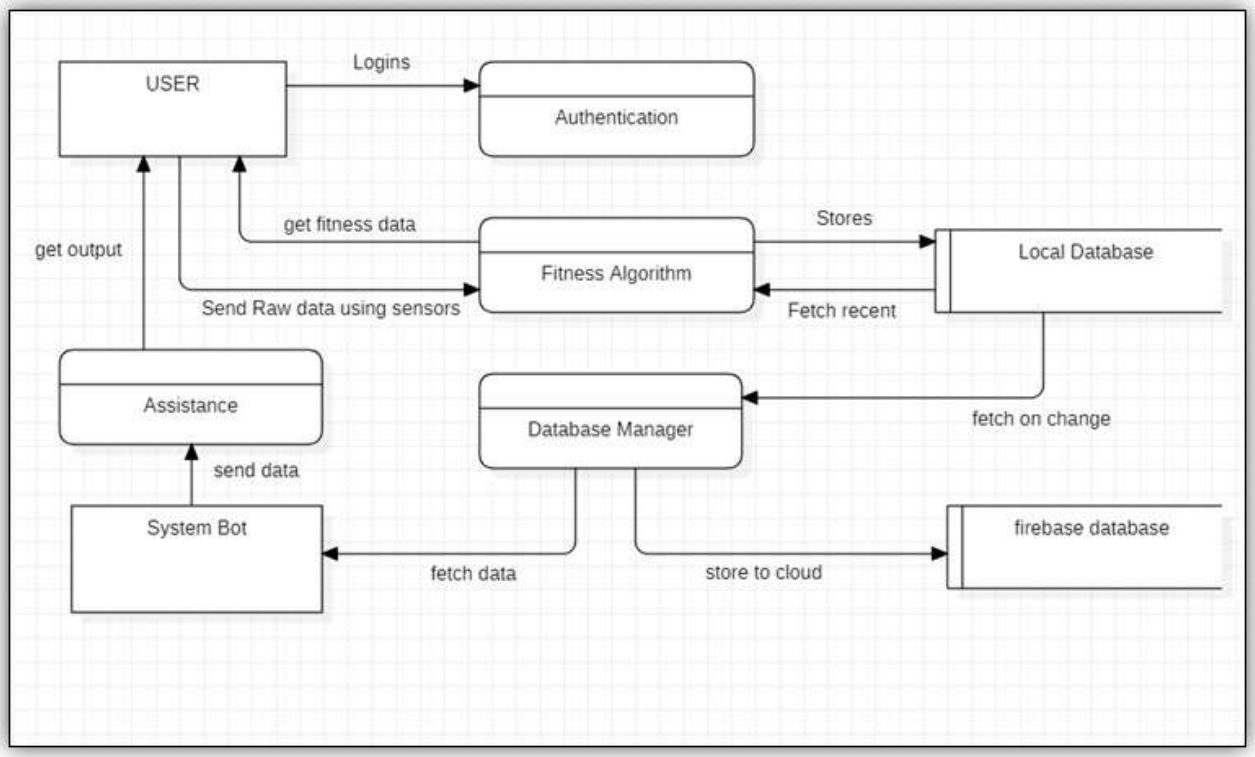
Project Analysis and Design

5.1 Use Case Diagram



The Activity Monitoring System's use case specifications define user interactions and system responses. Key use cases include "Track Physical Activity" where users record steps and monitor distances, "Record Dietary Intake" allowing users to log meals, and "Predict Caloric Intake" providing personalized daily intake predictions. "Authenticate User" ensures secure access. These specifications guide system behavior, ensuring a user-centric and efficient health monitoring experience.

5.2 Workflow



The fitness app's workflow begins with user authentication and retrieval of local fitness data. Utilizing sensors, it collects raw data, processes it to generate meaningful metrics, and stores both raw and processed data locally. Simultaneously, the app communicates with a database manager, transferring processed data to Firebase for cloud storage. The cyclic nature of fetching recent data ensures real-time updates, while a system bot provides user assistance, such as suggesting workout routines. This integrated approach ensures a secure, dynamic, and comprehensive fitness experience tailored to individual needs.

5.3 Time Schedule

Task	Start	End	Status
Formation of problem statement ,scope, objective, business objective of the project and learning Phase	June	July	Completed
Formation of the system architecture and Brainstorming	July	September	Completed
Wireframes, functionalities and Api's	September	October	Completed
Developing UI screens , backend api services and integration.	October	November	Completed
Making the final report, collecting feedback from project guide ,knowledge transfer	November	December	Completed

5.4 Team Organization

5.4.1 Team Structure

Our team: - Our team consists of developers, internal guide.

Developers:

- Kalpak Nemade 22120044
- Shreyas Borakhadikar 22010450
- Arya Yedekar 22120268
- Om Hambire 22120085

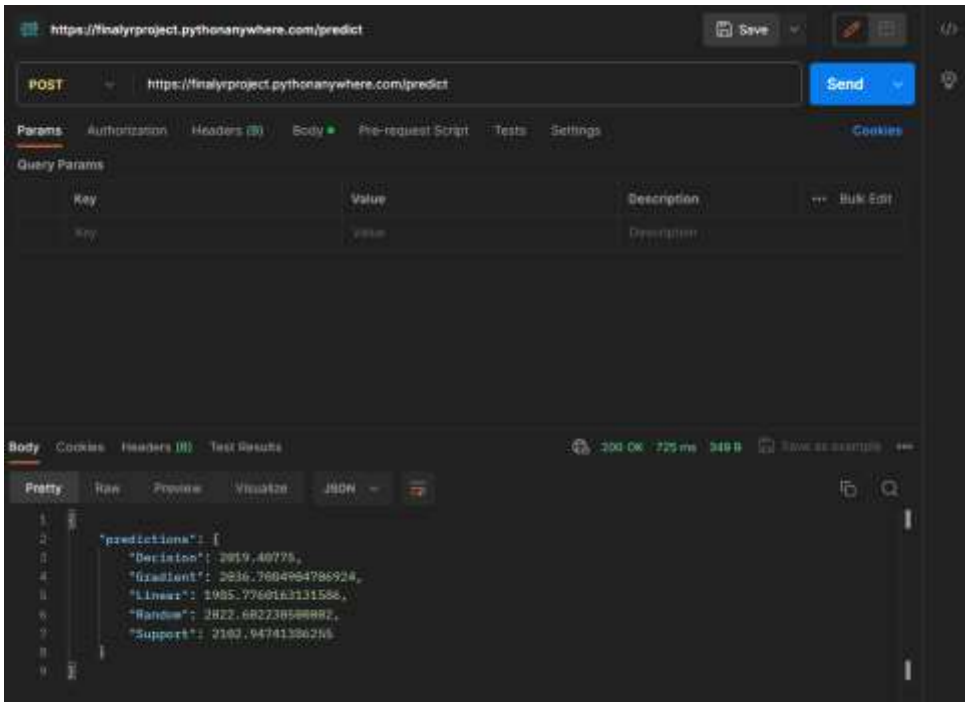
Internal Guide

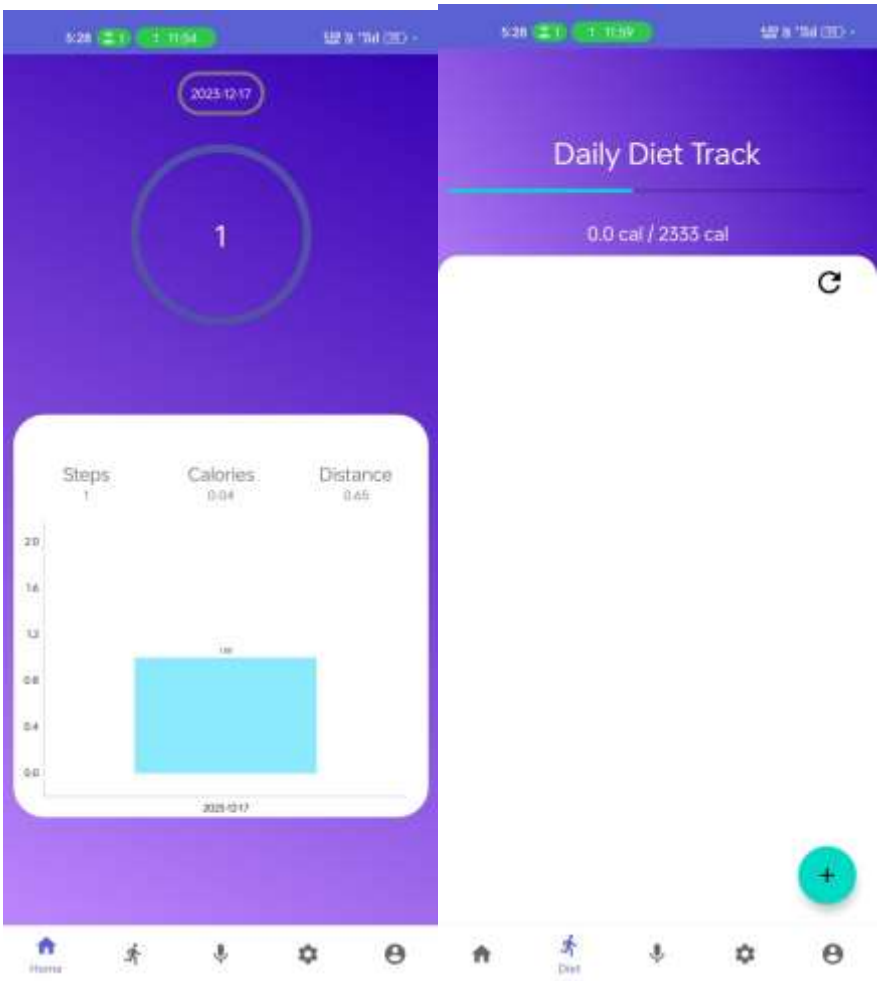
- Prof Ashwini Ranjit Nawadkar

Chapter 6

Implementation Testing

6.1 Implementation




2023-12-17
1
Steps
Calories
Distance
Daily Diet Track
0.0 cal / 2333 cal
Home
Diet


Today's steps count is 0
Input message / click mic
AI Assistant
Settings
Kalpak Nemade
Goal Settings
Change Password
Dark Mode
Step Recorder
Ask Question
About Us
LogOut

6.2 Introduction

The Activity Monitoring System is an innovative project designed to enhance holistic health management. This system leverages an Android app equipped with a pedometer sensor to track steps, calculate calories, and log dietary intake. The project's backbone is a robust backend infrastructure powered by Firebase, ensuring secure data storage, authentication, and efficient database management while prioritizing user privacy. The primary goal is to empower users by providing real-time activity tracking and insightful dietary analysis, encouraging a proactive approach to personal health.

6.3 Purpose

The purpose of this implementation testing is to validate that the Activity Monitoring System functions as intended, ensuring a seamless and reliable user experience. By conducting thorough testing, we aim to identify and rectify any potential issues or bugs in both the Android app and the Firebase backend, guaranteeing that users can trust the system for their health management needs.

6.4 Test Objective

The key objectives of this testing phase include:

- Verify that the Android app accurately tracks steps using the device's pedometer sensor.
- Confirm the precise calculation of calories based on the collected activity data.
- Ensure the correct logging of dietary intake through the app.
- Validate the security and privacy features of Firebase, including data storage and authentication.
- Test the reliability and efficiency of the database management in Firebase.
- Confirm that the app provides real-time activity tracking and insightful dietary analysis.
- Identify and address any performance issues, bugs, or user interface issues that may impact the user experience.

6.5 Process Overview

The testing process will involve the following steps:

1. Unit Testing: Verify individual components of the Android app and Firebase backend to ensure they function correctly in isolation.
2. Integration Testing: Validate the seamless interaction between the Android app and the Firebase backend to ensure data flow and processing are accurate.
3. Functional Testing: Evaluate the overall functionality of the app, including step tracking, calorie calculation, and dietary intake logging.
4. Security Testing: Assess the security features of Firebase to confirm data storage security and user authentication reliability.
5. Performance Testing: Evaluate the app's responsiveness and efficiency, especially concerning real-time tracking and analysis.
6. User Interface Testing: Ensure the app's interface is intuitive, user-friendly, and visually appealing.
7. Bug Tracking and Reporting: Document and report any identified bugs or issues, providing detailed information for developers to address them.

By systematically conducting these tests, we aim to deliver a high-quality Activity Monitoring System that meets the project's objectives and provides users with a reliable and secure tool for managing their health effectively.

6.6 Test Cases and Results

6.5.1 Login System

Case ID	Test case	Steps	Expected output	Actual output	Pass / fail
Login_1	Login Test with valid credentials	Open Application-> Enter valid login details.	The user shall login and redirect to dashboard.	The user was able to login and was redirected to dashboard	Pass
Login_2	Login test with invalid credentials	Open application-> enter invalid login details.	The user should not be able to login and should show error.	The user was shown error and was not logged in.	Pass

Login_3	Login test without internet connection	Open application -> try entering details	The application should show error of internet connection	The user was shown error of internet connection	Pass

6.5.2 Fetch data from databases

Case ID	Test case	Steps	Expected output	Actual output	Pass / fail
Data_1	Fetch data when internet is unavailable	Open application and login	The old data should be shown	The old data was shown	Pass
Data_2	Fetch data when internet is available	Open application and login	The new data should sync with app	The data was synod with application	Pass
Data_3	Change data when internet is available	Open application and connect to internet	The new data should save in local database	The data was saved and synced.	Pass

6.5.3 Change Profile

Case ID	Test case	Steps	Expected output	Actual output	Pass / fail
Profile_1	To view profile	Open application and navigate to profile	The profile of current user should show	The profile of user was shown	Pass
Profile_2	To view profile	Open application and	The profile of current user should show if	The saved profiled was shown	Pass

	when offline	navigate to profile	visited previously		
Profile_3	To edit profile	Enter new profile details	The profile should update	The profile was updated	Pass
Profile_3	To edit profile with improper details	Enter improper details in input fields	The error should generate	The error was generated	Pass

6.5.4 Every model used in ensemble learning model' mean squared error are given below:

Model	Mean Squared Error
Linear Regression	1926.884
Decision Tree	892.714
Random Forest	254.049
Support Vector	63973.013
Gradient Boosting	128.576

Chapter 7

Conclusion and Future work

7.1 Conclusion

In concise terms, the Activity Monitoring System is a multifaceted solution leveraging technology for comprehensive health management. The Android app, featuring a pedometer sensor, facilitates real-time tracking of physical activity, while diet monitoring adds a crucial nutritional aspect. Firebase integration ensures secure data handling, allowing users to seamlessly access and update their information. The incorporation of a Python-based calorie prediction model enhances the system's utility by providing personalized insights.

This project doesn't just address immediate health concerns but also lays the foundation for future enhancements. By encouraging proactive engagement with one's health, the Activity Monitoring System aims to contribute positively to individuals' lifestyles, fostering habits that promote long-term well-being. In essence, it stands as a testament to the potential of technology to play a pivotal role in cultivating healthier and more balanced lives.

7.2 Future Scope

The Activity Monitoring System lays the foundation for continuous innovation and expansion. Future enhancements may include:

1. Integration with Wearable Devices: Extend compatibility to a broader range of wearable devices, fostering a more diverse user base and capturing a wider spectrum of health metrics.
2. Enhanced Predictive Analytics: Evolve predictive modeling capabilities by incorporating more advanced machine learning algorithms, enabling more accurate and nuanced predictions.
3. Social Features and Community Engagement: Integrate social features to facilitate user interaction, challenges, and community engagement, promoting a supportive and motivating environment.
4. Health AI and Virtual Health Assistants: Implement AI-driven virtual health assistants for personalized health recommendations, leveraging advanced analytics for proactive health management.
5. Remote Monitoring for Chronic Conditions: Expand the system's utility in healthcare by enhancing features for remote monitoring, catering to individuals with chronic health conditions.
6. Gamification and Rewards System: Introduce gamification elements and a rewards system.

Chapter 8

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Department of Artificial Intelligence and Data Science, VIIT

2023-2024

CERTIFICATE

This to certify that

1. **Mr. Kalpak Nemade** **(22120044)**
2. **Mr. Shreyas Borakhadikar** **(22010450)**
3. **Ms. Arya Yedekar** **(22120268)**
4. **Mr. Om Hambire** **(22120085)**

have completed the necessary project work and prepared a report on the topic **Activity Monitoring System** under the course **Project Exam** in a satisfactory manner as a partial fulfillment of the requirement of **Btech. Artificial Intelligence and Data Science (Final Year).**

Mr. Parikshit Mahalle

(HOD AI & DS Dept.)

Mrs. Ashwini Nawadkar

(Project Guide)