**Fitnessstan**

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**Final Approval**

This is to certify that we have read the report submitted by ***Zain Ul Abideen (35515)*, *Obaid Ullah (35739), Huzaifa Khan (35726)*** for the partial fulfillment of the requirements for the degree of the Bachelors of Science in Computer Science (BSCS). It is our judgment that this report is of sufficient standard to warrant its acceptance by Riphah International University, Islamabad for the degree of Bachelors of Science in Computer Science (BsCs).

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| **2** | Dr. Musharraf Ahmed  (Head of Department) |

**Declaration**

We hereby declare that this document “**Fitnessstan**” neither as a whole nor as a part has been copied out from any source. It is further declared that we have done this project with the accompanied report entirely on the basis of our personal efforts, under the proficient guidance of our teachers, especially our supervisor **Muhammad Islam Abbasi**. If any part of the system is proved to be copied out from any source or found to be reproduction of any project from anywhere else, we shall stand by the consequences.

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**Dedication**

This work is devoted to Almighty Allah, the Most Merciful and the Most Beneficent, who granted us the knowledge, perseverance, and strength to complete this work. We also wish to extend our deepest gratitude to our parents for their unyielding love, support, and prayers along the journey. We finally dedicate this to our supervisor, “Muhammad Islam Abbasi”, with whose valuable guidance, mentorship, and encouragement we are able to make this project into reality.

**Acknowledgement**

We are grateful to Almighty Allah, the provider of all knowledge and wisdom, for giving us the strength and perseverance to bring this project to fruition.

We would like to extend our wholehearted gratitude to our supervisor, “Muhammad Islam Abbasi” who guided and encouraged us on this endeavor throughout the course of this project. His mentorship has been the backbone of our learning and growth.

We would also like to acknowledge the encouragement and constructive criticism offered by our faculty members and colleagues who guided us to correct our mistakes. Their encouraging words pushed us beyond our limits of apprehension. Last but not least, we express our profound appreciation to our families and friends for their exemplary support, prayers, and patience that provided us with strength in pursuit of excellence.

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**Abstract**

In today's fast-paced world, people work tirelessly with dedication but often neglect their health and fitness, leading to a steady rise in the number of unhealthy individuals. Addressing this concern, we aim to develop a comprehensive platform, available as both a website and a mobile application, to help users manage their daily exercise and food intake effectively.

Existing apps and websites in Pakistan often fall short in providing personalized food recommendations tailored to users’ needs. While some platforms suggest exercise routines, they rarely focus on balanced nutrition or calorie management, which are essential for maintaining overall health. Moreover, these platforms lack customization based on user preferences, leaving a gap in truly effective fitness solutions.

Our solution, Fitnessstan, bridges this gap by offering personalized food and exercise recommendations. Using Flutter technology, we developed a user-friendly app that integrates an AI model to suggest appropriate calorie intake and workouts based on individual requirements. For users preferring web access, we also created a responsive website using React.js.

Fitnessstan is designed to empower users with tailored guidance, promoting healthier lifestyles through a combination of technology, innovation, and convenience. With this platform, we strive to make fitness accessible and achievable for everyone.

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**Chapter 1:**

**Introduction**

# Introduction

**Fitnessstan** is a web-based and app-based platform designed to provide a holistic solution for fitness enthusiasts, including individuals with diabetes. In today’s world, achieving a healthy lifestyle can be challenging, especially for beginners who lack personal guidance on balancing exercise and nutrition. Neglecting either aspect often leads to unsatisfactory progress or health risks. Existing platforms fail to offer comprehensive and personalized solutions, particularly for users with specific health needs.

Fitnessstan addresses these challenges by integrating artificial intelligence to deliver customized workout and dietary plans tailored to each user’s unique health metrics, goals, and preferences. The platform specifically supports diabetic patients by incorporating features that help manage their condition through personalized exercise and nutrition guidance. This seamless integration of fitness and health ensures safe and effective progress for all users.

With features like progress tracking and adaptive recommendations, Fitnessstan ensures long-term results and user satisfaction. Whether its weight loss, muscle gain, or managing conditions like diabetes, Fitnessstan empowers individuals to take control of their health journey while promoting a culture of sustainable fitness and well-being.

## Goals and Objectives

### Goals

1. The platform in which Provide a personalized and user-friendly fitness platform for enthusiasts.
2. To facilitate users achieve and maintain their fitness goals through AI-powered workout and dietary recommendations.

### Objectives

1. To offer fitness workout plans as per users' fitness levels, preferences, and health metrics.
2. To provide dietary recommendations personalized to the specific needs of diabetic patients and general users, respectively.
3. To enable users to track progress and result analysis in measurable improvements over time.

## Scope of the Project

The scopes of the **“Fitnessstan”** are as following

1. Our website will be developed on java stack development and our app will be developed on Flutter.
2. We will develop a website and app that will provide platform for diabetic patient and for those people who loss, gain and maintain their weight.
3. User will upload their information without any hesitation because we are securing his information.
4. User will get personalized diet plan on the basis of his information.
5. Problem will be solved with Machine learning techniques.

The platform would also be accessible, interactive and user-friendly, and simplified for Users.

**Chapter 2:**

**Literature Review**

# Literature Review

## Introduction

**Fitnessstan** is a web-based and app-based platform designed to provide a holistic solution for fitness enthusiasts, including individuals with diabetes. In today’s world, achieving a healthy lifestyle can be challenging, especially for beginners who lack personal guidance on balancing exercise and nutrition. Neglecting either aspect often leads to unsatisfactory progress or health risks. Existing platforms fail to offer comprehensive and personalized solutions, particularly for users with specific health needs.

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With features like progress tracking and adaptive recommendations, Fitnessstan ensures long-term results and user satisfaction. Whether its weight loss, muscle gain, or managing conditions like diabetes, Fitnessstan empowers individuals to take control of their health journey while promoting a culture of sustainable fitness and well-being.

## Background and Problem Elaboration

While the industry of fitness is rapidly expanding, on many platforms users, especially first-time users, end up stuck in their goals due to the fact that most do not properly guide one both through exercise and nutrition. Most of them only give workout plans without connecting the critical role of nutrition for achieving fitness goals. This leads to less useful results, bad recovery, and potential health risks.

Also, many of these applications do not support different types of constraints, such as diabetes, and provide no full, personalized recommendations. There is also disconnection between guidance provided on exercise and nutrition, making the whole experience disjointed and giving the user no tools needed to be successful in the long term.

Fitnessstan offers a remedy to that problem by introducing AI-based online services combining customized workout routines, suggested diets, and monitoring to create one all-inclusive solution where every user will have the right resources for a holistic fitness journey.

## Detailed Literature Review

### Definition

Fitness refers to a state of health and well-being that allows an individual to perform daily tasks with energy and minimal fatigue. It has physical, mental, and emotional factors to it and, thus, outlines the importance of good regular exercise and lifestyle habits.

A diet, on the other hand, is a short-term measure that incorporates certain food-related restrictions designed to fit the requirements for achieving objectives like weight loss or improvement in the state of being healthy. Many diets are temporary and specific to the client's need.

On the other hand, a nutrition plan is generally a long-term approach or an eating regimen designed to maintain the body's necessary macronutrient and micronutrient inputs by proper consumption to achieve certain health and fitness goals.

### Related Research Work 1

**Reema Golagana** et al [1] proposed a diet recommendation system utilizing machine learning and deep learning techniques to create personalized meal plans based on a user’s physical characteristics and health conditions. The system evaluates factors like BMI, age, and gender to determine the optimal daily calorie intake, and it recommends meal plans by considering the nutritional requirements of individuals. Using algorithms such as Random Forest, K-means, and Long Short-Term Memory (LSTM), the system outperforms traditional methods in predicting diet plans. The model is designed to help users lead healthier lives by providing tailored nutrition advice. The research highlights the importance of personalized diet recommendations and the use of advanced machine learning techniques to improve accuracy.

### Related Research Work 2

**Mr. Abhijeet Pawar** et al [2]developed an AI-based fitness trainer app that helps users with their exercise routines at home using image and video processing. The goal of the app is to make fitness more accessible to people who can't afford gym memberships or have limited time. It calculates the user's BMI based on their height and weight and provides personalized workout plans according to different BMI categories, such as underweight, normal, overweight, and obese. The app uses OpenCV and Convolutional Neural Networks (CNN) to track body posture and movements during exercises. It offers features like real-time feedback, performance tracking, and the ability to detect and correct common mistakes to improve workouts. The app includes various exercise types, including cardio, flexibility, and strength training, to offer a complete fitness solution for home users.

## Literature Review Summary Table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| No. | Name | Authors | Year | Input | Output | Description |
| [1] | Diet Recommendation System Using Machine Learning | Reema Golagana, V. Sravani, T. Mohan Reddy, CH Kavitha | 2023 | User data (BMI, preferences) | Personalized diet plans | Uses Random Forest, K-Means, and LSTM for generating tailored diet recommendations. |
| [3] | Multi-Choice Diet Recommendation Application for Indian Scenario | Karthika Subbaraj | 2024 | BMI, TDEE, and Indian food dataset | Calorie-specific meal plans | Utilizes Random Forest for meal classification and KNN for alternative suggestions, achieving. |
| [4] | A Hybrid Healthy Diet Recommender System | Sara Sweidan, S.S. Askar, Mohamed Abouhawwash, Elsayed Badr | 2025 | Anthropometric and clinical measurements | Calorie and nutrient estimations | Combines SVR, LR, and DTR models to generate calorie estimates with R=0.985 for obesity treatment. |
| [5] | Personalized Diet Recommendation System Using Machine Learning | D. Navya Narayana Kumari, T. Praveen Satya, B. Manikanta, et al. | 2024 | User preferences and health parameters | Meal recommendations and preparation details | Employs Nearest Neighbors with cosine similarity for content-based filtering tailored to user preferences. |
| [6] | AI Fitness Traine | Ahsan Ashraf, Talha Shahid, | June 2024 | Real time tracking | * Customized Workouts * Live Feedback * Motion Tracking * Exercise Tracking   Integration with Wearable Devices | Pose Estimation with MediaPipe, and OpenCV for image and video processing, particularly using YOLOv5 for motion tracking and posture analysis. |
| [2] | FITNESS TRAINER APPLICATION USING ARTIFICIAL INTELLIGENCE | Mr. Rutvik Sonawane, Mr. Vaibhav Adke, Mr. Abhijeet Pawar | 2023 | Image processing and video processing | Workout plans and coorection of posture | Video Processing for real-time analysis and body posture detection and Convolutional Neural Networks (CNN) for deep learning to analyze user movements and provide feedback |

Table 1: Summary of Research Paper

## Problem Statement

The fitness industry faces significant challenges, particularly for beginners who are dedicated to workouts but lack awareness of the critical role nutrition plays in achieving their goals. This neglect of proper diet not only slows their progress but also poses health risks, including poor recovery, nutritional deficiencies, and the exacerbation of conditions like obesity and diabetes. Additionally, many individuals struggle with tailored strategies to effectively lose weight, gain muscle, or maintain their current fitness levels. Without a holistic approach that integrates both exercise and personalized nutrition, these issues continue to undermine the overall success and well-being of fitness enthusiasts.

**Chapter 3:**

**Requirements and Design**

# Requirements and Design

In this chapter, we have developed the functional requirements for our actors, i.e., **User** and **Admin**. These requirements are specifically designed for the Fitnessstan platform.

**Fitnessstan** is both a web-based and app-based platform that offers personalized fitness solutions by integrating AI-powered workout and dietary recommendations. The platform is user-friendly, easy to navigate, and provides an efficient way for users to achieve their fitness goals and for admins to manage the platform's functionality seamlessly.

We created system use cases against each functional requirement and designed use case diagrams and fully dressed use cases for our actors, i.e., **User** and **Admin**.

## Requirements

### User/Customer Functionalities:

|  |  |
| --- | --- |
| **ID** | **Functionality Description** |
| 1 | The user must be able to sign up. |
| 2 | The user must be able to login to their account. |
| 3 | The user must be able to recover and forget their password |
| 4 | Input personal information, like DOB, weight, height, gender, religion, sleep-hour, occupation and exercise level, to compute BMI. |
| 5 | Diet recommendations that are specifically tailored to the needs of diabetics. |
| 6 | Monitoring of progress - calories burned, workouts performed, and nutritional intake. |
| 7 | User will be read the article about features and supplements. |
| 8 | User shall be able to give feedback about our recommendation. |
| 9 | Weekly updates and alerts on progress and fitness plan. |

Table 2: User Functional Requirement

### Admin Functionalities:

|  |  |
| --- | --- |
| **ID** | **Functionality Description** |
| 1 | Admin must be able to login to the system |
| 2 | Administrators will be able to add users. |
| 3 | Admin must be able to delete the users. |
| 4 | Admin must be able to Manages user by adding, updating, or deleting accounts. |
| 5 | Admin must be reviewed the feedback given by user. |
| 6 | Monitor the platform’s overall performance and usage statistics. |
| 7 | Provide data security and impose privacy policies. |
| 8 | Manage system configurations and updates and Database management. |
| 9 | Resolve technical issues and provide platform support. |

Table 3: Admin Functional Requirement

## Hardware and Software Requirements

### Hardware Requirement

1. **Server:**  
   A dedicated server or cloud hosting service to host the website and app, ensuring efficient handling of user requests, AI processing, and data storage.
2. **Storage:**  
   Adequate storage capacity to store user profiles, workout and dietary data, progress reports, and AI-generated recommendations.
3. **Processing Power:**  
   Sufficient processing power to manage concurrent user requests, perform AI computations for personalized fitness plans, and handle real-time data tracking and updates.

### Software Requirement

1. **Operating System:**

The server should run a compatible operating system such as Linux, windows server or macOS server.

1. **React.js:**

It is a JavaScript library used for creating responsive and dynamic web interfaces.

1. **Spring Boot and Java:**

These are used for back-end development to ensure scalable and robust server-side functionality.

1. **Python:**

It is used for AI/ML tasks such as generating personalized fitness and dietary recommendations.

1. **MongoDB:**

It is a NoSQL database for managing user data, activity logs, and app-related information.

1. **Bootstrap:**

Used for creating beautiful and responsive user interfaces.

1. **VS Code:**

Primary IDE for coding and debugging.

1. **Git:**

A version control system to collaborate on development and manage source code.

## Proposed Methodology

Our solution focuses on providing personalized diet plans by leveraging advanced data clustering techniques and synthetic user data generation. To achieve this, we utilize unsupervised learning to cluster food items based on their nutritional values. This process categorizes foods into 14 distinct clusters, each representing specific nutritional characteristics, such as high protein and low fat, or high fiber and moderate carbohydrates. These clusters provide a structured representation of the nutritional profiles of various foods.

To align the dietary recommendations with individual needs, we create a synthetic dataset that simulates user information, including health metrics, dietary preferences, and fitness goals. This synthetic dataset enables the development and testing of personalized diet plans by mapping user requirements to the appropriate food clusters.

By combining nutritional clustering and synthetic user data, our approach ensures tailored, data-driven diet plans that cater to diverse dietary needs and health objectives, promoting sustainable and effective nutrition management.

### Methodology Diagram:

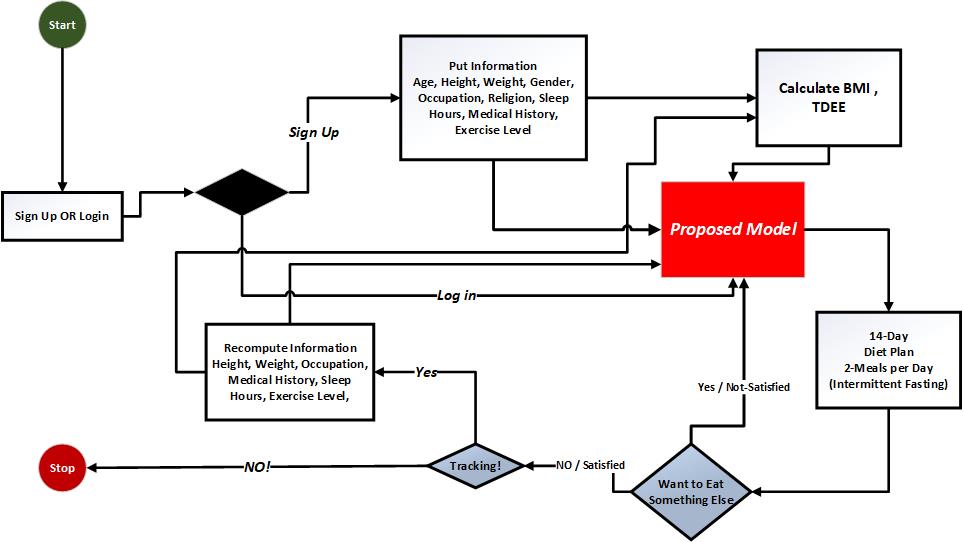


Figure 1: Methodology Diagram

### Proposed Model

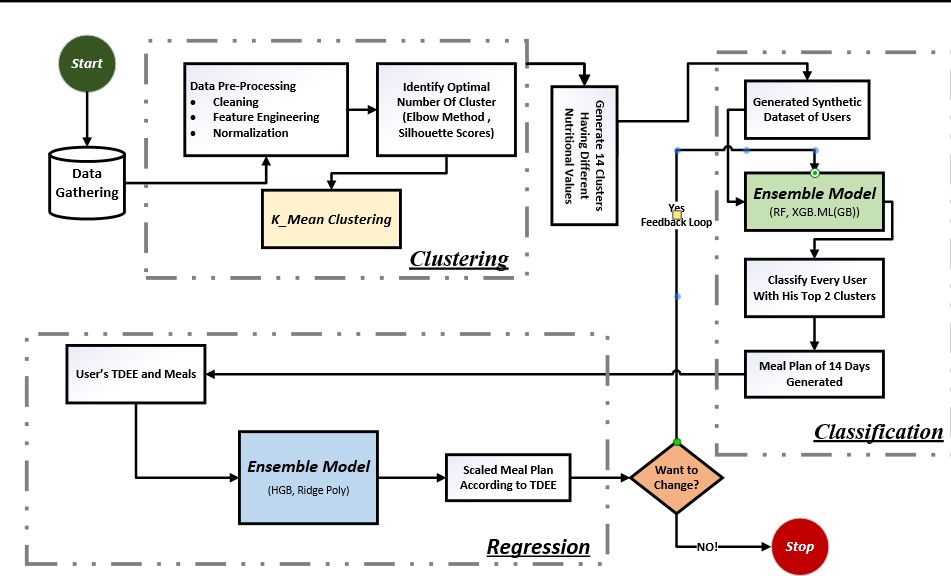


Figure 2: Proposed Model

## System Architecture

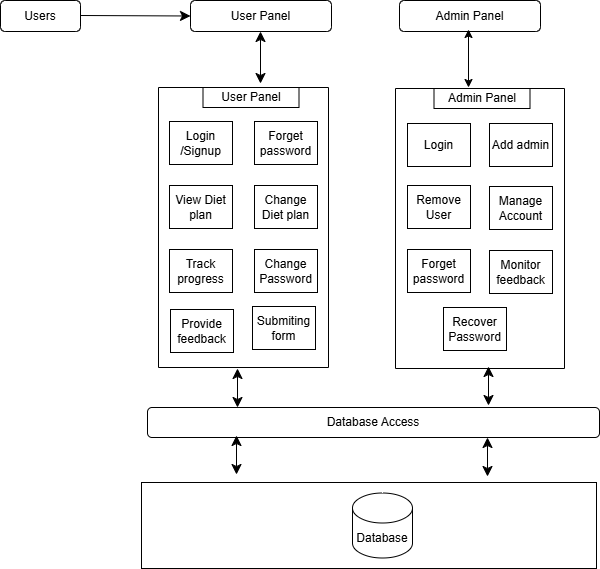


Figure 3: System architecture diagram

## Use Cases

### User Use-Case

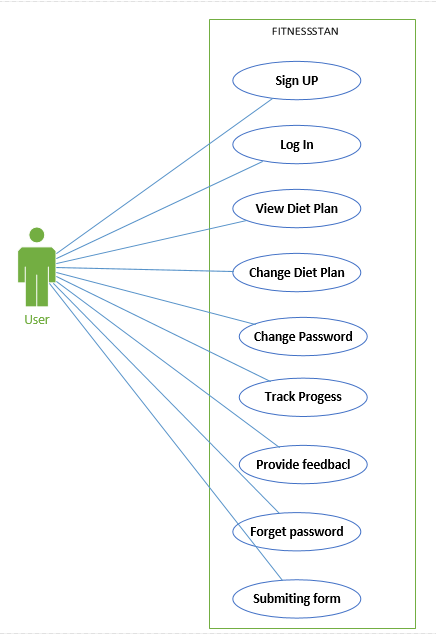
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Figure 4: User use case diagram

### Admin Use-Case

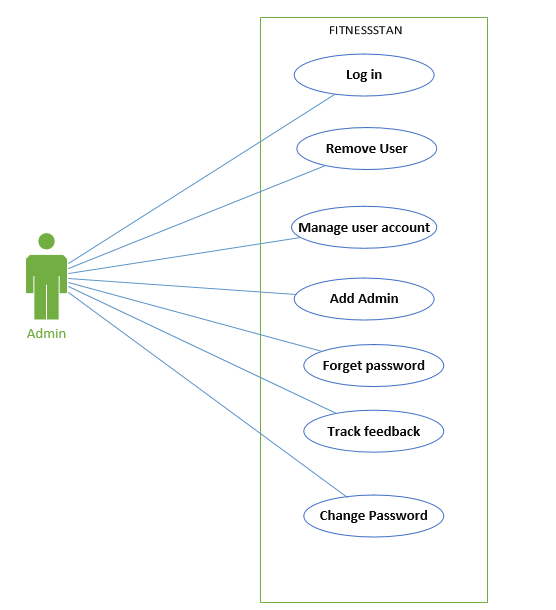


Figure 5: Admin use-case diagram

## Fully-Dressed Use Cases

### Login

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Login | | |
| Actors | | Admin, User | | |
| Summary | | The user must input their email address and password on the login form, following which they will be forwarded to the home page. | | |
| Pre-Conditions | | The user must be registered in to the system. | | |
| Post-Conditions | | The user will be sent to the system’s home page, and his or her session will be preserved. | | |
| Special Requirement | | Ensure password is not visible during verification. | | |
| **Basic Flow** | | | | |
| Actor Action | | | System Response | |
| 1 | The user navigates to the login page. | | 2 | The login page appears and asking for email address and password. |
| 3 | The user provide a valid email and password. | | 4 | The system verify the email and password, establishes a session and redirect to the appropriate dashboard. |
| **Alternative Flow** | | | | |
| A3 | The user enters invalid email and password. | |  | The system displays the following error message: incorrect email address and password. |

Table 4: Login

### Sign Up

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Sign Up | | |
| Actors | | User | | |
| Summary | | The user register a new account by entering the required information. | | |
| Pre-Conditions | | The user must be registered in to the system. | | |
| Post-Conditions | | New account is created and user redirect to the login page for authentication. | | |
| Special Requirement | | Validate email format and check the duplication of email | | |
| **Basic Flow** | | | | |
| Actor Action | | | System Response | |
| 1 | The user visit the sign-up page. | | 2 | The user is prompted to provide details like their name, email address and password on the sign-up page |
| 3 | The user provide their name, email address and password. | |  |  |
| 4 | The user fills out the sign-up form | | 5 | The system validate the information and send OTP to the user email. |
| 6 | The user put the OTP on the sign-up page. | | 7 | The system validate the OTP and generates a new account for user. |
|  |  | | 8 | The system display a success message, indicating that user account was successfully created. |
| **Alternative Flow** | | | | |
| A3 | If the user submit the sign-up form with incomplete or invalid information. | |  | The system display and error message, indicating specific fields that need to be corrected. |
| A6 | If the user enters invalid OTP. | |  | The system display the error message indicating you OTP is incorrect. |

Table 5: Sign Up

### Recover password

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Recover password | | |
| Actors | | Admin, User | | |
| Summary | | The admin and user can recover their password who has forgotten or lost their login credentials. | | |
| Pre-Conditions | | The user must have FITNESSSTAN account and user must have access to email address which is associated with his account. | | |
| Post-Conditions | | The user password is successfully reset and they can log in to their account using the new password. | | |
| Special Requirement | | The reset process must be secure to prevent the unauthorized access. | | |
| **Basic Flow** | | | | |
| Actor Action | | | System Response | |
| 1 | The user navigates to the login page. | |  |  |
| 2 | User click on the “Forgot Password” button. | | 3 | A password recovery form is displayed by the system. |
| 4 | In the recovery form user enter the email which is associated with their account. | |  |  |
| 5 | The user presses the “submit” button | | 6 | The system validate the email address and create the password reset link. |
|  |  | | 7 | The system send the reset link on the email which is associated with their account. |
| 8 | The user open their email and clicks on the password reset link. | | 9 | The system redirect the user to a password reset form. |
| 10 | In the prompted field the user enters a new password and verifies it. | |  |  |
| 11 | The user fill out the password reset form. | | 12 | The new password is validated by the system and added to the user account in database. |
|  |  | | 13 | When the password is successfully reset, the system display a confirmation message. |
| **Alternative Flow** | | | | |
| A4 | If a user provide an incorrect or unregistered email address. | |  | The system prompt the user to input a valid email address which is associated with their account. |
|  |  | |  | If the password reset link is expired the system prompts the user reset button for again process. |

Table 6: Recover password

### View Diet plan

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | View diet plan | | |
| Actors | | User | | |
| Summary | | The user will view their personalized diet plan which is recommend from ML model on the basis of his input. | | |
| Pre-Conditions | | The user must be login and navigate to user dashboard and click on the view diet button. | | |
| Post-Conditions | | The user will view their diet plan of one week. | | |
| Special Requirement | | None | | |
| **Basic Flow** | | | | |
| Actor Action | | | System Response | |
| 1 | The user must be login in the system. | | 2 | The System redirect the user on the user dashboard. |
| 3 | The user choose an option or view diet on his dashboard. | | 4 | The system will show the diet plan to the User |
| **Alternative Flow** | | | | |
| A3 | The user enters invalid email and password. | |  | The system displays the following error message: incorrect email address and password and redirect again on the login page. |

Table 7: View Diet plan

### Remove User

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Remove user | | |
| Actors | | Admin | | |
| Summary | | Admin can remove a user's account permanently from the system. | | |
| Pre-Conditions | | |  | | --- | | The admin must be logged into the system with appropriate permissions and The user account must exist in the database. | | | |
| Post-Conditions | | The user account will be removed from the system and cannot be recovered. | | |
| Special Requirement | | Ensure proper authorization is in place to prevent unauthorized removal of users. | | |
| **Basic Flow** | | | | |
| Actor Action | | | System Response | |
| 1 | The admin navigates to the user management section. | | 2 | The system displays a list of all registered users. |
| 3 | The admin selects a user and clicks on the "Remove User" button. | | 4 | The system confirms the removal with a confirmation message. Upon confirmation, the user is removed from the system. |
| **Alternative Flow** | | | | |
| A3 | The admin attempts to remove a non-existing user. . | |  | The system displays an error message: "User does not exist." |

Table 8: Remove User

### Manage User account

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Manage User Account | | |
| Actors | | Admin | | |
| Summary | | Admin can update or modify user account details such as email. | | |
| Pre-Conditions | | The admin must be logged into the system with appropriate permissions and The user account must exist. | | |
| Post-Conditions | | The changes to the user account are saved and reflected in the system. | | |
| Special Requirement | | Ensure proper input validation and role-based access controls. | | |
| **Basic Flow** | | | | |
| Actor Action | | | System Response | |
| 1 | The admin navigates to the user management section. | | 2 | The system displays a list of registered users. |
| 3 | The admin selects a user and edits the account details | | 4 | The system validates the changes and updates the user account successfully. . |
|  |  | | 5 | The system send update details notifications to the User email. |
| **Alternative Flow** | | | | |
| A3 | The admin enters invalid input (e.g., an email in an incorrect format). | |  | The system displays an error message: "Invalid input. Please correct the errors." |

Table 9: Manage User account

### Track Feedback

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Track Feedback | | |
| Actors | | Admin | | |
| Summary | | Admin can view feedback submitted by users and monitor trends or issues.   |  | | --- | |  | | | |
| Pre-Conditions | | The admin must be logged into the system. Feedback must exist in the database. | | |
| Post-Conditions | | Feedback is displayed and may be marked as addressed or unresolved | | |
| Special Requirement | | Provide filtering options for easier navigation of feedback | | |
| **Basic Flow** | | | | |
| Actor Action | | | System Response | |
| 1 | The admin navigates to the feedback tracking section. | | 2 | The system displays a list of user feedback with relevant details. |
| 3 | The admin selects a feedback to view details or mark it as addressed | | 4 | The system updates the feedback status accordingly. |
| **Alternative Flow** | | | | |
| A3 | The admin searches for feedback but none exists. | |  | The system displays a message: "No feedback available." |

Table 10: Track Feedback

### Manage content

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Manage Content | | |
| Actors | | Admin | | |
| Summary | | Admin can create, update, or delete content displayed on the platform. | | |
| Pre-Conditions | | |  | | --- | | The admin must be logged into the system. | | | |
| Post-Conditions | | |  | | --- | | Content changes are saved and displayed on the platform | | | |
| Special Requirement | | Ensure preview functionality is available before saving changes. | | |
| **Basic Flow** | | | | |
| Actor Action | | | System Response | |
| 1 | The admin navigates to the content management section. | | 2 | The system displays existing content items. |
| 3 | The admin creates new content or updates/deletes existing content. | | 4 | The system validates the action and saves the changes. |
| **Alternative Flow** | | | | |
| A3 | The admin does not have permission to update/delete the content | |  | The system displays a warning message: "you don’t have access to update/ delete the content." |

Table 11: Manage content

### Change diet plan

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Change diet plan | | |
| Actors | | User | | |
| Summary | | User will change his diet plan or specific diet if he/she do not like that diet meal. | | |
| Pre-Conditions | | The user must be login and must have already diet plan | | |
| Post-Conditions | | |  | | --- | | Diet meal is change according to user choice. | | | |
| Special Requirement | | None | | |
| **Basic Flow** | | | | |
| Actor Action | | | System Response | |
| 1 | User must be login with correct credentials. | | 2 | The system validate and redirect to the User dashboard. |
| 2 | The user navigate to the diet plan section on the dashboard. | | 3 | The system displays his/her existing diet meal and also give option to change diet meal. |
| 4 | The user click on the option of change diet meal. | | 5 | The system analyze and give meals option according to user choice. |
| 6 | The user select the meal according to his/her choice. | | 7 | The system update the meal in his diet plan of one week. |
| **Alternative Flow** | | | | |
| A1 | If the user input the incorrect email and password. | |  | The system displays a error message and ask “enter again email and password” |

Table 12: Change diet plan

### Change Password

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Change password | | |
| Actors | | user | | |
| Summary | | The user can change his/her password. | | |
| Pre-Conditions | | |  | | --- | |  |   The user must be go to change password form | | |
| Post-Conditions | | Password is changed | | |
| Special Requirement | | None | | |
| **Basic Flow** | | | | |
| Actor Action | | | System Response | |
| 1 | Click on the change password button | | 2 | System move to the change password form |
| 3 | User Enter the current password | |  |  |
| 4 | User enter the new password | |  |  |
| 5 | User enter the new password in the conform password field and click on the change password button | | 6 | System validate the requirement of the password and display password is changed |
| **Alternative Flow** | | | | |
| A3 | The user enter the wrong password | |  | The system show current password is incorrect. |
| A4 | The user enter new password < 6 characters | |  | The system show error password must be greater than 6 characters. |

Table 13: Change password

### Tracking calories

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Tracking calories | | |
| Actors | | user | | |
| Summary | | The user must track his calories through the system how much he/she intake calories. | | |
| Pre-Conditions | | |  | | --- | | The admin must be logged into the system. | | | |
| Post-Conditions | | |  | | --- | | View the calories intake in a day by the user. | | | |
| Special Requirement | | None | | |
| **Basic Flow** | | | | |
| Actor Action | | | System Response | |
| 1 | The user must be login. | | 2 | The system validate and redirect to the user dashboard. |
| 3 | The user move to dashboard and click the “tracking calories” option. | | 4 | The system shows the calories tracking meter where his/her calories intake are stored. |
| **Alternative Flow** | | | | |
| A3 | The user cannot register diet plan. | |  | The system display a message must be register for diet plan. |

Table 14: Tracking calories

### Give feedback

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Give feedback | | |
| Actors | | User | | |
| Summary | | The user give feedback about the system progress and diet suggestion or any problem they have. | | |
| Pre-Conditions | | |  |  | | --- | --- | | The user must be logged into the system. |  | | | |
| Post-Conditions | | Feedback is successfully submitted now is visible for everyone. | | |
| Special Requirement | | None | | |
| **Basic Flow** | | | | |
| Actor Action | | | System Response | |
| 1 | The User access to the FITNESSSTAN website or app and login to their account. | | 2 | The system validate the user credentials and redirect to the user dashboard. |
| 3 | The User have multiple option and choose the “feedback” option. | | 4 | The system redirect user to the feedback page. |
| 5 | The user select the option of post feedback. | | 6 | The system present a feedback form to the user. |
| 7 | User enters their feedback in the provided text area. | |  |  |
| 8 | User click on the “Submit” or “post” button to publish the feedback. | | 9 | The system adds the feedback to the feedback section. |
|  |  | | 10 | The System shows a notification conforming that the feedback was successfully posted. |
| **Alternative Flow** | | | | |
| A7 | If the user enters inappropriate or abusive feedback. | |  | Then the system may have implemented AI sentiments to identify and remove the abusive feedback. |

Table 15: Give feedback

### Submitting form

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Name | | Submitting form | | |
| Actors | | User | | |
| Summary | | The user submit the form about his details like: weight, height, age etc. | | |
| Pre-Conditions | | |  |  | | --- | --- | | The user must be logged into the system. |  | | | |
| Post-Conditions | | Form is successfully submitted. | | |
| Special Requirement | | None | | |
| **Basic Flow** | | | | |
| Actor Action | | | System Response | |
| 1 | The User access to the FITNESSSTAN website or app and login to their account. | | 2 | The system validate the user credentials and redirect to the user dashboard. |
|  |  | | 3 | The system show the form page. |
| 4 | The User answers the all questions which is in the form. | |  |  |
| 5 | The User click the submit button to submit the form | | 6 | The system shows the data is successfully submit. |
| **Alternative Flow** | | | | |
| A2 | The user does not give answer of all question. | |  | Then the system shows a red alert to show the user answer that question. |

Table 16: Submitting form

## Database Schema Diagram

### User Collection

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field Name | Type | Required? | Description | Indexes |
| \_id | ObjectId | Yes | Primary key | \_id (default) |
| username | String | Yes | User's username |  |
| email | String | Yes | User's email address |  |
| password | String | Yes | User's password (hashed) |  |
| roles | Array | Yes | Array of user roles (e.g., ADMIN, USER) |  |
| status | String | Yes | User's status (e.g., PASS, FAIL) |  |
| createdAt | Date | Yes | Timestamp of user account creation |  |
| updatedAt | Date | Yes | Timestamp of last account update |  |
| heightFt | Double | Yes | User's height in feet |  |
| dob | Date | Yes | User's date of birth |  |
| weightKg | Double | Yes | User's weight in kilograms |  |
| gender | String | Yes | User's gender (e.g., Male, Female) |  |
| occupation | String | Yes | User's occupation |  |
| religion | String | Yes | User's religion |  |
| exerciseLevel | String | Yes | User's exercise level (e.g., 6 days a week) |  |
| sleepHours | Double | Yes | Average sleep hours per night |  |
| medicalHistory | Array | Yes | Array of medical history (e.g., None, Diabetic) |  |
| bmi | Double | Yes | User's body mass index |  |
| ree | Double | Yes | Resting energy expenditure (REE) |  |
| tdee | Double | Yes | Total daily energy expenditure (TDEE) |  |

Table 17: User Collection Schema

### Diet Collection

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field Name | Type | Required? | Description | Indexes |
| \_id | ObjectId | Yes | Primary key | \_id (default) |
| user | ObjectId | Yes | Reference to the user in the users collection |  |
| mealPlan | Object | Yes | Object containing meal plans for each day (1-14) |  |
| startDate | Date | Yes | Diet plan start date |  |
| endDate | Date | Yes | Diet plan end date |  |

Table 18: Diet Collection Schema

### Exercises Collection

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field Name | Type | Required? | Description | Indexes |
| \_id | ObjectId | Yes | Primary key | \_id (default) |
| name | String | Yes | Exercise name |  |
| muscleGroup | String | Yes | Target muscle group (e.g., Core, Legs) |  |
| gifUrl | String | Yes | Path to the GIF representing the exercise |  |
| description | String | Yes | Short description of the exercise |  |
| equipment | String | Yes | Equipment used for the exercise (e.g., body weight, dumbbells) |  |

Table 19: Exercise Collection Schema

### Feedback Collection

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field Name | Type | Required? | Description | Indexes |
| \_id | ObjectId | Yes | Primary key | \_id (default) |
| name | String | Yes | Name of the person giving feedback |  |
| email | String | Yes | Email address of the person providing feedback |  |
| feedback | String | Yes | The actual feedback text |  |
| submittedAt | Date | Yes | Timestamp of when feedback was submitted |  |

Table 20: Feedback Collection Schema

### Workout Plan Collection

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Field Name | Type | Required? | Description | Indexes |
| \_id | ObjectId | Yes | Primary key | \_id (default) |
| user | ObjectId | Yes | Reference to the user in the users collection |  |
| planName | String | Yes | Name of the workout plan |  |
| startDate | Date | Yes | Start date of the workout plan |  |
| endDate | Date | Yes | End date of the workout plan |  |
| dayPlans | Array | Yes | Array of day plans, each containing a day number and exercises for that day |  |
| - dayNumber | Integer | Yes | Day number (1-14) |  |
| - exercises | Array | Yes | Array of exercises (references to exercises collection) |  |

Table 21: Workout Plan Collection schema

**Chapter 4:**

Implementation and

Test Cases

# Implementation and Test Cases

## Implementation:

We have successfully implemented key components of the website, model, and app. The website includes signup and login with role-based authentication (user/admin) and a user dashboard. The model uses clustering for dataset segmentation and classification for insights. The Fitnesstan app, built with Flutter, features a multi-screen interface with navigation, role-based authentication, and a dashboard showcasing workouts, diet plans, and sleep tracking, styled with a cohesive red-black gradient theme and interactive elements.

### Implementation of First Component/Algorithm:

#### Web Development:

**Platform**: The website is built using React, leveraging its component-based architecture for seamless development and scalability.

**Homepage Design**:

* **Introduction Section**: The homepage features a visually appealing layout with an introduction to the application accompanied by an aesthetically pleasing image on the right side.
* **Features Section**: Includes an introduction to the application's key features, followed by a button to navigate to the detailed Features Page.
* **Supplements Section**: A similar section introduces the supplements offered, with a button directing users to the dedicated Supplements Page for further details.
* **Admin-Approved Content Section**: A section displays content specifically approved by the admin for visibility on the homepage.
* **Team Collaboration Section**: Showcases the teamwork and collaboration behind the platform, highlighting contributors.
* **Feedback Section**: Provides a dedicated area where users can submit their feedback, enabling interaction and improvement.

**Footer**: A professionally designed footer credits contributors and acknowledges the work behind the platform, ensuring completeness and branding.

**Navigation**:

* **Sticky Navbar**: The website features a sticky navigation bar on the front page for improved usability and accessibility.
* **React Router DOM**: Well-defined routes seamlessly connect pages, including the Features Page, Supplement Page, Registration Page, Additional Info Page, and Email Verification Page.

**Interactive Buttons**:

* **Back to Top Button**: A custom-designed button smoothly transitions the user back to the top of the page.
* **Back to Home Button**: A functional button allows users to return directly to the homepage, enhancing navigation and user experience.

**Authentication**:

* A robust authentication system is implemented, enabling secure user signup and login functionalities.

**Admin Panel**:

* **Sidebar Design**: The admin panel replaces the standard navbar with a sidebar layout for better navigation and improved workspace efficiency. The sidebar serves as a quick-access menu, streamlining administrative tasks.
* **Theme**: Styled with a dark grey primary color and strong red accents as the secondary color, ensuring a visually appealing and professional look.
* **Functionality**: The admin panel includes tools and sections for managing website content, user data, and administrative settings.

**Visual Theme**: The entire website uses a dark grey primary and vibrant red accents for a modern, cohesive, and energetic design theme.

**User Engagement**: The interface is designed with a focus on usability and interactivity, ensuring an intuitive and smooth user journey across all pages and features.

#### Algorithm:

In algorithm we use the ensemble technique in which we use 3 types of algorithm that are k-mean clustering for making clusters and random forest for classification and multiple linear. Regression but know we implement the 2 model k-mean clustering and Random forest algorithm.

* **Data Collection:**

Data collection began with the food nutrition dataset which is sourced from USDA food database in the dataset there is a lot of food items and their corresponding nutrition values.

* **Data Preprocessing:**

Preprocessing involved cleaning and normalization the dataset, addressing issues like missing values, normalize the serving size or irrelevant data. This steps helps the model for best results.

* **Model training**:

We give the clean dataset to the model and we do clustering by using k mean clustering and make 14 cluster and each cluster is labeled for example high protein cluster, high carbs cluster etc. and then we use synthetic data of users to train the model Random forest for classification.

* **Trained Model:**

The final trained model is now implemented in which take a input from the user like weight, height, dob, religion, occupation, disease and then on the basis of this we calculate the BMI and on the basis of it we classify the user belongs to which cluster.

## Test Case Design and description

### Test Data

|  |  |
| --- | --- |
| **Test Data** | **TD-1** |
| **Form** | Signup Form |
| **Stakeholder** | User |
| **Field** | Full Name |
| **Technique** | Equivalence Class Partitioning (ECP) |
| **Valid** | {A…..Z, a……z} |
| **Invalid** | {1, 2, 3…..}  {@,# and other special characters} |

Table 22: Test Data Registration

|  |  |
| --- | --- |
| **Test Data** | **TD-2** |
| **Form** | Signup Form |
| **Stakeholder** | User |
| **Field** | Email |
| **Technique** | Equivalence Class Partitioning (ECP) |
| **Valid** | {a….z, A…..Z,1,2,3,…….@gmail.com},  { a….z, A…..Z,1,2,3….,@students.riphah.edu.pk} |
| **Invalid** | user@invalid.com, multiple ‘@’ characters and not ending with numbers like 1,2,3,4. |

Table 23: Test Data Registration

|  |  |
| --- | --- |
| **Test Data** | **TD-3** |
| **Form** | Signup Form |
| **Stakeholder** | User |
| **Field** | Password |
| **Technique** | Equivalence Class Partitioning (ECP) |
| **Valid** | Password length>==6 character{ { A…..Z, a…..z}, {1,2,3…9}} Special characters |
| **Invalid** | Password length <6 |

Table 24: Test Data Registration

|  |  |
| --- | --- |
| **Test Data** | **TD-4** |
| **Form** | Login |
| **Stakeholder** | User/Admin |
| **Field** | Email |
| **Technique** | Equivalence Class Partitioning (ECP) |
| **Valid** | {a….z, A…..Z,1,2,3,…….@gmail.com},  { a….z, A…..Z,1,2,3….,@students.riphah.edu.pk} |
| **Invalid** | user@invalid.com, multiple ‘@’ characters and not ending with numbers like 1,2,3,4. |

Table 25: Test Data Login

|  |  |
| --- | --- |
| **Test Data** | **TD-5** |
| **Form** | Login |
| **Stakeholder** | User |
| **Field** | Password |
| **Technique** | Equivalence Class Partitioning (ECP) |
| **Valid** | Password length>==6 character{ { A…..Z, a…..z}, {1,2,3…9}} Special characters |
| **Invalid** | Password length <6 |

Table 26: Test Data Login

|  |  |
| --- | --- |
| **Test Data** | **TD-6** |
| **Form** | Additional information |
| **Stakeholder** | User |
| **Field** | Date of Birth |
| **Technique** | Equivalence Class Partitioning (ECP) |
| **Valid** | Month/date/year |
| **Invalid** | Date/month/year, valid numbers |

Table 27: Test Data Additional information

|  |  |
| --- | --- |
| **Test Data** | **TD-6** |
| **Form** | Feedback |
| **Stakeholder** | User |
| **Field** | Post feedback |
| **Technique** | Equivalence Class Partitioning (ECP) |
| **Valid** | {A…..Z, a…..z}, {12, 3…..} |
| **Invalid** | Empty input |

Table 28: Test Data feedback

### Test Case

|  |  |
| --- | --- |
| **ID** | **TC-1** |
| **Form** | Registration |
| **Stakeholder** | User |
| **Field** | Full name |
| **Date** | 2/04/25 |
| **Input** | Obaid Ullah |
| **Partition Tested** | {A…..Z,a….z} |
| **Expected Output** | OK |
| ***Test case Passed*** | |

Table 29: Test Case Registration

|  |  |
| --- | --- |
| **ID** | **TC-2** |
| **Form** | Registration |
| **Stakeholder** | User |
| **Field** | Full name |
| **Date** | 2/04/25 |
| **Input** | 1234 |
| **Partition Tested** | {A…..Z,a….z,\_} |
| **Expected Output** | Error |
| ***Test case Passed*** | |

Table 30: Test Case Registration

|  |  |
| --- | --- |
| **ID** | **TC-3** |
| **Form** | Registration |
| **Stakeholder** | User |
| **Field** | Email |
| **Date** | 2/04/25 |
| **Input** | Obaidullah7601@gmail.com |
| **Partition Tested** | Contain ‘@’ along with a, b,….z, A, B,C,….Z 1,2,3,….before’@’.,\_ before the letter ‘@’ at the end following those three to four alphabetic letters |
| **Expected Output** | OK |
| ***Test case Passed*** | |

Table 31: Test Case Registration

|  |  |
| --- | --- |
| **ID** | **TC-4** |
| **Form** | Registration |
| **Stakeholder** | User |
| **Field** | Email |
| **Date** | 2/04/25 |
| **Input** | Obaidullah760gmail.com |
| **Partition Tested** | Contain ‘@’ along with a, b,….z, A, B,C,….Z 1,2,3,….before’@’.,\_ before the letter ‘@’ at the end following those three to four alphabetic letters |
| **Expected Output** | Error |
| ***Test case Passed*** | |

Table 32: Test Case Registration

|  |  |
| --- | --- |
| **ID** | **TC-5** |
| **Form** | Registration |
| **Stakeholder** | User |
| **Field** | Password |
| **Date** | 2/04/25 |
| **Input** | Zain\_12345 |
| **Partition Tested** | Password length >=6 character {A……Z,a…..Z}  {1,2,3…..9} special characters |
| **Expected Output** | OK |
| ***Test case Passed*** | |

Table 33: Test Case Registration

|  |  |
| --- | --- |
| **ID** | **TC-6** |
| **Form** | Registration |
| **Stakeholder** | User |
| **Field** | Password |
| **Date** | 2/04/25 |
| **Input** | Zain |
| **Partition Tested** | Password length >=6 character {A……Z,a…..Z}  {1,2,3…..9} special characters |
| **Expected Output** | error |
| ***Test case Passed*** | |

Table 34: Test Case Registration

|  |  |
| --- | --- |
| **ID** | **TC-7** |
| **Form** | Login |
| **Stakeholder** | User |
| **Field** | Email |
| **Date** | 5/04/25 |
| **Input** | Obaidullah7601@gmail.com |
| **Partition Tested** | Contain ‘@’ along with a, b,….z, A, B,C,….Z 1,2,3,….before’@’.,\_ before the letter ‘@’ at the end following those three to four alphabetic letters |
| **Expected Output** | OK |
| ***Test case Passed*** | |

Table 35: Test case Login

|  |  |
| --- | --- |
| **ID** | **TC-8** |
| **Form** | Login |
| **Stakeholder** | User/Admin |
| **Field** | Email |
| **Date** | 5/04/25 |
| **Input** | Obaidullah7601gmail.com |
| **Partition Tested** | Contain ‘@’ along with a, b,….z, A, B,C,….Z 1,2,3,….before’@’.,\_ before the letter ‘@’ at the end following those three to four alphabetic letters |
| **Expected Output** | Invalid Email |
| ***Test case passed*** | |

Table 36: Test Case Login

|  |  |
| --- | --- |
| **ID** | **TC-9** |
| **Form** | Login |
| **Stakeholder** | User/Admin |
| **Field** | Email |
| **Date** | 5/04/25 |
| **Input** | Obaidullah7601@gmail.com |
| **Assume** | User does not register |
| **Partition Tested** | Contain ‘@’ along with a, b,….z, A, B,C,….Z 1,2,3,….before’@’.,\_ before the letter ‘@’ at the end following those three to four alphabetic letters |
| **Expected Output** | Error ( User Does not Exist) |
| ***Test case passed*** | |

Table 37: Test Case Login

|  |  |
| --- | --- |
| **ID** | **TC-10** |
| **Form** | Feed back |
| **Stakeholder** | User |
| **Field** | Post feedback |
| **Date** | 9/04/25 |
| **Input** | I Like this platform and also I feel changes in my health |
| **Partition Tested** | {A…..Z, a…..z}, {12, 3…..} |
| **Expected Output** | Feedback posted successfully |
| ***Test case Passed*** | |

Table 38: Test Case Feedback

|  |  |
| --- | --- |
| **ID** | **TC-11** |
| **Form** | OTP |
| **Stakeholder** | User |
| **Field** | Enter OTP |
| **Date** | 14/04/25 |
| **Pre-Condition** | OTP send on Email |
| **Input** | 456445 |
| **Partition Tested** | {1, 2, 3…} |
| **Expected Output** | User register successfully |
| ***Test case Passed*** | |

Table 39: Test Case OTP

|  |  |
| --- | --- |
| **ID** | **TC-12** |
| **Form** | OTP |
| **Stakeholder** | User |
| **Field** | Enter OTP |
| **Date** | 14/04/25 |
| **Pre-Condition** | OTP send on Email |
| **Assume** | User enter invalid OTP |
| **Input** | 313412 |
| **Partition Tested** | {1, 2, 3…} |
| **Expected Output** | Incorrect OTP |
| ***Test case Passed*** | |

Table 40: Test Case OTP

|  |  |
| --- | --- |
| **ID** | **TC-13** |
| **Form** | Additional Form |
| **Stakeholder** | User |
| **Field** | Enter Information |
| **Date** | 18/04/25 |
| **Input** | Height= 5.6  Date of birth=03/28/2003  Occupation= student  Gender=Male  Muslim no exercise  9 hours |
| **Partition Tested** | Built in choose by user |
| **Expected Output** | Enter data successfully |
| ***Test case Passed*** | |

Table 41: Test case add information

|  |  |
| --- | --- |
| **ID** | **TC-14** |
| **Form** | Calculating BMI,TDEE and REE |
| **Stakeholder** | User |
| **Field** | Showing BMI , TDEE and REE |
| **Date** | 18/04/25 |
| **Input** | Height= 5.6  Date of birth=03/28/2003  Occupation= student  Gender=Male  Muslim no exercise  9 hours |
| **Partition Tested** | Built in choose by user |
| **Expected Output** | BMI = 51, TDEE = and REE= |
| ***Test case Passed*** | |

Table 42: Test Case calculating

|  |  |
| --- | --- |
| **ID** | **TC-15** |
| **Form** | Calculating BMI,TDEE and REE |
| **Stakeholder** | User |
| **Field** | Showing BMI , TDEE and REE |
| **Date** | 18/04/25 |
| **Input** | Height= 5.6  Date of birth=01/18/2004  Occupation= student  Gender=Male  Muslim 6 days exercise  8hours |
| **Partition Tested** | Built in choose by user |
| **Expected Output** | BMI = 22, TDEE = and REE = |
| ***Test case Passed*** | |

Table 43: Test Case calculating

|  |  |
| --- | --- |
| **ID** | **TC-16** |
| **Use case** | Making diet plan |
| **Stakeholder** | User |
| **Date** | 23/04/25 |
| **Input** | Height= 5.6  Date of birth=03/28/2003  Occupation= student  Gender=Male  Muslim no exercise  9 hours |
| **Partition Tested** | Built in choose by user |
| **Expected Output** | Model make a 14 days plan successfully |
| ***Test case Passed*** | |

Table 44: Test Case making Diet

bo

|  |  |
| --- | --- |
| **ID** | **TC-17** |
| **Use case** | Change meal |
| **Stakeholder** | User |
| **Date** | 26/04/25 |
| **Pre-condition** | Already diet plan exist |
| **Input** | Click on change meal |
| **Expected Output** | Model change the meal according to his/her need |
| ***Test case Passed*** | |

Table 45: Test Case Change meal

## Test Metrics

### Test case Matric

|  |  |
| --- | --- |
| Metric | Purpose |
| **Number of Test Cases** | 22 |
| **Number of Test Cases Passed** | 22 |
| **Number of Test Cases Failed** | 0 |
| **Test Case Defeat Density** | 0 |
| **Test Case Effectiveness** | 0\*100 |
| **Traceability Matrix** | Traceability refer to the ability to determine that each feature has a source in requirements and that each requirement has a matching implemented feature. |

Table 46: Test Case Matric

**Chapter 5:**  Experimental Result

& Analysis

# Experimental Result and Analysis

## Introduction

This chapter is all about experiments and their result analysis so we are going to present the experimental setup, results and analysis of our website “Fitnessstan”. We aim in this evaluation to validate the fitnessstan effectiveness when connecting a user with the website and its performance of recommendation system the experiments that we are going to discuss are designed for technical and user-centric metrics which will provide a comprehensive overview of fitnessstan capabilities and will also discuss about areas for improvement.

## Experiments Analysis

In the Fitnesstan our model is divided into three phases Clustering, Classification and regression.

### Clustering

#### Experimental Setup

In the first phase, we initially use a nutrition dataset from Kaggle, which contains 8,789 instances and 79 features. We then perform data preprocessing, including normalization, feature engineering, and removal of irrelevant features. After preprocessing, the dataset contains 8,789 instances and 25 features.

After preprocessing, we aim to create clusters from the dataset and determine the optimal number of clusters for Clustering. To find the optimal number of clusters, we use two methods: the **Elbow Method** and the **Silhouette Score**.

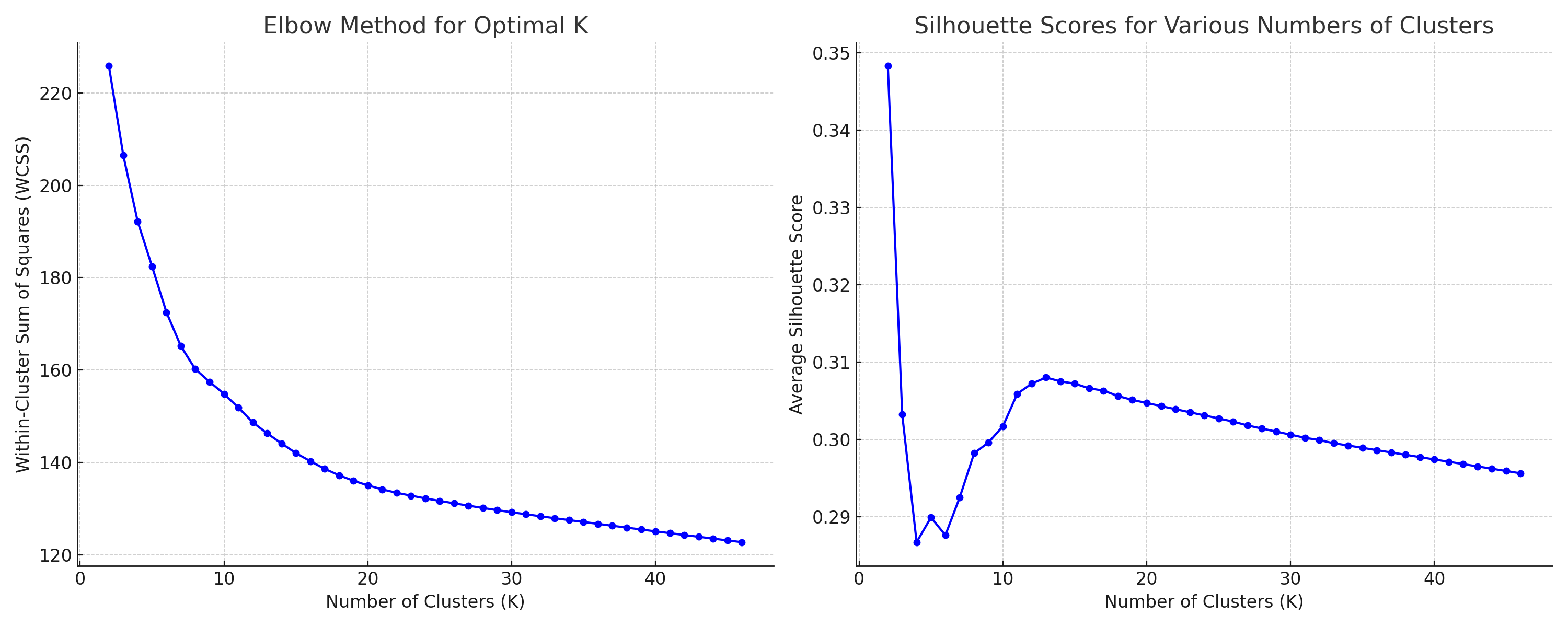


Figure 7: Evaluate number of cluster

Both the **Elbow Method** and **Silhouette Score** indicate that the optimal number of clusters is **K = 14**. The Elbow Method shows a significant reduction in WCSS at K = 14, while the Silhouette Score is highest at this value, suggesting the best cluster separation and cohesion.

#### ****Clustering Model Training:****

* **Data Input**: The dataset used in clustering contains 8,789 instances and 25 features after preprocessing.
* **Algorithm Execution**: Once the optimal K is determined using the Elbow Method and Silhouette Score, the **K-Means algorithm** is executed on the dataset to perform the clustering.
* **Model Output**: The output of the model will be a set of clusters, each containing instances that are similar to each other based on the feature set used for clustering.

# 

Figure 8: Clustering

This t-SNE visualization shows the K-Means clustering results of the dataset with 14 clusters. Each data point is assigned to one of the 14 clusters, represented by different colours, and the plot projects the high-dimensional data onto two dimensions for easier interpretation. The clusters appear to be well-separated, indicating that the data points within each cluster share similar characteristics, which could be useful for further analysis in the Fitnessstan recommendation system.

### Classification

#### Experimental Setup

In the classification phase first we make a synthetic dataset of different users to train the classification Model. First we make condition or data of different users with the help of expert then we used that dataset and we use CTGAN model which is used for to make synthetic dataset and we train on the dataset and after training the CTGAN model we make a synthetic dataset of 20000 users and after making the dataset we split dataset 80% for training and 20% for testing.

#### ****Classification Model Training:****

#### After creating the synthetic dataset, we proceeded to train classification models using four different algorithms: Random Forest, XGBoost, AdaBoost, and SVM. Initially, we evaluated these models, and their classification accuracies are shown in the figure.

#### 

Figure 9: Comparison of Models

#### 

After the first phase of training, we selected the top two models with the highest accuracy: Random Forest and XGBoost. In the second phase of classification training, we improved the dataset and performed hyper parameter tuning on both models to enhance classification accuracy. As a result, Random Forest achieved an accuracy of 60%, while XGBoost reached 49%.

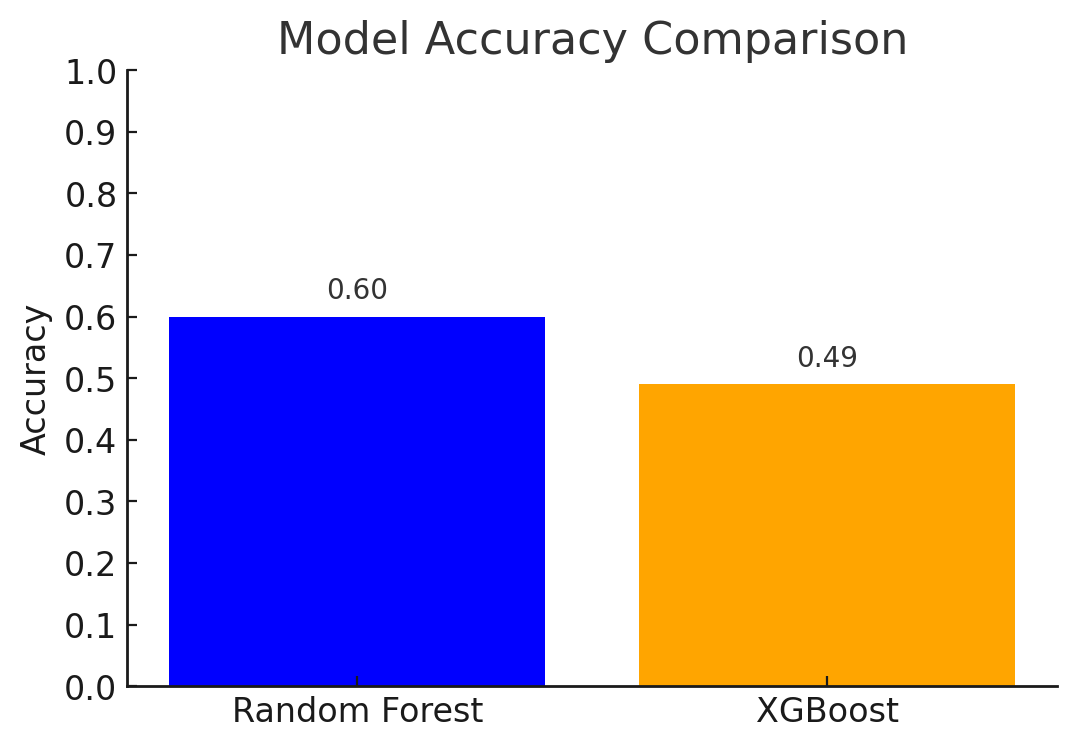


Figure 10: Models accuracy

In the third phase, to further improve classification accuracy, we applied an ensemble technique by combining both Random Forest and XGBoost models. Additionally, we used Gradient Boosting as a meta-learner, along with hyper parameter optimization and k-fold cross-validation to enhance overall performance. As a result, we achieved 72% accuracy for the primary cluster and 76% accuracy for the secondary cluster.

# 

Figure 11: Classification Final Model Accuracy

### Regression

#### Experimental Setup

This experiment start with loading the dataset from CSV file which contained food nutrition data such as protein, carbohydrates, fats and calories etc. The data was cleaned and pre-processed by removing non-numeric values and missing values filled with zeros. The data was split into training 80% and testing 20% to ensure the models could be evaluated on unseen data. These preprocessing steps ensured that the dataset was clean, structured, and ready for model training.

#### Regression Model training

In the model training phase we use two different machine learning models that are HistGradientBoostingRegressor (HGB) and ridge regression with polynomial features. To improve the performance, the predictions from both models were combined in an **Ensemble Model**, where the predictions from both the **HGB** and **Ridge** models were averaged. The **Ensemble Model** delivered the best results, with the lowest RMSE and MAE, and the highest R² value. Below is the comparison of the results from each model:

|  |  |  |  |
| --- | --- | --- | --- |
| Models | RMSE | MAE | R² |
| HGB | 13.80 | 7.36 | 0.993 |
| RIDGE | 12.12 | 6.19 | 0.995 |
| BLEND | 11.78 | 6.10 | 0.995 |

Figure 12: Regression model evaluation

## Conclusion

After completing the experiments, we obtained promising results across all three phases: clustering, classification, and regression. We then integrated these models to implement the core functionality of FITNESSSTAN, which delivers a personalized 14-day diet plan tailored to the user's preferences. The integration was successful, and the system produced effective results. Now if new users come on the Fitnessstan they put his/her information our model classify according to his/her information and assign the two clusters where they belong and after that our regression model assign the make a diet for 14 days according to his/her TDEE.IF they don’t like meal there is an option to change the meal and our model took the meal from cluster and give to the user.

# Chapter No 6

# Conclusion and future Direction

# Conclusion and Future Directions

## Introduction

Fitnessstan is a smart fitness platform that keeps users fit through customized diet plans and workout programs. The platform utilizes artificial intelligence to learn the individual needs and goals of users. The interface of the platform is user-friendly and supports both web and mobile applications. Notably, Fitnessstan is highly suitable for diabetes patients since it offers customized meal plans. Furthermore, the platform offers calorie tracking, user input, and progress tracking. In general, the goal is to make it easy, safe, and effective to handle fitness for everyone. By using technological innovation combined with user input, Fitnessstan provides an improved solution to fitness and health management.

## Achievements

Fitnessstan has made significant progress in providing a comprehensive fitness platform for users. The AI-powered system successfully delivers personalized diet and exercise plans, tailored to individual health profiles. The meal recommendation system offers a 14-day plan that adapts to user progress and health metrics. For users with specific needs, such as diabetics, customized nutrition guidance is offered. The platform’s calorie tracking and progress monitoring tools ensure users stay informed. Flexibility is incorporated with the Change feature, allowing users to modify meal plans. These achievements collectively enhance the user experience and support the platform’s mission to promote healthier lifestyles.

## Improvements and Future Directions

Improvements and Future Directions: Fitnessstan will focus on making the platform more user-friendly. This includes enhancing the user interface for a smoother and more intuitive navigation experience, making it easier for users to interact with the app and access their personalized fitness plans. Moving forward, Fitnessstan will implement dockerization to improve deployment, scalability, and ease of maintenance. The platform will also add multi-language support, allowing it to serve a broader, more diverse user base. Additionally, AI-powered workout customization will be introduced, enabling users to create and personalize their own workout routines, further enhancing the app's adaptability and user experience.

## Conclusion

A personalized fitness platform called Fitnessstan revolutionizes the way users approach fitness by seamlessly combining AI-powered diet and workout recommendations. The platform offers personalized fitness plans based on individual health metrics, and preferences, ensuring optimal results. By leveraging AI (Machine learning) for diet suggestions and exercise database for workout routines, it provides users with data-driven, effective guidance, particularly for individuals with specific health conditions like diabetes.

Designed for ease of use, Fitnessstan includes features such as progress tracking, personalized updates, and real-time adjustments. Looking ahead, the platform will integrate further enhancements like AI-driven workout customization, multi-language support, and dockerization, ensuring scalability and broad accessibility for users worldwide.

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