FINAL YEAR PROJECT REPORT

BS (COMPUTER SCIENCE)

HEALTHIFYMEAL

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ABSTRACT

It is observed that our society is a big consumer of unhealthy and unhygienic food, which increases the chance of severe chronic diseases and obesity. There is also literature available about how to plan and prepare healthy meals, but either that is irrelevant or very generalized for a specific individual. There is no one-size-fits-all formula as every individual has a different goal, dietary restrictions, allergies, and nutrient needs. In Pakistan, there is a vast working-class population with strict schedules and work commitments, due to which a vital aspect of healthy meal planning is often overlooked; therefore, junk food becomes the preferred option as it is readily available and quick to eat. This is where meal planner applications come to the rescue to build personalized meal plans with great customization to cater to every individual's needs.

HealthifyMeal addresses all these problems and provides a one-stop solution to consumers. HealthifyMeal creates personalized meal plans in a few seconds from a mobile application to help users reach their dietary and nutritional goals based on their food preferences and schedule. It is an AI-powered application that uses Machine Learning to search and recommend the best meal plan from the database of meals created by an expert Dietitian. In addition, it also offers users the facility to order the same suggested food from HealthifyMeal on a weekly recurring basis, so they are entirely focused on their health and daily life. We also provide users an option to have an on-demand 1:1 virtual consultation session with a Dietitian.

DECLARATION

I hereby declare that the work has been done by myself to fulfill the requirement of the BS (Computer Science) and no portion of the work contained in this report has been submitted in support of any application for any other degree or qualification of this or any other university or institute of learning.

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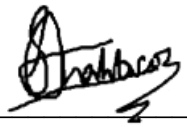

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TABLE OF CONTENTS

ABSTRACT **i**

DECLARATION **ii**

ACKNOWLEDGEMENT **iii**

TABLE OF CONTENTS **iv**

LIST OF TABLES **vii**

LIST OF FIGURES **viii**

LIST OF ABBREVIATIONS AND ACRONYMS **ix**

LIST OF APPENDIXES **x**

Chapter 1: INTRODUCTION **1**

1.1 Preamble 1

1.2 Problem Statement 2

1.3 Motivation and Need 2

1.4 Project Objectives 3

1.5 Limitations and Challenges 4

1.6 Structure of the Report 4

Chapter 2: BACKGROUND **5**

2.1 Introduction 5

2.2 Overview of Basic Technology 5

2.3 Background Research 8

2.4 Literature Review and Existing Applications 10

2.5 Summary 16

Chapter 3: PROJECT PLAN AND INITIAL DESIGN **17**

3.1 Introduction 17

3.2 Summary of Activity Schedule 17

3.3 Functional Requirements 18

3.4 Non-functional Requirements 18
3.5 Hardware Requirements 19
3.6 Summary 19

Chapter 4: DESIGN AND SPECIFICATION 20

4.1 Introduction 20
4.2 Block Diagram 20
4.3 Use Case Diagrams and Narratives 21
4.4 Entity Relationship Diagram (ERD) 34
4.5 Flow Chart 35
4.6 Summary 36

Chapter 5: SYSTEM PROTOTYPE AND DEVELOPMENT 37

5.1 Introduction 37
5.2 Algorithm 37
5.3 Wireframes 40
5.4 Prototype Design 48
5.5 Database Design 52
5.6 External Libraries 52
5.7 Summary 52

Chapter 6: RESULT ANALYSIS AND TESTING 53

6.1 Introduction 53
6.2 Test Cases 53
6.3 Summary 59

Chapter 7: CONCLUSION 60

7.1 Introduction 60
7.2 System Limitation and Challenges 60
7.3 Future Work 60
7.4 Summary 61

REFERENCES **62**

APPENDIX A **64**

Business Model Canvas 64

APPENDIX B **65**

Gantt Chart 65

LIST OF TABLES

Table. 1 HealthifyMeal vs. Competitors 16
Table. 2 User Registration 23
Table. 3 User Login 23
Table. 4 User Create Profile 24
Table. 5 User Get Diet Plan 24
Table. 6 User Order Meal 25
Table. 7 User Book Appointments 25
Table. 8 User Attend Appointment 26
Table. 9 Dietitian Registration 28
Table. 10 Dietitian Login 28
Table. 11 Dietitian Create Profile 29
Table. 12 Dietitian View Appointments 29
Table. 13 Dietitian Attend Appointments 30
Table. 14 Dietitian View Information 30
Table. 15 Admin Login 31
Table. 16 Admin View Appointments 32
Table. 17 Admin View Information 32
Table. 18 Admin View Orders 33
Table. 19 Test Case 1.1 53
Table. 20 Test Case 1.2 54
Table. 21 Test Case 2.1 54
Table. 22 Test Case 2.2 55
Table. 23 Test Case 2.3 56
Table. 24 Test Case 3.1 56
Table. 25 Test Case 3.2 57
Table. 26 Test Case 4.1 58
Table. 27 Test Case 5.1 58

LIST OF FIGURES

Fig. 1	Recommendation System Terminology and Concepts	6
Fig. 2	Phases of Recommendation Process	7
Fig. 3	Gantt Chart	17
Fig. 4	Block Diagram	20
Fig. 5	Use Case Diagram	21
Fig. 6	Entity Relationship Diagram	34
Fig. 7	Flow Chart	35
Fig. 8	KNN Algorithm Working Example:1	38
Fig. 9	KNN Algorithm Working Example:2	38

LIST OF ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
ML	Machine Learning
Ecommerce	Electronic Commerce
App	Application
App Store	Application Store
CF	Collaborative Filtering
CBF	Content-based Filtering
UI	User Interface
UX	User Experience
CBRS	Content-based Recommender System
CRS	Collaborative Recommender System
FODMAP	Fermentable, Oligosaccharides, Disaccharides, Monosaccharides, and Polyols
RS	Recommendation/Recommender Systems
ERD	Relationship Diagram
KNN	K-nearest Neighbor
SQL	Structured Query Language

LIST OF APPENDIXES

APPENDIX A: BUSINESS MODEL CANVAS 64
APPENDIX B: GANTT CHART 65

CHAPTER 1

INTRODUCTION

1.1 PREAMBLE

Promoting a healthy lifestyle and healthy meals is very important because diet plays a vital role in keeping us healthy. But unfortunately, unhealthy and unhygienic food dominates our society and is a direct threat to many individuals' lives and makes people sick. Additionally, there is no education available about it to the masses. For example, the average life of a Japanese individual is close to 85 years, as food quality and hygiene are their paramount concern. In contrast, the average life in Pakistan is around 55 years. Therefore, there is a massive demand for healthy meals, especially at gyms and workplaces, as they focus on this aspect of life.

We have many healthy meal planning applications available globally, but no application supports local Pakistani consumers and their needs. Moreover, foreign applications suggest food and ingredients tailored to their origin. We have a vast working-class population with strict schedules and work commitments, leading to unhealthy lifestyles and food due to low attention to such details. Many blogs on the internet suggest what to eat, but either that is irrelevant or very generalized for a specific individual. All the meal planner applications available on the internet only suggest food. The utility of such applications remains very low as they don't offer the same meal to be delivered to the customer, and there is no expert consultation available. To reiterate, we have a working-class population, and preparing healthy meals and collecting ingredients is a heavy lifting that can easily be solved by bringing all these aspects into a single application.

HealthifyMeal does just that; it is an android application powered by Artificial Intelligence to cater to different types of individuals and their needs. It turns healthy meal planning into an effortless and magical experience providing a variety of delicious and healthy recipes specific to user needs. Users can customize and control their diet; we have them covered whether they are vegetarian or non-vegetarian or looking to gain or lose weight. It helps save users' time and take the anxiety out of picking what to eat and how to prepare their meals — so they are no more wasting time searching and viewing cooking tutorials. Users are not skipping meals just because

they are missing an ingredient. Users can review their meals for the week and get them delivered. The target audience is any individual, a gym with a population of health-conscious people, and corporate organizations concerned about their employees' health.

1.2 PROBLEM STATEMENT

It is observed that our society is a big consumer of unhealthy and unhygienic food, which increases the chance of severe chronic diseases and obesity. There is also literature available about how to plan and prepare healthy meals, but either that is irrelevant or very generalized for a specific individual. There is no one-size-fits-all formula as every individual has a different goal, dietary restrictions, allergies, and nutrient needs.

In Pakistan, there is a vast working-class population with strict schedules and work commitments, due to which a vital aspect of healthy meal planning is often overlooked; therefore, junk food becomes the preferred option as it is readily available and it is quick to eat. This is where meal planner applications come to the rescue to build personalized meal plans with great customization to cater to every individual's needs. Unfortunately, most of those applications are made for people outside Pakistan and tailored to their preferences. They suggest meals and ingredients which are very unlikely to be consumed by a Pakistani consumer. A few businesses are built around this idea in Pakistan, but they only offer packaged food and supplements without customization and meal planning options.

HealthifyMeal addresses all these problems and provides a one-stop solution to Pakistani consumers.

1.3 MOTIVATION AND NEED

Promoting a healthy lifestyle and healthy meals is very important because diet plays a vital role in our lives in keeping us healthy. Unfortunately, the unhealthy and unhygienic food present in our society is a direct threat to many individuals' lives and potentially makes people sick. Additionally, there is no education available about it to the masses. The average life expectancy

of a Japanese individual is around 84 years, as food quality and hygiene are their paramount concern, whereas the average life in Pakistan is about 67 years.

There is a huge demand for healthy meals, especially at gyms and workplaces, as they focus on this aspect of life. The target audience is any individual, a gym with a massive population of health-conscious people, and corporate organizations concerned about their employees' health. We have many healthy meal planning applications available globally, but no application supports local Pakistani consumers and their needs. Moreover, foreign applications suggest food and ingredients tailored to their origin. We have a vast working-class population with strict schedules and work commitments, leading to unhealthy lifestyles and food due to low attention to such details. Many blogs on the internet suggest what to eat, but either that is irrelevant or very generalized for a specific individual.

All the meal planner applications only suggest food, and the utility of such applications remains very low as they don't offer the same meal to be delivered to the customer. To reiterate, we have a working-class population, and preparing healthy meals and collecting ingredients is a heavy lifting that can easily be solved by bringing both aspects to a single application.

HealthifyMeal creates personalized meal plans in a few seconds from a mobile application to help you reach your diet and nutritional goals based on your food preferences and schedule. In addition, it also offers you the facility to order the same suggested food from HealthifyMeal on a weekly recurring basis, so you are entirely focused on your health and daily life while we do the heavy lifting for you and get you your fresh and healthy meal to your doorstep. We also provide you an option to have a 1:1 virtual consultation session with your dietitian on-demand.

1.4 PROJECT OBJECTIVES

1. To create an automated meal planner application to promote healthy meals and lifestyle using Artificial Intelligence.
2. To develop the best available meal plans with the available literature and dietitians.

3. To monetize the platform and onboard users to take advantage of our learning and order meals with the convenience of the mobile application.

1.5 LIMITATIONS AND CHALLENGES

1. The food space is highly dominated by giants like Foodpanda and Cheetay, which have restaurants, so we need to grab and filter out those who want to switch to healthy meals.
2. To build a database of meal plans accommodating all sorts of users and their needs allowing them to shuffle the meals if they disagree.
3. Achieving the highest level of accuracy with the results of the application.
4. To maintain the quality and standard of food produced in the commercial kitchen and keep the cost low.
5. Approaching gyms to help us find out our potential clients.
6. Pitching HealthifyMeal to corporate clients to add it to their wellness program to sponsor healthy meals for their employees.

1.6 STRUCTURE OF THE REPORT

The structure of the report is stated below:

1. Introduction
2. Background
3. Project plan and initial design
4. System design and specifications
5. System prototype and development
6. Result analysis and testing
7. Conclusion

CHAPTER 2

BACKGROUND

2.1 INTRODUCTION

HealthifyMeal, at its core, is a recommender system to offer dietary and meal planning assistance to users. A recommender system is also called a recommendation system (sometimes replacing 'system' with a synonym such as a platform or an engine).

Humans require assistance in decision-making. Be it any decision such as "Which movie should I watch this weekend?", "Which mobile phone should I buy?", "What should I eat?" – all such decisions are often taken with the help and guidance of family and friends. In most cases, help from others comes with the best intentions, but it has a certain level of bias and is not effective [1]. Similarly, meal planning is very arduous and requires correct assistance because it is connected to health, and we cannot follow everyone's advice in this regard. Therefore, it would be great to have some personal advisors tailored to our needs and suggest the best meal choices considering our health. Luckily, this is possible to build using the recommender system.

2.2 OVERVIEW OF BASIC TECHNOLOGY

2.2.1 Recommendation Systems

As per [2], the term "idea" refers to a hypothesis about how we can effectively generate a recommendation. To further differentiate the specification of an idea is about distinguishing between recommendation classes, approaches, algorithms, and implementations (Fig. 1).

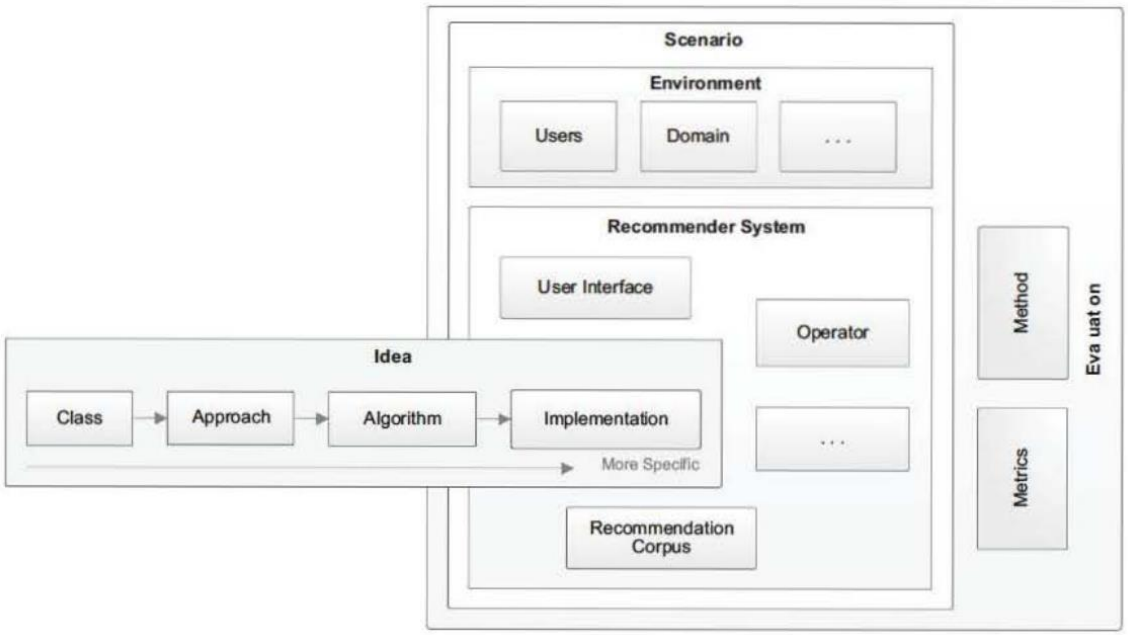


Fig. 1 Recommendation System Terminology and Concepts

A "recommendation class" describes how recommendations can be given. There are several recommendation classes, such as collaborative filtering (CF) and content-based filtering (CBF). collaborative filtering (CF) [2]. The differences between their underlying ideas are discussed later.

On the other hand, a "recommendation approach" is a model of bringing a recommendation class into practice. For example, the broad idea of collaborative filtering (CF) can be realized with user-based collaborative filtering (CF) [3], content-boosted collaborative filtering (CF) [4], and multiple other approaches [5]. These all are different approaches, but the underlying idea of collaborative filtering (CF) is the same.

A “recommendation algorithm” describes a recommendation approach. An algorithm does not have to be complete; it can specify important information and ignore the basics, e.g., weighting schemes. There can be several algorithms for a particular recommendation approach [2].

Here, the "implementation" refers to an actual source code of the recommendation algorithm [2]. The recommender system utilizes this source code after compiling it. There are no speculations as the source code describes every detail about how a recommendation is generated.

Finally, a "recommendation system" is a full-fledged software system that utilizes at least one implementation to generate recommendations [2]. Its scope also contains other components, such as a recommendation corpus, user interface (UI), and operator that runs the system.

The "recommendation scenario" defines the setting of a recommender system by incorporating the recommender system and the recommendation environment, i.e., the domain and the user characteristics [2].

2.2.2 Three Phases of Recommendation Process

The recommendation process has three phases (Fig. 2):

1. Information Collection Phase
2. Learning Phase
3. Prediction/Recommendation Phase

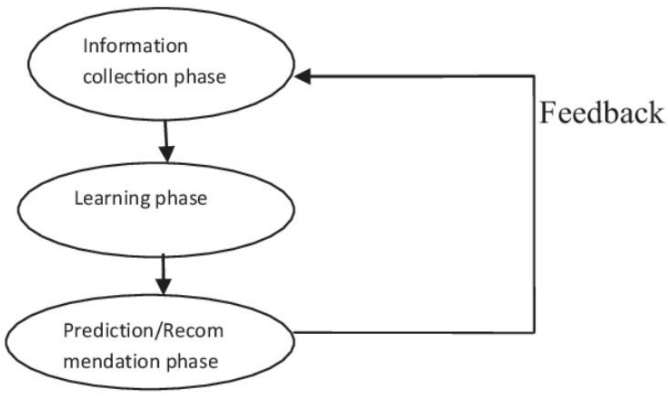


Fig. 2 Phases of Recommendation Process

The data and information are collected first about a particular problem from various sources, and the multiple solutions related to that problem are categorized. Then, in the

Learning Phase, various conclusions are made from the gathered information. Finally, in the Recommendation Phase, the output is given in which multiple recommendations are made. For example, HealthifyMeal is a healthy diet recommendation system; therefore, the recommendations will propose the diet plan based on the user's inputs, e.g., height, weight, age, dietary restrictions, and goals.

2.3 BACKGROUND RESEARCH

A recommender system has become a powerful and intelligent computer-based technique that predicts and generates recommendations based on users' preferences and usage. Today, most internet users have stumbled upon and interacted with recommender systems in some ways [1]. For example, Google recommends advertisements based on our preferences, YouTube recommends videos in accord, Facebook recommends prospective friends, etc. Such advancements in recommender systems [1] have achieved greater benefits in an e-commerce domain because e-commerce giants like Amazon, AliExpress, and eBay can recommend products customers are most interested in and will end up buying. The core objective of the recommender system is to help users in decision-making with the maximum accuracy possible [6]. Many researchers from different domains, e.g., artificial intelligence (AI), data mining, information security, approximation theory, information retrieval, and business, are interested in exploring more avenues and contributing more with their skillset and diverse research approaches [6].

Over the last few years, many advancements have been made in recommender systems discipline to improve their performance and applicability [7]. Technological challenges have occurred in building the recommender system, but many new methodologies and algorithms are also developed to resolve those challenges. Several recommendation techniques and algorithms have been proposed and successfully implemented. These algorithms mainly are content-based filtering (CBF), collaborative filtering (CF), and hybrid approaches. Many new techniques (either novel or amalgamations of existing methods) are continuously being proposed. The recent inductions used social networks and contextual information to generate dynamic features in the recommendation [6].

2.3.1 Recommendation Approaches Used for Recommendation System

This section presents a brief overview of the popular recommendation/filtering approaches in recommender systems.

2.3.1.1 Content-based Recommender System (CBRS)

The Content-based Recommender System (CBRS) uses Content-based Filtering (CBF). It generates recommendations of items by matching the user profile and the item description, where the user profile may include the previous history and searches [8]. This type of recommender system learns with time to recommend items similar to ones that users liked in the past. Here, the features of the items come into play to determine the similarity between items. For instance, if a user positively rates a horror movie, the recommender system will recommend movies of the same genre.

2.3.1.2 Collaborative Filtering Recommender System (CBRS)

The collaborative filtering recommender system (CFRS) is a very popular, recognized, and widely implemented recommender system [9][10]. A famous saying is that "a man is known by the company he keeps". The CFRS also follows the same philosophy. Here, the general assumption is that if two or more users' interests matched in the past, it is likely that their interests should match in the future, too [1]. Therefore, this approach keeps track of the user's past reviews and ratings to recommend similar items in the future. In an event where the user has not mainly dealt with that product, it will still be recommended because the peers of the users have used that product [11]. To achieve greater accuracy, a large dataset or a large number of users' data is required. Trust is an essential factor for reliable recommendations [12]. There are different categories of CF, such as [13]:

1. **Memory-based collaborative recommender system (CRS):** All those items that have been previously rated by a particular user play a part in looking for a neighbor with similar interests. Different algorithms could be

utilized when a neighbor is found, combining the taste to produce recommendations. These techniques have accomplished extensive results in real-life applications because of their usefulness of these strategies.

2. **Model-based CRS:** Models are developed using different machine learning and data mining algorithms to predict users' ratings of unrated items. There are many model-based CF algorithms such as clustering models, Bayesian networks, multiple multiplicative factor, latent semantic models such as singular value decomposition, probabilistic latent semantic analysis, latent Dirichlet allocation, and Markov decision process-based models.

2.3.1.3 Hybrid Recommender System (HRS)

In this technique, multiple filtering approaches are merged. The most popular pairing of HRS is that of CBS and CFRS. This merger helps increase the accuracy of the recommendations and eliminates the limitations of the individual filtering approaches [14].

2.4 LITERATURE REVIEW AND EXISTING APPLICATIONS

It is observed that consuming healthy meals positively impacts physical and mental well-being. It is also considered an investment for long-term health benefits [15]. Unfortunately, many researchers, policymakers, and media often tend to highlight the negative aspects of eating behavior, like counting calories, restricting specific types of meals, and building a narrative to sacrifice the eating joy for health benefits [16]. Research depicts that such restrained eating can increase the risk of obesity and eating disorders, thus, making it a counterproductive measure [17].

It is noticed that cooking practices and eating habits have changed now in developed countries, including the time allotted to cooking has decreased. For example, in the United States, it has reduced from 1:63 hours per day in 1965–1966 to 58 min in 2006–2007 [18]. The data represents

that people prefer to eat food outside to save time and effort. However, the food cooked outside the home is mostly junk and unhygienic, which can be a health hazard and become a major cause of obesity and other chronic diseases.

This is where a massive potential for meal planning applications exists to bridge the gap. As per [19], meal planning is a potential tool to save precious time and must be encouraged as it is a key promoter of a healthy diet. Unfortunately, meal planning activity has received very little attention in the literature.

2.4.1 EXISTING MEAL PLANNING APPLICATION

2.4.1.1 Mealime

Mealime [20] is an initiative to promote the culture of healthy meal planning. Mealime is a meal planner application available for Android and iOS. Mealime targets those individuals who don't have time to scour the web for healthy recipes and spend countless hours cooking them. This app lets you create a profile, add your food preferences, and choose your week's meals from recipes that the application curates for you.

Mealime promises to help you pick your weekly meals in minutes with over 200 personalization options. In addition, the application promises that all the recipes can easily be cooked in under 30 minutes. It will even generate a shopping list for you that can be imported into popular eCommerce applications such as Amazon for delivery.

While signing up, a user has complete control to pick the type of diet they want, such as:

1. Classic
2. Low Carb
3. Keto

4. Flexitarian
5. Paleo
6. Vegetarian
7. Pescetarian
8. Vegan

Next, the application also notes if a user has any allergies to gluten, egg, peanut, mustard, and dairy products. It also takes the input of the user's dislikes, such as seafood, certain vegetables, and cheese. Once the meal plan is generated, the application shows ingredients with their quantities and cookware to be used, along with the cooking instructions for each recipe.

The application is free, but upgrading to Pro unlocks access to many more recipes, nutrition information, and the ability to filter meals by calorie count, save meal plans, and add notes to a recipe. Importing favorite recipes from the web and creating a recipe from scratch is possible.

2.4.1.1.1 Pros

1. Free version with limited features.
2. Easy to use.
3. Generates recipes based on users' preferences.
4. Offers easy syncing between different devices.

2.4.1.1.2 Cons

1. Requires monthly payments for Pro membership with the full feature set.
2. No nutrition information in the free plan.
3. No 1:1 session with a dietitian for more customization and consultation.

4. No commercial kitchen to deliver the proposed meals.
5. Not tailored for Pakistani audience.

2.4.1.2 PlateJoy

PlateJoy [21] is a web and mobile application for building personalized meal plans. Their meal plans are made by nutritionists focusing on food preferences, fitness, calorie goals, and even accommodations for those who have diabetes or are on a low FODMAP plan.

PlateJoy membership costs $69 for six months and $99 for twelve months, offering very high customization of meal plans with specific dietary restrictions. First of all, users take a quick survey to help PlateJoy understand the user's particular needs, such as answering the dietary restrictions:

1. Low Carb
2. Paleo
3. Mediterranean Diet
4. Diabetic/Prediabetic
5. Ketogenic
6. 30-Day Cleanse
7. Low FODMAP

In addition, users can exclude specific proteins and input the allergies to particular items. After the survey, PlateJoy suggests meals for breakfast, lunch, dinner, and snacks. It also auto-generates the required groceries and offers seamless shopping with Instacart by importing the same grocery list. You can also add your recipes manually.

Users can also sync it to their FitBit to automatically add meals based on the user's calorie tracker. Many health insurance companies also partner with PlateJoy to offer a free subscription to their customers.

2.4.1.2.1 Pros

1. Nutritionist-designed and supported.
2. Free with some health insurance providers.
3. Seamless cloud sync across devices.

2.4.1.2.2 Cons

1. No free plan, requires membership.
2. Membership is costly.
3. No 1:1 session with a dietitian for more customization and consultation.
4. No commercial kitchen to deliver the proposed meals.
5. Not tailored for Pakistani audience.

2.4.1.3 Eat This Much

Eat This Much [22] creates personalized meal plans based on your food preferences, budget, and schedule. Users can reach their diet and nutritional goals with the calorie calculator, weekly meal plans, grocery lists, etc.

It is a web application and a mobile application available on iOS and Android platforms. It will generate custom meal plans using its vast database, using your preferences and calorie goals as a guide. It also allows users to import recipes from the web or manually add them. It's also a calorie tracker with a database of popular restaurant dishes and packaged foods. However, the app only allows daily meal plans unless you upgrade to the Premium account for $8.99 per month or

$3.99 a month when billed annually. The premium account allows for weekly plans with nutrition targets for each day, automatic shopping lists, and grocery delivery.

2.4.1.3.1 Pros

1. Calorie-goal oriented.
2. Good nutritional info per recipe.
3. Easy to use.
4. Large database of meals.

2.4.1.3.2 Cons

1. No 1:1 session with a Dietitian for more customization and consultation.
2. No commercial kitchen to deliver the proposed meals.
3. Not tailored for Pakistani audience.

2.4.2 HealthifyMeal vs. Competitors

	Mealime	PlateJoy	Eat This Much	HealthifyMeal
Android application	✓	✓	✓	✓
Vast database of meals	✓	✓	✓	✓
Cater to dietary restrictions	✓	✓	✓	✓
Free plan	✓	×	✓	✓
Weekly meal plans	✓	✓	×	✓
Nutrients information of meal	×	✓	✓	✓
Supports local Pakistani food	×	×	×	✓
1:1 session with Dietitian	×	×	×	✓
Ability to order meal	×	×	×	✓

Table. 1 HealthifyMeal vs. Competitors

2.5 SUMMARY

Recommendation Systems (RS) are software tools and techniques that provide suggestions to users based on their preferences and aids in decision-making. The effectiveness of the recommendation system relies on the algorithm it uses to generate the prediction. HealthifyMeal goal is also to offer maximum accuracy by implementing the best available approach so users can get the best suggestions and recommendations. Dealing with a massive amount of data will always be a tough challenge, but thanks to information retrieval and filtering mechanisms that make data preprocessing very easy and ultimately make recommendation systems very efficient. Different information retrieval techniques are available, such as machine learning, linear regression, logistic regression, association rule learning, decision tree, cluster analysis, Bayesian network classifier, support vector machine, deep learning, etc. The future of recommendation systems holds many exciting developments, and they will continue to improve and help us make decisions in the blink of an eye.

CHAPTER 3

PROJECT PLAN AND INITIAL DESIGN

3.1 INTRODUCTION

In this chapter, the project plan and initial design of the project are discussed. HealthifyMeal project focuses on building a mobile application that can run on maximum phones without any problem. The project's success will be based on the maximum number of active users. Therefore, the functional and non-functional requirements are written in such a manner that there is no compromise on the project's quality and performance.

3.2 SUMMARY OF ACTIVITY SCHEDULE

3.2.1 Gantt Chart

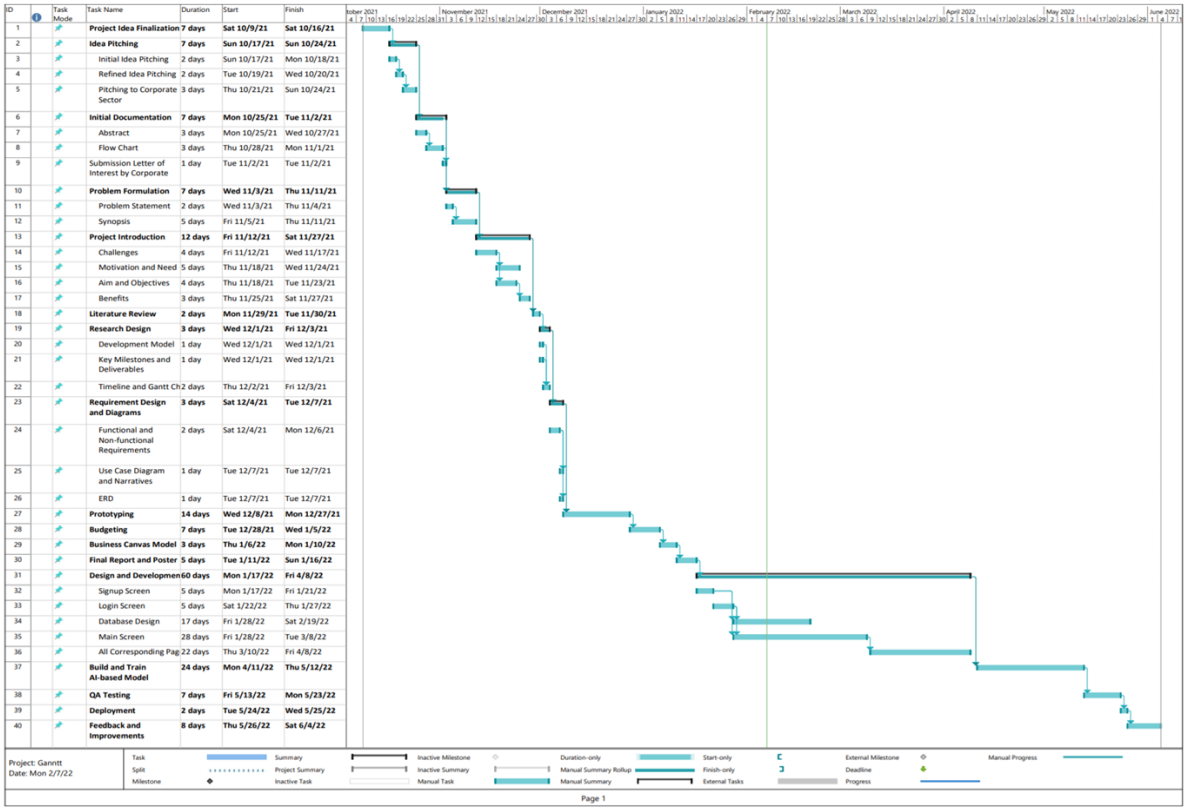


Fig. 3 Gantt Chart

3.3 FUNCTIONAL REQUIREMENTS

The HealthifyMeal application will be developed based on the following functional requirements:

1. The application will feature a signup and login screen along with "forget password" functionality.
2. Users can sign up and log in using the same signup screen; however, the Dietitian can join the application as an expert using a special link provided by the team.
3. All users will go through a small onboarding process to create profiles.
4. The information provided in the profile will help the AI-based model predict the weekly diet with special consideration to dietary restrictions and goals.
5. Users will have the option to regenerate the diet plan if the suggested one is not meeting the expectations.
6. The application will display ingredients and nutrient information of the suggested meals.
7. Users will have the option to order the suggested meal on a recurring and non-recurring basis.
8. Users can also book a 1:1 virtual session with an expert Dietitian as per the given availability.
9. Admin user of the application can view the total number of registered users and their activities.
10. Admin user can also post updates.
11. Admin user will have the right to enable/disable users' accounts.

3.4 NON-FUNCTIONAL REQUIREMENTS

The HealthifyMeal application will be developed based on the following non-functional requirements:

1. The mobile application should be responsive for all android devices.
2. The application should be lightweight in terms of its size.
3. The application uptime should be maximum.
4. It should be efficient and fast in terms of server and client responses.

5. The application should generate correct meal plans for users.
6. The mobile application should work in portrait mode only.
7. The mobile application should tolerate crashes and maintain consistency.
8. The mobile application should handle the high traffic.
9. The application should implement best security practices to ensure data safety and security.
10. The application should be available to the general public and deployed on Google Play Store.

3.5 HARDWARE REQUIREMENTS

The HealthifyMeal project requires a GPU to train the dataset and the required GPU is Nvidia GTX 1660 Super. In case of unavailability, Google Colab will be used to train the model.

3.6 SUMMARY

HealthifyMeal project has tight deadlines, but the project quality and performance will be the top-notch priority, and there will be no compromise on it. Moreover, the application will be dealing with huge amounts of textual data and with time the data volume will grow; therefore, it requires GPU to train the dataset. As an alternative, Google Colab can also be used to train the model.

CHAPTER 4

DESIGN AND SPECIFICATION

4.1 INTRODUCTION

In this chapter, the project design and specifications are discussed. In addition, this chapter features the use case diagram and their narratives, ERD, flow chart, and block diagram.

4.2 BLOCK DIAGRAM

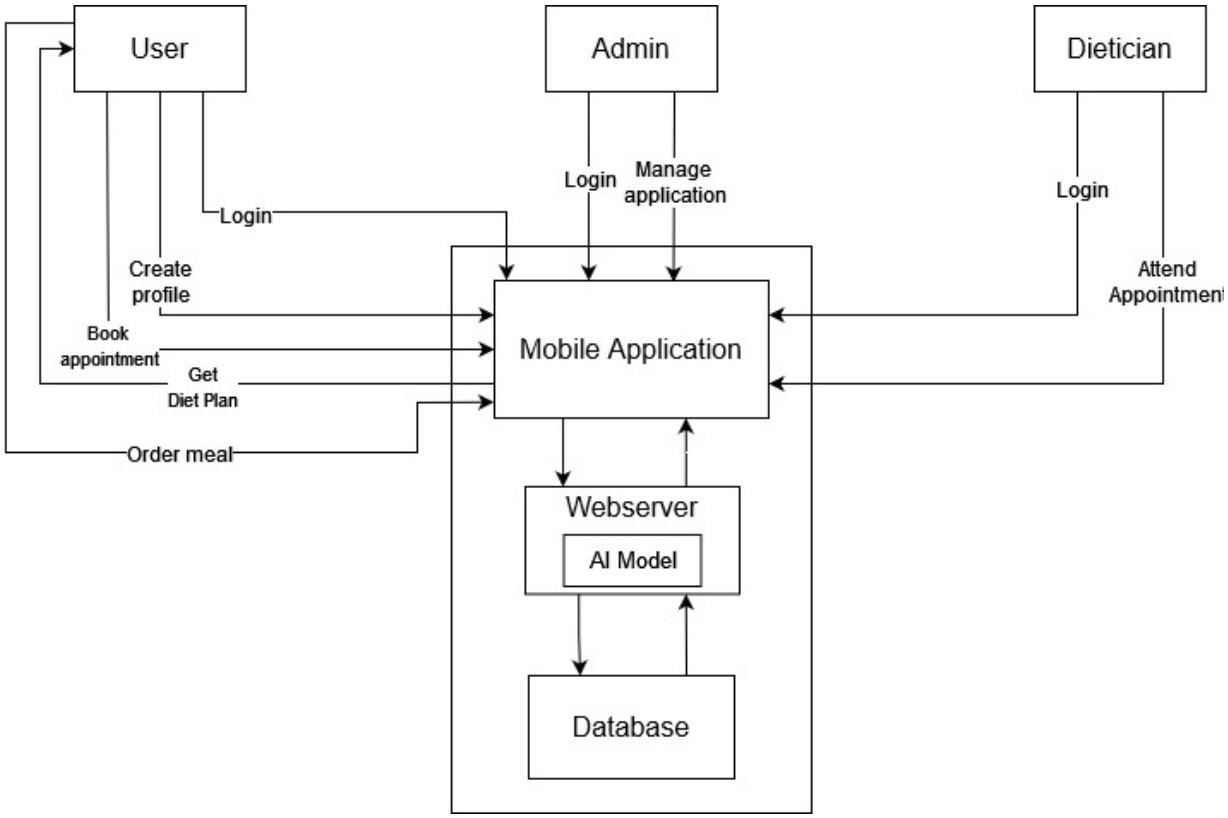


Fig. 4 Block Diagram

4.3 USE CASE DIAGRAMS AND NARRATIVES

4.3.1 Use Case Diagram

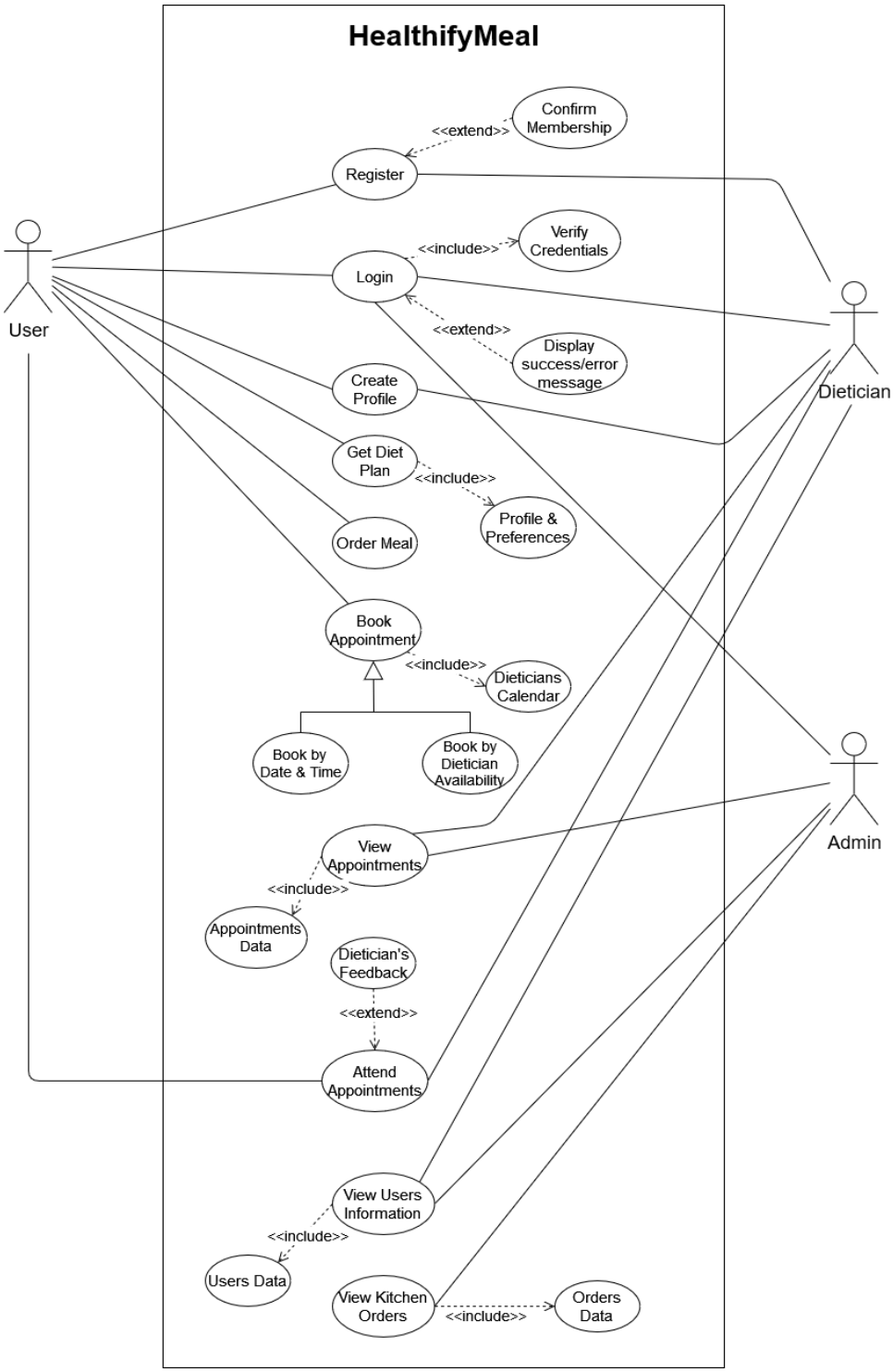
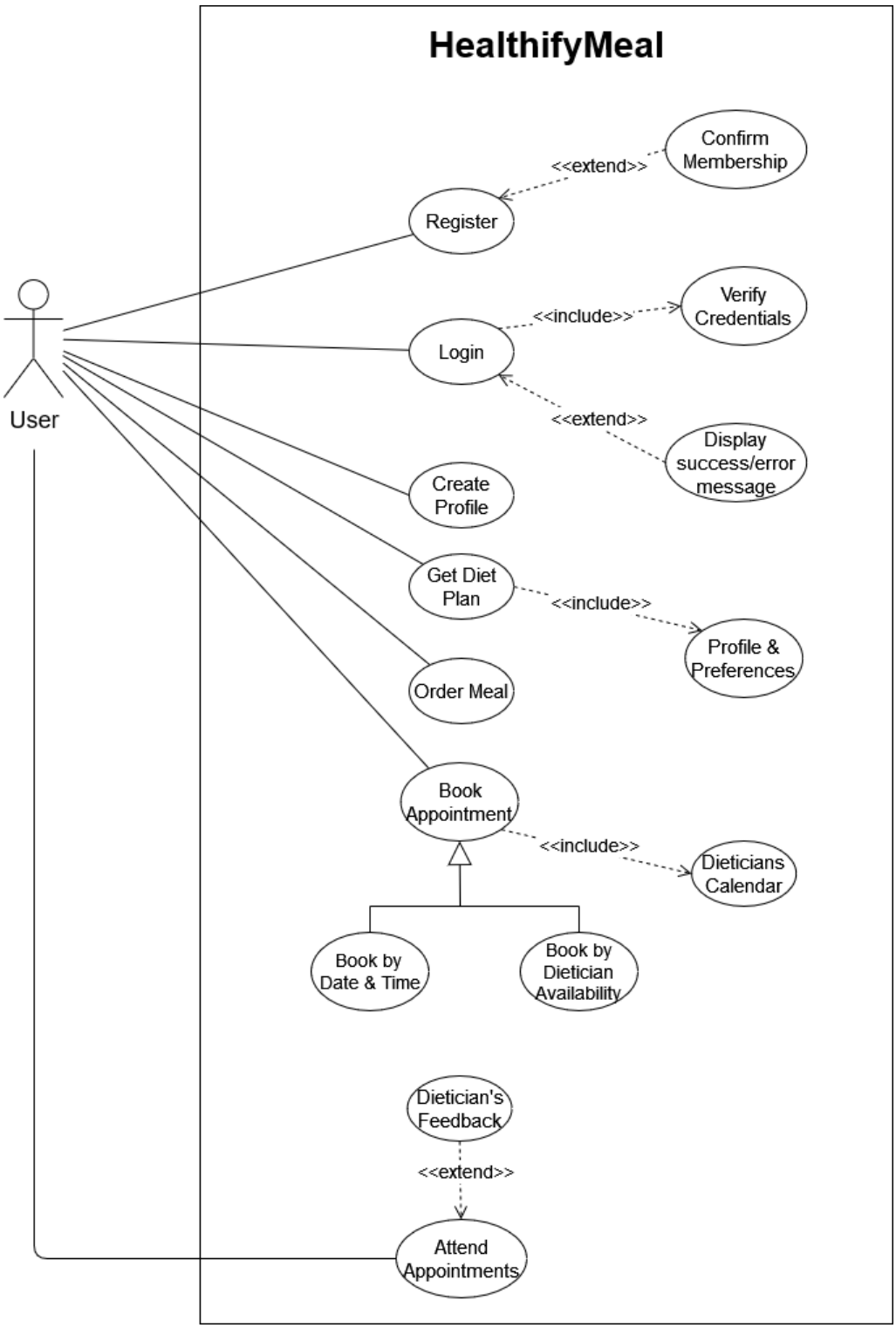


Fig. 5 Use Case Diagram

4.3.2 Use Case Narratives

4.3.2.1 User Actions



4.3.2.1.1 User Registration

Use Case Name:	User Registration	
ID:	user_registration	
Actors Involved:	User	
Brief Description	User register himself/herself by inputting the required information.	
Pre-Conditions	Same user has not registered before.	
Post-Conditions	User must confirm the registration.	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. User clicks the Register button. 2. Fill the registration form with the required information and submit it. 3. User confirms the registration using the email link.	1. System displays the registration form. 2. System validates the given information and send email confirmation to confirm registration. 3. Once the link is clicked, the system registers the user.

Table. 2 User Registration

4.3.2.1.2 User Login

Use Case Name:	User Login	
ID:	user_login	
Actors Involved:	User	
Brief Description	User log in to the application using the email and password.	
Pre-Conditions	User has registered before.	
Post-Conditions	User must create profile.	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. User clicks the Login button. 2. Fill the login form with the email and password and submit it.	1. System displays the login form. 2. System validates the given information and approve or reject the login.

Table. 3 User Login

4.3.2.1.3 Create Profile

Use Case Name:	Create Profile	
ID:	user_create_profile	
Actors Involved:	User	
Brief Description	User log in to the application first time and create a profile. Profile creation includes answering all the required questions for the next phase of diet plan generation.	
Pre-Conditions	User is logging in first time.	
Post-Conditions	-	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. User log in to the application first time. 2. User fill in all the required information for profile creation.	1. System detects the first login and display the profile creation form for user. 2. Once all the questions are answered, system saves that information with the associated user.

Table. 4 User Create Profile

4.3.2.1.4 Get Diet Plan

Use Case Name:	Get Diet Plan	
ID:	user_get_diet_plan	
Actors Involved:	User	
Brief Description	System generates the weekly diet plan based on the profile and preferences provided earlier. The user has the option to save it or regenerate it.	
Pre-Conditions	User has completed the profile and is logged in.	
Post-Conditions	User must save the diet plan or regenerate it.	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. User clicks the Generate Diet Plan button. 2. Once the weekly diet plan is generated, user can save it or regenerate it.	1. System fetches the profile and preferences information of the user. 2. System generates the weekly diet plan and show the options of saving it or regenerating it.

Table. 5 User Get Diet Plan

4.3.2.1.5 Order Meal

Use Case Name:	Order Meal	
ID:	user_order_meal	
Actors Involved:	User	
Brief Description	User orders the suggested weekly meal using the application on a weekly recurring on non-recurring basis.	
Pre-Conditions	User has saved the suggested diet plan.	
Post-Conditions	-	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. User orders the suggested meal by clicking Order Now button. 2. User schedule the delivery.	1. System will accept the order and forward it to the application admin and kitchen. 2. System will also save the same information and link it with the associated user.

Table. 6 User Order Meal

4.3.2.1.6 Book Appointment

Use Case Name:	Book Appointment	
ID:	user_book_appointment	
Actors Involved:	User	
Brief Description	User books the 1:1 virtual session with the expert Dietitian if user has any personal queries or require more personalization.	
Pre-Conditions	User has generated meal plan once.	
Post-Conditions	User and Dietitian are notified of the appointment.	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. User clicks the Book Appointment button. 2. Next, user enter the preferred day/time for the appointment or book the appointment with a specific Dietitian as per their calendar.	1. System fetches all Dietitians availability and show the available slots. 2. System will book the session as per the agreed time and send appointment information and reminder to both parties.

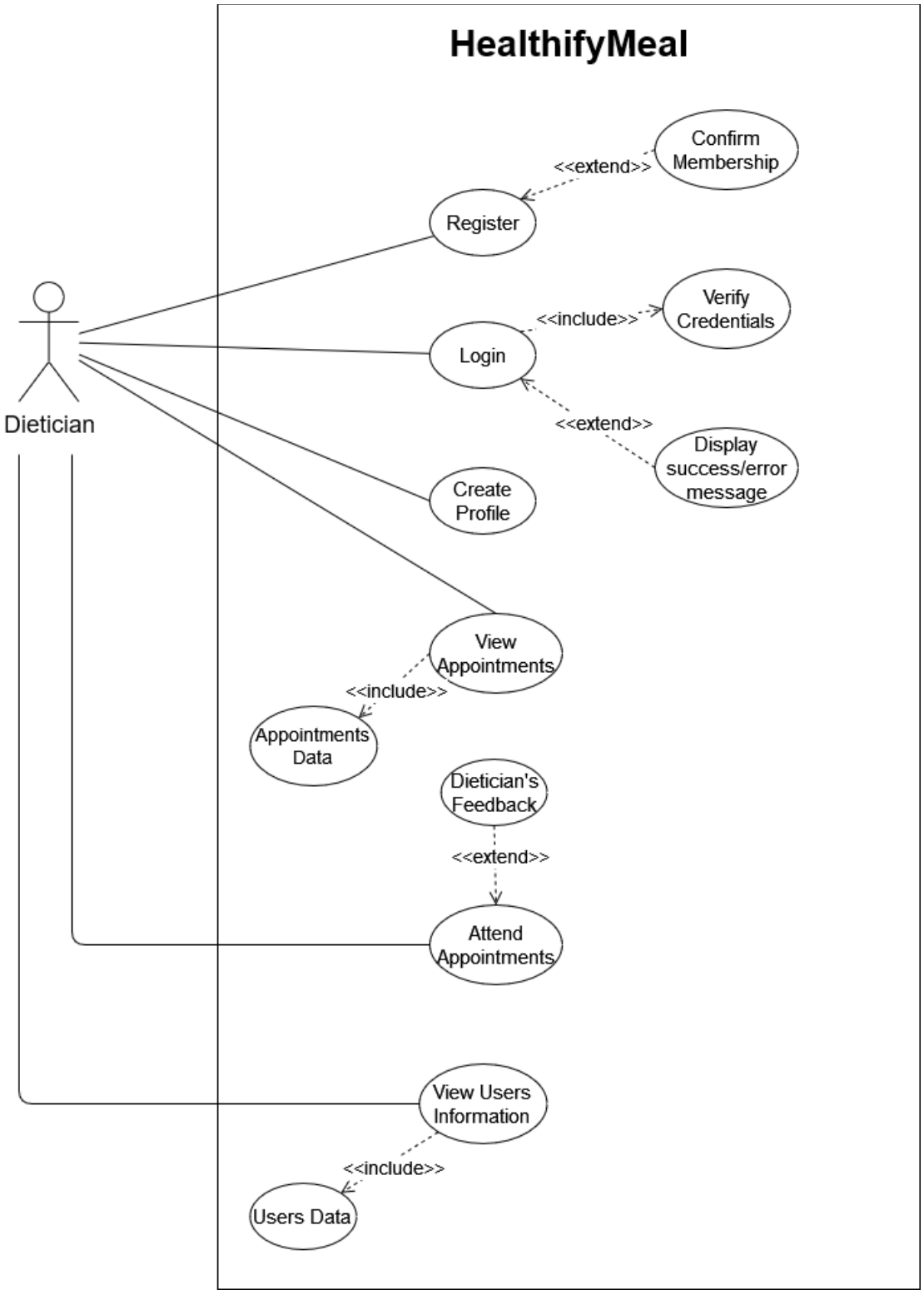
Table. 7 User Book Appointment

4.3.2.1.7 Attend Appointment

Use Case Name:	Attend Appointment	
ID:	user_attend_appointment	
Actors Involved:	User	
Brief Description	User and Dietitian attends the appointment and Dietitian gives feedback and personalized diet plan.	
Pre-Conditions	User has saved the suggested diet plan.	
Post-Conditions	-	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. User and Dietitian attends the appointment using a third-party software. 2. User gets personalized meal plan from Dietitian.	1. System will generate a meeting link before the session and send them to both parties. 2. Dietitian will enter the personalized diet of that particular user in the system so a user can order it if needed.

Table. 8 User Attend Appointment

4.3.2.2 Dietitian Actions



4.3.2.2.1 Dietitian Registration

Use Case Name:	Dietitian Registration	
ID:	Dietitian_registration	
Actors Involved:	Dietitian	
Brief Description	Dietitian register himself/herself by inputting the required information. Dietitian is invited via a special link by the HealthifyMeal team.	
Pre-Conditions	Same Dietitian has not registered before.	
Post-Conditions	Dietitian must confirm the registration.	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. Dietitian clicks the special link and is redirected to a registration page. 2. Fill the registration form with the required information and submit it. 3. Dietitian confirms the registration using the email link.	1. System sends the special link for registration. 2. Once clicked, it displays the registration form. 3. System validates the given information and send email confirmation to confirm registration. 4. Once the link is clicked, the system registers the Dietitian.

Table. 9 Dietitian Registration

4.3.2.2.2 Dietitian Login

Use Case Name:	Dietitian Login	
ID:	Dietitian_login	
Actors Involved:	Dietitian	
Brief Description	Dietitian log in to the application using the email and password.	
Pre-Conditions	Dietitian has registered before.	
Post-Conditions	Dietitian must create profile.	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. Dietitian clicks the Login button. 2. Fill the login form with the email and password and submit it.	1. System displays the login form. 2. System validates the given information and approve or reject the login.

Table. 10 Dietitian Login

4.3.2.2.3 Create Profile

Use Case Name:	Create Profile	
ID:	Dietitian_create_profile	
Actors Involved:	Dietitian	
Brief Description	Dietitian log in to the application first time and create a profile. Profile creation includes answering all the required questions related to credentials.	
Pre-Conditions	Dietitian is logging in first time.	
Post-Conditions	-	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. Dietitian log in to the application first time. 2. Dietitian fill in all the required information for profile creation.	1. System detects the first login and display the profile creation form for Dietitian. 2. Once all the questions are answered, system saves that information with the associated Dietitian.

Table. 11 Dietitian Create Profile

4.3.2.2.4 View Appointments

Use Case Name:	View Appointments	
ID:	Dietitian_view_appointments	
Actors Involved:	Dietitian	
Brief Description	Dietitian views all the scheduled appointments using the application.	
Pre-Conditions	Dietitian has completed the profile and is logged in.	
Post-Conditions	-	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. Dietitian views all the scheduled appointments using the application.	1. System fetches the booked appointments for that particular Dietitian. 2. System displays the booked appointments.

Table. 12 Dietitian View Appointments

4.3.2.2.5 Attend Appointments

Use Case Name:	Attend Appointment	
ID:	Dietitian_attend_appointment	
Actors Involved:	Dietitian	
Brief Description	Dietitian and user attends the appointment and Dietitian gives feedback and personalized diet plan.	
Pre-Conditions	Dietitian has completed the profile.	
Post-Conditions	-	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. Dietitian and user attends the appointment using a third-party software. 2. Dietitian gives personalized meal plan to the user.	1. System will generate a meeting link before the session and send them to both parties. 2. Dietitian will enter the personalized diet of that particular user in the system so a user can order it if needed.

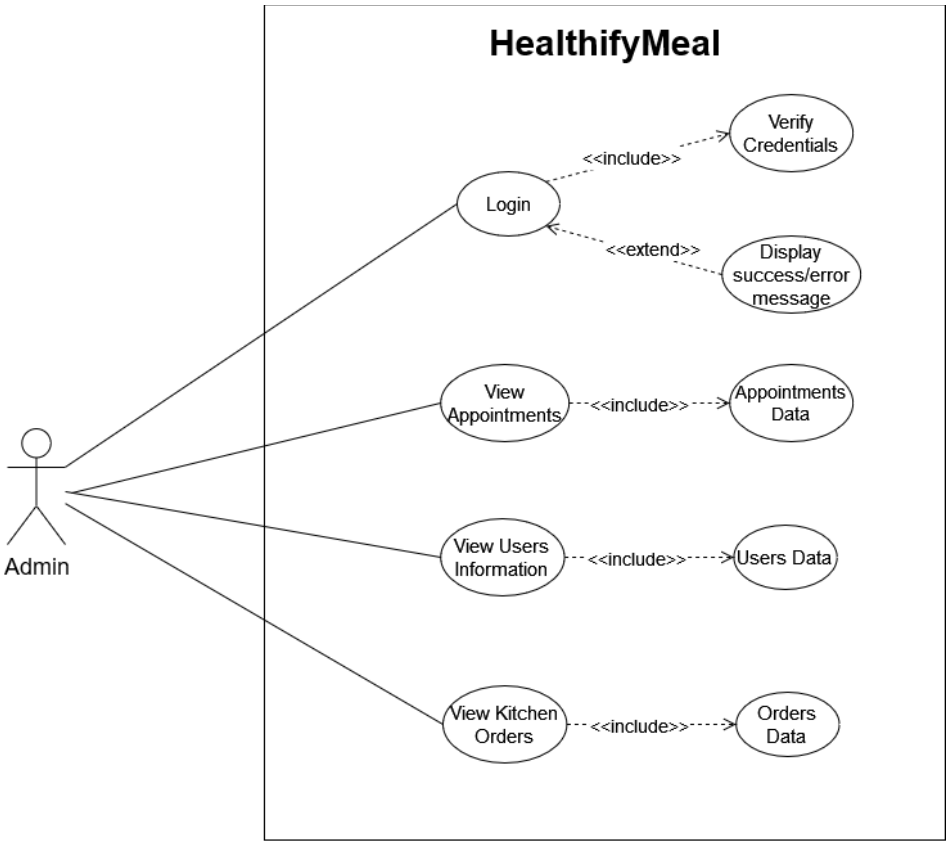
Table. 13 Dietitian Attend Appointments

4.3.2.2.6 View Users Information

Use Case Name:	View Users Information	
ID:	Dietitian_view_information	
Actors Involved:	Dietitian	
Brief Description	Dietitian views the user profile, history, appointments, and the meal plans suggested by the application.	
Pre-Conditions	Dietitian has completed the profile.	
Post-Conditions	-	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. Dietitian views the particular user information such as the profile, history, appointments, and the meal plans suggested by the application.	1. System fetches the particular user information. 2. System displays the user information.

Table. 14 Dietitian View Information

4.3.2.3 Admin Actions



4.3.2.3.1 Admin Login

Use Case Name:	Admin Login	
ID:	admin_login	
Actors Involved:	Admin	
Brief Description	Admin log in to the application using the email and password.	
Pre-Conditions	Admin user has registered before.	
Post-Conditions	-	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. Admin log in to the backend of the application. 2. Fill the login form with the email and password and submit it.	1. System displays the login form to access the backend. 2. System validates the given information and approve or reject the login.

Table. 15 Admin Login

4.3.2.3.2 View Appointments

Use Case Name:	View Appointments	
ID:	admin_view_appointments	
Actors Involved:	Admin	
Brief Description	Admin views all the scheduled appointments using the application.	
Pre-Conditions	Admin is logged in.	
Post-Conditions	-	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. Admin views all the scheduled appointments using the application.	1. System fetches all the booked appointments. 2. System displays the booked appointments.

Table. 16 Admin View Appointments

4.3.2.3.3 View Users Information

Use Case Name:	View Users Information	
ID:	admin_view_information	
Actors Involved:	Admin	
Brief Description	Admin views the user profile, history, appointments, and the meal plans suggested by the application.	
Pre-Conditions	Admin is logged in.	
Post-Conditions	-	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. Admin views the particular user information such as the profile, history, appointments, and the meal plans suggested by the application.	1. System fetches the particular user information. 2. System displays the user information.

Table. 17 Admin View Information

4.3.2.3.4 View Kitchen Orders

Use Case Name:	View Kitchen Orders	
ID:	admin_view_orders	
Actors Involved:	Admin	
Brief Description	Admin views and forward the kitchen orders placed by the user in the application.	
Pre-Conditions	Admin is logged in.	
Post-Conditions	-	
Normal Flow of Events:	**Actor Action**	**System Response**
	1. Admin views the kitchen orders placed by the user in the application. 2. Admin forwards the confirmed order to the kitchen.	1. System fetches the orders list. 2. System displays the order information.

Table. 18 Admin View Orders

4.4 ENTITY RELATIONSHIP DIAGRAM

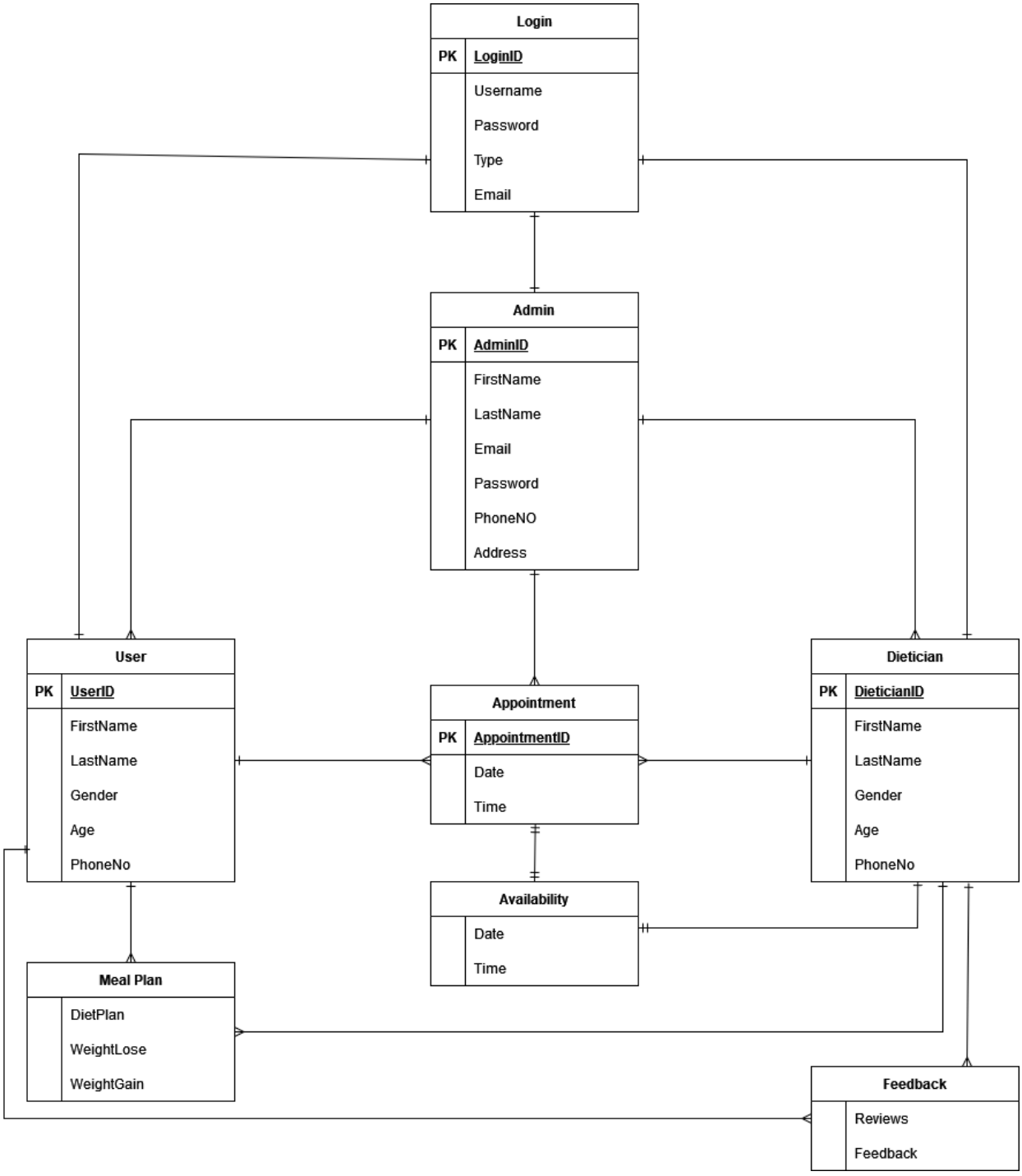


Fig. 6 Entity Relationship Diagram

4.5 FLOW CHART

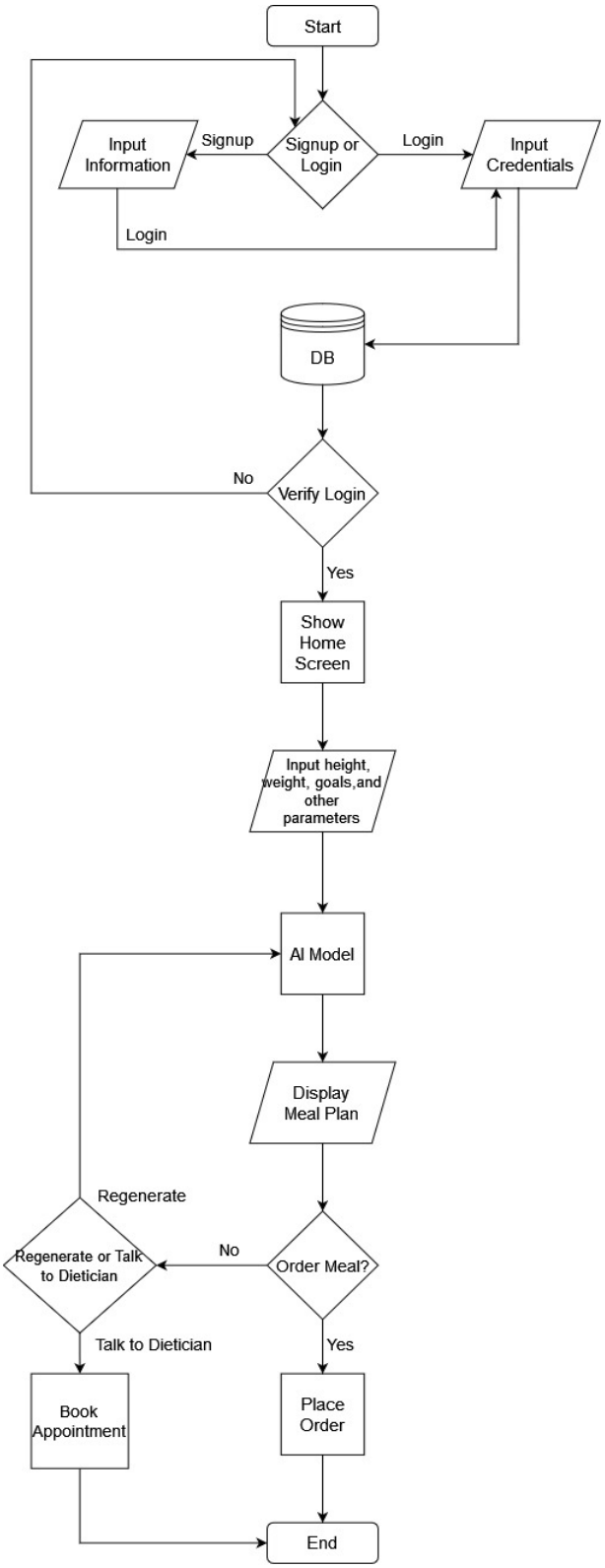


Fig. 7 Flow Chart

4.6 SUMMARY

In this chapter, block diagram, use case diagrams and their narratives, Entity Relationship Diagram (ERD), and flow chart are shown to portray the project's major aspects through visual representations. The block diagram explains the project at a glance; whereas, the ERD and use case diagrams dive deep into the project technicalities and show the project architecture and all the interaction of actors with the system respectively. Lastly, the flow chart helps to understand the flow of the task as how user onboards to the application and where their journey conclude through a funnel.

CHAPTER 5

SYSTEM PROTOTYPE AND DEVELOPMENT

5.1 INTRODUCTION

This chapter discusses algorithm, wireframe, prototype design, backend design, database queries, and external libraries.

5.2 ALGORITHM

K-nearest Neighbor (KNN) algorithm is used to generate predictions about the user's meal plan based on their chosen dietary goals. It is the simplest yet very effective supervised learning algorithm used for regression and classification problems. HealthifyMeal uses KNN for classification problem solutions.

A supervised machine learning algorithm is a type of algorithm that relies on labeled input data to learn a function that produces an appropriate output when given unlabeled data.

A classification problem has a discrete value as its output instead of continuous-valued output. Predicting whether the patient has a tumor or not is an example of a classification problem whether there are two acceptable answers, yes or no, and there is no middle ground.

The KNN algorithm uses feature similarities to predict the values of new data points, which further means that the new data point will be assigned a value based on how closely it matches the points in the training set.

5.2.1 KNN Algorithm Working with Example

The KNN algorithm assumes that similar things exist in close proximity. In other words, similar things are near to each other. The following example will demonstrate the working of the KNN algorithm.

Suppose we have a dataset that can be plotted as follows:

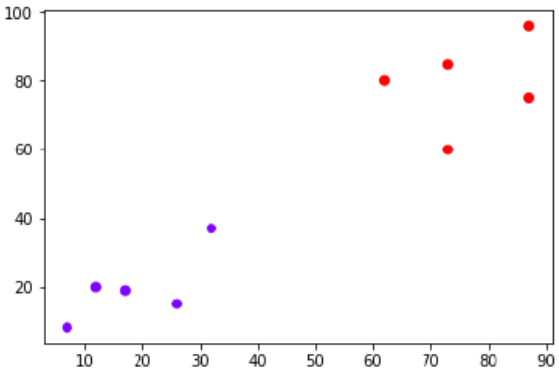


Fig. 8 KNN Algorithm Working Example:1

Next, we need to classify a new data point with a black dot (at points 60, 60) into red or blue classes. We are assuming K=3, i.e., it would find the three nearest data points as shown in the diagram below.

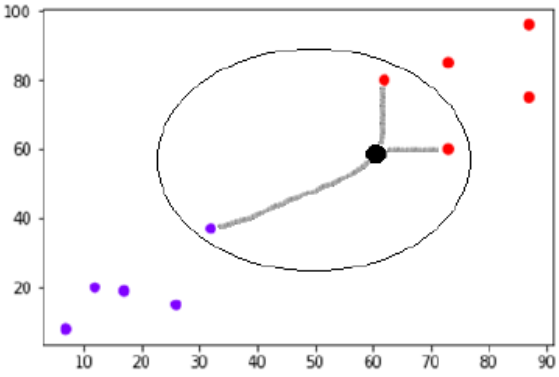


Fig. 9 KNN Algorithm Working Example:2

As shown in the diagram mentioned above, the three nearest neighbors of the data point with a black dot. Among those three, two lie in the red class; hence, the black dot will also be assigned in the red class.

5.2.2 KNN Algorithm Pros

1 KNN is a simple algorithm and easy to implement.
2 It is beneficial for non-linear data because this algorithm has no assumption about data.
3 The algorithm is versatile. It can be used for classification, regression, and search.
4 It has relatively high accuracy than other supervised learning algorithms. It is robust to the noisy training data.
5 It is more effective when the training data is extensive.

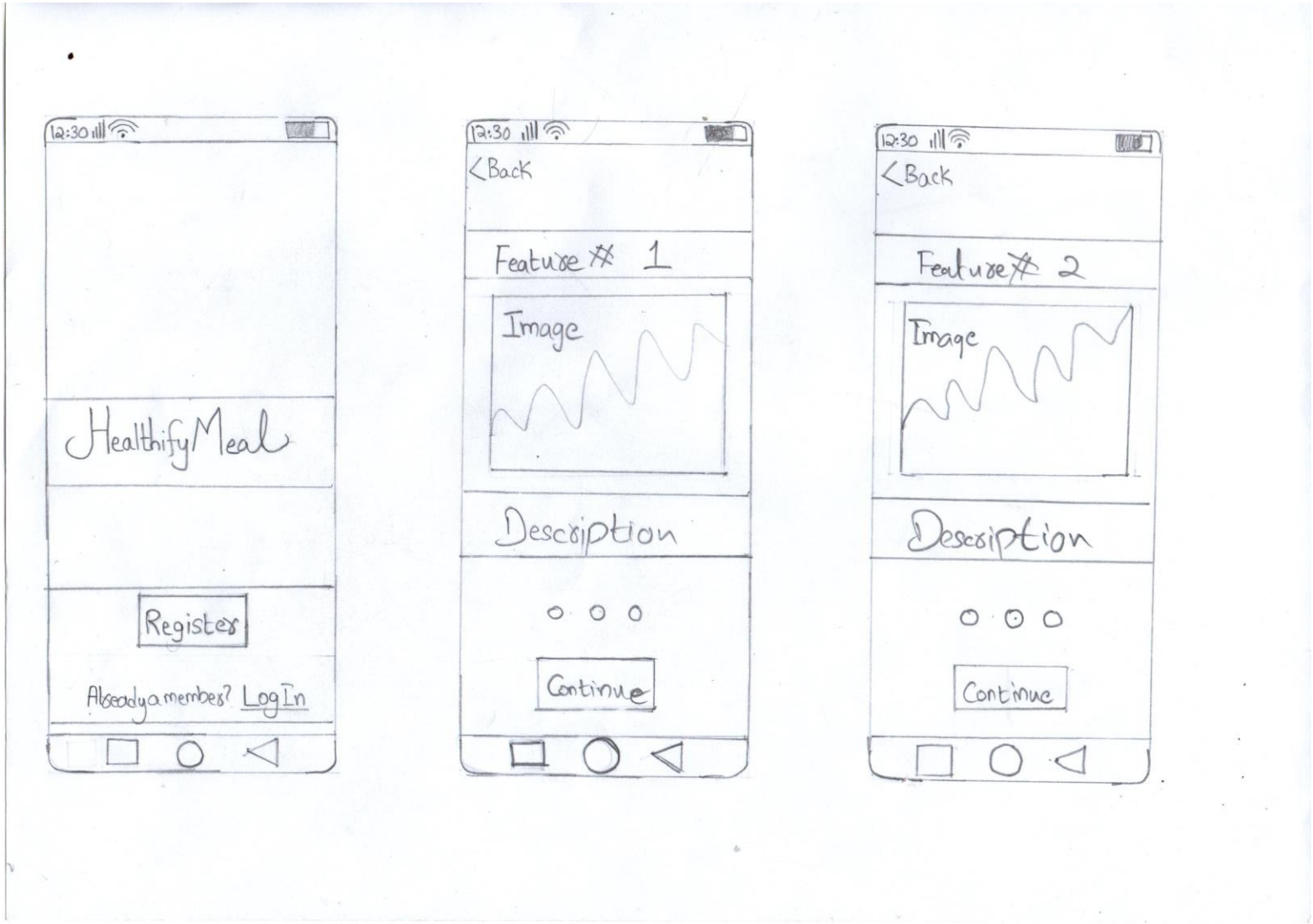
5.2.3 KNN Algorithm Cons

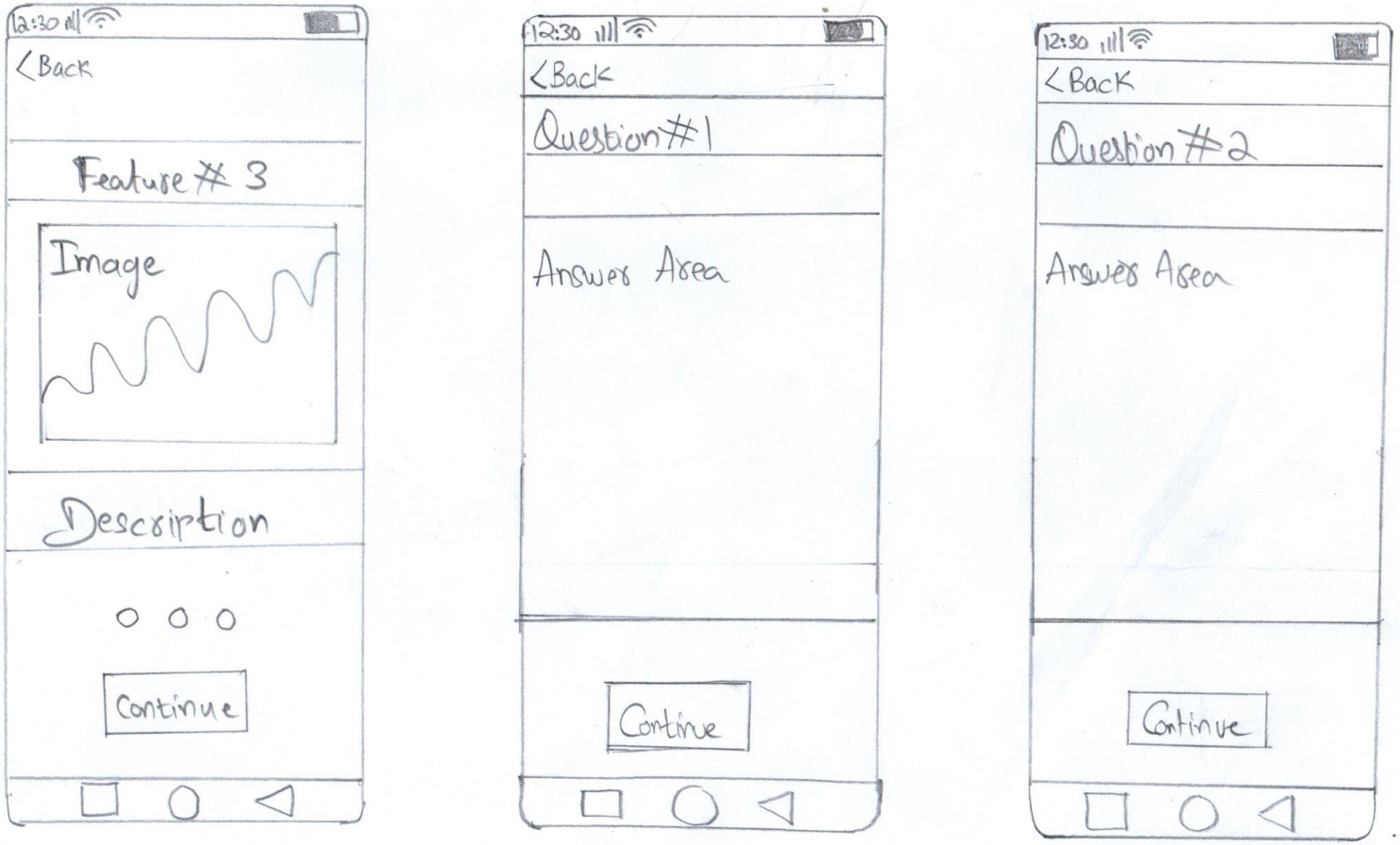
1 The computational cost is a bit expensive because of calculating the distance between the data points for all the training samples.
2 It requires higher memory storage as compared to other supervised learning algorithms.
3 It is sensitive to the scale of data as well as irrelevant features.

5.2.4 KNN Applications

1 The movie and music streaming apps generate recommendations based on related movies, and music user has watched.
2 It is used to find an individual’s credit rating by comparing with the person having similar traits.
3 Checking if the bank should give a loan to an individual or not based on the history and characteristics similar to the defaulters one.

5.3 WIREFRAMES

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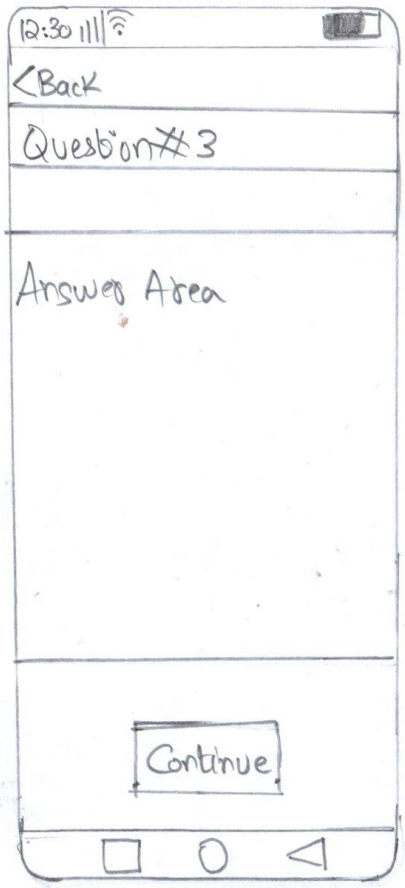
<Back
Feature # 3
Image
Description
Continue
12:30
<Back
Question #1
Answer Area
Continue
12:30
<Back
Question #2
Answer Area
Continue


12:30
<Back
Question #3
Answer Area
Continue


12:30
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Question #4
Answer Area
Continue


12:30
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Question #5
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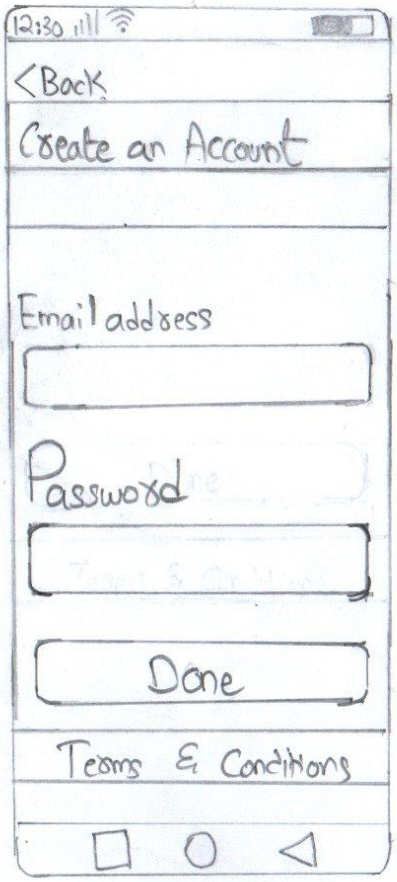
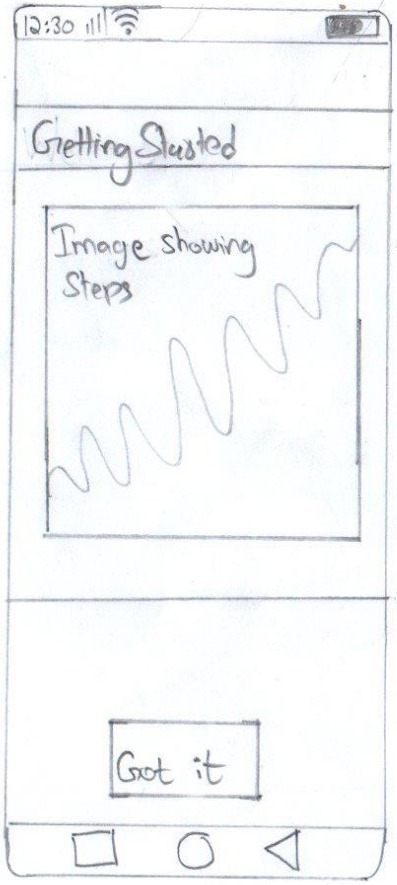
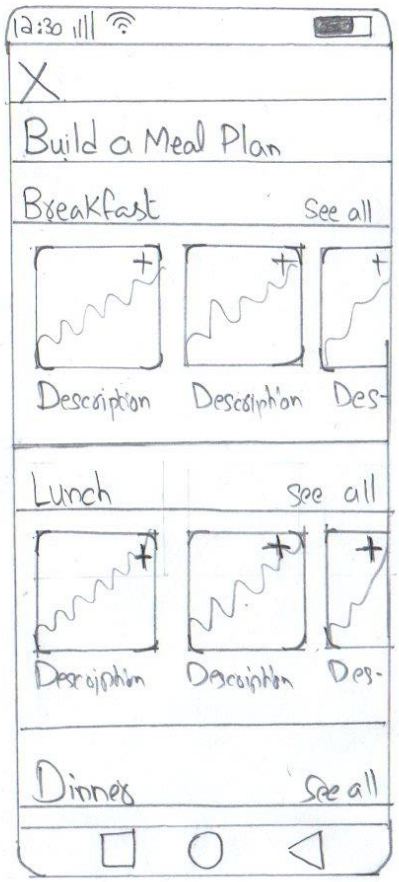
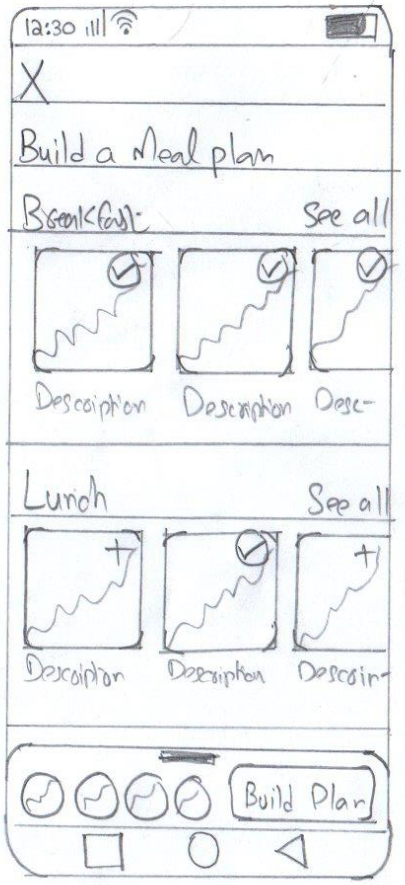
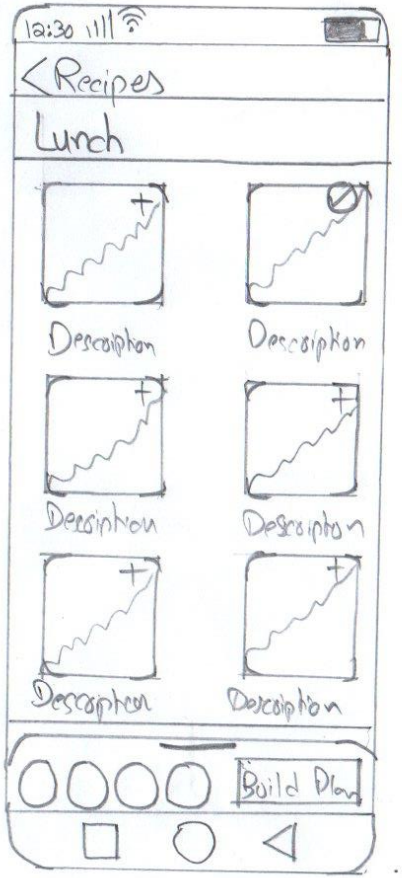

12:30
<Back
Create an Account
Email address
Password
Done
Teams & Conditions

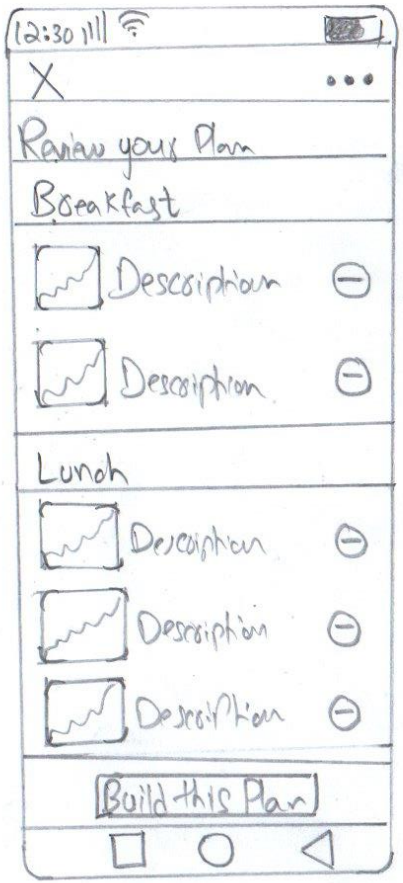

12:30
Getting Started
Image showing Steps
Got it

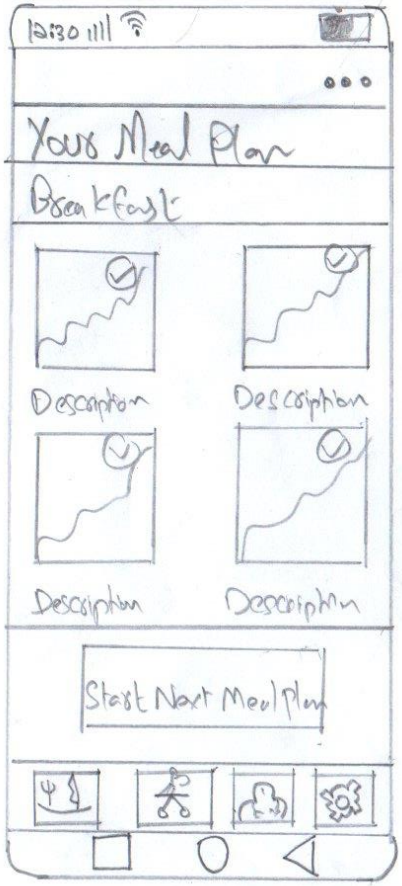

12:30
Your Personalized meal plan
Descaiption
Build Your First Meal plan

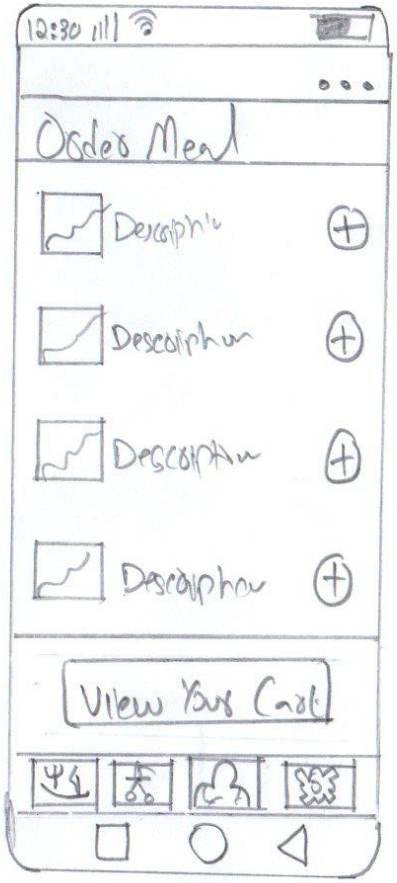

12:30
X
Build a Meal Plan
Breakfast
See all
Description
Description
Des-
Lunch
See all
Description
Description
Des-
Dinner
See all

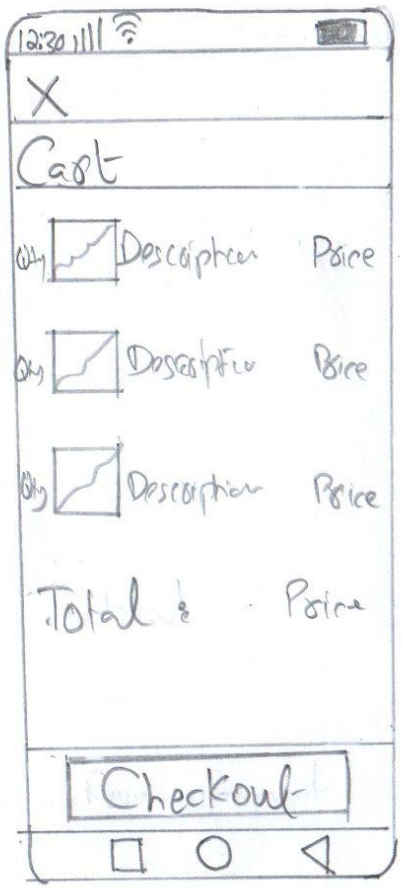

12:30
X
Build a Meal plan
Breakfast
See all
Description
Description
Desc-
Lunch
See all
Description
Description
Descrip-
Build Plan

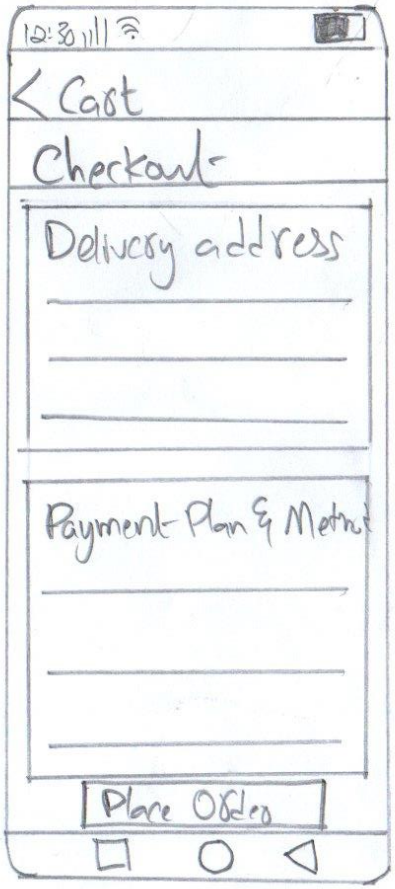

12:30
<Recipes
Lunch
Description
Description
Description
Description
Description
Description
Build Plan

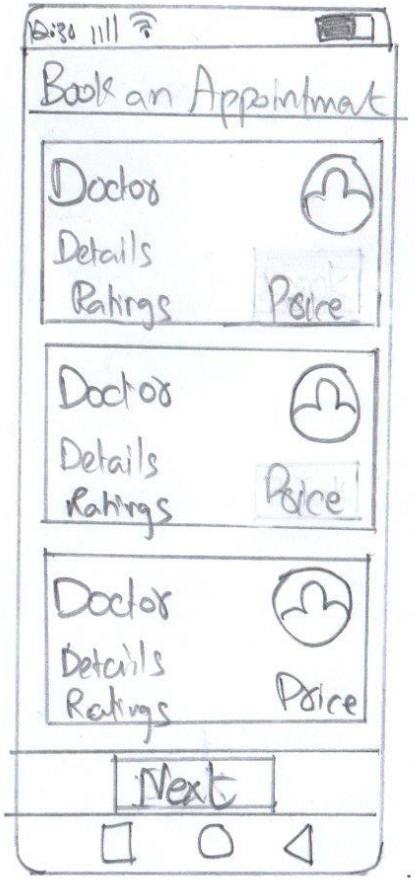

12:30
Review your Plan
Breakfast
Description
Description
Lunch
Description
Description
Description
Build this Plan

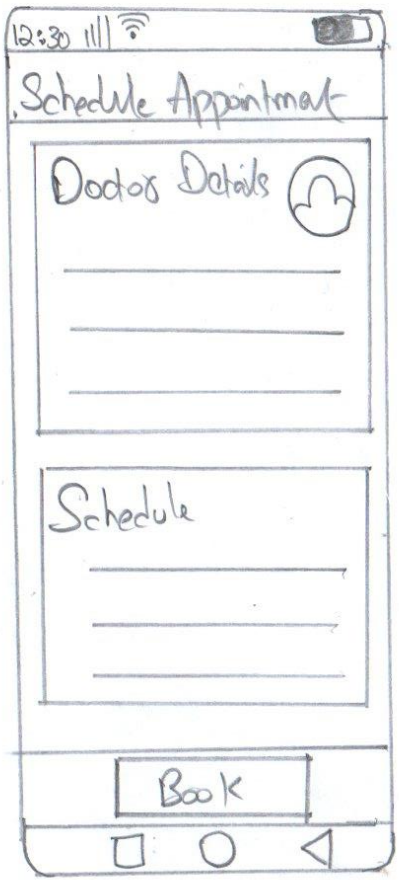

12:30
Your Meal Plan
Breakfast
Description
Description
Description
Description
Start Next Meal Plan

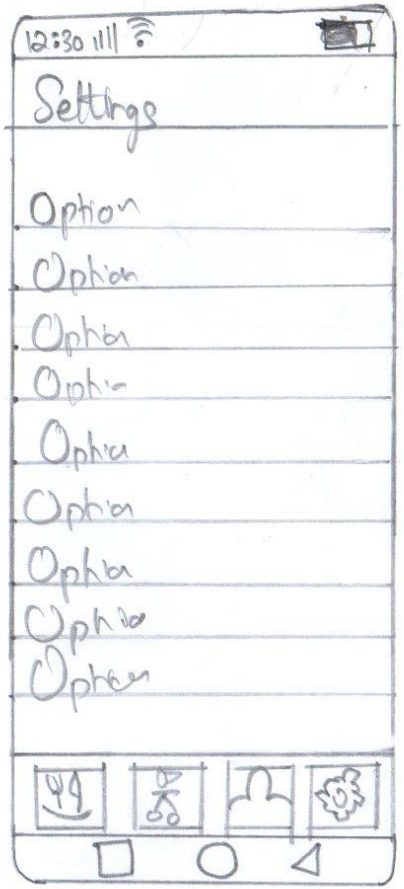

12:30
Order Meal
Description
Description
Description
Description
View Your Cart


X
Cart
Description
Price
Description
Price
Description
Price
Total
Price
Checkout

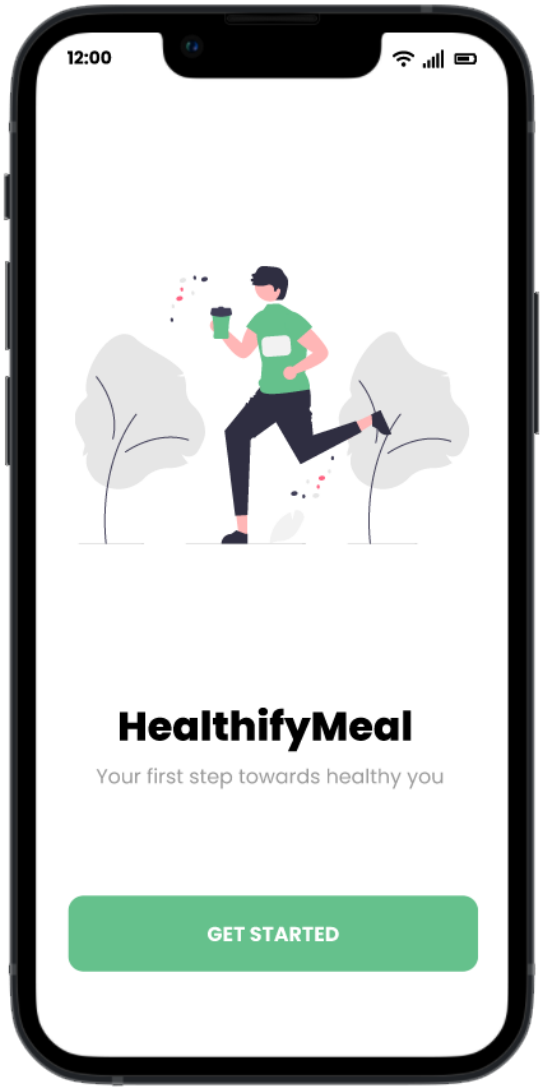

Cart
Checkout
Delivery address
Payment Plan & Method
Place Order

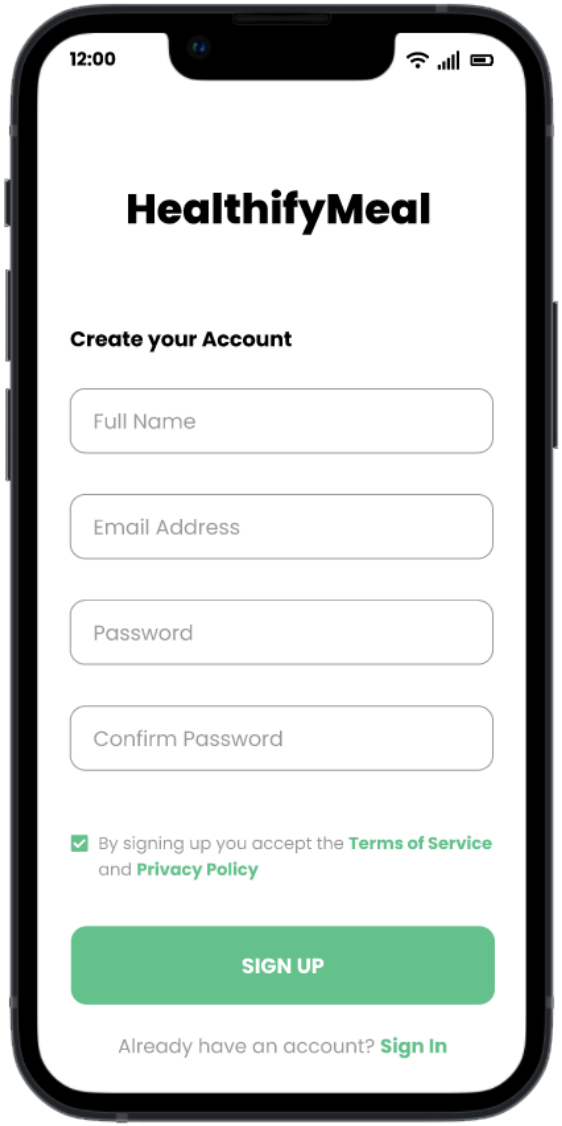

Book an Appointment
Doctor
Details
Ratings
Price
Doctor
Details
Ratings
Price
Doctor
Details
Ratings
Price
Next

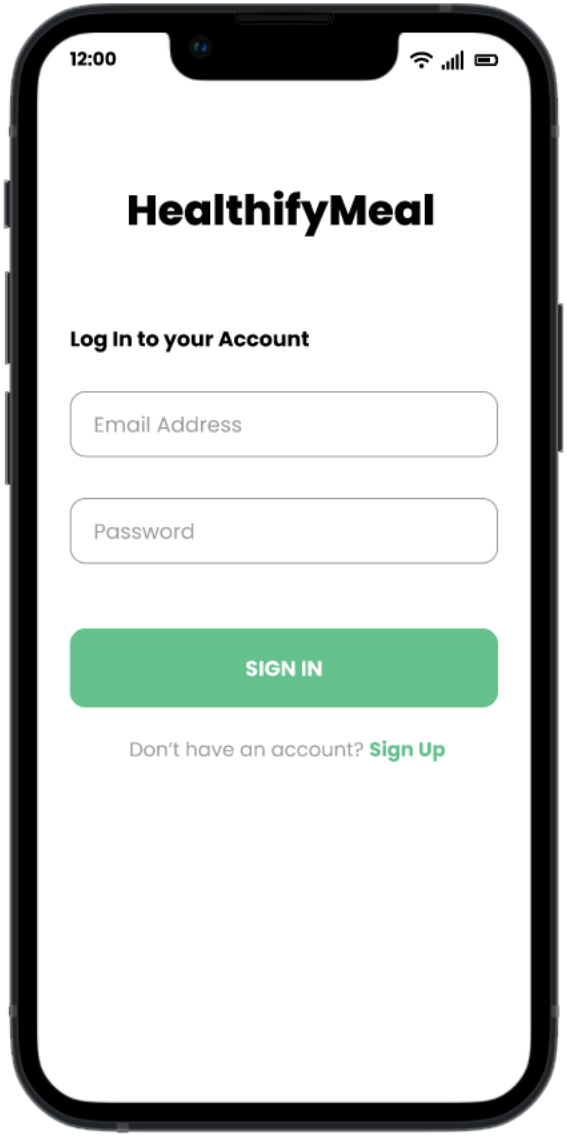

12:30
Schedule Appointment
Doctor Details
Schedule
Book

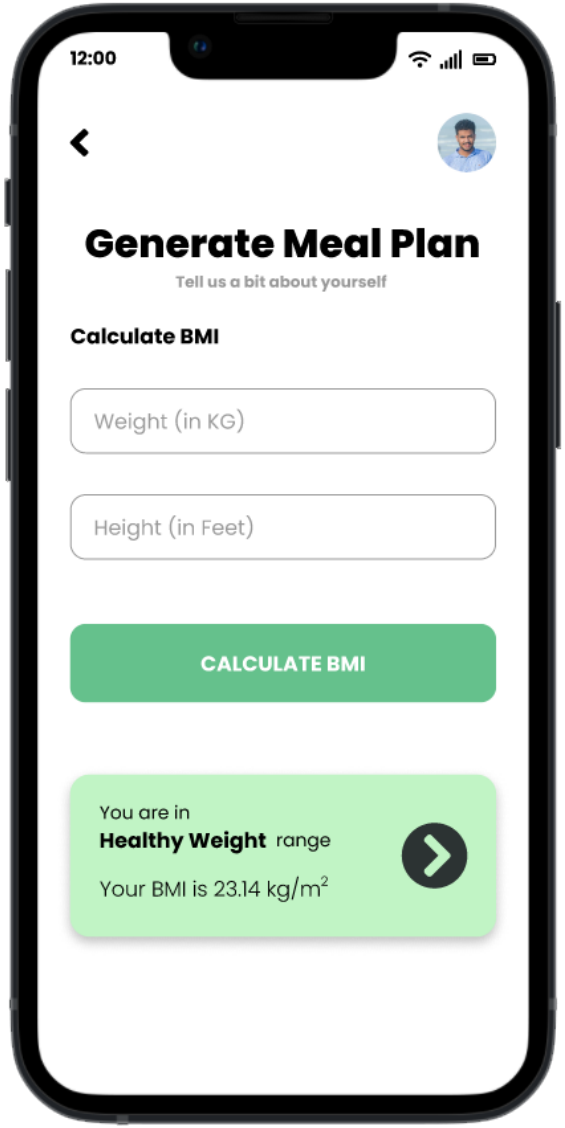

12:30
Settings
Option
Option
Option
Option
Option
Option
Option
Option
Option

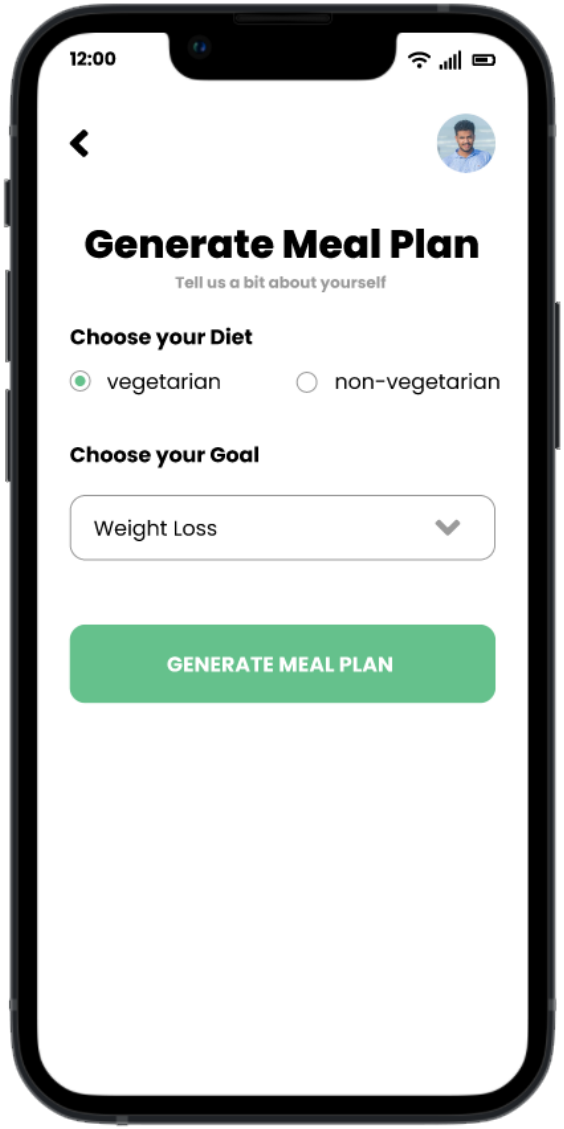
5.4 PROTOTYPE DESIGN

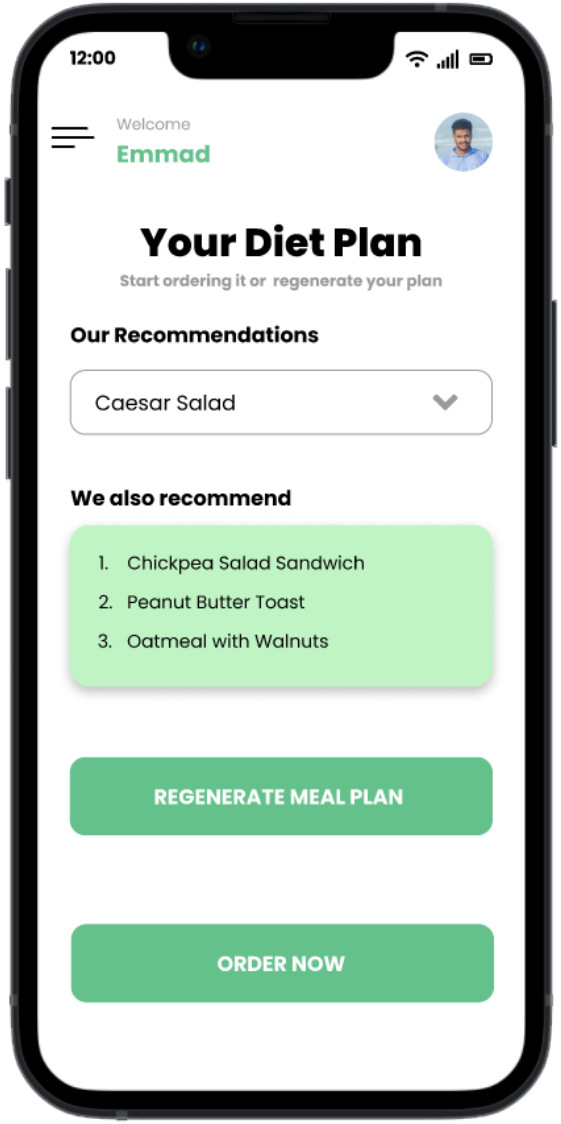


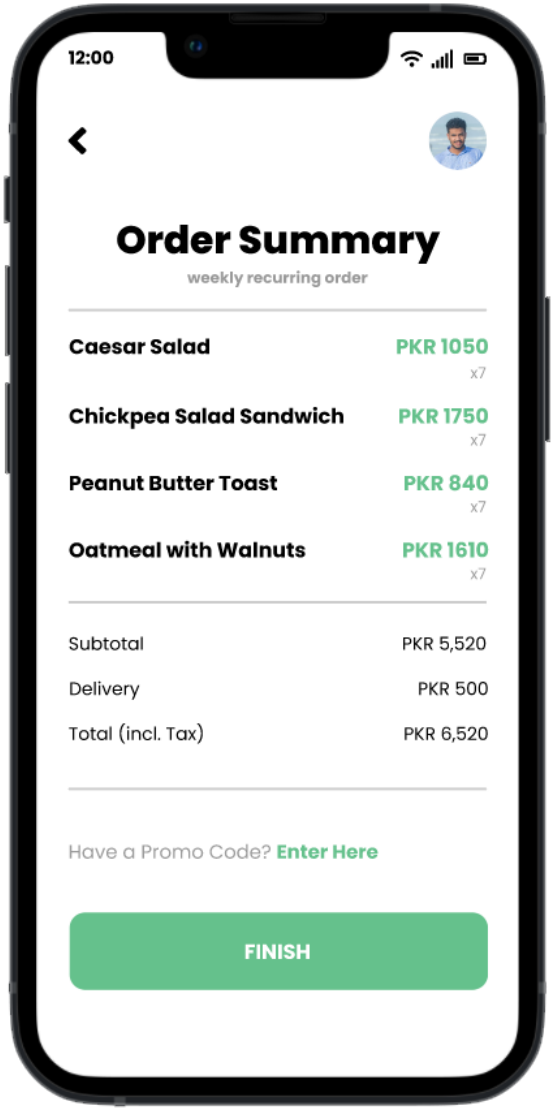


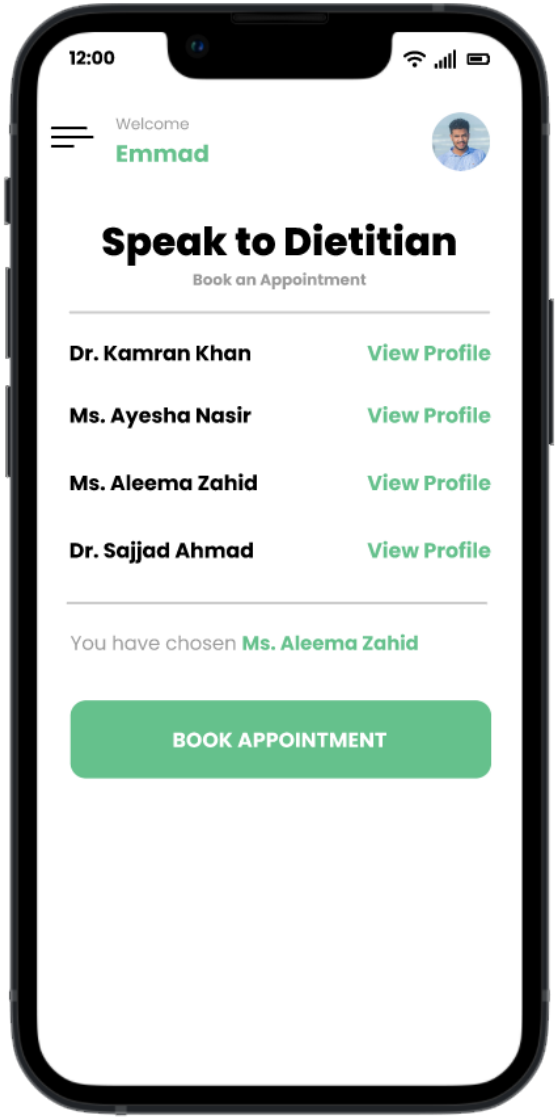

12:00
HealthifyMeal
Log In to your Account
Email Address
Password
SIGN IN
Don't have an account? Sign Up


12:00
Generate Meal Plan
Tell us a bit about yourself
Calculate BMI
Weight (in KG)
Height (in Feet)
CALCULATE BMI
You are in
Healthy Weight range
Your BMI is 23.14 kg/m²


12:00
Generate Meal Plan
Tell us a bit about yourself
Choose your Diet
vegetarian
non-vegetarian
Choose your Goal
Weight Loss
GENERATE MEAL PLAN

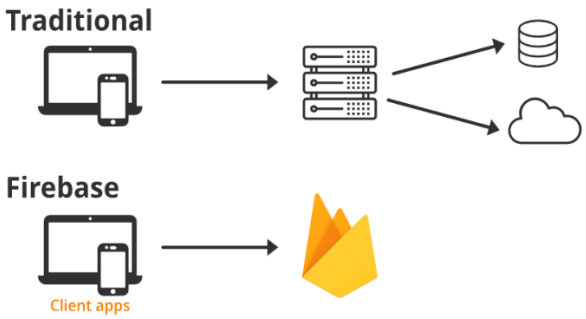

12:00
Welcome
Emmad
Your Diet Plan
Start ordering it or regenerate your plan
Our Recommendations
Caesar Salad
We also recommend
1. Chickpea Salad Sandwich
2. Peanut Butter Toast
3. Oatmeal with Walnuts
REGENERATE MEAL PLAN
ORDER NOW


12:00
Order Summary
weekly recurring order
Caesar Salad
PKR 1050
x7
Chickpea Salad Sandwich
PKR 1750
x7
Peanut Butter Toast
PKR 840
x7
Oatmeal with Walnuts
PKR 1610
x7
Subtotal
PKR 5,520
Delivery
PKR 500
Total (incl. Tax)
PKR 6,520
Have a Promo Code? Enter Here
FINISH


12:00
Welcome
Emmad
Speak to Dietitian
Book an Appointment
Dr. Kamran Khan
View Profile
Ms. Ayesha Nasir
View Profile
Ms. Aleema Zahid
View Profile
Dr. Sajjad Ahmad
View Profile
You have chosen Ms. Aleema Zahid
BOOK APPOINTMENT

5.5 DATABASE DESIGN

Google Firebase Realtime Database is used to meet the database needs for the application. It removes the need for a SQL database, and Google Firebase is also faster.



5.6 EXTERNAL LIBRARIES

The following external libraries are used in the project:

1. NumPy
2. Pandas
3. Scikit-learn
4. Math
5. Pickle
6. Flask
7. Matplotlib
8. Plotly
9. SciPy

5.7 SUMMARY

This chapter briefly explained the machine learning model that the project uses to generate predictions about the meal plan. Moreover, it shows the journey from wireframe to the advanced and improved prototype design. Furthermore, the information about the database design and the external libraries are also discussed.

CHAPTER 6

RESULT ANALYSIS AND TESTING

6.1 INTRODUCTION

This chapter discusses the test cases, front-end design testing, back-end design testing, and usability testing to determine whether the mobile application is working and performing all the operations as expected. This process helps to ensure the application has no bugs and errors before the deployment.

6.2 TEST CASES

Requirement Reference	1	**Project Name**	HealthifyMeal
Requirement Description	Verify the signup functionality of the application.		
Test Case Id	1.1	**Test Type**	UI
Test Case Description	To test that the signup screen has the required fields and button.		
Test Steps	1. First of all, open the application. 2. From the splash screen, click Get Started.		
Expected Result	The signup screen should have the Name, Email, Password, and Confirm Password fields. Furthermore, it should have the privacy policy, terms and conditions checkbox, and Sign Up and Sign In buttons.		
Actual Result	The signup screen featured all the required fields, checkboxes, and buttons.		
Pass/Fail	Pass		
Date Prepared	10th June 2022		
Date Run	20th July 2022		
Prepared By	Emmad Muhammad Ismail		
Tested By	Shahbaz Muhammad Saleem		

Table. 19 Test Case 1.1

Requirement Reference	1	**Project Name**	HealthifyMeal
Requirement Description	Verify the signup functionality of the application.		
Test Case Id	1.2	**Test Type**	Functionality
Test Case Description	To test that the signup is successful once all the data is entered.		
Test Steps	1. First of all, open the application. 2. From the splash screen, click Get Started. 3. Next, fill up all the information and agree to the privacy policy and terms and conditions. 4. Click Sign Up.		
Expected Result	The toast message should be displayed confirming that the user has successfully signed up, and it should move to the login page.		
Actual Result	The signup was successful upon entering all the information with a success toast message. The screen also switched to the login page.		
Pass/Fail	Pass		
Date Prepared	10th June 2022		
Date Run	20th July 2022		
Prepared By	Emmad Muhammad Ismail		
Tested By	Shahbaz Muhammad Saleem		

Table. 20 Test Case 1.2

Requirement Reference	2	**Project Name**	HealthifyMeal
Requirement Description	Verify the login functionality of the application.		
Test Case Id	2.1	**Test Type**	UI
Test Case Description	To test that the login screen has the required fields and button.		
Test Steps	1. First of all, open the application. 2. From the splash screen, click Get Started. 3. Next, click Log In.		
Expected Result	The login screen should have the Email and Password fields. Furthermore, it should have the Sign in button along with the Sign up button and Forget Password button.		
Actual Result	The login screen featured all the required fields and buttons.		
Pass/Fail	Pass		

Date Prepared	10th June 2022
Date Run	20th July 2022
Prepared By	Emmad Muhammad Ismail
Tested By	Shahbaz Muhammad Saleem

Table. 21 Test Case 2.1

Requirement Reference	2	**Project Name**	HealthifyMeal
Requirement Description	Verify the login functionality of the application.		
Test Case Id	2.2	**Test Type**	Functionality
Test Case Description	To test that the login is successful once correct details are entered.		
Test Steps	1. First of all, open the application. 2. From the splash screen, click Get Started. 3. Next, click Log In. 4. Next, enter the correct email address and the password. 5. Click Sign In.		
Expected Result	The toast message should be displayed confirming that the user has successfully signed in and should move to the homepage.		
Actual Result	The sign in was successful upon entering the correct login credentials with a success toast message. The screen also switched to the homepage.		
Pass/Fail	Pass		
Date Prepared	10th June 2022		
Date Run	20th July 2022		
Prepared By	Emmad Muhammad Ismail		
Tested By	Shahbaz Muhammad Saleem		

Table. 22 Test Case 2.2

Requirement Reference	2	**Project Name**	HealthifyMeal
Requirement Description	Verify the login functionality of the application.		
Test Case Id	2.3	**Test Type**	Functionality
Test Case Description	To test that the login is unsuccessful once incorrect details are entered.		
Test Steps	1. First of all, open the application. 2. From the splash screen, click Get Started. 3. Next, click Log In. 4. Next, enter the incorrect email address and the password. 5. Click Sign In.		
Expected Result	The toast message should be displayed informing the user about the wrong credentials, and it should stay on the log in page.		
Actual Result	The sign in was unsuccessful upon entering the incorrect login credentials with a failure toast message. The screen also stayed on the log in screen for the user to reset the password.		
Pass/Fail	Pass		
Date Prepared	10th June 2022		
Date Run	20th July 2022		
Prepared By	Emmad Muhammad Ismail		
Tested By	Shahbaz Muhammad Saleem		

Table. 23 Test Case 2.3

Requirement Reference	3	**Project Name**	HealthifyMeal
Requirement Description	Verify that the application generates the meal prediction.		
Test Case Id	3.1	**Test Type**	UI
Test Case Description	To test that the screen has the required fields and button.		
Test Steps	1. First of all, open the application. 2. From the splash screen, click Get Started. 3. Next, click Log In. 4. Enter your credentials and click Sign In. 5. Next, go to the Meal Generation screen.		
Expected Result	The application should have the necessary fields and buttons. The first screen should allow the user to calculate their BMI; the following screen should allow users to choose their diet and goal. The final screen should display the recommendations with the button to regenerate the		

	meal or order the same.
Actual Result	The screen features all the required input fields and buttons.
Pass/Fail	Pass
Date Prepared	10th June 2022
Date Run	20th July 2022
Prepared By	Emmad Muhammad Ismail
Tested By	Shahbaz Muhammad Saleem

Table. 24 Test Case 3.1

Requirement Reference	3	**Project Name**	HealthifyMeal
Requirement Description	Verify that the application generates the meal prediction.		
Test Case Id	3.2	**Test Type**	Functionality
Test Case Description	To test that the application generates the meal recommendations.		
Test Steps	1. First of all, open the application. 2. From the splash screen, click Get Started. 3. Next, click Log In. 4. Enter your credentials and click Sign In. 5. Next, go to the Meal Generation screen. 6. Next, enter Weight and Height. 7. Click Calculate BMI. 8. Next, choose your diet and goal. 9. Click Generate Meal Plan.		
Expected Result	The first screen should allow the user to calculate their BMI; the following screen should allow users to choose their diet and goal. The final screen should display the recommendations with the button to regenerate the meal or order the same.		
Actual Result	The screen features the expected flow.		
Pass/Fail	Pass		
Date Prepared	10th June 2022		
Date Run	20th July 2022		
Prepared By	Emmad Muhammad Ismail		
Tested By	Shahbaz Muhammad Saleem		

Table. 25 Test Case 3.2

Requirement Reference	4	**Project Name**	HealthifyMeal
Requirement Description	Verify that the order screen functions correctly.		
Test Case Id	4.1	**Test Type**	Functionality
Test Case Description	To test that, the application allows the users to order their meals.		
Test Steps	1. First of all, open the application. 2. From the splash screen, click Get Started. 3. Next, click Log In. 4. Enter your credentials and click Sign In. 5. Next, generate the meal plan. 6. Click Order Now. 7. Verify the Order Summary. 8. Click Finish.		
Expected Result	The screen should allow the user to order their meal. Once finished, the success toast message should be displayed.		
Actual Result	The screen features the expected flow and displays the success toast message.		
Pass/Fail	Pass		
Date Prepared	10th June 2022		
Date Run	20th July 2022		
Prepared By	Emmad Muhammad Ismail		
Tested By	Shahbaz Muhammad Saleem		

Table. 26 Test Case 4.1

Requirement Reference	5	**Project Name**	HealthifyMeal
Requirement Description	Verify that the appointment screen functions correctly.		
Test Case Id	5.1	**Test Type**	Functionality
Test Case Description	To test that, the application allows the users to book their appointments.		
Test Steps	1. First of all, open the application. 2. From the splash screen, click Get Started. 3. Next, click Log In. 4. Enter your credentials and click Sign In. 5. Next, click Speak to Dietitian from the menu bar.		

	6. Choose the dietitian and click Book Appointment.
Expected Result	The screen should allow the user to book their appointment. Once finished, the success toast message should be displayed.
Actual Result	The screen features the expected flow and displays the success toast message.
Pass/Fail	Pass
Date Prepared	10th June 2022
Date Run	20th July 2022
Prepared By	Emmad Muhammad Ismail
Tested By	Shahbaz Muhammad Saleem

Table. 27 Test Case 5.1

6.3 SUMMARY

The testing was extensively conducted to ensure the application is bug-free and has no errors from the start to the end. The testing helped to confirm that the application is working as expected.

CHAPTER 7

CONCLUSION

7.1 INTRODUCTION

This chapter summarizes the work completed for this project. In this chapter, system limitations, challenges, and future work are discussed. Limitations were included in order to help the user understand the system better. The future work section helps to identify the improvements that can be made to the existing system.

7.2 SYSTEM LIMITATIONS AND CHALLENGES

Here are the limitations of the HealthifyMeal application:

1. The application requires an active internet connection to work.
2. The application has limited recipes to offer.
3. The application needs an accurate reading of the user's weight and height so they can select the correct dietary goal based on their BMI score.

Here are some of the challenges which were encountered during the project development:

1. Integrating machine learning code with Java codebase.
2. Collecting the recipe data and getting it labeled by the dietitian.

7.3 FUTURE WORK

The application currently features two dietary goals such as weight loss and weight gain. More dietary goals can be offered as an improvement along with more types of diets as currently the application only offers vegetarian and non-vegetarian diet plans.

7.4 SUMMARY

The majority of the world uses a smartphone and healthy meal education is available at the fingertips but is that information tailored for that particular individual or not is a bigger question which HealthifyMeal addresses. It offers personalized meal plans, the ability to order the same, and speak to the expert dietitian on-demand.

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Appendix A: Business Model Canvas

The Business Model Canvas

Designed for: HealthifyMeal

Designed by: Group #39
Emmad and Shahbaz

Date: 06/01/2022
Iteration #1

Problem
1) Less food education and no meal planning.
2) Unhealthy food leading to obesity and chronic diseases.
3) Foreign countries applications not tailored to cater Pakistani users.

Existing Alternatives
1) Mealime
2) Eatthismuch
3) Platejoy

Solution
1) Meal planning platform to serve every type of user's needs.
2) Meal planning education and effortless generation of diet plans.
3) Building a kitchen to offer healthy meals.

Key metrics
1) New user acquisition
2) App store downloads
3) Number of active users
4) In-apps purchases
5) Number of diet plans generated
6) Number of sessions booked
7) Number of orders placed

Unique value proposition
1) Personalized meal plan for every individual considering their dietary restrictions and preferences.
2) Order healthy meals right from application.
3) Expert consultation available on-demand.

High-level concept
A meal planning application that provides personalized healthy meals with the facility to order the suggested meal and speak to expert dietician on-demand.

Unfair advantage
1) Proprietary recipes
2) No competition in Pakistan
3) Personal commercial kitchen
4) Expert available at a single click for consultation

Channels
1) SEO.
2) Social media.
3) Affiliates and referrals.
4) Commercials.
5) Online and offline advertisements.

Customer Segments
1) Health-conscious individual
2) Student and working professional
3) Users suffering obesity and related diseases
4) Gym going person
5) Corporate organizations

Early adopters
Users who want to switch to healthy meals and have fitness goals and corporate organizations concerned about employees' health.

Cost Structure
1) Development and Maintenance
2) Fees to be paid to expert dieticians to prepare database of meals
3) Advertisement and Marketing
4) Hosting

Revenue Streams
1) In-apps purchases
2) Corporate partnerships
3) Consultation sessions

APPENDIX B
Gantt Chart

ID	Task Mode	Task Name	Duration	Start	Finish
1		**Project Idea Finalization**	**7 days**	**Sat 10/9/21**	**Sat 10/16/21**
2		**Idea Pitching**	**7 days**	**Sun 10/17/21**	**Sun 10/24/21**
3		Initial Idea Pitching	2 days	Sun 10/17/21	Mon 10/18/21
4		Refined Idea Pitching	2 days	Tue 10/19/21	Wed 10/20/21
5		Pitching to Corporate Sector	3 days	Thu 10/21/21	Sun 10/24/21
6		**Initial Documentation**	**7 days**	**Mon 10/25/21**	**Tue 11/2/21**
7		Abstract	3 days	Mon 10/25/21	Wed 10/27/21
8		Flow Chart	3 days	Thu 10/28/21	Mon 11/1/21
9		Submission Letter of Interest by Corporate	1 day	Tue 11/2/21	Tue 11/2/21
10		**Problem Formulation**	**7 days**	**Wed 11/3/21**	**Thu 11/11/21**
11		Problem Statement	2 days	Wed 11/3/21	Thu 11/4/21
12		Synopsis	5 days	Fri 11/5/21	Thu 11/11/21
13		**Project Introduction**	**12 days**	**Fri 11/12/21**	**Sat 11/27/21**
14		Challenges	4 days	Fri 11/12/21	Wed 11/17/21
15		Motivation and Need	5 days	Thu 11/18/21	Wed 11/24/21
16		Aim and Objectives	4 days	Thu 11/18/21	Tue 11/23/21
17		Benefits	3 days	Thu 11/25/21	Sat 11/27/21
18		**Literature Review**	**2 days**	**Mon 11/29/21**	**Tue 11/30/21**
19		**Research Design**	**3 days**	**Wed 12/1/21**	**Fri 12/3/21**
20		Development Model	1 day	Wed 12/1/21	Wed 12/1/21
21		Key Milestones and Deliverables	1 day	Wed 12/1/21	Wed 12/1/21
22		Timeline and Gantt Ch	2 days	Thu 12/2/21	Fri 12/3/21
23		**Requirement Design and Diagrams**	**3 days**	**Sat 12/4/21**	**Tue 12/7/21**
24		Functional and Non-functional Requirements	2 days	Sat 12/4/21	Mon 12/6/21
25		Use Case Diagram and Narratives	1 day	Tue 12/7/21	Tue 12/7/21
26		ERD	1 day	Tue 12/7/21	Tue 12/7/21
27		**Prototyping**	**14 days**	**Wed 12/8/21**	**Mon 12/27/21**
28		**Budgeting**	**7 days**	**Tue 12/28/21**	**Wed 1/5/22**
29		**Business Canvas Model**	**3 days**	**Thu 1/6/22**	**Mon 1/10/22**
30		**Final Report and Poster**	**5 days**	**Tue 1/11/22**	**Sun 1/16/22**
31		**Design and Developmen**	**60 days**	**Mon 1/17/22**	**Fri 4/8/22**
32		Signup Screen	5 days	Mon 1/17/22	Fri 1/21/22
33		Login Screen	5 days	Sat 1/22/22	Thu 1/27/22
34		Database Design	17 days	Fri 1/28/22	Sat 2/19/22
35		Main Screen	28 days	Fri 1/28/22	Tue 3/8/22
36		All Corresponding Pag	22 days	Thu 3/10/22	Fri 4/8/22
37		**Build and Train AI-based Model**	**24 days**	**Mon 4/11/22**	**Thu 5/12/22**
38		**QA Testing**	**7 days**	**Fri 5/13/22**	**Mon 5/23/22**
39		**Deployment**	**2 days**	**Tue 5/24/22**	**Wed 5/25/22**
40		**Feedback and Improvements**	**8 days**	**Thu 5/26/22**	**Sat 6/4/22**