

EatCORRECT – A Healthy Dieting System

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2020



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**A dissertation submitted for the Degree of Master
of Information Technology**

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2020



Abstract

A meal planner can provide a list of recipes designed for a person to achieve a health goal such as reducing body weight. User can get a meal plan from a system and follow it but most meal plans are not tailored fit for a user. It might consist of foods or recipes that a user does not like to eat or with the foods that hard to find in some regions. Some meal plans are not built based on scientific facts. Apart from that following meal plan tightly is not always a possible task, if the user deviates from the plan it may not give expected results. User may not have a clear sight on achieving the goal. The EatCORRECT project provides a solution for this problem. It simply provides personalized meal plans with the recipes and foods that user loves to eat while tracking and informing user the progress powered by many supporting tools. EatCORRECT gets basic inputs such as weight, height, age, gender and meal preference as inputs from the user and calculates the total daily energy expenditure of the human body using most researched and scientifically proven methods. Based on the energy calculation, the EatCORRECT system generates a meal plan which consists with only the food that user likes to eat. The meal plans are well designed to address calorie requirement with well-balanced micro and macro nutrients that user required to achieve a healthy body. The meal plans are designed to achieve the weight goal of the user either to gain weight, lose weight or maintain the weight. EatCORRECT system provides an easy to use food database where user can find and record all the food nutrient information that consumed throughout the day. The system powered by a natural language processing based food nutrition search engine and activity tracker. Using these tools user can easily track the nutrition consumption, energy expenditure on activities and record the user progress on a digital diary. The EatCORRECT system always allow the user to get a meal plan whenever required. When user's current weight is changed, user can generate a new tailored fit meal plan to help to achieve the ultimate weight goal. Overall the EatCORRECT system is a complete human wellbeing solution.

Declaration

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge it does not contain any material published or written by another person, except as acknowledged in the text.

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Acknowledgement

Mr. K.L Jayaratne for his brilliant supervision, which made EatCorrect the success, it is.

Mr. Viraj Welgama for his enthusiasm in guiding the students through this course module throughout the year.

Guido Van Rossum for creating Python, and making it a free software.

Rasmus Lerdorf for creating PHP and making sources available for public.

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Abbreviations

API	Application Programming Interface
BMI	Body Mass Index
BMR	Basal Metabolic Rate
DBMS	Database Management System
FOSS	Free and Open Source Software
LP	Linear Programming
MVC	Model View Controller
NCD	Non-Communicable Disease
OOP	Object Oriented Programming
TDEE	Total Daily Energy Expenditure
UI	User Interface
URL	Uniform Resource Locator

Chapter 1 Introduction

1.1 Problem to be addressed

In this digital era, people are mostly attached to devices. People use machines and devices with technology for every work they do. This makes lives easy for people and save time but also it reduces the physical activity level of the human. While the physical activity level [1] reduced people run a busy life schedule, people find it hard to use healthy meal choices. Unlike in early days' people cannot spend time to find or prepare healthy meals therefore they tend to move into fast foods. The fast foods that can be prepared or get faster usually cost less but are unhealthy. For example, we can take all the fast food chains like McDonalds, KFC, etc. People find it easy to get food from these fast food chains and they tend to eat more processed food and unhealthy unnatural foods to ease their hunger.

Eating healthy foods and living active life style can lower the risks of developing health problems and help manage such diseases like heart diseases and diabetes. It also makes you feel good. Your food choices can make a big change to your health and wellbeing [2]. Most people are aware of the importance of eating healthy and being active but how can we do that while fulfilling our day-to-day duties in our busy schedule is the challenge.

When people realize that eating healthy food choices can improve their health, they have two choices. First one is to visit a nutritionist and get an advice or to explore the Internet to get a meal plan advice via an application or a system is the second one. Getting an advice from a professional is a good choice but it is very hard to get a tailored fit solution for each user by such a professional. The problem of other approach is when Internet provide information free it is doubtful that the information is accurate. People may find hundreds of meal plans in the Internet but the effectiveness to achieve a goal and impact on human health is subjective [3]. In addition, the most online tools generate meal plans much suitable for the region where the system was developed. Nevertheless, the foods consumed for breakfast by a person living in European region would be much different to the foods that are consumed by an Asian person for breakfast. It was the main concern of the EatCorrect project to provide a practical solution for this problem.

1.2 Motivation

Managing weight is one of the key processes of living a healthy life. There are many studies and proven researches done to find out the relationship between weight management and human health. There is a direct relationship between excess bodyweight and health related issues [4]. Some studies explain that obese men and women has declined physical functioning compared to normal-weighted persons [5]. Also, the excess bodyweight leads to many non-communicable diseases (NCD) such as strokes, most heart diseases, osteoarthritis, osteoporosis, etc. [6][7]. Apart from that bad eating habits and not including adequate amount of healthy food choices gives tendency to get an above mentioned diseases and some other diseases such as cancer, kidney diseases, etc [8][9]. Unawareness and ignorance of the healthy diet can be taken as reasons for such cases [10]. Managing weight by introducing a diet plan, increasing quality of nutrition and encouraging more physical activities is the sustainable solution for the mentioned issue. When we looking at the existing solutions, it is very hard to

find a complete solution that, help to fulfil all mentioned areas and cater a goal driven person to achieve a specific target. EatCorrect system provides the platform to address all the mentioned key areas as a complete solution.

1.3Objective

- Provides a web portal to determine the daily calorie [11] [12] requirement of the user, calculates body mass index (BMI) [13] and suggests a daily calorie limit to maintain.
- Generates personalized meal plans and provides eating guidance for 7 days (week) with the details of the food ingredients, ingredient quantities, preparation method (recipes) and provide nutritional information such as protein [14], carbohydrates [15] and fats [16].
- Tracking nutrition consumption for the user daily basis. System provides nutritional data for each food item and enables the user to enter new food items with nutritional values [17] to the system.
- Connects with nutrition application programming interface (API) [18] called Nutritionix[19].
- Tracking the user progress by getting user inputs and record the user inputs and provide analysis report how user reached the goals over the time.

Chapter 2 Background

2.1 System overview

From the initial stages to the latter stages of the EatCORRECT project, there were several objectives to be considered. They consist of necessary research and development to get the user food preference and generate meal plans according to the user meal preference while keep the user get the adequate nutrition macros [20]. Due to the fact that EatCORRECT purely works on numbers its effectiveness is highly depend on the accuracy of the nutritional information. Therefore, maintaining the information rich nutritional database is a main requirement. Generating a meal plan based on user's macro nutrient requirement is a resource problem. Hence research on resolving a resource problem also considered.

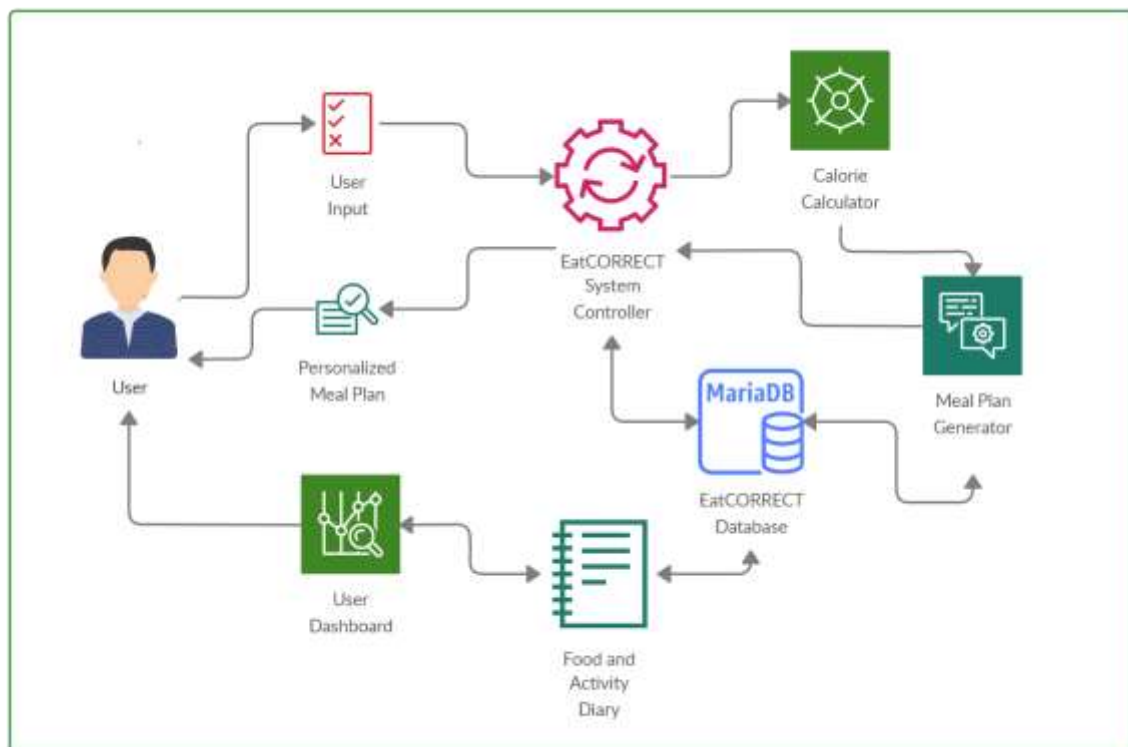


Figure 1.1 High-level architecture diagram

Main features of the research and development can be sub divided as following.

Calorie Calculator

Calorie requirement calculated for each user based on the total daily energy expenditure (TDEE) [21][22]. Usually TDEE is calculated by multiplying Basal metabolic rate [23] (BMR) by multiplier for activity level. Basal metabolic rate gives the number of calories that required by the human body to burn and get the energy to keep alive. BMR does not consider physical activity or the energy required digest the food consumed by human. Simply, BMR refers to the number of calories that human body would expend if the human laying in the bed for 24 hour period without doing any physical activity. This is the absolute minimum number of calories

required by human body to survive. There are many ways to calculate BMR using already available researches such as The Harris- Benedict Formula (BMR based on total body weight), Katch-McArdle formula [24] (BMR based on lean body weight). System calculates BMR using Mifflin-St Jeor equation which is found more accurate based on the studies [25][26][27]. The TDEE calculation done by multiplying BMR by activity multiplier known as Katch-McArdle multipliers [28]. According to the weight input provided by the user, system recalculates the calories requirement and system automatically suggests the regenerated meal plans for user. User can also select preferred foods and foods to be avoided when generating the meal plan. For example, vegan can avoid meats and a meat lover can prefer pork over chicken.

Food nutrition database

To generate proper meal plans, an accurate database is required to get the nutritional data. Therefore, a food database is maintained to get the nutritional values of certain foods. User allowed to enter new food items to this database. Also, the database supports to record the daily food consumption of the user. System connects to nutrition API of www.nutritionix.com [29] and provides online food nutrition searching by food name or brand in the system and add it on consumed food section. In order to make the feature more user-friendly system allows a dynamic search on both native database and www.nutritionix.com database which will auto populate food suggestions as user types food name on the search area. System supports natural language search option as well.

Meal Recipes

System generates meal plans with guidelines (recipe) to prepare the foods. System stores recipes in native database and the users who has admin privileges can add recipes to the system. System does not the ingredient amounts in recipe details or data tables. Recipes may hold multiple key ingredients which required to prepare a meal.

Meal Plan Generator

This is the key component of EatCORRECT project. Meal plan generator generates tailored fit meal plans based on the user inputs. After calculating TDEE based on user inputs, the system gets a list of recipes which matches perfectly to user's meal preference. From the generated list of recipes, system calculates the amount of ingredients to be used in meal preparation. Calculation of ingredient amount done based on solving resource problem. Resource constraints are constructed using TDEE and required macro nutrients of a particular user. Since the resource problem having constraints, linear programming model [30] used to resolve the problem. Linear programming (LP) is a technique for solving resource problems. It can determine the best for maximize, minimize or equalize the outcome. Which involves the optimization of a linear objective function, subject to the linear equality or inequality constraints of decision variables. There are several studies on minimizing food costs using linear programming [31][32]. In this project, computer based linear programming [33] is used to solve a nutrition problem.

Activity Data

EatCORRECT calculates user's energy expenditure on activities done throughout the day. Natural language processing-based [34] API used to implement the feature. User can update

the activity diary by simply providing the duration of the activity and the system calculates the energy expenditure of the particular activity user have selected and record it in daily log.

Track the user activity and progress

System stores all the user data input gender, age, height, weight, activity level, food preferences and target weight. System alerts the user for any deviations with the plan and also it will track the progress of the weight gain or weight loss. System generates reports to the user, regarding the progress made in a dashboard where user can easily identify the progress made. System also tracks all key nutritional values consumed by the user and generate a summary when user does not meet the recommended daily values of the key nutrition. Whenever user add consumed foods to the system, system generates auto hide balloon notification when the food is high on any particular nutritional value. With these alerts and tracking, the system helps the user to avoid nutritional deficiencies including vitamins and minerals.

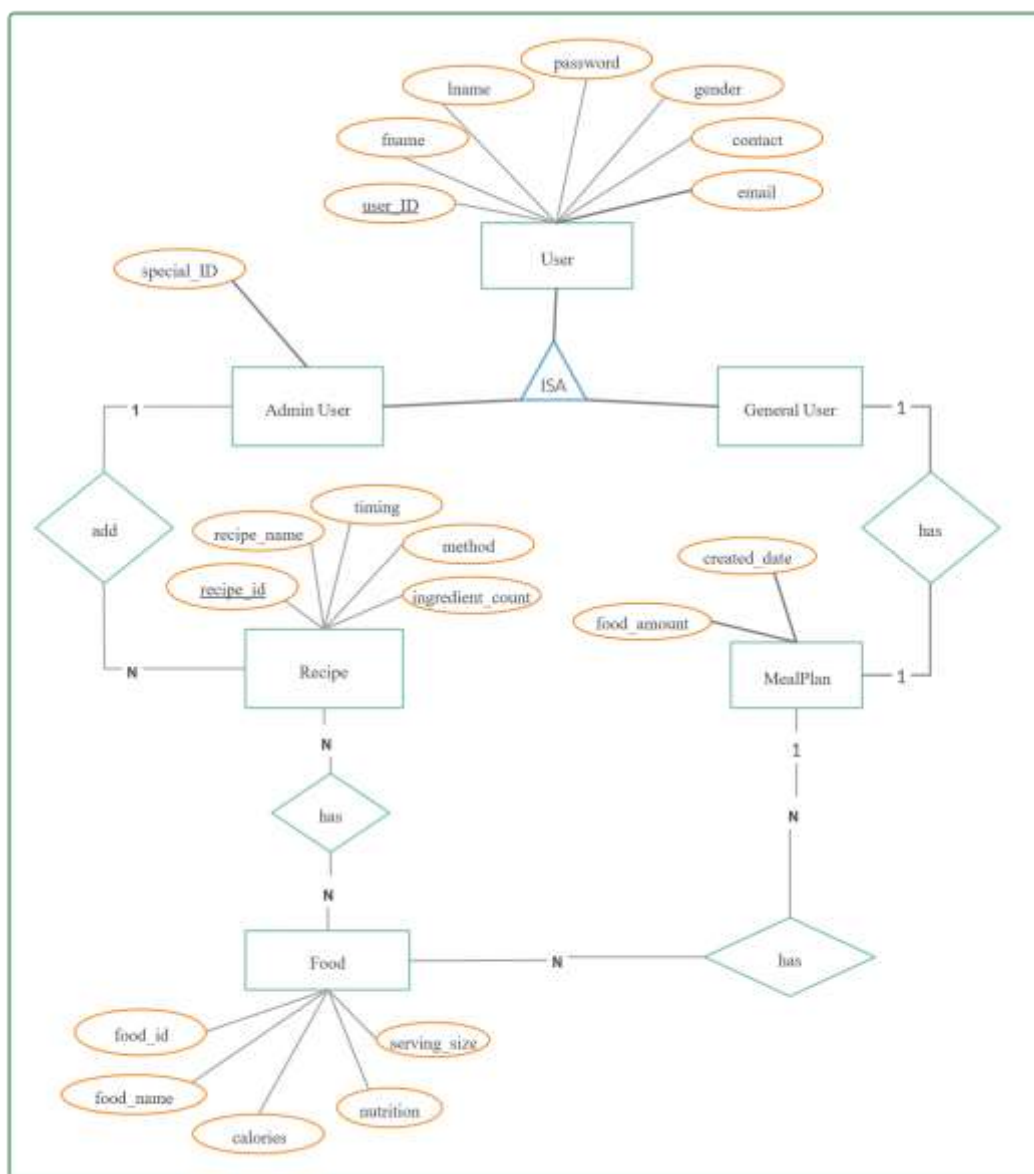


Figure 2.1 ER Diagram

2.2 Review of similar systems

2.2.1 Lazar Angelov Diet

Fitness model and personal trainer Lazar Angelov provides diet plans and training schedules generated online as a paid service. The online system[35] can be accessed via <https://usa.lazarangelov.diet/>. Being one of the most popular online diet plan provider Lazar Angelov diet system takes simple inputs namely gender, activity level, meat and fish to include or exclude, carbohydrate to include or exclude, fruits and veggies to include or exclude, processed foods to include or exclude, usual day to day activities, bad habits, age, weight, height and target weight. The procedure of taking user input has arranged in a very simple manner but the system takes the input single time to prepare the meal plan for 90 days, this can be very ineffective as the human body responds to level of energy (calories) provided within a short period of time. User is not allowed to do any changes or adjustments after generating the meal plan which means, if the proposed meal plan is ineffective, not responding or user changed any habits during the period, there is a high chance the meal plan go wasted. In the other hand, the system prompt user to select the target weight and calculate the calorie deficit or surplus based on that. The problem with that is, the target may be unachievable in a healthy manner. Other problem of the system is having the way it gets the input for activity level, which user is unaware unless the user has a great knowledge in physical fitness. System not having a way to record or track the progress of the plan.

The system input for user's physical activity:

1. Almost no physical activity
2. I often go for a walk
3. I exercise 1 - 2 times a week
4. I exercise 3 - 5 times a week
5. I exercise 5 - 7 times a week

The system input for user's typical day activities:

1. At the office
2. At the office, but I go out on a regular basis
3. I spend the better part of the day on foot
4. Manual labour
5. I mostly stay at home

2.2.2 My Fitness Pal

My fitness pal is the most popular mobile fitness platform[36]. My fitness pal allows the user to enter the following inputs to the system. Weight, target calories, daily food consumption are the inputs that user can enter in to the system. My fitness pal is calculating daily calorie consumption through the user inputs provided by the user and show any surplus or deficit of the calorie consumption daily. System acknowledge the user with the weight loss or weight

gain progress. Also, the system having a crowd sourced and system verified food nutritional database where the users can select the foods and enter the consumption from that database. System also allows the users to create their own food nutrition values to reuse. The major issue this system has is, it does not allow a way to find out the required daily calorie target for the user. Even though everything is based on target calorie use, user have to find it using another system and put in to my fitness pal app. Other issue is the app can be only used to track and record the progress and no meal plans were generated via the system.

2.2.3 8 Fit

8 fit is also a mobile platform[37] which can be used to calculate calorie requirement and generate meal plan and also a fitness plan based on that. This system also allows the user to input the basic data namely gender, activity level, age, weight, height and target weight. The system provides a meal plan based on the user inputs. The major issue that the system is having is there is no way to record the actual meal consumption and compare it with target calorie intake with that. Whenever user fail to prepare exact meal preparation proposed by the system, the total plan might get ineffective to get the desired results. Also, the system is more focused on providing fitness/training plan while providing minimum focus on the nutrition side.

2.3 Feature comparison

System is developed as a web-based system considering the portability to different devices such as mobile phones and tabs. PHP and python selected as programming languages on CodeIgniter MVC framework. PHP/CodeIgniter selected to make the development and debugging fast. Also, it makes easier to update the application. MySQL is the database management system (DBMS) selected for it's on demand scalability. Development always tried to use free and open source software (FOSS) development tools considering the flexibility. Easy to use distraction-free Interface design to the user despite which platform they use. System design is focused on the distraction free reading to its user. It provides user an environment, which is very user friendly.

	EatCorrect	Meal Planner	Fitness App
Web Based	✓	✓	✓
Mobile Access	✓	✓	✓
Native Food Database	✓	✗	✓
API Support	✓	✗	✓
Tailored Fit Meal Plans	✓	✓	✗
On Demand Meal Plans	✓	✓	✗
Dynamic Food Search	✓	✗	✗
Activity Data	✓	✗	✗
User Created Foods	✓	✗	✓
Track Progress	✓	✗	✓
Workout Plans	✗	✗	✓

Table 3.1 Similar system comparison

Chapter 3 Methodology



Figure 3.1 Main system components

Since the development done using CodeIgniter MVC, Object oriented programming (OOP) concepts are used in PHP. There are data models, controllers for models and views to show the inputs and outputs are being used. EatCORRECT system consists of four main components namely “MealPlan”, “Food”, “Nutritionix” and “Auth”. Components and key features provided by each component can be listed as follows.

3.1 MealPlan Model

Calorie Calculator: Calculates the TDEE for user based on the inputs provided.

Calorie Difference Calculator: Calculates the calorie deficit or surplus based on user goal.

Macro Calculator: Calculates the macro nutrient requirement of the user and return the protein, fats and carbohydrates requirement in grams.

Preferred Meal Finder: Returns a list of recipes that consists with only the ingredient foods preferred by the user. This function takes user food preference as an input and generates a list of recipes while eliminating all the recipes that consists any non-preferred ingredient by the user.

Food Amount Calculator: Calculates the amount of foods needed to cover the calculated macros and TDEE. The inputs will be TDEE, macros and list of food items. The list of food items prepared according to the preferred meal recipes of the user.

Manage Mealplan: Create, display and store meal plans for users.

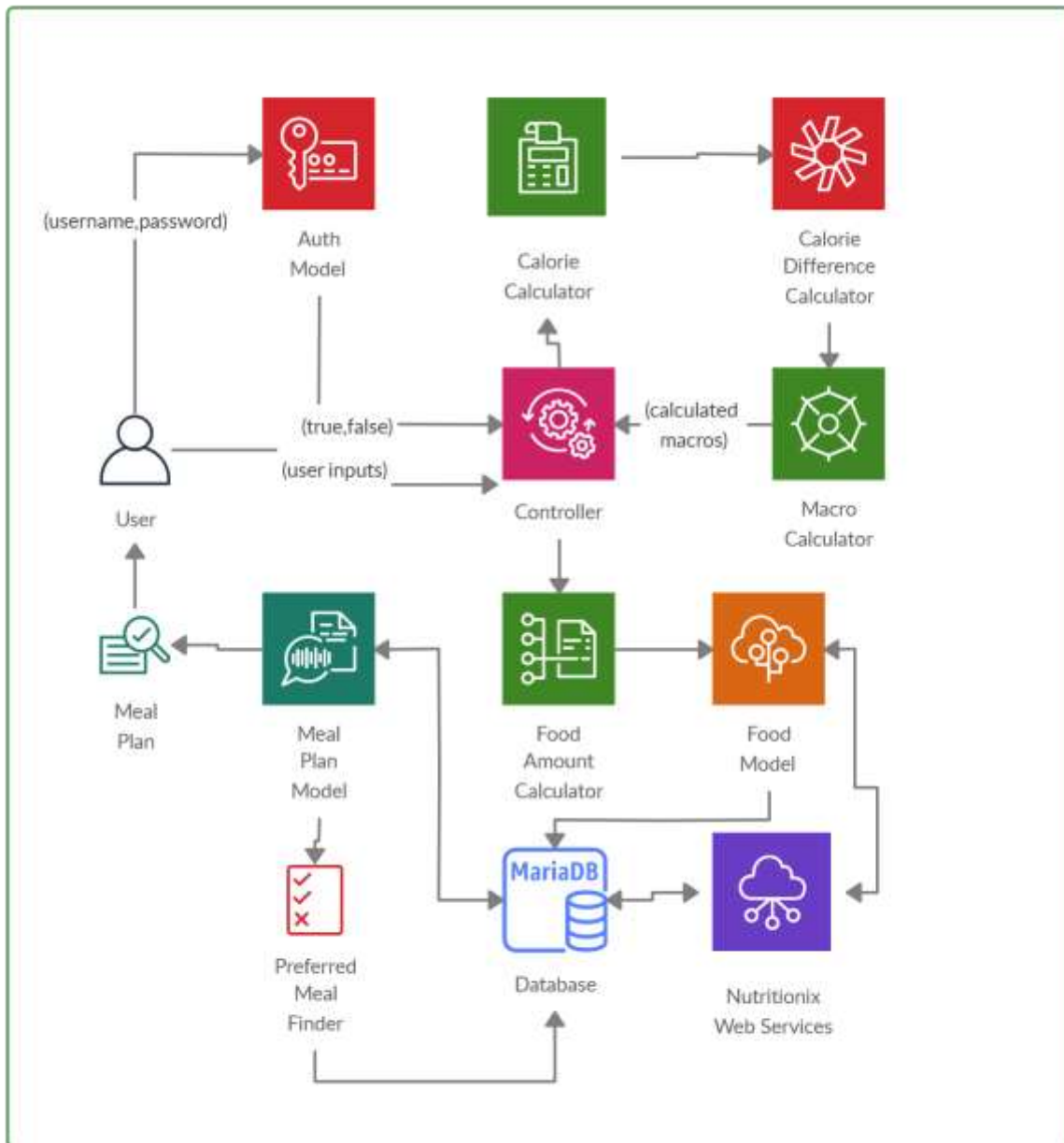


Figure 3.2 Functional level block diagram of meal plan model

3.1.1 Calories Calculator

Calorie calculator is based on user inputs of gender, weight, height and derived variable age. System use Mifflin-St Jeor equation and Katch-McArdle activity multipliers [38]. The calorie calculation can be simply expressed as follows.

$$\text{Total Daily Energy Expenditure (TDEE)} = \text{Basal Metabolic Rate (BMR)} * \text{Activity Multiplier}$$

BMR equation can be expressed as follows

Men: (10 x weight in kg) + (6.25 x height in cm) – (5 x age) + 5

Women: (10 x weight in kg) + (6.25 x height in cm) – (5 x age) – 161

Katch-McArdle Multipliers

Activity Level	Activity Multiplier
Little or no exercise	1.2
Exercise 1-3 times/week	1.375
Exercise 4-5 times/week	1.55
Intense exercise 3-4 times/week	1.725
Intense exercise 6-7 times/week	1.9

Table 3.2 Activity level multipliers

3.1.2 Calorie Difference Calculator

Calorie difference calculator works based on user's current body weight and target body weight. Depend on the goal the function either will add 20% deficit from TDEE to reduce weight, 20% surplus to gain weight or it will return zero to maintain the weight. Pseudo code can be expressed as follows.

If user current weight greater than target weight

Return $-TDEE * 0.2$

Else If user current weight lower than target weight

Return $+TDEE * 0.2$

Else

Return 0

3.1.3 Macro Calculator

Macro calculator consider user's target calorie and body weight as inputs and calculates the required amount of proteins, fats and carbohydrates in grams. Pseudo code can be expressed as follows.

Initialize macros

Input body weight, TDEE

Do the calculations

Proteins = bodyweight * 1.2

Fats = bodyweight * 0.8

$$\text{Carbohydrates} = (\text{TDEE} - (\text{Protein} * 4 - \text{Fats} * 9))/4$$

Create macros array

Macros=array (proteins, fats, carbohydrates)

Return macros

3.1.4 Preferred Meal Finder

Preferred meal finder takes user’s meal preference as input and returns a list of meal recipes made from the foods preferred by the user. This function purely created using an advance database query.

```

1 | select recipes.recipe_id, recipes.recipe_name, recipes.timing, recipes.food_count as
  | recipe_ingredient_count, count(ingredient.food_code) as ingredient_match_count
2 | from recipe_food_mapping rfm
3 | inner join (select food_code from foods where food_type IN ('1','3','7','8','17','19','20','21'))
  | ingredient
4 | on rfm.food_id = ingredient.food_code
5 | right outer join recipes
6 | on recipes.recipe_id = rfm.recipe_id
7 | WHERE recipes.timing = '2'
8 | group by recipes.recipe_id, recipes.recipe_name
9 | having ingredient_match_count = recipe_ingredient_count
10 | ORDER BY RAND()
  
```

Figure 3.3 Sample query of meal finder

recipe_id	recipe_name	timing	recipe_ingredient_count	ingredient_match_count
12	marinated chicken	2	1	1
9	spicy baked tuna	2	1	1
14	yogurt chicken	2	2	2
4	boiled long grain rice	2	1	1
18	chili chicken fried	2	1	1
20	barbecue cod steaks	2	1	1
16	barbecue tuna steaks	2	1	1

Figure 3.4 Sample query output for meal finder

3.1.5 Food Amount Calculator

Food amount calculator takes list of food items required to prepare meals allocated for user an array of food amounts. This is the core component of the EatCORRECT project. The resource problem is solved using linear programming. In-order to interpret the linear programming function in the project, python module created. Linear programming problem can be expressed as follows.

Let

$X_{1..n}$ be the number of grams/millilitres of food to use in meal preparation

$P_{1..n}$ be the number of protein grams in a serving of food

$F_{1..n}$ be the number of fat grams in a serving of food

$C_{1..n}$ be the number of carbohydrate grams in a serving of food

$U_{1..n}$ be the maximum number of servings of food

$E_{1..n}$ be the energy of one serving of a food in calories

PT be the number of protein grams required for user

FT be the number of fat grams required for user

CT be the number of carbohydrate grams required for user

TDEE be the total number of calories required by the user

where $X_{1..n}, P_{1..n}, F_{1..n}, C_{1..n}, U_{1..n}, E_{1..n}, PT, FT, CT, TDEE \geq 0$

Macro constraints are:

$P_1X_1 + P_2X_2 + \dots + P_nX_n \geq PT$ // Protein requirement of the user

$F_1X_1 + F_2X_2 + \dots + F_nX_n \leq FT$ // Fat requirement of the user

$C_1X_1 + C_2X_2 + \dots + C_nX_n \geq CT$ // Carbohydrate requirement of the user

Maximum serving size constraints:

$X_1 \leq U_1$

$X_2 \leq U_2$

...

$X_n \leq U_n$

The objective is to equal the TDEE

$TDEE = E_1X_1 + E_2X_2 + \dots + E_nX_n$

3.1.6 Manage Mealplan

This module contains all the functions which need to manage the meal plans for the specific user. It allows user to provide inputs and create tailored fit meal plans which satisfy the macro nutrient requirement. The module stores the meal plan on system database to view it later.

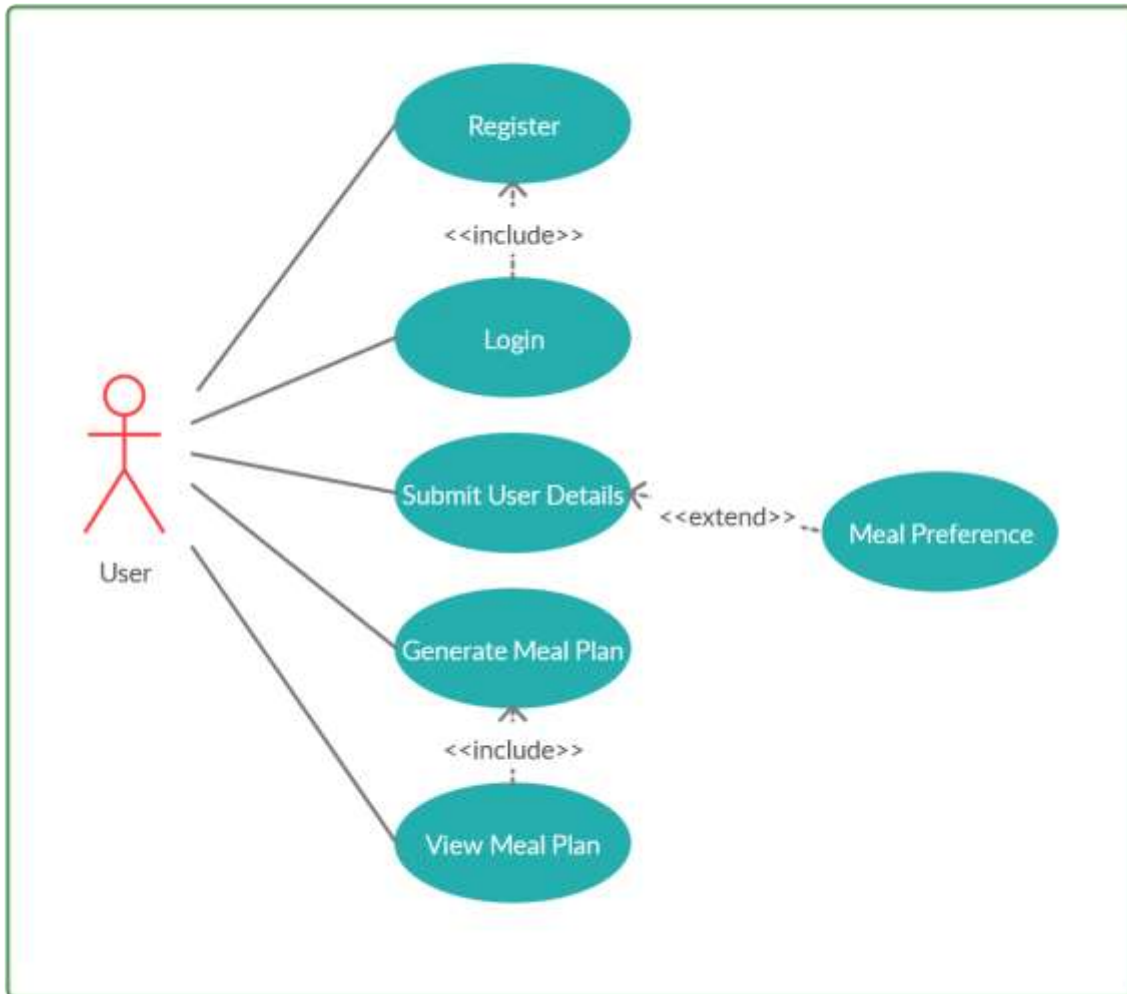


Figure 3.5 Use case diagram : Meal Plan

3.2 Food Model

Manage Foods: This module allows the user to view, create or delete food details. User can view nutritional information of the food items such as calories, protein, fat, carbohydrates, sodium, potassium, etc.

Manage Recipes: Recipes are consisting of foods. Apart from the food information recipes have the method to prepare it. The feature is allowing the user to view the recipe from the meal plan. Admin users can add or remove recipes.

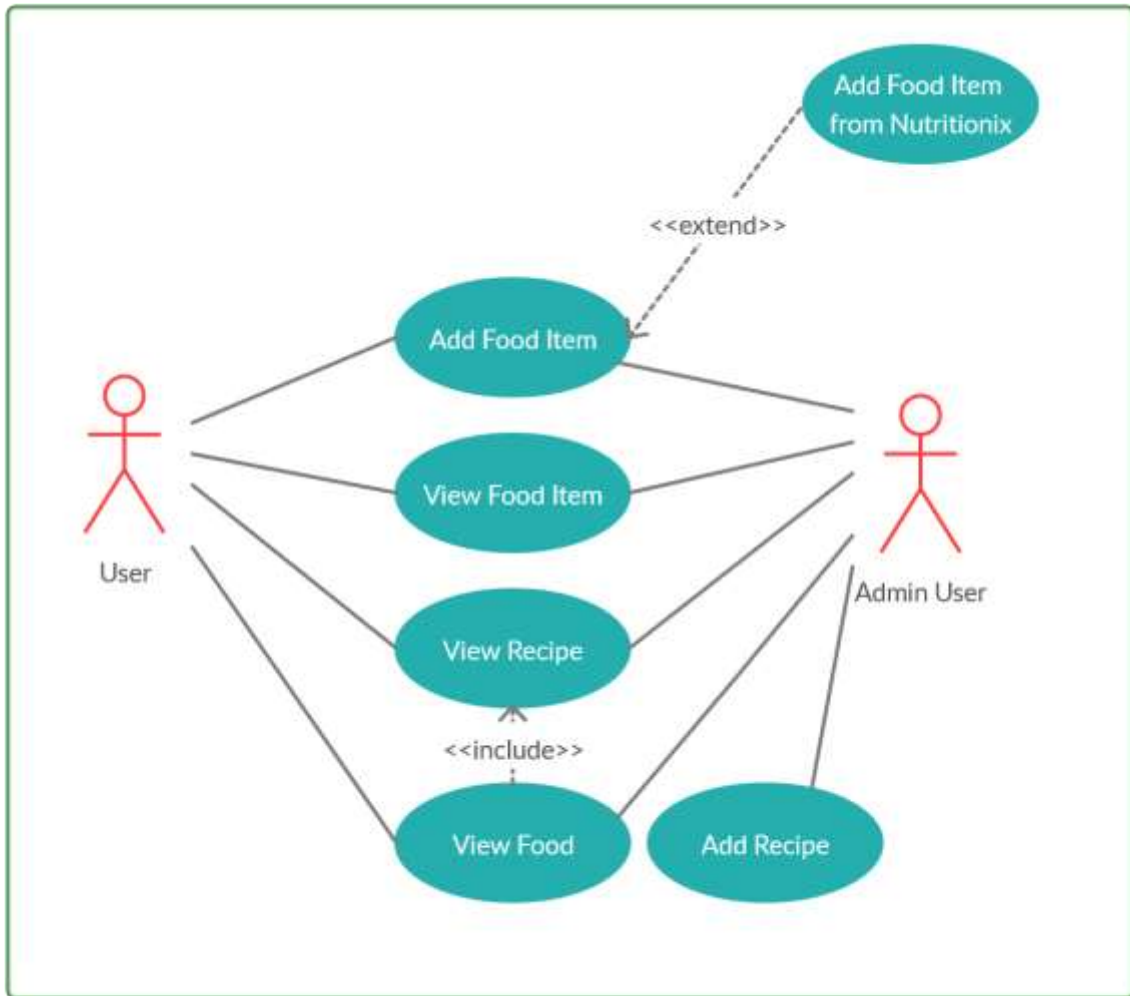


Figure 3.6 Use case diagram : Foods and recipes

Record Food Consumption: This module allows the user to record daily food consumption. It provides an informational view daily as a diary page where user can track the usage of foods throughout the day. User is allowed to add or remove the consumption records and also allowed to go forward or backward in the diary to do any changes. Smart copy features are provided to add consumption details quickly to the diary. For example, user can add foods consumed yesterday to today's diary page within one click.

Food Consumption of Viraj Senarathna 2020-05-07				
Food Consumption				Add
User Activity				Add
Breakfast				
Food	Brand	Serving Size	Calories	
cowpea	n/a	3	1008	Del
			Total	1008
Lunch				
Food	Brand	Serving Size	Calories	
rice	N/A	2	410.8	Del
fish_yellowfin_tuna	n/a	3	324	Del
Snack				
Food	Brand	Serving Size	Calories	
yogurt_greek_nonfat	n/a	2	116	Del
Dinner				
Food	Brand	Serving Size	Calories	
mixed_vegetable_salad_1	n/a	2.5	112.5	Del
long_grain_white_rice	n/a	2	730	Del
Activity				
Activity	Name	Duration	Calories	
Activity	running	35	485.92	Del

Figure 3.7 Sample diary page

3.3 Nutritionix Model

This model consists only a controller. The controller manages the functionality by loading food and auth models to the controller. This controller works with www.nutritionix.com APIs. It allows users to sync food details and activity details from the web services. The web services response with JSON arrays of data. Web service details are as follows.

Auto Complete Search: This feature allows user to search food items on the nutritionix website. Using GET method the search query passed to the web site. Result data is populated on user screen while typing on the search area. User does not need to press a button to trigger a button, the web service auto completes the query and populate data.

Search by ID: This feature loads the nutritional data from the nutritionix website. When user select a food returned on auto complete search items, respective unique id is selected from the returned results and passed as a get request to the website to load the nutritional data.

Search by food name: When auto complete result fails to fetch any food data from the nutritionix website, user can conduct a deep search using by simply clicking search button

which calls a web service on POST method. This query returns unbranded food items with nutritional information

Activity Details: This feature allows to enter daily user activities and calculate the calorie burned on the particular activity. The web service accepts the inputs in natural language via POST method. EatCORRECT system provides the user with a simple UI option to submit the activity data and add the data to the daily calendar page. User allowed to add or remove the activity records and also allowed to go forward or backward in the diary to do any changes.

3.4 Auth Model

This model used to provide user authentication and to store and get user related details. When user get registered in the EatCORRECT system, user get a notification via email with a link and token to activate the account. Passwords are stored in the database using a hash. Hash is compared when system need to authenticate the user. Following the link user can login to the system to use all the features mentioned above. Auth model providing following features.

- User Registration
- User Activation (via email)
- User Login
- Change Password
- Forgot Password (reset via email link)
- Update User Information
- User Activation/Deactivation (Admin feature)
- Store User Progress (Weight tracking)
- Store User Activity Data

3.5 Dashboard

When user login to the system immediately lands to the dashboard where user can quickly sneak peek to the progress made to the body weight and the nutrition values that completed throughout the day. This dashboard provides many information using eye-catching easy to read graphs, charts and widgets. It shows user weight updates as a line graph, calories consumed, calories burned, target calories, target nutrition macros, etc.

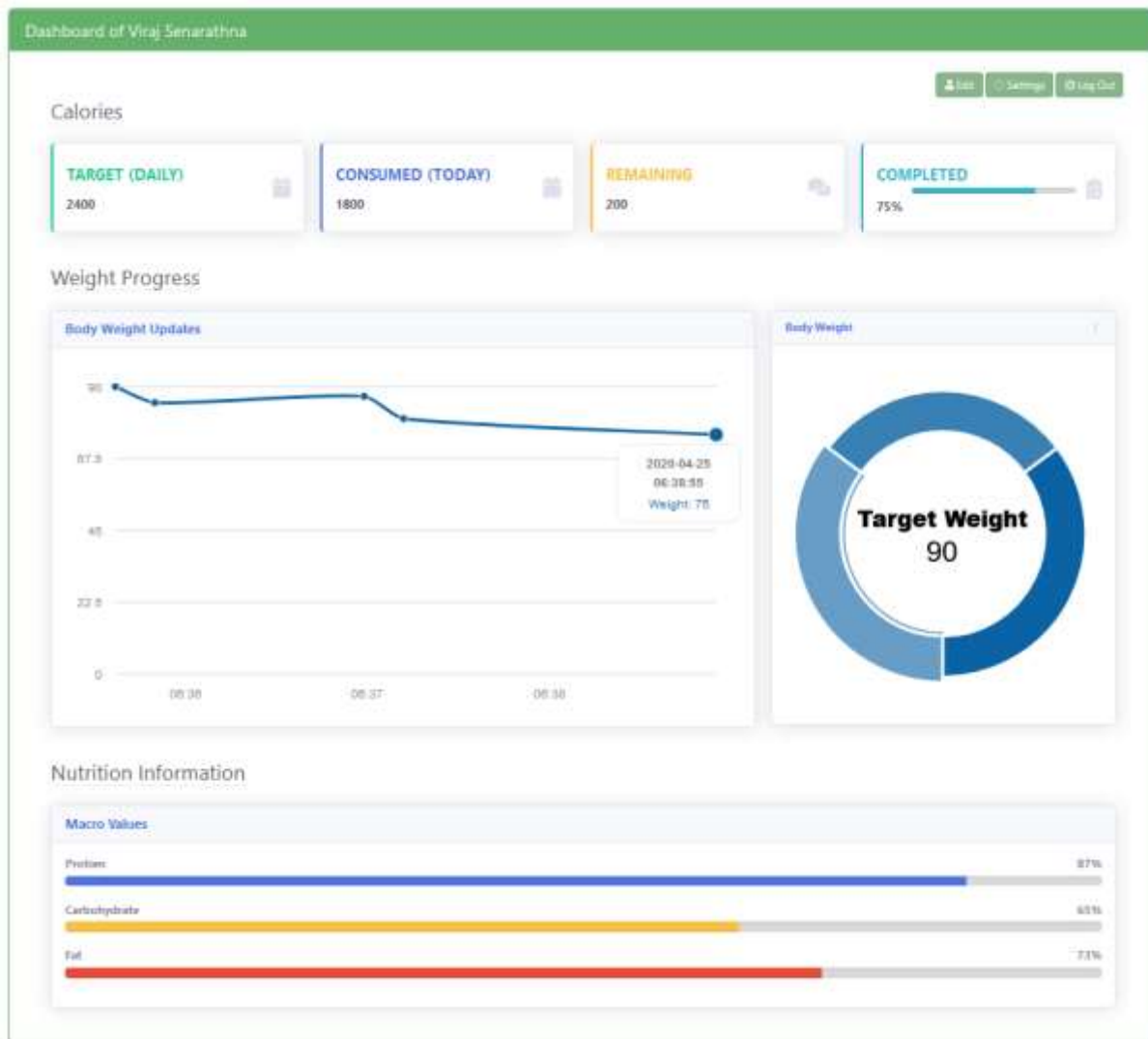


Figure 3.8 Dashboard

3.6 Database Model

The database design is made to cover key aspects such as security, performance and efficiency. At the designing stage, the understanding of the system, modelling the objects as database tables, avoiding data duplication and validating all the fields with proper data types and lengths and support all the models with minimum number of tables are taken in to the consideration.

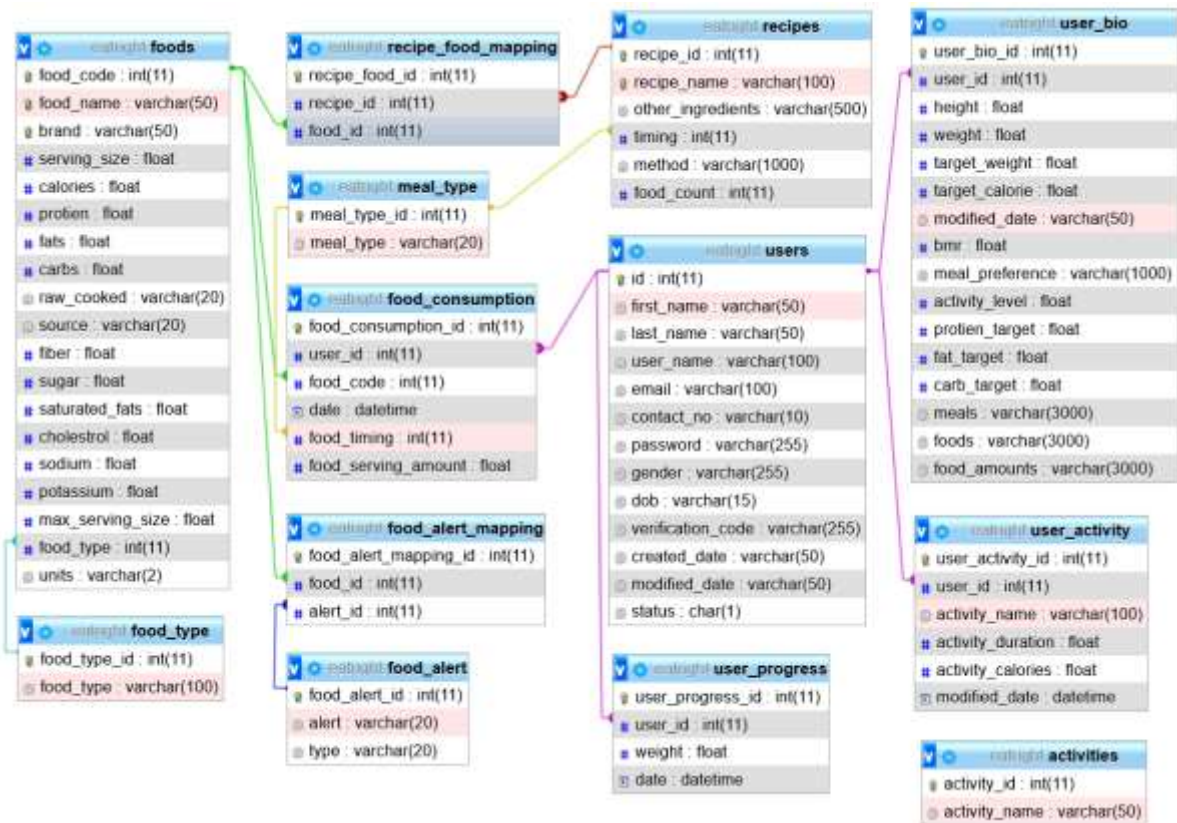


Figure 3.9 Database diagram

3.7 Software Development

System design is focussed on developing more user-friendly interfaces and deliver simplified system experience. In order to provide best user fit software model, the design and development used agile methodology. It provides more flexibility for the developer and is much effective as it has continuous iteration of development and testing. This way developer can introduce new features and more customized UI to the end user. Agile development is following few key principles. Unlike in waterfall software development methodology, Agile has iterative development cycles. Therefore, the developers can easily make the changes required by the stakeholders of the project. The methodology supports rapid development and rapid testing. Also the techniques like scrum meetings help to speed up the development of tasks that breakdown in to smaller parts and track the progress. Eat correct is a web-based system by considering the ease of access and applying changes to the system. With help of the agile methodology, lot of easy to use software functions can be introduced to the system in a quick time.



Figure 3.10 Agile software development cycle [39]

3.8 Tools and Technologies

A software which can be called as cross platform should have the ability operate on more than one computer architecture or operating system. The task of porting or simply making a software run on different platforms is a time-consuming and a tedious task because different operating systems have different application programming interfaces or APIs. To overcome this issue EatCorrect project considered cross platform technologies to be used most of the time.

3.8.1 Programming Languages

PHP is the main programming language used in this project. Mainly because it is a cross platform programming language. As the PHP code able to run smoothly on all operating systems, the developer no need to worry about the operating system where that the system is going to be hosted. Furthermore, PHP hosting service providers can be easily found. PHP syntax for programming in the hypertext pre-processor is quite similar to the C programming language. Hence it is an easy to use programming language. PHP web systems are quite fast compared to the web systems built using other technologies. To ensure a great user experience, PHP is a great choice. Open source and Powerful library support. Since developed and maintained by a cluster of PHP developers, this help in making a support community, extensive extension library. Documentations, guidelines and resources can be easily found over the internet and other formats such as books, videos, etc. PHP has been there for over two decades, so it is a very stable language where bugs and errors are minimal.

Python scripting language was the other programming language used in the project as it has several advantages oppose to using a compiled language such has being able to use the same copy of the software without specially compiling it to that particular architecture. Most of the

code has the capability run with a little or no modifications when we use a scripting language and a cross platform GUI framework.

- PHP 7.4.5
- Python 3.8.2

3.8.2 MVC Framework

Codeigniter is a powerful open source rapid software development toolkit which has several advantages. Since the project used agile software development model, rapid and dynamic development is a main aspect. Codeigniter MVC separates data, logic and presentation and supports rapid development. Codeigniter has a very informative bug handling system, it identifies the exact place of code where the error occurred and throws proper error message. Codeigniter has a vast range of helpers and libraries as built in features which makes developer's life easier. Developer can just load the library or helper and write single line of code to do a complex task. For example, codeigniter has a form validation library which covers many form validations functions where developer can validate number of rules with a line of code. It also has helpers and libraries to handle emails, calendar, URL unit testing, etc. CodeIgniter's data abstraction is quite remarkable. Developer can use its database abstraction layer to create, add, delete, and replace statements in a hassle-free way. It allows the user to use almost all standard database queries without writing a query. It need only just a line of code. The framework allows the developer to manage multiple connections using one application. With CodeIgniter, developer can modify the security strength according to the needs. It can stop all the non-defined URL paths to the application and rewrite the URLs in the way the developer wants where attackers find it difficult to find the correct path or lactation to execute the attack. Developer does not need apply mechanisms to avoid attacks such as SQL injections while retrieving information from the database. Also, it can enable cookie encryption, where the developer handle database and escape SQL queries directly

```
#user data for idee validation rules
$this->form_validation->set_rules('food_name','Food Name','required|is_unique[foods.food_name]');
$this->form_validation->set_rules('food_brand','Food Brand','required');
$this->form_validation->set_rules('serving_size','Serving Size','required|numeric');
$this->form_validation->set_rules('units','Units','required');
$this->form_validation->set_rules('calories','Calories','required|numeric');
$this->form_validation->set_rules('protien','Protien','required|numeric');
$this->form_validation->set_rules('fats','Fats','required|numeric');
$this->form_validation->set_rules('carbs','Carbs','required|numeric');
$this->form_validation->set_rules('fiber','Fiber','required|numeric');
$this->form_validation->set_rules('sugar','Sugar','required|numeric');
$this->form_validation->set_rules('food_form','Food form','required');
$this->form_validation->set_rules('saturated_fat','Saturated Fats','required|numeric');
$this->form_validation->set_rules('cholesterol','Cholesterol','required|numeric');
$this->form_validation->set_rules('sodium','Sodium','required|numeric');
$this->form_validation->set_rules('potassium','Potassium','required|numeric');
$this->form_validation->set_rules('max_serving','Maximum serving size','required|numeric');
```

Figure 3.11 Codeigniter validation class usage

```

public function returnRecipes()
{
$query = $this->db->get('recipes');
$query->result_array();
return $query->result_array();
}

```

Figure 3.12 Codeigniter database class usage

- CodeIgniter 3.1.11

3.8.3 Database Management System

When selecting PHP as programming language other rhyming word comes with it is MySQL. MariaDB is a community developed, forked project from MySQL. For EatCORRECT, the developer used MariaDB as the database management system considering several features. MariaDB releases faster and more transparent security releases, which enhance the security layer of the database. MariaDB offers more and better storage engines and much better performance. Migration also became very easy in MariaDB. With new features provided by MariaDB the system offers better caching on disk-intensive operations. The technology runs using temporary tables to speedup complex queries such as GROUP BY and DISTINCT. Also, it avoids the issues arises in highly scalable solutions. MariaDB provide better monitoring, better query optimization and easy to migrate database options.

- MariaDB 10.4.11

3.8.4 Other Tools

User Interface

- Bootstrap
- CSS

Text Editor

- Sublime 3

Graph Tools

- Raphael.js
- Morris.js

Scripting

- Javascript
- JQuery

Web Browser

- Mozilla Firefox 75 with Firebug

Development and Testing Workstation

- Processor: Intel(R) Core (TM) i7-8550U CPU @ 1.80GHz, 1992 Mhz, 4 Core(s), 8 Logical Processor(s)
- Memory: 16GB
- OS: Windows 10 Pro

Chapter 4 Evaluation

The main objective of the EatCORRECT project was to build a web portal that provide tailored fit meal plans to the user based on the user physical information and meal preferences, helping user to achieve a goal such as reduce or gain weight ,provides a platform to record meal consumption and activity data and improve overall wellbeing of the user by helping to keep eating habits and physical workouts directed to achieve a user goal. Mainly the system takes few user inputs such as body weight, height, date of birth and meal preference. Using that system calculates BMR, TDEE and Target body weight. Then the system uses the calculated variables to generate a meal plan which specifically helps the user to archive the target bodyweight. System also allows the user to record meal consumption and activity data and provide guidelines and alerts to systematically achieve a healthy body weight target. System also provides a simple yet eye-catching dashboard to the user to quickly identify the position of the nutrition consumption and calories burnt daily basis.

Major component of the system is generating meal plan for the user. Which is kind of a complex problem to solve. Developer researched on the methodologies already available to solve such problem and identified that the linear programming model can be used as an answer. Using linear programming model, the meal plan constructed as a resource solving problem. Basically, it tried to equalize a person's daily calories consumption of multiple foods to person's TDEE. As constraints, it took users basic macro requirement and maximum serving size of all the foods consumed. After solving the linear programming model, the system provides how much of each ingredient required for a specific user to prepare a meal to consume. Each and every module has gone through unit testing using a class in codeigniter called "Unit Test Class". All modules and made the EatCORRECT system, it has gone under the user level testing as well. Unit test case results are mentioned in "Appendix B" section.

System supports audit trails by configuring log details available on codeigniter. System logs all useful information such as user login, meal plan generation, system database updates, etc. System also logs errors with timestamp and user details with an error code. System administrators can easily track the root cause for the errors with reference guide provided with detailed error codes. Also the administrators can change the log information level to five different levels which helps to avoid recording all details all the time.

Creating an automated system which associates with human health is always challenging. Therefore, to provide more accurate and near perfect solution, the developer always used the formulas and methodologies which has many researches and studies. All the formulas used has a history of decades and published research papers and proven results. Therefore, validating the formulas done through trustworthy published researches.

4.1 Results and Discussion

The results are critically evaluated to prove the concept and the functionalities of the EatCORRECT system. The evaluation of the results done using two methods. The methods are discussed in detail later in this document. The formulas and the theories used to provide the solution are mentioned with references. Since the main project objectives are achieved through mathematical models, the validation of system-generated results is done through calculations. Basic inputs of weight, height gender, age and activity level considered for two use cases. One use case was considered a male user and other one is used a female user. Two users having different activity levels. First, two users are registered on the EatCORRECT system and feed the user data and generated meal plans for each user respectively, which will be discussed as method 1. Secondly using system-generated meal plans the food nutrition calculation done for both users manually, which will be discussed as method 2. Method 2 calculations are to validate meal plans. Following procedure is used to complete the calculation. The meal plans generated by the system taken one by one. For each meal plan all the foods used in the meal plan are listed with respective amount of servings. Using the verified available food items are used to calculate calorie amount of each food item with respective serving amount. Then the calculated values are compared with respective TDEE values and macros.

4.2 Critical Evaluation

Two users were created on the EatCORRECT system with following inputs. Then the meal plans were generated for each user. In the process of meal plan generation, the system calculates BMR and TDEE in kcals. The system calculated TDEE values displayed under “Profile” menu. Then using manual calculation method using the respective formulas, the TDEE values are calculated for each user. Manually calculated values and the system-generated values are compared for each user.

Inputs for user 1:

Age: 32
Gender: Male
Height: 173 cm
Weight: 80 kg
Activity Level: Exercise 1-3 times/week
Activity Multiplier: 1.375

Inputs for user 2:

Age: 30
Gender: Female
Height: 168 cm
Weight: 84 kg
Activity Level: No exercise
Activity Multiplier: 1.2

Method 1

TDEE calculation for user1

$$\text{BMR1} = (10 \times 80) + (6.25 \times 173) - (5 \times 32) + 5 = 2373.59$$

$$\text{TDEE1} = \text{BMR1} \times \text{Activity Multiplier} = 1726.25 \times 1.375 = 2373.59$$

TDEE calculation for user2

$$\text{BMR2} = (10 \times 84) + (6.25 \times 168) - (5 \times 30) - 161 = 1579$$

$$\text{TDEE2} = \text{BMR2} \times \text{Activity Multiplier} = 1579 \times 1.2 = 1894.8$$



Figure 4.1 System generated results : User 1



Figure 4.2 System generated results: User 2

Results calculated using method 1

User1 TDEE = 2373.59

User2 TDEE = 1894.8

Results from derived from the system

User1 TDEE = 2374

User2 TDEE = 1895

The manually calculated values for two users using method 1 and the values generated through the system are almost equal apart from the rounding off error which is less than 0.1%. The calculation methods are working as expected in the system.

Method 2

After generating meal plans for users through the system, all the food items and the food amounts required to prepare recipes mentioned in the meal plan are listed for each user respectively. Using those food amounts, nutritional value calculation is done in this method. According to the linear programming method described in methodology section, the system tries to equalize TDEE requirement of the user while equalizing or maximizing protein requirement, minimizing fat requirement and equalizing or maximizing carbohydrate requirement.

Analysis for user 1

Target TDEE : 2374

Target Macros:

$$\text{Proteins} = \text{bodyweight} * 1.5 = 80 * 1.5 = 120$$

$$\text{Fats} = \text{bodyweight} * 1.0 = 80 * 1.0 = 80$$

$$\text{Carbohydrates} = (\text{TDEE} - (\text{Protein} * 4 + \text{Fats} * 9)) / 4 = 293.5$$

Macro information of system generated meal plan for user 1

Food	Nutritional Values					System Calculated				
	Serving	Calories	Proteins	Fats	Carbs	Serving	Calories	Protein	Fat	Carbs
Chickpeas	100.00	364.00	19.00	6.00	61.00	257.00	935.48	48.83	15.42	156.77
Egg Whites	33.00	17.16	3.60	0.06	0.24	33.00	17.16	3.60	0.06	0.24
White rice	100.00	365.00	7.00	0.70	80.00	116.00	423.40	8.12	0.81	92.80
Chicken Breast	100.00	114.00	21.20	2.60	0.00	255.00	290.70	54.06	6.63	0.00
Carrots	46.00	16.00	0.30	0.10	3.80	138.00	48.00	0.90	0.30	11.40
Cabbage	75.00	17.00	0.90	0.10	4.10	75.00	17.00	0.90	0.10	4.10
Cucumber	50.00	7.50	0.30	0.10	1.80	50.00	7.50	0.30	0.10	1.80
Beet	50.00	22.00	0.84	0.09	4.98	100.00	44.00	1.68	0.18	9.96
Cocunut	25.50	116.40	0.80	7.20	13.20	51.00	232.80	1.60	14.40	26.40
Coconut Oil	14.00	117.00	0.00	14.00	0.00	42.00	351.00	0.00	42.00	0.00
						Total	2367.04	119.99	80.00	303.47
						Unit	kcal	grams	grams	grams

Table 4.1 Food calorie calculation: User 1

Analysis for user 2

Target TDEE : 1895

Target Macros:

$$\text{Proteins} = \text{bodyweight} * 1.5 = 84 * 1.5 = 126$$

$$\text{Fats} = \text{bodyweight} * 1.0 = 84 * 1.0 = 84$$

$$\text{Carbohydrates} = (\text{TDEE} - (\text{Protein} * 4 + \text{Fats} * 9)) / 4 = 158.75$$

Macro information of system generated meal plan for user 2

Food	Nutritional Values					System Calculated				
	Serving	Calories	Proteins	Fats	Carbs	Serving	Calories	Protein	Fat	Carbs
Bread	29.00	77.14	2.57	0.97	14.33	29.00	77.14	2.57	0.97	14.33
Egg Whites	33.00	17.16	3.60	0.06	0.24	33.00	17.16	3.60	0.06	0.24
Eggs	50.00	71.50	6.28	4.76	0.36	127.00	181.61	15.95	12.09	0.91
Mackerel Fish	100.00	159.00	23.50	6.30	0.00	370.00	588.30	86.95	23.31	0.00
Brown Rice	100.00	370.00	8.00	2.90	77.00	137.00	506.90	10.96	3.97	105.49
Red Cabbage	60.00	17.60	0.90	0.10	4.00	120.00	35.20	1.80	0.20	8.00
Carrot	46.00	16.00	0.30	0.10	3.80	138.00	48.00	0.90	0.30	11.40
Green Beans	50.00	17.20	0.90	0.20	3.90	200.00	68.80	3.60	0.80	15.60
Cauliflower	57.50	13.20	1.10	0.30	2.40	58.00	13.31	1.11	0.30	2.42
Coconut Oil	14.00	117.00	0.00	14.00	0.00	42.00	351.00	0.00	42.00	0.00
						Total	1887.42	127.44	84.01	158.40
						Unit	kcal	grams	grams	grams

Table 4.2 Food calorie calculation: User 2

	User 1		User 2	
	Expected Results	Actual Results	Expected Results	Actual Results
TDEE(kcal)	<= 2374	2367.04	<= 1895	1887.42
Protein(g)	>= 120	119.99	>= 126	127.44
Fat(g)	<= 80	80.00	<= 84	84.01
Carbohydrates(g)	>=293.5	303.47	>= 158.75	158.40

Table 4.3 Results comparison

The target TDEE and macro values calculated manually is almost same to the values calculated for the food item amounts generated from the system for each user meal plan with less than 0.5% variance. Therefore, the meal plans generated from the system are fit for the purpose.

4.3 Limitations

- The system calculates TDEE by multiplying BMR by activity multipliers. Both BMR and activity multipliers have some limitations where it can be concerns for the system as well.
- Gender: Men and women have different metabolic rates. Relative to women, men have faster metabolism.
- Age: Person’s metabolic rate getting slow as the person gets old. The main reason for that is when a person gets older the muscle tissue become lighter. This loss of muscle tissue and the changes to hormonal and neurological processes makes a slow metabolic rate. For example, a developing child has more rapid metabolic rates in some stages of the growing age.
- Muscle mass vs Fat mass. The mass of the human body determined by the muscle mass, fat mass and the water level between the muscle tissues. Muscle tissue requires more energy to exist than fat mass. Therefore a person has more muscle mass have a particular body mass required more energy than a person who has more fat mass and

same body mass. Strength training and resistive training make more muscle mass and lesser fat mass in the human body. Therefore, people who regularly exercise require more energy to sustain.

- Physical activity level: A person who spending more time doing physical activities have a relatively more muscle mass to fat mass ratio. That makes the more active person spending more energy even while resting compared to a person who is doing lesser physical activities.
- Body size. The people have large body frames having larger organs and fluid volume to maintain. This burns more energy compared to a person have smaller body size.
- Genetics. This is the most unexplainable limitation in the BMR method. Since the genes are different from one to another in every human being, some people burn more energy related to others. Some people have higher metabolic rates genetically.
- Hormonal factors. Hormonal imbalances can affect metabolism of the human body, which affects the BMR.
- Environmental Factors: The temperature in the human body is one of key factor to maintain and functioning the human body. To maintain the temperature of human body it needs to burn energy. Therefore in cold areas human body burns more energy and increase BMR.
- Diet habits: The metabolism is changing with the food consumption patterns. Because raw foods with more dietary fiber takes more energy to digest compared to processed foods with higher sugar content. In addition, some bad habits such as smoking, consuming alcohol doing more damage to the metabolic rate and create more changes in BMR.
- The system is having calorie requirement limitations. Currently the system designed to provide meal plans for the uses who having calorie requirement between 1300 to 4000 kcals. This range will cover majority of the people who does not have special needs. If the user's calorie requirement below or more than the mentioned range, the system provides an alert.

4.4 Future Work

The project currently considering satisfy the user's macro nutrient needs. Those are the amount of protein, fats and carbohydrates. But the linear programming model built on a way that it can handle many more constraints. Therefore, this project can easily be extended to generate meal plans to satisfy user's micro nutrient needs such as vitamins, minerals, etc. Also, with correct data feed it can extend further more to limit unhealthy meal consumptions by using constraints on sodium, unsaturated fats, etc.

Since the project database completed to prove the concept with limited period of time, it considered mostly the Sri Lankan recipes and food items. By increasing the validation and data feed, a rich database can be made. The database is designed to hold large number of values. If it can feed ample enough data to cover more regions, the system can hold a value to identify the user's region and populate the meal plan according to the region.

Since the system generates TDEE calculations based on average values it might work best on general users. Pro users who have a sound knowledge on food and fitness area might not get

the best output by using average number. This can be sorted out if the user allowed to choose activity multiplier range where user can check progress time to time and change the multipliers.

The system generates meal plans using a scientific approach and allows user to record food consumption and activity details. To be an one stop shop to satisfy a fitness geek, it just needs a fitness workout (exercise) planner. There are studies available on designing workouts for individuals using a scientific approach. That will be a nice addition to the project.

The food database already consists of food alerts such as high sugar, low fat, high sodium, etc. With this data, the system can easily generate meal plans for the people who have some medical conditions. For example, the system can avoid foods having high sodium for the people who are at heart risks.

Same food identified by different names in different countries in the world. It is very hard to find nutritional information using native names because most of food nutrition researches were recorded under common name or scientific name. The system can fill this gap by storing meta information such as common name, scientific name, other names, etc. Also it can allow the users of the system to enter the other names of the food items called a particular regions.

Today almost everyone is carrying a mobile device with them. Therefore, porting the project to a mobile version will be a great option. Already the system has responsive UI to use on any device, it can be easily ported in to mobile application.

Chapter 5 Conclusion

Human lifestyle changed rapidly over the time. Specially in the information era mostly the day to day tasks are automated and human activity levels have dropped drastically. While the activity levels are dropping down, the human eating patterns and the quality of the foods they consume also changed. People had to eat more processed and unhealthy food choices and eat leads to more non-communicable diseases lately. Lot of studies shows that selecting healthy food choices, maintaining a correct body weight (BMI) and exercise regularly can reduce health risks in a large scale and improve human wellbeing as well. But finding better food choices and maintaining recommended body weight while living a busy life is a very challenging to a person when time is precious. When people realize the importance of nutrition and importance of maintaining an ideal body weight people seek solutions using various mediums. Lot of people try to get information from the internet, books and other mediums such as radio, television, etc. But most of the things available on the internet are not accurate, sometimes they are expensive or very hectic and time-consuming methods. Since the nutritional science is a broad knowledge area, understanding through reading and finding information via other formats will be hard for many people. Visiting a professional nutritionist is a good option, but giving every individual a tailored fit meal plan is also a challenging thing for such a professional in a limited time. There are some tools already available in the internet that tries to address this issue. But most of the solutions are focussed on one or few aspects while the users having some more issues. For example, there are meal plan generators, but the generated meal plans don't contain any food item that the user likes to eat. This is happened due to the systems are created using data of a single region. Other problem is usually those systems highly focussed on commercial values and there is no way to validate the efficiency and user cannot measure any progress without using another tool.

EatCORRECT is there to answer that problem. The EatCORRECT research and development area to get the basic user data which is very easy to feed, calculate the required variables and generate meal plans which designed to achieve an user goal. User can simply enter basic parameters and generate the plan by himself. The plans are taken care of user meal preference therefore the user does not have to worry about eating unfamiliar foods. The EatCORRECT system always consider the Asian meal recipes and loaded them into the system. Even if the user fails to follow the meal plan. User can get an idea regarding the nutrition consumption by completing the meal diary daily. User is provided with handful of options to find the foods and their respective nutritional values from the system. The system allows the user to save their own food nutritional values in the system database and the system also allows the user to find food item on nutritionix.com and sync them to user database. The system also provides the user track the progress and quickly find the position of the progress by looking at simple charts and graphs in the dashboard. When continuously work with the EatCORRECT system, the user gets a complete report and idea regarding how the nutrition works on particular user body. EatCORRECT is not just a meal plan generator or a calorie counter. It will step to a different direction from the traditional solutions. Taking the user experience to a completely new level while taken care of almost all the user fitness goals with development of this healthy dieting system the days will be gone with people of overweight or underweight.

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Appendices

Appendix A

Sample service request

<https://trackapi.nutritionix.com/v2/search/instant?query=rice>

Sample output

```
{
  "branded": [
    {
      "food_name": "Cereal For Baby, Rice, Stage 1",
      "serving_unit": "cup",
      "nix_brand_id": "51db37c3176fe9790a8991f6",
      "brand_name_item_name": "Beech-Nut Cereal For Baby, Rice, Stage 1",
      "serving_qty": 0.25,
      "nf_calories": 60,
      "photo": {
        "thumb": "https://d2eawub7utcl6.cloudfront.net/images/nix-apple-grey.png",
        "highres": null,
        "is_user_uploaded": false
      },
      "brand_name": "Beech-Nut",
      "region": 1,
      "brand_type": 2,
      "nix_item_id": "51c38f3c97c3e6d3d972ef8d",
      "locale": "en_US"
    },
    {
      "food_name": "Organic Rice Cakes, Brown Rice, Lightly Salted",
      "serving_unit": "cake",
      "nix_brand_id": "51db37b8176fe9790a898b23",
      "brand_name_item_name": "Lundberg Organic Rice Cakes, Brown Rice, Lightly Salted",
```

```
"serving_qty": 1,
"nf_calories": 60,
"photo": {
  "thumb": "https://nutritionix-
api.s3.amazonaws.com/5cc40225892ab9da1dbd6443.jpeg"
},
"brand_name": "Lundberg",
"region": 1,
"brand_type": 2,
"nix_item_id": "51c3bf3397c3e6d8d3b4852e",
"locale": "en_US"
},
]
}
```

Appendix B

EatCORRECT System Unit Testing Results

Test Name	Load user login details
Test Datatype	String
Expected Datatype	String
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	28
Notes	function getUserDetails
Test Name	Load user bio details
Test Datatype	String
Expected Datatype	Integer
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	35
Notes	function getBioDetails
Test Name	Load activity list
Test Datatype	String
Expected Datatype	String
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	41

Notes	function returnActivityList
Test Name	Load food details
Test Datatype	String
Expected Datatype	String
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	48
Notes	function loadFoodList
Test Name	Load meal types
Test Datatype	String
Expected Datatype	String
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	54
Notes	function loadMealList
Test Name	Load alert types
Test Datatype	String
Expected Datatype	String
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	60
Notes	function loadFoodAlertList

Test Name	Load food types
Test Datatype	String
Expected Datatype	String
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	66
Notes	function loadFoodTypeList
Test Name	Load recipe list
Test Datatype	String
Expected Datatype	String
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	72
Notes	function returnRecipes
Test Name	BMR - Male
Test Datatype	Float
Expected Datatype	Float
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	82
Notes	function bmr for 173cm tall, 78kg weighted, 32 aged male
Test Name	BMR - Female

Test Datatype	Float
Expected Datatype	Float
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	91
Notes	function bmr for 152cm tall, 50kg weighted, 25 aged female
Test Name	Calorie difference - Reduce
Test Datatype	Float
Expected Datatype	Float
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	96
Notes	function calorieDifference for reduce weight
Test Name	Calorie difference - Gain
Test Datatype	Float
Expected Datatype	Float
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	101
Notes	function calorieDifference for gain weight
Test Name	Calorie difference - Maintain
Test Datatype	Integer

Expected Datatype	Float
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	106
Notes	function calorieDifference for maintain weight
Test Name	Macro - Protein
Test Datatype	Float
Expected Datatype	Float
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	115
Notes	function calculateMacros protein requirement
Test Name	Macro - Fats
Test Datatype	Integer
Expected Datatype	Float
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	124
Notes	function calculateMacros fat requirement
Test Name	Macro - Crbohydrates
Test Datatype	Float
Expected Datatype	Float

Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	133
Notes	function calculateMacros carb requirement
Test Name	Ideal body weight - Lower limit
Test Datatype	Float
Expected Datatype	Float
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	139
Notes	function calculateIdealBodyWeight for 173cm
Test Name	Ideal body weight - Upper limit
Test Datatype	Float
Expected Datatype	Float
Result	Passed
File Name	C:\xampp\htdocs\eatcorrect\application\controllers\testunit.php
Line Number	145
Notes	function calculateIdealBodyWeight for 173cm

Appendix C

System Error Codes

Code	Error
0125	SMTP connection failed. Check configurations.
1100	Database error on user creation. Check users table.
1101	Database error on food creation. Check foods table.
1102	Database error on food remove. Check foods table and food alert mapping.
1103	Database error on alert remove. Check food alert mapping.
1104	Database error on recipe creation. Check recipes table.
1105	Database error on recipe edit. Check recipes table.
1106	Database error on recipe delete. Check recipes table.
1107	Database error on consumption add. Check consumption table.
1108	Database error on consumption remove. Check consumption table.
1109	Database error on User bio update. Check user_bio table.
1110	Database error on store meal plan. Check user_bio table.
1111	Database error on manage users. Check user table.
2100	Logic error on shopping list generation. Check amounts.
2200	User activation code error. Check activation URL.
2300	Meal plan generation failed. Check serving amounts.
3200	Web service connectivity failed. On dynamic food search. Check internet/Proxy.
3201	Web service connectivity failed. On search by nutritionix id. Check internet/Proxy.
3202	Web service connectivity failed. On food search by name. Check internet/Proxy.
3203	Web service connectivity failed. On activity update. Check internet/Proxy.

Appendix D

EatCORRECT User Manual 1.0

1. User Related Functions

1.1 User Registration

First time users can register themselves at EatCORRECT web site by using the link available in login page. Please fill the basic data and click register button.



The screenshot shows the registration page of the EatCORRECT website. At the top left is the 'EatCORRECT' logo. At the top right are navigation links: 'Login', 'Profile', 'Foods', 'Diary', 'Meal Plan', and 'Logout'. Below the navigation is a green banner with the text 'Please register yourself to explore amazing features'. The main content area is titled 'Registration' and contains several input fields: 'Username' (with the example 'Cedren'), 'Email' (with the example 'vrajare@gmail.com'), 'Gender' (a dropdown menu with 'Male' selected), 'Password' (masked with '*****'), 'Zim.' (with the example '0770791205'), and 'Date of Birth' (with the example '01-12-1987'). A 'Register' button is located at the bottom right of the form. A small text link 'Already Registered User? Click here to login' is positioned above the 'Register' button.

User will get an email with a link to activate the user account. User will not be able to login to the system without activating the account.

1.2 User Login

User can login to the system using home page with valid information.



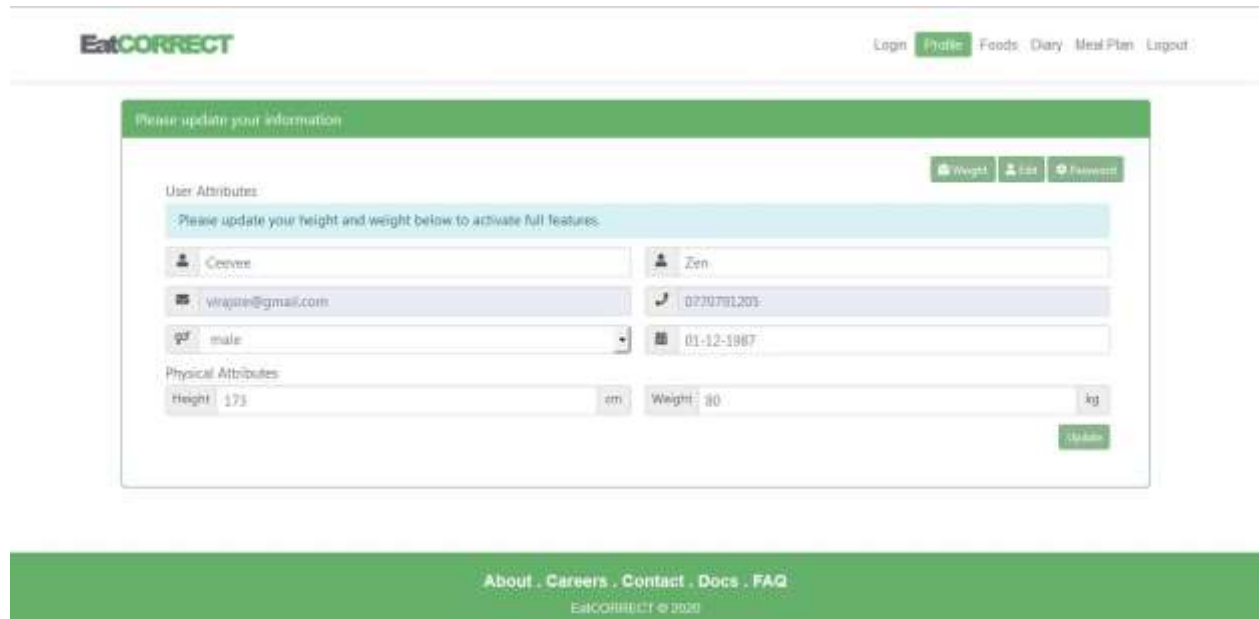
The screenshot shows the login page of the EatCORRECT website. At the top left is the 'EatCORRECT' logo. At the top right are navigation links: 'Login', 'Profile', 'Foods', 'Diary', 'Meal Plan', and 'Logout'. Below the navigation is a green banner with the text 'Please sign in to explore amazing features'. The main content area is titled 'Login' and contains two input fields: 'User Name/Email' and 'Password'. A 'Login' button is located at the bottom right of the form. A link 'Not a user yet? Register Now' is positioned above the 'Login' button, and a link 'Forgot Password?' is positioned below the 'Password' field.

1.3 Reset Password

User can reset password if the user forgot the password. User will get a new password via email. User can login in and change password.



1.4 Edit User

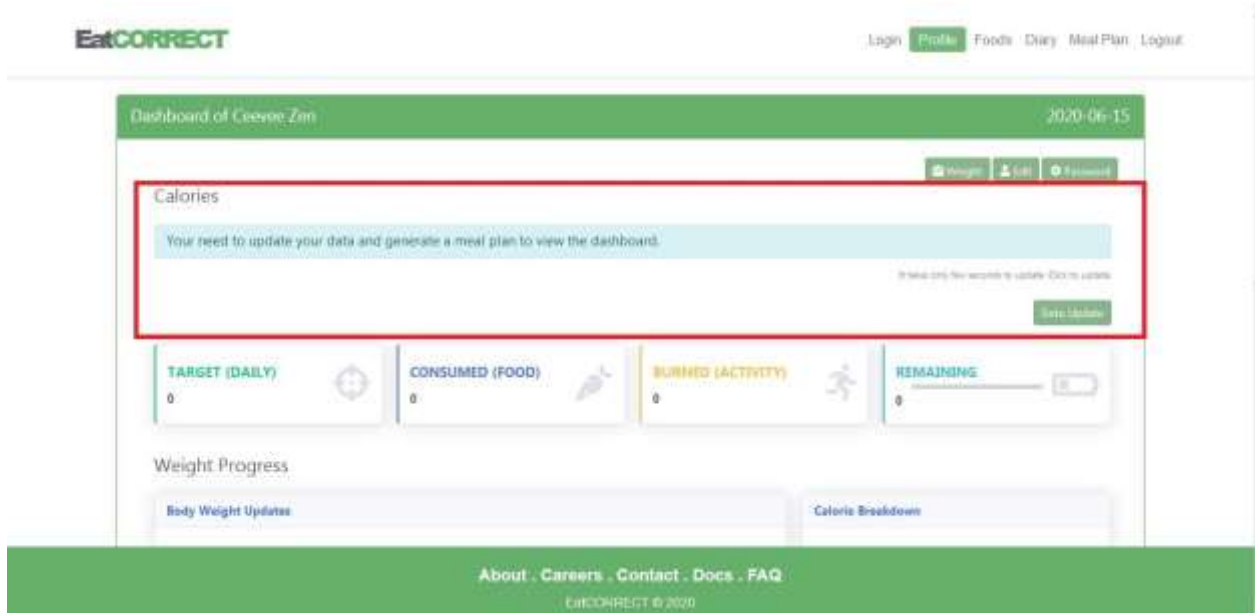


From this panel, user can edit any detail other than email and mobile number.

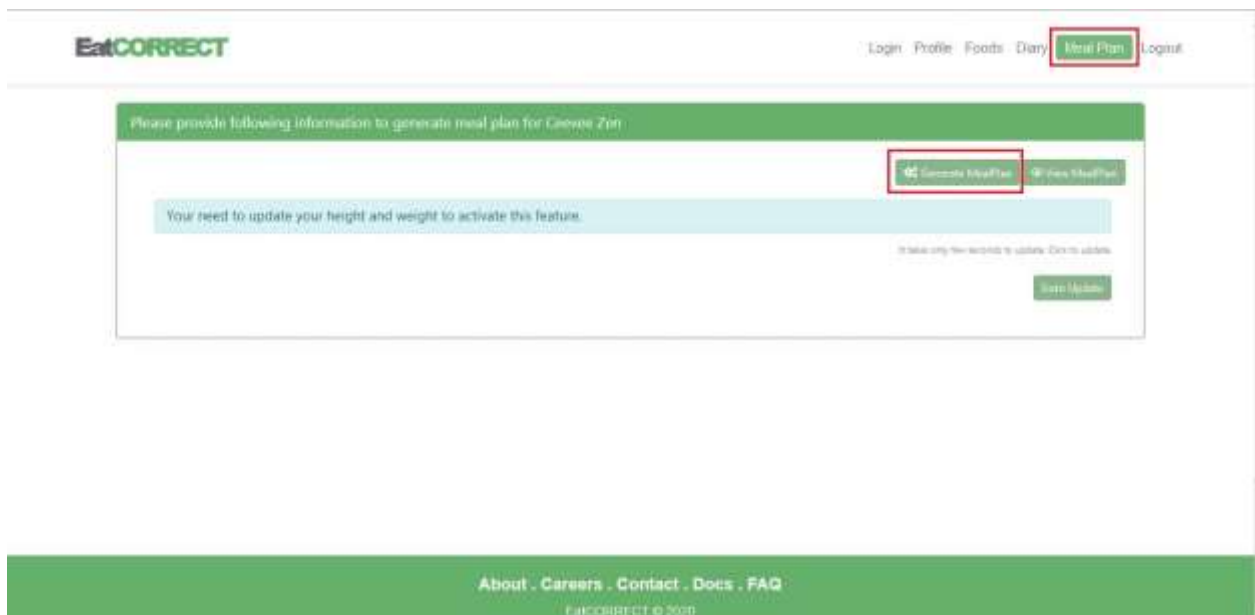
2 Meal Plan

2.1 Generate Meal Plan

In order to generate a meal plan, user need to enter few details such as height and weight. After initial login, user will see a dashboard like this mentioning whether data is set or not.



User can generate a meal plan any time you need by selecting “Meal Plan” from menu. Select sub menu generate meal plan button on meal plan page.



If user's weight and height not set, please set those using go to update button from meal plan menu or edit button on user profile menu.

2.2 Customizing Meal Plan

Please select a target weight for the user. User can see the ideal weight range will be display. Also, please select the activity level from the drop down. Then user can select all the food choices from meal preference. More food choices will give more precise and easy to follow meal plan.

Please provide following information to generate meal plan for Carevet Zen

[Generate Meal Plan](#) [View Meal Plan](#)

You don't have any previously generated meal plans. Please follow the instructions.

Target Weight

Target Weight kg

Your ideal weight range is: 55.37 kg to 74.82 kg

Activity Level

Select Activity Level

Meal Preferences(Select all the foods you like)

Meat/Fish

- Fish
- Chicken
- Pork
- Beef
- Eggs

Yam/Veggie/Fruit

- Potato
- Sweet Potato
- Fruit
- Vegetable
- Beans

Grain

- Rice
- Cornmeal
- Cornmeal
- Green Lentil
- Oat

Products

- Egg
- Milk
- Cheese
- Yogurt
- Soy

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2.3 View Meal Plan

After generating meal plan user can view it anytime by clicking the view meal plan button on meal plan page. User can view the food recipes by clicking on view button in front of each recipe name.



Meal Plan of Corinna Zim

Shopping List Generate Meal Plan **View Meal Plan** Logout

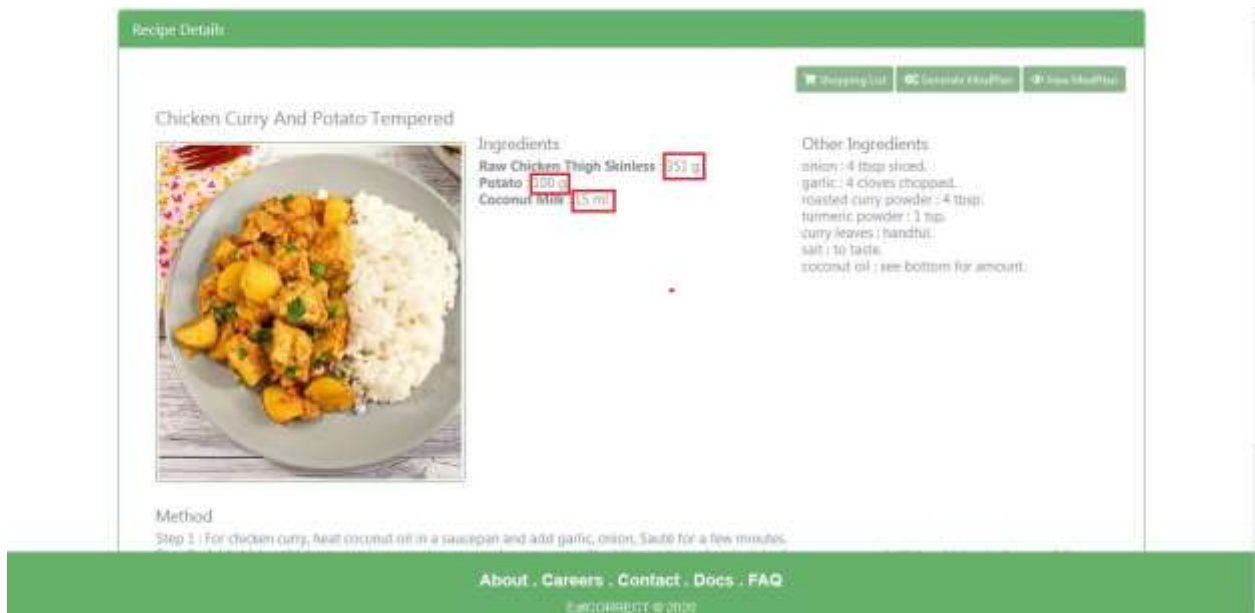
Meal plan generated successfully.

Meal	Recipe	View
Monday		
Breakfast	omelette with bread	View
Lunch	spicy baked toasty	View
Lunch Sidedish	cooked white rice	View
Snack	boiled egg whites	View
Dinner	stir fried vegetables	View
Tuesday		

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2.4 Recipe Details


The instructions to make recipe will be appear on page.



Recipe Details

Shopping List Generate Meal Plan **View Meal Plan**

Chicken Curry And Potato Tempered



Ingredients

- Raw Chicken Thigh Skinless 351 g
- Potato 100 g
- Coconut Milk 15 ml

Other Ingredients:

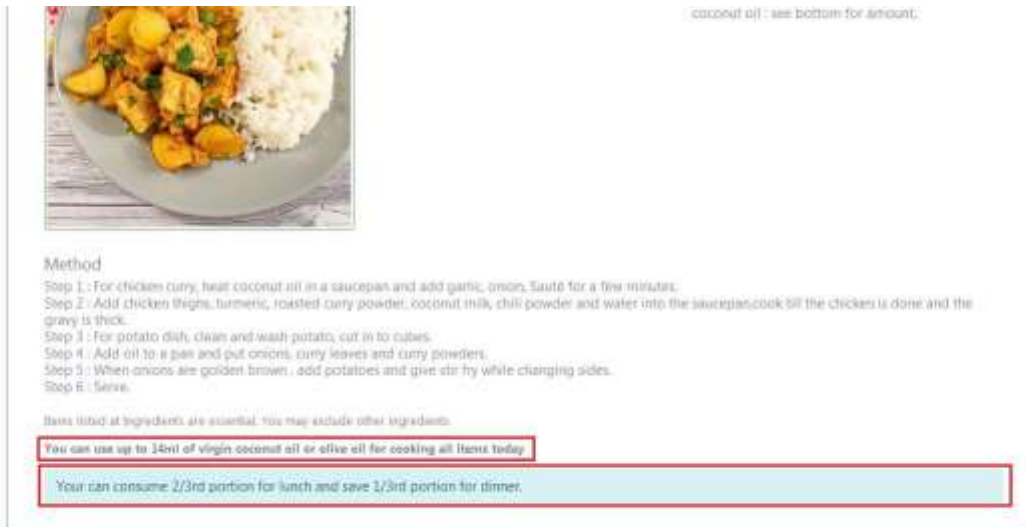
- onion : 4 tbsp sliced.
- garlic : 4 cloves chopped.
- roasted curry powder : 4 tbsp.
- turmeric powder : 1 tsp.
- curry leaves : handful.
- salt : to taste.
- coconut oil : see bottom for amount.

Method

Step 1 : For chicken curry, heat coconut oil in a saucepan and add garlic, onion. Sauté for a few minutes.

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Details regarding how to consume food and details regarding oil amounts will be displayed on the bottom.



Method

Step 1 : For chicken curry, heat coconut oil in a saucepan and add garlic, onion, Sauté for a few minutes.

Step 2 : Add chicken thighs, turmeric, roasted curry powder, coconut milk, chili powder and water into the saucepan, cook till the chicken is done and the gravy is thick.

Step 3 : For potato dish, clean and wash potato, cut in to cubes.

Step 4 : Add oil to a pan and put onions, curry leaves and curry powders.

Step 5 : When onions are golden brown , add potatoes and give stir fry while changing sides.

Step 6 : Serve.

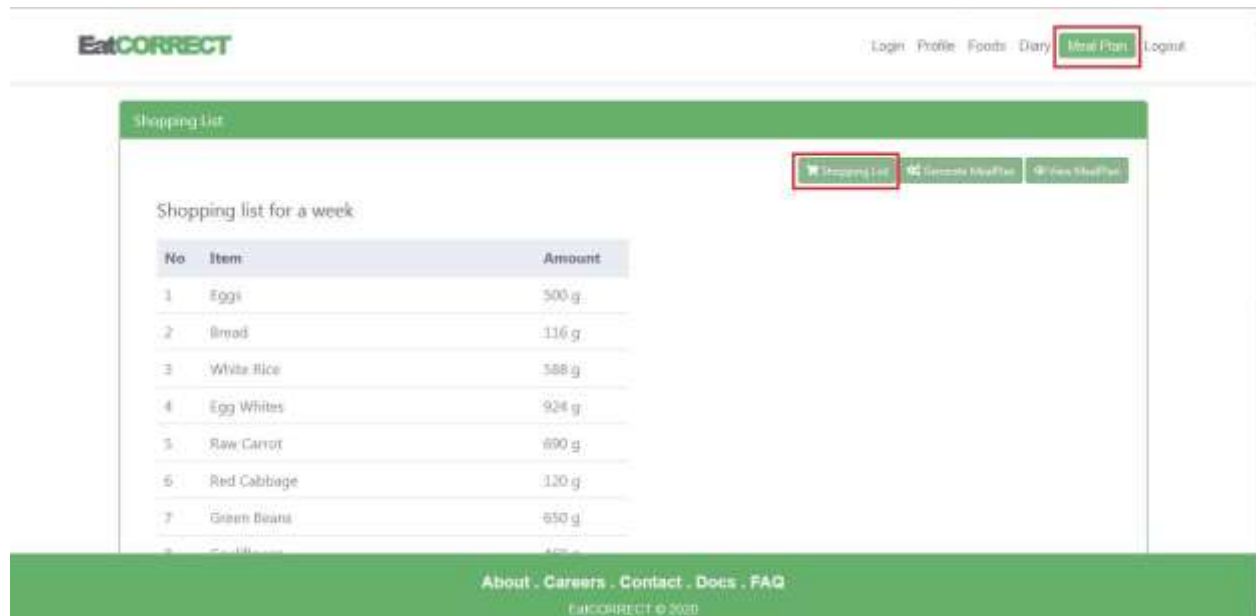
Items listed at ingredients are essential, You may exclude other ingredients.

You can use up to 14ml of virgin coconut oil or olive oil for cooking all items today.

You can consume 2/3rd portion for lunch and save 1/3rd portion for dinner.

2.5 Shopping List

System generates a shopping list for items required to cook for one week. User can print it or email it for later reference.



Login Profile Foods Diary **Meal Plan** Logout

Shopping List

Shopping List Generate Meal Plan View Meal Plan

Shopping list for a week

No	Item	Amount
1	Eggs	500 g
2	Bread	116 g
3	White Rice	588 g
4	Egg Whites	924 g
5	Raw Carrot	690 g
6	Red Cabbage	320 g
7	Green Beans	650 g

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3 Food

3.1 Search Foods on EatCorrect

User can search food items on the system to record consumption by selecting foods menu and click search button. System populates matched items as typing on search bar. Click on view and view the details.



3.2 Add consumption

User can view the food details and add consumption by clicking add to diary.



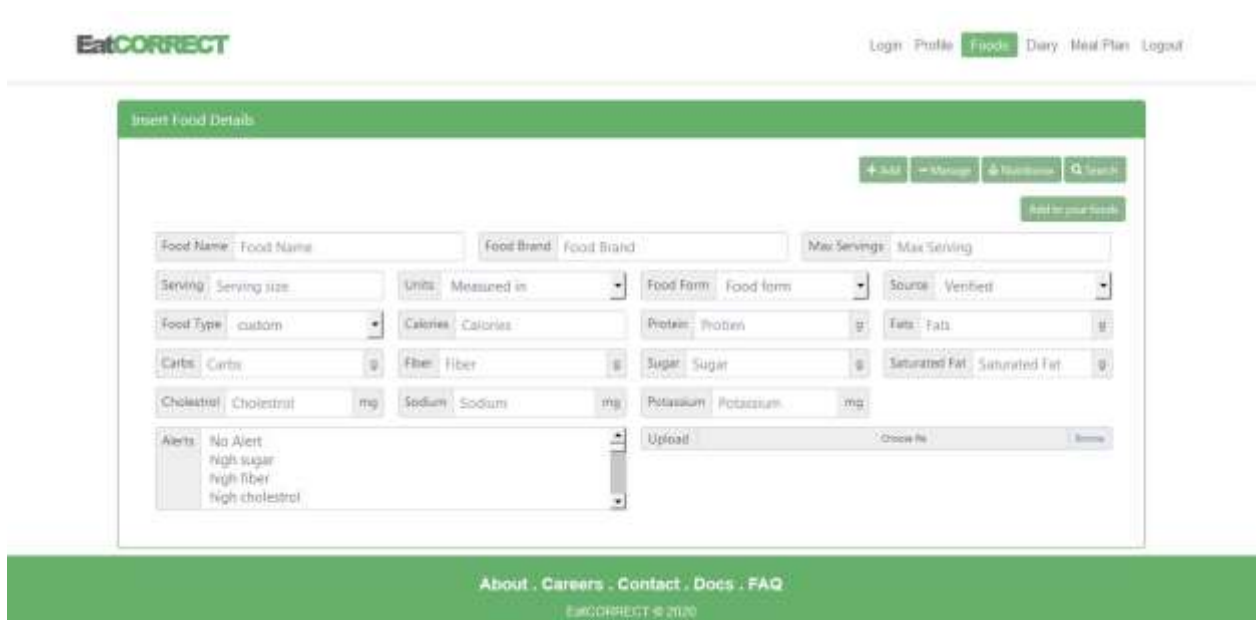
3.3 Search on Nutritionix

If system does not have search results for user food search. User can search it on nutritionix site. Site will provide results as you type on search bar. If no results appear, click on search it will return best-matched result. User can view the details and add it to your food button to save it on system for later reference.



3.4 Add food

If user cannot find any food details on search. User can add details using add option. User can even upload photograph of the food.



3.5 Manage Food

User can delete or edit food details using edit panel.



4 Diary

4.1 Smart Copy

User can view old consumption data and copy it to today by clicking this option under diary menu.



4.2 Meal Plan Sync

If user followed the meal plan properly, user can take this option to record it on diary page.

4.3 Undo Consumption

This feature will remove consumption details on selected date.

4.4 Update Activity

User can enter activity details using this page.



4.5 Dashboard

The consumption and activity details are display on dashboard. By looking at dashboard user can identify the required calories and the macro targets.



5 Administration

Admin users have different options that normal users does not have. Those options appears only if the user has admin privileges.

5.1 Manage Users

Admin users can activate or deactivate other users. Once the user is deactivate, the user cannot login to the system. The feature is listed under profile menu.

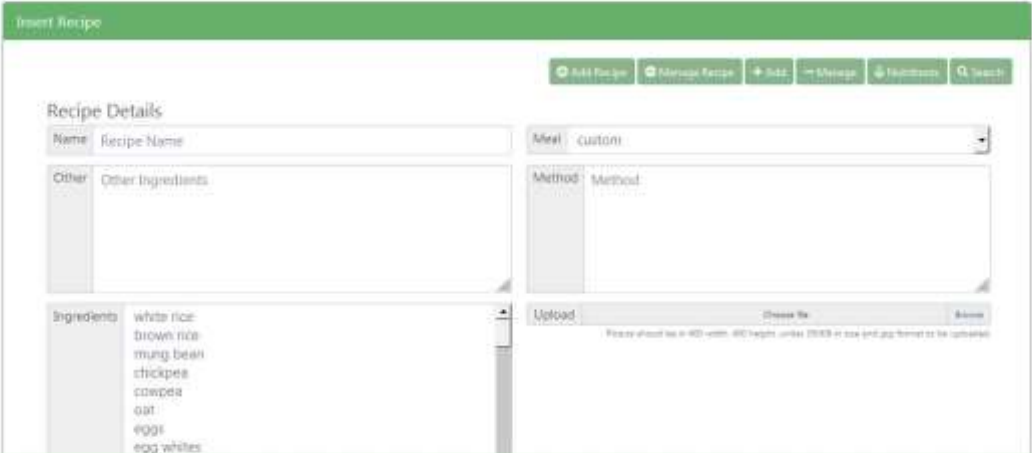


Manage Users (Admin)

First Name	Last Name	Email	Status	
Viraj	Senarathna	virajrc@gmail.com	Active	Deactivate
Yugantha	Ranawera	yuganthiranawera@yahoo.com	Active	Deactivate
Ceevne	Zen	virajrc@gmail.com	Active	Deactivate

5.2 Add Recipes

Admin users can add recipe details to the system. User must select all the ingredients required to prepare the meal with correct instructions. Admin not needed to enter the ingredient amounts. The feature is listed under foods menu.



Insert Recipe

Recipe Details

Name:

Meal:

Other:

Method:

Ingredients: white rice, brown rice, mung bean, chickpea, cowpea, oat, egg, egg whites

Upload:

Footer: About . Careers . Contact . Docs . FAQ
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5.3 Manage Recipes

Admin users can edit or delete the recipes. The feature is listed under foods menu.

