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Project Report

Version 2

CENG 408 Innovative System Design and Development II

Cook Hub: Cook Recipes and Virtual Fridge

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Abstract

Most people today find themselves in a hustle. They have a heavy pace of work or some other routine hassle. So, they are neglecting themselves. When cooking or eating food they do not even care about their wellbeing. At the same time, humans are lazy with the developing technology. They still use those high-tech devices when making plans. They even get help with what to eat at home for example for dinners There are applications for this which suggest recipes. Time is more important than their wellbeing, according to research on humans. And they prefer fast cooked meals such as fast food. And this is putting their health at risk. Or let's just say we 're home cooking. We can search the recipes we like, quickly. The problem is we don't know what we can eat for our body and our health. At the same time, our taste will adhere to this recipe. Our application is being developed at this point as a solution to those problems. CookHub is an Android application recommended for recipes. You will find recipes that you're searching for. But the app will send you suggestions as well. But it doesn't give us the same suggestions. Rather, we deliver tailored meals that satisfy those requirements. For example, the person's health status, taste, existing materials already in the house. While we were preparing this report, we reviewed the articles about Machine Learning, AI and Data Science. We also searched articles on health and diet to classify recipes that fit the health status of users.

Keywords: Health, Recipe Recommendation, Machine Learning, Data Science, Android Application, Big Data analysis, Matching Algorithms

1.1Introduction

With the developing technology, people meet all their needs with technology. For this the use of mobile devices is the most practical. People nowadays care about their time, and want to improve their business handling speed. So, instead of looking from a book, they tend to look at a recipe from applications. The application data sets contain a huge amount of data (millions of recipes). Users can't determine which of the data to choose from. CookHub is designed to help these people.

At the register stage, we are asking questions to those users. Via these questions, we learn about their health conditions, body mass measurements, the tastes they like to eat (about sweet, sour, salty, spicy, etc.). Based on the initial details, we prepare our recommendations. Users will then evaluate the recipes later. Those results are now being considered as we plan new recommendations. Naturally we are teaching the algorithm to do this for our device (application).

We have provided thousands of recipes to the user to offer variety in our application. We've done long-term work into the dataset. A dataset is a data collection. A dataset corresponds to one or more database tables, in the case of tabular data. Every column has a given variable and each row has a particular record. [27] We tried to answer the question first: "Where do we find datasets?" . Then we came across a great many websites. Like “FiveThirtyEight, BuzzFeed News, Kaggle, Socrata, Awesome-Public-Datasets on GitHub, Google Public Datasets, UCI Machine Learning Repository, Data.gov”.

We chose to "Kaggle". Kaggle allows users to find and publish data sets, explore and build models in a web-based data science environment, collaborate with other data scientists and machine learning engineers, and join competitions to solve data science challenges. [28] Many of the databases are available for use. It does depend on the dataset, however. Many of the bigger companies have additional requirements that their data can't be used without more written permission.

The data collection we use includes the following details; a step-by - step explanation of how the food should be prepared and cooked, food ingredients, statistics on calories, nutritional values, cooking time, etc.

We used MySQL to keep the wide collection of data. We chose Python to make efficient use of Machine Learning. We'll also use Pandas, Mathplotlib, Numpy, which are essential libraries of Python to us. The Pandas is a Python programming language software library. It is used for computer programming, processing and analysis of data. Firstly, it includes data structures and tables and time series updating operations. [1] Matplotlib is a Python 2D plotting library that produces quality figures for the publication across platforms in a variety of hardcopy formats and interactive environments. Plots, histograms, power spectra, bar charts, error charts, scatterplots, etc. can be created [2] NumPy (Numerical Python) is a mathematical library which allows us to perform rapid scientific calculations. It is focused on arrays of numpy arrays. [3]

We are going to use those libraries together. And we can get our big data collection processed. When we recommend new recipes to users, we find them dependent on their favorite recipes and the health status stated in them. We define in short tags the characteristics of the recipes. Spicy, with eggs, without lactose, for example ... We keep those tags in the data set as well. With these tags, users are

rendered from the best match. We scale the corresponding rate for the newly proposed recipe and user details with the word "accuracy."

Our application's most distinctive aspect is to care for the user's health while offering customized recipes. For example, when registering, an user with an allergy to lactose adds this to his or her records. Thus, when we recommend a recipe, we give her/him recipes with the label "lactose-free." When registering for users planning to diet, we ask a lot of questions. So, we want to give him/her the most appropriate diet. "Who will be consuming what? Who would like to stop what? Who will be taking how many calories a day? " We plan to create an app for recipes that can help you answer these questions.

Another feature of the application is a screen where you can click on already available materials in your home. Those materials of your choice will match the tags in the background data set. And what you can do with the products in your home will be suggested to you.

1.2 Related Works

Cooking is an art and it has to be performed by rules to success. Also another important issue is the recipe of the food. These are the rules of the cooking a food. But how about health and taste? Not all foods are for all peoples taste and health. Why not to combine machine learning and cooking for the aim of health and perfect palatal delight.

There is already a lot of service to search for recipes. For example, Google Recipe Search [5], Yummly, Foodily and MyTaste… Good results can be achieved by using these services. Because these services have many search capabilities. This makes it easy to use them. For example, applications have search limits such as ingredients, species, cooking time, portions and nutritional values. Some of this information is clearly marked as machine-readable. [6]

Figure (a) is an easy-to-read flow chart. But the machine should have .csv file to understand the values and data of the food recipe. [7]

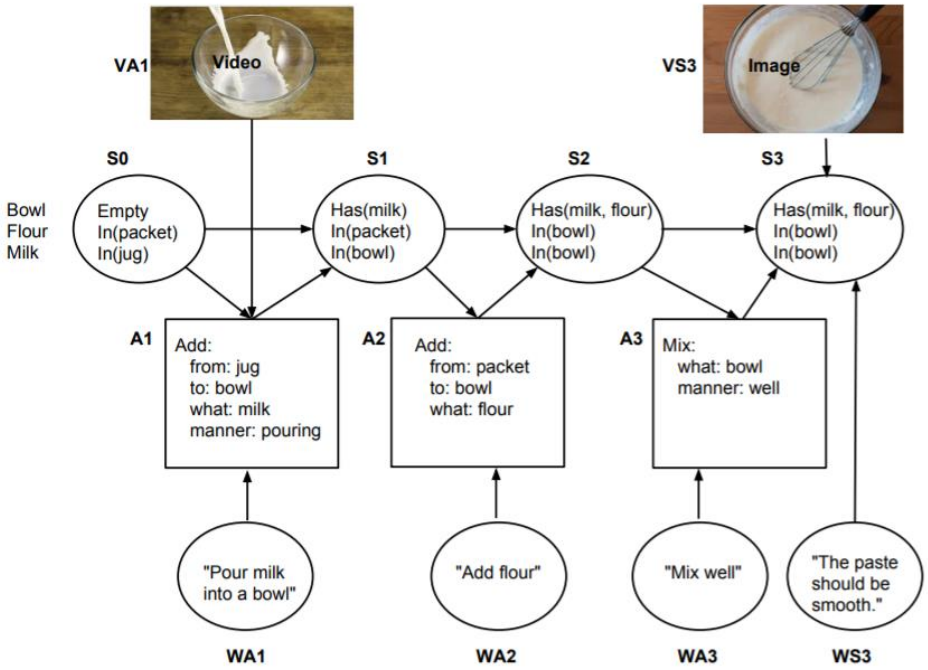

Figure (a): the actual steps of the recipe [7]

A machine can not recommend every food to every human group. Everybody has different concerns like health, gluten free, calorie level, taste. By this reason machine have to learn these issues about each user group interactively. By this machine learning system recommendation system works more successful as the groups uses the system. Taste, health concerns etc. are detected by tags of the data in a data. Furthermore, we help people to plan their meals without eating foods they don't like while they are improving their health and life standards.

Despite technological advancement, people are still not implementing healthy diet programs. It is possible to find diet programs from books, websites and mobile applications. However, people prefer these programs to be personal. Finding such programs is not easy. So, the food mentioned in any diet program is not attractive. And users will not strictly follow the diet rules. In order to solve this problem, they create personalized meal plans suggestion systems. Studies on this subject have focused on general users. One of the main considerations when designing a proposal is that food and consumption are recurring. In fact, people eat at similar times a day and every day, and they plan their meals sequentially. A smart machine can help to pick healthy and tasty foods for them. [8]

The usage of the internet make peoples life easy in any ways. Especially in needs like food. Recipe recognition with large multimodal food dataset is very important because the main challenge is size of the data set. Food category classification is a key technology for many food-related applications such as monitoring healthy diet, computational cooking, food recommendation system, etc. In, a novel smart phone application to record daily meal activities by image retrieval technique is developed. Based on this personal dietary data log system, they were able to conduct further usage preference experiments and food nutrition balance estimation.

The Open Meal System aims to invent new intelligent cooking appliances. This is a Purdue University Technology Assisted Diet Assessment (TADA) project. The aim of the project is to develop a mobile food recorder. This device records diet information. The device plans this information on a daily basis. It considers daily nutritional intake. Food category classification should be in all these applications. [9]

Recommendation system is a relative concept. Netflix is a good example for recommendation system. Netflix, to date, has just over 100 million subscribers on its platform. But with each subscription having multiple profiles, the real number is double that. That's a lot of data, and with over 80% of TV shows being watched on the platform, it has its work cut out, to keep people engaged. But it doesn't have to do all the hard work.

Netflix effectively outsources some of the processes to you. Information on how you use the platform, how you rate content, and what you search for are all harvested and analyzed by Netflix to better improve your user experience.

When you access the Netflix service, a suggestion system is activated. The main purpose of the system is to show you the ideal show or film. We can think of Netflix as a film catalog. In this catalog, movies that you are likely to watch are presented according to the following factors:

- Your interactions with the Netflix service (such as your viewing history)
- Other members with similar preferences
- Types, categories, players, year of publication and so on. Information about topics

Netflix knows what to watch with these factors. It also looks at the following to personalize a similar and best suggestion:

- The time of day you watch
- The devices you are watching Netflix on
- How long you watch.

All of these factors mentioned above are kept as data. These data are the inputs of the Netflix algorithm. (The algorithm is the sequence of steps and processes followed to solve a problem.) Netflix does not take age and gender into consideration when deciding on the most appropriate recommendations. [10]

The Effectiveness of a Smartphone Application is an important concept for diet and healthy life. In 10 October 2018, José I Recio-Rodríguez and his team published an article about The Effectiveness of a Smartphone Application on Modifying the Intakes of Macro and Micronutrients in Primary Care. The objective of this study is to evaluate the long-term (12 months) effectiveness of adding a diet smartphone application to standard counseling to modify dietary composition (macro and micronutrients and food groups). According to this research consisting of nutritional counseling and a diet smartphone application, achieved better results than counseling alone in modifying the diet. [11]

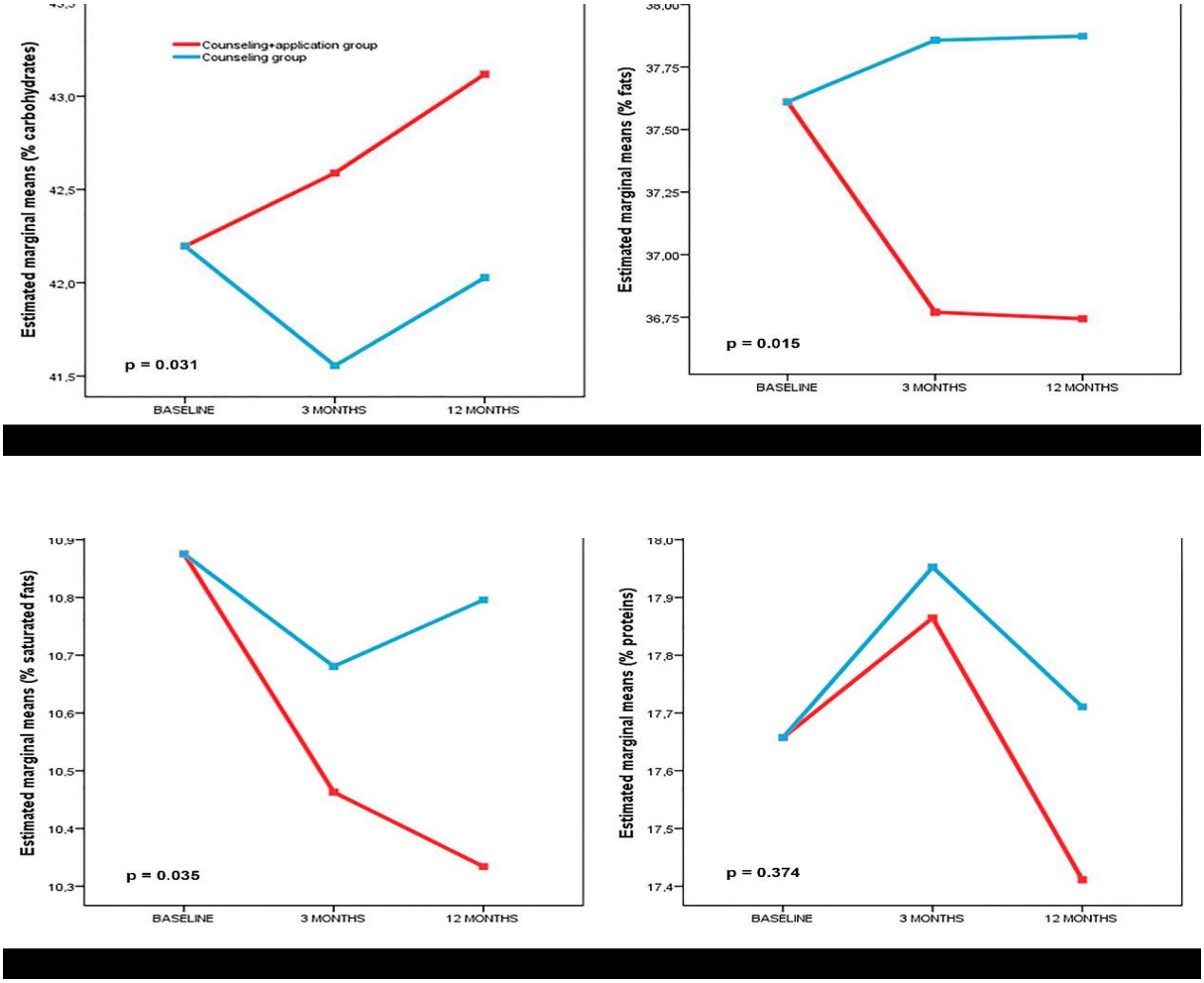

Figure (b): Changes in macronutrients after randomization by group (repeated measures analysis). [11]

Rapid developments in technology have encouraged the use of smartphones in health promotion research and practice. Although many applications (apps) relating to diet and nutrition are available from major smartphone platforms, relatively few have been tested in research studies in order to determine their effectiveness in promoting health. In qualitative studies, participants preferred applications that were quick and easy to administer, and those that increase awareness of food intake and weight management. In randomized trials, the use of smartphone apps was associated with better dietary compliance for lower calorie, low fat, and high fiber foods, and higher physical activity levels which resulted in more weight loss.

Smartphone apps are likely to be a useful and low-cost intervention for improving diet and nutrition and addressing obesity in the general population. The accuracy of diet and nutrition measurements obtained using mobile devices has generally been found to be good. Participants prefer applications that are quick and easy to administer and those that increase awareness of food intake and weight management. [12]

The software toolkits and programming paradigms used by application developers have a large impact on the design of architecture and user interface of the applications they develop. Especially now, that technological advances are presenting us with affordable hardware that is capable of both sensing and displaying information with unprecedented accuracy, vividness, and bandwidth, there is an increased need to explore and develop tools that enable creative designers and developers to turn their ideas into reality. These tools must both allow for rapid prototyping to evaluate new ideas

quickly, and be able to take advantage of the full computing power offered by cutting edge technology. Python Kivy framework is one them. [13]

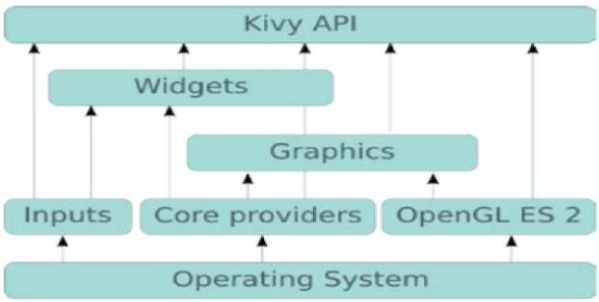

Figure (c): A general architecture of Kivy.[13]

As a result of the lifestyle-related disease epidemic, dietary life is now attracting attention. Good eating habits are important for maintaining a healthy life. However, menu planning requires one to take various factors into consideration, such as the nutritional value, food in stock, food preferences, and cost. Thus, people need to expand a lot of effort toward planning their daily menu. Against this background, a number of cooking websites comprising various food recipes have recently been launched, such as Cookpad[14.1] and AllRecipes[14.2]. Many people refer to these websites when planning their menu. Cookpad contains 900,000 recipes and has 10,000,000 monthly users. This data reflects the high demand for recipe-providing services. However, these websites do not reflect user's preferences and conditions, although these two factors need to be considered if the goal is to provide high-satisfactory recipes.

In January 2011, Mayumi Ueda and her team published an article about this subject. In their paper, they presented a method for extracting the user's food preferences for recipe recommendation. Their method estimates a user's preferences from his/her past actions, such as through their recipe browsing and menu planning history. For extracting the preferences, their method breaks recipes down into their ingredients and scores the recipes using the frequency and specificity of ingredients. Since their method can estimate the preferences through their browsing and cooking history, the user convey his/her preferences to the system without having to carry out any particular operation. [14]

Another application that has parallel functions with us is Kochbot. Kochbot is a cooking assistant application for smartphones and tablet devices. This application allows you to search from a wide collection of recipes and explains cooking commands step by step. The most important feature of this application is that it is focused on speaking and listening. The main advantage of the application is that it has a hands-free scenario. and user satisfaction is quite high. [15]

Internet provides us many knowledge sharing facility and searching for any information from any corner of the world. Recipe websites are good examples of these knowledge sharings. People can find millions of recipes via using the internet.The manys recipes that internet provides is kind a diffucult for a person who just want to search a recipe fits in his taste. In the Internet the most of these websites are simple minded as not reliable on recommendation system which was recommends recipes based on rating and comment-based recipes in the site. In these cases a person who has been looking for a recipe for his taste can't always happy about what they gets.

Bon Vivant is an interactive platform for discovering flavor mappings based on flavor compound analysis. It makes combinations of meals. It can match many factors, being able to do so. Eg ingredients, recipes, regional kitchens and aroma compounds. This platform enables the user to

achieve a healthier lifestyle. Because it is based on nutritional requirements when making recommendations. [16]

Smart mobile phones, which have entered almost every home in our age, do many things to make our lives easier. Good eating habits are important for a healthy life. How-ever food planning requires consideration of different factors, such as nutritional value, food in stock, food preferences, and cost. . Additionally, people need to expand a lot of effort and time towards to planning their daily food cooking. For these subjects a various websites provides various food recipes have been published in worldwide such as Cookpad[14.1] and Yahoo! Recipe[17]. Many people refers to these websites for answer their "how to cook" question. Cookpad contains now almost 100 million people around the world use Cookpad every month and over 4 million recipes have been created on the platform. It's available in almost 70 countries around the world in 23 languages. [18]

2. Software Requirements Specification

2.1 INTRODUCTION

2.1.1 Problem Definition

Most people nowadays find themselves in a hustle. They have a busy pace of work or some other daily hassle. So, they are neglecting themselves. When preparing or eating food they do not even think about their health. At the same time, humans are lazy with the new technology. They use these high-tech devices while making plans. They even get help with what to eat at home for example in the evening. There are applications for this which suggest recipes. Time is more valuable nowadays than their wellbeing, according to research on humans.

2.1.2 Purpose

The purpose of this document is to delineate the Cook Hub project. Cook Hub is an Android application that recommends a recipe. You can generate your own virtual fridge which is used to cook section. You can also find some recipes that you're searching for. The app can also make suggestions to you, though. But it doesn't offer everyone the same suggestions. Instead, we give custom meals which meet certain conditions.

2.1.3 Scope

This software system will be a cross-platform application for everyone who wants to use it in their everyday lives. The program is designed to assist the user in:

- Do we have the necessary ingredients to prepare recipes? In order to answer this question, we have created a virtual fridge in which we record the already existing food in the house.
- Search for cookable food

- Create Diet Plan
- Filter search by tags
- Recommendation system according to users choices
- Create Shopping List

2.1.4 Definitions, acronyms, and abbreviations

TERM	DEFINITION
Database	Collection of all the information monitored by this system.
User	Any person on the system.
Android	A mobile device operating system developed by Google Inc.
IOS	A mobile device operating system developed by Apple Inc.
Spyder IDE	Spyder is a powerful scientific environment written in Python, for Python, and designed by and for scientists, engineers and data analysts. [1]
Software Requirements Specification (SRS)	A document that completely describes all of the functions of a proposed system and the constraints under which it must operate. For example, this document.

2.1.5 References

[1] Spyder: The Scientific Python Development Environment – Documentation

https://docs.spyder-ide.org/#spyder-the-scientific-python-development-environment-documentation

2.2 OVERALL DESCRIPTION

In this part of the system, users can add or request for any desired ingredient, food or tag. To do so, relevant information will be given briefly on different system requirements. In Cook Hub the user can tag search based, search based on ingredients, set timer, add ingredient in virtual fridge, then the application runs along and interacts with a database server and runs for each part of the system.

2.2.1 Product Perspective

Cook Hub is a mobile cross-platform application with a database server to find a recipe or make shopping list or a diet plan. The mobile application will run on mobile devices as Android or IOS. These will include data processing, machine learning and AI features. When users run the app, they can use the device's functionalities. All information that can be accessed by users with or without registration will be stored on the database.

2.2.2 Product Functions

Cook Hub consists of these main tasks:

- Authentication

- Data Managing : We work with a very large data set. These data sets include recipes. We classified the characteristics of the recipe with short words that we call tag. We also use many different tags to describe the ingredients. Both of these information are stored in the data set.

In order to provide diversity in our application, we have presented thousands of recipes to the user. We have done long dataset research. A dataset is a collection of data. In the case of tabular data, a dataset corresponds to one or more database tables. Each column has a certain variable and each row has a specific record. [27] We first tried to answer that question: “Where can we find datasets?” Then we came across a lot of websites. Like “FiveThirtyEight, BuzzFeed News, Kaggle, Socrata, Awesome-Public-Datasets on GitHub, Google Public Datasets, UCI Machine Learning Repository, Data.gov”.

We chose to "Kaggle". Kaggle allows users to find and publish data sets, explore and build models in a web-based data science environment, collaborate with other data scientists and machine learning engineers, and join competitions to solve data science challenges. [28] Many of the datasets are available for use. It does depend on the dataset, however. Many of the bigger companies have additional requirements that their data can't be used without more written permission.

The data collection that we use includes the following details; a step-by-step explanation of how to prepare and cook the food, food ingredients, details on calories, nutritional values, time to cook.

- Tag based search : The user can search for food of his / her preference from a recommendation table of features which we provide him / her with. Those features suit the tags in the relevant data set. Suggestions thus become more personalized.

- Ingredient based search : With tag-based search this type of search has the same concept. The users see all of the materials listed. They mark what they would like to delete from the list. Or vice versa, what they want to use is marked. They may also use this method of searching as follows; marking materials which already exist at home. So we can help them cook and not leave the house. We recommend recipes with the ingredients they want, through Ingredients Tags.

- Add ingredient in Virtual Fridge : The users may mark already existing materials at home. We are going to use that for two purposes. First, we'll be giving the user recipes he / she can make with the ingredients he / she has. Or let's say the user selected a recipe. Via this virtual fridge we'll decide what's missing to prepare this recipe at home.

- Create Diet Plan : At the register stage we asked if there were any major health issues for the user. If these health issues are related to nutrition, we give the user even more customized recipes.

- Create Shopping List : It is a task associated with process "Add ingredient in virtual Fridge". Comparison of your virtual fridge and ingredients while choosing a recipe. Then, this application creates a shopping list in your home with missing products.

2.2.3 Constraints, Assumptions and Dependencies

Users of this application are any device user with Android or IOS that loads this application to their devices. All users are in the same class, and there is only one kind of user. As described above, the operating environment is an Android OS or mobile device with IOS. For proper user experience an android or IOS device is required to meet simple application dependencies. On the other hand, our database server and services can run on any OS such as Windows or Ubuntu which can provide the basic dependencies and needs of the database server. Privacy and security are one significant constraint. The users should only have access to the authenticated data.

2.3 SPECIFIC REQUIREMENTS

In this chapter and its sections, the requirements are explained.

2.3.1 Interface Requirements

There will be two interfaces in our system, one will be between user and system, and the other will be between system and database.

2.3.2 Functional Requirements

This section explains the use cases.

2.3.2.1 Download Cook Hub Use Case

Use Case:

- App Market
- Apple Store
- Google Play Store
- Download Cook Hub

Diagram:

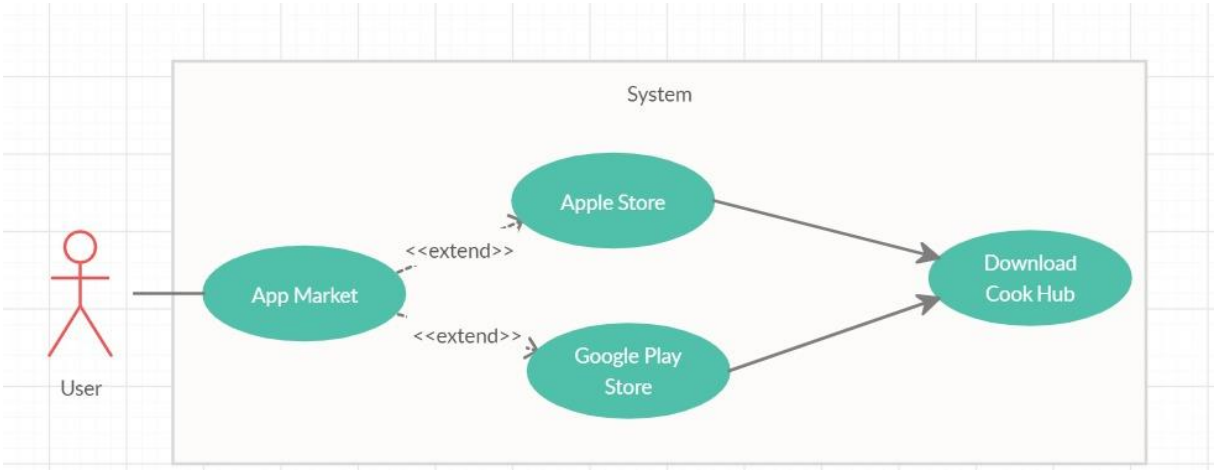

Figure 1 Download Cook Hub Use Case

Brief Description:

Figure 1 shows participant Download Cook Hub Use Case diagram. When user opens his currently phone's market application, he/she can download Cook Hub and start to use it.

Initial Step-By-Step Description:

1. User must have a smart phone in order to download and use Cook Hub application.
2. User must have select Cook Hub from his currently phone's market application in order to download Cook Hub application.

2.3.2.2 User Registration Use Case

Use Case:

- User Registration
- Agree with term and Conditions
- Check Previous Password and correctness
- Login
- Check Login Detail
- Confirm Login
- Login Failed
- Login Without Registration
- Mistyped Password

Diagram:

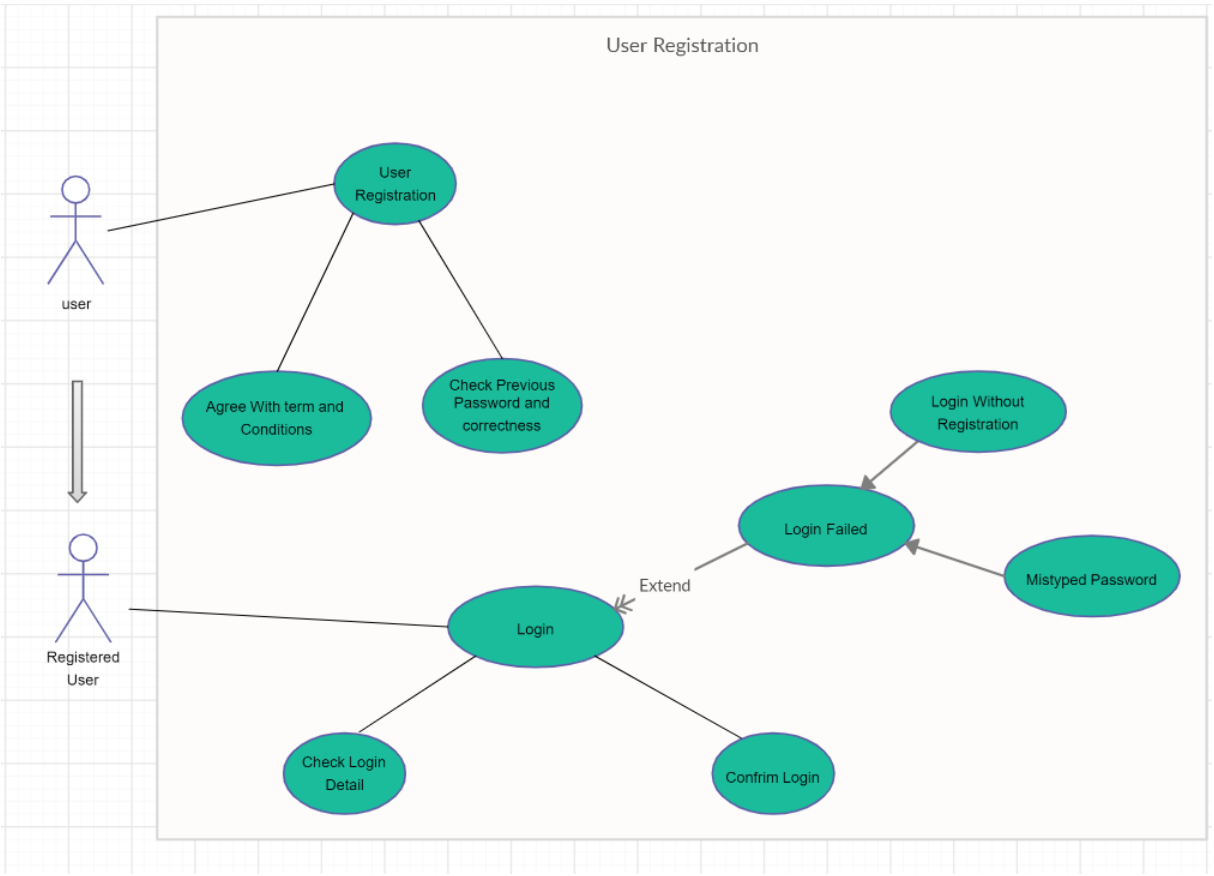

Figure 2 User Registration Use Case

Brief Description:

Figure 2 shows participant User Registration Use Case diagram. When the user opens the application he/she can login the application if he/she has already an account. If he/she is not has an account, can be register using the button.

Initial Step-By-Step Description:

1. If user has already an account (Registered User), he/she can login the application by selecting Login button. Application will look for the password through the database and confirm if user has write the password correctly.

2. If user has not an account before he/she can create an account by using Register button. User must have, fill all the blanks with their personal information and their desired diet type in order to register the application and then must agree with term and conditions in order to success his account.

3. If user, writes a password that is not matched with account name or tried to login without registration, login will be failed.

2.3.2.3 Virtual Fridge Screen Use Case

Use Case:

- Add Ingredient
- Delete Ingredient
- Edit Ingredient Quantity
- Save
- Exit

Diagram:

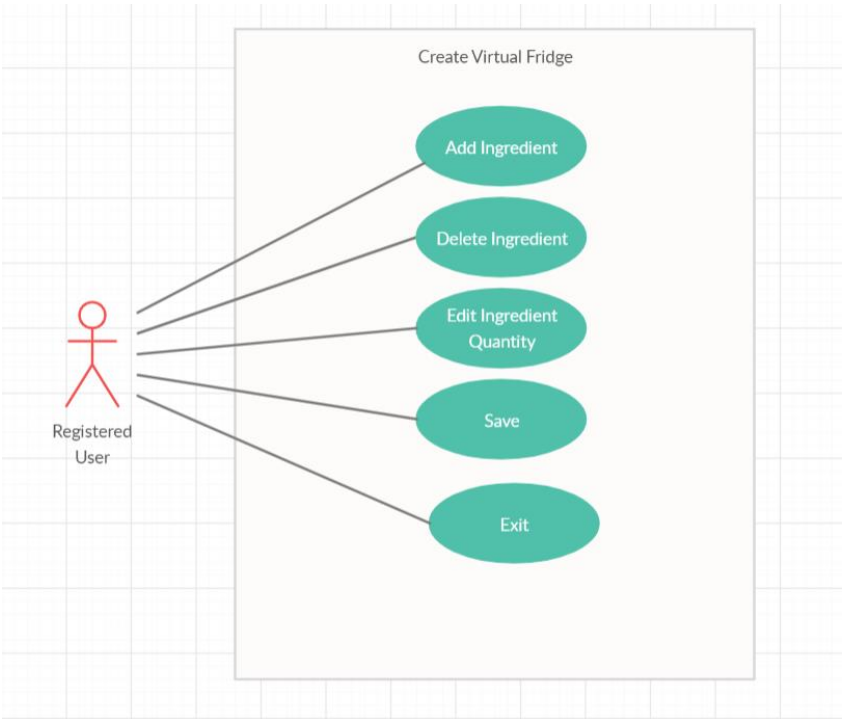

Figure 3 Virtual Fridge Screen Use Case

Brief Description:

Figure 3 shows participant Virtual Fridge screen use case diagram. User can create his own virtual fridge which will be used for how to cook page and online marketplace page. User can select from the options which were Add Ingredient, Delete Ingredient, and Edit Ingredient Quantity, Save, Exit.

Initial Step-By-Step Description:

1. If user selects Add Ingredient, user will select or write the ingredients that he/she wanted to add his virtual fridge.

2. If user selects Delete Ingredient, user will remove the unwanted ingredient from his own Virtual Fridge.
3. If user selects Save, user allows program to save changes.
4. If user selects Exit, user will be back for main page.

2.3.2.4 Search a Recipe Use Case

Use Case:

- Search
- Search by Recipe or Ingredient
- Search by Ingredient
- With Virtual Fridge
- Without Virtual Fridge
- Make Recommendation
- Results

Diagram:

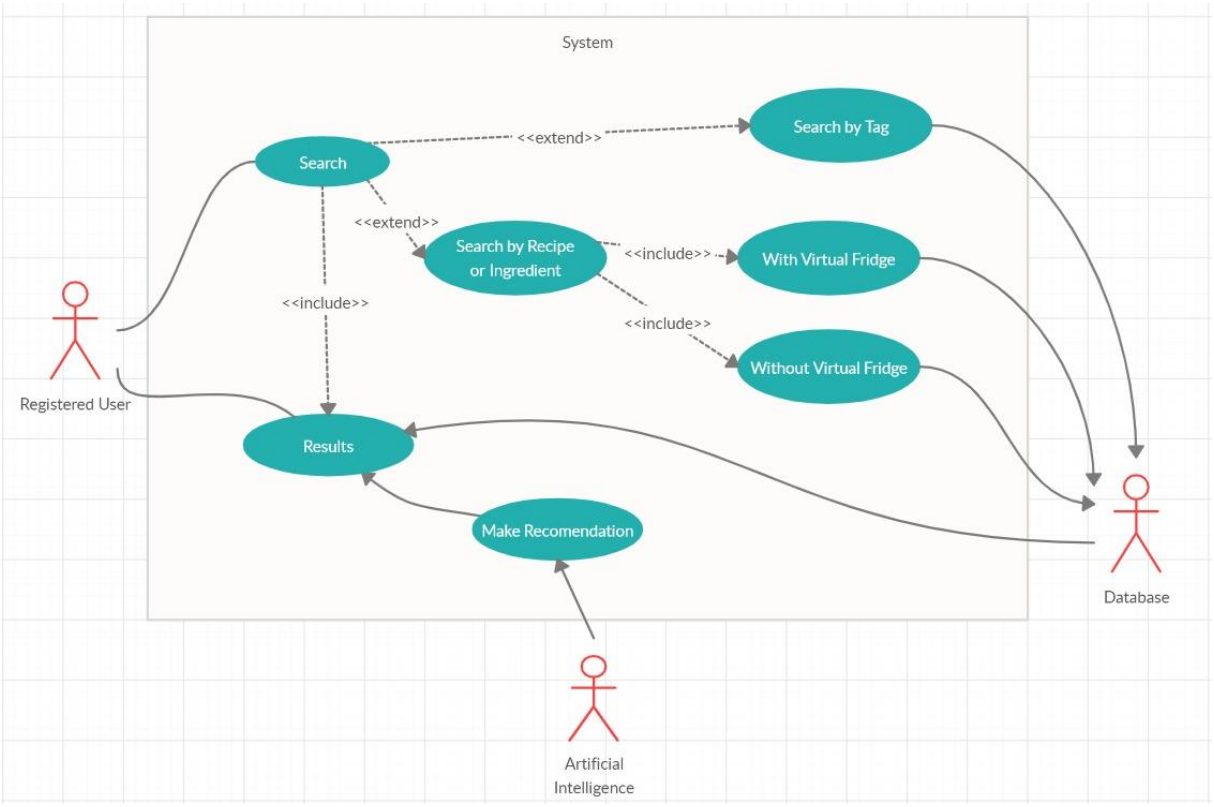

Figure 4 Search a Recipe Use Case

Brief Description:

Figure 4 shows participant Search a Recipe Use Case Diagram. User can search recipes in three ways which were; Search by Recipe or Ingredient, Search by Tag. After the user has been select from these option and fulfil the selected option's properties, he/she can review the result of the desired recipe/recipes.

Initial Step-By-Step Description:

1. User will select one of three search options.
2. If user select Search by Recipe option, user can review the recipes by typing their desired food and application will display the desired food's recipe if that food's recipe exists on the application's database.
3. If user selects Search by Ingredient option, user can review the recipes from the application with two options which were; typing their desired ingredient by using auto-complete typing system by not using the virtual fridge or choosing ingredients by using multi search selecting system from among the ingredients that has been saved before on the virtual fridge by the user.
4. If user selects Search by Tag option, user can review the recipes by selecting from search criteria's by using auto-complete typing system or multi search selecting system.
5. After the user has select one of these options and use it the application will display the desired recipe/recipes result with respect to Artificial Intelligence recommendation system.

2.3.2.5 Food Recommender System Use Case

Use Case:

- Rate Recipe
- Rate Recommendations
- Make as Favorite Recipe
- Make as Favorite Tag
- Access Recommendations
- Search by Recipe, Tags or Ingredient
- Gather User data
- Calculate Similarity Scores
- Show Predictions

Diagram:

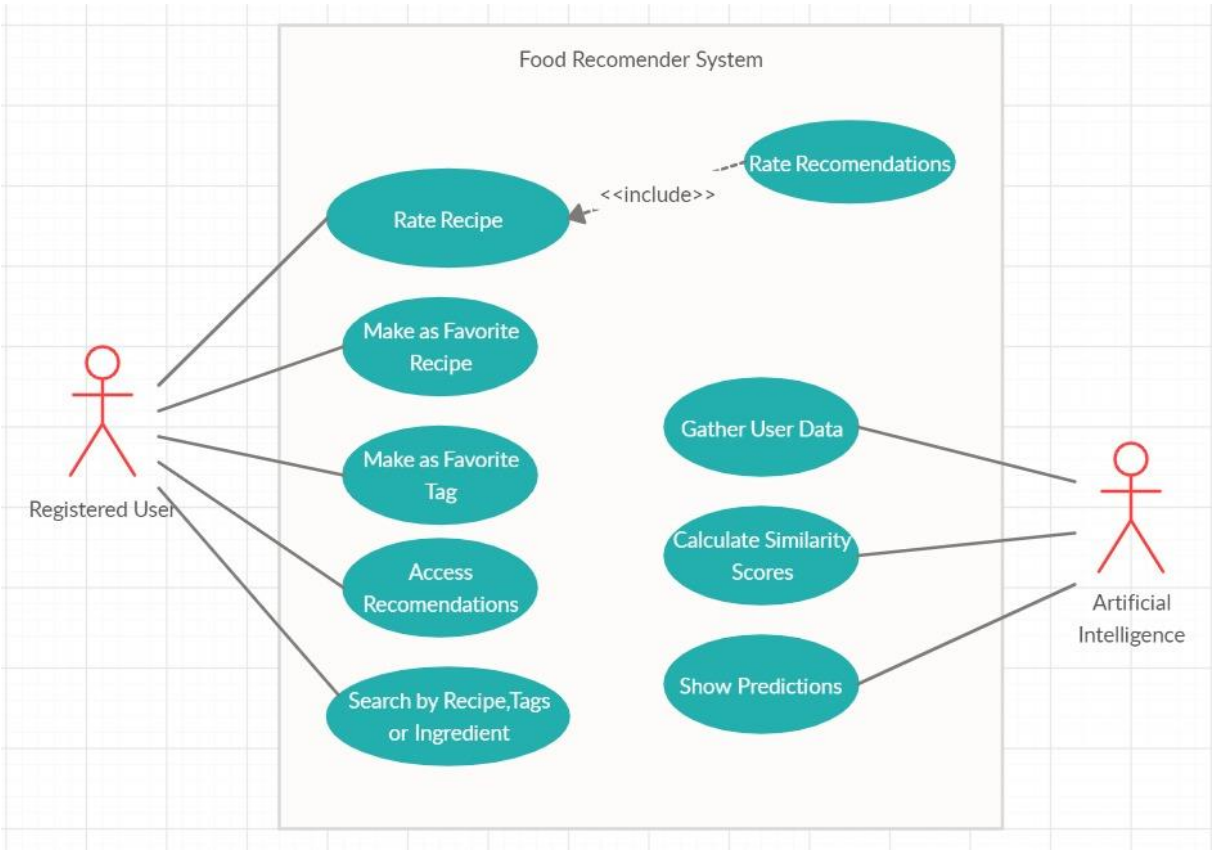

Figure 5 Food Recommender System Use Case

Brief Description:

Figure 5 shows participant Food Recommender System use case diagram. User can rate the recipes that they choose to love their taste and they can rate the Cook Hub's Artificial Intelligence's recommended recipes if they have wanted to. User can favourite the recipes or tags that their wanted, Access recommendations and can search for recipes with 3 sub search algorithms. While user uses food recommender service Cook Hub's Artificial Intelligence at back-end will gather the user data and calculate the similarity scores.

Initial Step-By-Step Description:

1. When user uses the food recommender service he/she can search for recipes by using Search by Recipe, Tags, and Ingredient. Search by recipe let the user, their typed food comes to screen with its recipe, Search by Tag let the user, choose from different tags and system will display the fitted recipes that he/she has choose before, Search by Ingredient let the user, choose the ingredients from its own virtual fridge or by typing each ingredient and system will display the fitted recipes that he/she has choose or typed before.
2. Users can favorite the recipes that they are enjoyed to eat it.
3. Users can favorite the tags that they are often used for their search criteria.

4. Users can rate the recipes that they have want it by 1 to maximum of 5. 1 means user disliked the recipe while 5 means user has enjoyed the recipe.
5. Users can rate the Cook Hub's Artificial Intelligence recommended recipe if they are want it by 1 to maximum of 5. 1 means user disliked the recipe while 5 means user has enjoyed the recipe
6. Cook Hub's Artificial Intelligence will be store the user's data with log user activities, ingredient count in virtual fridge, favorite food etc. for to give a better quality recommendation system.
7. Cook Hub's Artificial Intelligence will calculate similarities scores with using Pearson correlation[29]
8. Cook Hub's Artificial Intelligence will show the prediction as a recommendation to user due to calculated similarity scores.

2.3.2.6 Shopping List Use Case

Use Case:

- Manipulate Shopping lists
- Add a new shopping list
- Delete a shopping list
- Save changes
- Manipulate content of shopping lists
- Add an item
- Delete an item/items
- Check off an item/items

Diagram:

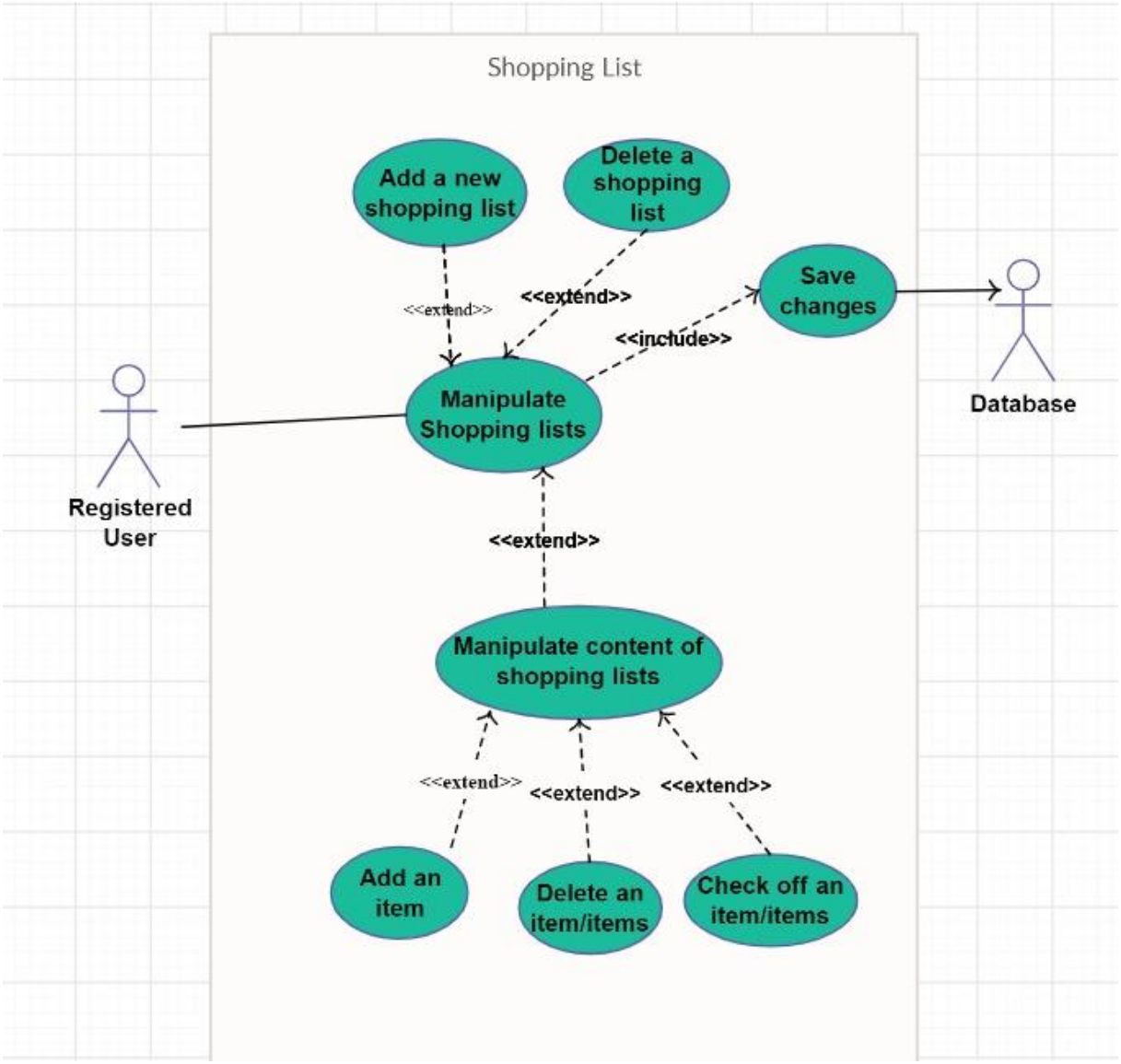

Figure 6 Shopping List Screen Use Case

Brief Description:

Figure 6 shows participant Shopping List use case diagram. User can create one or more shopping lists which will help them reduce the time on their time during shopping. After user has done the market shopping, they can select add to fridge option and all the ingredients in the list will be goes to virtual fridge automatically.

Initial Step-By-Step Description:

1. If user want's to a create one or more shopping lists he/she can create one that will help in reduce their shopping time.
2. User can add or remove items in their current shopping list.
3. User can check of an item if the selected items has already in the virtual fridge or not.
4. User can rename the shopping list that he/she has created.
5. User can switch between the shopping lists by choosing among the list names

6. User can delete the shopping lists by choosing among the list names.
7. After user has done and bought all of the shopping list items, he/she can use add to fridge button that will instantly remove all the current shopping list items and add them on the user's own virtual fridge.

2.3.3 Non-Functional Requirements

- System recommendation will avoid suggesting a recipe that will trigger the user's disease or allergies that user has specified before.
- When the user searches for any recipe system will load rapidly
- System will recommend the recipe to user at least %50 similarity as the taste of the user.
- System will hold the calorie data of the each meal user has eat then calculate the average calorie of the user gain's from his meals in a day row then system will primarily recommends foods with similar calories. To succeed with this a user must have specify the all meal they have eat at least for 7 days.
- System will check the calorie values of the user's meals during the day then review the user's average calorie per day then primarily based on recommend the recipes which has calorie's close to the average calorie value.
- Whenever user has search for a food that will exceed the average daily calorie value, system will gives a warning. User can skip the warning if he/she wanted to review the recipe.

2.3.4 Design Constraints

- We will use "agile method" and Object – Oriented Programming paradigm.
- We will use Python as programming language. The Android version of the device should be 2.3 or higher. The system does not requires Internet connection.

2.3.5 Performance Requirements

The Cook Hub project's respond and match system must run smoothly without delay. Because of the non-visual contents project do not need a high system. Any user that download the Cook Hub should be able to use the system any time. The response time of the system should be 5 seconds at most.

- ✓ NETWORK : Technology GSM / HSPA / LTE/ WIFI
- ✓ DISPLAY : No minimum requirement

- ✓ PLATFORM : OS Android 4.4.2 (KitKat)
- ✓ Chipset : Qualcomm MSM8974AC Snapdragon 801
- ✓ CPU : Quad-core 2.5 GHz Krait 400
- ✓ MEMORY : 350MB
- ✓ RAM : 1GB

2.3.6 Software System Attributtes

2.3.6.1 Portability

- ✓ Cook Hub is intended for any kind of android OS mobile platform.
- ✓ After installation there is no need for any internet connection to use the Cook Hub.

2.3.6.2 Performance

- ✓ Back-ground calculations work every time a recipe is cooked, does not stack

2.3.6.3 Usability

- ✓ Every recipe contains multiple tags
- ✓ Every recipe contains multiple ingredents
- ✓ Every recipe contains multiple levels of calorie

2.3.6.4 Adaptability

- ✓ Dataset is fetched by the data set since the dataset is internal at phone Android OS is required

2.3.6.5 Scalability

- ✓ Because of the offline working system every user's information is stored at the internal storage. There is no scalability requirement.

2.3.7 Safety Requirements

People have to know and select their diseases and allergies before looking for the food they wanted or they could be harmful. Users should have tested the oven and stove periodically when using the Cook Hub application, and check the timer at the application to avoid unexpected effects.

3. Software Design Description

3.1.1 Purpose

The purpose of this document is to delineate the Cook Hub project. Cook Hub is an Android application that recommends a recipe. You can create your own virtual fridge which is used to cook page. You can also find some recipes that you're searching for. The app can also make suggestions to you, though.

3.1.2 Scope

This software system will be a cross-platform application for anyone wanting to use it in their everyday lives. The program will be designed to assist the user in:

- Do we have the required ingredients to prepare the recipes? We have created a virtual fridge to reply this request, in which we record the already existing food in the house.
- Search for cookable food according to virtual fridge data
- Create Diet Plan
- Filter search by tags, ingredients or recipes
- Recommendation system according to users choices
- Create Shopping List

3.1.3 Overview of the Section

This section provides information about the contents of the rest of the document as follows: Part 2 describes the problem and details the design of this project along with the class architecture. Part 3 displays and explains the block diagram of the system, which is designed according to use cases in SRS document.

3.1.4 Glossary

TERM	DEFINITION
Database	Collection of all the information monitored by this system.
UML Diagram	It is a modelling language which is used in Software Engineering.

Block Diagram	The type of schema which the components in the system are displayed in blocks.
Activity Diagram	Describes activities and actions taking place in a system
Machine Learning	Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed.
Software Design Document (SDD)	A software design description (a.k.a. software design document or SDD; just design document; also Software Design Specification) is a written description of a software product, that a software designer writes in order to give a software development team overall guidance to the architecture of the software project.
IOS	A mobile device operating system developed by Apple Inc.
Kivy Framework	Kivy is a free and open source Python library for developing mobile apps and other multitouch application software with a natural user interface (NUI).
Android	A mobile device operating system developed by Google Inc.
Spyder IDE	Spyder is a powerful scientific environment written in Python, for Python, and designed by and for scientists, engineers and data analysts. [1]

Figure 7 Glossary of SDD

3.1.5 References

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https://docs.spyder-ide.org/#spyder-the-scientific-python-development-environment-documentation

3.1.6 Motivation

We are a group of senior students in the department of computer engineering with an interest in mobile application and machine learning. We aimed to develop a program offering recipes that would

fit people, their tastes and their health. We choose Pyhton language for development because Python is a high-level programming language that is commonly used in web development, app development, scientific and numerical data analysis and computing, building desktop GUIs, and software development. For our recommender program Python is also a cut out. We choose Kivy Framework as a platform for application. Kivy is a free and open source Python library with a natural user interface (NUI) for designing mobile applications and other multitouch application software. On 21 June 2019 Kivy released their stable version. Our database will be on MySQL. Our development environment for the application will be Spyder IDE.

The target platform will be Android but our application will be cross-platform application and the development environment is Microsoft Visual Studio 2019.

3.2 DESIGN OVERVIEW

3.2.1 Problem Definition

Nowadays, most people are in a hustle. They have a busy work tempo or other daily hassle. So they neglect themselves. They don't even think about their health when preparing or eating food. At the same time, with the developing technology, people become lazy. Even when making plans, they use these high-tech machines. For examples in the evening, they even get help with what to cook at home. There are applications suggesting recipes for this. According to research on people, nowadays, time is more important than their health.

3.2.2 Architecture Design

3.2.3 Simulation Design Approach

3.2.3.1 Sequence Diagram

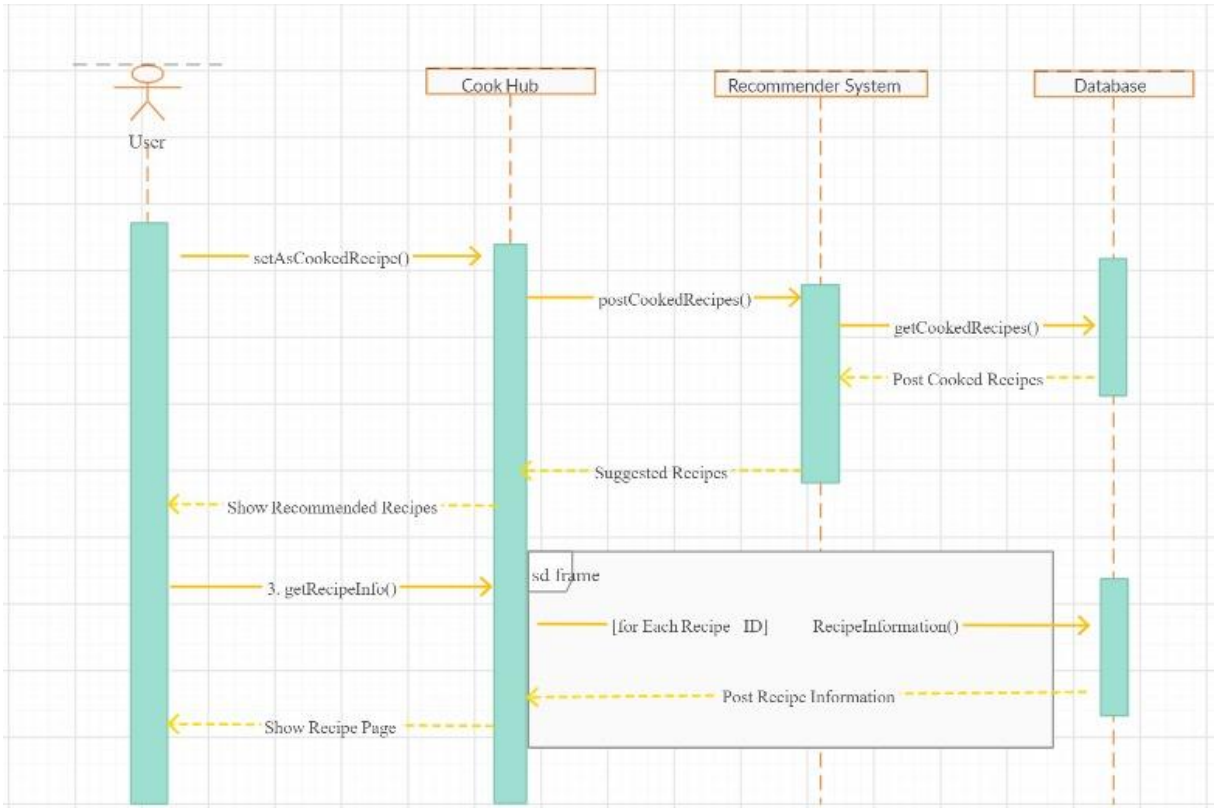

Figure 8 Sequence Diagram

Figure 8 displays sequence diagram. The user enters information about her/his taste and health. Recommend System creates recommendations to user. Then user chooses the any recipe from recommends. I f user cooked this recipe, s/he should mark the “I cooked it” button. With this method, the following recommendations will be even more accurate and personalized.

3.2.3.2 Activity Diagram

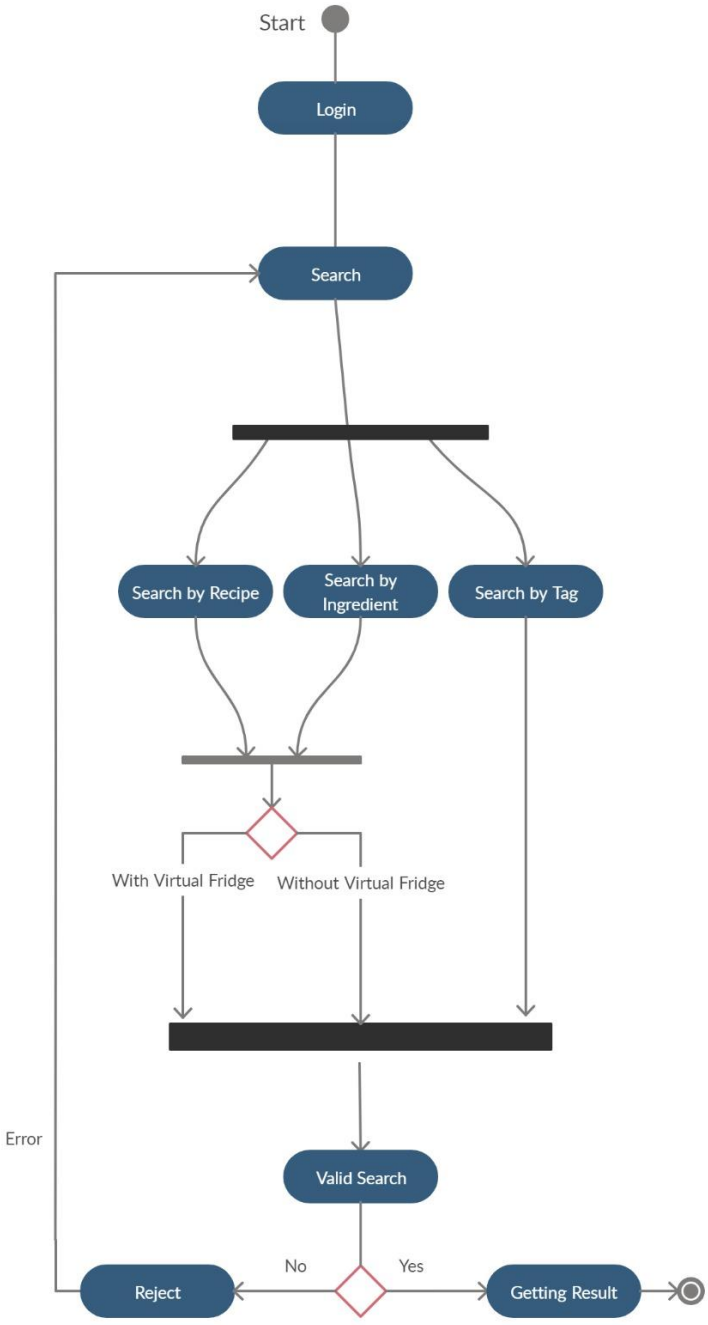

Figure 9 Activity Diagram

The Figure 9, shows that how the scenario generation works as an activity diagram. When the user open to the application, she/he sees the home page of the application. If user goes to search page, they can find three searching method; Search by Tag, Search by Ingredient, Search by Recipe. After searching, user reaches the accurate recipes.

3.2.3.3 Class Diagram

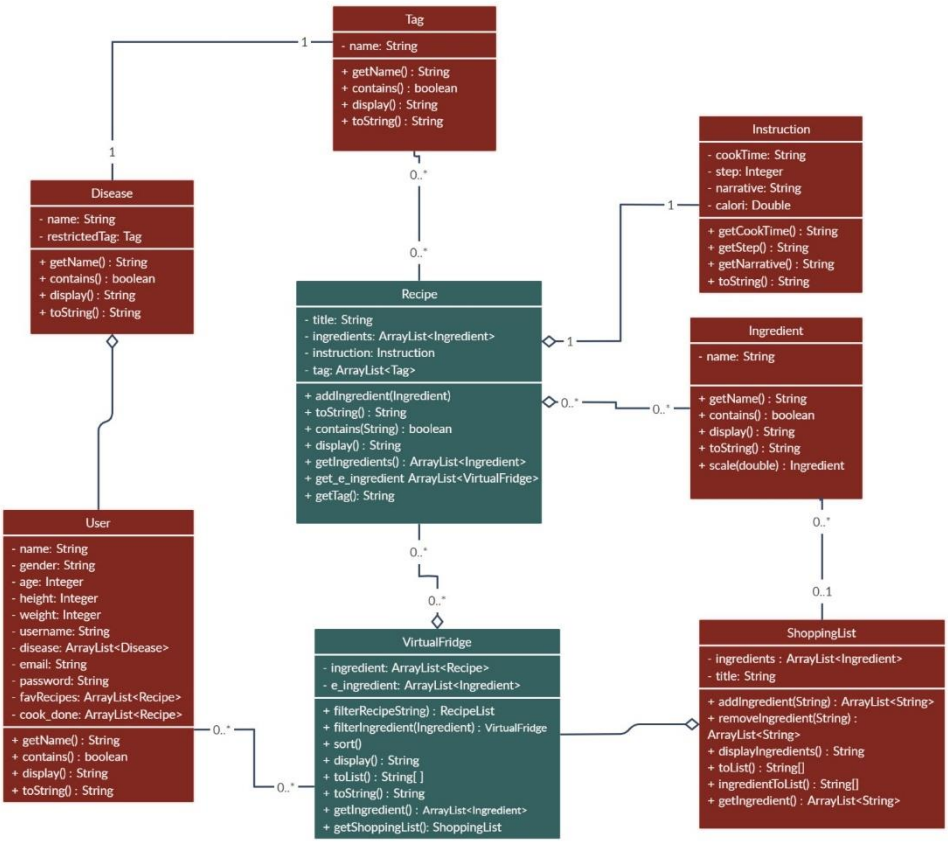

Figure 10 Class Diagram

Figure 10 shows the main components of system and their functions. Relationships between these tables are showed with links.

3.2.4 Architecture Design and User Interfaces

3.2.4.1 What should I cook? (Home Page)

Summary: This system used by registered users. The Home Page will host for several recipes which was recommend by the Cook Hub AI. Although users can search for food if they have wanted to. Users can search for food recipes by 3 ways; search by tag, search by ingredient, search by recipe.
Actor: User
Precondition: Login the system
Basic Sequence:

1. User must login if he/she has an account.
2. User can see the ten most popular recipes (according to user's personal information and tastes) on Home Page if s/he uses the application for the first time.
3. As the user chooses from the recipes s/he sees here, s/he will encounter even more personalized recipes each time.

4. User can update his/her personal information by selecting edit profile button from user menu.

Exception: None

Post Conditions: None

Priority: High

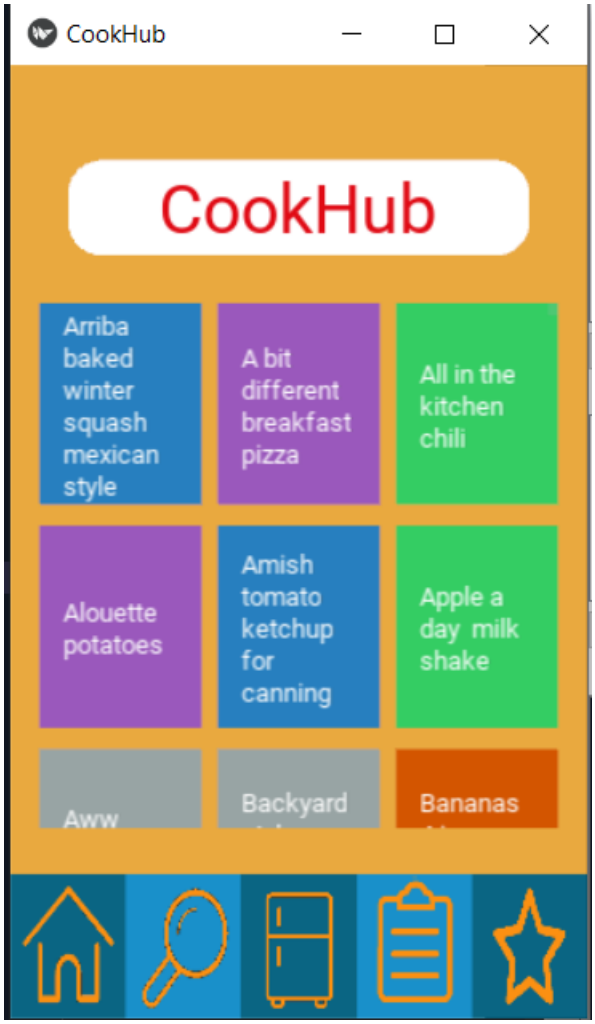

Figure 11 Home Page

3.2.4.2 Search Screen

Summary: Users can manually search for recipes. They can search for food recipes by 3 ways; search by tag, search by ingredient, search by recipe. The recipes presented to them as a result of the search will again be limited according to their personal information.

Actor: User

Precondition: Click Search Button.

Basic Sequence:

1. If user chooses the “Search by Recipe”, with the name of the meal s/he can reach the recipe directly.
2. If user chooses the “Search by Ingredient”, users will encounter two search methods.
3. With “Enter Ingredients” button the user will type the material name by hand. S/he will choose the materials s/he finds. Multisearch can be done here.

4. When user click the “Virtual Fridge” button, a drop down list will be opened below. This list shows the ingredients already exist in the refrigerator. Multisearch can be done here.
5. When user click “Search”, these two methods will be combined.
6. If user chooses the “Search by Tag”, users will encounter an eye symbol. If user clicks this eye, a pop up that shows all tags will be appear on the screen. They can choose more than one tags by clicking.
7. Also if user clicks the “Enter Tag”, they can manually add tags. Recommended recipes will be include intersection of these tags.

Exception: Database connection can be failed.
Post Conditions: None
Priority: Medium

Figure 11 Search by Recipe

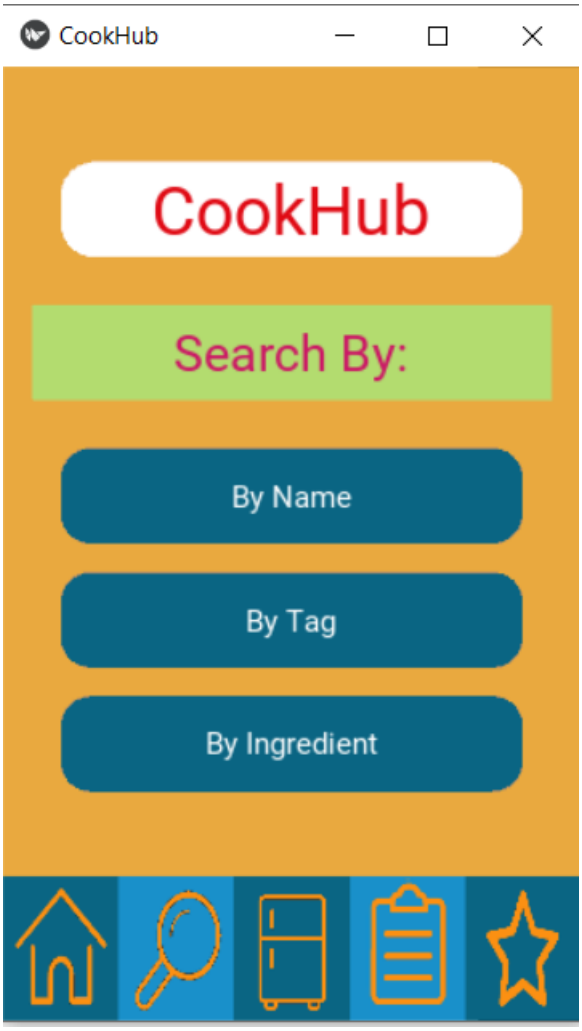

Figure 12 Search Screen

Figure 13 Search by Ingredient

Figure 14 Search by Tag

3.2.4.3 Virtual fridge and Shopping List

Summary: After all searching steps, finally user find and select a recipe to prepare.
Actor: User
Precondition: Choose a recipe.
Basic Sequence:

1. The necessary ingredients in the recipe selected by the user are compared with the ingredients in your Virtual Fridge.
2. If there are no more than 2 missing, these are automatically added to the shopping list.
3. Also shopping list can be controlled manually. You can manipulate the list by adding something (marked with a tick) or delete something (unmark).
4. When user buys the missing ingredients, then s/he should tick them from shopping list. These ingredients will be included to Virtual Fridge anymore.
5. Users can create many shopping list by clicking the plus sign above. Then a new list will be created as a new tab.

Exception: Database connection can be failed.
Post Conditions: None
Priority: Low

Figure 15 Shopping List

Figure 16 Virtual Fridge

3.2.4.4 Favourite Recipes

Summary: Purpose of this page, user can click the star sign when they are on recipe screen. These starred recipes will be added to the favorite recipe list.
Actor: User
Precondition: Choose a recipe.
Basic Sequence:

1. Users can create many recipe list by clicking the plus sign above. Then a new list will be created as a new tab.

Exception: None
Post Conditions: None
Priority: Low

Figure 17 Favorite Recipes

3.2.5 USE CASE REALIZATION

3.2.5.1 Project Components

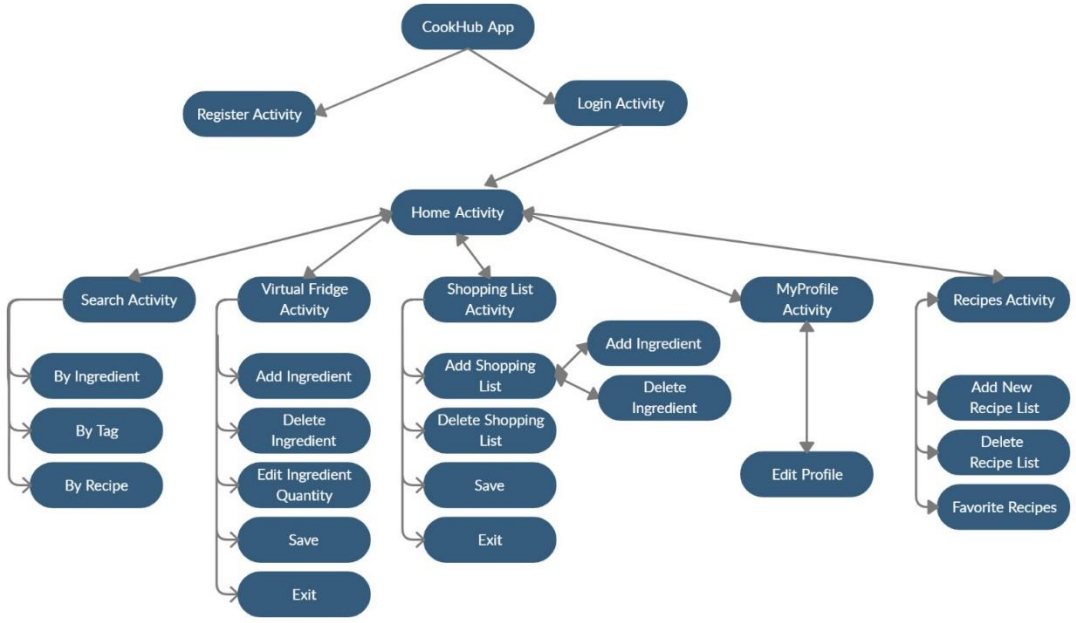

Figure 18 Block Diagram of System Components

All designed systems of the system are displayed in the block diagram in the figure. There are two main components of the system which have their own sub-systems.

4. Conclusion

People are incredibly busy with their everyday lives. They want things done quickly. Also while thinking, they want speed. And when they decide, of course. They really can't decide what to eat sometimes. They even don't know what they should / shouldn't eat. That’s why we decided to create an application that recommends both healthy and personalized recipes and shows you how to make it step by step. To develop this application we have created a number of algorithms. We took a look at related works from various articles. And in our Report we mentioned them.

5. Acknowledgement

We are grateful for guidance we have received from Assist. Prof. Dr. Roya Choupani. The help we received from them was a great asset to improve this project and ourselves.

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