
THE UNIVERSITY OF HONG KONG

DEPARTMENT OF COMPUTER SCIENCE

# AI NUTRITION MEAL PLANNER

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# 1 Introduction

## 1.1 Background

According to the [1]recent research conducted by the Department of Health in Hong Kong, some major non-communicable diseases, such as being overweight (50 %), hypertension (27.7 %), diabetes (8.4%) and high cholesterol (49.5%), were prevalent among the general population. It can be deduced that the health issue among the citizens are getting more and more serious. Unfortunately, most of the general public underestimate this problem. They are still keeping all the unhealthy behaviours and living in those unhealthy lifestyles. They somehow believe that they will be lucky enough and can avoid getting those food-caused disease. To alleviate the problem and to deeply change the mindset of the public, some additional actions are needed to be taken by the government or the media, e.g. promoting the importance of balanced diet to the public and encouraging people to exercise daily.

In the meanwhile, technology is getting more advanced with years and digital technology even changes the everyday lives of the general public. Nowadays, the population of smartphone and tablet users grows to an exaggerated number. Mobile devices have penetrated every area all around the world. No matter you are living in a rural area or cities, basically, you have a mobile phone in your hand. It allows you to connect the world anywhere, anytime and anyplace. Therefore, this creates numerous technical opportunity which can help increase the living standard of the citizens. For instance, the homemakers can place a tablet or a smartphone on the kitchen table during their preparation of food and cooking time. There can have some digital technologies which aid their works.

Combining the above-mentioned background information, a mobile application can be introduced to help raise the awareness of the food nutritive value and eating practices, and further, create a balanced diet for the general public. It will be convenient for the homemaker to use; also there will be comprehensive and detailed nutrition information provided to them.

## 1.2 Research on existing solutions

In the nowadays app market, a few similar apps exist in the App Store, which serves and provide food-scanning feature to the app purchaser. For example, Foodzilla and Calorie Mama. Comparing the project idea and that of the above-mentioned app, there are several remarkable differences which can distinguish the apps.

Firstly, for other existing apps, their focus of target audience is on one individual user, i.e. they assist the management of a person's diet. When the user launches the app for the first time, it requires the user to enter only one person's health information, including age, weight, height and prefered diet styles. But when comparing to this project, this project targets not only the individual but also the whole family. The project idea is to allow input the data of all the family members, like their respective age, height, weight and health goals. Then by measuring and analysing the data as a group of people, it can provide better nutrition management for the family.

Secondly, the existing apps in the market only allow user to record the food consumed in their daily diet. To illustrate, the user will use the app to scan a burger and add it to his breakfast section in the app. The app will then show its nutritive value and further calculate the user's daily nutrition intake and consumption. However, this project idea is to create a digital kitchen which allows the homemakers to understand the nutrition information of all the food that their home has currently. To illustrate, the user will

scan all the foods in his refrigerator and the app will record all the food data. Then, it will display their corresponding nutrition information in different data visualization method. Also, there will be various feature to help the user to have better management of their foods.

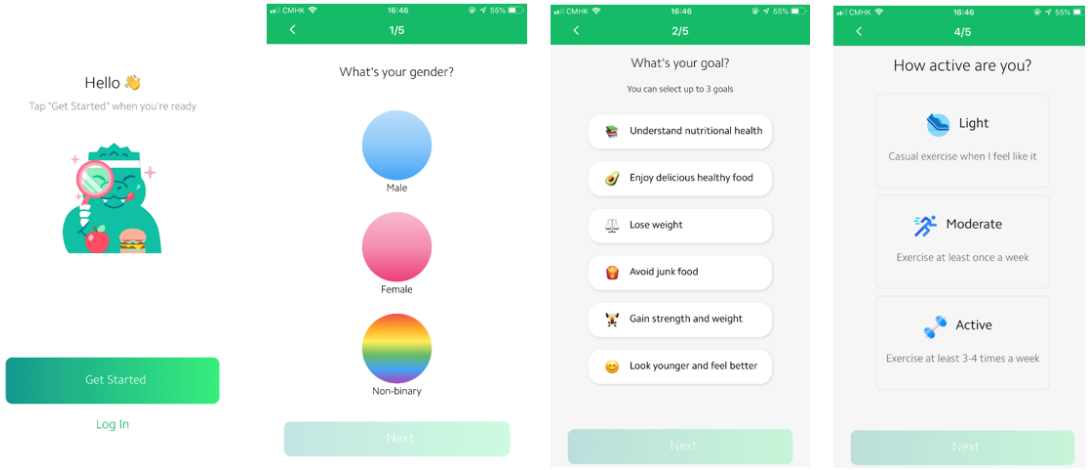


Figure 1: show the workflow using Foodzilla

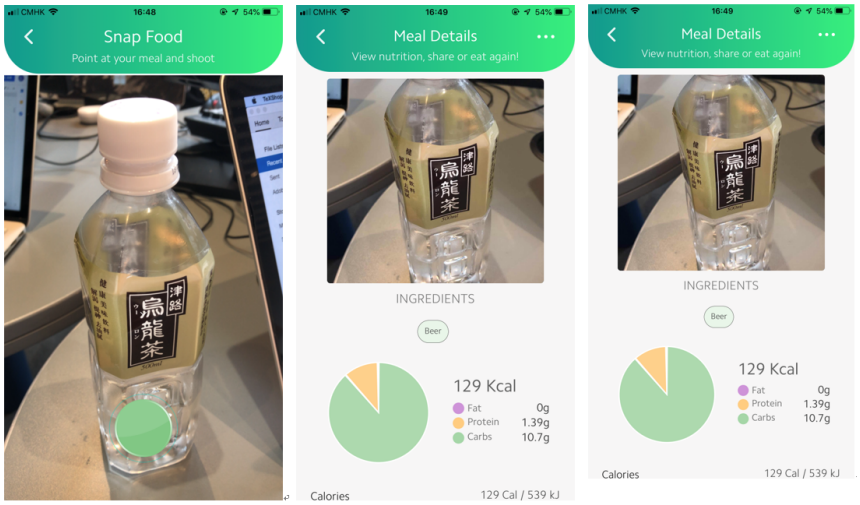


Figure 2: show the food record function

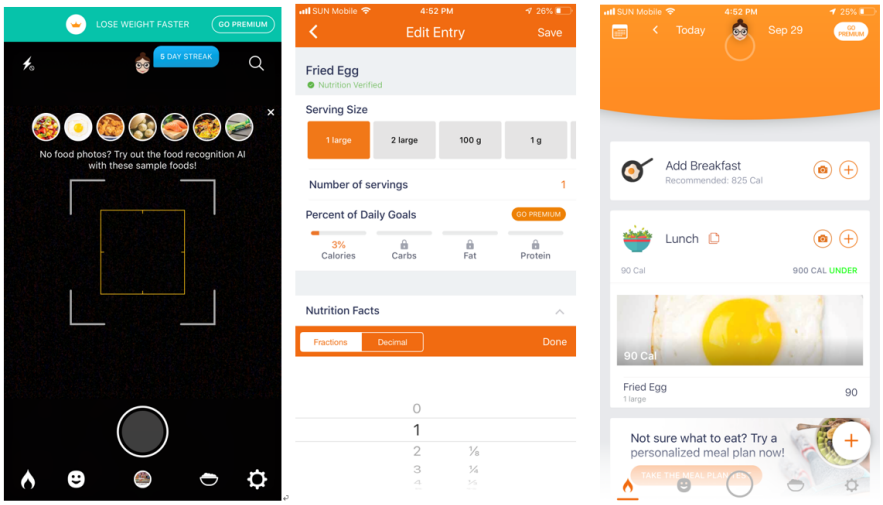


Figure 3: show the recipe function

Thirdly, the existing apps in the market allow the user to browse some recipes(See Figure 3), but all of them are provided by the app company. This somehow lacks the interaction between users and this single channel of data source cannot provide comprehensive data to the users. Comparing to this project, the app will allow the user the browse, post, like and share recipes. In this way, a social network can be formed and this can increase user loyalty to the application.

## 1.3 Project objectives

There are a few objectives for the whole project. Firstly, the project aims to provide effective management of food and nutrients intake for the family by providing a detailed breakdown of the foods inside the refrigerator. Secondly, it aims to prompt the concept of a balanced diet to the public as people always underestimate the importance of it. Thirdly, it aims to create a network and platform for the public to share their cooking knowledge, such as their collection of recipes. Finally, the mobile app can be released in the app store with a stable version and can able to achieve more than one thousand users download.

# 2 Project Scope

## 2.1 System features and feature priority list

### 2.1.1 Mobile Application

**Comprehensive user group** The application will allow the user to create a family-based account. The account owner will be directed to input the personal health information of his family. For each of the family member, the user need to choose his gender, age, height, current weight, health goals (e.g. gain strength and weight, lose weight or avoid junk food), workout active level (e.g. light, moderate or active) and potential allergies (e.g. dairy, egg, gluten, peanut, seafood). Then, the application will analyse the above data and recommend the family's daily approximate intake of basic nutrients (e.g. fat, protein and carbohydrates), and also some healthy recipes for the user to follow.

**Digital Refrigerator** The application will allow the user to scan the whole refrigerator or the food, and automatically insert them into the user's app record. If the application cannot detect the approximate amount of the food, the user can input the serving size manually. By displaying the nutrition information using various data visualization methods, the user can then have a comprehensive record for the nutritive value of food which his home currently has.

**Ingredients Library** The application will allow the user to check the detailed nutrition information by a simple search. For instance, the nutrition data of watermelon will be breakdown into different sub-category of nutrients, such as its amount of sodium, calcium, Vitamin A and saturated fat. The nutrition data will be visualized by providing a doughnut chart or other suitable graphs to indicate the amount of those nutrients.

**Recipes Explore** The application will recommend some sample recipes based on the current food existed in the digital refrigerator. And the user can choose his prefered group of diets (e.g. vegan, low-carbs, low-fodmap) and his disliked food. So that the application can then make a better recommendation to him. Moreover, there will be a separate feature for user to write, like and share his recipes; and also explore the recipes written by others. It will display the ingredients and the corresponding nutrition information of the recipes. Step-by-step video cookbook for those recipes will also be provided.

**Food Package Purchase** The application will sell some food packages designed by nutritionist based on the recipes recommended or provided in the app community. So that the homemaker can buy those food packages and cook their meal by simply following the recipe of that food package. Also, there will be cooperation with different food provider; food quality and safety will be aligned with the policy of the Department of Health in Hong Kong. Then, The food packages will then be delivered to the user's home.

**Alert System** The application will alert the user if the food is not recommendable, e.g. pregnant women are not recommended to consume sushi, coffee and tuna. Or the food contains potential allergies which may be harmful to some family members. It will also alert the user through push messages if his family daily intake is not enough. Moreover, it will also predict the chance of developing cancers, cardiovascular disease using AI algorithms.

### 2.1.2 CMS(Content Management system)

**Multi-Language Content Management** The application will allow the translator to handle all the text translation as the mobile application will support several languages

in order to attract more users from different countries. The default language of the mobile application will be English. The application will include all the words which appear and use in the mobile application, then the user can input the respective words in different languages.

**Food Delivery System** The application will allow the CMS users to handle and manage all the orders of those food packages purchased by the user in the mobile app. It will integrate with different food provider and send an email notification to inform that food provider if there is an order for them. Status will also be shown in the application, such as delivered, awaiting payment and completed.

**Data Analytics** The application will allow the CMS users to have a thorough and detailed analysis of the user's behaviour in the mobile app and also the users' data gathered. For example, the duration of the users' activity on different app pages will be shown. In this way, the functionalities and the system feature and be evaluated and can have further improvement by making some amendment. Moreover, in the research view, it can collect a large set of data from the users. It represents the dataset of how the general public consume for their daily nutrients.

**Dataset management** In this function, the application allows the administrator to manage the dataset stored in the database. Administrator can insert new nutrient information of food. When the information needs to change, the administrator can modify that record. Similarly, it allows the user to delete the data. To modify a large number of record, the user can upload the ".xlsx"(xlsx file), and the system will insert the records to the database automatically.

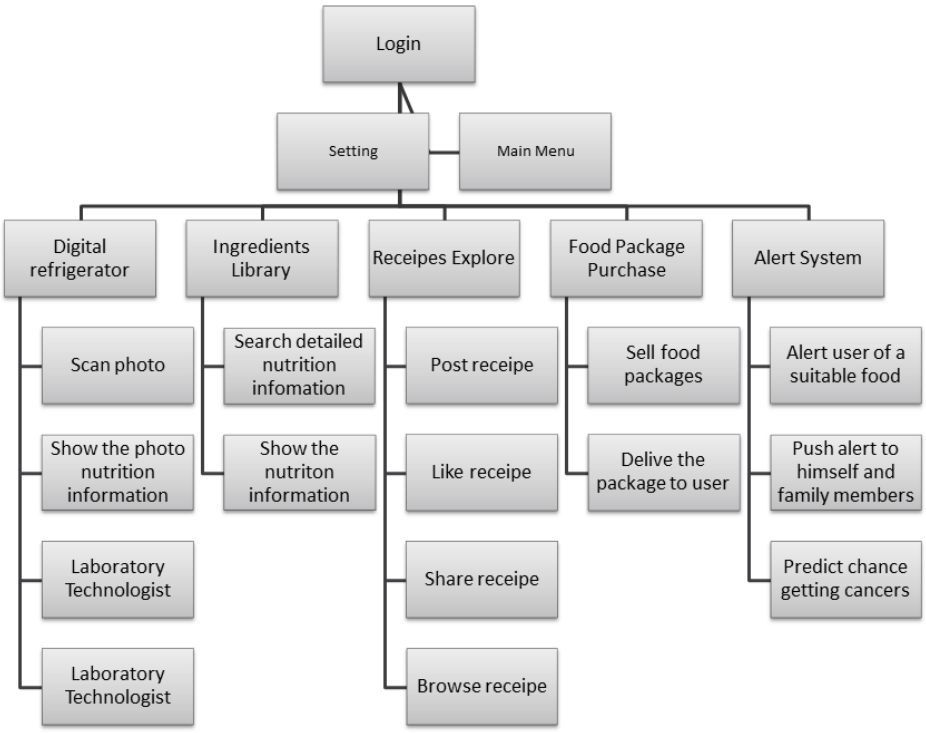


Figure 4: System structure (Mobile Application)

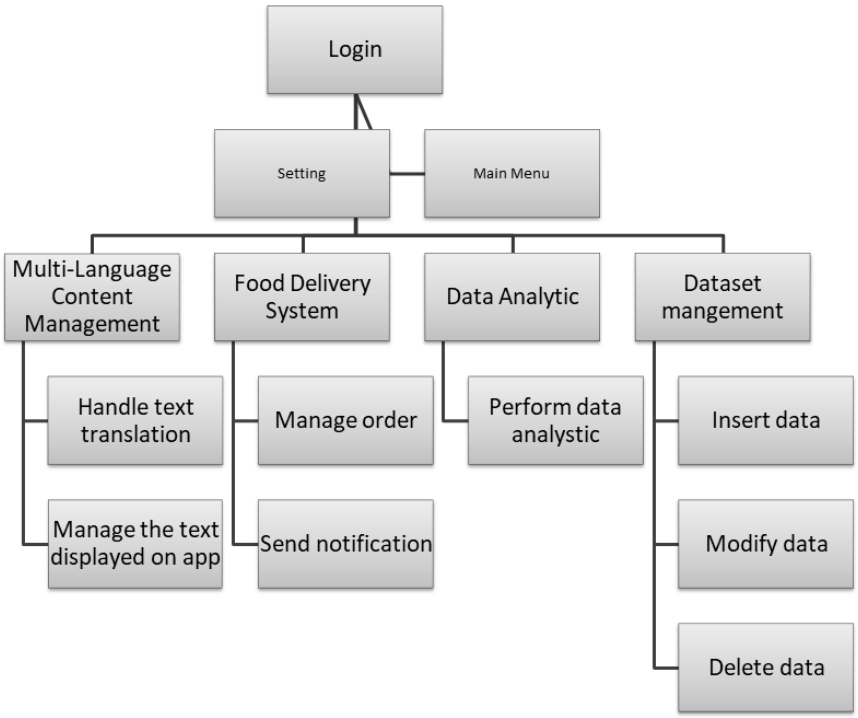


Figure 5: System structure (CMS)

# 3 Methodology

## 3.1 System Architecture

The whole mobile application can be divided by three layers, which are the view, controller and model layer. Each of the layer will be explained below:

### 3.1.1 View Layer

In the software development process, user interface design is the all-important component. A good user interface and user experience design can attract more people to use the application, and it can fulfil all the functional requirement proposed in the current initial design. However, poor user interface design can cause users to feel dissatisfied. Sketch and Flinto will be chosen as the design software which will be used in the later stage. Using Sketch, the general layout for all the app pages will be designed and different UI elements will be created and be well-positioned. Then with the use of Flinto, the transitional animations can be made and it can further create an interactive prototype as the reference of the later application development stage.

### 3.1.2 Controller (Business Logic) Layer

**Image Recognition** In order to perform image recognition, an Artificial Intelligence model could be used. The *Vision* API developed by Google may help with the implementation of this project. Because By simple API calling, usability and feasibility are quite high and convenient. If there are some restriction existed in the model, such as the model is not able to return the correct result. Then, a self-trained model is also required as the backup. Google provides a service named *Cloud AutoML*, which is a platform for developer to train Machine Learning models. Using the platform, the prediction is hoped to become more accurate.

**Giving the recommendation based on the user's information** The recommendation is based on the two following inputs. They are photos taken by the user and the user-inputted information. When a user captures the photos of registrators, the API will return the objects found in the photo and related nutrition information by retrieving from the database. Using that information and the user inputted records calculate the amount (in gram) of basic nutrient and calories consumed and the intakes. In details, the system will display the needed food's information to the user so that the user can follow them to eat. The nutrition information uses the dataset provided by the centre of food safety.

**Recommendation Algorithm for Recipes (Instagram-like)** The receipts are designed by some favour nutrients. The system recommends a suitable user. In order to know the quality of the recipes, user, users can press the like buttons under the recipes, the system will record the frequency of pressing like buttons. The system will recommend the most-like receipts by performing searching in the database to the user first. Also, a recommendation engine, namely recombee could be integrated into the application. The engine will use the past record provided with the AI algorithms designed by Recommbee to give a recommendation to the user.

**User-based collaborative filtering** In this model, products are recommended to a user based on the fact that the products have been liked by users similar to the user. For example, if Derrick and Dennis like the same movies and a new movie come out that Derick likes, then we can recommend that movie to Dennis because Derrick and Dennis seem to like the same movies. Item-based collaborative filtering: These systems identify similar items based on users' previous ratings. For example, if users A, B and C gave a 5-star rating to books X and Y then when a user D buys book Y they also get a recommendation to purchase book X because the system identifies book X and Y as similar based on the ratings of users A, B and C.

**Alert and Synchronization system** There will be an alert system implemented in the mobile application, so that it can notify the user if his daily nutrients intake is not enough, i.e. there will be a pop up in the user's mobile devices. To do so, the system will adopt the third-party service, named*Airship* [2]. Airship is a notification system, it sends the text message to the user's mobile phone.

**Payment System** When the user intends to purchase the food packages online, a bill payment request will be prompted. Since it is impossible to collect the cash face-to-face from the user, the app needs to allow the user to pay his fee using some advanced e-payment methods, e.g. credit card payment, Alipay, Android and Apple pay. In order to realise such payment options, from a technical perspective, some plugins or packages should be implemented in the project code. For instance, the *braintree payment plugin*[**?**] in Flutter is a satisfying option for the development of the payment feature. It is comprehensive which supports nearly all the common payment approaches. Moreover, the integration of this plugin in the project code is easy and clear as it only requires four code-adding steps in the project.

### 3.1.3 Model Layer

**Database Storage** There will have local data storage in the user's mobile device. The mobile application will connect with *SQLite* database. The model of database will mainly be related to the digital refrigerator feature and also saved recipe feature. Moreover, since the users' food record and recipes, data will be stored in the system. Therefore, a powerful online database is required for data management. MySQL supports a larger number of records. Data stored in the MySQL is used for non-frequency usage data, such as the links of videos. In addition, the videos will be hosted in Cloud Storage. Many advantages can be brought from cloud hosting. Google Cloud is needed to store the CMS System, which is a management system for the administrator.

**Dataset Usage** The nutrition dataset will be needed in the mobile application. Since the application will breakdown the nutrient distribution of all the foods. It requires an authentic and precise record which is provided by the professional nutritionist. Part of the data will be acquired from the Hong Kong Safety Council. [3]

## 3.2 Development tools

### 3.2.1 Mobile Development

The mobile application of this project will be developed under the Flutter framework which supported and developed by Google. There are several reasons why Flutter framework is chosen in this application development. The code written in Flutter framework will be cross-platform which means that it can run in both Android and IOS. Flutter also provides a full set of widgets which are flexible and convenient to use. Flutter framework will compare and replace the changed widget if the user interface is updated. Therefore, it leads to great app performance and efficiency. Additionally, when comparing with React native framework, it has higher compatibility since it supports more API and also it is getting more attention and become more popular nowadays.

### 3.2.2 CMS(Content website management) Web Development

The CMS that manage the mobile application will be a web-based system. From the technical perspective, the React.js framework will be implemented in the front-end while Node.js framework will be applied in the back-end. From the technical perspective, React.js framework use virtual DOM which enable the CMS website to become a fast and scalable application. The original DOM will compare with the virtual DOM and update those components that changed. This is the key reason why the React.js framework adopted in this project. Meanwhile, for the Node.js framework, it is lightweight and fast. By combining the React.js and Node.js framework, the CMS could be well-developed.

## 3.3 Software Development Cycle

**Aglie software Approach** Instead of the waterfall model approach, the Agile software approach will be adopted in this project. There will have different agile development activities, including sprint planning, sprint review and sprint retrospective. Technically, each of the main components will break down intro small-sized tasks based on the functionalities of the application. These tasks, also named stories, will be allocated to the workbench of the developers of this project. Moreover, small prototypes will also be built to test the feasibility and also functionalities. There will have a different version of release in different stages.

## 3.4 Project schedule

| Completed Date | Project Task | Status (Done, On-going, Processing) |
|---|---|---|
| 20 September 2019 | • Finalize the project ideas | Done |
| 29 September 2019 | • Submit the project website<br>• Submit the project report | On-going |
| 10 October 2019 | • Set up the database<br>• Import the data in the database<br>• Finish basic UI/UX designs<br>• Build a small prototype, digital refrigerator | Processing |
| 24 October 2019 | • Finish all the UI/UX design<br>• Finalize the database design | Processing |
| 17 November 2019 | • Complete the user function (input the user information)<br>• Build a self-trained model | Processing |
| 30 December 2019 | • Test the mobile application<br>• Complete the digital refrigerator function | Processing |
| 9 January 2020 | • Complete the integrated library and recipe explore functions and the previous function if not yet finished<br>• Fix the errors/bug if exists<br>• Improve the system usability/ user experience | Processing |
| 13 January 2020 | • Set up the CMS system<br>• Demo the function to the supervisor<br>• Start to develop food purchase functions | Processing |
| 2 February 2020 | • Finish the food purchase function<br>• Submit the project interim report | Processing |
| 17 February 2020 | • Fallback day<br>• Finish the functions if not yet finished | Processing |
| 2 March 2020 | • Fix the errors/bug if exists<br>• Improve the system usability/ user experience | Processing |
| 16 March 2020 | • Fallback day<br>• Finish the functions if not yet finished | Processing |
| 30 March 2020 | • Complete the alert system and health application synchronization function | Processing |
| 6 April 2020 | • Fallback day | Processing |

Table 1: The project schedule

# 4 References

## References


[1] Health liftstyle urged. Accessed: 2019-09-29. [Online]. Available: https://www.news.gov.hk/tc/categories/health/html/2017/11/20171127_170209.shtml

[2] Airship api. Accessed: 2019-09-29. [Online]. Available: https://docs.airship.com/api/ua/

[3] Braintree api. Accessed: 2019-09-29. [Online]. Available: https://developers.braintreepayments.com/guides/authorization/overview

[4] Nutrient information inquiry. Accessed: 2019-09-29. [Online]. Available: https://www.cfs.gov.hk/tc_chi/nutrient/index.php