VIETNAM GENERAL CONFEDERATION OF LABOR
TON DUC THANG UNIVERSITY
FACULTY OF INFORMATION TECHNOLOGY

LE THANH TIEN – 521H0485
PHAM VAN TIEN DAT – 521H0030

DEVELOPING FRESH FOOD EXPIRY DATE TRACKER MOBILE APPLICATION

FINAL PROJECT MOBILE APPS DEVELOPMENT
SOFTWARE ENGINEERING

HO CHI MINH CITY, 2023

VIETNAM GENERAL CONFEDERATION OF LABOR

TON DUC THANG UNIVERSITY

FACULTY OF INFORMATION TECHNOLOGY

LE THANH TIEN – 521H0485

PHAM VAN TIEN DAT – 521H0030

DEVELOPING FRESH FOOD EXPIRY DATE TRACKER MOBILE APPLICATION

FINAL PROJECT MOBILE APPS DEVELOPMENT

SOFTWARE ENGHINEERING

Instructor

Ph.D. Le Van Vang

HO CHI MINH CITY, 2023

ACKNOWLEDGEMENT

To begin with, we would like to acknowledge the generous support of Ton Duc Thang University and the Faculty of Information Technology, who provided us with the essential documents and equipment that facilitated our development process. These resources enabled us to optimize our productivity and experiment with various solutions for our application.

Furthermore, we would also like to extend our thanks to our instructor, Ph.D. Le Van Vang, for his valuable guidance, constructive feedback, and constant encouragement. His insights were instrumental in shaping the direction and outcome of this project. Our learning experience was enhanced with the acquisition of specialized knowledge that helped us overcome the challenges and difficulties encountered during the development process.

Ho Chi Minh City, 25th December 2023
Author

Le Thanh Tien

Dat

Pham Van Tien Dat

CONFIRMATION AND ASSESSMENT SECTION

Instructor’s name: ....

Comments: ....

....

....

....

Overall score according to rubric: ....

Ho Chi Minh City, date month year 20
Instructor
(Signature and full name)

DECLARATION OF AUTHORSHIP

We fully declare that this is our project and is guided by Ph.D. Le Van Vang; The research contents and results on this topic are honest and have not been published in any form before. The data in the tables for analysis, comments, and evaluation are collected by the author himself from different sources, clearly stated in the reference section.

Besides that, the project also uses some comments, assessments as well as data from other authors, other agencies, and organizations, with citations and source annotations.

Should any fraud be found, we will take full responsibility for the content of our report. Ton Duc Thang University is not related to copyright and copyright violations caused by us during the implementation process (if any).

Ho Chi Minh City, 25th December 2023

Author

Le Thanh Tien

Dat

Pham Van Tien Dat

ABSTRACT

This paper presents the software requirement specifications for Fresh Food Expiry Date Tracker Mobile Application. This mobile app aims to help users reduce food waste by keeping track of the expiry dates of their fresh food items. The app enables users to scan the barcodes of their food products and store information about products on a cloud platform. The app also sends notifications to users when their food items are close to expiring and suggests recipes based on the available ingredients. The paper describes the functional requirements of the app, such as scanning, storing, notifying, and suggesting features, and the non-functional requirements of the app, such as performance, reliability, security, and usability. The paper also provides the use cases, user interface design, and testing plan of the app. The paper follows the IEEE 830-1998 standard for SRS documentation (Anon 1984).

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

API	Application Programming Interface
BoM	Bill of Materials
EAN	European Article Number
HTTP	HyperText Transfer Protocol
HTTPS	HyperText Transfer Protocol Secure
IDE	Integrated Development Environment
ML	Machine Learning
MVVM	Model-View-ViewModel
NoSQL	Not only Structured Query Language
QR Code	Quick Response Code
UI	User Interface
UPC	Universal Product Code

CHAPTER 1 – INTRODUCTION

1.1 Purpose

The purpose of this paper is to provide a detailed description of the software requirements for the Fresh Food Expiry Date Tracker Mobile Application. This document will cover the functional and non-functional requirements, the scope and boundaries, the assumptions and constraints, and the intended users and operating environment of the application. The application aims to help users monitor the expiry dates of their fresh food items including fresh meat, fruits, vegetables, and dairy products; and to provide them with notifications, reminders, and suggestions on how to consume or dispose of them before they spoil. The application also intends to promote food safety and reduce food waste among users.

1.2 Scope

With a view to achieving food and beverage savings, we developed a solution to help a user perform the expiry date management tasks including importing items' information to the application conveniently, raising notifications about food and drink items that are near to reaching their use-by date, and giving recipe recommendations to cook diverse common dishes to take usage of available food, drink, and leftovers in customers' refrigerators. Since this application gives individuals convenient opportunities to consume all ingredients timely, the amount of food and drink wastage could be reduced considerably. In other words, each person could make a great contribution to the global effort to save food and drink.

In summary, this solution is named Fresh Food Expiry Date Tracker Mobile Application and allows users to perform the following functions to monitor the expiry date of foods and beverages:

- Scan the barcode of their ingredient items and store them in a virtual kitchen.
- Detect the barcode from the ingredient's packaging image to get information.
- Divide the kitchen into different categories such as fridge, pantry, and freezer.
- Manage the expiry date of foods and drinks including fresh and canned food.
- Give recommendations to keep fresh food in different conditions and temperatures.

- Give notifications about food that almost reached its expiry date (3 or 5 days before the expiry date based on the type of food)
- Give some tips and recipes to use their leftovers to make a stunning dish.
- Set restrictions about what type of dishes are recommended based on personal taste or allergy.
- Create a planner for meals of the date.
- Create a profile to store and sync all information about their food.
- Explore the recipes of stunning dishes from all over the world.
- Invite their colleagues, friends, or family members to track the kitchen together.

CHAPTER 2 – OVERALL DESCRIPTION

2.1 Product perspective

2.1.1 System interfaces

The application integrates with the notification systems to provide timely alerts about foods and beverages when they are near expiring.

The application also integrates with barcode scanning technology to get the information of ingredients conveniently.

2.1.2 User interfaces

Regarding the logical characteristics of each interface, since this application is developed on the mobile platform, it requires the devices to have a touchscreen, virtual keyboard, and portrait orientation.

Furthermore, given the growing concern for nutritional well-being among people ranging from 13 to 50 years old, this application aims to create a user experience that caters to this party's preferences and expectations. Thus, the following aspects are considered to optimize the interface with the target audience including:

- A new user who is in the age of younger or older generation can use the barcode scanning to import a new ingredient to the kitchen 2 minutes after the first or second attempt.
- A new user who is in the age of younger or older generation can import a new ingredient to the kitchen by importing a packaging image in 1 minute after the first or second attempt.
- A common user can find a place to view the recipes of dishes based on available ingredients easily on the main screen.
- A common user can switch among kitchen types in the virtual kitchen with one touch.
- The information or error message is short within one line in the snack bar.

2.1.3 Hardware interfaces

The application utilizes standard smartphone hardware components including cameras for barcode scanning and push notification capabilities.

2.1.4 Software interfaces

The application is compatible with the recent versions of Android operating systems. The minimum requirement of the Android version is Android 10 (API level 29).

The application also integrates with the following third-party libraries and frameworks to take advantage of the benefits of these current state-of-the-art technologies to support key features in this application.

- Firebase: This is an app development platform that is backed by Google Cloud that enhances the development process to scale the application easily. The application benefits from some productions in this platform to accelerate the effectiveness of crucial features in this application which are mentioned in the following list.

  - Firebase BoM version 32.6.0 (Anon n.d.-b)
  - Firebase Authentication version 22.3.0 (Anon n.d.-c) is adapted to tackle authentication and authorization tasks in the application. This product also integrates with Google Sign-in and OAuth 2.0 (Anon n.d.-f) to simplify the signing process of users when they first access the application.
  - Firestore Database version 24.9.1 (Anon n.d.-d), a NoSQL document database, is the core database of the application. Since the key characteristics of Firebase are automatic scaling, high performance, and ease of development, it is an appropriate solution for the discrete data concept in this application.

- ML Kit’s barcode scanning API version 17.2.0 (Anon n.d.-a), which is in the ML Kit package, is used to build the barcode scanning feature in the application. This API supports the diverse types of standard formats including QR Code, Codabar, EAN-8, UPC-A, and UPC-E, …

- Retrofit version 2.9.0 (Anon n.d.-e), which is a type-safe HTTP client for Android, is used to communicate with other APIs to retrieve necessary data from them.

2.1.5 Communication interfaces

The application communicates with the OAuth 2.0 server and Firebase for data synchronization across devices and user account management.

Secure communication protocols (HTTPS) are also implemented for data transfer to ensure confidentiality and prevent sensitive data from being exposed.

2.1.6 Memory

Regarding the client-side memory, the application is optimized to efficiently use device memory for smooth operation on smartphones with varying memory capacities. Furthermore, cache management strategies are implemented to enhance performance and responsiveness.

About the server-side memory, due to the adaptation of Firebase, the backend server can handle a growing database of user information and ingredient entries. Besides that, memory optimization techniques are employed to ensure efficient data retrieval and storage.

2.2 Product functions

- User Registration and Authentication:

- The user must be able to create accounts with unique usernames and passwords.
- The application must implement secure authentication mechanisms to protect user data.

- Ingredient Management:

- The user can add new food and drink items by entering details manually or importing them automatically through barcode scanning.
- The user can modify and delete the items in the kitchen.

- Personalized Notifications:

- Notifications must include details about the expiring item and be configurable based on user preferences.
- The user can set personalized notifications for upcoming expiry dates.

- Categorization:

- The user can categorize the food and beverage items based on storage locations.

- The application offers a visual representation of the remaining shelf life of each item through color-coded indicators, enhancing user understanding immediately.

2.3 User characteristics

The target users for the Fresh Food Expiry Date Tracker Mobile Application are individuals aged 13 to 50 years old who have a concern for nutritional well-being and wish to manage their fresh food and beverages efficiently, reduce food waste, and adopt sustainable consumption practices. It caters to users with varying levels of technological expertise, offering a user-friendly experience for all.

2.4 Constraints

- Memory constraints: The application must operate within the memory constraints of mobile devices, optimizing resource usage for optimal performance.

- Confidentiality considerations: The application must ensure the safety of personal data and ingredient data of users.

2.5 Assumptions and dependencies

- Users are assumed to have a stable internet connection for real-time data synchronization.

- The application is subject to the regulatory and privacy constraints of the regions in which it operates.

CHAPTER 3 – REQUIREMENT SPECIFICATION

3.1 Stakeholders for the system

- According to the requirements, the stakeholders of the system can be defined as two groups including internal and external stakeholders.

- Internal stakeholders: Project manager, development team.
- External stakeholders: Users and the government.

- Since these stakeholders have separate impacts on the project, a stakeholder prioritization list is proposed to decide what kinds of deliverables and resources should be informed to each stakeholder.

- The project manager, who has high power and high interest manages closely in the project.
- The Government which has high power, and less interest is kept satisfied. It means the project must follow the current policies.
- The user and development team who have less power and high interest are kept informed.

3.2 Use case model

3.2.1 Graphical Use Case Model

According to the requirements of the Fresh Food Expiry Date Tracker Mobile Application, we gather information and generate user stories to understand the demand of users for this application. Then we conduct the use case diagram to understand how users interact with the application which is illustrated in the following figure:

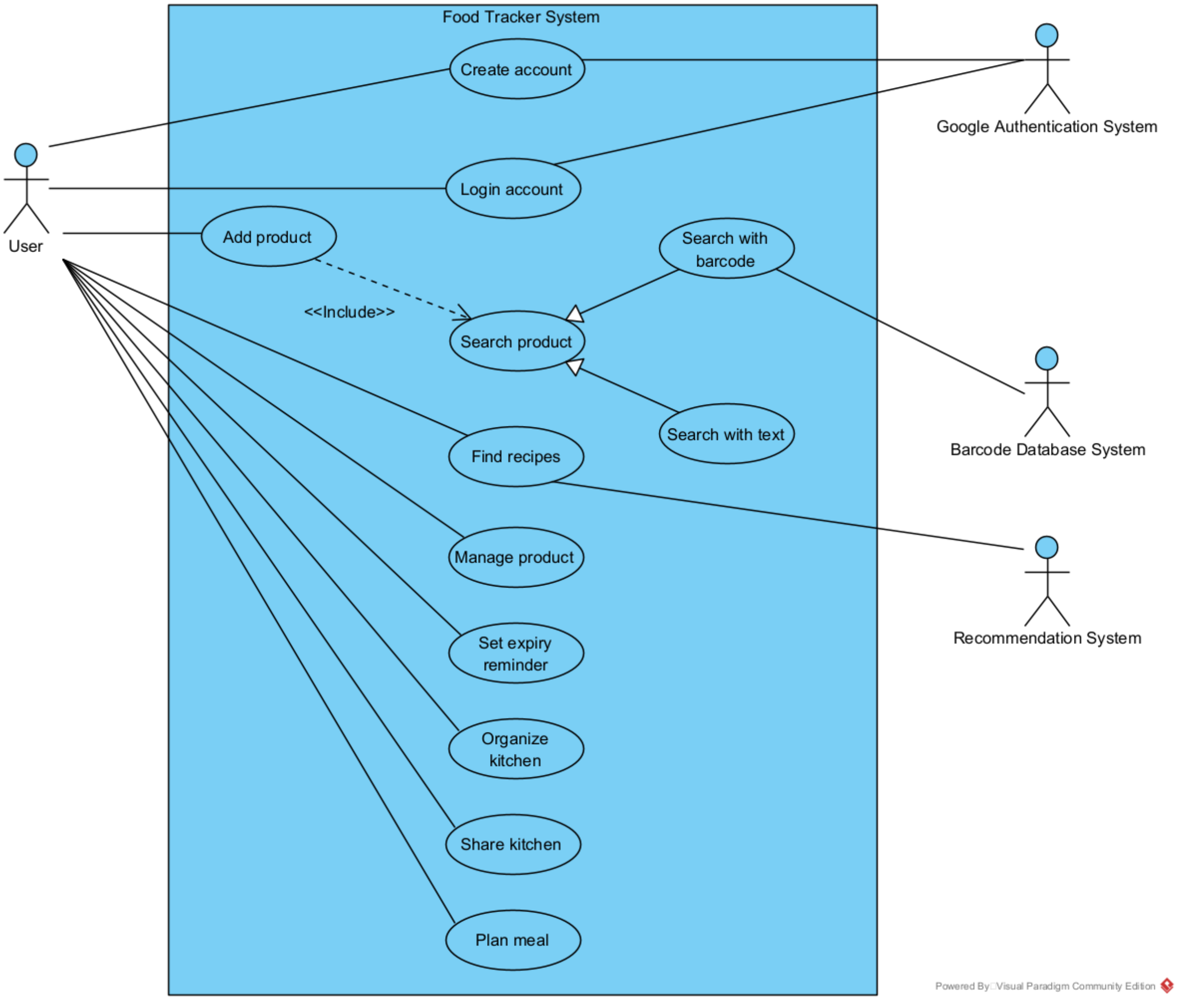


Figure 3.1 The use case diagram of the system

3.2.2 Textual Description of Use cases

3.2.2.1 Brief Use Case Description

Use cases	**Actors**	**Brief use case description**
Create Account	User, Google Authentication System	Users enter valid information and the system processes and creates a new account for them.
Login Account	User, Google Authentication System	Users provide correct information and the system processes and gives access to the application to users.

Organize Kitchen	User	Users manage their foods and beverages in diverse spaces and the system processes tasks based on current data.
Add Product Item	User	Users add product data and the system processes and adds new items to selected categories.
Search with Barcode	User, Barcode Database System	Users scan the barcode on the label of food and drinks packaging and the system retrieves and returns information about the product.
Search with Text	User	Users get product items with text input, fill in product data, and the system processes product information.
Manage product item	User	Users update and delete product items with valid data, and the system processes and updates corresponding items.
Set expiry date reminder	User	Users set expiry date reminders based on preferences and the system alerts reminders based on the selected options.
Share Kitchen	User	Users add other users to the existing kitchen to share data with other people and the system adds the selected users to the kitchen.
Set restrictions	User	Users set restrictions about their foods and drinks and the system gives warning about imported products and limits the recommended recipes.

Find recipes	User, Recommendation System	Users choose the recipe-finding option and the system gets responses from the recommendation system and processes to send to users.
Plan for meal	User, Recommendation System	Users choose dishes for each meal in a day and the system repairs to give recipe recommendations and a shopping list.

Table 3.1 Brief use cases description

3.2.2.2 Create Account Use Case

Use case name	Create Account	
Scenario	Create an account when using the app for the first time	
Triggering event	Users want to create a new account to access the application.	
Brief description	Users manage their foods and beverages in diverse categories and the system processes tasks based on current data.	
Actors	User, Google Authentication System	
Preconditions	The email was not registered before. The user’s Google account exists. The device connects to the Internet successfully.	
Postconditions	The new account is registered successfully.	
Flow of activities	Actor	System
	1. User touches the “Sign up” button on the screen and chooses a Google account to register.	1.1 System processes the selection and sends a request to the Google Authentication System.
	2. The Google Authentication System processes the request,	2.1 System receives the response and authorizes the account.

	authenticates the account, and responds to the system.	2.2. System gives access to the user.
Exception conditions	2a. The Google Authentication System disconnects from the application.	

Table 3.2 Fully Create Account Use Case Description

3.2.2.3 Login Account Use Case

Use case name	Login Account	
Scenario	Sign in to access the application	
Triggering event	Users want to log in to their accounts to access the application.	
Brief description	Users provide correct information and the system processes and gives access to the application to users.	
Actors	User, Google Authentication System	
Preconditions	The user’s Google account is registered. The device connects to the Internet successfully.	
Postconditions	User signs in successfully.	
Flow of activities	Actor	System
	1. User touches the “Sign in” button on the screen and chooses a Google account to register.	1.1 System processes the selection and sends a request to the Google Authentication System.
	2. The Google Authentication System processes the request, authenticates the account, and responds to the system.	2.1 System receives the response and authorizes the account. 2.2. System gives access to the user.
Exception conditions	2a. The Google Authentication System disconnects from the application.	

Table 3.3 Fully Login Account Use Case Description

3.2.2.4 Organize Kitchen Use Case

Use case name	Organize Kitchen	
Scenario	Organize the kitchen to adapt to different usages	
Triggering event	Users want to store their foods and beverages in different spaces.	
Brief description	Users manage their foods and beverages in diverse spaces and the system processes tasks based on current data.	
Actors	User	
Preconditions	The user's Google account is registered. The device connects to the Internet successfully.	
Postconditions	User signs in successfully.	
Flow of activities	Actor	System
	1. User chooses an option to add a product.	1.1 System processes the selection. 1.2 The adding product screen shows.
	2. User chooses a space to store the product and confirms the adding activity.	2.1 System processes the request. 2.2 System navigates to the previous screen.
	3. User chooses a space in the kitchen screen to view the list of products.	3.1 System processes the selection. 3.2 System returns the corresponding list to the user.
Exception conditions	N/A	

Table 3.4 Fully Organize Kitchen Use Case Description

3.2.2.5 Add Product Item Use Case

Use case name	Add Product Item
Scenario	Import new products to the kitchen
Triggering event	Users want to import new products to the kitchen to monitor.

Brief description	Users add product data and the system processes and adds new items to selected categories.	
Actors	User	
Preconditions	The user’s Google account is registered. The device connects to the Internet successfully. Users have information about the product by the “Search Product” Use Case successfully.	
Postconditions	A new product item is added to the system successfully.	
Flow of activities	Actor	System
	1. User searches product information.	1.1 System processes and returns results to the user.
	2. The user picks the expiry date of the product and fulfills other required inputs.	N/A
	3. User touches the adding button to save a new product.	3.1 System processes the request. 3.2 System returns results to the user.
Exception conditions	2a. User does not fulfill all required inputs.	

Table 3.5 Fully Add Product Item Use Case Description

3.2.2.6 Search with Barcode Use Case

Use case name	Search with Barcode
Scenario	Search product information based on the barcode on the packaging
Triggering event	Users want to get product information based on the barcode on the packaging

Brief description	Users scan the barcode on the label of foods and drinks' packaging and the system retrieves and returns information about the product.	
Actors	User, Barcode Database System	
Preconditions	The user’s Google account is registered. The device connects to the Internet successfully. The database of barcodes lives.	
Postconditions	Users have product information successfully.	
Flow of activities	Actor	System
	1. User chooses the option to scan an image or pick an image from the gallery.	1.1 System opens the camera if the selection is using a camera; otherwise, the system shows the image gallery.
	2. User focuses on the barcode of the chosen barcode image to get information about the product.	2.1 System processes captured image and gets the barcode number. 2.2 System retrieves information on the product from the Barcode Database System. 2.3 System returns the information to the user.
Exception conditions	2a. The permissions to open camera or media access are not granted. 2.1a System cannot process the barcode image. 2.2a The Barcode Database System disconnects from the application.	

Table 3.6 Fully Search with Barcode Use Case Description

3.2.2.7 Search with Text Use Case

Use case name	Search with Text

Scenario	Get product's information manually	
Triggering event	Users want to get product information manually.	
Brief description	Users get product items with text input, fill in product data, and the system processes information about the product.	
Actors	User	
Preconditions	The user's Google account is registered. The device connects to the Internet successfully.	
Postconditions	Users have information about the product successfully.	
Flow of activities	Actor	System
	1. User chooses the option to import the product manually.	1.1 System opens the adding product screen with blank inputs.
	2. User enters information about the product in the required inputs.	N/A
Exception conditions	2a. User cancels the process to add product.	

Table 3.7 Fully Search with Text Use Case Description

3.2.2.8 Search with Text Use Case

Use case name	Share Kitchen
Scenario	Share kitchen with other users
Triggering event	Users want to share a kitchen with their friends and/or family members.
Brief description	Users add other users to the existing kitchen to share data with other people and the system adds the selected users to the kitchen.
Actors	User
Preconditions	The user's Google account is registered.

	The device connects to the Internet successfully. User’s friend has an account in the application.	
Postconditions	Users share their kitchen with other users successfully.	
Flow of activities	Actor	System
	1. User touches the icon button of the sharing feature.	1.1 System processes requests and shows a sharing screen.
	2. User enters the email of another user to share the kitchen	2.1 System processes requests and sends an invitation to the selected user.
	3. The selected user accepts the invitation.	3.1 System processes requests and gives access to a kitchen to the selected user.
Exception conditions	2a. User cancels the process to share a kitchen. 3a. The selected user declines the invitation.	

Table 3.8 Fully Share Kitchen Use Case Description

3.2.2.9 Set expiry date reminder Use Case

Use case name	Set expiry date reminder
Scenario	Notification when the expiration date is near.
Triggering event	The system supports users to monitor the product's expiration date to use it before it expires.
Brief description	The system notifies the product's expiration date in both users' kitchens and their heir friends and/or family member's kitchens when they share a kitchen. Products with an expiration date of less than 3 days will be reminded.
Actors	Recommendation System
Preconditions	The user’s Google account is registered.

	The device connects to the Internet successfully. User’s friend has an account in the application.	
Postconditions	The system sends a notification about each product's expiration date successfully.	
Flow of activities	Actor	System
	1. User allows turn-on notification of the app.	1.1 System sends a notification about each product’s expiration date when an expiration date of less than 3 days will be reminded, even when the application is turned off.
	2. User touches on a notification to display detail	2.1 System displays detailed information such as kitchen name and product expiration date of each kitchen.
Exception conditions	2a. User does not allow turn-on notifications of the app.	

Table 3.9 Set Expiry Date Reminder Use Case Description

3.2.2.10 Set restrictions Use Case

Use case name	Set restrictions
Scenario	Users set restrictions about their foods and drinks.
Triggering event	Users to want set restrictions about their foods and drinks to search for suitable recipes.
Brief description	Users set restrictions about their foods and drinks and the system gives warnings about imported products and limits the recommended recipes.
Actors	User

Preconditions	The user’s Google account is registered. The device connects to the Internet successfully. User’s friend has an account in the application.	
Postconditions	User adds some restrictions successfully.	
Flow of activities	Actor	System
	1. User touches the icon button of the profile feature.	1.1 System processes requests and shows a profile screen.
	2. User touches on the text “Set restrictions”	2.1 System processes requests and shows a restriction screen.
	3. User selects some restrictions and clicks the button Add to Restriction to save data.	3.1 System processes requests and displays a success message.
	4. User selects the “none” button and clicks the button Add to Restriction to reset the restriction.	4.1 System processes requests and displays a success reset message.
Exception conditions	N/A	

Table 3.10 Set restrictions Use case Description

3.2.2.11 Find recipes Use Case

Use case name	Find recipes
Scenario	Users find recipes from the recommendation system.
Triggering event	Users want to choose the recipe-finding option.
Brief description	Users find recipes based on their restrictions and ingredients in the kitchen. The system gets responses from the recommendation system and processes to send to users.
Actors	User, Recommendation System

Preconditions	The user’s Google account is registered. The device connects to the Internet successfully. User’s friend has an account in the application. Kitchen is not empty	
Postconditions	System uploads data successfully.	
Flow of activities	Actor	System
	1. User touches the icon button of the recipes feature.	1.1 System processes requests and shows a recipe screen.
	2. User touches on a dish in the Daily inspiration item.	2.1 System processes requests and shows an ingredient screen.
	3. User touches the calendar icon button in the dish image.	3.1 System processes requests and shows an add dish for the planning screen.
	4. User sets a planning date, type of meal, and number of foods, and clicks Add to Planner.	4.1 System processes requests and displays a success message.
	5. User clicks the cancel button when finished adding.	5.1 System processes requests and shows an ingredient screen.
	6. User touches the back icon button when finished viewing recipe details.	6.1 System processes requests and shows a recipe screen.
	7. User touches into a country's traditional meals in the Stunning meal section.	7.1 System processes requests and shows a Traditional meal screen.
	8. User touches a dish on the Traditional meal screen.	8.1 System processes requests and shows detailed recipes in the ingredient screen.

Exception conditions	1. User cancels the process of adding a dish for planning. 2. User does not fulfill all required inputs.

Table 3.11 Find recipes Use case Description

3.2.2.12 Plan for meal Use Case

Use case name	Plan for meal	
Scenario	Users plan for meals in a day.	
Triggering event	Users want to choose dishes for each meal in a day.	
Brief description	Users choose dishes for each meal in a day and the system gives recipe and ingredient recommendations.	
Actors	User, Recommendation System	
Preconditions	The user’s Google account is registered. The device connects to the Internet successfully. User’s friend has an account in the application.	
Postconditions	User adds some dishes for each meal successfully.	
Flow of activities	Actor	System
	1. User touches the icon button of the planner feature.	1.1 System processes requests and shows a planner screen.
	2. User touches the date adjustment button.	2.1 System processes requests and shows a date picker.
	3. User selects a day and clicks the OK button.	3.1 System processes requests and displays date text in the date adjustment button.
	4. User selects an Add Meal button in the planner screen.	4.1 System processes requests and displays a Search dish screen
	5. User fills in any dish name or ingredient, and presses enter.	5.1 System processes requests and displays the list of dish/ ingredient names.

	6. User touches a dish in the Search dish screen.	6.1 System processes requests and displays an Ingredient screen.
	7. User touches the calendar icon button in the dish image.	7.1 System processes requests and shows an added dish for the planning screen.
	8. User enters the number of foods, and clicks Add to Planner.	8.1 System processes requests and displays a success message.
	9. User clicks cancel button when finished adding.	9.1 System processes requests and shows an ingredient screen.
	10. User touches the back icon button when finished viewing recipe details.	10.1 System processes requests and shows a planner screen.
	11. User touches the delete icon button to remove the dish.	11.1 System processes requests and displays a success message.
	12. User touches the day adjustment button and selects a day on which the dish was previously added.	12.1 System processes requests and displays some dishes of each meal on this day.
Exception conditions	1. User cancels the process of adding a dish for planning. 2. User does not fulfill all required inputs.	

Table 3.12 Plan for meal Use case Description

3.3 Functional requirements

ID	**User story**	**Functional Requirement Description**
FR_AC_1	As a user, I want to register an account so that I can access the application.	The application must allow users to register an account with an email and password.

FR_AC_2	As a user, I want to log in to the application so that I can access my account.	The application must allow users to log in securely to access their accounts.
FR_IP_1	As a user, I want to import new ingredients to the kitchen so that I can monitor the ingredients' health conveniently.	The application must allow users to add a new ingredient with details including name, categories, and expiry date.
FR_IP_2	As a user, I want to modify or delete ingredients from my kitchen so that my kitchen can be cleaner.	The application must allow users to modify and remove the existing items from their kitchen.
FR_IP_3	As a user, I want to store my ingredients in different spaces as a refrigerator so that I can find items quickly in the real world.	The application must support the categorization of ingredients based on storage location including fridge, pantry, and freezer.
FR_SN_1	As a user, I want to set notifications for upcoming expiry dates based on my preferences so that I can get ready to use all items easily.	The application must allow users to set personalized notifications for upcoming expiry dates.
FR_SN_2	As a user, I want to quickly remember information on upcoming expiry date ingredients so that I can plan to use them.	The application must include details about the expiring item.
FR_SR_1	As a user, I want to exclude the recommended recipes based on my taste and health so that I can choose proper recipes easily.	The application must allow users to set restrictions about what type of dishes are recommended based on personal taste or allergy.

FR_UI_1	As a user, I want to prioritize using the upcoming expiry date items so that I can cook them timely.	The application must provide a visual representation of the remaining shelf life of each ingredient using color-coded indicators.
FR_RD_1	As a user, I want to have recipes to cook dishes from my current items so that I can save time to find proper dishes.	The application must provide a list of recipes based on available ingredients in the users' kitchens.
FR_RD_2	As a user, I want to explore the recipes of diverse dishes so that I can have more inspiration to cook.	The application must provide the recipes of diverse dishes from different countries all over the world.
FR_SK_1	As a user, I want to share my kitchen with other people so that we can monitor our kitchen together.	The system must allow users to share their kitchen with other users.
FR_SK_2	As a user, I want to have a plan for the meal of the date so that I can prepare ingredients easily.	The system must allow users to plan for their meals on the date.

Table 3.13 Functional Requirements Description for the application

3.4 Functional requirements

ID	**ISO Characteristic**	**ISO Sub-characteristic**	**Non-functional Requirements Description**
NF_PERF_1	Performance efficiency	Capacity	The application must handle many users and data entries efficiently.
NF_PERF_2	Performance efficiency	Time behavior	The response time of each request must be 0 to 50 milliseconds.

NF_PERF_3	Performance efficiency	Time behavior	The screen containing the list of ingredients load time must be no more than 1 second.
NF_PERF_4	Performance efficiency	Resource utilization	The application must keep track of data on all shared kitchens.
NF_COMP_1	Compatibility	Co-existence	Each request or transaction must be processed respectively, without detrimental impact on any other requests.
NF_COMP_2	Compatibility	Interoperability	The application must keep track of the data in the database in the cloud platform.
NF_USAB_1	Usability	Appropriateness recognizability	The application must perform the ingredient management feature with a simple action flow.
NF_USAB_2	Usability	Learnability	The UI must be designed consistently on every screen.
NF_USAB_3	Usability	Operability	The application must be able to be upgraded without any manual intervention.
NF_USAB_4	Usability	User error protection	The application must provide a confirmation notification for

			the user before updating or deleting data.
NF_USAB_5	Usability	User interface aesthetics	The UI must be designed friendly with bright colors and transparent text, especially for people in non-technical fields.
NF_USAB_6	Usability	Accessibility	The UI must have navigation consistently to prevent users from getting confused.
NF_RELI_1	Reliability	Availability	The application must operate stably in large data.
NF_RELI_2	Reliability	Fault tolerance	The application must hold the operation process stable when there are any software errors.
NF_SECU_1	Security	Confidentiality	The sensitive data must only be accessed by the authorized account.
NF_SECU_2	Security	Non-repudiation	The kitchen must only be accessed by the user in the shared kitchen.
NF_MAIN_1	Maintainability	Modularity	The application must be built from modules or components that can be updated or replaced easily.

NF_MAIN_2	Maintainability	Analyzability	The document and code must be reviewed into 2 levels.
NF_MAIN_3	Maintainability	Modifiability	The source code must be structured with a coding convention.

Table 3.14 Functional Requirements Description for the application

CHAPTER 4 – ARCHITECTURE

4.1 Architectural styles used

Briefly, the architectural style used for this Android application is Model-View-ViewModel (MVVM). This style decouples the presentation layer (View) from the domain layer and data layer (Model) by using an intermediary class (ViewModel). The View binds to the data and commands exposed by the ViewModel, which in turn interacts with the Model through abstractions such as repositories or use cases. The ViewModel also manages the state and lifecycle events of the View, including orientation changes or configuration changes. The MVVM architecture facilitates a clear separation of concerns, testability, and reusability of the components.

4.2 Architectural model

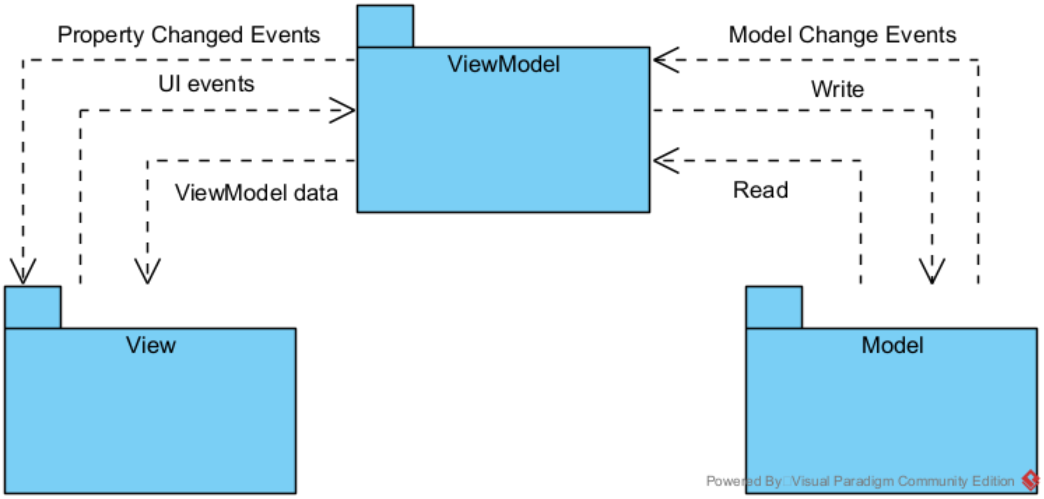


Figure 4.1 The architectural model of the application

4.3 Technology, software, and hardware used

4.3.1 The technology and software used

Android Development: This application is implemented on the Android platform. The development process will utilize the AndroidX libraries, which provide compatibility and support for various Android features and components including the advanced camera for barcode scanning feature; and the Android Studio IDE, which is an integrated development environment that offers a variety of tools and functionalities for coding and testing purposes.

Fragment, ViewModel, and LiveData: With these techniques, UI components are encapsulated in fragments, which are reusable and independent units of the UI. Regarding data and business logic, they are handled by ViewModels, which are classes that store and manage UI data in a life-cycle-aware way.

Firebase: The application leverages the Firebase platform as its backend solution, enabling data storage and retrieval in real-time through its cloud-based backend database service including the Firestore Database.

Firebase Authentication, Google Sign-In, and OAuth 2.0: To ensure the security and reliability of user registration and login processes, this application adopts Firebase Authentication, a cloud-based service that provides various authentication methods. Moreover, this application integrates Google Sign-In from the Google API and OAuth 2.0, which are widely used authentication protocols, to leverage the large user base of Google accounts.

Material Design 3: This application's user interface adheres to the Material Design 3 principles, which aim to provide a modern and intuitive user experience through visual design elements and interactions.

ML Kit from Google: This application is integrated with Google’s ML Kit to benefit from its barcode scanning model. This component enables the application to efficiently and accurately recognize various types of barcodes, including UPC and EAN codes. The barcode scanning functionality is essential for the application’s performance and usability, as it allows users to quickly and conveniently access product information related to the scanned items.

With the distinctive characteristics of the above technologies, the technology stack of this application is summarized in the following table.

Part of Application	Technologies, Libraries…	Usage
Front-end	Android Studio	Integrated Development Environment (IDE) for application development

	Java	The main programming language for this application
	Material Design 3	Provide theming and interface components for this application
	Support libraries including Retrofit2, OkHttp, Gson…	Call APIs from the barcode database and recipe recommendation
	Barcode scanning from Google’s ML Kit	Implement a barcode-scanning feature
Back-end	Firebase Authentication, Google Sign-In, OAuth 2.0	Implement authentication and authorization
	Firestore Database	NoSQL database to store users’ data in this application

Table 4.1 The technology stack for the application

4.3.2 The hardware requirements

- Android Devices: The application is designed to run a variety of Android devices having a minimum Android 10 version (API level 29).

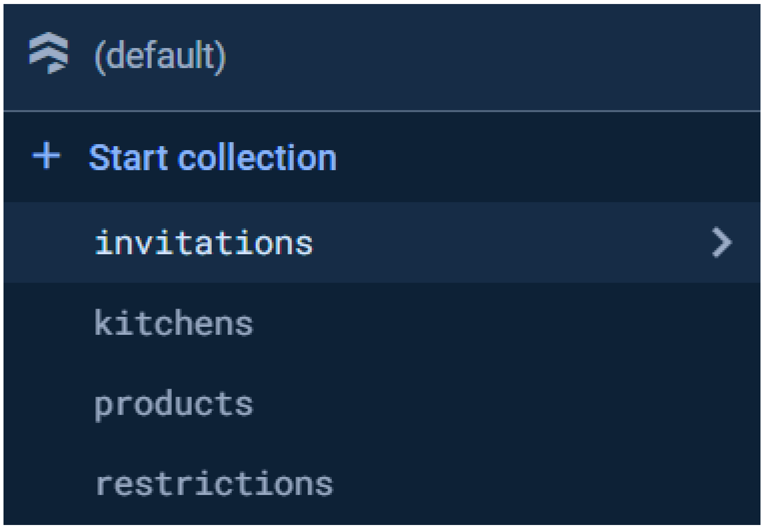
- Camera: The application utilizes the device’s camera for barcode scanning functionality powered by ML Kit.

- Internet Connection: A stable internet connection is required for Firebase services, ensuring real-time data synchronization and authentication

CHAPTER 5 – DESIGN

5.1 Database design

- According to the requirements, the following figure shows the list of collections used in the application to store data and users' activities.



(default)

+ Start collection

invitations >

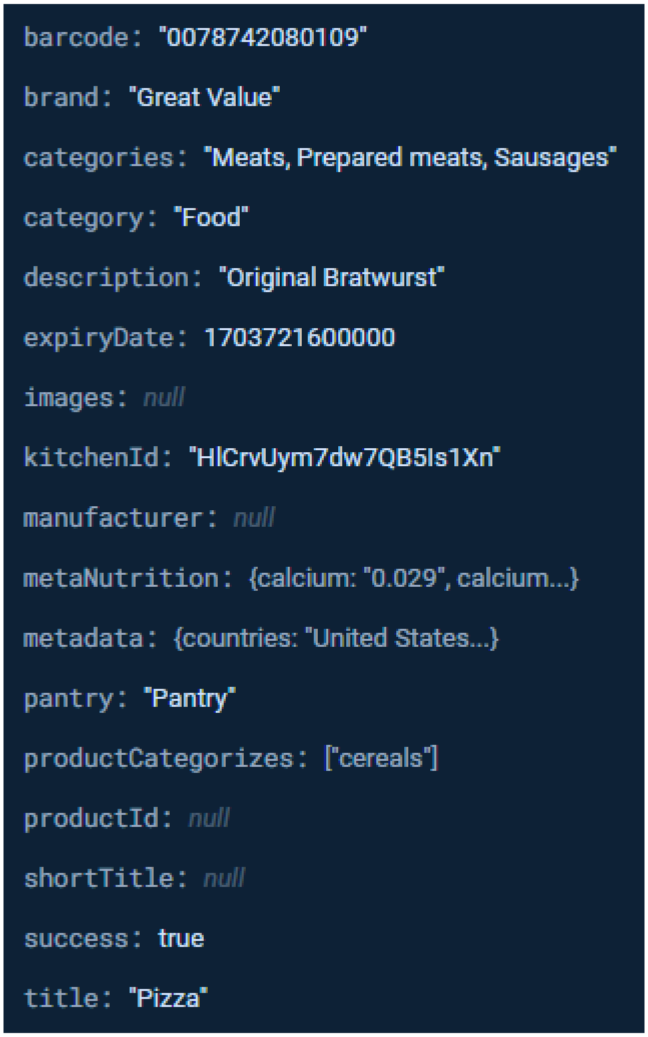
kitchens

products

restrictions

Table 5.1 The collections in the Firestore Database

- The following figure shows the fields of a document in the "products" collection including product title, barcode, brand, origin, and nutrition information.



```
barcode: "0078742080109"
brand: "Great Value"
categories: "Meats, Prepared meats, Sausages"
category: "Food"
description: "Original Bratwurst"
expiryDate: 1703721600000
images: null
kitchenId: "HlCrvUym7dw7QB5Is1Xn"
manufacturer: null
metaNutrition: {calcium: "0.029", calcium...}
metadata: {countries: "United States...}
pantry: "Pantry"
productCategorizes: ["cereals"]
productId: null
shortTitle: null
success: true
title: "Pizza"
```

Table 5.2 A document in the “products” collection

5.2 User interface design

5.2.1 Register and Login Account

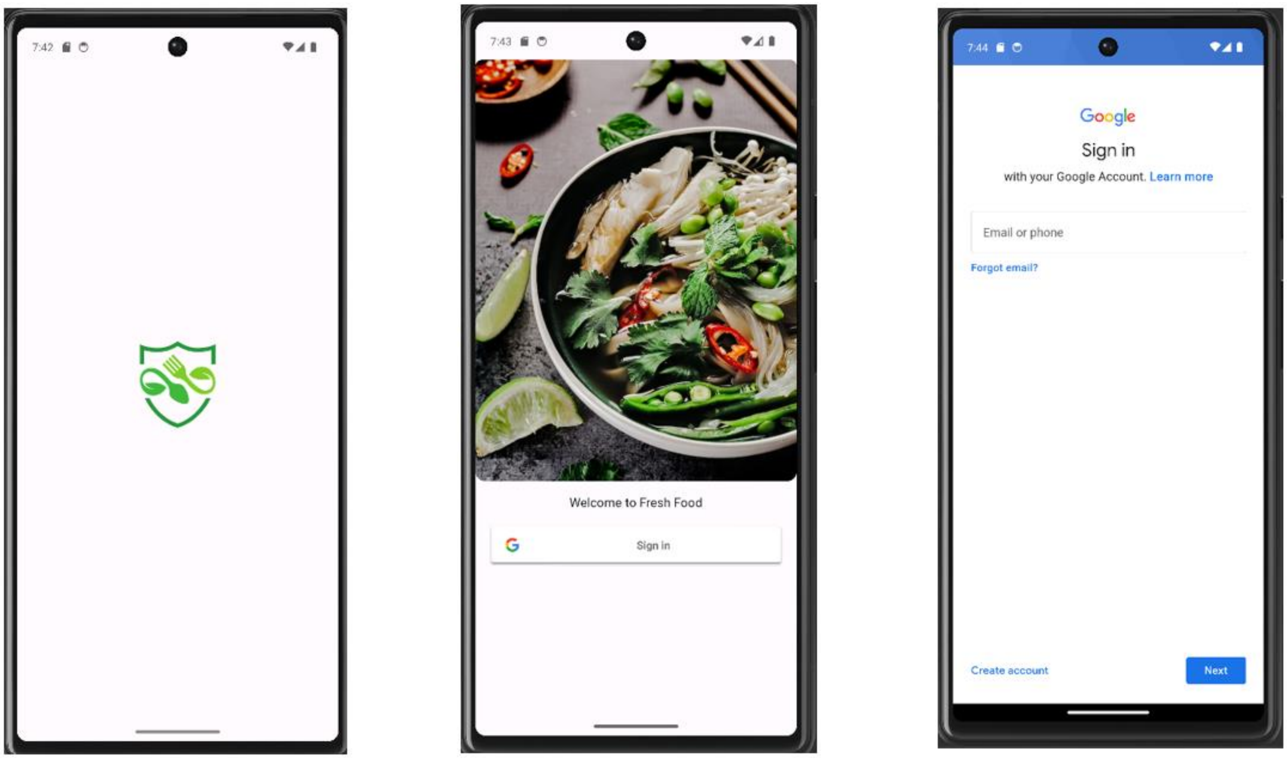
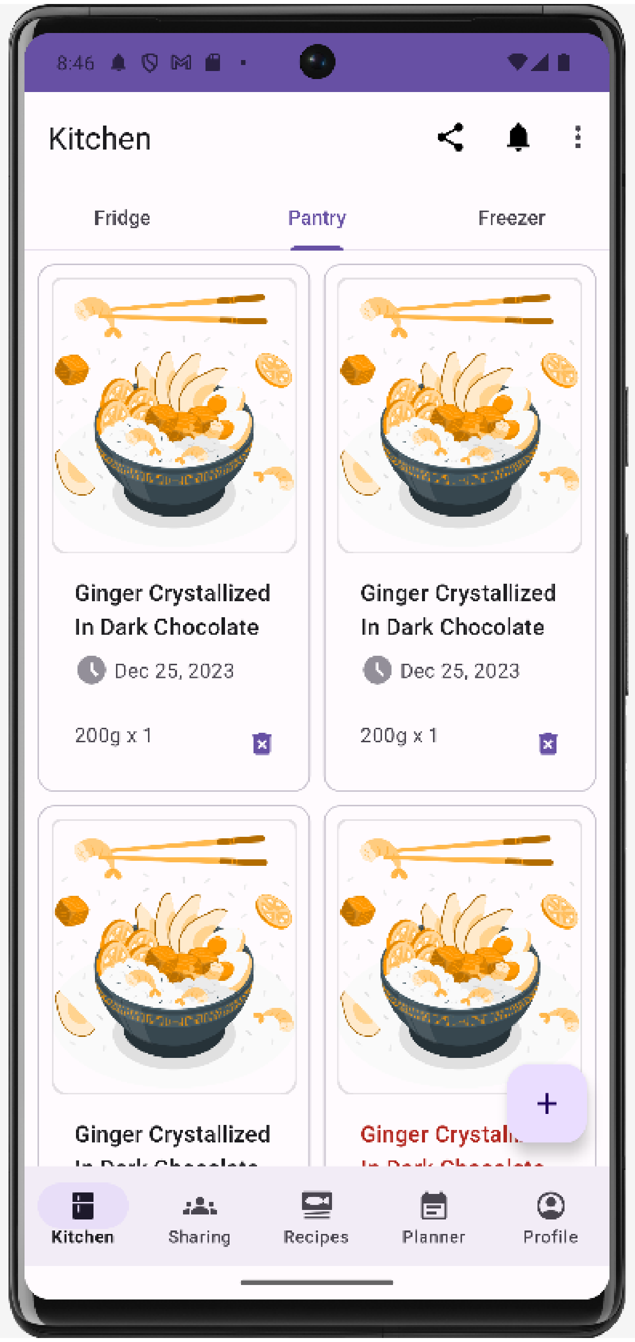


Figure 5.1 The UI of the loading and signing-in screen

- When opening the app the first, user needs to log in with a Google account.
- In the next, the account will automatically log in when opening the app.

5.2.2 Organize Kitchen



Ginger Crystallized In Dark Chocolate
Dec 25, 2023
200g x 1

Ginger Crystallized In Dark Chocolate
Dec 25, 2023
200g x 1

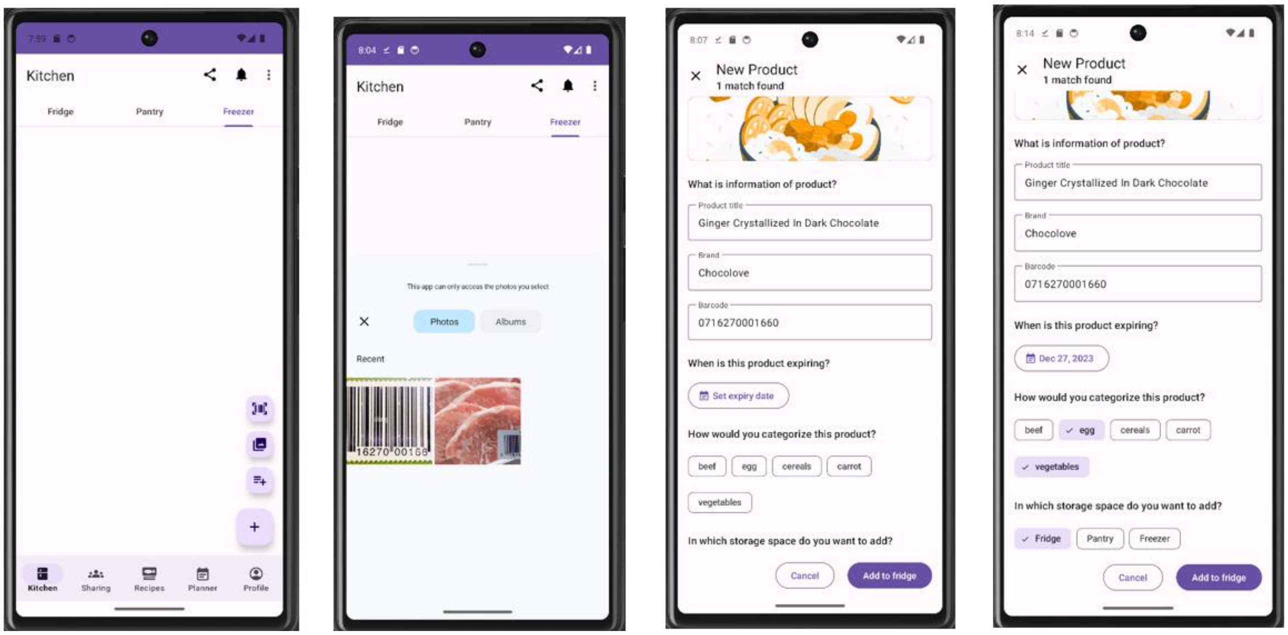
Ginger Crystallized

Ginger Crystall...

Figure 5.2 The screen of the kitchen screen

- Users manage their foods and beverages in diverse categories (Fridge, Pantry, Freezer) and the system processes tasks based on current data.

5.2.2 Add Product Item



New Product
1 match found

What is information of product?

Product title: Ginger Crystallized In Dark Chocolate

Brand: Chocolove

Barcode: 0716270001660

When is this product expiring?

Set expiry date

How would you categorize this product?

beef, egg, cereals, carrot, vegetables

In which storage space do you want to add?

New Product
1 match found

What is information of product?

Product title: Ginger Crystallized In Dark Chocolate

Brand: Chocolove

Barcode: 0716270001660

When is this product expiring?

Dec 27, 2023

How would you categorize this product?

beef, ✓ egg, cereals, carrot, ✓ vegetables

In which storage space do you want to add?

✓ Fridge, Pantry, Freezer

Figure 5.3 The adding product screens

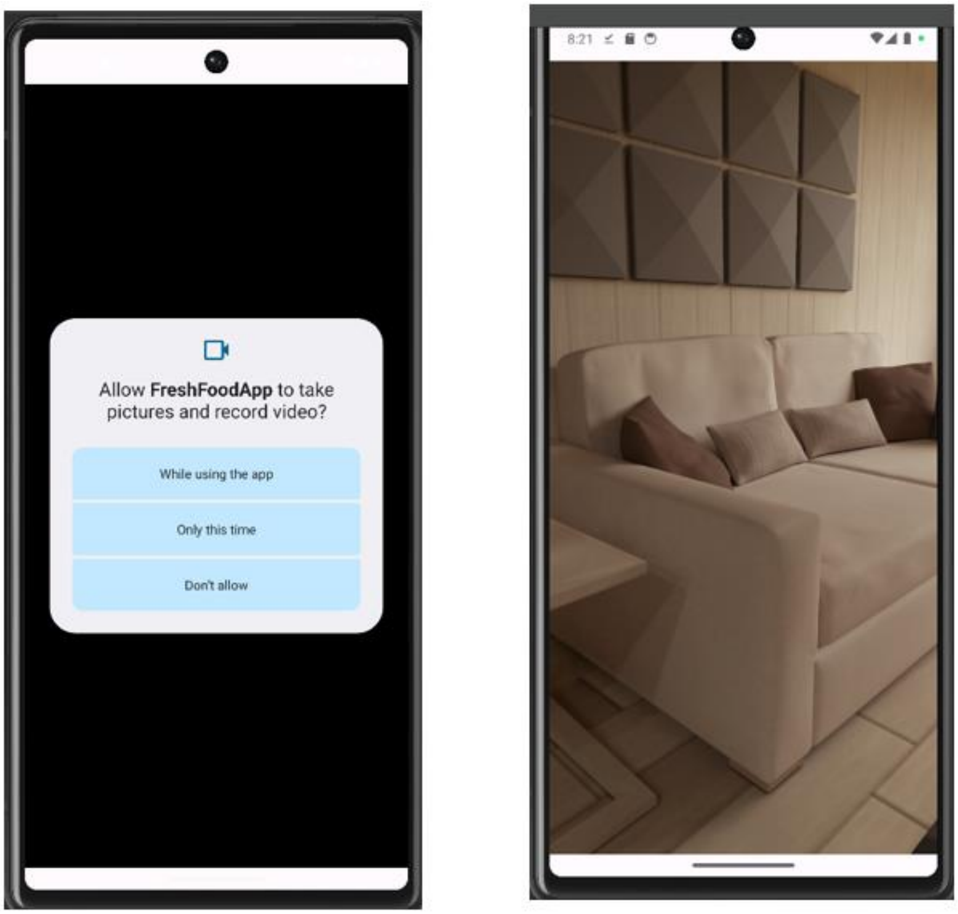
- Users can click on the add icon button on the screen to add a new product by barcode, image, or text.

- User adds product data and the system processes and adds new items to selected categories (Fridge, Pantry, Freezer).

- When adding by barcode image, the system will find information and automate fill-in

The user only needs to set the expiry date, categorize this product, and storage space to add a new product to the fridge.

5.2.3 Search with Barcode

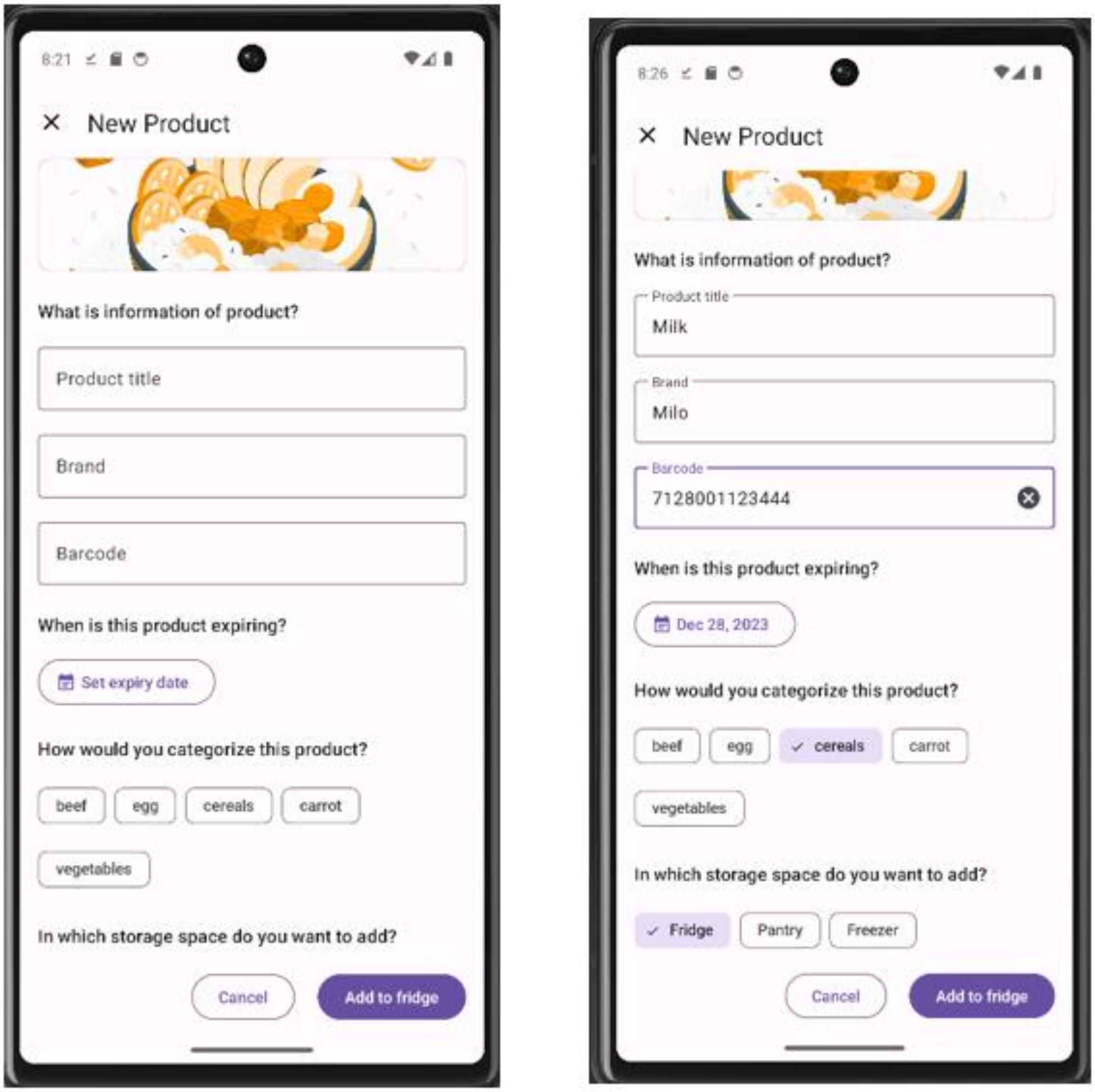


Allow **FreshFoodApp** to take pictures and record video?

Figure 5.4 The barcode scanning screen

- When adding by scan barcode, the system requests access permission from the user.
- Users scan the barcode on the label of food and drinks packaging and the system retrieves and returns information about the product.

5.2.4 Search with Text


8:21
New Product
What is information of product?
Product title
Brand
Barcode
When is this product expiring?
Set expiry date
How would you categorize this product?
beef
egg
cereals
carrot
vegetables
In which storage space do you want to add?
Cancel
Add to fridge
8:26
New Product
What is information of product?
When is this product expiring?
How would you categorize this product?
beef
egg
carrot
vegetables
In which storage space do you want to add?
Pantry
Freezer
Cancel
Add to fridge

Product title: Milk

Brand: Milo

Barcode: 7128001123444

Dec 28, 2023

✓ cereals

✓ Fridge

Figure 5.5 The screen to add product manually

- Users get product items with text input, fill in product data, and the system processes information about the product.

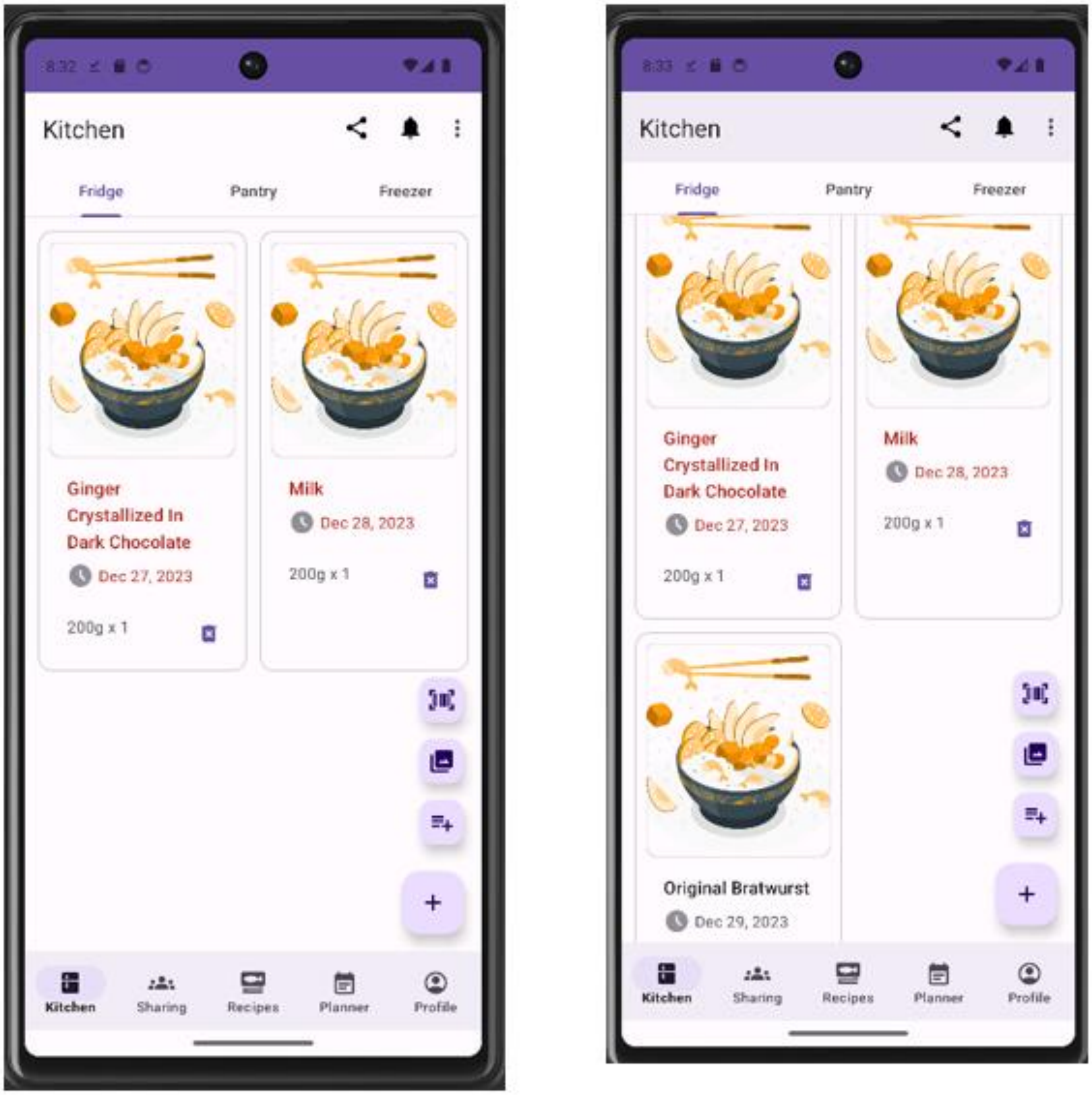
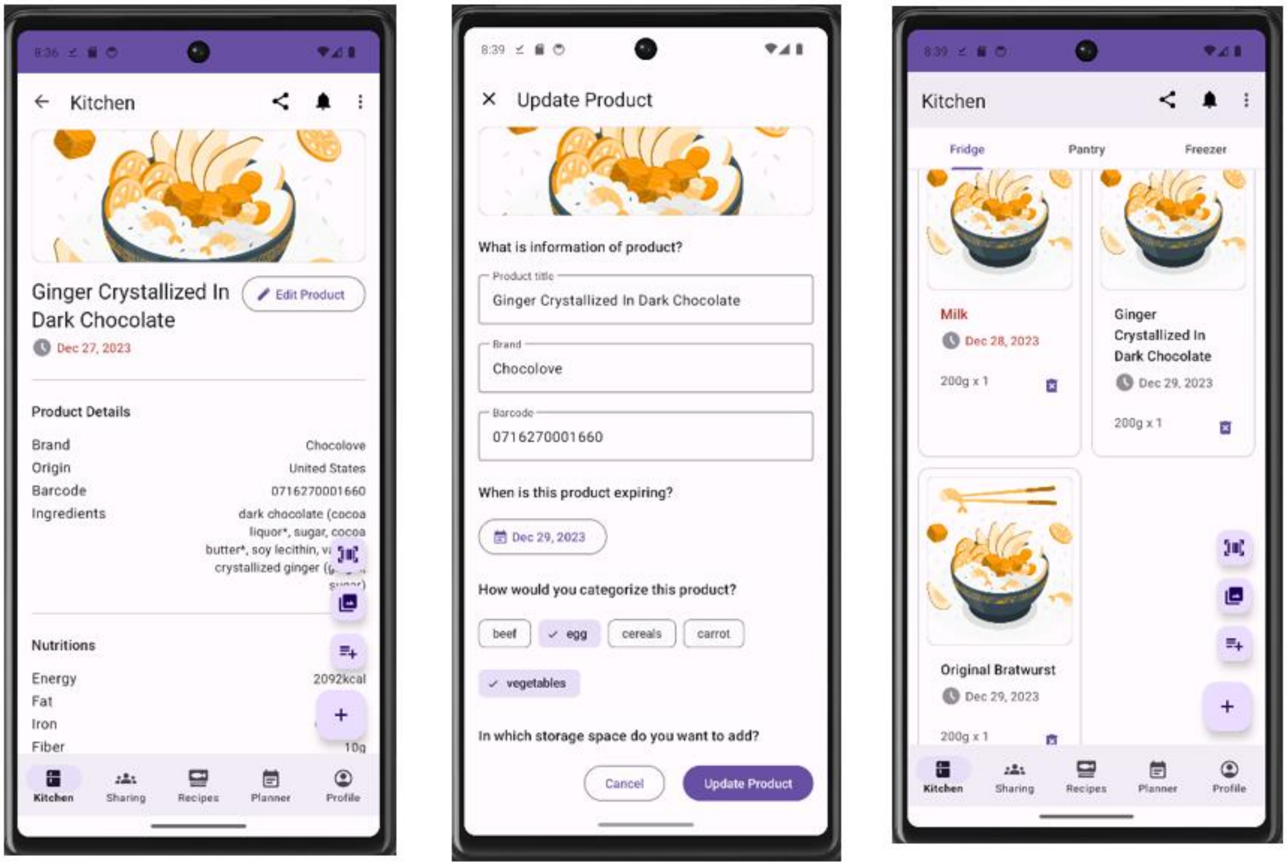


Figure 5.6 The new product is added successfully

- After being added successfully, the product with a red label means the product is about to expire.

5.2.6 Manage product item



Ginger Crystallized In Dark Chocolate
Dec 27, 2023

Product Details

Brand Chocolove
Origin United States
Barcode 0716270001660
Ingredients dark chocolate (cocoa liquor*, sugar, cocoa butter*, soy lecithin, vi crystallized ginger (
sugar)

Nutritions

Energy 2092kcal
Fat
Iron
Fiber 10g

What is information of product?

Product title: Ginger Crystallized In Dark Chocolate
Brand: Chocolove
Barcode: 0716270001660

When is this product expiring?

Dec 29, 2023

How would you categorize this product?

beef | ✓ egg | cereals | carrot | ✓ vegetables

In which storage space do you want to add?

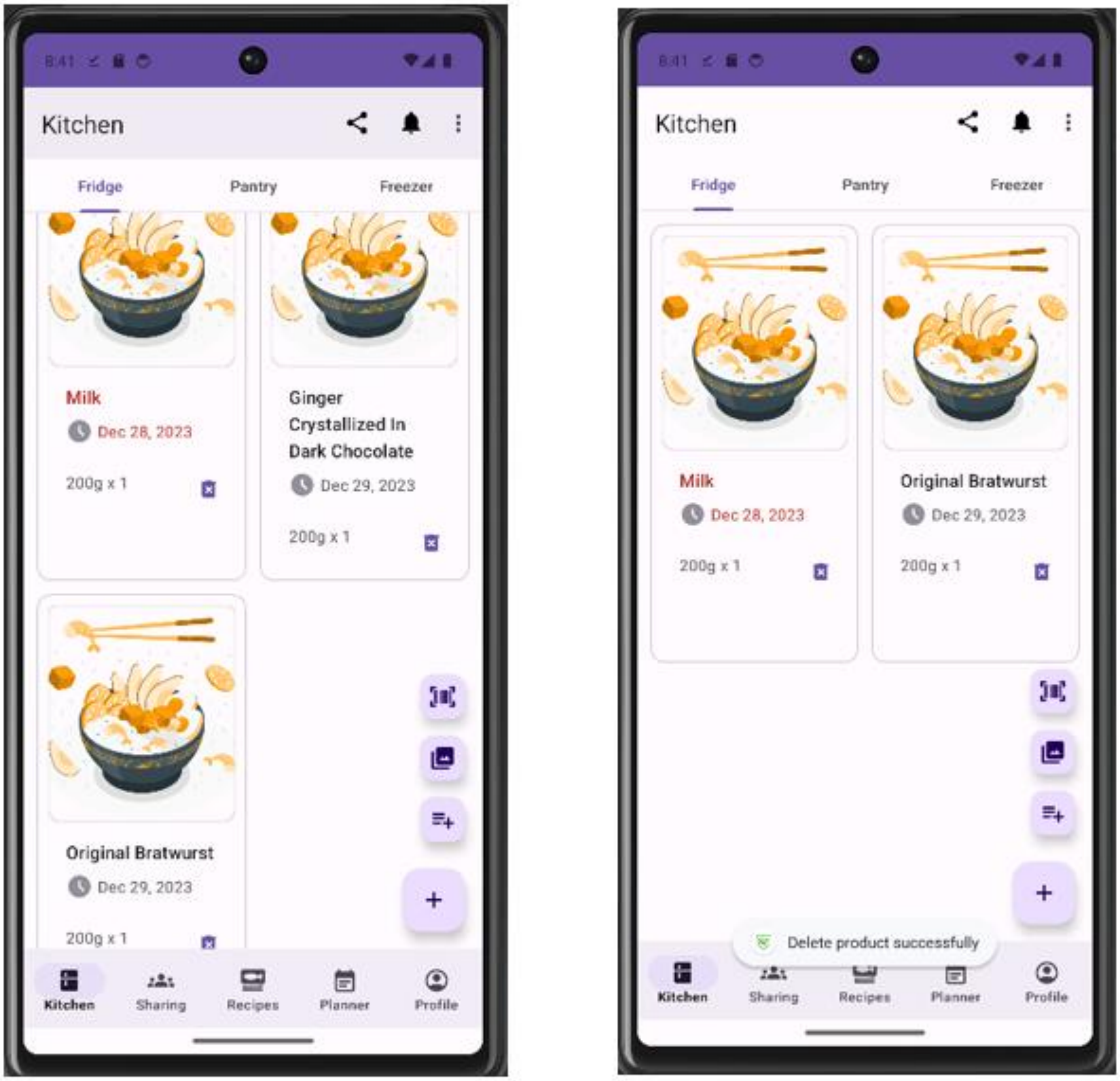
Milk
Dec 28, 2023
200g x 1

Ginger Crystallized In Dark Chocolate
Dec 29, 2023
200g x 1

Original Bratwurst
Dec 29, 2023
200g x 1

Figure 5.7 The product management screens

- User can update the information of the product when clicking on this item of product.
- User chooses the Edit Product button to update data.
- After updating the expiry date, the label name changes from red to black.

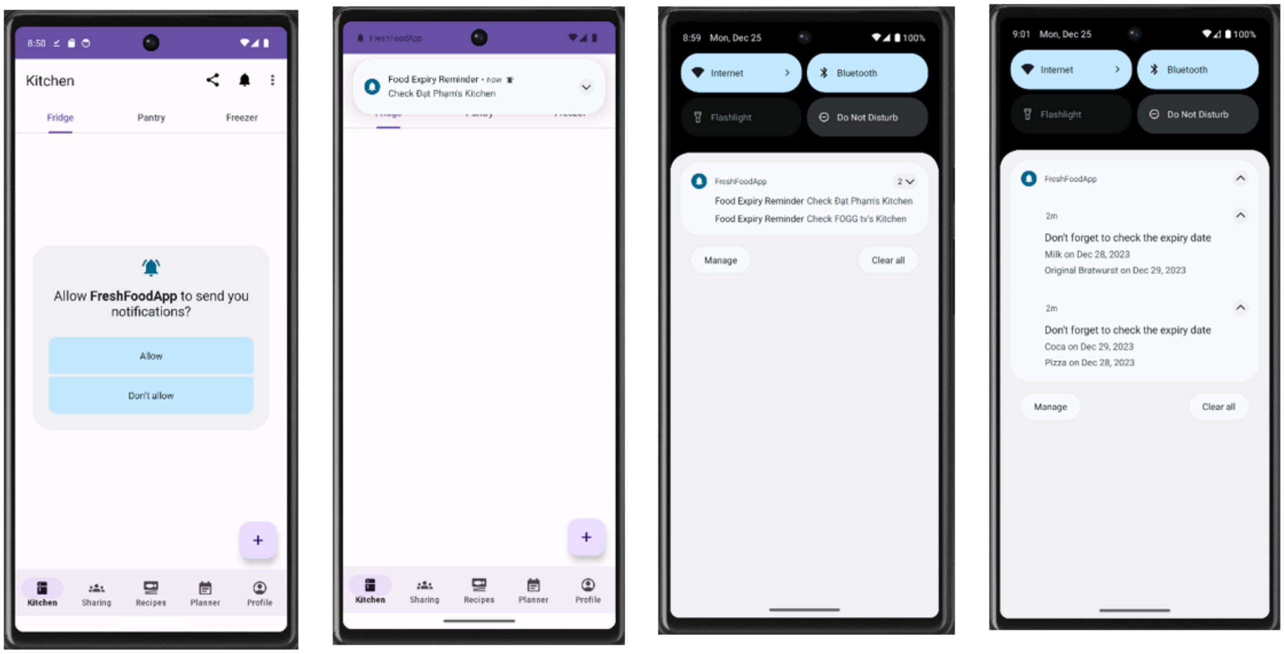


Delete product successfully

Figure 5.8 The selected product is deleted successfully

- Besides, the user can delete the product when clicking on the remove icon button in the product item.

5.2.7 Set expiry date reminder



Allow **FreshFoodApp** to send you notifications?

Food Expiry Reminder • now
Check Đạt Phạm's Kitchen

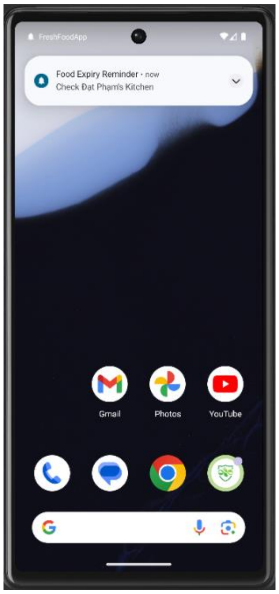
Food Expiry Reminder Check Đạt Phạm's Kitchen
Food Expiry Reminder Check FOGG tv's Kitchen

Don't forget to check the expiry date
Milk on Dec 28, 2023
Original Bratwurst on Dec 29, 2023

Don't forget to check the expiry date
Coca on Dec 29, 2023
Pizza on Dec 28, 2023

Figure 5.9 The expiry date reminder notifications

- When starting the app, the system notifies that products are about to expire within 3 days.

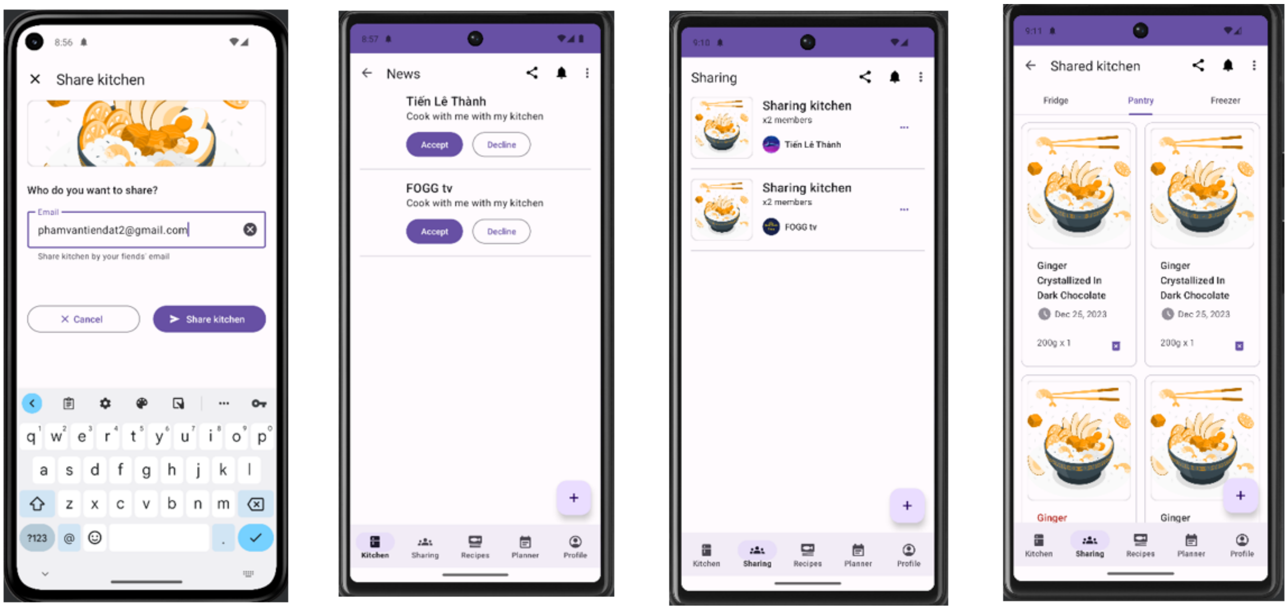


Food Expiry Reminder • now
Check Đạt Phạm's Kitchen

Figure 5.10 expiry date reminder notification when the application closes

- When turning off the app, the system notifies that products are about to expire within 3 days.

5.2.8 Share Kitchen



Share kitchen

Who do you want to share?

Email: phamvantiendat2@gmail.com

Share kitchen by your fiends' email

News

Tiến Lê Thành – Cook with me with my kitchen

FOGG tv – Cook with me with my kitchen

Sharing

Sharing kitchen – x2 members – Tiến Lê Thành

Sharing kitchen – x2 members – FOGG tv

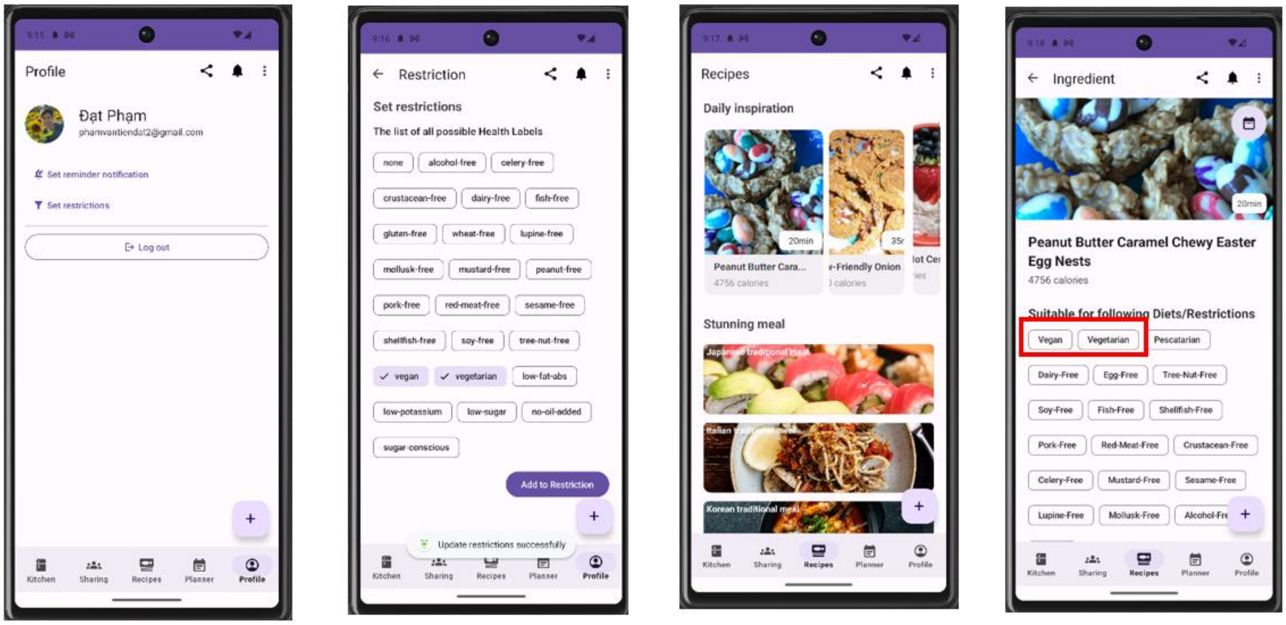
Shared kitchen

Ginger Crystallized In Dark Chocolate – Dec 25, 2023 – 200g x 1

Figure 5.11 The sharing kitchen screens

- User adds other users to the existing kitchen to share data with other people and the system adds the selected users to the kitchen.
- User can see the accept when clicking on the notification bell icon button.
- User can share the kitchen when clicking on the share icon button.

5.2.9 Set restrictions



Profile

Đạt Phạm
phamvantiendat2@gmail.com

Set reminder notification

Set restrictions

Log out

Restriction

Set restrictions

The list of all possible Health Labels

none, alcohol-free, celery-free, crustacean-free, dairy-free, fish-free, gluten-free, wheat-free, lupine-free, mollusk-free, mustard-free, peanut-free, pork-free, red-meat-free, sesame-free, shellfish-free, soy-free, tree-nut-free, ✓ vegan, ✓ vegetarian, low-fat-abs, low-potassium, low-sugar, no-oil-added, sugar-conscious

Update restrictions successfully

Recipes

Daily inspiration

Peanut Butter Cara... 4756 calories 20min

-Friendly Onion 35

Stunning meal

Japanese traditional meal

Italian traditional meal

Korean traditional meal

Ingredient

Peanut Butter Caramel Chewy Easter Egg Nests

4756 calories

20min

Suitable for following Diets/Restrictions

Vegan, Vegetarian, Pescatarian, Dairy-Free, Egg-Free, Tree-Nut-Free, Soy-Free, Fish-Free, Shellfish-Free, Pork-Free, Red-Meat-Free, Crustacean-Free, Celery-Free, Mustard-Free, Sesame-Free, Lupine-Free, Mollusk-Free, Alcohol-Fre

Figure 5.12 The setting restrictions screens

- Users set restrictions about their foods and drinks and the system gives warnings about imported products and limits the recommended recipes.
- The recipes in Daily Inspiration only show dishes that include Vegan and Vegetarian.

5.2.10 Find recipes

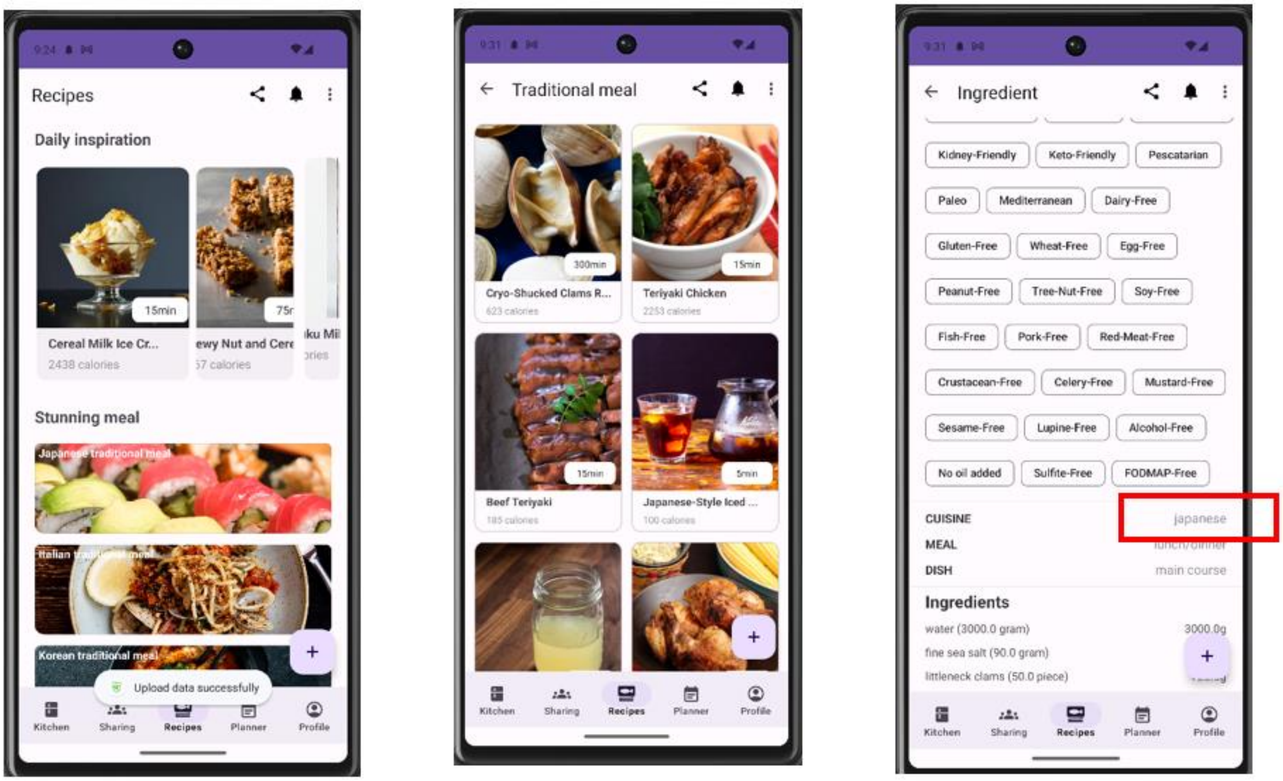
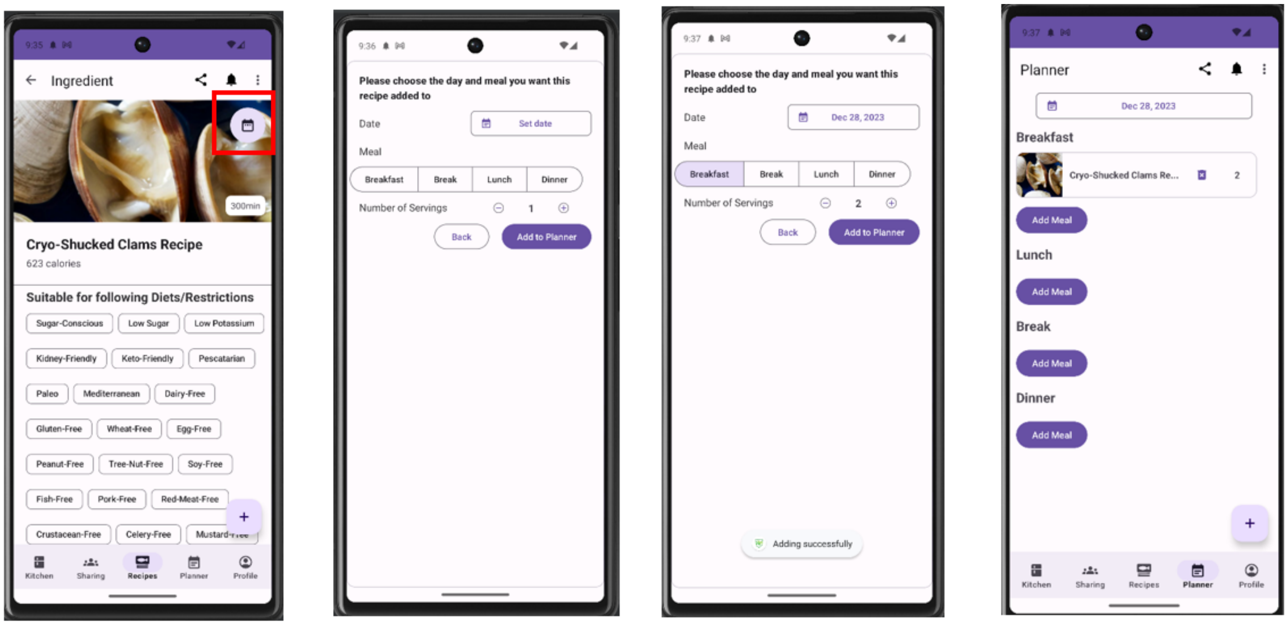


Figure 5.13 The finding recipes screens

- The system shows some recipes based on ingredients and restrictions of the user.
- Users can select the country's traditional meals in the Stunning Meal section.
- The recipes in Stunning Meal only show dishes that include cuisine Japanese when clicking on the Japanese traditional meal card.



Please choose the day and meal you want this recipe added to

Adding successfully

Figure 5.14 The planner screens to set dishes for meals

- In addition, the user can add a dish to plan for a meal when clicking on the calendar icon button.
- After adding successfully, the dish will display on the Planner screen in date Dec 28, 2023

5.2.11 Plan for meal

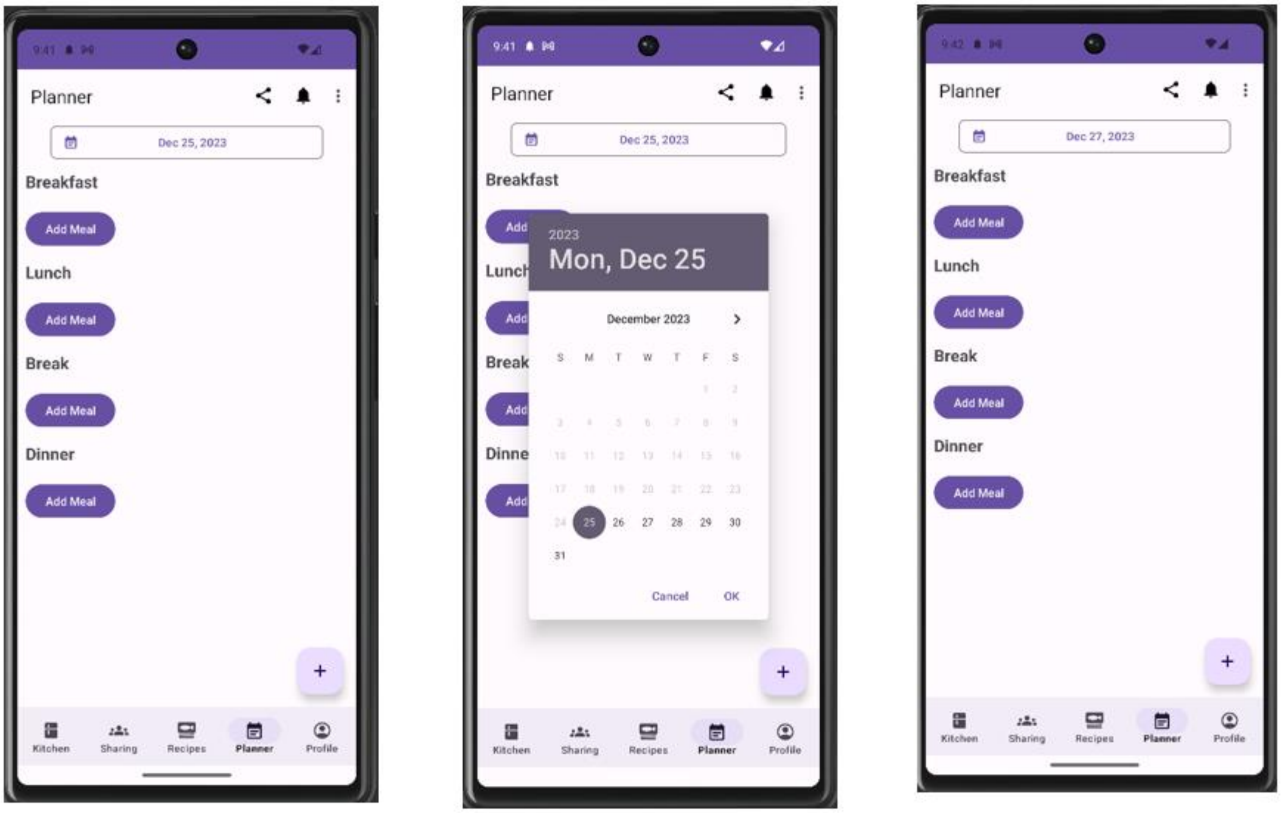
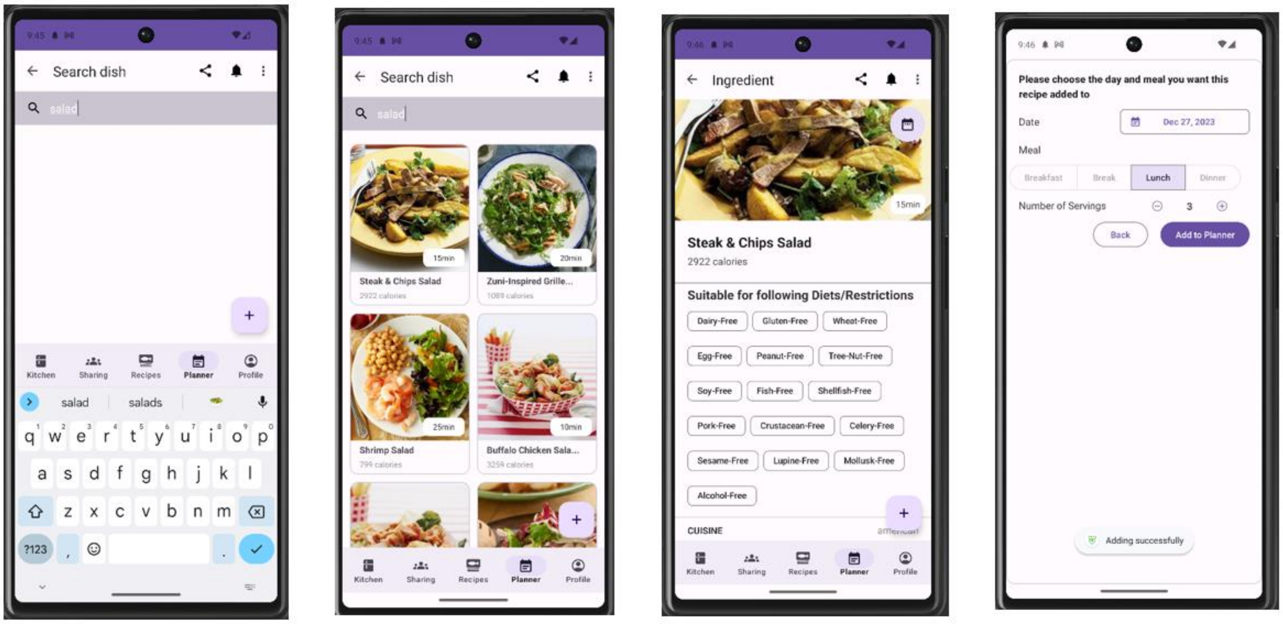


Figure 5.15 The main planner screens

- When clicking on Dec 27, 2023, the planner screen is empty.



Please choose the day and meal you want this recipe added to

Date: Dec 27, 2023

Meal: Breakfast | Break | [✓ Lunch] | Dinner

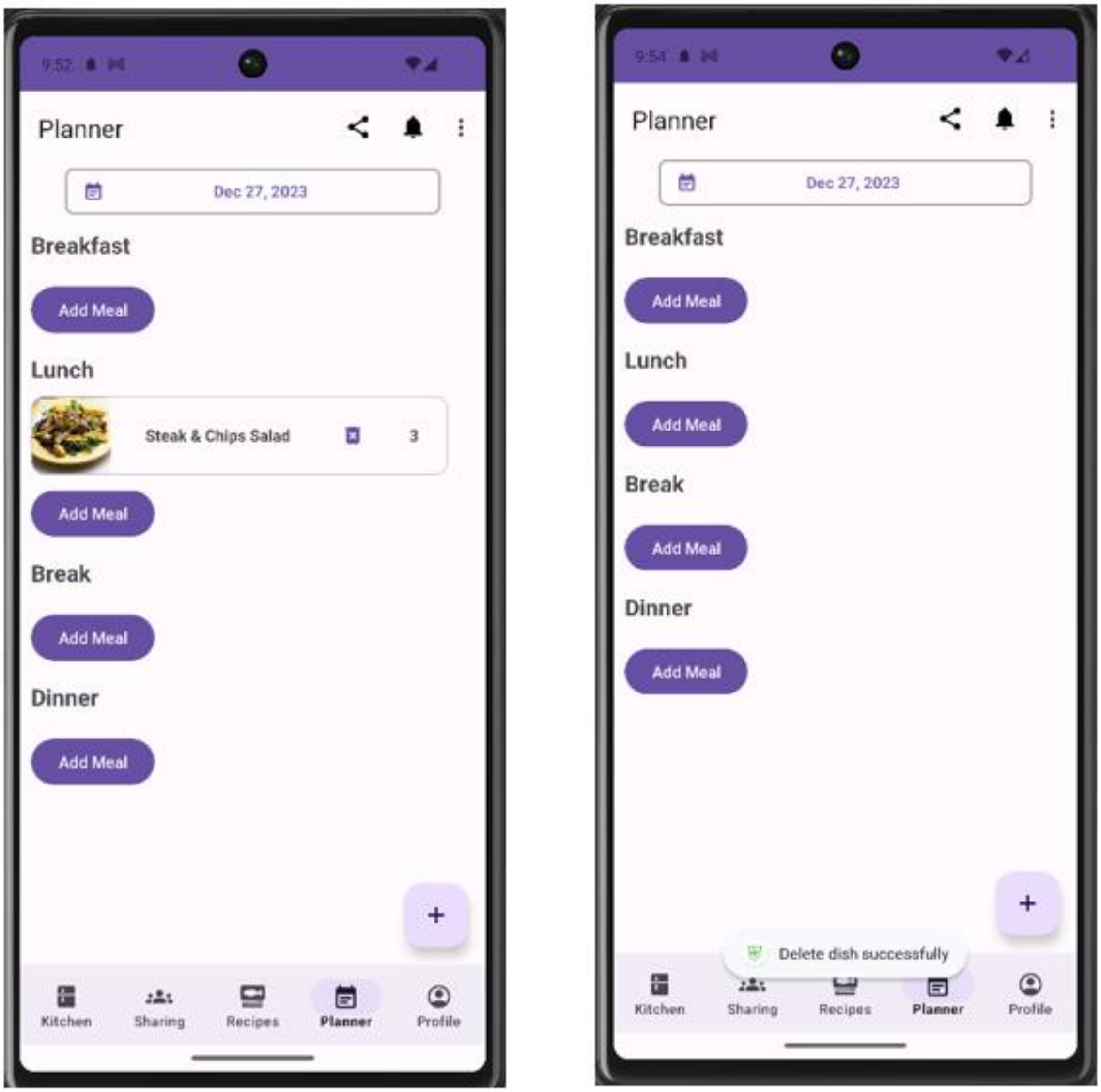
Number of Servings ⊖ 3 ⊕

Figure 5.16 The search screens to find proper recipes

- When a user clicks on Lunch Meal, the system allows searching by dish name or ingredient name.

- Users can select any dish and add this dish to the planning for a meal with the calendar icon button.

- However, the date and meal are blocked, the user only changes the number of foods and clicks the Add to Planner button.



Delete dish successfully

Figure 5.17 The dish is deleted successfully

- The user can delete this dish when clicking on the delete icon button on the dish item.

REFERENCES

English

1. Anon. 1984. “IEEE Guide for Software Requirements Specifications.” *IEEE Std 830-1984* 1–26. doi: 10.1109/IEEESTD.1984.119205.

2. Anon. n.d.-a. “Barcode Scanning | ML Kit.” *Google for Developers*. Retrieved December 25, 2023 (https://developers.google.com/ml-kit/vision/barcode-scanning).

3. Anon. n.d.-b. “Firebase Android SDK Release Notes.” *Firebase*. Retrieved December 25, 2023 (https://firebase.google.com/support/release-notes/android).

4. Anon. n.d.-c. “Firebase Authentication.” Retrieved December 25, 2023 (https://firebase.google.com/docs/auth/).

5. Anon. n.d.-d. “Firestore.” *Firebase*. Retrieved December 25, 2023 (https://firebase.google.com/docs/firestore).

6. Anon. n.d.-e. “Retrofit.” Retrieved December 25, 2023 (https://square.github.io/retrofit/).

7. Anon. n.d.-f. “Using OAuth 2.0 to Access Google APIs | Authorization.” *Google for Developers*. Retrieved December 25, 2023 (https://developers.google.com/identity/protocols/oauth2).