UPLB TAKAM: A Smart Mobile Cookbook and Ingredient Management Mobile Application

Mikaela Gillian M. Guzman and Mylah Rystie U. Anacleto

***Abstract*— The UPLB TAKAM mobile application represents a timely and essential solution post pandemic, addressing the challenges that UPLB students face in meal preparation, budgeting, and nutrition. Through its innovative features such as intelligent ingredient management, personalized meal plans, and budget-friendly recipes, UPLB TAKAM aims to alleviate the burdens of time constraints, financial limitations, and unhealthy eating habits. By providing convenient access to budget-friendly, nutritious meals, UPLB TAKAM helps students make healthier food choices, develop cooking skills, and improve their well-being, supporting long-term health in a changing educational and global environment.**

Index Terms—cookbook, ingredient management, mobile application

I. INTRODUCTION

A. Background of the Study

Food is one of the most fundamental human necessities. It supplies the necessary energy and nutrients for growth and development, gaining strength, and working productively. While you can eat many things to survive, cooking makes food taste better. Simply put, cooking enables us to prepare and eat safe and nutritious food, giving us the fuel and building blocks we need for growth and repair. Cooking also makes it possible for one to exhibit self-expression and creativity by preparing one's own unique dishes and playing around with various flavors and ingredients to create recipes. A recipe is a set of instructions telling you how to prepare and cook food, including a list of what food is needed [1]. Name, procedure, tools and ingredients, time, and serving size are only a few of the components that make up a cooking recipe.

The coronavirus disease (COVID-19) brought turmoil and uncertainty around the world. As a result, the COVID-19 epidemic influenced the buying habits of people worldwide. As the Philippine government imposed lockdowns to stop the spread of the virus, it had a significant impact on daily life, frequently having negative effects on mental health [2]. Clearly, food preferences have also evolved. People have begun focusing on food health concerns and have become more particular about the food quality they consume daily [3] [4]. In light of these issues, people must maintain their immunity to the disease. Thus, customers were instructed to adhere to health protocols to prevent the spread of COVID-19. The World Health Organization (WHO) also encouraged people to have a healthy lifestyle by consuming healthier foods and minimizing or eliminating alcohol [5]. According to the study conducted by Tariga, Nolasco, and Barayuga (2021) [6], the results depicted a growing pattern of home-based cooking both before and during the pandemic. Based on the results, respondents who cook every day have a 5% rise before (93%) and during the pandemic (98%), while those who do not cook frequently decrease. This is evident since people were restricted to stay home to prevent local transmission of the virus, they prefer to cook at home daily. This also indicates that Filipino consumers altered their food consumption patterns before and during the pandemic, with the likelihood of further change after the COVID-19 outbreak, encouraging Filipinos to choose healthier cuisine and cook at home.

In general, people enjoy cooking but lack inspiration for what to cook. The question "What should I eat/cook today?" continues to arise. In addition to their unfamiliarity with a variety of dishes, they wish to learn specific recipes that suit their preferences. Moreover, although most individuals can cook at home, not everyone can easily memorize the recipes they want. For someone who lacks a passion for cooking, having a limited supply of ingredients also becomes one of the factors that contribute to a limited variety of cooking creations. A college student who goes to classes every day, especially if they live alone in a dorm, wants to cook food for themselves as quickly and easily as possible when they are busy. But having the same easy-to-cook food over and over can be tiring and get old for them, so it would be better to recommend a variety of food they can cook "easily" [7]. Certainly, this issue can be quickly resolved by looking online like cooking apps or websites for more food recipes. Even though these apps take into account their users' needs and interests, they don't take into account their users' constraints, such as the availability of ingredients, the user's skill level, their budget, or dietary restrictions.

As time has progressed, technology has evolved into a tool that enables communication between people. The use of technology is fundamental to many of humanity's daily activities, such as cooking and preparation of food. In this current age of technology, new things have been made to make it easier for people to find and collect the recipes they want. With the integration of food and technology, the development of a wide range of food recipe applications can be possible. Concurrently, the need for food recipe applications has dramatically increased in response to the sudden increase of people who prefer to stay and cook meals in their homes due to the ongoing pandemic, as well as the

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tendency of people to make healthier food choices during the pandemic [6].

B. Statement of the Problem

The pandemic hindered many individuals in all aspects — majority of stores were closed and people were stuck in a lockdown for more than a year. Since the price markup of meals and using food delivery apps became reasonably impractical, majority opted for own meal preparations inside their homes. However, meal preparation has been viewed as a problem since it is an extra responsibility on top of the other responsibilities a person holds. Moreover, meal repetition of unhealthy foods has been common to help suffice the problem of having more responsibilities for simple meal preparation.

C. Significance of the Study

The development of the new application, UPLB TAKAM, aims to lessen the burden of meal preparation by making it easier to prepare and think of meals without exerting a lot of effort and consuming a lot of time by also taking in mind the budget-friendliness and healthiness of meals. Good nutrition is vital for college students' overall well-being, academic performance, and mental health. However, the limited availability of nutritious food options and the prevalence of unhealthy eating habits can pose significant challenges. UPLB TAKAM places emphasis on healthiness, offering a selection of nutritious recipes that cater to students' dietary needs. By promoting healthier food choices, the application encourages students to adopt sustainable eating habits that can positively impact their physical and mental health.

D. Objectives of the Study

The objective of this study is to provide a mobile application to UPLB students that would be helpful for their meal preparation and lessen the burden of treating meal preparation as a responsibility. Specifically, it intends:

1) To provide a budget-friendly meal recipe cookbook application;
2) To assist students in creating a balanced meal plan encompassing a variety of food from the three basic food groups (go, grow, and glow), with minimal to no meal repetition;
3) To provide inventory management features for ingredients; and
4) To provide grocery list generation features.

E. Scope and Limitations of the Study

The recipes included in this mobile application will be limited to 28 Filipino budget-friendly meals. This is to ensure that the students have the capability to purchase the raw materials needed to prepare meals. Additionally, this is done to guarantee that the ingredients needed in the meals are commercially available in supermarkets, grocery stores, and marketplaces. One of the reasons for this restriction is the data and storage constraints of Firebase's free Spark Plan, which limits the data that can be stored and accessed. The sampling population for this research will be limited to UPLB constituents with kitchen aid and equipment to ensure that they have the resources and capacity to prepare meals.

II. REVIEW OF RELATED LITERATURE

A. Effects of the Pandemic in the Philippines

The COVID-19 lockdowns implemented from 2020 to early 2022 caused widespread unemployment, with the bulk of jobs in the services sector, which was largely unable to operate during that period. According to the Philippine Statistics Authority (PSA), the annual unemployment rate in 2020 was 10.3% or 4.5 million unemployed Filipinos. Since April 2005, this has been the highest annual unemployment rate ever recorded. As a result, the Philippine economy entered a deep recession with households forced to seek aid from the national government, dip into savings, secure loans, or all of the above to make ends meet [8].

On top of the unemployment crisis, the majority have been experiencing mental health problems due to different stressors that add to their worries about their health, safety, and well-being. The problems encountered by Filipinos are further aggravated by incidents of natural disasters, armed conflicts, and animal disease outbreaks alongside the pandemic crisis [9].

The Philippines' national debt increased by 26.7% to P9.7 trillion in 2020. This had risen to P10.3 trillion at the end of January 2021 after the government took out a new bridge loan from the BSP to cover financial obligations. Revenue also fell by 9% in 2020 due to rising expenses resulting in a P1.37 trillion budget deficit in 2020 due to higher expenses and decreased revenue [10].

B. Food Consumption Habits

Based on the results of the study conducted by Janssen, et al. (2021) [11], people in Denmark, Germany, and Slovenia reduced their consumption of fresh food when the epidemic began, with the exception of households with children. This shift is associated with reduced shopping frequency across all countries during the pandemic and with elevated COVID-19 risk perceptions in Denmark and Germany. This study's findings imply that individuals' levels of COVID-19-related worry, income loss, home composition, and gender all played a role in the shifts in eating behavior that occurred during the first wave of the pandemic [11]. On the other hand, the study conducted by Di Renzo, et al. (2020) [12] provided information on the COVID-19 lockdown diet, lifestyle, and eating habits of the Italian population. Some 48% of the population has seen they've put on weight, while 38% of those polled have noticed they've become slightly more active, especially in terms of bodyweight exercise.

According to the study conducted by Tariga, Nolasco, and Barayuga (2021) [6], the results depicted a growing pattern of home-based cooking both before and during the pandemic in the Philippines. Based on the results, respondents who cook every day have a 5% rise before (93%) and during the

pandemic (98%), while those who do not cook frequently decrease. This is evident since people were restricted to stay home to prevent local transmission of the virus, they prefer to cook at home daily. This also indicates that Filipino consumers altered their food consumption patterns before and during the pandemic, with the likelihood of further change after the COVID-19 outbreak, encouraging Filipinos to choose healthier cuisine and cook at home.

C. Inflation in the Philippines

According to the PSA, inflation jumped to its highest level in four years in September, reaching 6.9%. This increase was mostly driven by increasing food prices [13]. It was a significant improvement from the 4.1% that was recorded in 2021. It increased inflation during the year to date to 5.1%, which is getting close to the top end of the range that the government anticipates for 2022, which is 4.5 to 5.5%.

The volatility of oil prices has a directly proportional relationship with inflation. This leads to rising production costs that will burden consumers, increasing the prices of goods and services. As the inflation rate in 2022 continues to rise, the highest increases in the indices of transport, food and non-alcoholic beverages, housing, water, electricity, gas, and other fuels have been recorded highest [14].

Focusing on food inflation, it was stated that the national average inflation rate for food climbed from 6.5 percent in August to 7.7 percent in September. This increase was highlighted in the study. Sugar, confectionery, and desserts account for 30.2% of the total increase in the cost of food, while corn accounts for 26.2%, and oils and fats account for 10.4%.

The costs of meat and fish products have been elevated for some time now and are one factor that goes into determining the overall level of food inflation. Even though the price hike seems minimal, regular customers still cannot afford their products [15].

Moreover, onions, a staple in Filipino cuisine, its price increased up to 600 pesos per kilogram. Making it 2-3 times more expensive than chicken, pork, or beef, and even greater than the minimum wage for a day's work here in the Philippines [16].

D. Rise of E-Commerce

Amid the slowing economic activity, COVID-19 has led to a surge in e-commerce and accelerated digital transformation. As lockdowns became the new normal, businesses and consumers increasingly "went digital", providing and purchasing more goods and services online, raising e-commerce's share of global retail trade from 14% in 2019 to about 17% in 2020 [17].

As a result of unemployment and rising expenses, a lot of people resorted to starting small businesses online—Shopee, Lazada, Tiktok, and Facebook Marketplace are some of the most popular avenues for these businesses. This was and is still a popular practice in the Philippines since it is not only more convenient to both buyers and sellers due to door-to-door delivery and a bigger variety of goods, but also because products are priced lesser online compared to the commercialized stalls in malls.

However, when it comes to food deliveries, products are priced higher than usual compared to diners who order the same meal at the restaurant, having 7% up to 91% markup of meals in food delivery applications like FoodPanda and GrabFood excluding the delivery fees [18]. Even though food delivery presents several advantages such as convenience, a wide variety of options, and efficiency, not all people view this service as practical to patronize given the circumstances of inflation [19].

E. Technology in Food Management and Cooking Applications

The rise of mobile applications and technology in food management and cooking has been evident in recent years. Various mobile applications, websites, and software have been developed to assist individuals in meal planning, recipe discovery, and ingredient management. These applications aim to provide convenient, budget-friendly, and healthy cooking solutions for users.

For example, applications like Yummly, Allrecipes, and Tasty offer a vast collection of recipes, catering to diverse culinary preferences and dietary requirements [20]. They provide step-by-step cooking instructions, ingredient lists, and nutrition information, empowering users to experiment with different dishes. Websites like Supercook.com have also gained popularity, allowing users to search for recipes based on the ingredients they have on hand [21]. Supercook.com uses advanced algorithms to generate recipe suggestions from a database of millions of recipes, enabling users to make the most of their available ingredients and minimize food waste.

Moreover, meal planning applications like Mealime and MealBoard enable users to create weekly meal plans, generate grocery lists, and manage their inventory efficiently [22]. By integrating technology with food management, these applications streamline the meal preparation process, helping users save time and make smarter shopping decisions.

III. METHODOLOGY

A. Development Tools

The information system will be developed on a machine with the following specifications:

- Operating System: Windows 11 64-bit
- Processor: 11th Gen Intel® Core™ i5-11400H with clock rate 2.70GHz
- Memory: 16GB RAM L1 cache 480KB

The following software development tools and technology stack will be used for the development of the system.

1) Environment
   - ***Visual Studio Code***
     A feature-rich source code editor which served as the main environment for developing the mobile application.
2) Technologies

- ***React Native***
  An open-source portable UI software framework for building cross-platform mobile applications using JavaScript and React.js.
- ***Firebase***
  A database management program that manages the database of the mobile application.
- ***Cloud Firestore***
  A cloud-hosted NoSQL database that supports real-time data synchronization and storage for mobile and web applications.
- ***Expo Go***
  A development platform that provides tools and services for building, deploying, and maintaining cross-platform React applications for iOS and Android.

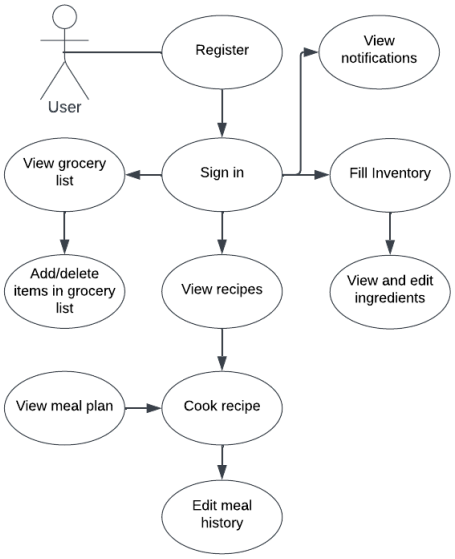

Fig. 1. Use Case Diagram for UPLB TAKAM: A Smart Mobile Cookbook and Ingredient Management Mobile Application

B. Types of Users

There is only one type of user that can use the application:

1) User

- The user enters the following information to sign up in the application:
  a) First Name
  b) Last Name
  c) Email
  d) Password
- The user is required to sign in and enter the following information to use the application:
  a) Email
  b) Password
- The user needs to fill up the inventory with ingredients to effectively use the filter features of the application.
- The user can view the ingredients added and may edit the details of the ingredients:
  a) Expiration Date
  b) Stock
- The user can view the recipes available in the application and choose the recipe to cook.
- The user can view the meal plan made by the application.
- The user can view a grocery list generated from ingredients that are low in stock or nearing their expiration date.
- The user can edit the grocery list, he/she can add or delete items in the list.
- The user can edit the meal history tracker, he/she can input the meals consumed for the day.
- The user can view the notifications.

C. Features

This section shows the features, the user can access:

1) *Sign Up*
   Users are required to have an account before signing in. The user enters the following information to sign up in the application:
   - Name
   - Email
   - Password
2) *Sign Up*
   Users are required to sign in to use the mobile application. The user enters the following information to sign in to the application:
   - Email
   - Password
3) *View Inventory*
   Users can view their kitchen inventory to check the available ingredients.
4) *Add Ingredient to Inventory*
   Users can manually add ingredients and its quantity to the inventory.
5) *View Ingredient*
   Users can view an ingredient and its details such as the number of stock available, date bought, and expiration date.
6) *Edit Ingredient*
   Users can edit the ingredient details, such as adding or deducting the stock available, and changing the expiration date.
7) *View Grocery List*
   Users can view the automated grocery list generated from ingredients that are low in stock or nearing their expiration date.

8) *Edit Grocery List*
   Users can add or delete an ingredient from the grocery list.
9) *View Recipes*
   Users can view the available recipes in the database.
10) *Filter Recipes*
   Users can filter the recipes by the ingredients available in the inventory or the difficulty level of the recipe.
11) *Cook Recipe*
   Users can choose to cook the recipe selected, and all ingredients used in the recipe will automatically be deducted from the inventory.
12) *View Meal Plan*
   Users can view the automated healthy meal plan made by the mobile app that minimizes meal repetition. The meal plan is organized and refreshed weekly.
13) *Edit Meal History*
   Users can edit the meal history tracker, he/she can input the meals consumed for the day. The meal history tracker is refreshed weekly.
14) *View Notifications*
   Users receive and can view notifications regarding low stock or near-expiration ingredients. Additionally, the app notifies users when the meal plan and history are reset.

D. Database Design

The database design consists of seven entities: user, recipe, ingredients, meal history, grocery list, meal plan, and notifications. The user entity uses its email as its unique id while the recipe, ingredients, grocery list entities use its name as their unique id. The meal history, meal plan, and notifications entities have their own attribute as their unique id. The entity-relationship diagram is shown on Figure 2.

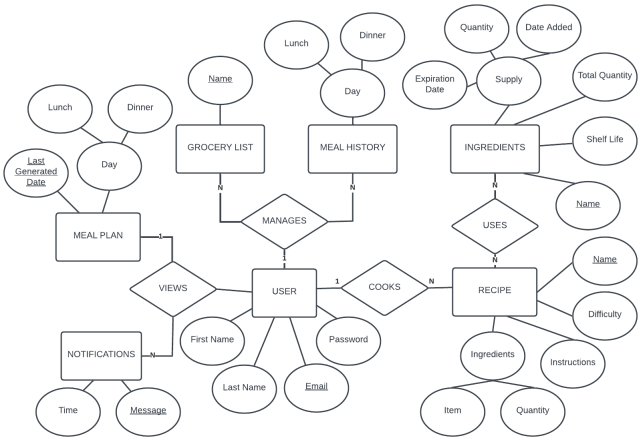

Fig. 2. Entity-Relationship Diagram for UPLB TAKAM: A Smart Mobile Cookbook and Ingredient Management Mobile Application

IV. RESULTS AND DISCUSSION

A. Development Stage

Throughout the study's development phase, Firebase played a significant role by providing an array of tools and services that facilitated the integration of essential features into the app. The study relied on Firebase's free Spark Plan to start development, which provided a solid foundation. However, recognizing its limitations compared to the paid Blaze plan, the study still refrained from upgrading its plan primarily due to its cost [23]. While the Blaze plan offers expanded capabilities and resources, making it suitable for scaling applications with higher demands, the decision to stick with the Spark Plan was driven by budgetary considerations. Moreover, the free Spark Plan adequately met the current needs of the application, and the study found its features to be sufficient for the application's requirements. Additionally, the simplicity and ease of use offered by the Spark Plan makes it an accessible choice for the development process.

Firebase Authentication was crucial in enhancing the security and user management aspects of the application. It helped ensure that only authorized users could access the application's features and functionalities. Utilizing Firebase's Authentication services, such as email/password authentication and verification, made it easier for the users to sign up and log in to the application, ensuring a smooth user experience.. Moreover, this service provided strong security features, such as password hashing and encryption, keeping user credentials safe from potential security threats. The authentication system also enabled the study to implement customizable authentication rules, allowing control over user access and permissions within the application. However, the free Spark Plan imposes limits on the number of emails that can be sent daily, which is 1,000 emails per day [24].

The Cloud Firestore database and storage was essential as it served as the backbone of the application, it is where various collections of data such as users, recipes, ingredients, meal plans and history, grocery lists, and notifications were stored. The application heavily relied on Firebase's Cloud Firestore for data storage and retrieval, with Firebase Storage used to store user data and assets. However, under the Spark Plan, limitations exist regarding both simultaneous connections and storage space. Specifically, the Spark Plan imposes a limit of 100 simultaneous connections for responses sent from a single database [25]. These responses encompass simultaneous broadcast and read operations initiated by the server from a single database at any given time. Additionally, the Spark Plan provides a limited amount of storage space and bandwidth, requiring implementation of strategies such as compressing images to stay within the storage limits.

React Native and Expo were the software framework tools used to develop the mobile application in this study. React Native's services and features helped efficiently develop the application. Its third-party libraries and reusable components helped find optimal solutions which helped enhance the capabilities of the application. These features were well complemented by Expo, as its fast development cycle due to the hot-reloading feature, allowing to see changes in real-time without having the need to recompile the whole application sped up the development process and testing.

B. User-side Module

Users are required to register with any valid email, preferably their UP mail, along with their name. After signing up,

users receive a verification link via email to ensure the security and validity of their account. Once the account is verified, users can log in and access the app. Firebase Email and Password-based Authentication was utilized for this feature.

Upon logging in, users are presented with the homepage and six main components: the Inventory Page, Recipes Page, Meal Plan Page, Grocery List Page, Meal History Page, and Notifications Page. Each component is designed to enhance the overall user experience by providing specific functionalities that work together efficiently.

The Recipes Page offers a diverse collection of budget-friendly and healthy recipes. Users can filter recipes based on the available ingredients in their inventory or by the difficulty level of preparation. This feature helps users make the most of their existing kitchen supplies, saving both time and money. Each recipe includes detailed information such as difficulty level, the total time for preparation and cooking, number of servings, ingredients needed, and step-by-step instructions.

The Inventory Page allows users to keep track of their ingredients, including stock levels and expiration dates. Users can add ingredients with specified quantities, and expiration dates are automatically generated based on shelf life, which can be adjusted manually. This feature integrates with the Recipes Page to filter recipes based on available ingredients.

The Meal Plan Page automates a 7-day meal plan for lunch and dinner, resetting every Sunday at midnight. The meal plan is curated based on the user's meal history from the previous week to avoid repetition. By providing meal plans, this feature promotes healthier eating habits and saves users time in planning their meals.

The Grocery List Page generates a grocery list based on the user's inventory. It automatically adds ingredients that are low on stock and near its expiration date. Users can modify the list by adding or deleting items. This feature helps users avoid forgetting essential ingredients.

The Meal History Page keeps a record of the meals consumed by the user. Users manually input their meals, and the meal plan feature relies on this page to ensure minimal to no meal repetition.

The Notifications Page displays all notifications from the application. When users open the app, a banner notification appears with information about stock levels, expiration dates, meal plans, or meal history. Notifications pop up when an ingredient is low on stock or near its expiration date and also notify the user when the meal plan and history have reset.

C. Testing

The usability of the UPLB TAKAM application was evaluated through the participation of 15 UPLB students as respondents representing diverse academic backgrounds, including Computer Science, Nutrition, Communication Arts, Math, and Engineering. These students actively engage in meal preparation and cooking, resorting to purchasing meals when faced with time constraints.

The System Usability Scale (SUS) questionnaire was utilized to assess the usability of the application from the perspective of these users. The SUS consisted of statements evaluating the usability of the application. Each respondent rated the statements on a five-point scale, ranging from "Strongly Disagree" to "Strongly Agree." The average SUS score obtained for students was 89.46 indicating a favorable level of usability, the application can be classified as excellent in terms of usability for the users. The individual scores for users are depicted in Figures 3 and 4. The following statements were included:

1) I think that I would like to use this system frequently.
2) I found the system unnecessarily complex.
3) I thought the system was easy to use.
4) I think that I would need the support of a technical person to be able to use this system.
5) I found the various functions in this system were well integrated.
6) I thought there was too much inconsistency in this system.
7) I would imagine that most people would learn to use this system very quickly.
8) I found the system very awkward to use.
9) I felt very confident using the system.
10) I needed to learn a lot of things before I could get going with this system.

In the evaluation phase, individual scores were computed based on the responses to the SUS. The scores were then used to calculate the mean score, which provides an overall assessment of the application's usability.

The application received notably high scores on statements S5 and S9, both reaching a translated score of 3.8. This indicates that users found the app well-designed and easy to navigate. Statement 5 highlights how smoothly the app's features work together, making it easy for users to interact with. Similarly, Statement 9 shows that users felt confident using the app, with its intuitive design and interface. On the other hand, statements S2, S4, and S10 received the lowest scores, suggesting that users found the app very user-friendly and intuitive, without needing additional technical support or extensive learning. Overall, these scores affirm that the app is easy to use and provides a positive experience for users across different backgrounds.

During the survey, respondents were also given the opportunity to provide optional suggestions for improvements, as well as share their commendations about the application. The feedback for the UPLB TAKAM application was overwhelmingly positive, with users appreciating its cute and fun design, user-friendly interface, and intuitive navigation. Users found the app very easy to use, praising its big, easy-to-read fonts and eye-pleasing color palette. Many commented that the app is simple yet effective, with the potential to help address food waste and support healthier eating habits. Some mentioned that it was rare to have an application that has the recipe filtering feature. Several users mentioned that they have recommended and shared the app with their friends, indicating strong user satisfaction and endorsement. Overall, users expressed that the app has a lot of potential and is very promising, especially with further development and incorporation of the suggested features.

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	Individual Scores
R1	5	1	5	1	5	2	5	2	5	1	95
R2	5	1	4	2	5	1	5	2	5	1	92.5
R3	4	1	5	1	5	2	5	1	5	1	95
R4	5	1	5	2	5	2	4	2	5	2	87.5
R5	5	1	5	1	5	1	5	1	5	2	97.5
R6	5	2	5	2	4	1	5	1	5	2	90
R7	5	1	5	1	5	1	5	1	5	1	100
R8	5	2	4	1	4	2	5	1	4	2	85
R9	5	1	5	1	5	1	5	1	5	1	100
R10	4	1	5	1	4	1	4	1	4	2	87.5
R11	4	2	4	2	5	1	4	2	5	2	82.5
R12	4	3	4	2	5	2	4	1	4	2	77.5
R13	4	2	4	3	5	2	3	2	5	2	75
R14	4	2	4	1	5	2	5	1	5	1	90
R15	5	2	5	2	5	1	5	2	5	1	92.5
Mean Score	4	3.5	4	3.5	4	3.5	4	4	4	3.5	**89.46**

Fig. 3. SUS Individual Scores Table for Users

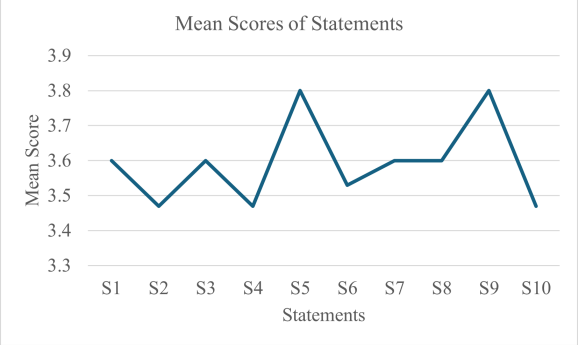

Fig. 4. Mean Scores of SUS Statements

V. CONCLUSION AND FUTURE WORK

In conclusion, the development of the UPLB TAKAM mobile application has effectively addressed the growing need for a convenient and efficient solution for meal planning, cooking, and ingredient management. The application has successfully achieved its objectives of providing users with access to a diverse collection of budget-friendly and healthy recipes, simplifying the process of finding recipes based on available ingredients, and assisting users in managing their kitchen inventory. Additionally, the app's meal planning feature, combined with meal history tracking, automates the process of planning meals for the week. This ensures variety, minimizes repetition, and tailors meal suggestions based on users' past preferences and consumption patterns, ultimately saving time and promoting a more enjoyable and diverse dining experience. Through user feedback and usability testing, the effectiveness and usability of the UPLB TAKAM application have been evaluated, further validating its role as a valuable tool for users seeking to simplify their kitchen management tasks.

UPLB TAKAM has opportunities for improvement and expansion across various aspects. These include enhancing its recipe database to cater to a wider range of user preferences and dietary requirements. Additionally, refining inventory management functionalities, such as enabling users to manually input ingredients and implementing automatic inventory updates, can simplify kitchen inventory management processes. Integrating detailed nutritional information into recipes empowers users to make informed dietary choices, promoting their health and wellness goals. Furthermore, establishing a community platform within the app fosters user engagement and collaboration by facilitating the sharing of tips, recipes, and meal ideas. Collaborating with nutrition experts ensures that the app's offerings align with current dietary guidelines, enhancing its credibility and utility as a health-focused kitchen management tool. By addressing these areas, UPLB TAKAM can evolve to better meet the dynamic needs of its users and enhance its reputation as a reliable kitchen management tool.

APPENDIX

SCREENSHOTS OF THE APPLICATION

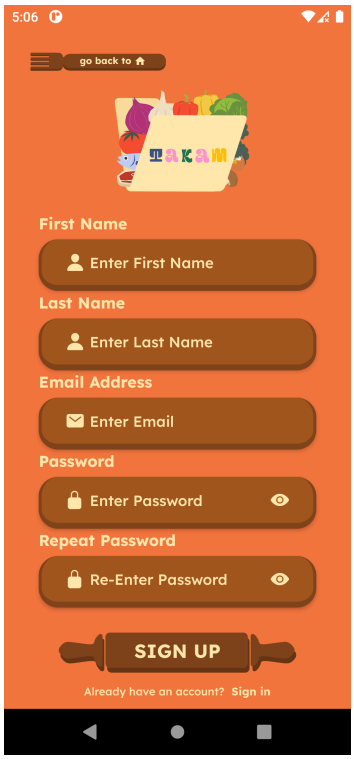

Fig. 5. Sign Up Page

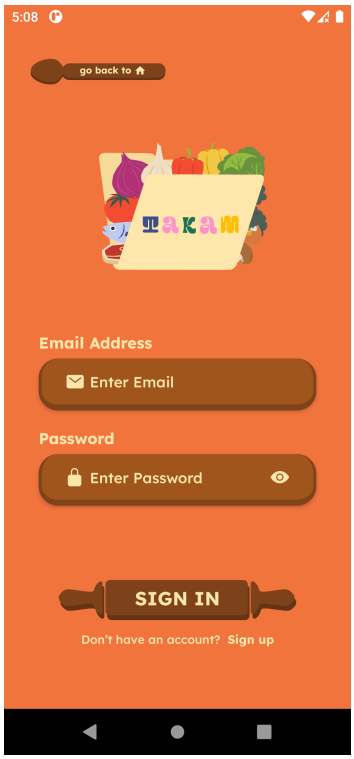

Fig. 6. Sign In Page

Fig. 7. Home Page

Fig. 8. Inventory Page

Fig. 9. Add Inventory Page

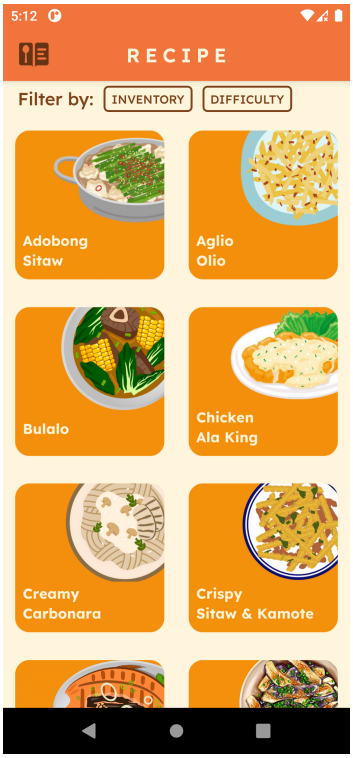

Fig. 11. Recipes Page

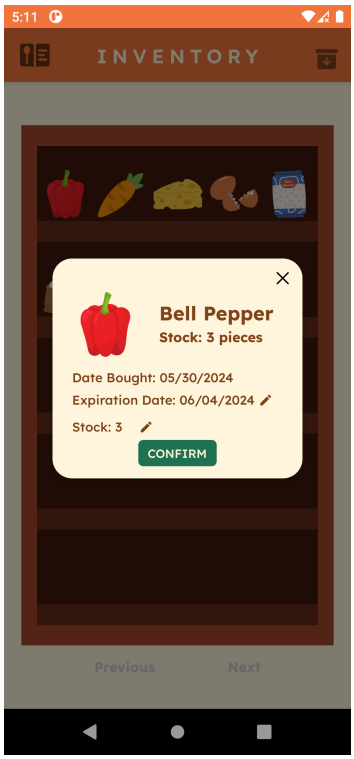

Fig. 10. View Ingredient

Fig. 12. Recipe Details Page

Fig. 13. Recipe Ingredients Page

Fig. 15. Meal Plan Page

Fig. 14. Recipe Instructions Page

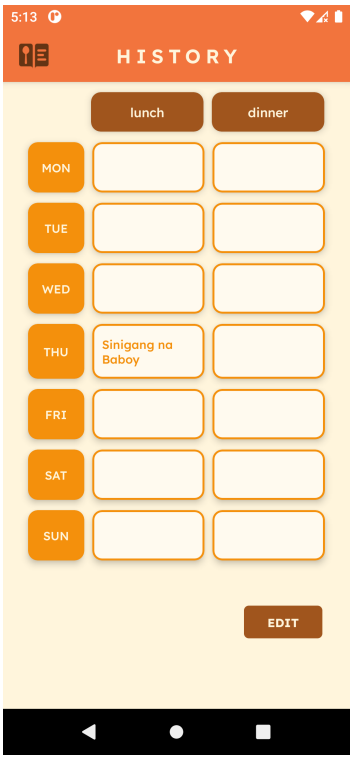

Fig. 16. Meal History Page

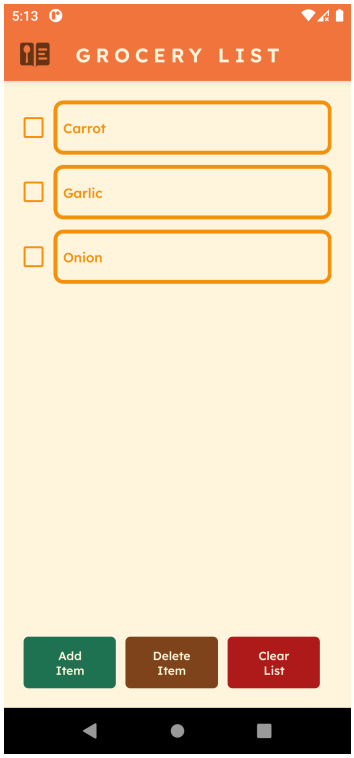

Fig. 17. Grocery List Page

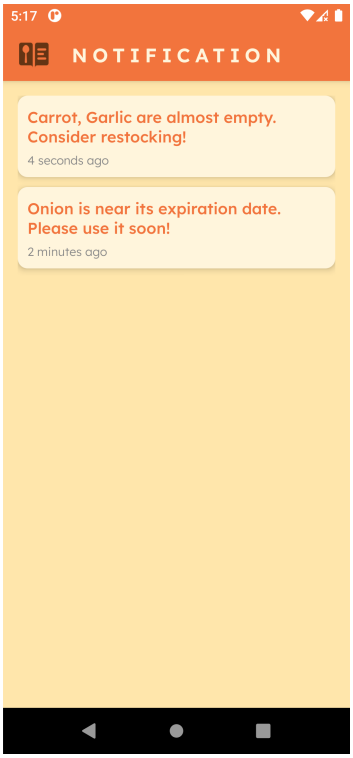

Fig. 19. Notifications Page

Fig. 18. Push Notifications

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Mikaela Gillian M. Guzman is a Computer Science student from the University of the Philippines Los Baños. She served as the Director for Learning and Development in AIESEC in UPLB (A.Y. 2022).