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GrocerEase: A Mobile Application for Recipe-based Grocery List Generation and Quantity Optimization

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Abstract— GrocerEase is a mobile application created to address common challenges faced by individuals when managing meals, grocery shopping, pantry inventory, and food-related expenses. These challenges have become increasingly complex for individuals with busy lifestyles, particularly students and young adults. Existing mobile applications often address these tasks separately, resulting in fragmented experiences, repeated manual input, and limited integration between meal planning, grocery lists, and pantry tracking. This paper presents GrocerEase, a smart mobile application designed to integrate meal planning, grocery list management, pantry monitoring, and budget tracking within a single platform. A review of related applications, including Mealime, AnyList, Eat This Much, and MealBoard reveals that while they provide useful individual features, they lack comprehensive integration, intelligent scanning capabilities, and strong budget awareness. These gaps were further supported by findings from distributing a questionnaire survey, which highlighted the demand for automated grocery list generation, pantry expiry alerts, customizable recipes, and reduced manual data entry. Guided by these findings, the project adopts a structured system development methodology involving requirement analysis, system modelling, and prototype design. Unified Modelling Language (UML) diagrams, such as use case, activity, sequence, and data flow diagrams, were developed to represent system functionality, workflows, and data movement. A high-fidelity prototype was then created to demonstrate key features, including weekly and monthly meal planning, smart scanning for food and recipes, automatic grocery list generation, pantry tracking, and budget monitoring. GrocerEase apps aims to improve user efficiency, reduce food waste, and support informed decision-making through an integrated and user-centred mobile application design.

Keywords— Meal Planning, Grocery Management, Pantry Tracking, Smart Scanning, Budget Monitoring, Mobile Application.

I. INTRODUCTION

Meal planning and grocery shopping are routine activities that can become inefficient and stressful when handled without proper organisation [1]. Many individuals rely on handwritten lists or basic note-taking applications to manage their grocery needs. However, these methods do not automatically combine ingredients from multiple recipes, adjust quantities based on servings or consider items already available at home. As a result, users often forget important ingredients, purchase duplicate items or overestimate quantities, leading to food waste and unnecessary spending.

Despite the availability of various grocery and meal-planning applications, many existing systems focus only on isolated features such as recipe browsing or simple list creation. There remains a lack of integrated tools that intelligently process recipes, optimise ingredient quantities and support pantry awareness within a single mobile application [2]. These limitations highlight the need for a smarter grocery planning solution.

Current grocery planning practices suffer from several limitations. Users face difficulty managing ingredient lists when preparing multiple meals, especially when recipes require similar items in different quantities. Most existing tools require manual calculations and do not provide automated quantity scaling or ingredient consolidation [2]. In addition, the absence of pantry tracking causes users to buy items they already own, contributing to overspending and food wastage [3].

Without intelligent automation, grocery planning remains inefficient, error-prone and time-consuming [1]. These issues demonstrate the need for a system that can automatically generate optimised grocery lists by analysing recipes, adjusting quantities accordingly and filtering out items already available at home.

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The main objective of this study is to develop a mobile application that supports efficient grocery planning through automation. The specific objectives of the study are to:

1. automatically generate grocery lists based on selected recipes
2. aggregate and optimise ingredients quantities according to the number of servings
3. reduce duplicate and unnecessary purchases through pantry awareness
4. provide a structured and organized grocery planning experience for users

The scope of the study focusses on the design and development of GrocerEase, a mobile-based system/apps intended to assist users in managing meal planning, grocery lists, pantry inventory, and food-related budgeting in an integrated manner. The apps primarily target individual users, particularly students and young adults, who require an efficient and convenient solution for organizing daily food planning activities

The main entities involved in the apps include users, meal plans, recipes, grocery lists, pantry and fridge items, budget records, and scanned inputs. Users can register and log in to the system to access personalized features such as creating and managing meal plans, saving and customizing recipes, generating grocery lists automatically, tracking pantry inventory with expiry dates, and monitoring monthly food budgets. The apps also incorporate a smart scanning feature that allows users to scan food items, written recipes, and pantry contents to reduce manual data entry.

II. Literature Review

Existing apps related to grocery and meal planning were reviewed to identify their features, strengths, and limitations. An analysis highlighting similarities and differences among the systems is presented to provide a clear comparison and to identify gaps that motivate the proposed solution. The comparison is summarised in Table I.

A. Review of Existing Systems

Several existing grocery and meal-planning applications were analysed, including Mealime, AnyList, Eat This Much, and MealBoard. These applications were selected due to their relevance to meal planning, grocery list generation, and recipe management.

Mealime provides personalised meal planning and automatic grocery list generation but offers limited pantry tracking and requires subscription access for advanced features [4], [5].

AnyList focuses on shared grocery lists and recipe imports, however it lacks automated meal planning and quantity optimisation [6].

Eat This Much emphasises calorie-based meal planning and nutrition goals but is less suitable for general grocery organisation and pantry awareness [7], [8].

MealBoard supports pantry tracking and recipe scaling, but its availability is limited to IOS platforms, and its interface is less modern compared to newer applications [9].

B. Comparison Between Existing Systems

Table I presents a comparison of key features across existing grocery and meal-planning applications. While most apps support basic meal planning and grocery list creation, pantry tracking and automated quantity scaling are often missing or only partially supported [6]. Some advanced features are also restricted behind paid subscriptions, reducing accessibility for users [4].

TABLE I.

COMPARISON BETWEEN EXISTING SYSTEMS

System	Features				
	Meal Planning	**Grocery List Creation**	**Pantry/ Inventory Tracking**	**Recipe Import**	**Budget Tracking**
Mealime	✓	✓	×	✓	×
AnyList	✓	✓	×	✓	×
Eat This Much	✓	✓	×	×	✓
MealBoard	✓	✓	✓	✓	×
GrocerEase	✓	✓	✓	✓	✓

C. System Adaptation Summary

Based on the review of existing apps, GrocerEase was designed to address the identified gaps by integrating the most effective features from each application while introducing improvements. From Mealime, GrocerEase adopts structured meal planning and recipe-based grocery list generation. From AnyList, it incorporates flexible grocery list management and recipe organization concepts. From Eat This Much, it draws inspiration from budget-aware planning and nutritional considerations. These features are further enhanced through the introduction of a smart scanning function, pantry expiry alerts, and a centralized dashboard. By combining and improving upon existing

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solutions, GrocerEase aims to provide a more comprehensive, user-centred system that supports efficient food planning, reduces manual effort, and promotes better decision-making in daily meal and grocery management.

III. Methodology

A. Development Approach

Fig. 1 shows the agile development methodology adopted for this study due to its iterative and flexible nature [10], [11]. Agile supports continuous feedback, allowing requirements and system features to be refined throughout the development process [12]. This approach is suitable for GrocerEase, as user needs are derived from survey findings and may evolve based on usability evaluation and supervisor feedback [13].

The Agile lifecycle used in this project consists of requirement analysis, design, development, testing, deployment and review phases. Each iteration focuses on delivering incremental improvements, ensuring steady progress and early identification of issues [14].

Fig. 1 Agile Development Lifecycle for GrocerEase Apps

B. Requirement Gathering

User requirements were collected through an online questionnaire distributed to 50 respondents [15]. The survey aimed to understand users' grocery shopping habits, challenges and interest in potential features such as meal planning, pantry tracking, and budget monitoring [16]. The collected data was analysed to prioritise core features for the GrocerEase prototype. Ethical considerations such as voluntary participation and response anonymity were maintained throughout the data collection process [17].

The survey results indicated a strong preference for an integrated system that combines meal planning, grocery listing, and pantry tracking within a single platform [18]. Many respondents expressed interest in features that reduce manual input, particularly smart scanning for food items and recipes. Budget tracking and expiry date alerts were also highlighted as important functions for improving cost control and reducing unnecessary purchases [19]. These findings were analysed and used to prioritise the core features incorporated into the GrocerEase prototype, ensuring that the system design aligns closely with real user needs and expectations.

C. System Design Overview

Fig 2. presents the use case diagram that shows the functional scope of the GrocerEase apps and the interactions between the user and the apps [20]. The user is the primary actor who accesses the system after completing the registration or login process. Once authenticated, the user can interact with five main modules: Home (Dashboard), Plan (Meal Plan and Recipes), Grocery List, Pantry, and Profile. Each module represents a set of system functionalities designed to support meal planning, grocery organization, pantry tracking, and budget management.

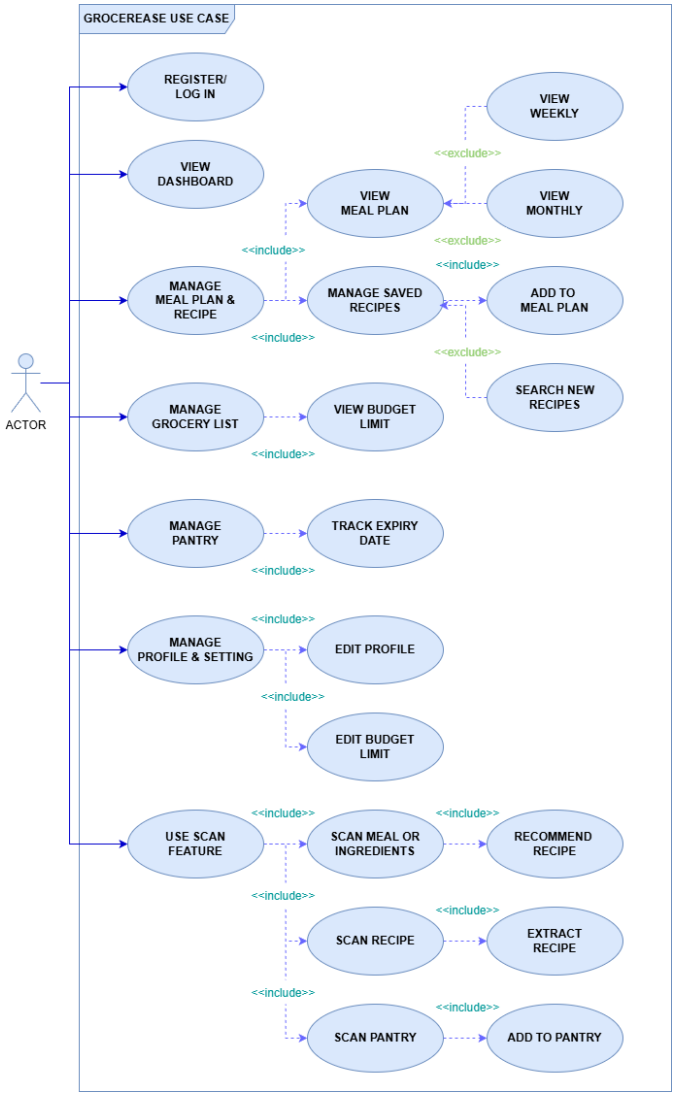

Fig. 2. Use Case Diagram for GrocerEase Application

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The diagram also includes a smart scanning feature, which is shared across multiple modules and modelled using an <<include>> relationship to represent its reuse within the system. Optional actions, such as sharing a recipe or generating a grocery list after adding a meal plan, are represented using <<extend>> relationships [21]

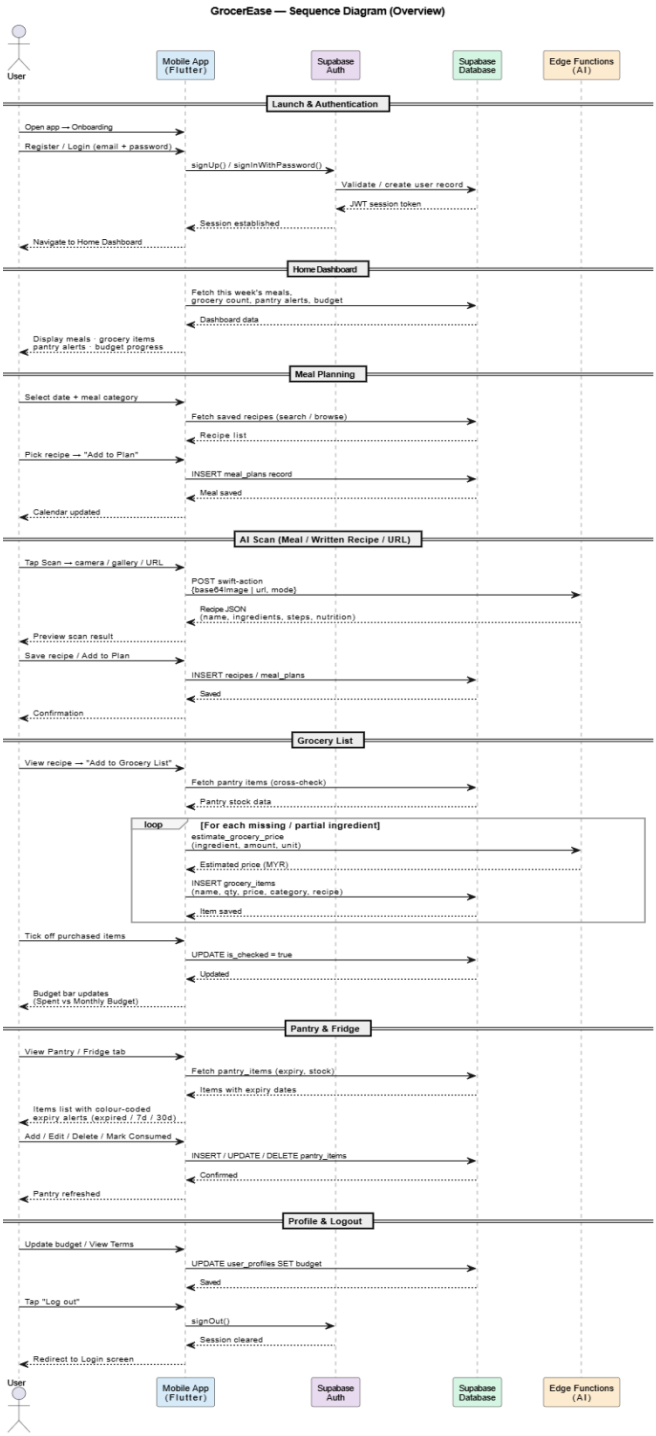

Fig. 3. Sequence Diagram for GrocerEase Application

Fig. 3 presents the end-to-end interaction flow of the GrocerEase mobile application, depicting how the user, the Flutter-based mobile interface, Supabase Authentication, Supabase Database, and the AI Edge Functions communicate with one another across the system's core features. The flow begins with the user launching the application, where they are guided through an onboarding experience before being directed to either register a new account or log in, both of which are handled securely through Supabase Authentication with email verification support via deep linking. Once authenticated, the home dashboard is loaded by simultaneously fetching the user's weekly meal plan, grocery list summary, pantry alerts, and budget information from the database, giving the user an at-a-glance overview of their current status. From there, the user is able to plan meals by selecting recipes from their saved collection or through search, with each selection being recorded into the meal plans table. The application also supports an AI-powered scanning feature, where the user can either capture or upload a photo of a meal, a set of ingredients, or a written recipe, all of which are sent to the Supabase Edge Functions for AI analysis and returned as structured recipe data that can be saved or added to the meal plan [22]. When adding ingredients to the grocery list from a recipe, the system first cross-checks the user's existing pantry and fridge items to identify what is already available, then calls the AI pricing service to estimate the cost of remaining items in the Malaysian retail market before inserting them into the grocery list. The grocery list itself supports checking off purchased items, which simultaneously updates the budget spending tracker, while the pantry module allows the user to manage food items with expiry date colour-coding to reduce food waste [23]. The sequence concludes with the user's ability to log out, which clears the active session through Supabase and redirects the application back to the login screen.

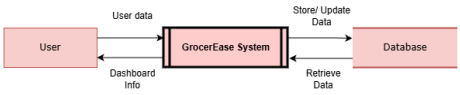

Fig. 4. Data Flow Diagram - Level 0 for GrocerEase

Fig. 4 illustrates the Level 0 Data Flow Diagram, which is also known as the context diagram, represents GrocerEase as a single process interacting with external entities [24]. In this diagram, the user is the main external entity who provides inputs such as meal plans, grocery items, pantry updates, and budget information. The system processes these inputs and returns outputs including dashboard summaries, alerts, and recommendations. A central data store represents the system database, which stores and retrieves all persistent data required by the system.

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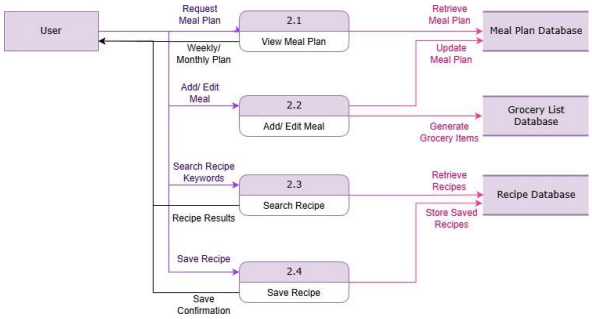

Fig. 5. Data Flow Diagram - Level 1 for GrocerEase

Fig. 5 depicts the Level 1 Data Flow Diagram that expands the single process shown in Level 0 into several major subprocesses [25]. These include managing user accounts, handling meal plans and recipes, generating grocery lists, tracking pantry inventory, and processing scanned inputs. Each process interacts with its respective data store, such as user data, meal and recipe data, grocery data, and pantry data. Data flows between the user, processes, and data stores are clearly defined to show how information is processed and stored within the system.

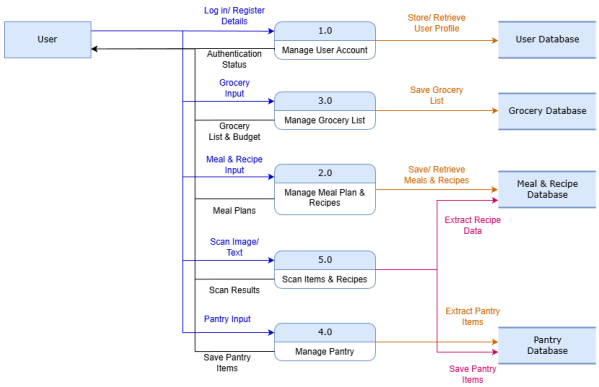

Fig. 6. Data Flow Diagram - Level 2 for GrocerEase

Fig. 6 shows the Level 2 Data Flow Diagram that further decomposes one of the main processes, specifically the meal planning and recipe management process [25]. This diagram shows detailed subprocesses such as viewing meal plans, adding or editing meals, searching for recipes, and saving selected recipes. When a meal is added, the system updates the meal plan data store and generates related grocery items, which are then sent to the grocery list data store. This detailed view illustrates how data flows between closely related features within the system. Flows between the user, processes, and data stores are clearly defined to show how information is processed and stored within the system.

D. Prototype UI/UIX Design

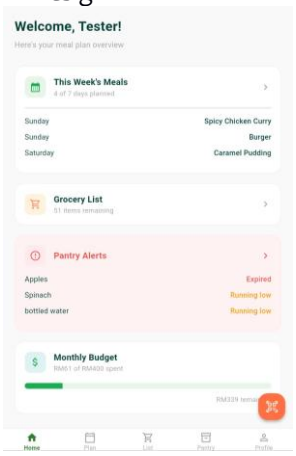

Fig. 7. Home Page

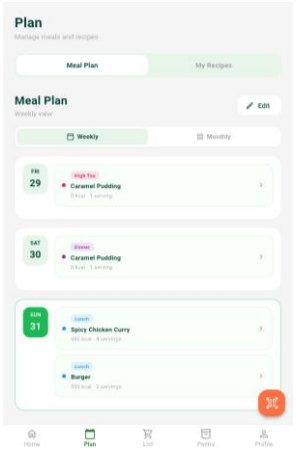

Fig. 8. Plan Page

Fig. 7 displays the home page functions as the main dashboard of the GrocerEase application. It provides a summarized view of key information, including the user's meal plan status, grocery list progress, pantry reminders, and monthly budget usage. Each section includes a navigation button that directs the user to the relevant detailed page. This design allows users to quickly understand their current food planning status and access important features with minimal effort [26].

Fig. 8 portrays the plan page that supports meal organization and recipe management. It is divided into two sections, which allow users to view meal plans and manage recipes. The meal planning section enables users to plan meals using weekly or monthly views, helping them organize their meals more effectively. When meals are added or edited, the system automatically updates the grocery list. This integration reduces manual work and improves planning efficiency.

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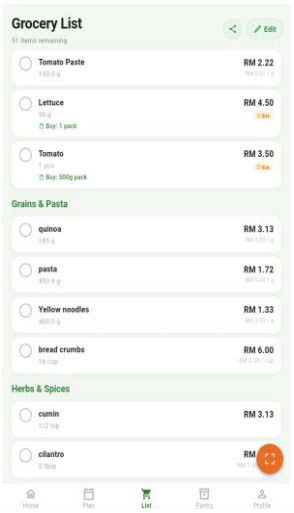

Fig. 9. List Page

Fig. 9 presents the list page displaying the user's grocery items in an organized manner. Grocery items can be viewed as a complete list or grouped by specific recipes. Each item includes quantity and estimated cost, allowing users to monitor their spending in relation to their budget. Users can also edit or remove items and share the grocery list for convenient use during shopping [27].

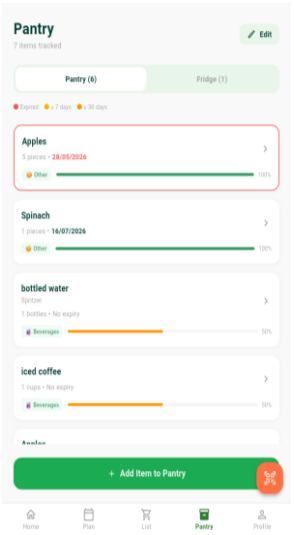

Fig.10. Pantry Page

Fig. 10 displays the pantry page allowing users to track available items stored in their pantry and fridge. Items are displayed together with quantity and expiry date information, enabling users to monitor food availability and avoid wastage. Alerts are provided for items that are nearing expiry or running low [28]. Users can update pantry records manually or through the smart scan feature.

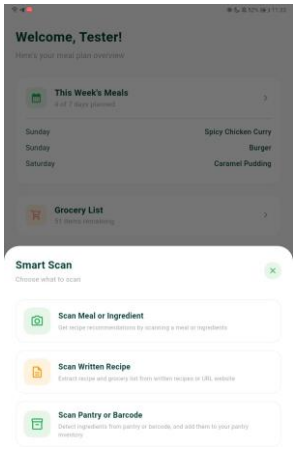

Fig. 11. Smart Scan Feature

Fig. 11 shows the smart scan feature that is designed to reduce manual data entry by allowing users to scan food items, recipes, or pantry contents. The system processes the scanned input to identify ingredients, extract recipe details, or update pantry inventory automatically. This feature improves user convenience and supports faster interaction with the application across multiple pages [29].

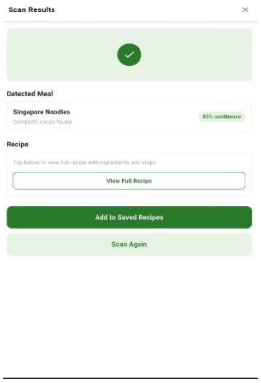

Fig. 12. Scan meal Result Page

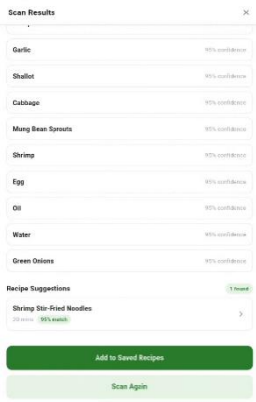

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Fig. 13. Scan Ingredients Result Page

Fig 12 and 13 shows the scan meal and ingredients page that opens a live camera preview with two switchable modes at the top, Detect Meal and Detect Ingredients. In Detect Meal mode, the user points the camera at a prepared dish or captures it from their gallery, and the AI returns the full recipe including the name, prep and cook time, servings, estimated budget, tools required, ingredients with amounts, and step-by-step cooking instructions. In Detect Ingredients mode, the same camera flow is used but the AI instead identifies all visible raw ingredients in the image and lists them with their quantities and units. Once analysis is complete, the results are displayed on the Scan Results screen where the user can save the recipe to their library or add it directly to their meal plan.

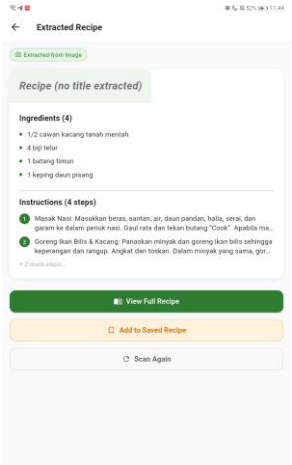

Fig. 14. Scan Written Recipe Result Page

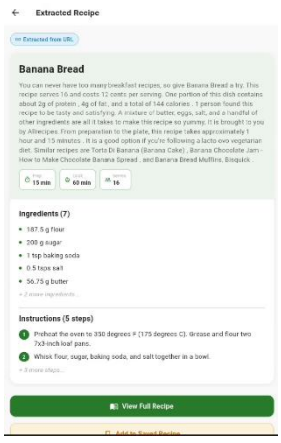

Fig. 15. Scan URL Recipe Result Page

Fig 14 and 15 presents the scan-written recipe page that allows users to extract a full recipe from either a photo of a handwritten or printed recipe, or by pasting a link to any recipe website. When an image is used, the app encodes it and sends it to the AI edge function which reads the visible text and returns the recipe title, description, ingredients, instructions, prep time, cook time, and servings. When a URL is pasted, the edge function fetches and parses the webpage on the server side, bypassing the restrictions that recipe websites often place on mobile requests and returns the same structured recipe data. The extracted recipe is shown in a preview screen where the user can review and confirm before it is saved to their recipe library.

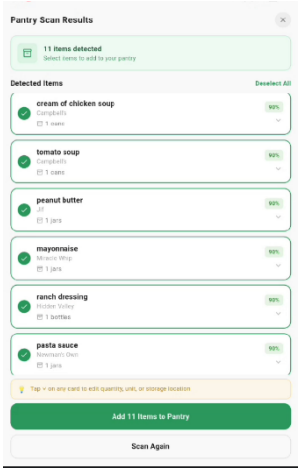

Fig. 16. Scan Pantry Result Page

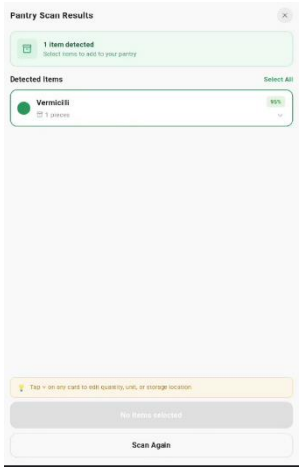

Fig. 17. Scan Barcode Result Page

Fig 16 and 17 illustrates the scan pantry and barcode page serves as a single camera screen for adding items to the pantry using two different detection methods. In Scan and Recognise mode, the user takes a photo or uploads an image

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of their pantry shelf or fridge contents, and the AI identifies all visible food items and returns them as a list with name, category, estimated quantity, unit, storage location, and confidence score. The user then selects which detected items to save to their pantry. In Scan Barcode mode, the camera continuously scans for product barcodes using real-time detection; once a barcode is found, the app looks it up against the Open Food Facts database to retrieve the product name, brand, category, and quantity. If the barcode is not found in the database, a bottom sheet appears giving the user the option to add the item manually or scan a different barcode.

IV. Project Development, Implementation and Evaluation

A. *System integration*

GrocerEase is built using Flutter (Dart) as the cross-platform mobile frontend, targeting both Android and iOS platforms. Supabase serves as the backend-as-a-service (BaaS), providing a PostgreSQL relational database for all persistent data storage and Supabase Auth for secure user registration and login. Table II summarises the technology stack.

TABLE II.

TECHNOLOGY STACK

Component	Technology/Package	Purpose
Front end	Flutter / Dart	Cross-platform mobile UI (Android & iOS)
Database	Supabase (PostgreSQL)	Cloud relational database for persistent data
Authentication	Supabase Auth	Secure user registration and login
Navigation	Go router	Declarative routing between apps screen
State management	Provider	Application state handling and UI reactivity
Smart scan	Camera image picker, http	Image capture and external AI API for food/recipe recognition

B. System Output

I. Administrator

GrocerEase apps does not include a dedicated admin panel in this prototype iteration. System administration is performed via the Supabase dashboard, where database tables, user authentication records, and API access can be managed directly.

II. User(s)

Authenticated users access the system through five modules via a bottom navigation bar:

- Home (Dashboard): Displays a summary of the weekly meal plan, grocery list progress, pantry expiry alerts and monthly budget usage, with quick-access navigation to each module.
- Plan – Meal Plan & Recipes: Supports weekly and monthly meal scheduling. When a meal is added, the system automatically aggregates its ingredients and updates the grocery list. Users can save and customise recipes with proportional quantity scaling per serving.
- Grocery List: Displays required ingredients (consolidated across all planned recipes, with pantry items deducted). Items show quantity and estimated cost. Users can edit items or share the list externally.
- Pantry: Tracks pantry and fridge contents with quantity and expiry dates. Push notifications alert users to items nearing expiry (within three days) or running low. Items can be added manually or via Smart Scan.
- Smart Scan: Provides three modes: (1) scan a food item for recipe recommendations, (2) scan a written recipe to extract ingredients via OCR and (3) scan pantry contents to auto-populate inventory. This feature reduces manual data entry across all modules.

C. System testing

I. User Acceptance Testing (UAT)

UAT was conducted with six volunteer participants (students and working adults) to verify that GrocerEase meets all defined functional requirements. Participants performed predefined tasks independently while testers recorded actual outcomes against expected results.

II. UAT Test Cases

TABLE III presents the UAT test cases developed based on the functional requirements of GrocerEase. Each test case covers a specific system feature, specifying the expected result and the actual outcome observed during testing. All ten test cases were executed by participants and returned a Pass status, confirming that the system behaves as intended across all primary modules.

TABLE III.
UAT Test Cases

ID	Test Scenario	Expected Result	Status
T C-01	User Registration & Login	User registers and logs in successfully	Pass

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T C-02	Weekly Meal Plan Creation	Meals assigned to each day; plan saved correctly	Pass
T C-03	Auto Grocery List Generation	Grocery list generated from meal plan with correct ingredients	Pass
T C-04	Ingredient Quantity Aggregation	Duplicate ingredients merged with summed quantities	Pass
T C-05	Pantry Availability Filter	Items in pantry excluded from grocery list	Pass
T C-06	Pantry Expiry Alert	Push alert triggered for items expiring within 3 days	Pass
T C-07	Smart Scan – Food Item	Food identified; relevant recipes recommended	Pass
T C-08	Smart Scan – Written Recipe	Ingredients extracted via OCR and added to grocery list	Pass
T C-09	Smart Scan – Pantry	Multiple pantry items detected and added to inventory	Pass
T C-10	Budget Monitoring	Monthly spending tracked; remaining balance displayed	Pass

III. Enhancement

Based on UAT feedback, the following improvements were made to the prototype:

- Expiry alert threshold made user-configurable (default: 3 days).
- Grocery list enhanced with category grouping (e.g., Produce, Dairy) for easier in-store use.
- Smart Scan result screen updated to allow ingredient review and editing before submission.

V. Conclusions

All four study objectives were successfully addressed in the prototype. GrocerEase automatically generates grocery lists from selected recipes, aggregates and optimises ingredient quantities based on servings, filters out pantry-available items to prevent duplicate purchases and provides a structured five-module interface for organised food planning. UAT results confirmed this, with all 10 test cases passing.

The study has four constraints in terms of scanning accuracy, budget data and platform. The apps using ML Kit where the performance depends on image quality, poor lighting and irregular handwriting reduce OCR precision. Grocery item prices are pre-defined estimates which real time market pricing was outside the study scope. The application was validated only on Android mobile devices, therefore, its compatibility with iOS devices is unexplored.

I. Future Enhancement (Modules)

A dedicated Administrator Dashboard should be developed for in-app user and content management. A Community module enabling recipe and meal plan sharing among users would further enhance engagement.

II. Future Enhancement (Functions)

Barcode scanning for faster pantry entry, nutritional analysis for planned meals and real-time grocery pricing through supermarket API integration are key functional improvements for future releases.

III. Future Enhancement (Features)

- Online Grocery Ordering: Direct integration with supermarket delivery services from within the app.
- Multi-User Household Mode: Shared accounts for collaborative meal planning and grocery management.
- Food Waste Analytics: Dashboard tracking discarded expired items to support waste-reduction habits.

GrocerEase addresses a clear gap in existing mobile applications by integrating meal planning, grocery management, pantry tracking, and budget monitoring within a single platform. Guided by Agile methodology and user survey findings, the prototype successfully demonstrated all core features. UAT results validated that all functional requirements were met. Despite constraints related to scope and platform coverage, the project achieves its intended objectives and establishes a solid foundation for a fully deployable, commercially viable grocery planning solution.

Acknowledgment

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

Authors Contribution Statement

Alin Farhain Abdul Rajat @ Abdul Razak contributed to the conceptualization, literature review, system analysis,

system design, mobile application development, implementation, testing, data analysis, and preparation of the manuscript. Nur Eilyana Eirdyna Ismail contributed to the system development, prototype implementation, testing, validation, and manuscript review. Shuhaili Talib supervised the research, provided guidance on the project methodology and system design, reviewed the manuscript, and contributed to the interpretation of the findings. All authors read and approved the final version of the manuscript.

Data Availability Statement

The data supporting the findings of this project include the questionnaire responses collected during the requirement gathering phase, system design documents, and User Acceptance Testing (UAT) results used in the development and evaluation of the GrocerEase mobile application. The data are not publicly available as they contain research materials intended solely for academic purposes. However, relevant data and supporting materials may be made available by the corresponding author upon reasonable request.

Ethics Statement

This study involved the collection of questionnaire responses for system requirement analysis and the participation of volunteer users in User Acceptance Testing (UAT). Participation was voluntary, and all responses were collected anonymously. No personally identifiable information was used during the development, testing, or evaluation of the GrocerEase application. The study was conducted in accordance with institutional research ethics guidelines to ensure participant privacy, confidentiality, and responsible research practices.

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