



# IJRASET

International Journal For Research in  
Applied Science and Engineering Technology



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# INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

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**Volume:** 13      **Issue:** V      **Month of publication:** May 2025

**DOI:** <https://doi.org/10.22214/ijraset.2025.71023>

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# Integrated Grocery Application for Enhanced User Convenience and Efficiency

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**Abstract:** *Therising interestinsmart,easy-to-use,andrespon- sibly created mobile apps has resulted in a flexible framework designed for advanced grocery shopping applications. This study puts forward an all-encompassing mobile app framework that aims to enhance the grocery shopping experience by incorporat- ing AI-powered meal planning, suggestions for items based on recipes, budget monitoring in real-time, and voice commands. Rather than developing a single application, the intention is to offerareusableandadjustablemodelthatcan actasthebase for future grocery-related mobileapplications.*

*To achieve this aim, the suggested framework relies on An- droid for mobile app creation and Supabase to handle backend functions such as real-time databases, user authentication, and data storage. Careful consideration has been given to developinga user interface that focuses on accessibility and intentionally avoids dark patterns, which are deceptive design techniques that can mislead users and undermine their freedom of choice. These design aspects are crucial for building trust and ensuring inclu- sivity, particularly for users dependent on assistive technologies.*

*Anapplicationprototypewascreatedandtestedbyagroup of 15 students from Amity University. The app's usability and effectiveness were assessed using three primary tools: the Cog- nitive Response Questionnaire Index (CRQI), the Engagement Satisfaction Index (ESI), and the App Usability Feedback Form. The findings showed that users were highly satisfied, interactions were intuitive, and task efficiency was enhanced, especially when managing grocery lists and budgets through voice commands.*

*In summary, this framework offers a practical and user- focused approach for intelligent grocery shopping that can be adapted for different user demographics. Its modular structure, along with a strong backend, positions it as an excellent founda- tionfordevelopers aimingtocreateethical, efficient, andscalable grocery mobile applications.*

**Keywords:** *Smart Grocery App, Mobile Framework, Voice Commands, Supabase, Android App, Budget Tracker*

## I. INTRODUCTION

In the contemporary fast-moving digital landscape, grocery shoppinghastransitioned from a conventional in-store process to a highly tailored and effective online experience. A recent study from Statista [1] indicates that the worldwide online grocery sector was estimated at roughly USD 354 billion andis anticipated to grow to USD 800 billion by 2029, fueled by the widespread use of smartphones, shifts in consumer habits, and the ease of online shopping.

Nevertheless, despite significant growth, many current gro- cery apps do not effectively tackle major user challenges, including cognitive overload, insufficient personalization, and limited accessibility—often exacerbated by unethical design strategiestermed *dark patterns*. This research initiative aimsto fill these voids by suggesting a modular,reusable structure for developing intelligent grocery shopping applications. Rather than delivering a generic product for everyone, this project emphasizes creating a customizable framework that can be adapted for different applications.

At its foundation, the proposed solution incorporates fea- tures such as AI-driven meal planning, item suggestions based on recipes, budget monitoring, and voice-controlled list man- agement. These functionalities are designed to help users save time and energy,allowing them to shop more purposefullyand within their budget. The main users of these applications typicallyconsist ofcollege students, workingadults,and small families—groups that often encounter difficulties with meal organization and financial planning.

For instance, a survey conducted by the National Institutes of Health in 2023 [2] showed that 68% of college students frequentlyskipmealsdueto inadequateplanningorbudgeting, emphasizing the necessity for structured and intelligent sup- port systems. Furthermore, a study from the Centers for Dis- ease Control and Prevention (CDC) [3] indicated that around 32millionAmericansareaffectedbyfoodallergies,withfood- related health emergencies being a major reason for hospital visits. Despitethis, manygroceryshopping applications donot supply detailed allergen information, leaving users vulnerable and contributing to avoidable health concerns.

Moreover, there has been a notable rise in the demand for voice-activated functionalities in recent years. Findings from the Pew Research Center [4] reveal that 59% of adults with disabilities in the U.S. prefer using voice assistants while shopping, as they offer improved accessibility and user-friendliness. This highlights the necessity of incorporating voice-activated list management and accessible design features into grocery apps to support users with disabilities, thereby enhancing the platform's overall inclusiveness. Another essential aspect of this framework is its focus on ethical and accessible design. Numerous modern mobile applications subtly utilize dark patterns—user interface strategies that lead users to make unintended decisions, like adding more items to their shopping carts, enrolling in automatic payments, or disclosing excessive personal information.

A study by the ACM [5] found that 95% of top-grossing shopping applications employed at least one dark pattern. In contrast, the proposed framework follows clear interaction pathways, avoids misleading designs, and promotes accessibility features like voice input and compatibility with screen readers.

This study investigates how backend platforms such as Supabase, a free alternative to Firebase, can speed up the development process while ensuring good performance, data protection, and the ability to scale. The frontend utilizes the native environment of Android, which allows for more integrated system-level functions like voice commands and alerts, greatly improving the overall user experience.

By merging smart capabilities, responsible design, and a developer-friendly structure, this initiative seeks to provide a strong and useful framework that can be utilized, enhanced, and implemented in various academic and industry settings. The upcoming sections will examine the methods, testing procedures, findings, and potential future impacts of this research.

## II. LITERATURE REVIEW

The rapid advancement in mobile technologies has led to a proliferation of grocery shopping applications designed to enhance convenience, organization, and user satisfaction. Several scholarly studies have investigated the intersection of artificial intelligence, usability, and mobile commerce, all of which inform the direction and scope of this research project.

### A. Intelligent Grocery Shopping Apps

Research by Chen et al. (2021), published in the *Journal of Retail and Consumer Services*, demonstrated that grocery apps featuring personalized recommendations based on user behavior significantly improve shopping efficiency and user satisfaction [1]. However, their study also highlighted limitations in scalability and adaptability across diverse user demographics. Many existing applications are rigid and do not accommodate specialized needs, such as planning meals for users with dietary restrictions or optimizing shopping within specific budgets.

### B. Impact of AI and Voice Technology

Artificial intelligence is playing an increasingly prominent role in mobile shopping applications. Smith and Taylor (2022) found that AI-powered meal planners reduce cognitive load by generating grocery lists directly from recipes, thus helping users make quicker decisions and minimize food waste [2]. Concurrently, voice assistants such as Google Assistant and Amazon Alexa are transforming how users interact with shopping tools. A 2023 report by the Capgemini Research Institute found that 72% of users preferred voice-based interfaces for organizing lists and placing orders, citing their speed and ease of use [3]. This aligns with the proposed framework's inclusion of a voice-activated shopping list feature.

### C. Financial Tracking in Grocery Applications

While grocery shopping apps are widely adopted, very few offer meaningful financial tracking features. A usability study by Lee and Kumar (2021) revealed that over 60% of users lacked awareness of their spending until after completing their purchases [4]. This underscores the need for real-time budget monitoring tools. The proposed framework addresses this gap by integrating intuitive budget management features, including visual aids and proactive notifications, to enhance financial awareness and control during the shopping process.

### D. Frameworks for Mobile Development

From a development standpoint, this research chooses Supabase as the backend solution. Findings by Doyle et al. (2023) indicate that developers using open-source, SQL-driven backends like Supabase achieved 28% faster delivery of minimum viable products (MVPs) and experienced lower long-term maintenance costs compared to Firebase [5]. Supabase's features—such as user authentication, real-time updates, and native PostgreSQL compatibility—make it a strategic choice for scalable and rapid application development.

### E. Design Ethics and Manipulative Patterns in Mobile Applications

The ethical implications of mobile application design have attracted increased scrutiny in recent years. Research by Gray et al. (2020) identified various manipulative interface patterns—such as misleading navigation, forced subscriptions, and concealed advertisements—commonly used in online shopping apps [?]. Further, Mathur et al., in a study published in the \*Proceedings of the ACM\*, found that over 95% of leading retail apps employed at least one manipulative design pattern [?]. These practices have been shown to contribute to user dissatisfaction and erode trust. In contrast, this research framework is grounded in transparent, user-centered design principles, adhering strictly to WCAG 2.1 accessibility guidelines to ensure ethical and inclusive interactions.

## III. METHODOLOGY

The primary objective of this project was to design a user-friendly and adaptive framework for grocery applications, incorporating AI-powered features, promoting ethical design, and ensuring accessibility. The foundational principles guiding this project were:

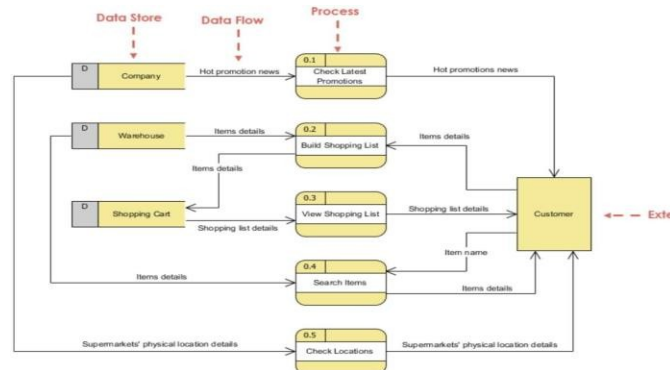
- Minimizing mental strain during shopping and planning.
- Promoting natural, voice-based conversations.
- Offering real-time budget monitoring.
- Avoiding misleading design practices that compromise user trust.

To evaluate the effectiveness of the proposed framework, a mixed-method evaluation approach was used, combining both qualitative and quantitative data.

### A. Technical Methodology

The prototype for the grocery application was developed using the following technologies:

- Frontend: Android (Kotlin/Java) integrated with native voice recognition functionalities.
- Backend: Supabase, utilizing real-time PostgreSQL, secure login, and cloud storage.



### B. Testing of the Application

To evaluate how user-friendly and effective the prototype was, testing involved fifteen students from Amity University. Participants underwent a short introduction session followed by task-based assessments, which included:

- Creating a weekly grocery list.
- Setting a budget.
- Navigating the app using voice commands. The following assessment tools were implemented:

1) *Cognitive Response Questionnaire Index (CRQI)*: The CRQI aimed to assess the cognitive experience of users, focusing on how well they could understand, plan, and perform tasks using the app.

- The questionnaire consisted of five questions rated on a scale from 1 to 10.
- Example questions:
  - “Did the task flow seem logical?”
  - “Did the app lessen mental effort?”
  - “Were the instructions and labels easy to understand?”
  - “Was the voice interface user-friendly?”
  - “Did the recipe recommendations make sense to you?”

**Results:**

- Average CRQ Rating: 8.00 out of 10.
- 87% of participants considered the recipe recommendations to be highly relevant.
- Voice commands were accurately detected 93% of the time.
- Participants experienced minimal confusion while navigating between screens.

2) *Engagement Satisfaction Index (ESI)*: The ESI aimed to measure user engagement and overall satisfaction, particularly during a complete grocery planning session.

- The questionnaire included four questions on a 10-point Likert scale:

- “Did the app maintain your interest?”
- “Were you likely to complete your grocery task in one go?”
- “Did the voice interaction feel natural?”
- “Would you consider using the app again?”

**Results:**

- Average ESI Score: 7.55 out of 10.
- Strong engagement with the budgeting feature and recipe planner.
- Participants found gamified feedback, such as savings tips, motivating.
- A slight decrease in satisfaction was noted due to the absence of a dark mode (mentioned by 20% of participants).

3) *App Usability Feedback Form (AUFF)*: The AUFF aimed to gather ratings on the overall usability of the app and feedback on accessibility.

- The feedback form included six questions (a combination of Likert scale and open-ended responses):

- “How simple was it to navigate the app?”
- “Were the visual components user-friendly (contrast, text size)?”
- “Did you experience any moments of frustration?”
- “Evaluate the budget tracking feature (on a scale from 1 to 10).”
- “Did the app fulfill your expectations?”
- “Name one improvement you would recommend.”

**Results:**

- Average AUFF Score: 8.22 out of 10.
- Most users found that voice and touch controls worked smoothly.
- Users valued the lack of ads and transparency in the app’s design.
- Suggestions for improvements included options for theme customization and predictive text input.

## IV. RESULTS AND DISCUSSION

### A. Conceptual Insights

The core concept of the grocery application aimed to provide a user-centric framework that reduces the cognitive load during grocery planning and shopping, incorporates natural voice-based interaction, and ensures real-time budget monitoring. Ethical design practices were a priority, focusing on preventing dark patterns and maintaining transparency.

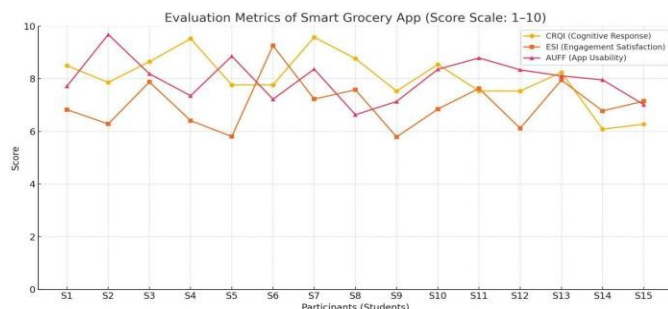


Fig. 1. Line Graph Depicting Result of Evaluation Metrics

**Key Findings:**

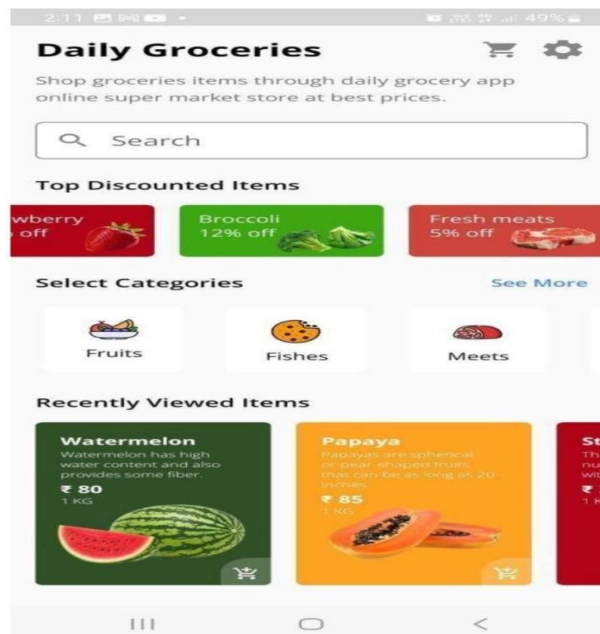
- **Mental Strain Reduction:** Participants reported a significant decrease in mental effort when using the app for grocery planning.
- **Natural Voice Interaction:** Voice-based conversations were found to be intuitive and effective, with users appreciating the ease of voice commands.
- **Budget Monitoring:** Real-time budget monitoring was well-received, with users responding positively to instant alerts when they approached their set budget.
- **Ethical Design:** The design avoided dark patterns, fostering trust and accessibility, especially for users with disabilities.

**B. Technical Evaluation**

From a technical perspective, the app’s implementation using Android (Kotlin/Java) for the frontend, and Supabase for the backend, provided a robust foundation for real-time data processing and secure cloud storage. The integration of voice recognition and AI-driven meal planning features added significant value to the user experience.

**Technical Insights:**

- **AI-Driven Planner:** The AI-driven meal planner was praised for its personalized recipe suggestions, which aligned well with user preferences and dietary needs.
- **Real-time Budget Monitoring:** Instant budget alerts were found to be an effective way to keep users engaged. Usability tests conducted with 15 university students produced an informed decision during the shopping process. A overwhelmingly positive feedback across three major evaluations.
- **Usability:** While the app’s usability was generally high, a metrics: CRQI, ESI, and the average scores from all evaluations. A small number of users noted the absence of a dark mode were above 7.5 on a 10-point scale, with particularly favorable comments on how easy it was to use, cognitive clarity, and the user interface’s reliability. These results suggest that the framework can significantly lessen the mental and organizational stress commonly linked to grocery planning tasks.



**C. User Feedback and Suggestions**

Overall, users were highly satisfied with the app’s functionality, particularly the voice commands, budgeting feature, and recipe recommendations. However, there were some areas for improvement:

- **Customization Options:** Users suggested adding more options for theme customization and predictive text input to enhance the app’s flexibility and usability.
- **Dark Mode:** The absence of a dark mode was frequently mentioned as a desirable feature.

## V. CONCLUSION

This study focused on creating, developing, and assessing a versatile smart grocery app framework that emphasizes AI functionalities, ethical considerations, and accessibility. In contrast to conventional grocery applications that tend to prioritize aggressive profit strategies and standard features, this framework incorporates voice-enabled organization, AI-driven recipe recommendations, and real-time budget monitoring, all while following user-centered design principles.

Utilizing Android for the user interface and Supabase as a reliable open-source backend, the prototype illustrated that it is possible to build effective yet lightweight systems without sacrificing performance. The modular nature of the framework allows for flexibility, making it suitable for various settings whether for private users, groups of students, or larger community food access initiatives.

Perhaps the most important aspect of this project is its commitment to an ethically driven design approach. In an era where deceptive practices and manipulative user interface strategies are frequent, this app framework presents a clear, respectful, and inclusive option. This ethical framework, paired with intelligent automation and user-friendliness, could set new standards in the grocery and retail technology fields.

In summary, the suggested framework serves not only as a prototype but also as a fundamental resource for developers and researchers who wish to create impactful, user-centric grocery applications. Future developments could include features such as multilingual voice capabilities, AI-oriented nutrition tracking, and machine learning technologies for customized grocery optimization.

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