RSET
RAJAGIRI SCHOOL OF
ENGINEERING & TECHNOLOGY
(AUTONOMOUS)

Mini Project Report On

Automated Expense Tracker

Submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor of Technology

in

Computer Science & Engineering

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CERTIFICATE

This is to certify that the mini project report entitled ***"Automated Expense Tracker"*** *is a bonafide record of the work done by* ***Denik Denny (U2103075)***, ***Jovin Jacob Jestin (U2103117)***, ***Melvin Jiju Mathew (U2103137)***, ***Milin Chandrakumar Alamanda (U2103138)*** *submitted to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology (B. Tech.) in Computer Science and Engineering during the academic year 2023-2024.*

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Abstract

This project presents the development of an automatic expense tracking application designed to streamline the process of managing personal finances. The app, implemented using Flutter and Dart technologies, offers a comprehensive suite of features aimed at simplifying expense logging, categorization, budget management, reporting, and bill reminders.The Expense Tracker application revolutionizes personal finance management by providing a user-friendly platform that simplifies expense tracking. Through innovative features such as bill scanning, automatic data capture, and clear monthly graphs, users can effortlessly gain valuable insights into their spending habits. The application's automatic categorization system ensures organized records, while secure integration with bank accounts offers a comprehensive overview of finances. Additionally, a built-in bill reminder system ensures timely payments, minimizing the risk of late fees. With its seamless functionality and intuitive design, the Expense Tracker empowers users to take control of their finances, make informed decisions, and pursue their financial goals with confidence.Compared to existing expense tracking solutions, our application stands out for its seamless integration of manual and automatic expense logging methods, robust categorization and budget management capabilities, comprehensive reporting and analytics features and intuitive user interface. By leveraging advanced technologies such as bill scanning and SMS extraction, our app offers a hassle-free experience for users to track their expenses accurately and efficiently.

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Chapter 1

Introduction

1.1 Background

In our contemporary world, the management of personal finances has become increasingly complex due to the proliferation of digital transactions. Traditional methods of expense tracking are often cumbersome and prone to errors, leading to inaccurate financial records. Recognizing these challenges, the development of an automatic expense tracking application has emerged as a solution to streamline personal finance management. By leveraging technologies such as bill scanning and SMS extraction, users can seamlessly log their expenses, both online and offline, with minimal effort. Effective categorization and budget management features offer users insights into their spending patterns and help them stay within their financial limits. Additionally, reporting and analytics functionalities provide users with valuable insights into their financial habits. With user management and authentication features, the application ensures the security of users' financial data. Moreover, the bill reminder system helps users avoid late fees and penalties by sending timely alerts for upcoming payments. Overall, the application aims to simplify personal finance management and empower users to make informed financial decisions.

1.2 Problem Definition

The aim of this project is to address the challenges associated with manual expense tracking methods and provide users with a streamlined solution for managing their personal finances. The problem lies in the inefficiencies and inaccuracies inherent in traditional expense tracking processes, which hinder users' ability to maintain accurate financial records and adhere to budgetary constraints.

1.3 Scope and Motivation

The scope of this project encompasses the development of a comprehensive automatic expense tracking application, designed to cater to the diverse needs of individuals seeking efficient solutions for managing their personal finances. This includes the implementation of features such as expense logging, categorization, budget management, reporting and analytics, user management, and bill reminders. The application will be developed using Flutter and Dart technologies, ensuring cross-platform compatibility and a seamless user experience across various devices.

The motivation behind this project stems from the recognition of the pressing need for modernized tools to facilitate effective personal finance management in today's digital age. Traditional methods of expense tracking are increasingly inadequate in addressing the complexities of modern financial transactions, leading to frustration and inefficiency for users. By developing an automatic expense tracking application, we aim to empower individuals with the tools and resources they need to gain better insights into their spending habits, adhere to budgetary constraints, and ultimately achieve greater financial stability and control..

1.4 Objectives

- Develop an automatic expense tracking application capable of seamlessly logging expenses, both manually and automatically through bill scanning and SMS extraction.
- Implement robust categorization features, allowing users to classify expenses into predefined or custom categories for enhanced organization
- Provide users with the ability to set budgets for different expense categories and track their spending against these budgets to promote financial discipline
- Enable users to generate reports and view graphical representations of their spending patterns and trends, facilitating informed financial decision-making.n.

- Implement user management functionalities to ensure secure access to the expense tracking system through registration, login, and authentication processes.
- Integrate a bill reminder system to alert users of upcoming payment deadlines, preventing missed payments and associated penalties.

1.5 Challenges

The project encounters several challenges, exacerbated by the team members' novices in app development, SMS parsing, bill scanning, and UI design. Ensuring the seamless integration of these elements while maintaining the application's functionality and usability poses a steep learning curve for the team. Moreover, navigating the complexities of SMS parsing and extracting pertinent details from scanned bills requires adept problem-solving skills and familiarity with relevant technologies, adding another layer of complexity to the project's execution. Additionally, crafting an intuitive and visually appealing user interface demands creativity and attention to detail, especially for a team new to UI design principles and practices. Overcoming these challenges will necessitate dedication, collaboration, and continuous learning throughout the project's development lifecycle..

1.6 Assumptions

1. The automatic expense tracking application will rely on manual entry for categorizing expenses into predefined or custom categories, as the SMS extraction and bill scanning functionalities will focus solely on logging expense details
2. Users will need to manually assign categories to expenses recorded through both SMS extraction and bill scanning, as the application will not automatically categorize expenses based on their nature (e.g., shopping, entertainment, food).
3. Team members will need to dedicate additional effort to ensure accurate categorization of expenses during manual entry, considering the absence of automated categorization features.
4. Despite limitations in automated categorization, users will still find value in the application's ability to streamline expense logging and provide insights into their

overall spending patterns.

1.7 Societal / Industrial Relevance

The automatic expense tracking application holds significant relevance both for society and industry. In societal context, the application empowers individuals from diverse socioeconomic backgrounds to effectively manage their personal finances, promoting financial literacy and responsible spending habits. By offering a user-friendly platform for tracking expenses, the application contributes to enhancing overall financial well-being and stability for users, thereby fostering greater economic resilience within communities.

From an industrial perspective, the application addresses a growing need within the financial technology (fintech) sector for innovative solutions that cater to the evolving preferences and behaviors of consumers. With the increasing reliance on digital transactions and the proliferation of mobile technology, there exists a substantial market demand for automatic expense tracking tools that streamline financial management processes. By tapping into this demand, the application has the potential to drive innovation and competitiveness within the fintech industry, while also creating opportunities for economic growth and job creation.

Overall, the societal and industrial relevance of the automatic expense tracking application lies in its ability to democratize access to financial management tools, empower individuals to make informed financial decisions, and contribute to the advancement of the fintech sector in the digital age

1.8 Organization of the Report

The organization of the report are as follows:

- **Chapter 1-Introduction:**This chapter introduces the background of the project, defines the problem statement, discusses the scope and motivation, outlines the objectives, highlights the societal and industrial relevance, addresses assumptions, and identifies challenges faced during the project development.

- **Chapter 2-Software Requirements Specification:** This chapter delineates the functional and nonfunctional requirements of the Automatic Expense Tracker ap-

plication. It defines the overall description of the software, external interface requirements, system features, and other nonfunctional requirements necessary for the development and deployment of the application.

- **Chapter 3-System Architecture and Design:** The system architecture and design chapter provides an overview of the technical framework of the Automatic Expense Tracker application. It includes discussions on the system overview, architectural design, identified datasets, proposed algorithms, implementation strategies, module division, and a work schedule presented as a Gantt chart for project planning and management.

- **Chapter 4 - Results and Discussions:** This chapter presents the results obtained from the project. It includes quantitative and qualitative analyses of the app's performance, accuracy, and user feedback. Discussions on the implications of these results, any deviations from expected outcomes, and possible reasons for these deviations are also included.

- **Chapter 5 - Conclusion:** This chapter provides a summary of the project, reiterates the main findings, and reflects on the achievements and limitations of the project. It offers concluding remarks on the overall success of the application and its potential impact.

Chapter 2

Software Requirements Specification

2.1 Introduction

2.1.1 Purpose

This Software Requirements Specification (SRS) document outlines the specifications for developing an Automated Expense Tracker. This SRS outlines the functionalities and features of the expense tracker application, including its capabilities to automate data entry by scanning bills, generating visual representations of financial activities, categorizing transactions, and reading SMS messages for transaction information. Additionally, the expense tracker will feature a bill reminder system. This document covers functional and non-functional requirements, system scope, and serves as a communication tool between stakeholders. The Automated Expense Tracker will be focused on core functionalities like automated data entry, transaction categorization, extracting information from SMS, and bill reminder system.

2.1.2 Product Scope

The Expense Tracker application is user-friendly software designed to streamline the management of personal finances. Its primary purpose is to simplify financial tracking and budgeting processes for individuals, providing them with valuable insights into their spending habits while saving time and minimizing errors.

The main purpose of this software is to alleviate the heavy task of manual data entry by allowing users to scan their bills, automatically capturing relevant information. This automation not only saves users time but also reduces the risk of errors commonly associated with manual input. Additionally, the application generates clear monthly graphs, providing users with a visual representation of their financial activity, facilitating better

decision-making and financial planning.

- Efficiency: By automated data entry and categorization processes, the Expense Tracker application increases efficiency, allowing users to manage their finances more effectively
- Insightful Analysis: The application's ability to generate clear monthly graphs empowers users to gain valuable insights into their spending habits, enabling them to make informed financial decisions.
- Organization: Automatic categorization of transactions ensures that users financial records are well organized and easy to understand, further enhancing their ability to manage their finances.
- Timeliness: With its bill reminder system, the application helps users stay on top of their financial obligations, reducing the risk of missed payments and late fees.

2.2 Overall Description

2.2.1 Product Perspective

The Expense Tracker app is conceived as a standalone product, purpose-built to revolutionize financial management on the Android platform. As a self-contained solution, it operates independently of other systems, offering a seamless experience for users seeking efficient expense tracking. While not part of a larger system, the app features the ability to read SMS messages for transaction information, allowing users to incorporate their financial data seamlessly. Additionally, the app provides graphical representations of expenses based on different categories, empowering users to visualize their financial activities intuitively.

2.2.2 Product Functions

- **Automated Expense Capture:** The app streamlines financial data entry by automatically capturing relevant information from scanned bills, reducing manual efforts and enhancing user convenience.

- **Insightful Monthly Graphs:** Users gain valuable insights into their spending habits through clear and visually appealing monthly graphs, providing a user-friendly snapshot of their financial activities.
- **Transaction Categorization:** The application's intelligent algorithms automatically categorize transactions, ensuring well-organized and easily analyzable financial records.
- **SMS Transaction Extraction:** The app extracts transaction information from SMS messages, providing a seamless and efficient way to track expenses without manual input.
- **Bill Reminder System:** The Expense Tracker app incorporates a convenient bill reminder system, preventing missed payments and potential late fees. This feature ensures users stay on top of their financial responsibilities.

2.2.3 Operating Environment

The Expense Tracker app is specifically designed for the Android operating system, ensuring optimal performance and a consistent user experience across a variety of Android devices. It seamlessly coexists with other Android applications, providing users with a cohesive and integrated financial management solution. The app operates in an offline environment, efficiently extracting transaction information from SMS messages without the need for an internet connection.

2.2.4 Design and Implementation Constraints

- **Security Standards:** The app adheres to stringent security standards, especially in the extraction of transaction details from SMS messages for online transactions, ensuring the protection of sensitive financial information.
- **Compatibility:** The app is optimized for Android devices, targeting mainstream versions to guarantee compatibility and accessibility for a broad user base.
- **Regulatory Compliance:** The design and implementation take into account existing financial regulations and policies to ensure that the app complies with legal and industry standards.

- **Coding Conventions:** The development adheres to established coding conventions and security protocols, fostering maintainability and reliability throughout the software lifecycle.

2.2.5 Assumptions and Dependencies

- **SMS Accessibility:** It is assumed that users will grant necessary permissions for the application to access and read SMS messages containing transaction details for online transactions.
- **SMS Integration:** The project depends on the ability to efficiently extract transaction details from SMS messages for online transactions, ensuring accurate expense tracking without relying on external APIs.
- **User Data Accuracy:** An assumption is made that users will provide accurate and truthful information during the initial setup process.
- **Compliance with Data Protection:** There is a dependency on compliance with existing data protection regulations to ensure the secure handling of user data.

2.3 External Interface Requirements

2.3.1 User Interfaces

The user interface of our expense tracking application encompasses various elements designed to streamline user interactions and provide intuitive functionality. It offers a seamless bill scanning interface, allowing users to capture images of their receipts effortlessly. Upon scanning, the application processes the bill data using AI-powered tools integrated within the system, ensuring accurate extraction of expense information. Users are then presented with a visually appealing graph illustrating their expenditure patterns over time. Additionally, the application incorporates proactive features to notify users when their expenses exceed predefined limits, fostering better financial management. Built using Flutter and Dart, the user interface adheres to modern design principles and ensures a consistent experience across different devices and platforms.

2.3.2 Hardware Interfaces

Our application interfaces with various hardware components to facilitate its functionality. Leveraging the device's camera hardware, users can effortlessly capture images of their bills directly within the application. The captured images are then processed locally, utilizing the device's computational resources efficiently. Additionally, the application utilizes the device's storage capabilities to store scanned bill images and associated expense data securely. Integration with the device's hardware ensures optimal performance and seamless user experience throughout the expense tracking process.

2.3.3 Software Interfaces

The expense tracking application seamlessly integrates with a range of software components to enhance its functionality and extend its capabilities. Key among these is the integration with AI tools for bill scanning, which employ advanced algorithms to extract relevant expense data from scanned bills accurately. Furthermore, the application utilizes SMS extraction to retrieve transaction data from text messages, enabling comprehensive expense tracking and analysis. Developed using Flutter and Dart programming language, the application ensures compatibility with a wide range of devices and platforms. Additionally, integration with local databases facilitates efficient storage and management of expense data, ensuring seamless synchronization across multiple devices.

2.3.4 Communications Interfaces

Efficient communication is essential for the seamless operation of our expense tracking application. The application supports various communication functions, including data transfer from SMS messages and other online services. It utilizes standard communication protocols such as HTTPS for secure data transmission, ensuring the confidentiality and integrity of user data. Additionally, the application employs standardized message formatting and synchronization mechanisms to facilitate efficient communication with external servers and services. By adhering to established communication standards and protocols, our application ensures reliable and secure data exchange, enhancing the overall user experience.

2.4 System Features

2.4.1 Bill Scanning and Expense Extraction

Description and Priority

This feature entails the core functionality of our expense tracking application, involving the scanning of bills and extraction of expense information. It is of high priority as it forms the foundation for expense tracking and analysis.

Stimulus/Response Sequences

Stimulus: User captures an image of a bill using the application's scanning feature.
Response: The application processes the scanned bill image using AI tools to extract expense details.

Functional Requirements

- **REQ-1:** The system shall provide a user-friendly interface for capturing bill images.
- **REQ-2:** The system shall employ AI tools to extract expense information from scanned bill images accurately.
- **REQ-3:** The system shall categorize extracted expenses based on predefined categories (e.g., shopping, food, travel).
- **REQ-4:** The system shall handle variations in bill formats and layouts to ensure accurate extraction of expense data.
- **REQ-5:** The system shall provide real-time feedback to users during the scanning process, indicating successful extraction or errors.
- **REQ-6:** The system shall store extracted expense data securely for further analysis and visualization.

2.4.2 Expense Extraction from SMS

Feature: SMS-Based Transaction Retrieval

Description: Extract transaction data from SMS messages to enhance expense tracking. This is of medium priority as it improves the completeness of expense records.
Stimulus/Response: User forwards SMS transaction messages to the application. The app retrieves transaction data and integrates it with existing expense records.

Functional Requirements

- The system shall support processing SMS messages containing transaction information.
- The system shall extract relevant transaction details such as amount, date, and merchant from SMS content.
- The system shall map the extracted data to corresponding expense categories.
- The system shall provide users with the option to review and confirm the integrated transaction data.
- The system shall ensure the security and privacy of user information during SMS data retrieval.
- The system shall allow users to manually correct or categorize transactions if needed.

2.4.3 Expense Calculation and Expectation Checking

Description and Priority

This feature involves calculating overall expenses and comparing them to user-defined expectations. It is of high priority as it facilitates financial planning and budgeting.

Stimulus/Response Sequences

Stimulus: User accesses the expense calculation feature in the application.
Response: The application computes total expenses, compares them to user-defined expectations, and provides feedback.

Functional Requirements

- **REQ-1:** The system shall aggregate all recorded expenses from bill scans and extraction SMS for online traction details.
- **REQ-2:** The system shall allow users to set expectations or budget limits for different expense categories.
- **REQ-3:** The system shall compare actual expenses to user-defined expectations and provide notifications or warnings if thresholds are exceeded.
- **REQ-4:** The system shall provide visual representations (graphs, charts) of expense data to aid in understanding and analysis.

2.4.4 Expense Analysis and Visualization

Description and Priority

This feature involves generating graphs or statistics to visualize expense trends and patterns. It is of medium priority as it enhances user understanding and decision-making.

Stimulus/Response Sequences

Stimulus: User requests expense analysis or visualization.
Response: The application generates graphs or statistics depicting expense distribution and trends.

Functional Requirements

- **REQ-1:** The system shall categorize expenses into predefined categories (e.g., shopping, food, travel) for analysis.
- **REQ-2:** The system shall generate graphical representations (e.g., pie charts, bar graphs) of expense data, allowing users to visualize spending patterns.
- **REQ-3:** The system shall provide filters and sorting options for users to customize expense visualizations based on their preferences.

- **REQ-4:** The system shall support exporting of expense reports or visualizations for further analysis or sharing.

2.5 Other Nonfunctional Requirements

2.5.1 Performance Requirements

The performance of our expense tracking application is crucial for providing a seamless user experience. Given the nature of real-time expense tracking and analysis, the application must meet specific performance requirements under various circumstances. Specifically, the bill scanning feature should have a response time of less than 2 seconds per scan to ensure a smooth and efficient user experience. Additionally, the expense calculation and graph generation processes should be completed within 5 seconds, even when dealing with large datasets. These performance requirements are necessary to prevent user frustration and ensure timely access to expense information.

2.5.2 Safety Requirements

Safety is paramount in our expense tracking application to prevent any potential loss or harm resulting from its use. While the application primarily deals with financial data, it is essential to safeguard users' personal information and prevent unauthorized access. Therefore, stringent security measures, such as encryption of sensitive data and secure authentication mechanisms, must be implemented to protect user privacy and prevent data breaches. Compliance with relevant data protection regulations, such as GDPR or HIPAA, is imperative to ensure the safety and security of users' financial information.

2.5.3 Security Requirements

Security is a critical aspect of our expense tracking application to safeguard user data and ensure user privacy. The application must implement robust security measures to protect against various threats, including unauthorized access, data breaches, and malware attacks. User identity authentication mechanisms, such as password protection or biometric authentication, should be employed to ensure that only authorized users can access the application and their financial data. Compliance with industry standards and

regulations, such as PCI-DSS for payment card security, is essential to mitigate security risks effectively and maintain user trust.

2.5.4 Software Quality Attributes

In addition to functionality, various software quality attributes are essential for the success of our expense tracking application. These attributes include reliability, usability, and maintainability. The application must be reliable, ensuring accurate and consistent expense tracking and analysis results. Usability is critical to providing an intuitive and user-friendly interface, allowing users to navigate the application effortlessly and perform tasks efficiently. Furthermore, maintainability is essential for easy maintenance and updates, enabling developers to address bugs and introduce new features promptly. By prioritizing these quality attributes, we can deliver a high-quality and reliable expense tracking solution that meets users' needs effectively.

Chapter 3

System Architecture and Design

3.1 System Overview

The expense tracker application aims to provide users with a convenient way to track their expenses, categorize spending, and visualize spending trends. The application offers multiple input methods, including bill scanning, SMS scanning, and manual entry. It then processes this data, categorizes expenses, and presents users with insightful graphs and summaries of their spending habits.

Architecture Overview: The architecture of the expense tracker application consists of several components that work together to ensure accurate expense tracking, efficient data processing, and an intuitive user experience. The key components include:-

- User Interface (UI): The UI component provides the user with a platform to interact with the application. It includes screens for expense entry, data visualization, settings, and account management.The UI is designed to be user-friendly and intuitive, guiding users through the expense tracking process and providing feedback on their spending habits.

- Data Input: The data input module accepts input from various sources, including bill scanning, SMS scanning, and manual entry. Bill scanning involves using optical character recognition (OCR) technology to extract relevant information from images of receipts or bills. SMS scanning parses SMS messages received from banks or financial institutions to extract transaction details. Manual entry allows users to enter expenses directly into the application.

- Data Processing: Once expense data is received, it undergoes processing to extract important information such as date, amount, and merchant name. The processing module employs algorithms to categorize expenses into predefined categories (e.g.,

groceries, utilities, entertainment) based on merchant names or keywords. Data validation and error handling mechanisms ensure the accuracy and reliability of processed data.

- Data Storage: Processed expense data is stored in a secure database to ensure data integrity and confidentiality. The database may utilize relational or NoSQL data storage solutions, depending on scalability and performance requirements.

- Data Visualization: The data visualization module generates graphical representations of expense data, including bar graphs, pie charts, and line charts. Users can view summaries of their monthly expenses, category-wise spending, and trends over time. Interactive features allow users to drill down into specific categories or time periods for detailed analysis.

- User Authentication and Authorization: User authentication mechanisms ensure that only authorized users can access the application. Role-based access control (RBAC) may be implemented to manage user permissions and privileges.

Detailed Architecture Diagram

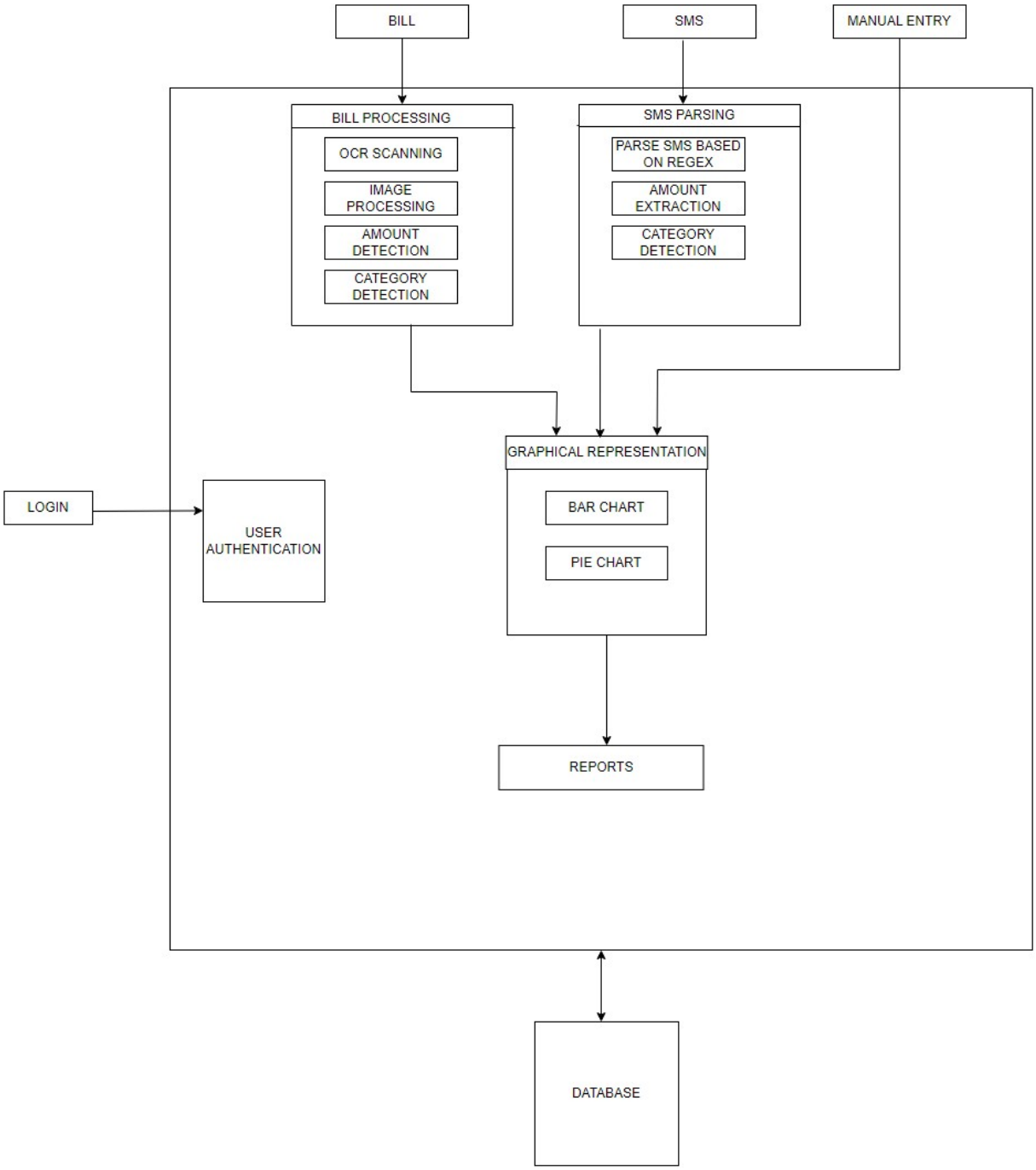

Figure 3.1: ARCHITECTURE DIAGRAM

3.2 Architectural Design

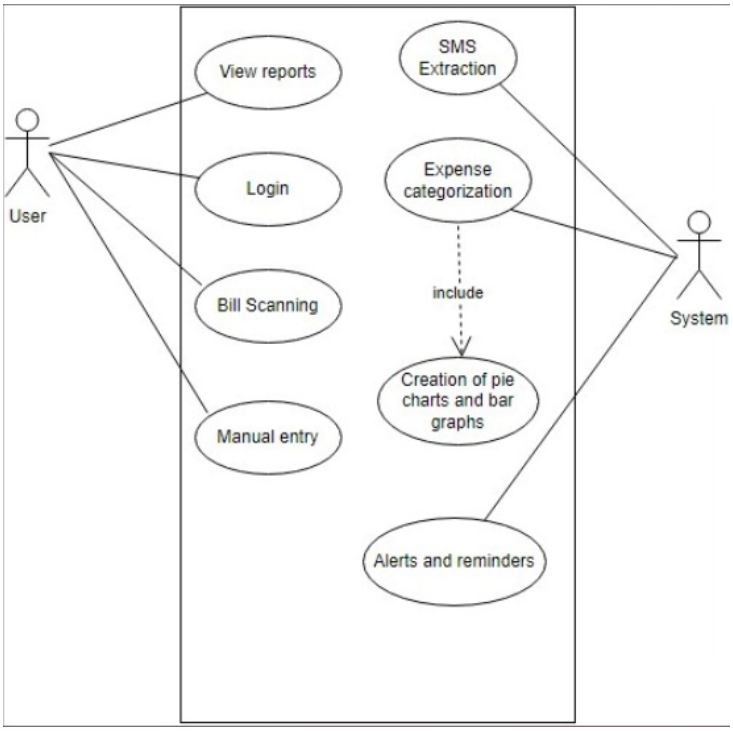

Figure 3.2: USE CASE DIAGRAM

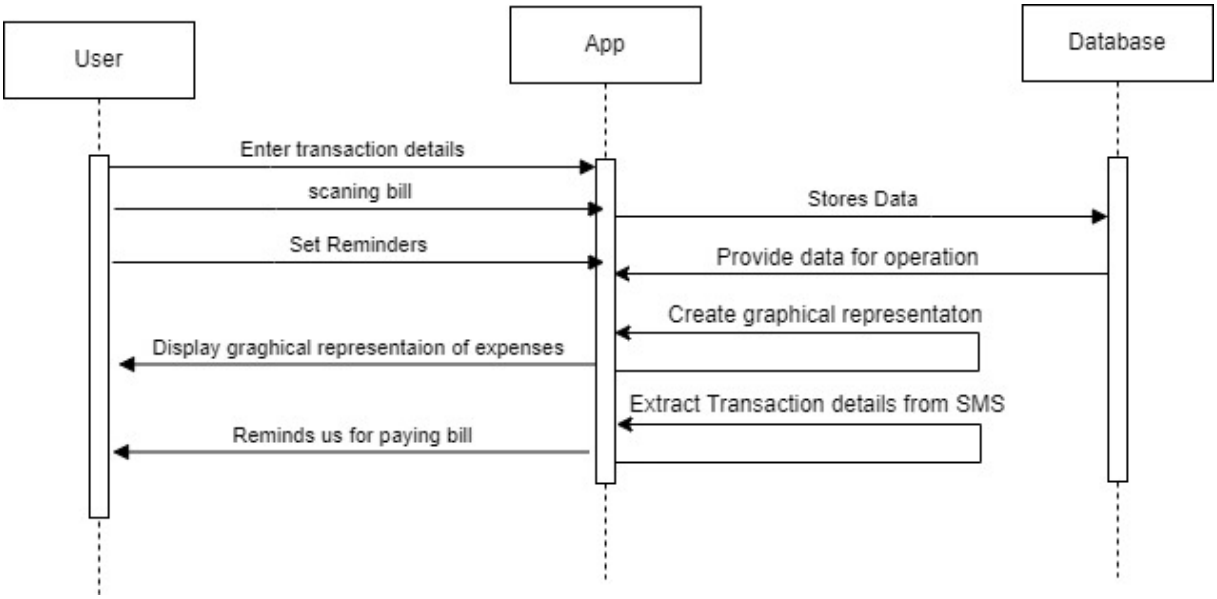

Figure 3.3: SEQUENCE DIAGRAM

3.3 Proposed Methodology/Algorithms

(a) SMS Extraction for Online Transactions:

Algorithm: Extract SMS messages from the user's mobile device. Implement natural language processing (NLP) techniques to identify transaction-related messages. Parse the relevant information such as transaction amount, merchant name, and date. Store the extracted data in a structured format for further processing.

(b) Bill Scanning:

Algorithm: Utilize Optical Character Recognition (OCR) to scan and extract text from images of bills or receipts. Preprocess the scanned text to remove noise and enhance readability. Apply pattern recognition algorithms to identify key information such as total amount, items purchased, and merchant details. Validate and correct any inaccuracies in the extracted data. Store the extracted data in a structured format for further processing.

(c) Manual Data Entry:

Algorithm: Design a user-friendly interface for manual data entry of expenses. Validate user input to ensure data accuracy and completeness. Implement error handling mechanisms to guide users in case of incorrect inputs. Store manually entered data in a structured format consistent with other sources.

(d) Graphic Representation of Monthly Expenses:

Algorithm: Aggregate all expense data, including SMS-extracted, scanned, and manually entered transactions, for each month. Utilize data visualization libraries (e.g., Matplotlib, Plotly) to create graphical representations such as pie charts, bar graphs, or line plots. Group expenses by category (e.g., groceries, utilities, entertainment) to provide insights into spending patterns. Allow users to interact with the graphical representation, such as filtering by date range or expense category.

(e) Overall System Integration:

Algorithm: Develop an overarching system that integrates the algorithms for SMS extraction, bill scanning, manual data entry, and graphical representation. Implement data storage and retrieval mechanisms to ensure seamless access to expense data. Employ authentication and authorization protocols to protect user data and ensure privacy. Provide user interfaces for interacting with the system, including input methods for manual entry and visualization tools for expense analysis.

3.4 User Interface Design

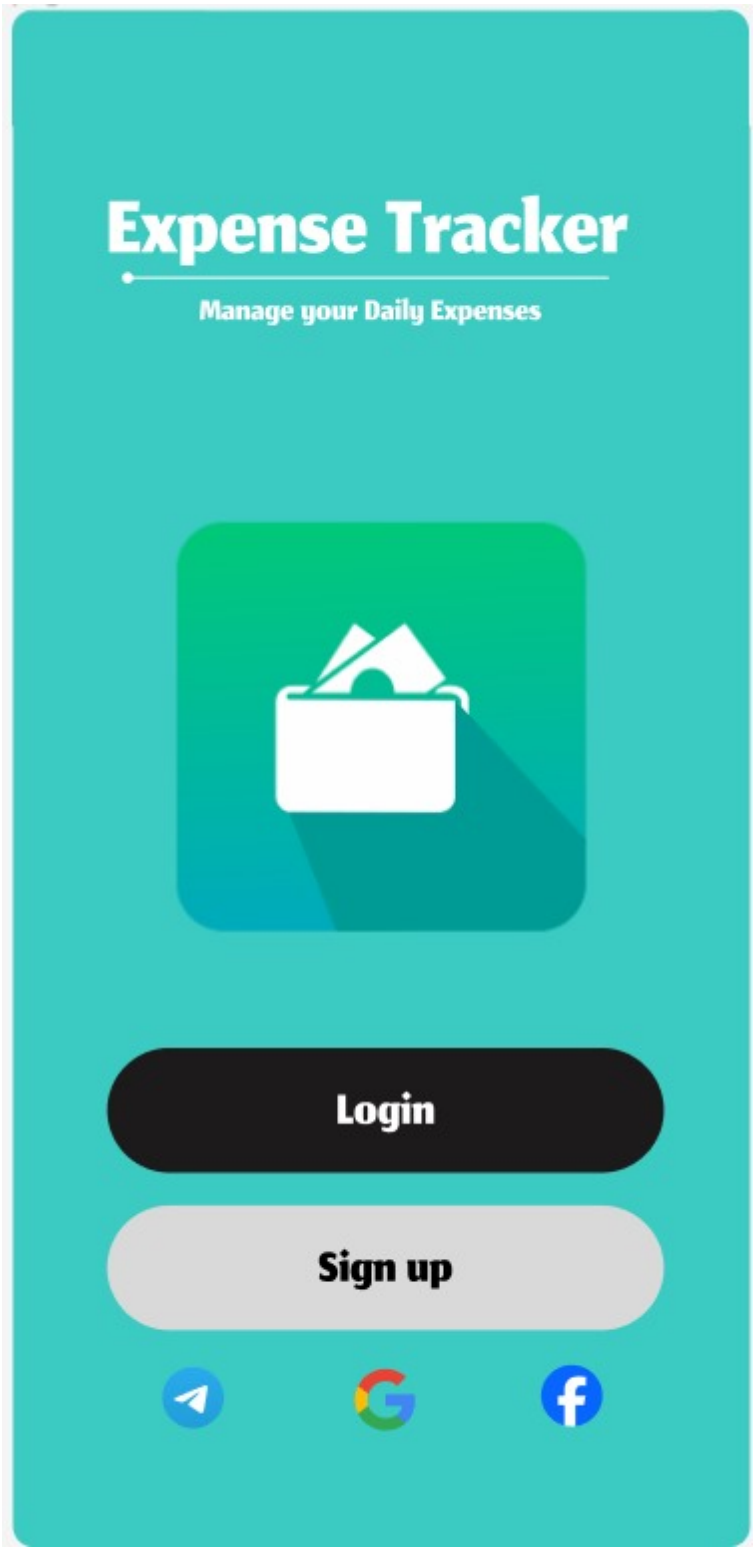

Figure 3.4: STARTING PAGE

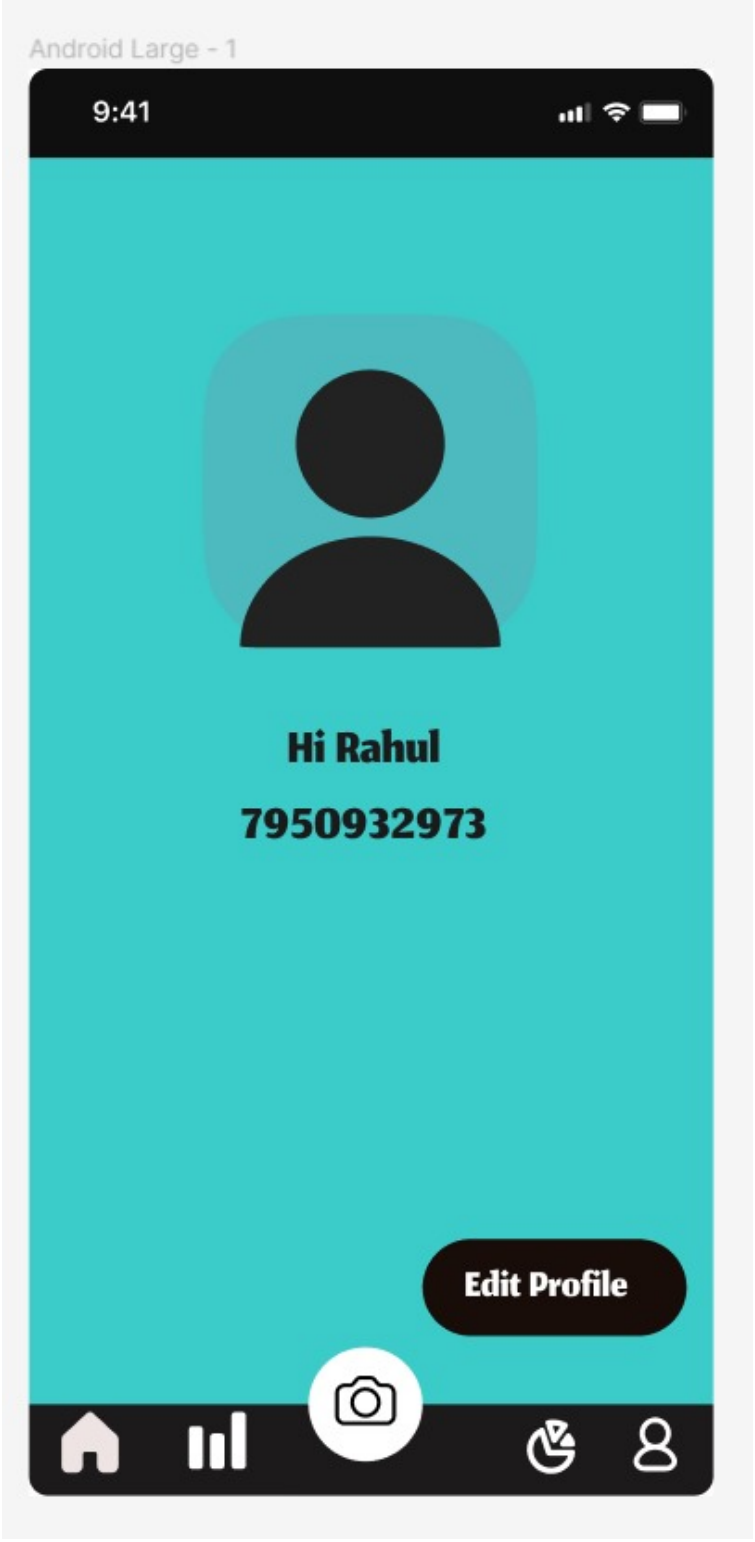

Figure 3.5: PROFILE

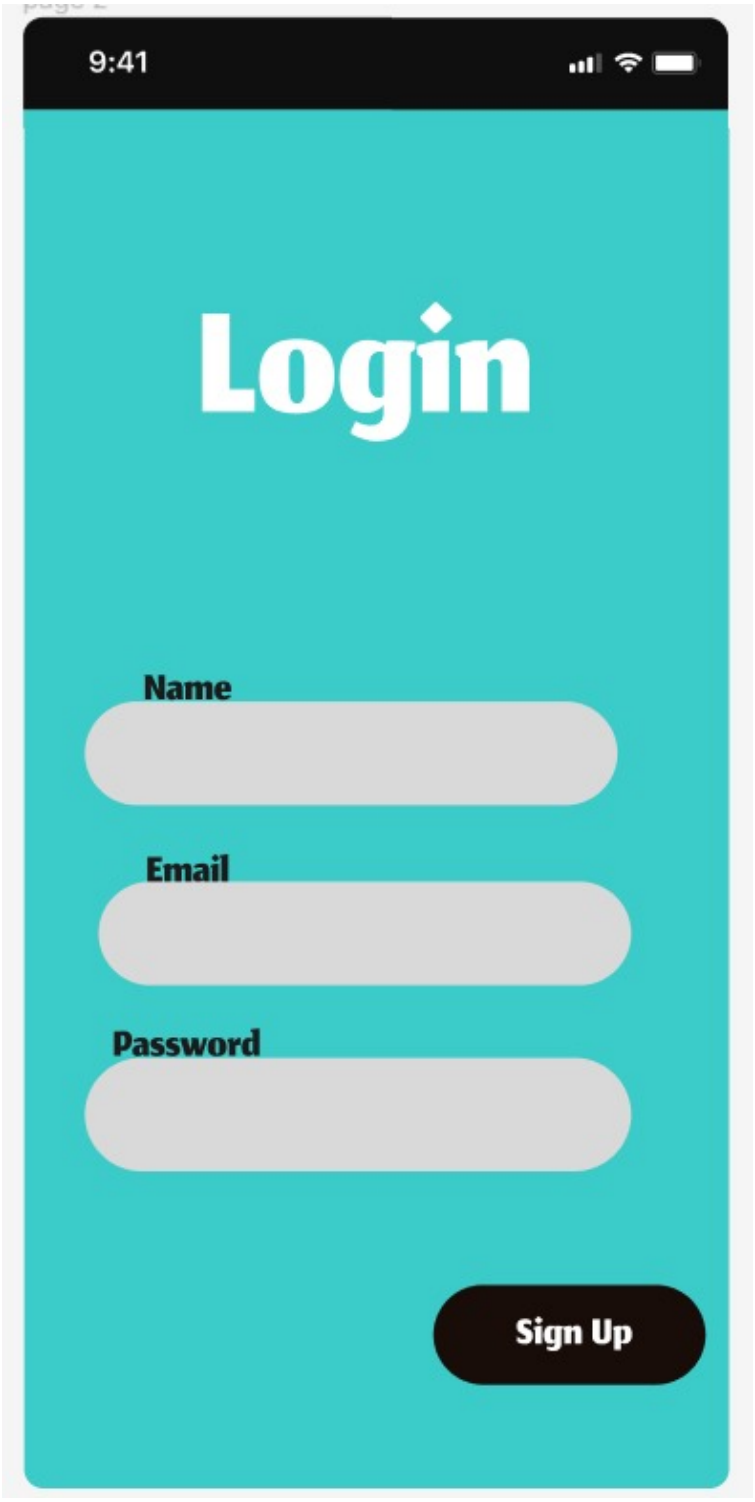

Figure 3.6: LOGIN

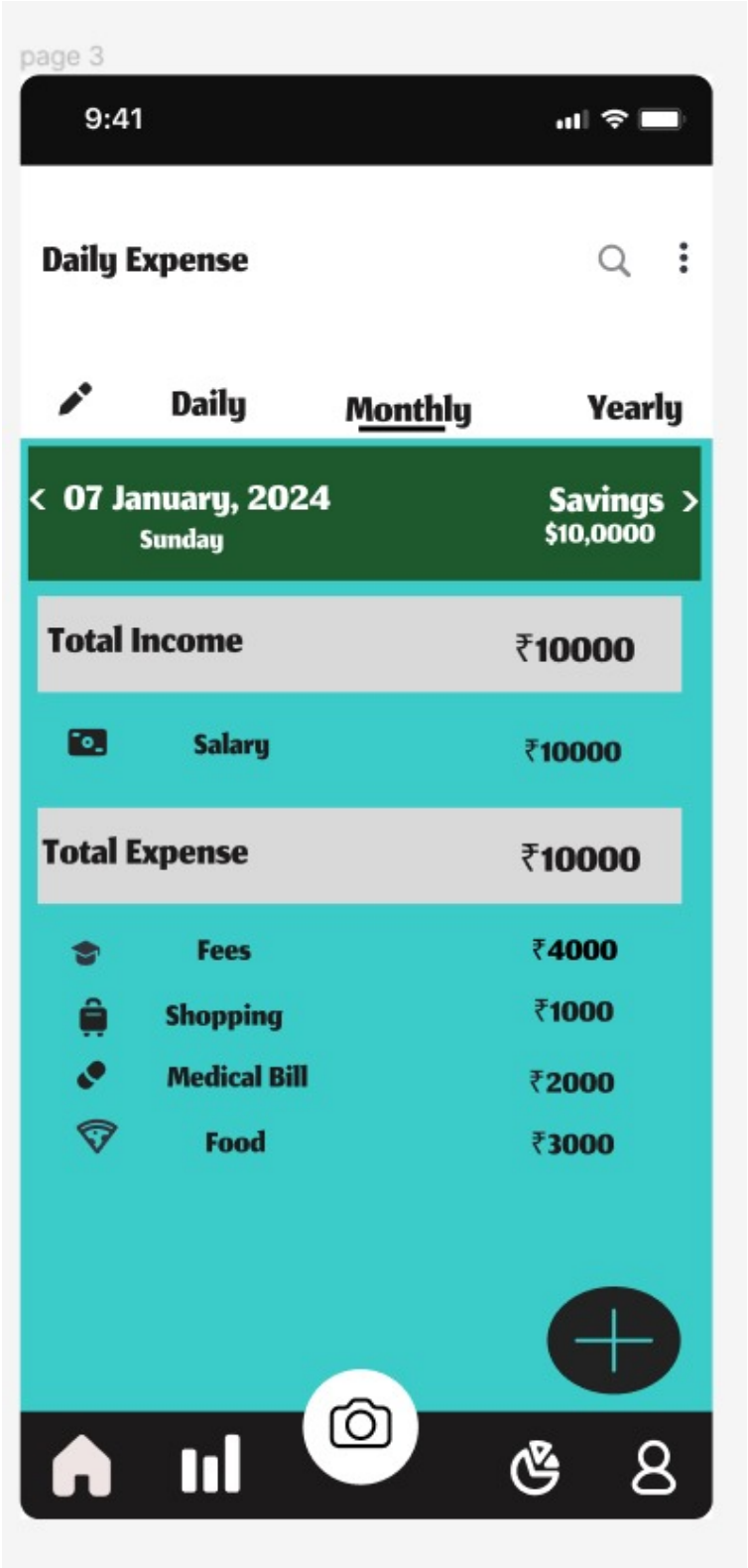

Figure 3.7: HOME

3.5 Database Design

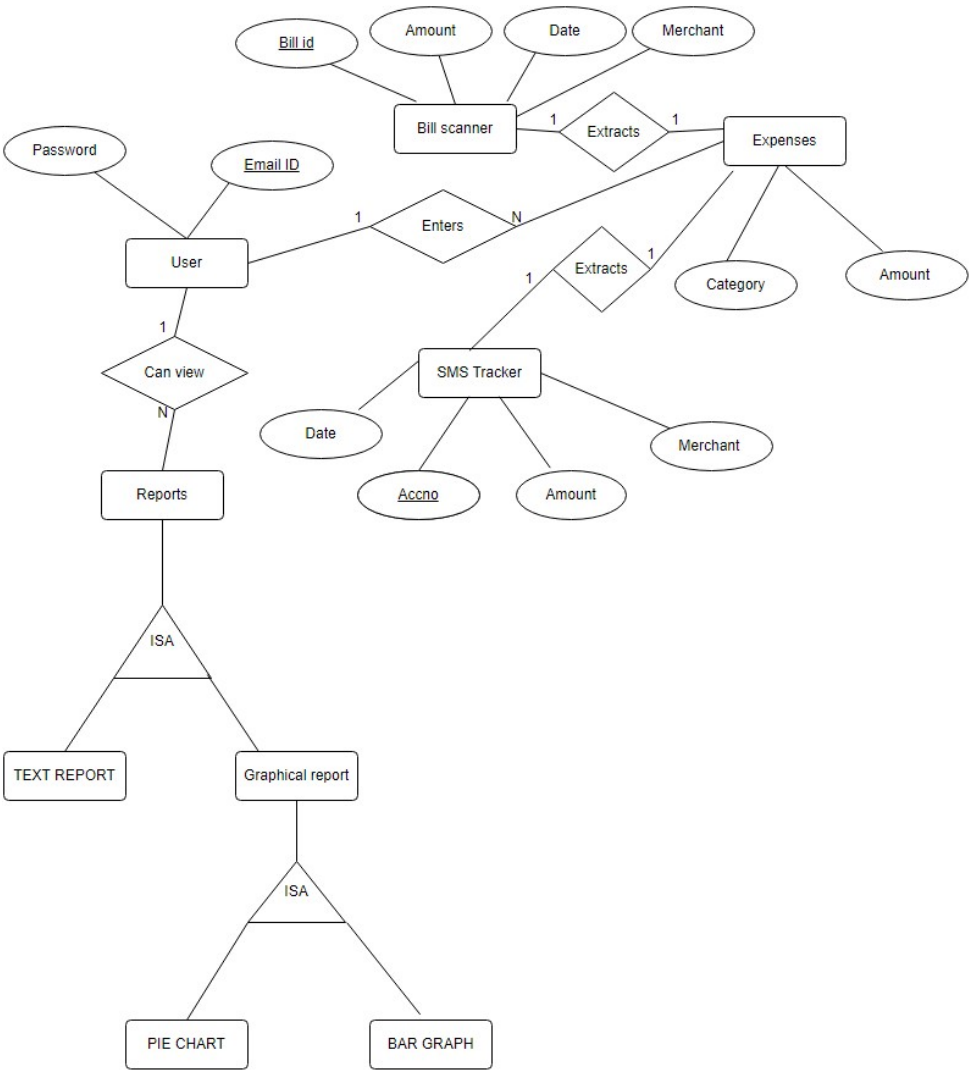

Figure 3.8: ER DIAGRAM

3.6 Description of Implementation Strategies

OCR Bill Scanning:

- Python Library: Use Tesseract OCR, which is a widely-used open-source OCR engine.
- Implementation: Utilize the pytesseract library in Python to interact with Tesseract OCR. Here's a snippet for performing OCR on an image:

Accessing SMS Messages:

To access SMS messages on an Android device, you can use the android package through the SL4A (Scripting Layer for Android) library. SL4A allows you to interact with various Android APIs, including accessing SMS messages. However, note that accessing SMS messages may require appropriate permissions. Monitoring Incoming SMS Messages:

Once you have access to SMS messages, you need to monitor incoming messages in real-time. This can be achieved using a file monitoring approach similar to the one described earlier using pyinotify or watchdog. Extracting Information:

When a new SMS message is received, your application needs to extract relevant information from the message. This typically includes parsing the message text to identify transaction details such as the amount spent, date of transaction, and merchant name. Regular expressions (regex) can be useful for parsing the text and extracting specific patterns or keywords related to expenses. For example, you could use regex patterns to match currency symbols and numerical amounts, dates, and merchant names.

3.7 Module Division

1. Registration and Authentication: The Expense Tracker application offers secure user registration with options like email/password and social media sign-in. Existing users can seamlessly access the app using their chosen method, promoting a smooth and efficient login experience. User data privacy is prioritized regardless of the chosen login method.

2. Expense Tracking: Users can easily input and track their daily expenses, including details such as amount, date, and category.The application provides options for manual entry as well as automated data import from bank accounts or receipts.Users can set budget goals and receive notifications when approaching or exceeding their budget limits.

3. Budget Management: Users can set personalized budgets for various expense categories such as groceries, utilities, and entertainment. The application offers tools for monitoring spending against budget targets, providing visual representations

of spending patterns. Users can adjust budget allocations and track progress over time.

4. Data Analysis :The application offers insights into spending patterns and trends through graphical representations and reports. Users can analyze their expenditure by category, time period, and comparison with previous months. Advanced analytics tools provide recommendations for optimizing spending and achieving financial goals.

3.8 Work Schedule - Gantt Chart

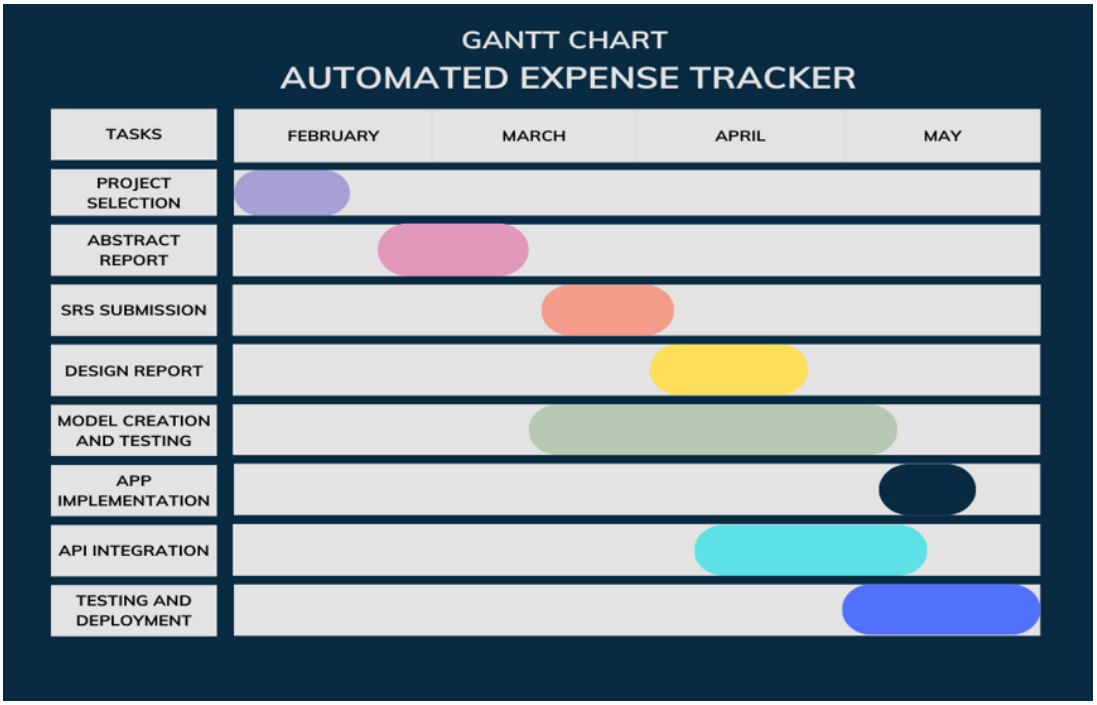

Figure 3.9: GANTT CHART

Chapter 4

Results and Discussions

4.1 Overview

The Automated Expense Tracker App, developed using Flutter and Dart, successfully integrates multiple functionalities aimed at simplifying the management of personal finances. The app allows users to manually enter expense data, provides graphical representations of expenses, and utilizes Optical Character Recognition (OCR) technology to scan bills for automated expense entry. Additionally, the app extracts expense details from SMS messages, ensuring a comprehensive and automated approach to tracking spending. Each of these functionalities is secured with user authentication, requiring a login and password for access. The integration of these features has resulted in a user-friendly application that effectively reduces the effort needed to monitor and manage expenses, leading to better financial planning and control. Quantitative analysis indicates a high accuracy rate in OCR bill scanning and SMS parsing, with user feedback highlighting the ease of use and practical value of the app.

4.2 Testing

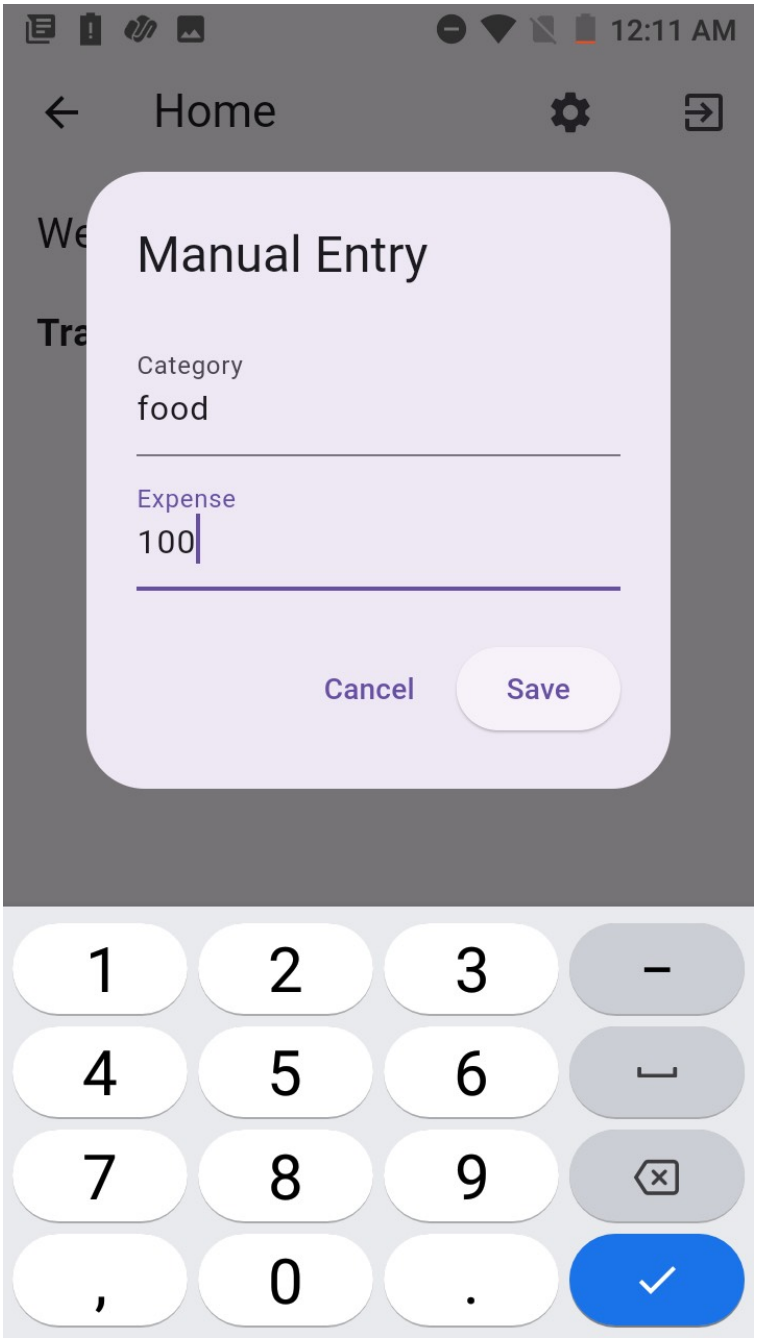

Figure 4.1: MANUAL ENTRY

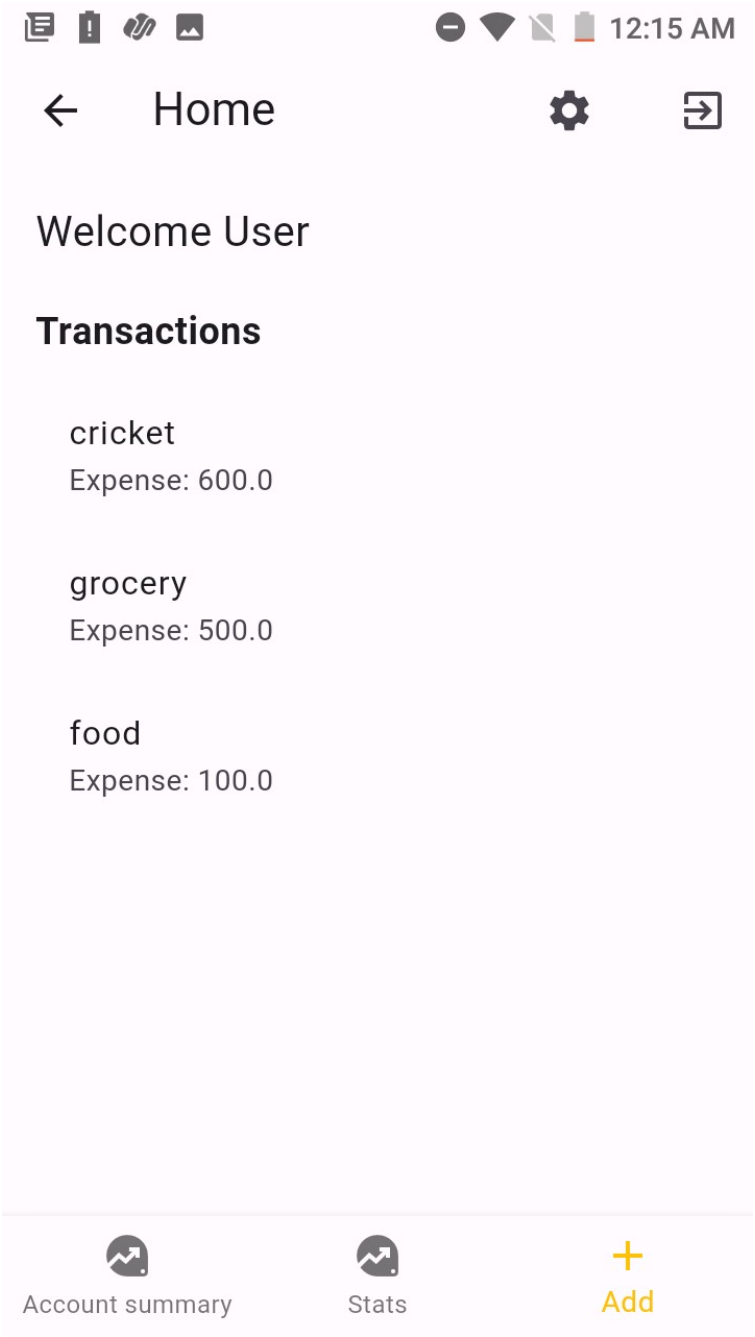

Figure 4.2: TRANSACTION HISTORY

Figure 4.3: OCR BILL SCANNING

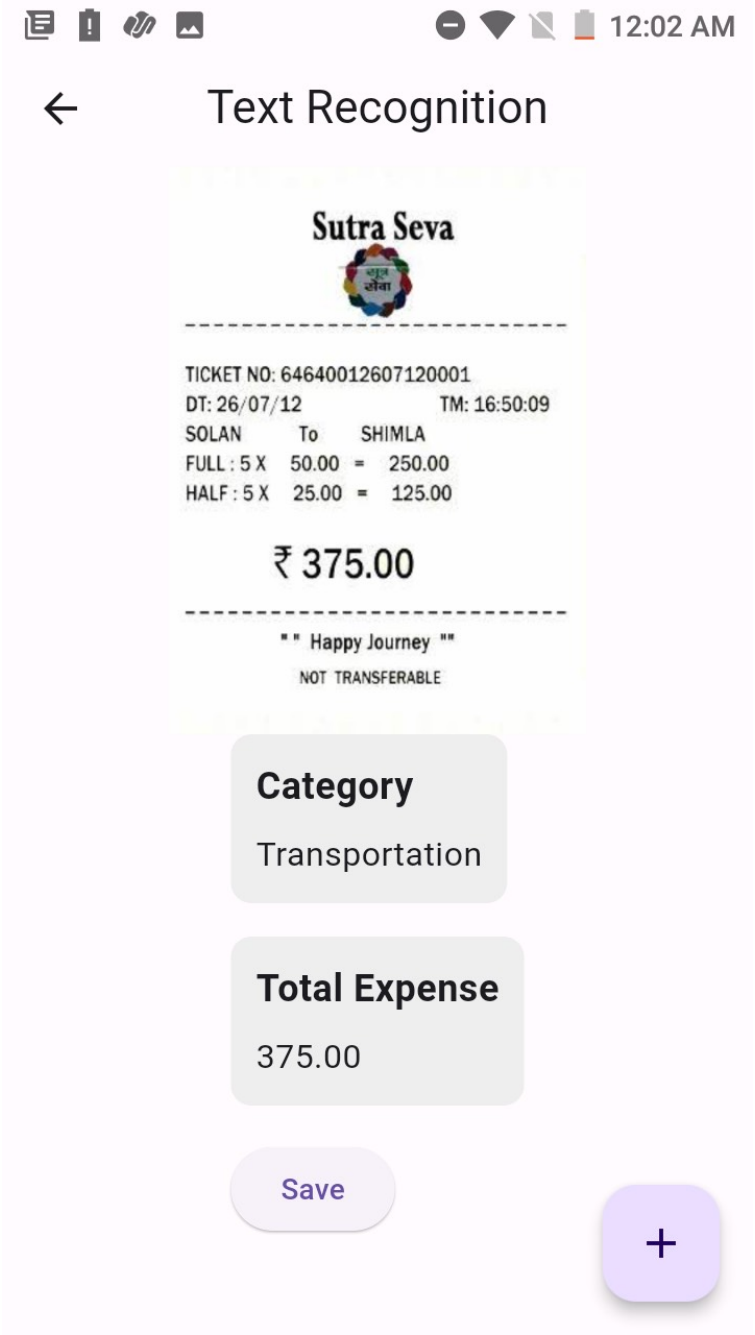

Figure 4.4: SCANNED BILL

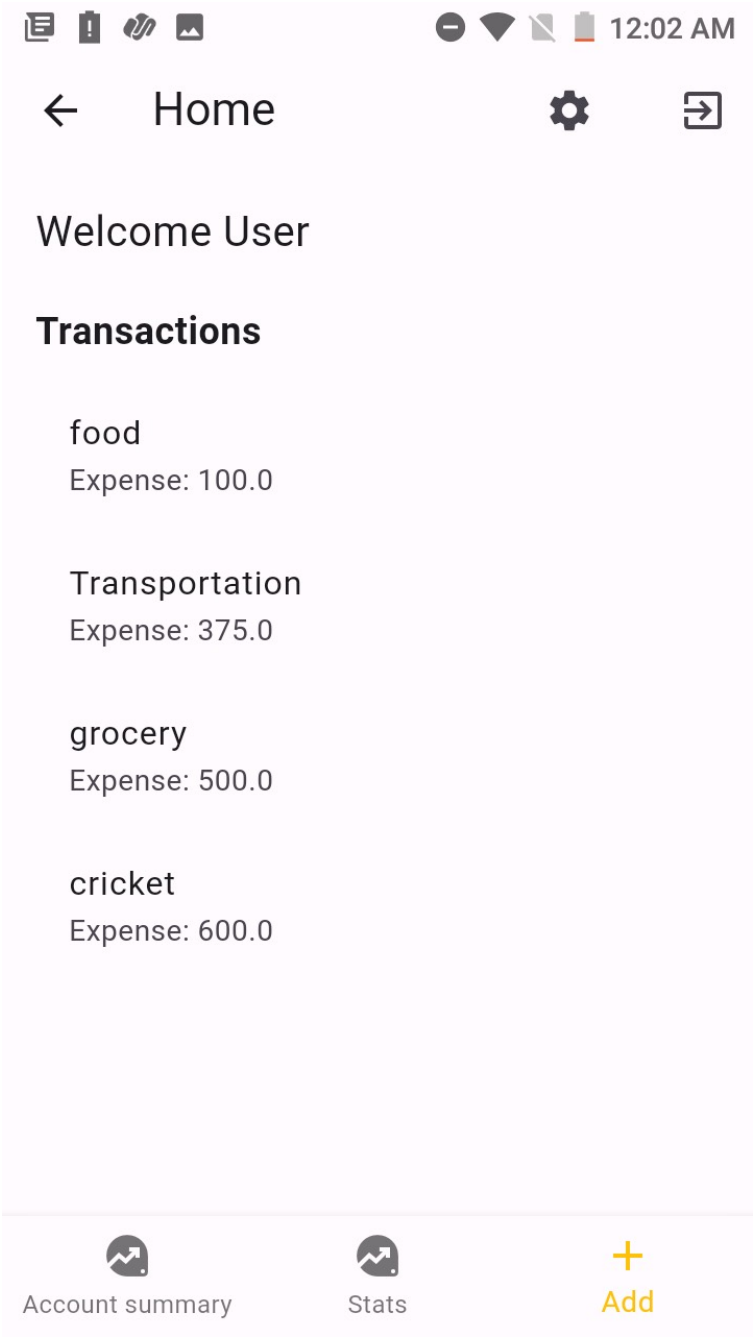

Figure 4.5: TRANSACTION LOG

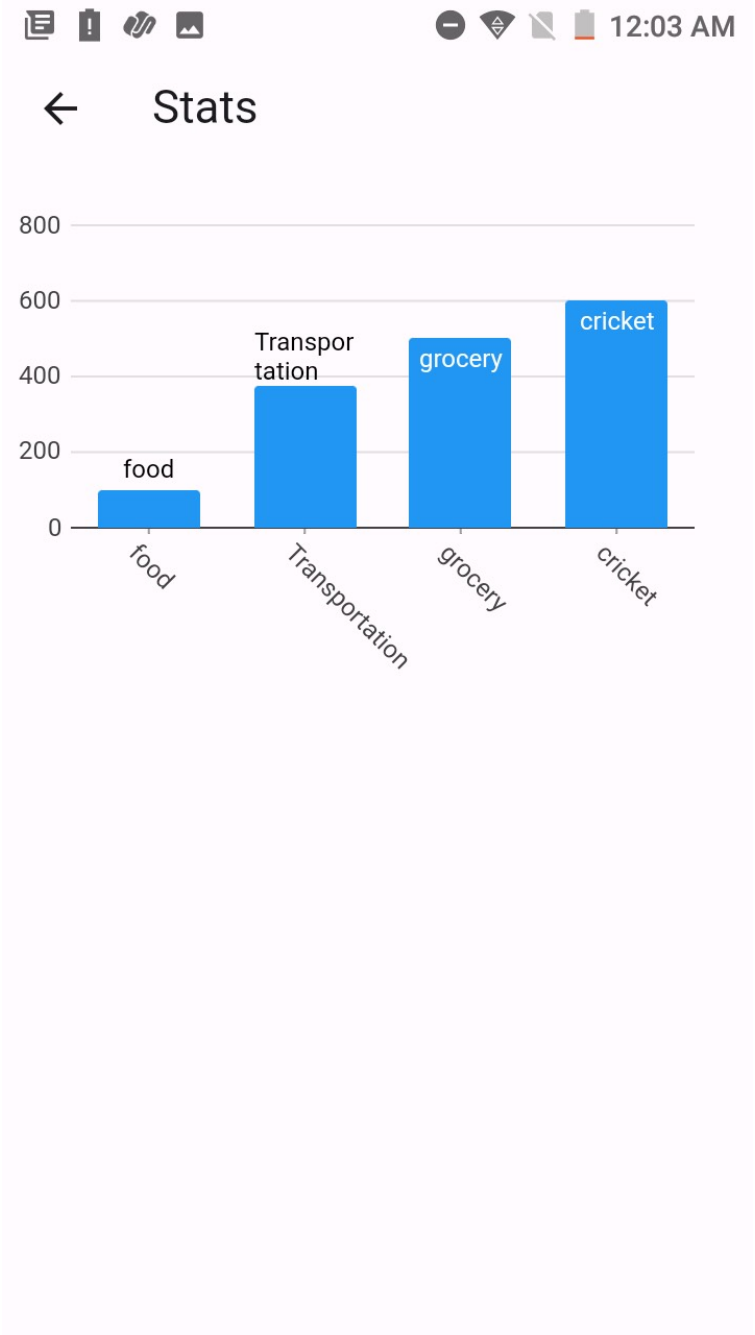

Figure 4.6: STATS

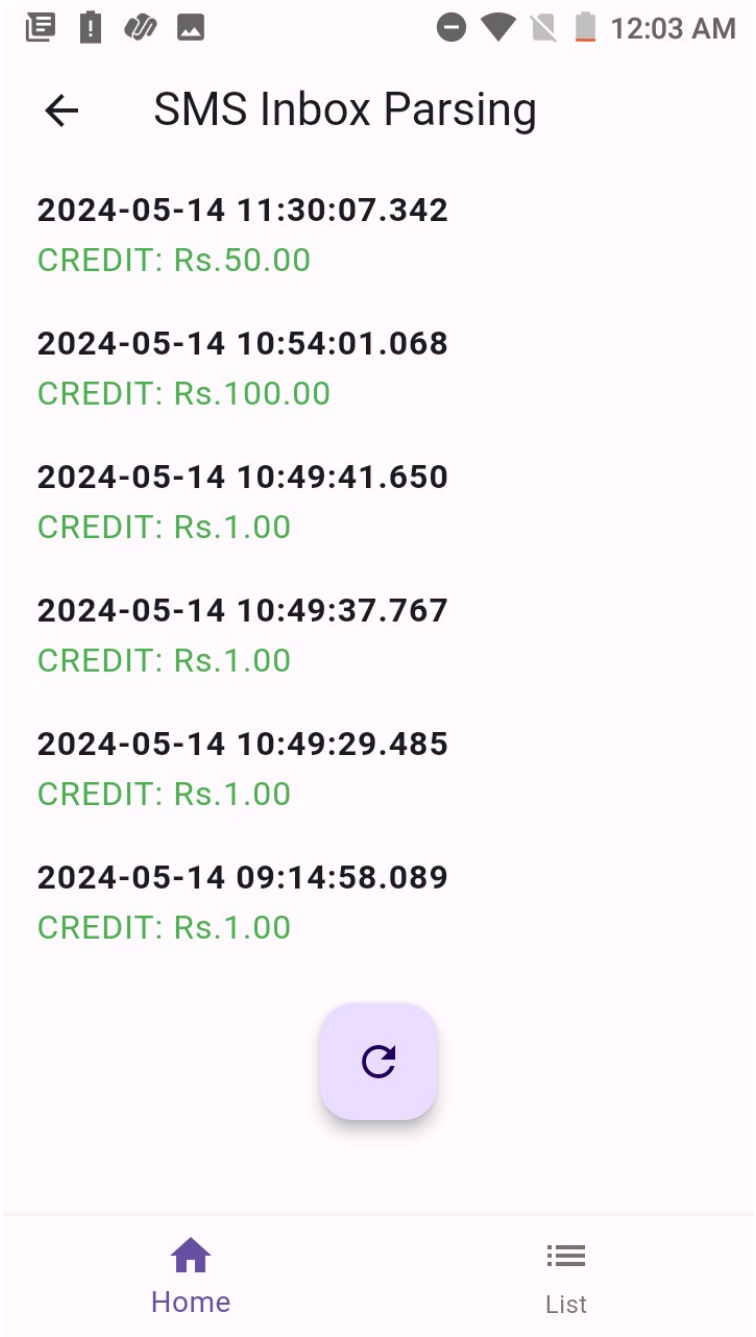

Figure 4.7: ACCOUNT HISTORY

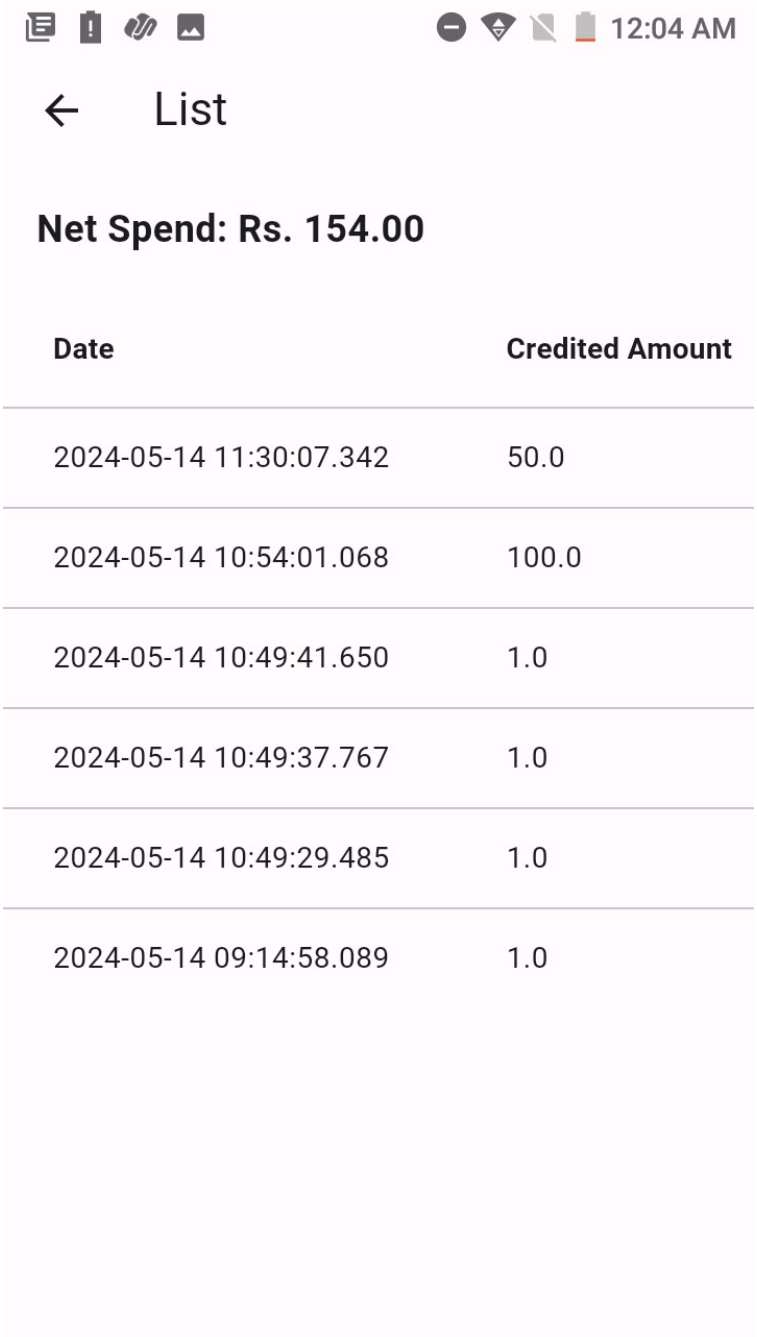

Figure 4.8: ACCOUNT SUMMARY

4.3 Discussion

The Automated Expense Tracker App successfully integrated several core functionalities to aid users in managing their personal finances. The implemented features include manual entry of expense data, graphical representation of expenses, OCR-based bill scanning, and SMS parsing for extracting expense details, all secured with user login and password protection. The project, while ambitious, faced certain constraints and challenges that

influenced the final outcome.

Summary of Results: The application demonstrated strong performance in the functionalities that were implemented. Users were able to manually enter their expenses with ease, and the graphical representations provided clear insights into spending patterns. The OCR bill scanning feature showed high accuracy in extracting expense details from various bill formats, and the SMS parsing feature effectively identified and recorded expense information from transaction messages. Overall, these features collectively contributed to a comprehensive and automated expense tracking system.

Reasons Behind the Results: Several factors contributed to the positive results. The choice of Flutter and Dart provided a robust framework for developing a responsive and efficient application. The OCR and SMS parsing libraries used in the project were instrumental in achieving high accuracy for automated data entry. Additionally, rigorous testing ensured that the implemented features worked seamlessly and met user expectations.

Deviations and Challenges: Despite the success, there were notable deviations and challenges. As beginners to Flutter and Dart, the development team faced a steep learning curve, which impacted the overall progress. A significant portion of the development time, approximately most of the time was dedicated to implementing and fine-tuning the SMS parsing and OCR bill scanning features. These functionalities required extensive testing and refinement to handle various data formats and ensure accuracy. This focus on perfecting complex features reduced the time available to implement additional planned features, such as alerts for expense (budget setting).

Moreover, integrating OCR technology and SMS parsing posed technical challenges. The team had to address issues with different bill formats and the diverse nature of SMS messages from various providers, extending the development timeline.

In conclusion, while the Automated Expense Tracker App did not include all initially planned features, it successfully delivered a robust set of core functionalities that effectively automate and simplify expense tracking. The challenges faced during development, particularly the learning curve associated with new technologies and t he time-intensive nature of implementing advanced features, were key factors in the deviations from the initial plan. Moving forward, the focus can shift to adding the remaining features, such as budget alerts, to further enhance the app's functionality and user experience.

Chapter 5

Conclusion

5.1 Conclusion

The Automated Expense Tracker App project aimed to create a comprehensive tool for managing personal finances using Flutter and Dart. The initial plan included five key functionalities: manual entry of expense data, graphical representation of expenses, expense data extraction from bill scanning using OCR technology, extracting expense details from SMS parsing, and alerts for expense (budget setting). Despite the challenges encountered, the project successfully implemented the first four functionalities, along with user authentication through login and password.

The app allows users to manually input their expenses, which are then visually represented through intuitive graphs, providing clear insights into spending patterns. The integration of OCR technology enables the automatic extraction of expense details from scanned bills, reducing manual entry efforts. Additionally, the SMS parsing feature effectively captures expense information from transaction messages, ensuring a comprehensive tracking of expenses from various sources.

While the budget alert feature was not completed due to time constraints and the team's relative inexperience with Flutter and Dart, the project achieved its primary goal of creating a functional and user-friendly expense tracking app. The focus on perfecting OCR and SMS parsing consumed a significant portion of the development time, demonstrating the complexity and importance of these features in the overall functionality of the app.

In conclusion, the Automated Expense Tracker App successfully meets the needs of users looking for an efficient and automated way to manage their finances. The project's outcomes highlight the potential for further development, particularly in adding budget alerts, to enhance the app's capabilities. This project provided valuable experience in mobile app development, Flutter, Dart, and the integration of advanced features like OCR

and SMS parsing, laying a strong foundation for future improvements and expansions.

5.2 Future Scope

The future scope of the Automated Expense Tracker App includes several promising extensions to enhance its functionality and user experience. Firstly, implementing the alerts for expense (budget setting) feature will help users manage their finances more effectively by setting spending limits and receiving notifications when these limits are approached or exceeded. Collaborative Expense Tracking can be introduced to allow group or family members to contribute transactions to a shared account, facilitating collective financial management. Integration with digital wallets and payment platforms, such as PayPal and Venmo, will enable users to link their accounts for seamless transaction imports. Additionally, localized currency and language support will make the app accessible to a broader audience by accommodating multiple currencies and languages. A bill reminder system can also be added to help users remember due dates and ensure timely payments, promoting better financial responsibility. These enhancements will not only complete the initially planned functionalities but also significantly expand the app's utility and user base.

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[2] https://ieeexplore.ieee.org/abstract/document/8628070 from Google Scholar

[3] https://journals.uob.edu.bh/handle/123456789/4875 from Google Scholar

[4] Flutter tutorials from GitHub: `https://github.com/iamshaunjp/flutter-beginners-tutorial`

[5] The SMS parsing feature and OCR scanning feature are referenced from the GitHub repository: `https://github.com/VedantRawale/FinTrack_S-The-Advanced-Expense-Tracking-Flutter-Application`

Appendix A: Presentation

AUTOMATED EXPENSE TRACKER

Guide : Ms. Anu Maria Joykutty

Denik Denny
Jovin Jacob Jestin
Melvin Jiju Mathew
Milin Chandrakumar Alamanda

Contents

Introduction

Our Automated Expense Tracker streamlines expense management through automation

- **Relevance**: Addressing the need for efficient financial management in today's fast-paced world.
- **Efficiency**: Automates data entry and categorization, saving time.
- **Accuracy**: Ensures precise tracking by scanning bills and reading SMS messages

Problem Definition

- **Manual Data Entry**: Users find it time-consuming and manually enter data from bills into financial spreadsheets or apps.
- **Lack of Insights**: Without a clear overview of their spending habits, users may struggle to identify areas where they can cut costs

Objectives

- Create a user-friendly and intuitive interface
- Create efficient Optical Character Recognition (OCR) algorithms for accurate extraction of data from scanned bills and invoices.
- Develop categorization algorithms for accurate transaction classification.
- Create streamlined OCR and categorization algorithms with robust security measures

Scope and Relevance

- Automated data entry through bill scanning functionality.
- Visual representations of financial activities for easy analysis and monitoring.
- Transaction categorization for efficient organization and tracking.
- SMS message parsing for extracting transaction information.

System Overview

- **Expense Tracking**: Users can easily record their daily expenses.
- **Simplified Interface**: The system boasts a user-friendly interface designed for intuitive navigation and ease of use.
- **Secure Data Storage**: With robust security measures in place, users can trust that their financial information is stored securely within the system

Architectural Diagram

Module Division

- Registration and authentication
- Expense Tracking
- Data Analysis

Registeration and authentication

- The Expense Tracker application offers secure user registration with options like email/password and social media sign-in.
- Existing users can seamlessly access the app using their chosen method, promoting a smooth and efficient login experience.
- User data privacy is prioritized regardless of the chosen login method.

Expense Tracking

- Users can easily input and track their daily expenses, including details such as amount, date, and category.
- The application provides options for manual entry as well as automated data import from bank accounts or receipts.
- Users can set budget goals and receive notifications when approaching or exceeding their budget limits.

Data Analysis

- The application offers insights into spending patterns and trends through graphical representations and reports.
- Users can analyze their expenditure by category

Algorithm 1

Optical Character Recognition (OCR)

Input: Scanned bill image

Output: Extracted text data

Steps:

1. Preprocess the scanned image to enhance clarity and reduce noise.
2. Segment the image into individual characters or words.
3. Apply pattern recognition techniques to recognize characters and convert them into text.
4. Post-process the extracted text to improve accuracy and formatting.
5. Output the extracted text data for further processing.

Algorithm 2

SMS Extraction

Input: Receive SMS messages containing transaction information.

Preprocessing:

- Clean the SMS messages to remove any unnecessary characters or noise.
- Tokenize the cleaned messages into words or phrases.

Algorithm 2

Information Extraction:

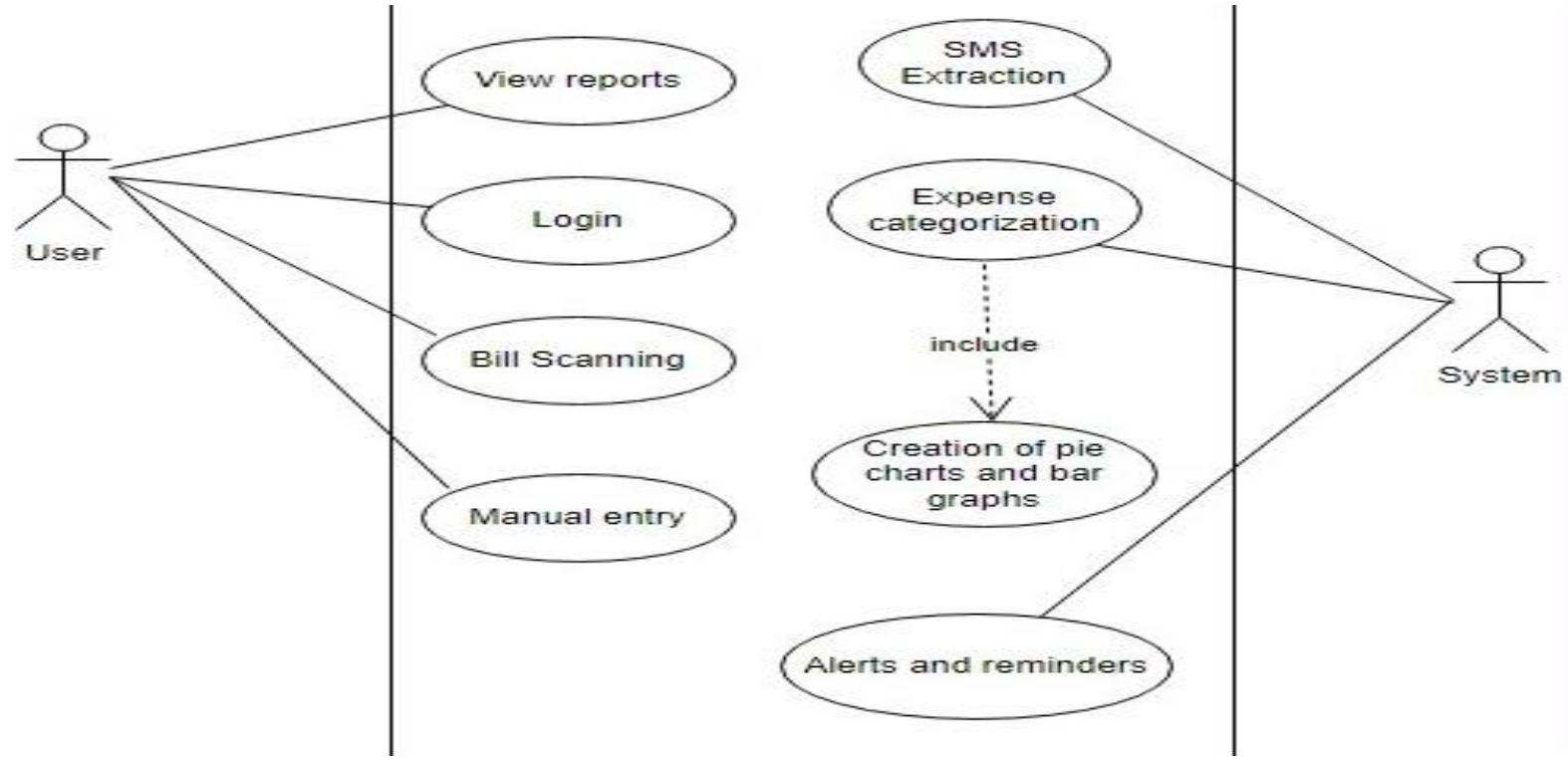
- For each segmented part of the message:
- Extract the transaction amount using regular expressions or numerical parsing techniques.
- Extract the merchant name or description using contextual analysis around keywords like "at", "from", or "paid".
- Extract the transaction date using date parsing techniques or by identifying date formats within the message.

Algorithm 2

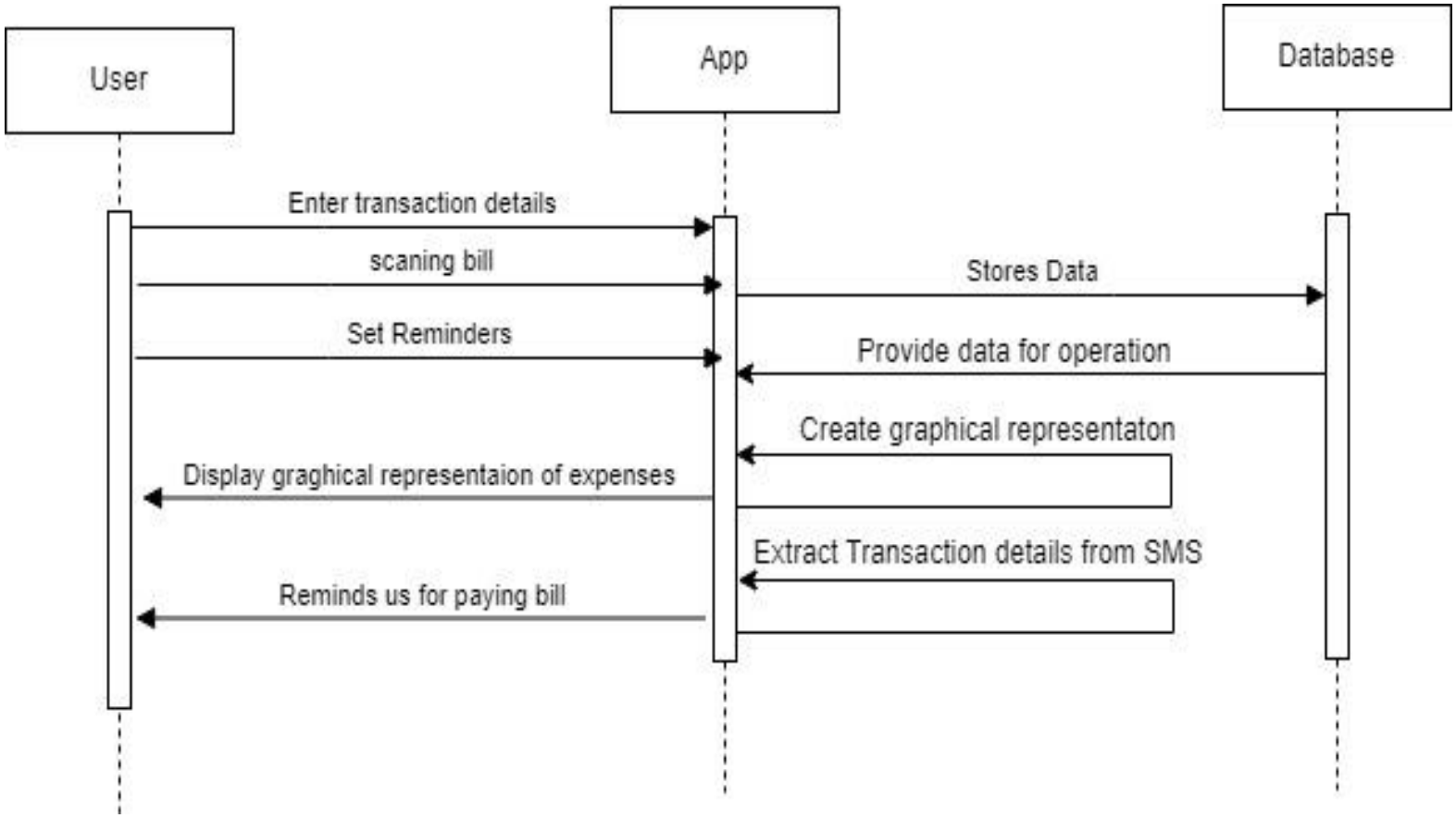
Data Structuring:

- Organize the extracted information (amount, merchant, date) into a structured format such as a dictionary, tuple, or object.
- Store each transaction as a structured data entry.

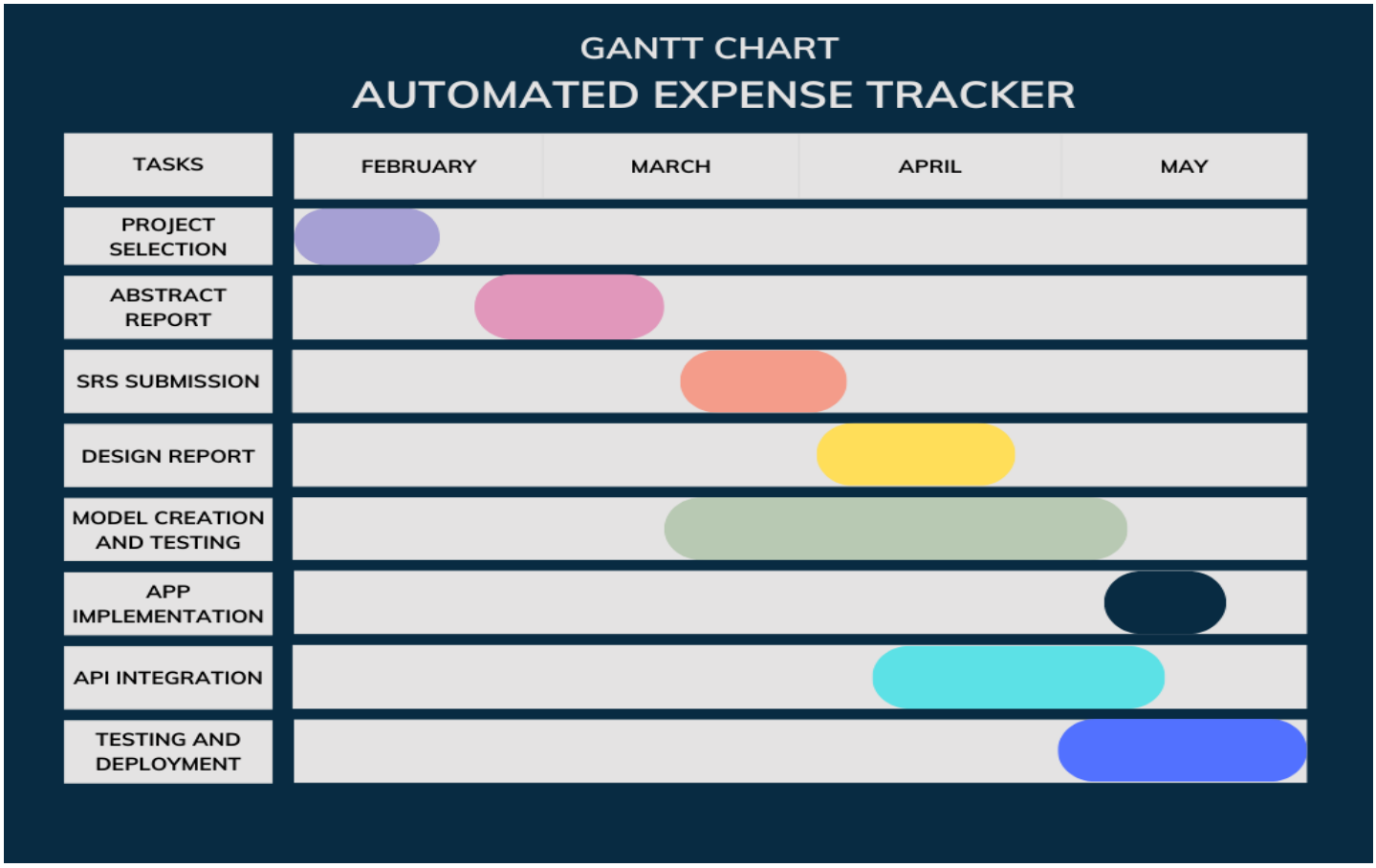
Use Case Diagram



Sequence Diagram



Work Division



Software/ Hardware Requirements

Software :-

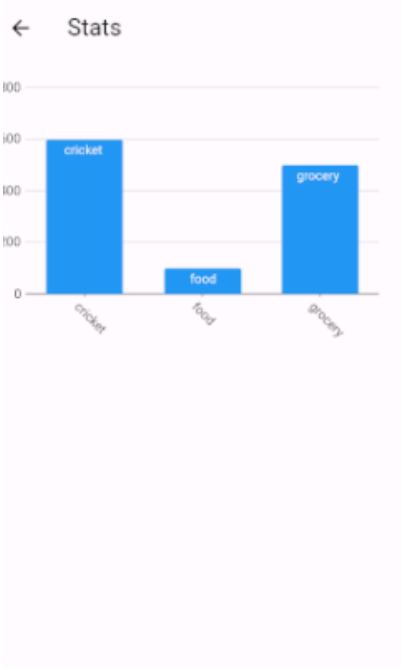
- Flutter SDK
- Dart Programming Language
- Firebase SDK
- Android Studio
- Android OS version 5.0 (Lollipop) or later.

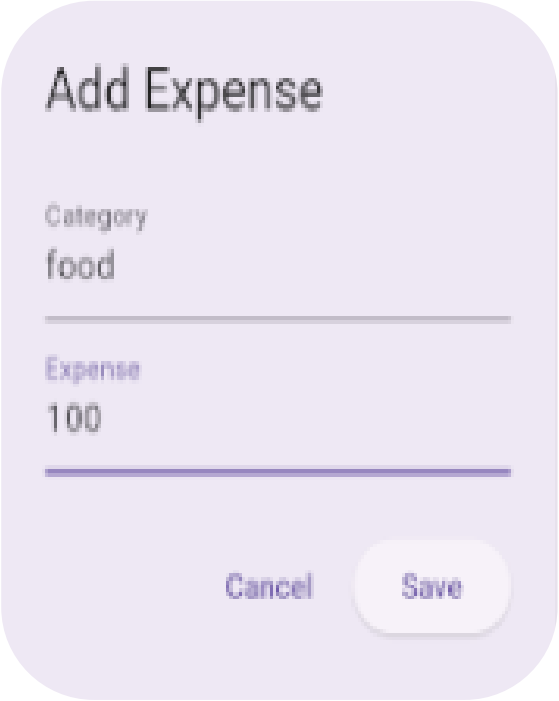
Software/ Hardware Requirements

Hardware :-

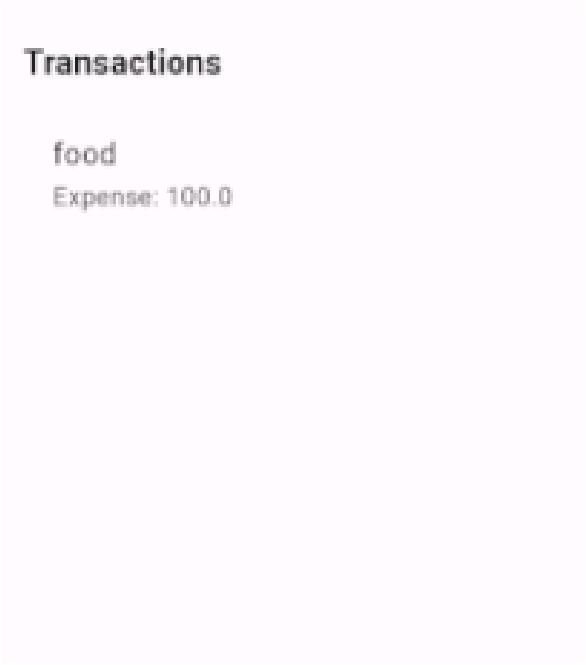
- Any smartphone or tablet running on Android OS
- Memory (RAM) Minimum 2GB RAM for smooth performance.
- Storage at least 200MB of free storage space

Results


Stats
cricket
food
grocery
cricket
food
grocery

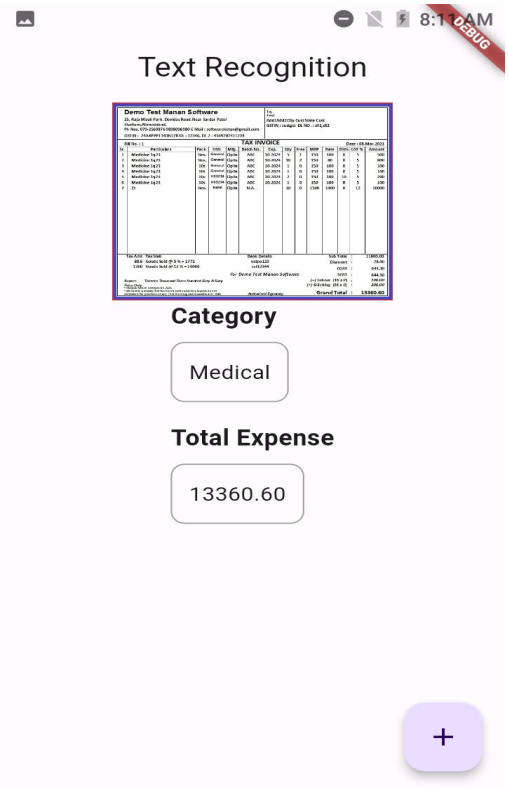

Add Expense
Category
food
Expense
100
Cancel
Save

Transactions

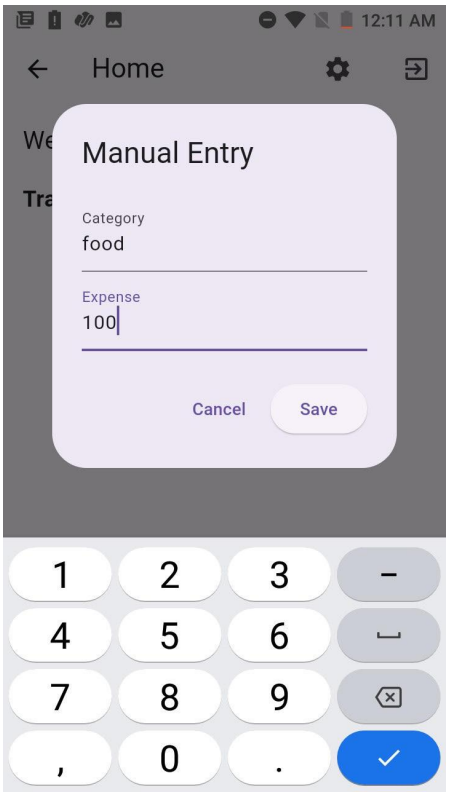


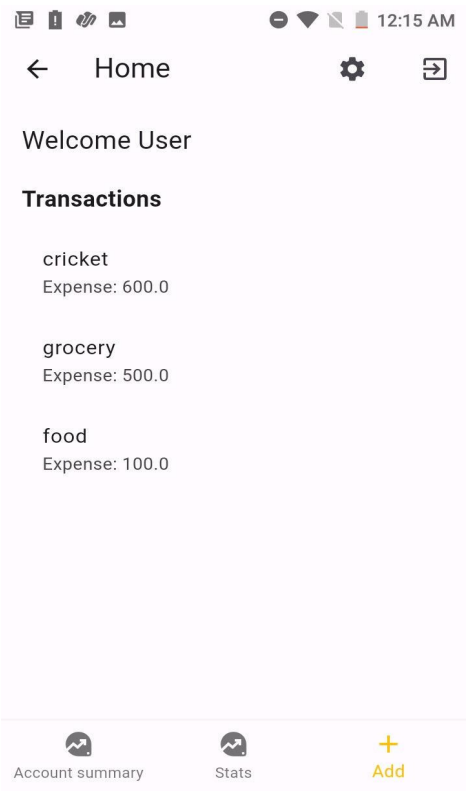
Profile

Text Recognition



Manual Entry



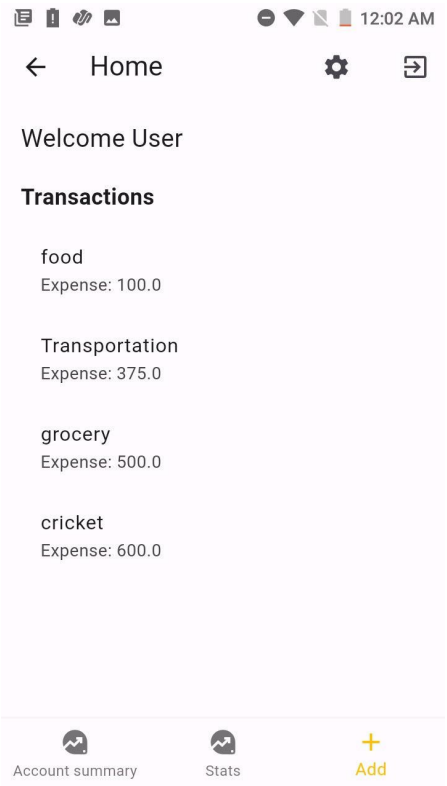


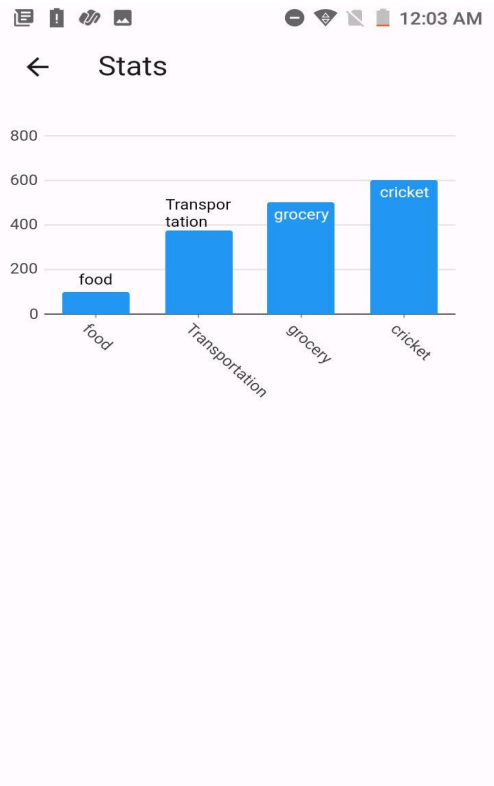
OCR


12:01 AM
Text Recognition
Pick an image for text recognition
No Result

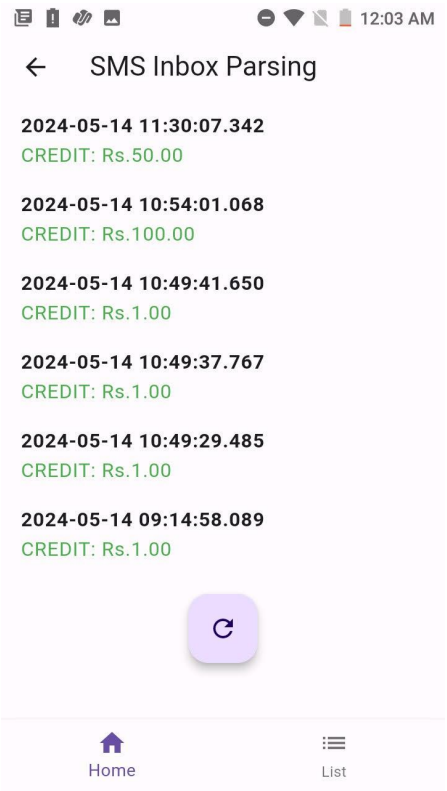

12:02 AM
Text Recognition
Sutra Seva
TICKET NO: 64640012607120001
DT: 26/07/12 TM: 16:50:09
SOLAN To SHIMLA
FULL : 5 X 50.00 = 250.00
HALF : 5 X 25.00 = 125.00
₹ 375.00
" " Happy Journey ""
NOT TRANSFERABLE
Category
Transportation
Total Expense
375.00
Save

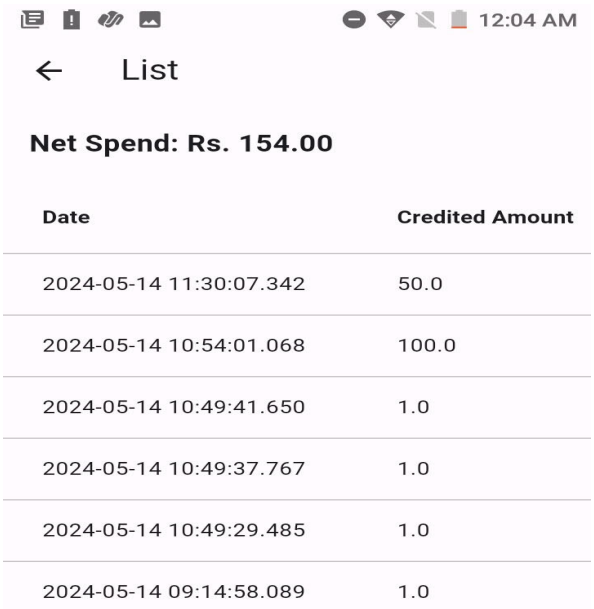
Expense Stats





Expense Listing





Conclusion

- Our user-friendly expense tracker simplifies personal finance management with seamless expense tracking, budget management, and secure data storage.
- Key features include daily expense tracking, personalized budgets, and spending pattern analysis, all within a simplified interface with customizable categories.

Future Enhancements

- **Collaborative Expense Tracking**: Introduce features for group or family expense tracking, where multiple users can contribute transactions to a shared account.
- **Integration with Digital Wallets and Payment Platforms**: Allow users to link their digital wallets and payment platforms such as PayPal, Venmo, etc.
- **Localized Currency and Language Support**: Expand the app's availability by offering support for multiple currencies and languages.
- **Bill reminder system:** To ensure timely payment and financial responsibility.

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Appendix B: Vision, Mission, Programme Outcomes and Course Outcomes

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING
RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY (AUTONOMOUS)
RAJAGIRI VALLEY, KAKKANAD, KOCHI, 682039
(Affiliated to APJ Abdul Kalam Technological University)

Vision, Mission, Programme Outcomes and Course Outcomes

Institute Vision

To evolve into a premier technological institution, moulding eminent professionals with creative minds, innovative ideas and sound practical skill, and to shape a future where technology works for the enrichment of mankind.

Institute Mission

To impart state-of-the-art knowledge to individuals in various technological disciplines and to inculcate in them a high degree of social consciousness and human values, thereby enabling them to face the challenges of life with courage and conviction.

Department Vision

To become a centre of excellence in Computer Science and Engineering, moulding professionals catering to the research and professional needs of national and international organizations.

Department Mission

To inspire and nurture students, with up-to-date knowledge in Computer Science and Engineering, ethics, team spirit, leadership abilities, innovation and creativity to come out with solutions meeting societal needs.

Programme Outcomes (PO)

Engineering Graduates will be able to:

1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and Team work: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

10. Communication: Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Programme Specific Outcomes (PSO)

A graduate of the Computer Science and Engineering Program will demonstrate:

PSO1: Computer Science Specific Skills

The ability to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas by understanding the core principles and concepts of computer science and thereby engage in national grand challenges.

PSO2: Programming and Software Development Skills

The ability to acquire programming efficiency by designing algorithms and applying standard practices in software project development to deliver quality software products meeting the demands of the industry.

PSO3: Professional Skills

The ability to apply the fundamentals of computer science in competitive research and to develop innovative products to meet the societal needs thereby evolving as an eminent researcher and entrepreneur.

Course Outcomes

After the completion of the course the student will be able to:

CO1:

Identify technically and economically feasible problems (Cognitive Knowledge Level: Apply)

CO2:
Identify and survey the relevant literature for getting exposed to related solutions and get familiarized with software development processes (Cognitive Knowledge Level: Apply)

CO3:
Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques (Cognitive Knowledge Level: Apply)

CO4:
Prepare technical report and deliver presentation (Cognitive Knowledge Level: Apply)

CO5:
Apply engineering and management principles to achieve the goal of the project (Cognitive Knowledge Level: Apply)

Appendix C: CO-PO-PSO Mapping

COURSE OUTCOMES:

After completion of the course the student will be able to

SL. NO	DESCRIPTION	Blooms' Taxonomy Level
CO1	Identify technically and economically feasible problems (Cognitive Knowledge Level: Apply)	Level 3: Apply
CO2	Identify and survey the relevant literature for getting exposed to related solutions and get familiarized with software development processes (Cognitive Knowledge Level: Apply)	Level 3: Apply
CO3	Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques (Cognitive Knowledge Level: Apply)	Level 3: Apply
CO4	Prepare technical report and deliver presentation (Cognitive Knowledge Level: Apply)	Level 3: Apply
CO5	Apply engineering and management principles to achieve the goal of the project (Cognitive Knowledge Level: Apply)	Level 3: Apply

CO-PO AND CO-PSO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO3
CO1	3	3	3	3		2	2	3	2	2	2	3	2	2	2
CO2	3	3	3	3	3	2		3	2	3	2	3	2	2	2
CO3	3	3	3	3	3	2	2	3	2	2	2	3			2
CO4	2	3	2	2	2			3	3	3	2	3	2	2	2
CO5	3	3	3	2	2	2	2	3	2		2	3	2	2	2

3/2/1: high/medium/low

JUSTIFICATIONS FOR CO-PO MAPPING

MAPPING	LOW/ MEDIUM/ HIGH	JUSTIFICATION
101003/CS622T.1-PO1	**HIGH**	Identify technically and economically feasible problems by applying the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
101003/CS622T.1-PO2	**HIGH**	Identify technically and economically feasible problems by analysing complex engineering problems reaching substantiated conclusions using first principles of mathematics.
101003/CS622T.1-PO3	**HIGH**	Design solutions for complex engineering problems by identifying technically and economically feasible problems.
101003/CS622T.1-PO4	**HIGH**	Identify technically and economically feasible problems by analysis and interpretation of data.
101003/CS622T.1-PO6	**MEDIUM**	Responsibilities relevant to the professional engineering practice by identifying the problem.
101003/CS622T.1-PO7	**MEDIUM**	Identify technically and economically feasible problems by understanding the impact of the professional engineering solutions.
101003/CS622T.1-PO8	**HIGH**	Apply ethical principles and commit to professional ethics to identify technically and economically feasible problems.
101003/CS622T.1-PO9	**MEDIUM**	Identify technically and economically feasible problems by working as a team.
101003/CS622T.1-PO10	**MEDIUM**	Communicate effectively with the engineering community by identifying technically and economically feasible problems.
101003/CS622T.1-P011	**MEDIUM**	Demonstrate knowledge and understanding of engineering and management principles by selecting the technically and economically feasible problems.
101003/CS622T.1-PO12	**HIGH**	Identify technically and economically feasible problems for long term learning.
101003/CS622T.1-PSO1	**MEDIUM**	Ability to identify, analyze and design solutions to identify technically and economically feasible problems.
101003/CS622T.1-PSO2	**MEDIUM**	By designing algorithms and applying standard practices in software project development and Identifying technically and economically feasible problems.
101003/CS622T.1-PSO3	**MEDIUM**	Fundamentals of computer science in competitive research can be applied to Identify technically and economically feasible problems.
101003/CS622T.2-PO1	**HIGH**	Identify and survey the relevant by applying the knowledge of mathematics, science, engineering fundamentals.

101003/CS622T.2-PO2	**HIGH**	Identify, formulate, review research literature, and analyze complex engineering problems get familiarized with software development processes.
101003/CS622T.2-PO3	**HIGH**	Design solutions for complex engineering problems and design based on the relevant literature.
101003/CS622T.2-PO4	**HIGH**	Use research-based knowledge including design of experiments based on relevant literature.
101003/CS622T.2-PO5	**HIGH**	Identify and survey the relevant literature for getting exposed to related solutions and get familiarized with software development processes by using modern tools.
101003/CS622T.2-PO6	**MEDIUM**	Create, select, and apply appropriate techniques, resources, by identifying and surveying the relevant literature.
101003/CS622T.2-PO8	**HIGH**	Apply ethical principles and commit to professional ethics based on the relevant literature.
101003/CS622T.2-PO9	**MEDIUM**	Identify and survey the relevant literature as a team.
101003/CS622T.2-PO10	**HIGH**	Identify and survey the relevant literature for a good communication to the engineering fraternity.
101003/CS622T.2-PO11	**MEDIUM**	Identify and survey the relevant literature to demonstrate knowledge and understanding of engineering and management principles.
101003/CS622T.2-PO12	**HIGH**	Identify and survey the relevant literature for independent and lifelong learning.
101003/CS622T.2-PSO1	**MEDIUM**	Design solutions for complex engineering problems by Identifying and survey the relevant literature.
101003/CS622T.2-PSO2	**MEDIUM**	Identify and survey the relevant literature for acquiring programming efficiency by designing algorithms and applying standard practices.
101003/CS622T.2-PSO3	**MEDIUM**	Identify and survey the relevant literature to apply the fundamentals of computer science in competitive research.
101003/CS622T.3-PO1	**HIGH**	Perform requirement analysis, identify design methodologies by using modern tools & advanced programming techniques and by applying the knowledge of mathematics, science, engineering fundamentals.
101003/CS622T.3-PO2	**HIGH**	Identify, formulate, review research literature for requirement analysis, identify design methodologies and develop adaptable & reusable solutions.

101003/CS622T.3-PO3	**HIGH**	Design solutions for complex engineering problems and perform requirement analysis, identify design methodologies.
101003/CS622T.3-PO4	**HIGH**	Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
101003/CS622T.3-PO5	**HIGH**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools.
101003/CS622T.3-PO6	**MEDIUM**	Perform requirement analysis, identify design methodologies and assess societal, health, safety, legal, and cultural issues.
101003/CS622T.3-PO7	**MEDIUM**	Understand the impact of the professional engineering solutions in societal and environmental contexts and Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions.
101003/CS622T.3-PO8	**HIGH**	Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions by applying ethical principles and commit to professional ethics.
101003/CS622T.3-PO9	**MEDIUM**	Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
101003/CS622T.3-PO10	**MEDIUM**	Communicate effectively with the engineering community and with society at large to perform requirement analysis, identify design methodologies.
101003/CS622T.3-PO11	**MEDIUM**	Demonstrate knowledge and understanding of engineering requirement analysis by identifying design methodologies.
101003/CS622T.3-PO12	**HIGH**	Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change by analysis, identify design methodologies and develop adaptable & reusable solutions.
101003/CS622T.3-PSO3	**MEDIUM**	The ability to apply the fundamentals of computer science in competitive research and prior to that perform requirement analysis, identify design methodologies.
101003/CS622T.4-PO1	**MEDIUM**	Prepare technical report and deliver presentation by applying the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
101003/CS622T.4-PO2	**HIGH**	Identify, formulate, review research literature, and analyze complex engineering problems by preparing technical report and deliver presentation.

101003/CS622T.4-PO3	**MEDIUM**	Prepare Design solutions for complex engineering problems and create technical report and deliver presentation.
101003/CS622T.4-PO4	**MEDIUM**	Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions and prepare technical report and deliver presentation.
101003/CS622T.4-PO5	**MEDIUM**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools and Prepare technical report and deliver presentation.
101003/CS622T.4-PO8	**HIGH**	Prepare technical report and deliver presentation by applying ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
101003/CS622T.4-PO9	**HIGH**	Prepare technical report and deliver presentation effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
101003/CS622T.4-PO10	**HIGH**	Communicate effectively with the engineering community and with society at large by prepare technical report and deliver presentation.
101003/CS622T.4-PO11	**MEDIUM**	Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work by prepare technical report and deliver presentation.
101003/CS622T.4-PO12	**HIGH**	Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change by prepare technical report and deliver presentation.
101003/CS622T.4-PSO1	**MEDIUM**	Prepare a technical report and deliver presentation to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas.
101003/CS622T.4-PSO2	**MEDIUM**	To acquire programming efficiency by designing algorithms and applying standard practices in software project development and to prepare technical report and deliver presentation.
101003/CS622T.4-PSO3	**MEDIUM**	To apply the fundamentals of computer science in competitive research and to develop innovative products to meet the societal needs by preparing technical report and deliver presentation.
101003/CS622T.5-PO1	**HIGH**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
101003/CS622T.5-PO2	**HIGH**	Identify, formulate, review research literature, and analyze complex engineering problems by applying engineering and management principles to achieve the goal of the project.

101003/CS622T.5-PO3	**HIGH**	Apply engineering and management principles to achieve the goal of the project and to design solutions for complex engineering problems and design system components or processes that meet the specified needs.
101003/CS622T.5-PO4	**MEDIUM**	Apply engineering and management principles to achieve the goal of the project and use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
101003/CS622T.5-PO5	**MEDIUM**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools and to apply engineering and management principles to achieve the goal of the project.
101003/CS622T.5-PO6	**MEDIUM**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities by applying engineering and management principles to achieve the goal of the project.
101003/CS622T.5-PO7	**MEDIUM**	Understand the impact of the professional engineering solutions in societal and environmental contexts, and apply engineering and management principles to achieve the goal of the project.
101003/CS622T.5-PO8	**HIGH**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice and to use the engineering and management principles to achieve the goal of the project.
101003/CS622T.5-PO9	**MEDIUM**	Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings and to apply engineering and management principles to achieve the goal of the project.
101003/CS622T.5-PO11	**MEDIUM**	Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments and to apply engineering and management principles to achieve the goal of the project.
101003/CS622T.5-PO12	**HIGH**	Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change and to apply engineering and management principles to achieve the goal of the project.
101003/CS622T.5-PSO1	**MEDIUM**	The ability to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas. Apply engineering and management principles to achieve the goal of the project.

101003/CS622T.5-PSO2	**MEDIUM**	The ability to acquire programming efficiency by designing algorithms and applying standard practices in software project development to deliver quality software products meeting the demands of the industry and to apply engineering and management principles to achieve the goal of the project.
101003/CS622T.5-PSO3	**MEDIUM**	The ability to apply the fundamentals of computer science in competitive research and to develop innovative products to meet the societal needs thereby evolving as an eminent researcher and entrepreneur and apply engineering and management principles to achieve the goal of the project.