Faculty of Engineering & Technology

Department of Electrical & Computer Engineering

ENCS5200 – Section 6

Electronic Receipt Application "TrackReceipts System"

Prepared By:

Eman Naji 1200358

Donia Yasin 1201813

Noor Shamali 1200016

Supervised By:

Dr. Ayman Hroub

An introduction to the graduation project submitted to the Department of Electrical and Computer Engineering in partial fulfillment of the requirements for the degree of B.S. in Computer Systems Engineering.

BIRZEIT

December, 2024

Abstract

Every day, more and more businesses are moving away from traditional paper receipts and choosing to adopt electronic receipts instead. An Electronic Receipt, commonly known as an E-Receipts, is a digital version of a traditional paper receipt that is generated and delivered electronically. This application is divided into two critical components: a vendor-side system integrated into cashier systems for seamless transaction processing and a client-side mobile app for users to scan barcodes and instantly store digital copies of their receipts on smartphones. This method not only reduces the environmental damage caused by plenty of paper waste but also improves the consumer experience by supporting a more organized and accessible way of managing receipts. The E-Receipt system provides a lot of benefits, such as permanent receipt storage, automated receipt tracking, and data analytics that help users know their spending habits. This data can further be used to evaluate broader economic trends like a cost-of-living pointer. Beyond mere receipt storage, the application supports financial insight generation and monthly report creation, allowing users to enhance their budgeting and personal finances. The combining of features like manual receipt entry and receipt sharing ensures that this system provides a public solution for receipt management, making it a valuable tool for both individuals and businesses alike. This innovation stands as a significant step forward in striving for a more sustainable and efficient future.

المستخلص

في بيئة العمل التقليدية، كثيراً ما تصدر الشركات فواتير مطبوعة لعملائها لتقديم دليل على الدفع مقابل السلع أو الخدمات التي قدموها . وفي القرن الواحد والعشرين الذي هو عصر الرقمنة أصبح العالم يتجه إلى تحويل الخدمات الاعتيادية إلى تطبيقات رقمية على الأجهزة الذكية . ومع تزايد أهمية الاستدامة، أصبح من الضروري إعادة تقييم العديد من الصناعات بمنظور بيئي واعٍ . ومن جملة ذلك الفواتير الورقية، التي تُطبع بملياراتها سنوياً مسببة تلوثاً وهدراً كبيراً للموارد . إن استخدام الفواتير الرقمية بدلاً من الورقية لا يساهم فقط في حماية البيئة، بل يوفر أيضاً الوقت والمال ويقلل من استهلاك الورق . كما أنه يلغي الحاجة إلى الطابعات الخاصة والورق المخصص، ويخفض تكاليف الحبر.

تطبيق الايصالات الالكترونية هو عبارة عن نسخة رقمية من الفواتير الورقية العادية والتي تُعطى للعملاء من خلال تطبيقات الهاتف المحمول أو غيرها من الوسائل الرقمية، ومع نمو أنظمة الإيصالات الإلكترونية، يمكن للمستخدمين الحصول على مكان واحد لتتبع معلوماتهم المالية وحفظها والاطلاع عليها، مما يوفر خياراً طويل الأمد وفعالاً، كما أنه يقدم للعملاء خدمات أخرى مثل مساعدتهم على إدارة نفقاتهم الشهرية والسنوية وتحسين ميزانياته، والتي سيتم مناقشتها في هذا التقرير.

Table of Contents

List of Figures

List of tables

List of Abbreviations

E-Receipt	**Electronic Receipt**
QR	**Quick Response**
HTTP	**Hypertext Transfer Protocol**
UI	**User Interface**
API	**Application Programming Interface**
POS	**Point of Sale**
AI	**Artificial Intelligence**
ML	**Machine Learning**
AOT	**Ahead of Time**
JIT	**Just in Time**
SQLite	**Structured Query Language Lite**

Chapter 1: Introduction

Contents

1.1. Motivation

The need for sustainability is very important now in the modern world. As the world is moving towards development, an environmentally conscious mindset can re-evaluate all industries around the world. Despite the advancements in technology, paper receipts remain used in several stores and businesses. However, this contributes to several problems, especially for the environment. For example, the continued use of paper receipts leads to cutting down trees, creating waste, and polluting the environment. In addition, most receipts are thrown away immediately after use. When paper receipts go through the processes of production, delivery, and discard, the environment gets harmed for now and for the future. On the other hand, paper receipts cause several problems not only for the environment but also for individuals. They are easy to lose, damage, or misplace, which makes it problematic to return items or keep track of spending. Furthermore, organizing and finding paper receipts can be time and effort-consuming, especially for people with many receipts. Without a productive system, it is difficult for people to track their expenses, budget, or save money. [1]

1.2. Problem Statement

There is a lack of a comprehensive digital solution that not only offers receipt storage but also provides insightful data analytics on spending habits. While some applications permit receipt scanning, they typically lack essential features such as automatic receipt tracking, expense categorization, or the ability to generate financial reports. As a result, Consumers constantly struggle to find a single, integrated tool that can combine the convenience of managing receipts with the insights needed to make smart financial decisions, Therefore, the motivation for this project is not only to provide a sustainable solution but also to create tools to improve consumer finance and analyses the economy more broadly.

1.3. Methodology

1.3.1. Requirement Elicitation

1.3.1.1. Problems with Traditional Receipt Systems

Traditional receipt systems have a number of weaknesses for both clients and vendors. Clients have to put up with the loss and damage of paper receipts, making it difficult to track expenses, process returns, or claim warranties. Secondly, managing and categorizing paper receipts for budgeting is very manual and prone to errors; it consumes a great deal of time and effort. [2] The environmental drawbacks include that paper receipts, besides contributing to waste and deforestation, are also increasing printing costs for businesses through heavy carbon emissions. On the vendor side, it means inconvenience in storing and maintaining enormous quantities of paper receipts, which leads to clutter, extra storage costs, and inefficiency in transaction monitoring. The inability to provide analytics and insight is another limitation; conventional systems do not provide categorized expense reports or financial trends on which users can make decisions. Accessibility issues further exacerbate the problems, with clients unable at times to retrieve receipts urgently required for refunds or tax purposes. [3] Also, there is limited communication between vendors and clients due to a lack of options to efficiently provide digital receipts and transaction tracking, and offer incentives such as discounts via receipt data. Problems

that need urgent attention due to a dire need for a more efficient, digital, and environment-friendly alternative.

1.3.1.2. Solutions Provided by the E-Receipt System

- **Digital Receipt Storage:**
  The E-Receipt system provides safe digital storage of receipts without the risk of losing or damaging paper receipts. Through a central platform, clients can always access their receipts; this will promote convenience and confidence. Vendors reduce dependencies on paper receipts through digital storage, hence improving operational efficiency and reducing storage costs.
- **QR Code/Barcode Integration:**
  It has integrated QR codes and barcode scanning for easy retrieval and storage of receipts. Clients can access their receipts faster by scanning a code generated at the point of sale, which will ensure seamless transactions. The vendors are able to streamline the generation and communication of receipts to customers while enhancing the efficiency of transactions. [4]
- **Automatic Expense Categorization:**
  Predefined categories, like groceries, utilities, and entertainment, are automatically included in their respective categories within the system. This helps clients to track their spending without interference and manage budgets more comfortably. That makes financial planning quite easy, providing ordered insight into categorized expenses.
- **Manual Receipt Entry:**
  If a transaction is not captured digitally, this application allows the client to fill in the details of the receipt manually. That way, no expenditure, from even vendors or purchases that are outside the digital receipt ecosystem, goes untracked, since the client can maintain full records of their expenditures for better financial management.
- **Monthly Financial Reports:**
  It produces comprehensive reports of expenditure breakdowns of money spent on different categories of monthly expenses. It could be helpful for clients to develop trends of spending, optimize the budget, and make data-based decisions. These reports visualize these through charts and graphs with a friendly interface for use in the analysis of their spending habits.
- **Financial Insights and Alerts:**
  Advanced analytics provides clients with actionable insights into their spending habits. Notification based on budget milestones, overspending, or unusual spending patterns will be sent out to enable users to keep financial discipline. Vendors take this opportunity for targeted marketing, offering discounts or other incentives related to purchase behavior.
- **Receipt Sharing:**
  The E-Receipt application gives clients the opportunity to share electronic receipts in a secure manner via email or any other digital way. It is very helpful for claims of warranty, product return, and even expense reimbursements without maintaining the receipts physically. Any user can easily share receipts whenever needed without any inconvenience.
- **Environmental Sustainability:**

This, therefore, will reduce the dependency on paper material for receipts, hence contributing to saving the environment. Both the clients and vendors help conserve the environment by reducing the quantity of paper used in waste receipts, thereby reducing carbon footprints produced during the manufacture of such receipts. Besides that, vendors save on operational costs, including printing expenses. [5]

1.3.2. Software Development

1.3.2.1. Development Process

The vendor-side system and client-side mobile application use the Agile methodology, as the user needs may evolve with continuous feedback. The project is divided into sprints, each for different features such as barcode scanning, receipt storage, analytics, and report generation. At the end of each sprint, user feedback is collected and then integrated into subsequent iterations, making the application user-centric and full of features. [6]

1.3.2.2. Data Analytics and Expense Tracking

The E-Receipt system makes use of receipt data for data analytics and expense tracking so that users may perceive their spending habits with meaningful insights. Data from receipts are categorized according to predefined categories, such as groceries, utilities, and entertainment, to make tracking easier. Using visual tools, the user can view his expenditure data. Machine learning algorithms can be utilized as well in addition to the tools discussed while keeping in mind that the main objective is to promote usability and add value. [7]

1.4. Anticipated Contributions

1.4.1. Environmental Impact

This system will go a long way in ensuring environmental sustainability, which is an effect brought about by the replacement of traditional paper receipts. This is because various studies and research across the globe have established that billions of paper receipts are produced daily. This increase is made on the negative impacts to the environment, for example, deforestation, waste, and carbon emissions resulting from the production and disposal of paper. This project reduces the environmental footprint of retail transactions through the transition to electronic receipts. Besides the reduction in paper waste, this system fosters environmental awareness among businesses and consumers, dovetailing with general global efforts to contain climate change and reach sustainability objectives. [8]

1.4.2. User Benefits

E-receipt makes life so much easier for any consumer; it is a very reliable means of managing receipts. Since the receipts are kept digitally, they will never get torn, lost, or misplaced, which is a common problem with paper receipts. Moreover, the application will provide tools for tracking expenses and their categorization, thereby empowering users to keep track of their spending habits. These are further extended to generate monthly and yearly financial reports so that the users can make better financial decisions, optimize their budgets, and improve their general financial well-being. These features address a critical gap in current receipt management practices and offer a user-centric solution.

1.4.3. Economic Contributions

As receipt data is aggregated, which the system then transmits, it includes much-valuable macroeconomic information. The segmentation and analytics of spending patterns of consumers through the app result in a bundle of information on trends of cost of living and other economic indicators. This would be great ammunition for policymakers, researchers, and economists to estimate the inflation rate, trace changes in consumer behavior, and improve the cost-of-living indices. This is a data-driven approach that yields a truer and more responsive view of the economic situation, hence enabling decision-making at local and national levels to become better informed. [9]

Chapter 2: Background

Contents

In developing an E-Receipt system, instead of creating separate applications for each operating system, We want to focus on developing cross-platform applications. Developing these types of applications requires creating applications that are compatible with various operating systems. By building on the same code base for Android, iOS, and web apps, we simplify the development process to ensure consistency and extensibility. and provide a consistent user experience across all platforms. This strategy is designed to maintain high performance and functionality across different operating systems.

2.1. Benefits of cross-platform development

The benefits associated with developing cross-platform applications are:

- Integrated codebase: Easy to maintain using a single source code and can be updated in a single codebase.
- The fastest development times: This can be achieved using a single code. Instead of developing special code for each platform.
- Cost-effectiveness ratio: By reducing duplication. The associated development time and costs can therefore be reduced.
- Concurrent deployment: Features and updates can be released simultaneously across all platforms.
- Reach a Wide Audience: This app is available to a wide audience. Available to all viewers on Android, iOS, and the web. [10]

2.2. Technologies

The technologies that we intend to use for developing our application are:

2.2.1. Flutter

This cross-platform framework provides developers with a library for creating native user interfaces for Android, iOS, and web applications, using a single code base. It allows the creation of a responsive and beautiful user interface. Flutter uses the Dart programming language and its own rendering engine, Skia C++ to provide an extremely user-friendly that looks like its own. The main functionalities of Flutter consist of:

- Same UI and Business Logic for All Platforms: Flutter lets you use one code that works across different operating systems.
- Customizable Widgets: Flutter has many widgets for Material Design (Android) and Cupertino (iOS) for making user interfaces that are nice and responsive.
- Good Performance: The Skia engine helps with smooth animations and good rendering, giving almost native app performance.
- Simple Maintenance: Using one codebase makes updates easier and cuts down on development time.

Flutter has useful tools like Hot Reload, which allows instant code changes while working, boosting productivity and lowering debugging time. Its flexibility and efficiency make it suitable for making scalable applications like the E-Receipt system. [10]

2.2.2. Sqflite

This is the most commonly used local database plug-in for flutter. It serves SQLite seamlessly. It allows to:

- Store user information right on the phone, which includes financial records, receipts, and spending categories.
- Offline capability of the app permits data access while the phone may not have internet access.
- Custom queries allow for advanced manipulation and analysis of any data. [11]

2.2.3. Dart

Dart is a well-documented object-oriented programming language. It is designed for high-performance applications. It includes basic language features such as classes, inheritance, interfaces, and attributes. Its main functionalities are:

- Just-In-Time (JIT) and Ahead-Of-Time (AOT) Compilation: JIT enables quick development with hot reloads, while AOT provides better performance for final products. [12]
- Tree Shaking: Removes any unused code to make the app smaller and quicker.
- Asynchronous Programming: Allows non-blocking code, helping apps stay responsive and efficient.
- Cross-Platform Development: Write once and use on many platforms (Android, iOS, and web).
- High Performance: Dart's fast compilation leads to quick startup and smooth operation.
- Dart's strong features allow for fast development and good performance, making it a great option for building apps with Flutter. [13]

2.2.4. Node.js with Express.js

Node.js is an open-source, cross-platform JavaScript runtime environment built on Chrome's V8 JavaScript engine, enabling fast server-side application development. effective and can be scaled.

Main features of Node.js include:

- High Performance: Node.js uses an event-based, non-blocking I/O model to efficiently handle multiple concurrent connections.
- Scalability: Its lightweight architecture makes it suitable for applications that require real-time communication and high transaction volumes.
- Extensive library support: Node.js has a large library of JavaScript modules, which makes backend development easier. and reduces the need to write unnecessary code.
- Caching: Node.js supports caching to reduce load times and improve response rates.
- Community Support: Node.js has a large community that provides access to resources, plugins, and tools.

Express.js is a minimal framework for Node.js, making the process of building web server APIs easier. It provides essential features for routing, middleware, and HTTP management, making it a powerful tool for backend development in E-Receipt systems. [14]

2.2.5. QR Code Integration

QR code technology makes it easy to log in and manage receipt information. QR codes can encode important receipt information, such as transaction details and amounts. which can scan and extract data immediately the main advantages of QR code integration are:

- Speed and speed: QR codes reduce manual data entry, reduce errors, and improve efficiency.
- User Friendliness: Users can quickly scan receipts using their mobile devices. Make the work process easier
- Automation: Data retrieval and storage processes are improved. This leads to a better user experience.
- QR code technology increases the convenience of using the system. [15]

2.2.6. OneSignal

OneSignal is a popular notification platform used to send real-time notifications to users. Increase user engagement and ensure timely updates.

Key features of OneSignal include:

- Privacy: Send users customized messages about budget constraints. the new receipt or financial trends
- Improved engagement: Keep users informed and connected.
- Real-time notifications: Notifications are sent instantly. This ensures that users receive timely updates.
- Automation: Supports automatic notifications based on user behavior or default triggers. [16]

2.3. Current Trends

As general mobile money management solutions gain popularity, innovative electronic receipt products are also gaining interest. The move from paper receipts to electronic alternatives has prepared the way for money management. The combination of Flutter, SQLite, and QR code technologies would essentially create a digital receipt system that helps the individual plan their budget, provides easy access to data, and overall facilitates an eco-friendly mindset. Most of our work was in integrating electronic solutions, so it quickly became clear that these electronic systems would become central to the toolkits of individuals and corporations.

Chapter 3: Related Work

Contents

3.1. Feature Comparison Between Our Application and Existing Applications

Our application has features that go beyond simple electronic receipt management, offering monthly report generation, automatic receipt tracking, manual receipt entry, user receipt summary, financial insights and alerts, barcode/QR code integration, and receipt sharing. Though there are other apps for the same purpose, our application differs in targeting these features specifically to allow for comprehensive receipt management and insight into one's finances.

Application's features:

1- Monthly Report Generation

2- Automatic Receipt Tracking

3- Manual Receipt Entry

4- User Receipts Summary

5- Financial Insights and Alerts

6- Barcode/QR Code Integration

7- Receipt Sharing

The table below shows a detailed comparison, in terms of features and where each one is created, between our e-receipts application (TrackReceipts App) and similar applications.

Table 1: Comparison between E-Receipts Applications and Their Features

Apps	Features							Country
	F1	F2	F3	F4	F5	F6	F7	
TrackReceipts	√	√	√	√	√	√	√	Palestine
Expensify	√	√	√	√	√	×	√	U.S.-San Francisco, California
Zoho Expense	√	√	√	√	√	×	√	Indian-Chennai
Square POS	√	√	×	√	×	√	√	U.S.-San Francisco
PayPal Invoicing	√	√	×	√	×	√	√	U.S.-San Jose, California
Venmo	×	√	×	×	×	√	√	U.S.-New York
Google Pay	×	×	×	×	×	√	√	U.S.-Mountain View, California
TapToBook	×	√	×	√	×	√	√	U.S.-Miami, Florida
Apple Wallet	×	×	×	×	×	√	√	U.S.-Cupertino, California
Receipta	×	√	√	√	√	√	√	UK
Smart Receipts	√	√	√	√	√	√	√	U.S.

3.2. Overview of Receipt and Payment-Related Applications

- **Expensify:**
  Expensify is a total Expense management solution that serves both individuals and businesses.
  Features: scans and extracts data from receipts, automatic expense categorization, real-time expense reporting, tracks expenses in multiple currencies for global use, and aligns credit/debit card transactions automatically. [17]
- **Zoho Expense:**
  Zoho Expense is a cloud-based expense management solution customized for small and medium Businesses.

Features: receipt scanning, automatic expense categorization, uploading receipts, and tracking expenses from mobile devices, indicates expenses that do not meet company policies, integrates with other Zoho applications and other accounting systems, making it a convenient choice for businesses that use other Zoho products. [18]

- **Square POS:**
  Square POS is a simple system that helps small businesses and shops manage sales. It's easy to use and it makes checkout faster, helping track products and deal with the customers easily.
  Features: gives businesses the ability to send digital receipts and keep an eye on their products and sales. As well as customers can pay using QR codes, and it works with loyalty programs to keep them coming back. [19]
- **PayPal Invoicing:**
  PayPal Invoicing is a tool that is mostly used by freelancers and small business owners to send and track invoices online. It's easy to use and helps manage payments and customer details.
  Features: allows you to make invoices the way you want, sends reminders for unpaid bills, and connects to other PayPal tools, it also supports QR. [20]
- **Venmo:**
  It's a vital part of PayPal, which is a popular peer-to-peer payment application, which is used basically for personal payments, especially between friends and family. It also supports the social media-like interface, where users can add notes and share transactions.
  Features: Venmo supports quick transfers, QR code payments, and payment splitting. While other apps are not designed to invoice businesses or manage receipts, they have a transaction history log, which basic receipt-tracking tool that can be served. [21]
- **Google Pay:**
  Google Pay is a digital wallet and payment platform that also offers e-receipt capabilities. While not a dedicated expense management solution, it is mainly used for payments, it also serves as an efficient solution for managing e-receipts by organizing transaction details and purchase history.
  Features: it stores and organizes receipts for online and offline purchases, provides a clear overview of past transactions, tracks spending, and provides financial Insights on expenses. [22]
- **Apple Wallet:**
  is a digital wallet application, that is designed for the purpose of storing cards, tickets, and digital receipts. This application is connected to Apple Pay, which allows users to pay in-store and online securely.
  Features: it supports QR code-based payments, digital ticket storage, and connection with loyalty programs. This app offers real-time transaction, tracking and storing receipts for Apple Pay purchases, by improving privacy and security features for all transfers. [23]
- **Receipta:**
  is an electronic receipt management application that allows users to store and split digital receipts into different categories, to reduce paper waste and provide an easy-to-access transaction history.

Features: offering receipt scanning, auto category splitting, and data extraction, especially for financial reports. This allows users to share receipts and integrates QR code-based digital receipt management, which can make it easy to keep a comprehensive expense record. [24]

- **Smart Receipts:**
  Smart Receipts This app is designed for both personal and professional use, by focusing on easy receipt, scanning, and generating reports for expense tracking. This app is popular because of its flexibility and detailed reporting options.
  Features: It includes receipt scanning with data extraction, automatic expense categorization, and customizable report generation. Users can also manually input receipts and track expenses by project or client, which will make it suitable for freelancers and small business owners. [25]
- **TapToBook:**
  is a digital engagement tool that targets customer loyalty and E-receipts generation, particularly for businesses in hospitality and retail. It allows businesses to interact with customers digitally, by providing E-receipts and promotional offers.
  Features: This app includes QR code receipts, appointment booking, loyalty program management, and customer analytics. It allows businesses to track customer interactions and provide personalized promotions based on purchase history, while users receive E-receipts and rewards. [26]

Chapter 4: Proposed Design

Contents

4.1. E-Receipt Specifications

4.1.1. Functional Features

1. **Generation and Storage:** Allow electronic generation of receipts upon every transaction and storage. The user must be allowed access to the receipts with permanent and secure storage.
2. **Barcode/QR Code Integration:** Give a facility for the user to retrieve his/her receipts by scanning a barcode/QR code reflected on the vendor's system.
3. **Auto-receipt tracking:** Auto-classification based on the details of each transaction. A specific example could be groceries, utilities, etc. Have a repository in order to keep organized and make access and retrieval easy.
4. **Manual Receipt Entry:** Allow the user to manually enter receipt details for those receipts that were not digitally captured.
5. **Monthly Report Generation:** This will be designed to generate detailed financial reports that summarize monthly expenses, categorized by types of spending.
6. **Categorization of Expenses:** It should be able to categorize automatically the different types of expenses into predefined categories such as food, utilities, or entertainment.
7. **Financial Insights and Alerts:** This is where analytics on spending would form. Allow setting budget limits, and sending alerts for unusual spending patterns.
8. **Sharing of Receipts:** Allow users to securely share receipts via email or other digital platforms.
9. **Cross-Platform Accessibility:** The whole system must be accessible across all mobile, web, and desktop platforms.
10. **Notification System:** Notify users of new receipts, budget milestones, or financial advice.

4.1.2. Non-Functional Features

1. **Scalability:** The ability to support a constantly increasing number of users and transactions on an ever-growing application.
2. **Reliability:** The systems should ensure uptime, 24/7, with minimum downtime.
3. **Performance:** Ensure that the system response is optimized, which means a less-than-two-second process for QR code scanning and retrieval of a receipt.
4. **Security:** Protect user data through encryption and secure communication protocols. Implement secure authentication for user accounts.
5. **Usability:** Easy to use, intuitive interface for navigation across all functionalities, with special access to visually or physically challenged users.
6. **Maintainability:** The use of a modular design should allow updating and maintenance without affecting the whole application.
7. **Offline Support:** Access receipts stored locally when the Internet is down and perform manual entries.
8. **Eco-Friendly:** Save the environment from wastage that happens due to conventional, paper-based receipts.
9. **Integration Capability:** Allow for seamless integrations with third-party systems, including financial tools, email clients, and accounting software.

10. **Data Integrity:** Store data correctly and consistently in various receipts, reports, and analytics across platforms.

4.1.3. Use case diagram

This use case diagram in Figure 1 shows the main functionalities of the TrackReceipts System from the User or Client-side and the Vendor-side.

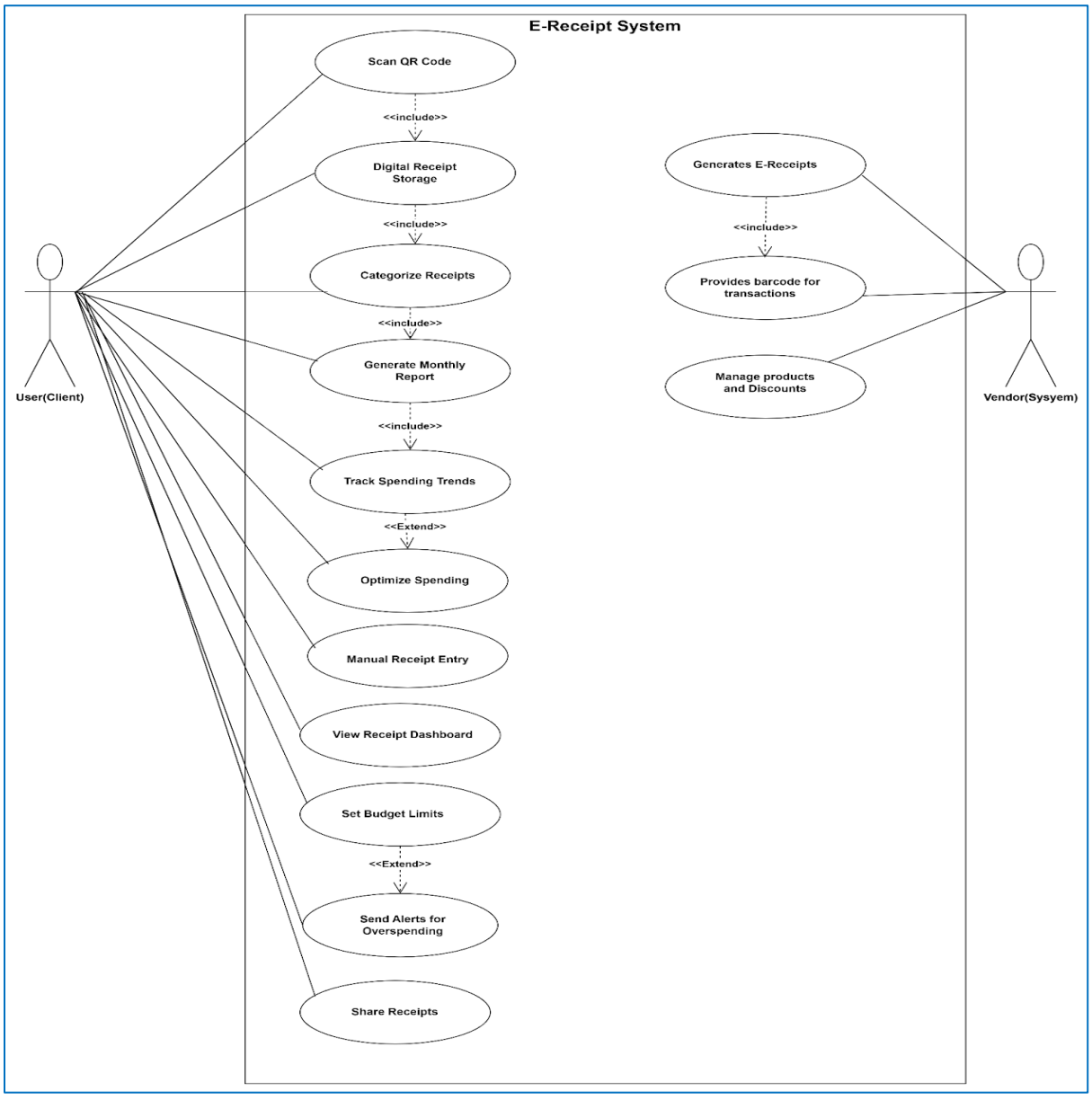

Figure 1: Use case diagram of TrackReceipts System

4.1.4. Sequence diagram

This sequence diagram in Figure 2 shows the interaction between the user, the application interface, the main system (TrackReceipts System), and external components such as the vendor and the database. The diagram describes how the core actions in the system are executed in order step by step.

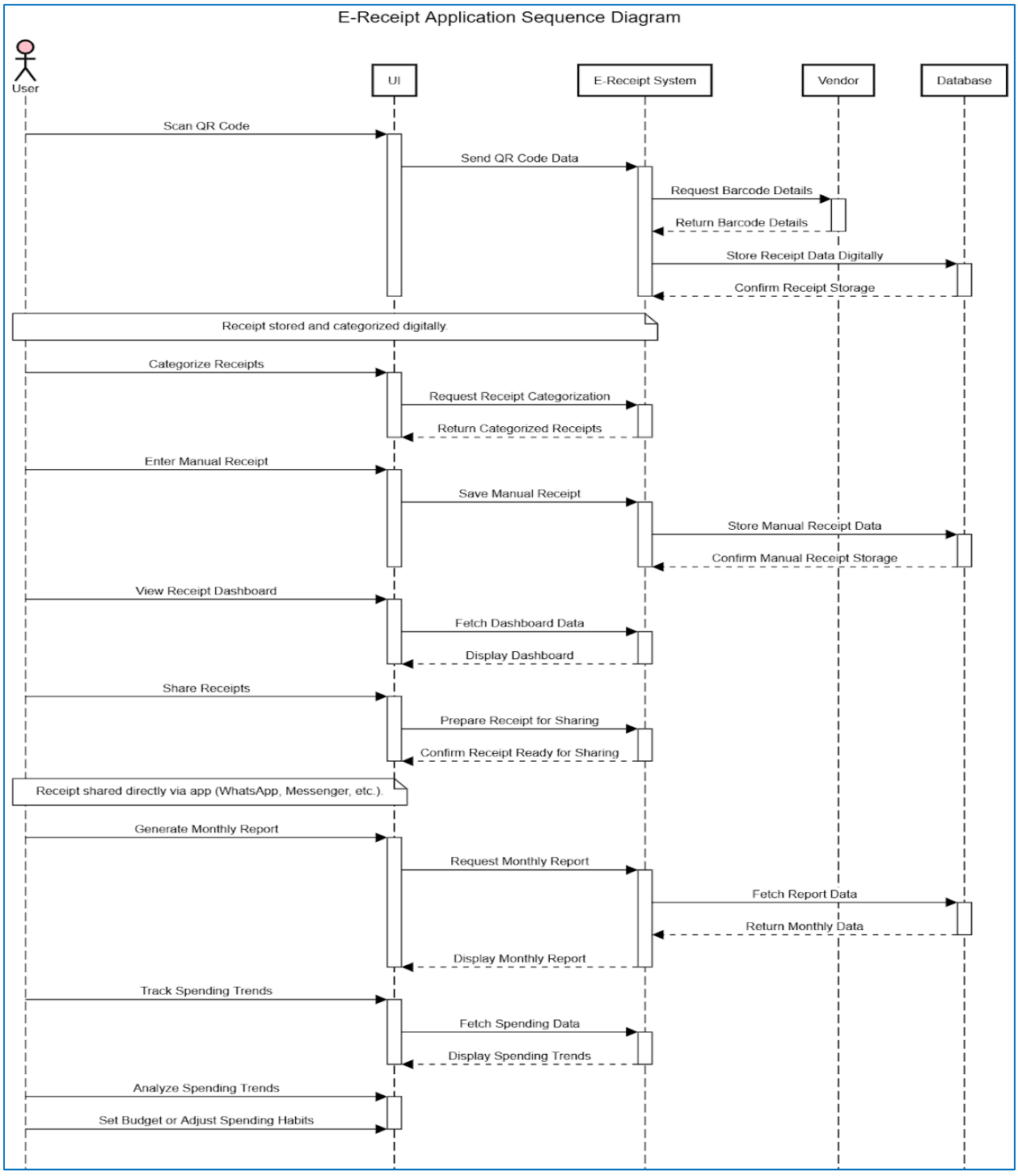

Figure 2: Sequence diagram of TrackReceipts System

4.1.5. Class diagram

Figure 3 shows the Class Diagram of the E-Receipt Application, describing the structure the system will take, key classes like 'User', 'Receipt', 'Vendor', 'Transaction', 'Report', 'SpendingTrend' and 'BudgetAlert', including attributes and methods, besides their relations. The associations, aggregation, and composition between class entities guarantee that users interact flawlessly with receipts and vendors in managing receipts and drawing insight into one's finances and budget. This would enable the system to achieve a more user-oriented, extensible, and effective architecture.

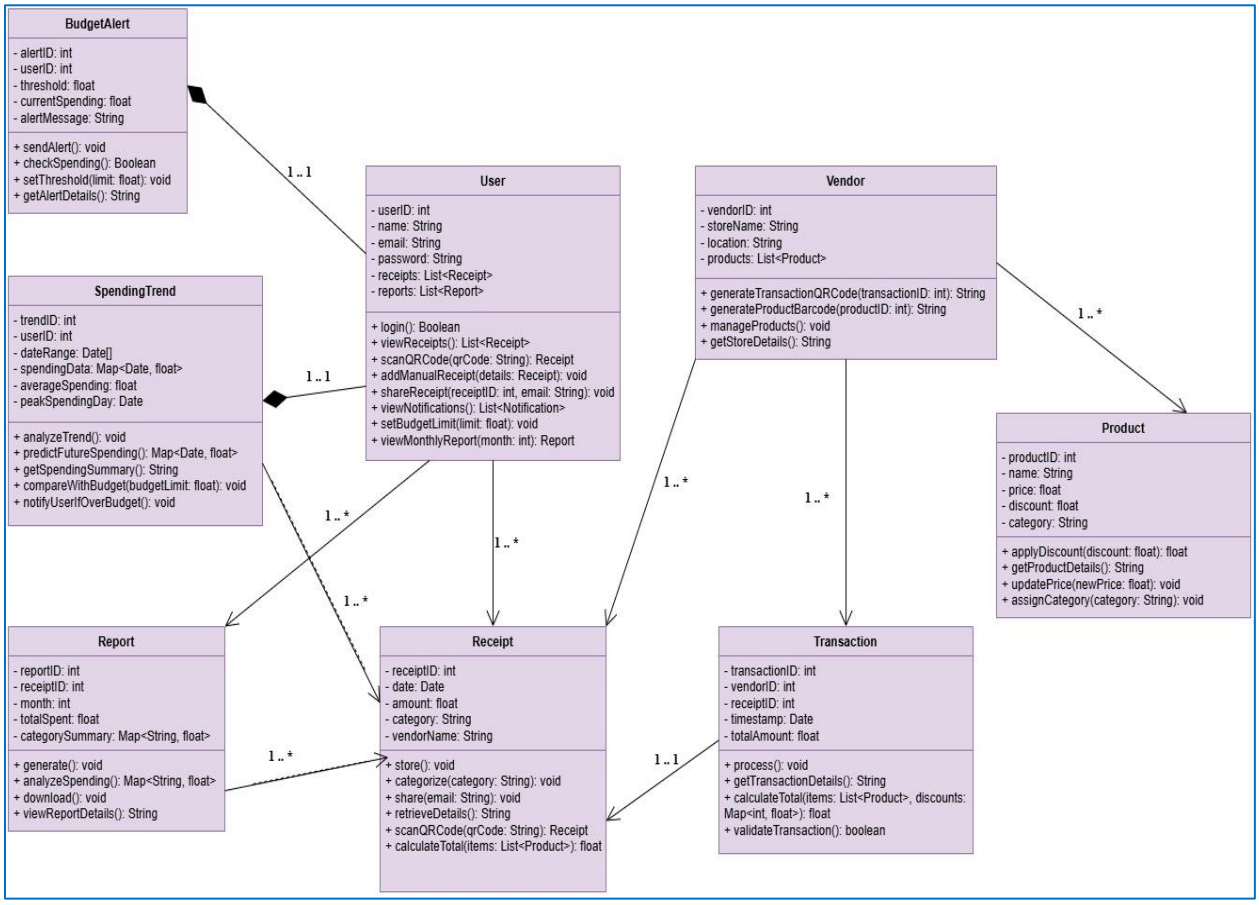

Figure 3: Class diagram of TrackReceipts System

4.1.6. Architecture diagram

The architecture diagram in Figure 4 shows a three-layer system: the UI Layer, Middle Layer, and Infrastructure Layer. This diagram represents a clear separation of responsibilities and, therefore, modularity, and interaction between the layers are done efficiently.

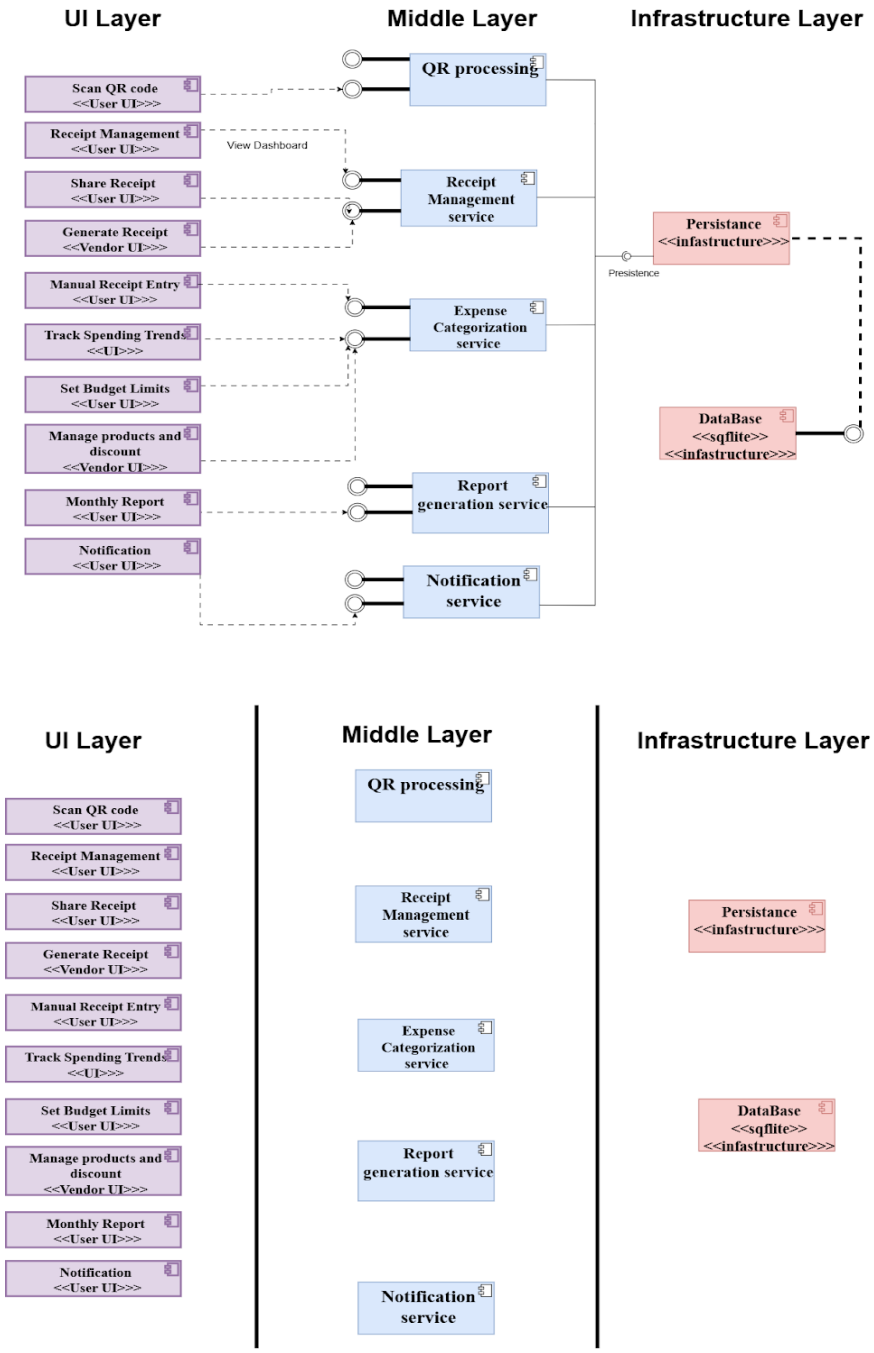

Figure 4: Architecture diagram of TrackReceipts System

Chapter 5: Project Plan

Contents

The Agile project methodology will be applied with sprints every 2 weeks approximately. Development of the project is divided between Flutter at the front-end, Node.js at the back-end, and SQLite for the database. Distribution of tasks among three developers to ensure efficiency and collaboration.

5.1. Main Tasks and Milestones

Table 2 shows the tasks, milestones, and deadlines with task allocation for each developer.

Table 2: Main Tasks and Milestones

Task/Activity	Developer(s)	Start Date	End Date	Duration
1. Project Initialization - **Environment setup (Flutter/Node.js)**	Developer 1	03/01/2025	10/01/2025	1 Week
- **Database design (SQLite)**	Developer 2	03/01/2025	10/01/2025	1 Week
- **Set up version control (Git)**	Developer 3	03/01/2025	10/01/2025	1 Week
2. UI Design (user and vendor UI)	Developer 1	11/01/2025	24/01/2025	2 Weeks
3. Backend Development - **Develop a QR processing service** - **Receipt management APIs** - **Expense categorization APIs** - **Report and notification APIs**	Developer 2	25/01/2025	15/03/2025	7 Weeks
4. Database Integration - **Set up persistence (SQLite)**	Developer 3	25/01/2025	15/02/2025	3 Weeks
5. Front-End Development - **Develop a QR code-scanning module** - **Manual entry and receipt storage** - **Expense tracking and reports** - **Notifications and budget limits**	Developer 1 & 3	16/03/2025	25/04/2025	6 Weeks

6. System Integration - **Connect front-end to back-end** - **End-to-end testing**	All Developers	26/04/2025	09/05/2025	2 Weeks
7. User Testing and Refinement - **Collect user feedback** - **Fix bugs and optimize the system**	All Developers	10/05/2025	24/05/2025	2 Weeks
8. Documentation and Delivery - **Write a final report and deploy**	Developer 1	25/05/2025	10/06/2025	2 Weeks

5.2. Team Responsibility

- Developer 1: Front-end design (UI/UX) and Flutter development.
- Developer 2: Back-end services (Node.js APIs).
- Developer 3: Database integration and front-end/back-end testing.

5.3. Work Breakdown Structure (WBS)

Figure 5 shows the TrackReceipts System WBS.

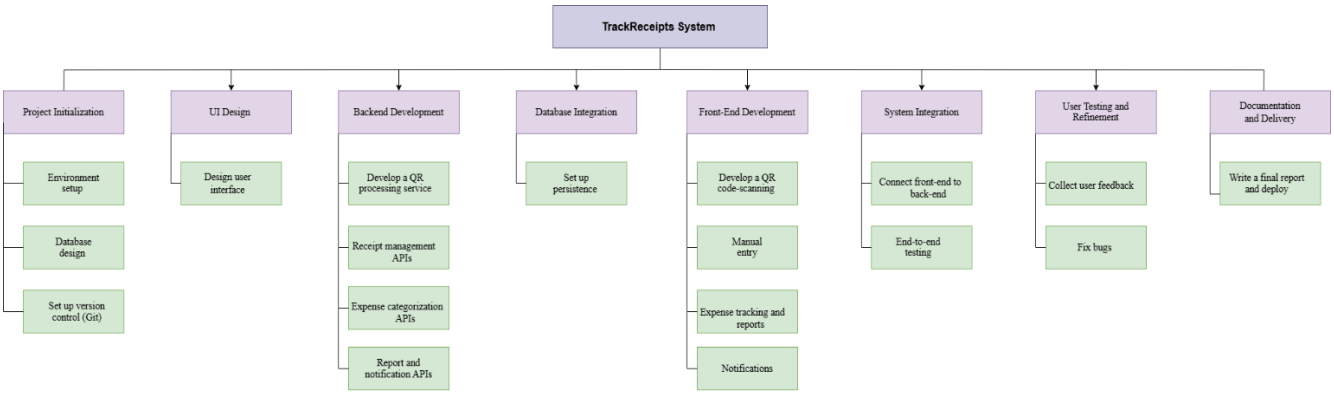

Figure 5: TrackReceipts System WBS

5.4. Gantt Chart

Figure 6 shows the TrackReceipts System Gantt Chart.

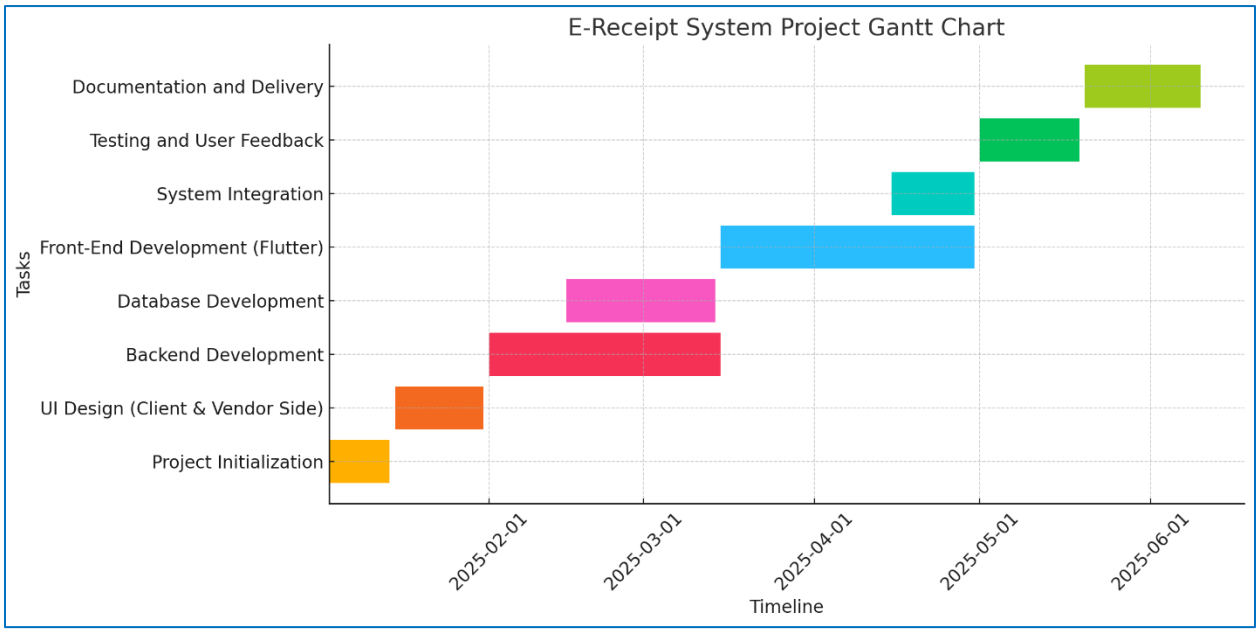

Figure 6: TrackReceipts System Project Gantt Chart

Chapter 6: Conclusion and Future Work

Contents

6.1. Conclusion

The E-Receipt Application was built to eliminate the inefficiency and troubles of traditional paper-based systems, thus offering a digitized solution that is also friendly to the environment for every vendor and client. Therefore, by embedding QR/Barcode scanning, automatic categorization of expenses, receipt sharing, and financial insights, the system simplifies receipt management and provides important budgeting and financial planning features. While it eases processes for users, it saves paper wastage and thereby contributes to environmental sustainability. This turns out to be a fully integrated platform aimed at an enhanced user experience, better efficiency in operations for the vendor, and actionable insights toward better financial management.

6.2. Future Work

The E-Receipt Application still has room for enhancement in order to remain innovative and on par with the latest technologies. The following areas are suggested for future work:

- AI: Artificial intelligence can be incorporated in order to analyze the spending trends of users and offer personal suggestions for budgeting and finance advice.
- Machine Learning: ML models are built on predicting future expenses and spending trends using historical receipt data and user behavior.
- Implement Financial Tools: Implement integration with third-party financial and accounting software to extend functionality for the work in terms of enabling smooth financial management within one application.
- Blockchain Technology: It offers tamper-proof digital receipts; thus, transactions in trustless, transparent manners can be tracked using this technology.
- Cloud Integration: Integrate cloud storage to access the receipts from anywhere at any time and improve scalability for huge amounts of data.
- Multi-Language Support: Provide multilingual support for extending the usage of the application among a wide variety of global customers.

These enhancements will make sure that the system keeps evolving to meet future user needs, leverages cutting-edge technologies, and becomes a leading solution for digital receipt management and financial optimization.

References

[1] "www.sunavin.com," [Online]. Available: https://www.sunavin.com/ar/receipt-paper-why-it-fades-and-how-to-restore-it/?utm_source=chatgpt.com.

[2] "www.refive.io," [Online]. Available: https://www.refive.io/en/blog/digital-receipt-system/?utm_source=chatgpt.com.

[3] "visionx.io," [Online]. Available: https://visionx.io/blog/what-are-paper-receipts/?utm_source=chatgpt.com.

[4] "www.scantrust.com," [Online]. Available: https://www.scantrust.com/qr-code-on-receipts/ .

[5] "www.greenamerica.org," [Online]. Available: https://www.greenamerica.org/skip-the-slip.

[6] "www.pmi.org," [Online]. Available: https://www.pmi.org/learning/library/blending-agile-waterfall-successful-integration-10213 .

[7] "www.mdpi.com," [Online]. Available: https://www.mdpi.com/2078-2489/15/10/592.

[8] "kunakair.com," [Online]. Available: https://kunakair.com/environmental-impact-paper-industry/ .

[9] "www.researchgate.net," [Online]. Available: https://www.researchgate.net/publication/366696785_Analyzing_Consumer_Spending_Behavior_Using_Graph_Databases.

[10] "blog.codemagic.io," [Online]. Available: https://blog.codemagic.io/cross-platform-mobile-apps-development-with-flutter/.

[11] "www.cybrosys.com," [Online]. Available: https://www.cybrosys.com/blog/how-to-manage-database-using-sqflite-plugin-in-flutter .

[12] "medium.com," [Online]. Available: https://medium.com/@arunb9525/understanding-flutters-dual-compiler-system-jit-and-aot-explained-85c5d9cbfbc6.

[13] "www.xavor.com," [Online]. Available: https://www.xavor.com/blog/dart-programming-language-features-and-applications/.

[14] "www.simform.com," [Online]. Available: https://www.simform.com/blog/nodejs-advantages-disadvantages/.

[15] "qrcodedynamic.com," [Online]. Available: https://qrcodedynamic.com/blog/qr-code-on-receipt/.

[16] "onesignal.com," [Online]. Available: https://onesignal.com/financial.

[17] "www.expensify.com," [Online]. Available: https://www.expensify.com/ .

[18] "www.zoho.com," [Online]. Available: https://www.zoho.com/expense/.

[19] "squareup.com," [Online]. Available: https://squareup.com/us/en/point-of-sale .

[20] "www.paypal.com," [Online]. Available: https://www.paypal.com/us/business/accept-payments/invoice .

[21] "venmo.com," [Online]. Available: https://venmo.com/ .

[22] "pay.google.com," [Online]. Available: https://pay.google.com/about/ .

[23] "www.apple.com," [Online]. Available: https://www.apple.com/wallet/ .

[24] "www.receipta.com," [Online]. Available: https://www.receipta.com/.

[25] "www.smartreceipts.co," [Online]. Available: https://www.smartreceipts.co/.

[26] "www.taptobook.com," [Online]. Available: https://www.taptobook.com/.