



Faculty of Computer Science and Information Technology

***FINANCIAL MANAGEMENT SYSTEM WITH MACHINE
LEARNING SUPPORT***

CALEIGH SUSAN ANAK JEFFRY

Bachelor of Software Engineering with Honours
2026

FINANCIAL MANAGEMENT SYSTEM WITH MACHINE LEARNING SUPPORT

CALEIGH SUSAN ANAK JEFFRY

This project is submitted in partial fulfilment of the requirements for the degree of
Bachelor of Software Engineering with Honours

Faculty of Computer Science and Information Technology
Universiti Malaysia Sarawak
2026

FINANCIAL MANAGEMENT SYSTEM WITH MACHINE LEARNING SUPPORT

CALEIGH SUSAN ANAK JEFFRY

Projek ini merupakan salah satu keperluan untuk Ijazah Sarjana Muda
Kejuruteraan Perisian Dengan Kepujian

Fakulti Sains Komputer dan Teknologi Maklumat
Universiti Malaysia Sarawak
2026

ABSTRACT

Effective personal financial management is increasingly important for university students, particularly in a cashless environment where digital transactions are prevalent. Despite the convenience of cashless payments, students often face challenges in tracking daily expenses, managing fixed bills and handling shared expenses with peers. This can lead to poor financial awareness and overspending. To address these issues, this project proposes Spendette, a web-based financial management system designed to support students in monitoring and managing their personal finances efficiently. The system provides core functionalities including user authentication, expense and income management, expense categorization, fixed bill tracking with reminders, group expense management and financial summary generation. Additionally, Spendette incorporates spending pattern analysis to assist users in identifying potential overspending behaviours and receiving timely notifications. The system was developed using web technologies and follows an agile-based development approach to ensure flexibility and continuous improvement. Overall, Spendette aims to enhance financial awareness and promote responsible spending habits among university students.

ACKNOWLEDGEMENT

I would like to express my sincere appreciation to the Faculty of Computer Science and Information Technology, Universiti Malaysia Sarawak (UNIMAS) for providing the academic support, learning environment and resources that enabled the successful completion of this Final Year Project.

I would like to convey my deepest gratitude to my project supervisor, Dr Yanti Rosminie Binti Bujang, for her invaluable guidance, constructive feedback and continuous support throughout the duration of this project. Her expertise, patience and professional advice were instrumental in shaping the direction and quality of this work.

I am also profoundly grateful to my parents for their unwavering support, encouragement, and understanding throughout my academic journey. Their constant motivation and belief in my abilities provided the foundation for the successful completion of this project.

Finally, I would like to acknowledge my friends and peers for their cooperation, assistance and moral support during the development of this project. Their contributions and encouragement are sincerely appreciated.

TABLE OF CONTENT

ABSTRACT	i
ACKNOWLEDGEMENT	ii
TABLE OF CONTENT.....	iii
LIST OF TABLES.....	v
LIST OF FIGURES.....	vi
CHAPTER 1: INTRODUCTION	1
1.1 Introduction	1
1.2 Problem Statement	2
1.3 Scope	3
1.4 Aims and Objectives.....	5
1.5 Brief Methodology	6
1.6 Significance of Project	7
1.7 Project Schedule	9
1.8 Expected Outcome	10
1.9 Project Outline.....	12
1.10 Summary	13
CHAPTER 2: BACKGROUND STUDY	14
2.1 Introduction	14
2.2 Review of Existing System	15
2.2.1 System 1: Pennywise	15
2.2.2 System 2: Spendee	22
2.2.3 System 3: Goodbudget.....	27
2.3 Comparison Between Existing System and Proposed System.....	33
2.4 Technology Review	37
2.5 Summary	39
CHAPTER 3: REQUIREMENTS ANALYSIS AND DESIGN	40
3.1 Introduction	40
3.2 Agile Methodology.....	40
3.2.1 Scrum Framework.....	41

3.3 User Requirements Gathering	43
3.3.1 Finding & Analysis	44
3.3.2 Functional Requirements	68
3.3.3 Non-Functional Requirements	70
3.4 System Design.....	71
3.4.1 Use Case Diagram.....	71
3.4.2 Use Case Table	74
3.4.2 Activity Diagram	88
3.4.3 Sequence Diagram	89
3.4.4 System Architecture.....	91
3.4.5 User Interface	92
3.5 Summary	100
REFERENCES.....	101

LIST OF TABLES

Table 1 Comparison Between Similar Existing System and Proposed System	33
Table 2 Summary of Respondents' Educational Level	45
Table 3 Summary of Respondents' Gender	46
Table 4 Summary of Respondents' Income Sources	48
Table 5 Payment Methods Commonly Used for Daily Transactions	49
Table 6 Proportion of Respondents Sharing Expenses.....	50
Table 7 Frequency of Using Expense Tracking Systems	53
Table 8 Limitations Experienced by Users of Expense Tracking Systems	55
Table 9 Overall Satisfaction with Expense Tracking Systems	57
Table 10 Suggested Improvements and Additional Features	58
Table 11 Summary of Current Methods of Financial Management	60
Table 12 Common Challenges Faced in Managing Expenses	62
Table 13 Summary of Suggested Features or Benefits	63
Table 14 Additional Suggestions and Expectations for the Spendette System	67
Table 15 Functional Requirements of Spendette System.....	68
Table 16 Non-Functional Requirements of Spendette System.....	70
Table 17 UC01-Register Account	74
Table 18 UC02-Log In	76
Table 19 UC03-View Dashboard	77
Table 20 UC04-View Financial Summary	78
Table 21 UC05-Generate Financial Summary	79
Table 22 UC06-Analyze Spending Pattern	80
Table 23 UC07-Send Notification.....	81
Table 24 UC08-Receive Notification.....	82
Table 25 UC09-Manage Expense.....	83
Table 26 UC10-Manage Income	84
Table 27 UC11-Manage Fixed Bills.....	85
Table 28 UC12-Manage Group Expense.....	86
Table 29 UC13-Manage Expense Categories.....	87

LIST OF FIGURES

Figure 1.1 Scrum Framework.....	6
Figure 1.2 Gantt Chart for FYP I	9
Figure 1.3 Gantt Chart for FYP II	10
Figure 2.1 Dashboard	16
Figure 2.2 Add Category Popup	17
Figure 2.3 Add Expense	18
Figure 2.4 Fixed Bill Feature	19
Figure 2.5 Sample of Report for Monthly Spending.....	20
Figure 2.6 Expense Summary	21
Figure 2.7 Machine Learning Insights	21
Figure 2.8 List of Transactions.....	23
Figure 2.9 Add Expenses.....	24
Figure 2.10 Overview Page	25
Figure 2.11 Connected Bank Account Feature.....	26
Figure 2.12 Dashboard that displays the List of Transactions	28
Figure 2.13 The Fill Envelope page	29
Figure 2.14 Add Transaction	30
Figure 2.15 Sample of Pie Chart based on Envelope	31
Figure 2.16 Report Category	32
Figure 3.1 Distribution of Respondents by Level of Study.....	45
Figure 3.2 Distribution of Respondents by Gender.....	46
Figure 3.3 Types of Income Received by Respondents	47
Figure 3.4 Distribution of Payment Methods Used for Daily Transactions.....	49
Figure 3.5 Distribution of Respondents Sharing Expenses.....	50
Figure 3.6 Respondent Distribution by Prior Experience	51
Figure 3.7 Respondents' Usage Frequency of Expense Tracking Systems.....	52
Figure 3.8 Distribution of Limitations of Existing Expense Tracker.....	54
Figure 3.9 Respondents' Overall Satisfaction with Expense Tracking Systems.....	56
Figure 3.10 Respondents' Methods for Managing Personal and Shared Expenses	59
Figure 3.11 Distribution of Challenges Encountered in Managing Expenses	61
Figure 3.12 Level of Agreement on the Importance of Proposed Features.....	65

Figure 3.13 Use Case Diagram for Spendette Web Application	72
Figure 3.14 Activity Diagram.....	89
Figure 3.15 Sequence Diagram	90
Figure 3.16 System Architecture	91
Figure 3.17 Login Page of Spendette Web Application	93
Figure 3.18 Transaction List Page in Spendette Web Application	94
Figure 3.19 View Transaction Details	95
Figure 3.20 Add New Expense Form	96
Figure 3.21 Add New Income Form.....	97
Figure 3.22 Create New Expense Category	98
Figure 3.23 Add New Fixed Bills Feature.....	99
Figure 3.24 Create Group Expense Feature	100

CHAPTER 1: INTRODUCTION

1.1 Introduction

Managing personal finances effectively as a student is an essential life skill to preserve financial stability and sustain long-term growth. Nowadays, students often use digital transactions which leads to problems when it comes to organizing their daily expenses and struggle to control their spending. This is because it is harder to track daily expenses when it comes to cashless payment as it has less emotional impact of spending. This difficulty is further compounded by those who share their daily expenses with friends. Shared expenses encourage informal and manual tracking habits that lead to confusion and delay payment. Hence, this project introduces Spendette, a web application expense analyzer designed to address these issues by integrating personal and group finance management within a single platform. Spendette allows users to manage their daily expenditures while managing shared expenses for various purposes such as accommodation, trips, or group activities. This financial management system promotes transparency by ensuring that all the users clearly understand their financial responsibilities. Furthermore, Spendette incorporates Machine Learning to analyze users' historical spending data, provide personalized budgeting recommendations and detect unusual or excessive expenses. This digital approach enables users to nurture better financial habits. The system also features monthly spending trends to enhance users' understanding of their financial behavior. By integrating personal and shared financial management with predictive insights, Spendette offers an approach to financial organization that promotes responsible spending and strengthens financial literacy among its users.

1.2 Problem Statement

University students often lack the knowledge and experience needed to manage their finances, leading to poor financial decisions and financial stress that can affect their mental health and wellbeing. (Cappelli et al., 2024). This issue frequently happens among students that face difficulties in managing their financial situation efficiently, especially tracking both of their personal and shared expenses. In addition, Irby (2024) mentioned that frequent small purchases can accumulate unexpectedly and result in budget overruns, therefore, systematically tracking expenses through receipt collection and categorized spending records enables individuals to identify and manage areas of excessive expenditure more effectively. Students need an automated financial management system to track their daily spending accurately and improve their financial decision. Manually tracking their spending and budget can lead to a range of problems such as below:

- i. **Difficulty in expense tracking:** Many students face challenges in efficiently managing both personal and shared expenses due to the lack of exposure to organized tracking system. With the rise of cashless transactions such as e-wallet and online banking, students may forget or overlook small purchases that accumulate over time. Without an automated system, manual tracking can be time-consuming, especially when expenses are split among several people. This lack of clarity can lead to overspending, delayed payments and prone to errors.
- ii. **Limited budget control and financial awareness:** Many students have a strict budget constraint. Without integrated tracking and analytic tools, students often struggle to monitor their spending behavior and maintain financial discipline within their budget. The absence of real-time tools makes it difficult to identify spending patterns that will make students

unknowingly prioritize short-term satisfaction such as dining out, shopping, or entertainment over essential needs like transportation, academic materials, or savings. This lack of visibility often results in poor financial decisions that can cause stress or long-term financial consequences.

- iii. **Challenges in managing shared financial responsibilities:** Group expenses like rent, utilities and groceries require a transparent and systematic platform for tracking individual contributions in shared student expenses. Without an automated system, students often rely on manual methods such as chat messages, verbal reminders or manually updated spreadsheets. This can easily lead to confusion, miscalculations and delay payments. This project would minimize the issues by offering automated tracking and clear transaction histories.

1.3 Scope

The scopes of Spendette, a financial management system project, define the system boundaries by outlining the essential features and functionalities that support students in managing both personal and shared expenses. The system is designed to be secure, intelligent, and user-friendly, with the following key components:

i. System Boundaries

- **User Authentication:** This feature restricts access to authorized users only as a step to safeguarding sensitive financial information and preventing unauthorized manipulation of records.

- **Financial Management:** This feature enables users to log on to their daily expenses, organize budget and manage shared expenses with peers. This feature also helps users to visualize their cash flow and maintain control over their budget.
- **Data Visualization Tools:** This feature allows users interpret their spending trends and budget usage by using data visualization tools.
- **Machine Learning Integration:** This Machine Learning Model analyzes users' historical spending patterns, offer personalized budget suggestions and detect overspending.
- **User Interface:** The system features a clean and intuitive interface designed to ensure that users can easily access key features, input data and interpret financial insights without requiring technical expertise.

ii. Type of User

Primary users of Spendette Web Application will include:

- University students who need a simple and effective system to manage personal and shared expenses.

1.4 Aims and Objectives

The main reason to conduct this project generally is to develop an automated system to help users track their daily expenses and provide a clear summary of their budget usage. This project addresses the financial challenges by offering a digital solution for its user to make informed financial choices, avoid overspending and build healthier budgeting routines over time. Below is a detailed description of each aim and objective:

- i. **To develop a responsive web application that enables users to record, manage and monitor both personal and shared financial transactions to ensure accuracy and transparency** - This system allows users to efficiently track and organize their expenses and ensure accessibility across multiple devices. In addition to providing basic transaction recording, the system will have a responsive design to ensure users convenience and absolute access whether users are on a phone, tablet or desktop.
- ii. **To generate clear financial summaries and balance sheets that assist users in monitoring their spending effectively** - This project aims to provide users with visual and organized representations of their financial data by generating summaries and balance sheets. It helps users make informed decisions, track savings goals, and maintain financial discipline.
- iii. **To implement a machine learning model to analyze spending habits and provide personalized budgeting recommendations for improved financial planning** - The integration of Machine Learning Model that examines users' historical spending data, predict potential overspending and offer personalized recommendations. By identifying

recurring expenses, the model can generate tailored suggestions to help users optimize their budget and may also alert users when they are close to exceeding their usual spending.

1.5 Brief Methodology

The methodology section outlines the structured approach used to guide completion of this project. Given the integration of machine learning models, it is essential to adopt a flexible and iterative framework. For this reason, the project will be completed using Agile Methodology, specifically the Scrum framework. Below are the breakdowns of the methodology:

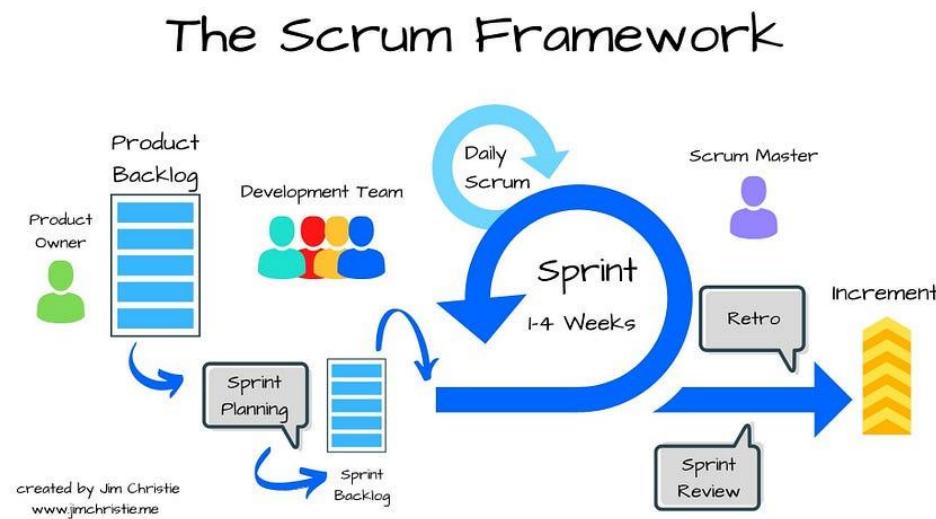


Figure 1.1 Scrum Framework

Source: <https://share.google/images/Vv92JcPmkuQuWGzCL>

i. Product Backlog

A dynamic list of features, requirements, enhancements and fixes and continuously updated to reflect changing needs.

ii. Sprint Planning

A set of time to identify the goal of the sprint which includes what tasks will be completed and how the work will be accomplished.

iii. Sprint Execution

A structured process to deliver incremental value through planned iterations, continuous improvement and adaptive planning to efficiently achieve project goals.

iv. Sprint Review

To demonstrate completed work, gathers feedback, ensures alignment with the product vision and identifies improvements to promote continuous improvement.

v. Sprint Retrospective

To evaluate past sprint and create a plan to address areas of improvement for the future.

vi. Product Increment

A new developed or refined feature that is created at the end of each sprint.

1.6 Significance of Project

The significance of Financial Management System with Machine Learning Support project that introduces Spendette lies in its potential to promote financial awareness and responsible money management among students. Through Machine Learning, the system provides personalized recommendations, empowering users to make smarter financial decisions and develop sustainable financial habits. Below is the significance of the project:

i. Promotes Financial Awareness and Responsibility.

The project helps users better understand their spending behavior by tracking both personal and shared expenses. By recording daily transactions, users become more conscious of their financial habits which avoid unnecessary expenses. Over time, this promotes a sense of responsibility and discipline in managing finances.

ii. Enhances Transparency in Shared Financial Management.

This project promotes transparency by providing a single platform where users can manage both individual and group expenses. The system minimizes confusion and delays in repayments by keeping a transparent record of all shared financial activities. Each member in the group can view their shared costs in real-time. This fosters better communication among users who share common financial responsibilities.

iii. Adaptability with Machine Learning.

By integrating Machine Learning, the system gains the ability to analyze users' historical spending patterns. This feature allows Spendette to offer personalized budgeting recommendations that align with each user's financial behavior. This adaptability not only enhances the functionality of the system but also empowers users to make smarter financial decisions.

1.7 Project Schedule

Below is the project schedule for Final Year Project I and Final Year Project II.

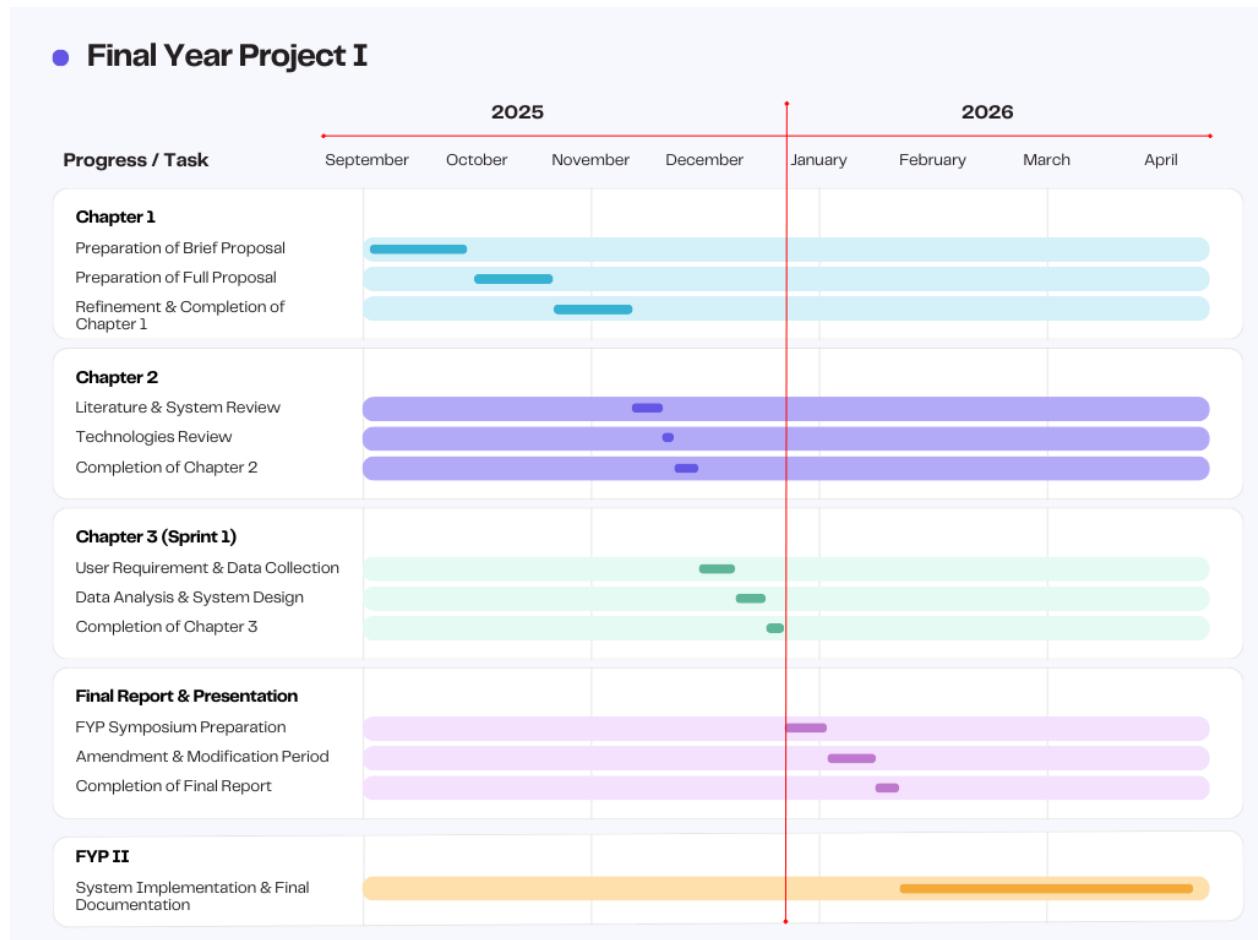


Figure 1.2 Gantt Chart for FYP I

● Final Year Project II

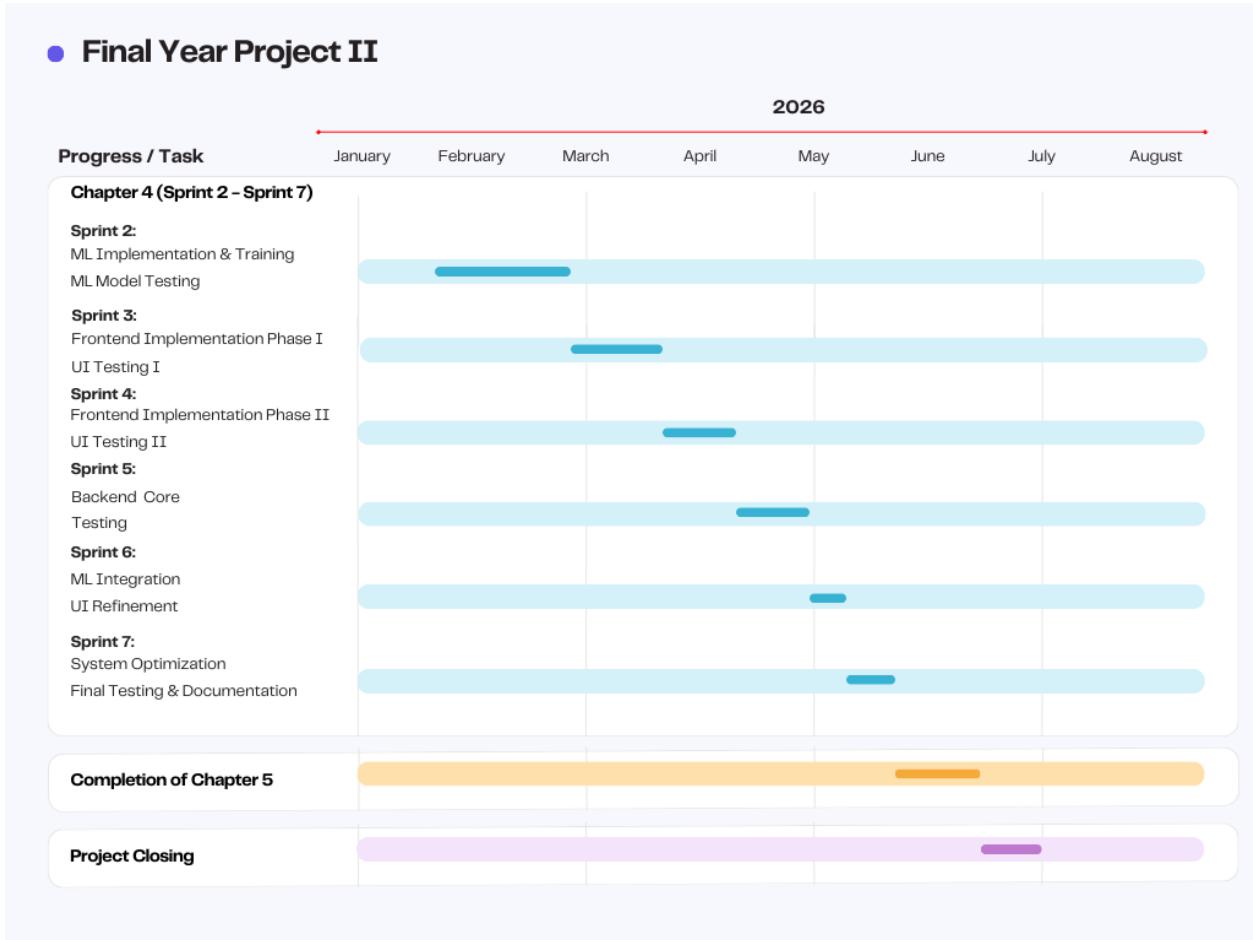


Figure 1.3 Gantt Chart for FYP II

1.8 Expected Outcome

The expected outcomes of the Financial Management System with Machine Learning Support project are designed to ensure that the implementation of the system meets the needs of user experience and overall efficiency. These outcomes highlight improvements in financial tracking accuracy and intelligent budgeting support to ensure the system delivers meaningful value to its users. Below is the detailed description of each expected outcome:

- i. A fully functional web application financial management system capable of monitoring both personal and shared expenses of an individual.**

This outcome focuses on developing a responsive web application that enables users to manage and track both individual and group financial activities in one platform. By integrating these functions, users can easily organize their finances, avoid duplication of records and maintain a clear overview of their personal and shared spending.

- ii. Comprehensive financial summaries that provide users with clear insights into their spending patterns and financial transactions.**

This outcome aims to generate detailed reports and visual summaries that allow users to analyze their financial behavior effectively. The system will display spending trends, budget usage and monthly comparisons to help users identify overspending habits, manage their budgets more efficiently and make informed decisions to improve financial stability.

- iii. A machine learning model capable of analyzing users' spending habits and generating personalized recommendations to help them plan and manage their finances more effectively.**

This outcome emphasizes the implementation of a Machine Learning component that intelligently examines historical spending data to recognize patterns and detect irregularities. Based on these analyses, the system will provide personalized budgeting tips and financial recommendations tailored to each user's spending behavior.

1.9 Project Outline

Chapter 1: Introduction

Chapter 1 provides the introduction of Financial Management System project and the overview of Spendette. This chapter contains Introduction, Problem Statement, Project Scope, Aims and Objectives, Methodology, Significance of Project, Project Schedule, Expected Outcome, Project Outline and Chapter Summary.

Chapter 2: Literature Review

This second chapter contains background research into the existing system and the comparison between existing systems and Spendette. With this background research, the weaknesses and limitations of previous systems are being analyzed.

Chapter 3: Methodology

Chapter 3 describes the appropriate software development methodology that will be applied to develop the system. This chapter will explain how the methodology helps in achieving the project objectives and why the methodology was chosen.

Chapter 4: Implementation

This chapter presents the implementation and testing of the proposed system. The implementation phase outlines the development process based on the software requirements identified in the previous chapter.

Chapter 5: Testing

Chapter 5 focuses on the testing of the system, which includes functionality testing, user interface evaluation, and security validation. These tests are carried out to ensure that all system features operate correctly and deliver smooth user experience.

1.10 Summary

The chapter is organized into several key sections, including the introduction, problem statement, aims and objectives, methodology, project scope, significance of the project, expected outcomes, and the overall project outline. The following chapter will present the literature review, providing a detailed examination of existing studies and theories relevant to this research.

CHAPTER 2: BACKGROUND STUDY

2.1 Introduction

The proposed system in this project is Spendette, a web application for financial management systems with machine learning support. Managing finance is one of the critical skills for all students. This skill is important to be practiced from a very young age to develop beneficial habits that help avoid problems like debt or poor credit in later life. According to Sabirin et al. (2023), financial management strengthens financial stability and resilience by equipping individuals with essential skills to manage money wisely, participating fully in the financial system and contributing to broader economic and social development. Managing financial effectively also fosters long-term financial security that enables students to handle unexpected expenses and plans. In addition, students often share expenses with roommates or friends to manage costs for rent, utilities, groceries and other daily necessities. Although sharing expenses can ease financial burdens, it can also cause conflicts and stress when contributions are unequal, spending habits differ, unexpected costs arise or payments are missed that this will potentially affect well-being and academic performance (Trevor et al., 2025).

Hence, it is important to have an automated financial management system. Keeping a traditional expense diary is prone to calculation errors, so automated expense tracker system aims to ease the burden by allowing users to conveniently record daily spending and their financial patterns through clear visual charts (Gehlot et al., 2024). This financial management system has integrated machine learning models such as Random Forest to support analysis and predictive forecasting for improved financial planning. David et al. (2024) mentioned that Random Forests are valued for their interpretability and robustness in financial datasets, with decision trees

simplifying complex decisions into binary steps and random forests boosting predictive accuracy by combining multiple trees. Thus, Random Forest Model help capture complex nonlinear patterns of the user's expenses, allowing the system to deliver accurate insights and adaptive budget recommendations based on user income and behavior.

This chapter analyses three existing systems and compares them with the proposed system to identify each system's strengths and weaknesses, highlighting the improvements the proposed system can offer.

2.2 Review of Existing System

In this section, a background study of three similar existing systems which are Pennywise, Spendee and Goodbudget is conducted and compared to provide a comparative foundation for the development of the proposed system. The three existing systems are being studied in terms of their design and characteristics to define each of their strengths and limitations.

2.2.1 System 1: Pennywise

2.2.1.1 System URL

<https://www.pwise.app/login-otp/>

2.2.1.2 System Description

The first system is Pennywise, a personal finance management system designed to help users track and control their spending. The platform allows users to record daily expenses, categorize spending

and set spending limit for each category. Build with security and accessibility in mind, Pennywise offers OTP-based secure login and registration to ensure user data remains protected. The implementation of One-Time Password (OTP) strengthens the protection of username and password data in web application authentication processes (Kurniawan et al., 2021).

Users can also access an interactive dashboard featuring intuitive charts and graphs that visualize their spending patterns and financial trends. This allows users to quickly understand trends, compare categories and monitor their financial health in an engaging way. Figure 2.1 shows the dashboard view in Pennywise system that visualizes and analyses users' daily expenses and financial behavior.

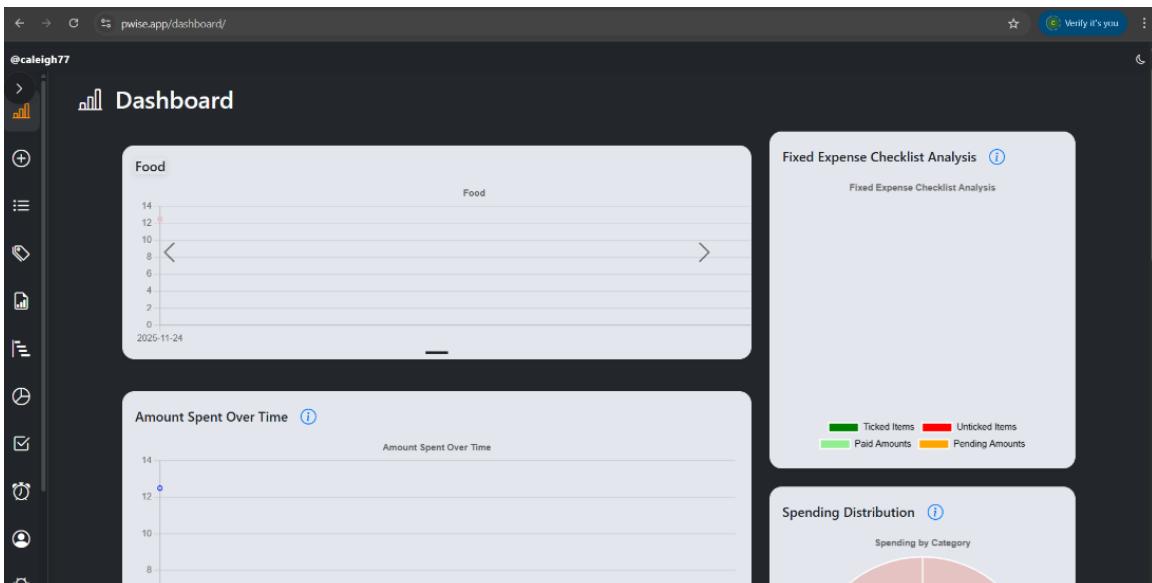


Figure 2.1 Dashboard

Based on Figure 2.2, user can add and categorize their daily expenses and group. This is to ensure that every transaction is organized for easier review and analysis. Pennywise allow users to add new category and set the limit of their spending for each category to avoid overspending.

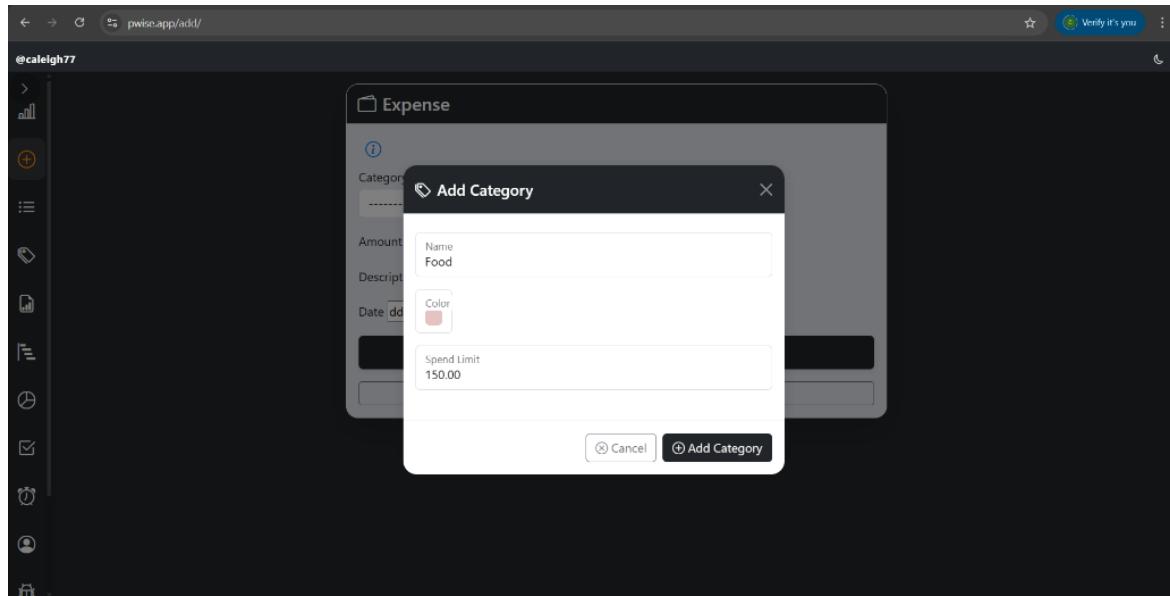


Figure 2.2 Add Category Popup

Figure 2.3 shows the add expenses feature in Pennywise system. To add new expenses, users can select the category, enter amount, description of their spending and specify the date of the expense. This process ensures that each expense is accurately recorded and allows clear categorization and easier tracking of financial activities.

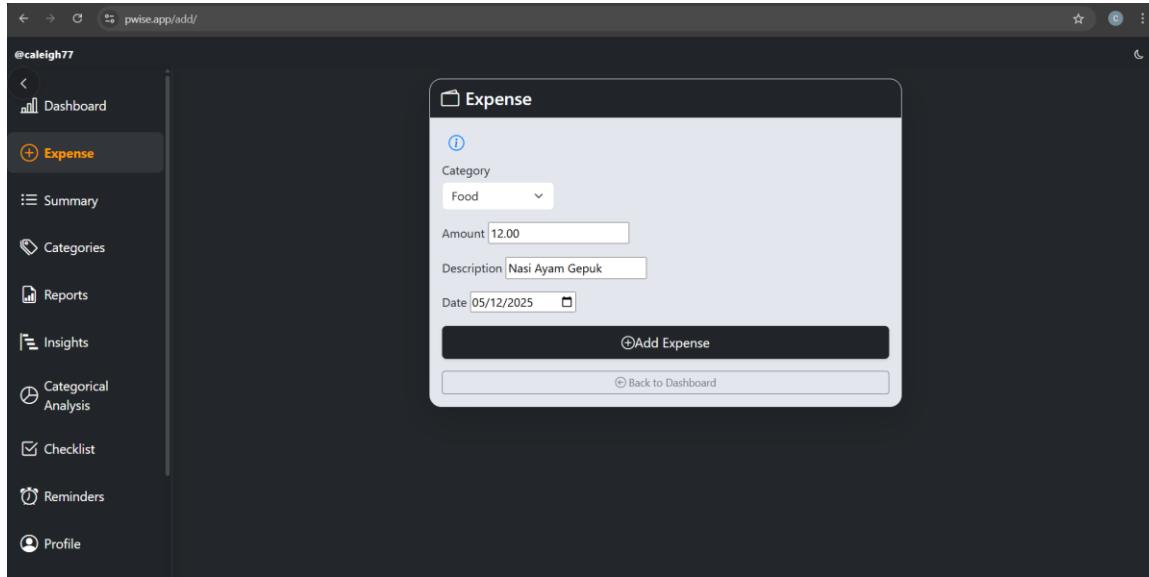


Figure 2.3 Add Expense

Other than that, Figure 2.4 illustrates that Pennywise also includes a fixed bill feature where users can set recurring bill amounts and view their payment status. This allows users to track essential monthly commitments such as rent, utilities and loan payment. This feature helps users avoid missed payment and maintain better control over recurring financial obligation.

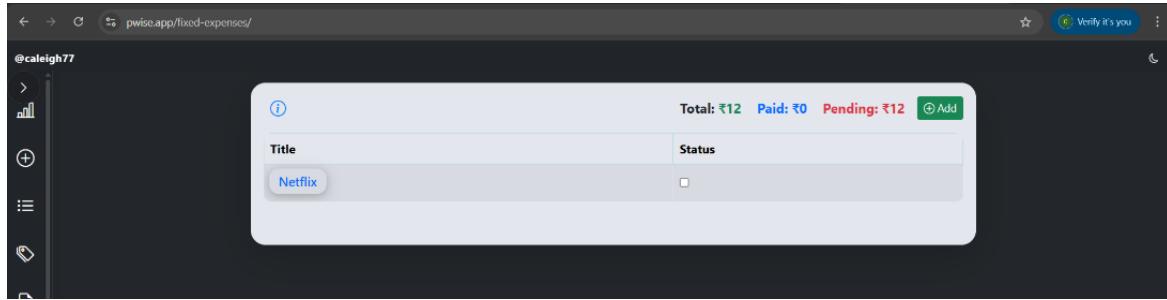


Figure 2.4 Fixed Bill Feature

To support financial awareness, Pennywise includes customizable financial reminders that can be scheduled by the users at their preferred time and categories as shown in Figure 2.5. In addition, this system not only can summarize daily spending, but it can also automatically generate monthly and yearly reports, which can be exported as PDF files for documentation, review or financial planning purposes.

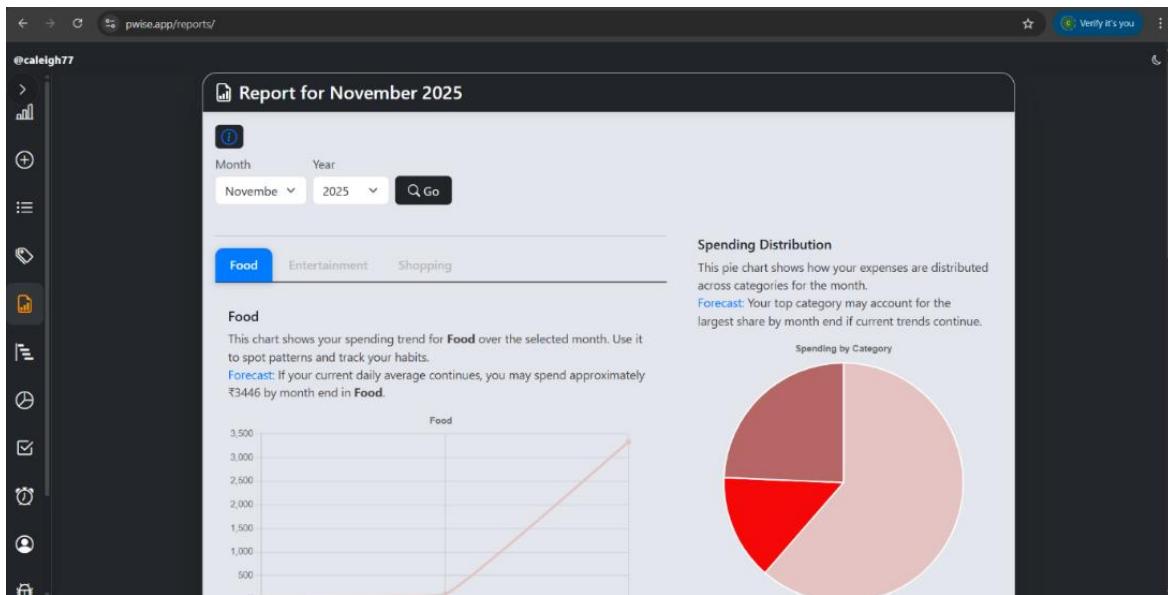


Figure 2.5 Sample of Report for Monthly Spending

Figure 2.6 shows the expense summary page in Pennywise system. This page shows users' transaction list that can be filtered by category, amount and description. Users can also edit and delete their transaction list.

The screenshot shows a web browser window with the URL `pwise.app/summary/`. The main content is a card titled "Expense Summary - November 2025". At the top right, it says "Total Expenses: ₹12". Below the title, there are filters: "Category" set to "All", "Amount" with "Min" and "Max" buttons, and a "Description" search bar containing "Nasi Ayam Geprek + Horlicks Peng". On the left, there's a sidebar with icons for home, profile, add, filter, and export. The main table has columns for Date, Category, Amount, Description, and Actions (with edit and delete buttons). One row is visible: "Nov. 24, 2025" under Date, "Food" under Category, "₹12" under Amount, "Nasi Ayam Geprek + Horlicks Peng" under Description, and edit/delete buttons under Actions.

Figure 2.6 Expense Summary

Based on Figure 2.7, machine learning model capabilities further enhance the system by identifying spending patterns and predicting future expense. This feature helps users make informed financial decisions. Abdulla and Al-Alawi (2024) argue that machine learning empowers financial risk management by enhancing risk assessment and decision making.

The screenshot shows a card titled "Machine Learning Insights". It contains the following information:

- Your spending is below average this month.

Next Month Prediction: ₹N/A

Spending Streak: 1 days

Figure 2.7 Machine Learning Insights

2.2.1.3 Limitation & Weakness

Pennywise primarily focuses on expense tracking and budgeting without offering an income management feature. The lack of income management feature can limit users' complete view of their overall financial status. While Pennywise provides strong tools for monitoring spending and generating reports, the absence of income tracking requires user to rely on external methods or traditional way to record their earnings. Kumar and Jadhav (2025) mentioned that it has been observed that a significant number of people face difficulties in maintaining consistent records of income and expenses when using manual approaches or basic spreadsheet tools. As a result, users may find it more challenging to assess their true financial habit and make a fully informed financial decisions.

2.2.2 System 2: Spendee

2.2.2.1 System URL

<https://www.spendee.com/>

2.2.2.2 System Description

Spendee is a modern personal finance management application designed to help users gain clear visibility and control over their financial activities. The system additionally supports multiple currencies making it suitable for users to handle international transactions. Effective management of budgeting applications across diverse currencies necessitates tools that integrate real-time exchange rates to ensure precise financial monitoring (Frisby, 2025).

Figure 2.8 displays the transaction list provided in Spendee where users can view and manage all their financial activities in a structured layout. The system provides filter options that allow users to sort transactions making it easier to locate specific records. The simple and organized layout enables users to record financial entries efficiently.

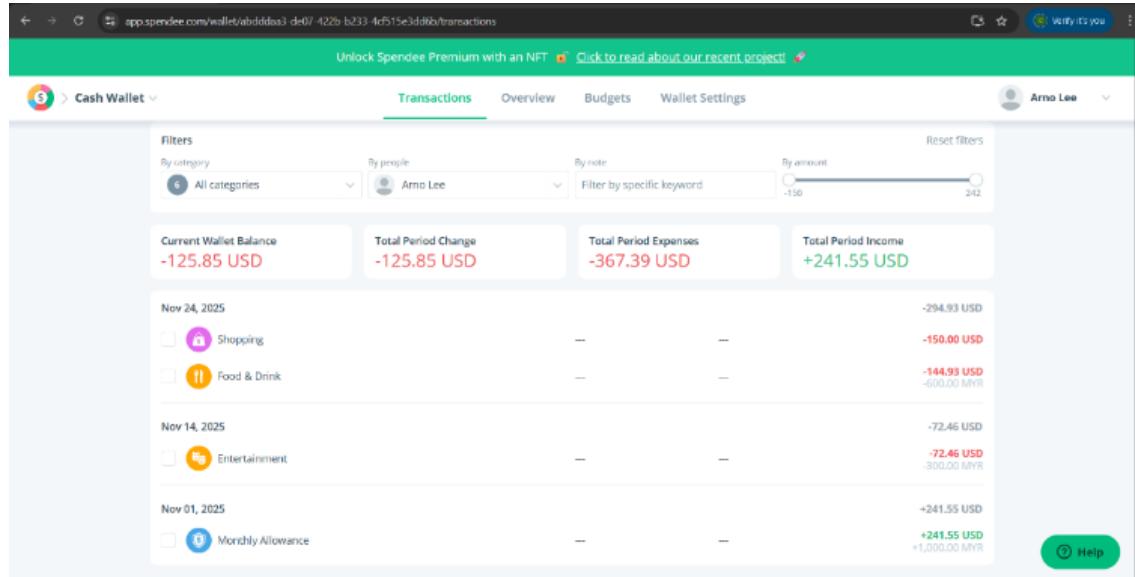


Figure 2.8 List of Transactions

When it comes to recording new expenses, Spendee allows user to select a category, expenses details and set the transaction as recurring if needed. Figure 2.9 shows the popup screen of add expense feature in Spendee. This popup makes it easier for users to quickly record their expenses and ensure up-to-date tracking.

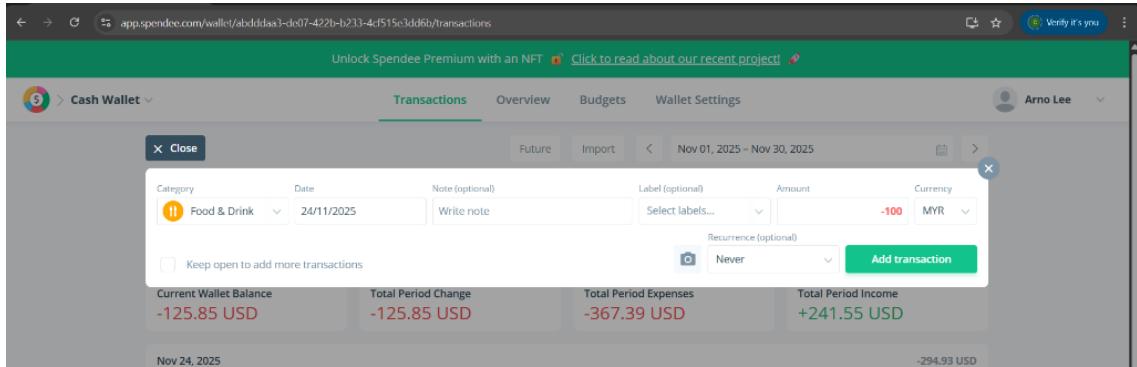


Figure 2.9 Add Expenses

As shown in Figure 2.10, Spendee has a feature called overview that serves as a dashboard which provides users with a clear and organized summary of their wallet activity within a selected period. It includes flexible filters for categories, people, notes and transaction amounts. This feature presents key information such as current wallet balance and overall changes during the chosen period, supported by visual charts that display balance trends and transaction movement.

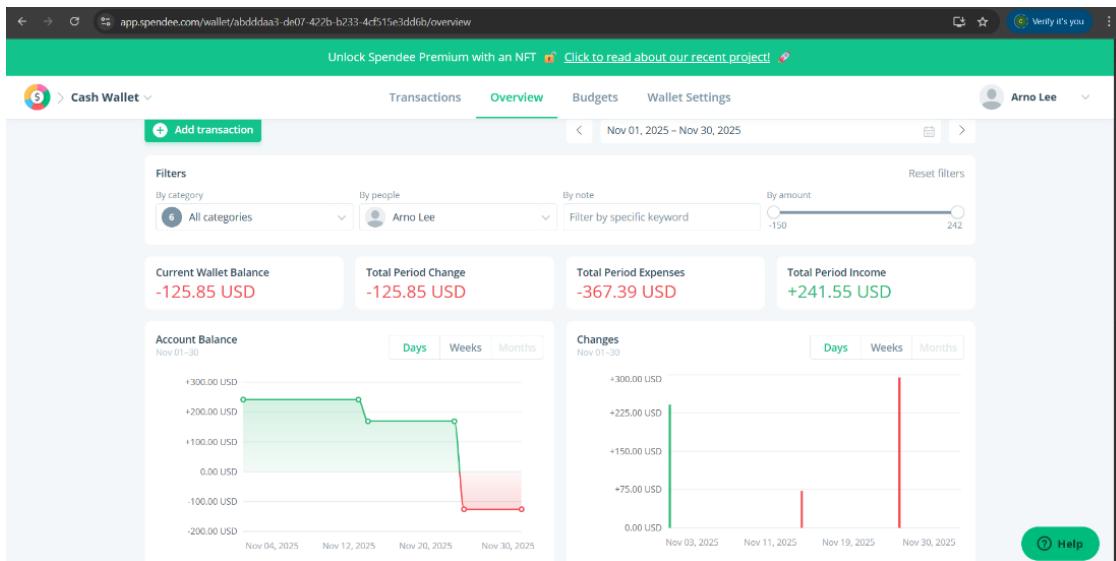


Figure 2.10 Overview Page

Based on Figure 2.11, Spendee allows users to track their daily expenses and income with ease, either manually or through automatic synchronization with bank accounts. Expenses and income are imported directly, reducing the need for manual entry and ensuring records remain accurate. Transactions are often categorized automatically, helping users quickly identify spending patterns.

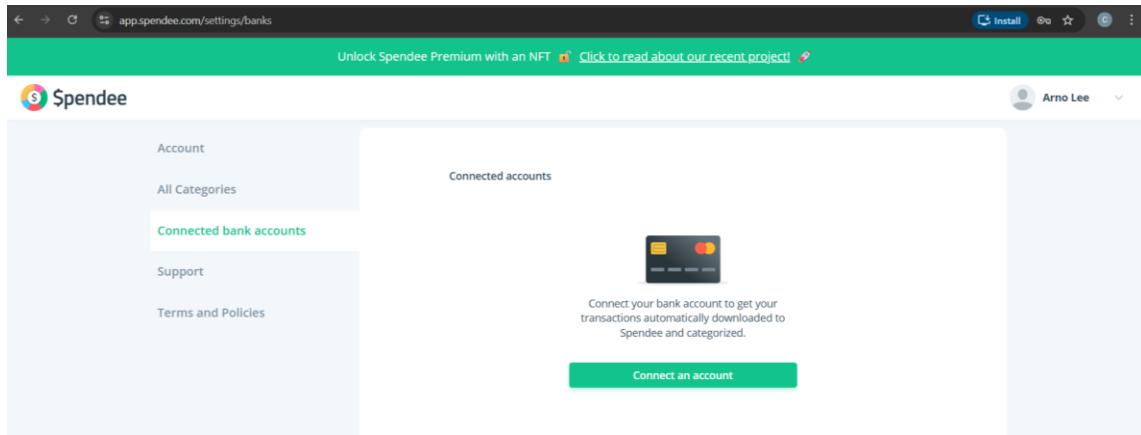


Figure 2.11 Connected Bank Account Feature

2.2.2.3 Limitation & Weakness

Spendee offers a standard email-based login system, but this level of security may not be sufficient considering the app is linked to users' bank account details for real-time transaction syncing. In addition, this synchronization can be limited in coverage and occasionally unreliable, with some banks not supported and technical issues such as duplicate or delayed transactions. Beyond synchronization, Spendee also faces concerns regarding data security, as linking sensitive financial accounts to a third-party platform raises apprehension about privacy and potential breaches. Rajesh

et al. (2025) mentioned that some vulnerable systems can reveal sensitive financial details and inadequate authentication enables intruders to gain unauthorized access.

2.2.3 System 3: Goodbudget

2.2.3.1 System URL

<https://goodbudget.com/>

2.2.3.2 System Description

Goodbudget is a personal finance and budgeting app that uses the envelope budgeting method to help users plan and control their spending. Instead of tracking expenses after they happen, the system encourages users to pre-allocate their income into categories so they always know how much they can spend.

Figure 2.12 displays the Goodbudget dashboard that offers an organized summary of the user's envelopes and their remaining balances after income allocation and spending. Recent transactions are also listed showing categories, description and amount.

The screenshot shows the Goodbudget home page. On the left, there's a summary of envelopes and accounts. The envelope section shows a total of 858.10 available, with monthly allocations for Food (-\$6.90), Entertainment (-\$5.00), and Transport (-\$2.60). The annual allocation for Savings is \$0.00. On the right, a large 'Transactions' section lists recent expenses: Sushi (\$57.90), Grab (\$25.00), Karaoke (\$50.00), Nasi Ayam Geprek (\$9.00), and an update to the monthly allowance. A 'Need Help?' button with a question mark icon is visible at the bottom right.

Date	Type	Payer	Amount	Status
11/25/25	Sushi	Food • Montly Allowance	\$57.90	
11/25/25	Grab	Transport • Montly Allowance	\$25.00	
11/25/25	Karaoke	Entertainment • Montly Allowance	\$50.00	
11/25/25	Nasi Ayam Geprek	Food • Montly Allowance	\$9.00	
11/25/25	Updated Montly Allowance	[Available] • Montly Allowance	+\$1,000.00	

Figure 2.12 Dashboard that displays the List of Transactions

Bai (2023) stated that mental budgeting is a key component of financial well-being, enabling individuals and households to cognitively organize their resources by allocating income into distinct spending categories to maintain effective control over their finances. Hence, Figure 2.13 shows that Goodbudget allows users to assign their available income to different spending categories, known as envelopes. This feature ensures every portion of the user's income is intentionally planned and categorized before being spent, supporting a structured budgeting approach.

The screenshot shows the Goodbudget 'Fill Envelopes' interface. The top navigation bar includes links for Home, Reports, Help, Learn, and a user profile. A sidebar on the right provides helpful tips and links to premium features.

Step 1: Fill from

- New Income
- Available

Fields include: Amt: [redacted], Date: 11/25/2025, Payer: Income, Acct: Monthly Allowance [858.10].

Step 2: Fill your envelopes

Under 'Monthly (Primary)', the 'Filled' status is shown for three categories:

- Food:** Add, Set, 0.00, -66.90, 600.00
- Entertainment:** Add, Set, 0.00, -50.00, 100.00
- Transport:** Add, Set, 0.00, -25.00, 50.00

Step 3: Review and save

Review section shows: Income Amount: 0.00, Amount Filled: 0.00. Notes: (Optional).

Buttons: Save, Cancel.

Figure 2.13 The Fill Envelope page

As shown in Figure 2.14, users can enter their transaction details such as date, payee, amount of spending, categories and description of the spending. The system will ensure users' spending aligned with the allocated budget.

The screenshot shows a modal dialog titled "Add Transaction". At the top, there is a navigation bar with tabs: "Expense/Credit" (which is selected), "Transfer", "Income", and "Debt Transaction". Below the tabs, there are several input fields:

- Date:** A text input field containing "11/25/2025" with a calendar icon to its right.
- Payee:** A text input field with a placeholder character "█".
- Amount:** A text input field containing "0.00" with an information icon ("i") to its right.
- Envelope:** A dropdown menu with the placeholder "-- Select Envelope --".
- Account:** A dropdown menu with the placeholder "Monthly Allowance [858.10]".
- Check #:** A text input field containing "465" with the note "(Optional)" to its right.
- Notes:** A text area with the note "(Optional)" above it.

At the bottom left of the dialog, there is a checkbox labeled "Schedule this...". At the very bottom, there are three buttons: "Save" (highlighted in purple), "Save & New", and "Cancel".

Figure 2.14 Add Transaction

Goodbudget also offers a visual breakdown of how users' budget has been used across different spending categories as shown in Figure 2.15. This helps users identify their spending patterns and understand which areas take up the largest share of their budget.

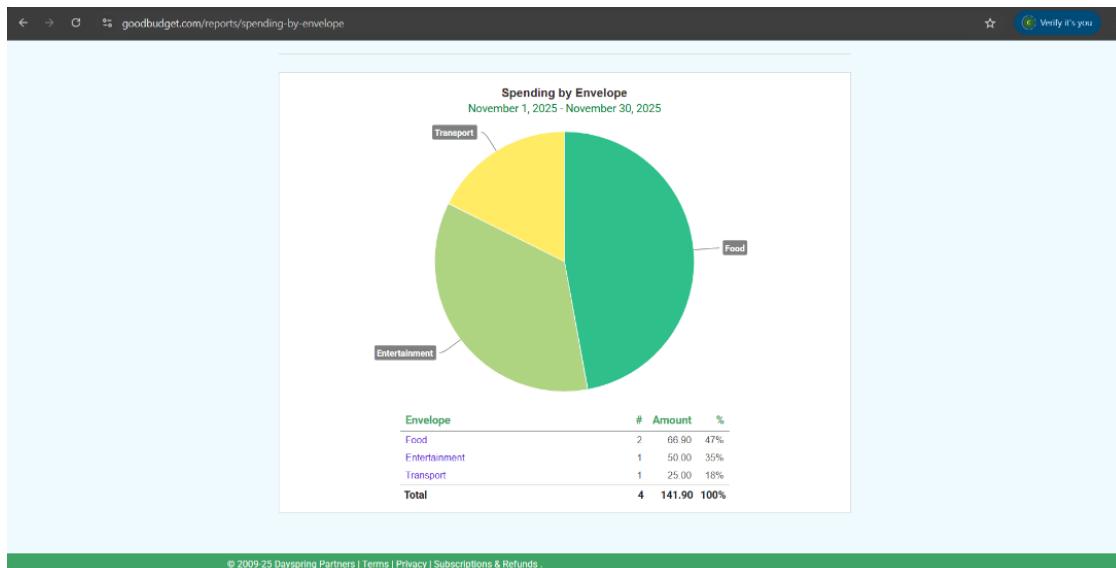


Figure 2.15 Sample of Pie Chart based on Envelope

Other than that, Figure 2.16 shows that users can also view the report of their expense, income, budget allocation and credit expansion.

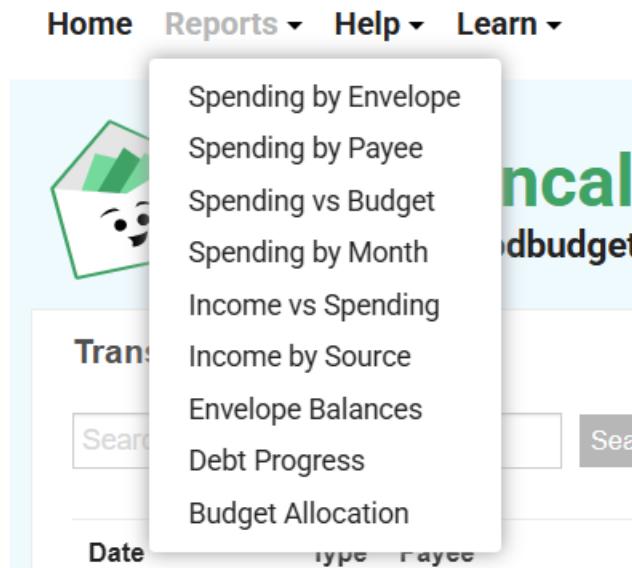


Figure 2.16 Report Category

2.2.3.3 Limitation & Weakness

A major limitation of Goodbudget is the absence of advanced analytical functionalities that have increasingly become normative within modern expense tracker. While the system provides basic spending reports, it does not extend to deeper financial insights such as spending pattern analysis, forecasted budget performance or personalized recommendations based on user behavior. The progression of these analytical models reflects the practice of financial technology's readiness to address the inherent complexity of financial system, where traditional statistical methods often prove inadequate (Abdulla & Al-Alawi, 2024). In the absence of these analytical capabilities, users face constraints in managing their finances and detecting overspending.

2.3 Comparison Between Existing System and Proposed System

In this section, the core similarities and differences between the three systems are being highlighted and compared with the proposed system. While all aim to enhance financial management efficiency, each system emphasizes distinct features ranging from data interpretability to user engagement. Table 1 illustrates the differences and similarities of existing systems and the comparison of the existing system and the proposed system.

Table 1 Comparison Between Similar Existing System and Proposed System

Feature	Existing System			Proposed System
	Pennywise	Spendee	Goodbudget	Spendette
Add Expenses	Users can log daily expenses with category, amount, description and date.	Allow detailed expense entry with category, notes, labels and recurrence.	Users can record expenses under specific envelopes.	Users can input their daily expenses details which are amount, category, date, description, payment method and recurring expenses.
Add Income	Not available in the current	Income entry supported by	Income added into income	Allows detailed income logging

	Pennywise feature set.	categories and currency options.	envelopes to allocate budget.	including source, date, amount, description and categorization.
Expense Tracking	Track all expenses and display them clearly in history	Track transaction with filtering and breakdown summaries.	Tracks spending is based on envelope allocations.	Offers a full breakdown of the transaction details with filters feature.
Add Expenses Category	User can create and customize categories.	Categories available but limited customization in free version.	Categories are predefined under envelopes.	Fully customizable categories designed to match user lifestyles and spending habits.
Group Expense Feature	This functionality is not available in the system.	This functionality is not available in the system.	This functionality is not available in the system.	The system offers group expense feature.

Dashboard	Interactive dashboard with charts and summaries.	Overview dashboard with balance, income and expense visuals.	Simple envelope-based dashboard showing remaining budget.	Personalized dashboard with real-time summaries, machine learning insights and spending habits
Report Generation	Monthly/Yearly PDF reports are downloadable.	Provides spending insights and downloadable reports.	Provides basic reports based on envelopes and spending history.	Produces a report with category comparisons and spending history.
Reminder & Notification	Finance reminders via email and system notification.	Notification for planning and payment alerts for premium users only.	No built-in reminder or notification systems.	The reminder will be sent directly to the users' email for better visibility and timely action.

Login & Security	OTP-secured login and registration.	Standard email and password login.	Basic login system without advanced security layers.	Uses username and password to log in with integrated CAPTCHA authentication.
Fixed Bills Management	Users can set recurring bills.	Recurring transactions available.	No dedicated recurring payment feature.	Fully supports recurring bills and monthly summary of fixed commitment.
Machine Learning Model	Auto-categorization and spending prediction.	Auto categorization is available in premium version only.	No machine learning integrations.	Uses machine learning to detect unusual spending, generate personalized insight and predict upcoming based on spending patterns.
Security Feature	OTP, encrypted user data and	Standard secured login and extra protection	Basic security with no advanced	Secured authentication and encrypted user data.

	secure authentication.	available in premium version.	protective features.	
--	------------------------	-------------------------------	----------------------	--

The table shows the comparison between the proposed system and the similar existing systems that highlights significant differences in functionality, flexibility and overall user support. The proposed system is Spendette, a financial management system with machine learning support.

Spendette provides the most comprehensive feature set. The proposed system supports detailed expense tracking, income recording, full category customization, interactive dashboard and financial reports. Spendette also includes email-based reminders, ensuring users stay updated on bill due dates, spending limits and budgeting alerts. In addition, Spendette has integrated machine learning components which offers personalized budgeting recommendations and spending insights based on user behaviour. David et al. (2024) mentioned that machine learning can handle large amounts of data and uncover patterns that traditional statistical methods may overlook. Hence, Spendette offers advanced features to help users in their individual financial management.

2.4 Technology Review

The development of Spendette relies on combination of web technologies, backend frameworks, database and machine learning algorithms designed to support an efficient financial management system. On the frontend side, Spendette is built using HTML, CSS and JavaScript. These languages

are widely used as the fundamental technologies for creating responsive and user-friendly web interfaces. HTML defines the structure of a webpage, CSS controls its visual presentation, and JavaScript adds interactivity and dynamic behaviour allowing the web application to be well-organized and user-responsive web applications (Challapalli et al., 2021). These programming languages are commonly used in expense tracking systems due to their lightweight nature and cross device compatibility.

On the server side, Spendette uses PHP as the backend language and MySQL (SQL) as the database management system. PHP is a well-established scripting language known for its stability and seamless integration with MySQL. This makes it suitable for authentication, data processing and CRUD operations in financial management systems. SQL databases are also ideal for handling structured financial records due to their high consistency and relational data design.

To advance the systems, Spendette integrates with machine learning model, specifically Random Forests. According to Siddique and Wahid (2025), Random Forest is an ensemble learning algorithm that effectively addresses classification and prediction tasks by managing complex non-linear relationship and multiple predictors while reducing overfitting, making it particularly valuable in retail contexts with numerous influential variables. In this project, the machine learning model will be trained within the system to generate personalized budget recommendations for users and to detect potential overspending. Real-time spending forecasts advance financial planning by enabling users to allocate resources effectively, make analytical decisions and manage expenditure proactively to achieve their financial objectives and sustain financial well-being (Lingayat et al., 2024). These capabilities illustrate how the integration of advanced machine learning can actively support user financial decisions.

2.5 Summary

This chapter presents a comparison of three existing systems related to the proposed solution, with the aim of identifying their strengths, weaknesses, and functional gaps. By analyzing these systems in detail, the chapter provides insights that inform and guide the enhancement of features in the proposed system, ensuring it offers a more comprehensive and effective user experience. This chapter also outlines the review of technologies used in the development of proposed system.

CHAPTER 3: REQUIREMENTS ANALYSIS AND DESIGN

3.1 Introduction

This chapter outlines the methodological framework adopted in the development of Spendette, a financial management system designed to support both personal and shared expenses. This chapter is divided into three components which are the methodology of project execution, the requirement analysis, user interfaces and system designs. These major components provide a structured foundation for the system's development, ensuring technical accuracy is balanced with user-centered design principles.

3.2 Agile Methodology

The development of Spendette, a financial management system with machine learning support, will be completed using the Agile methodology, specifically Scrum framework. Srivastava et al. (2017) mentioned that Scrum is an agile framework that combines iterative and incremental models, enabling successive builds with expanding functionality for object-oriented software development.

Agile supports continuous learning, progressive refinement and manageable task segmentation as it breaks the development work into smaller iterations called sprints. Each sprint focuses on completing a specific set of features that enables the review of progress frequently, identify issues early and adjust development plan as needed. These advantages of Agile are important for the development of Spendette as this system combines financial tracking, web development and machine learning where requirement and technical decisions may evolve as the project progresses. Additionally, the iterative nature of Agile helps in refining the machine learning

model training results and adjusting the system performance during development. Agile provides adaptability, clarity and incremental structure to manage and deliver Spendette.

3.2.1 Scrum Framework

In this section, the framework of Scrum Methodology will be outlined. The Scrum framework consists of Product Backlog, Sprint Planning, Sprint Execution, Sprint Review, Sprint Retrospective and Product Increment.

3.2.1.1 Product Backlog

The product backlog is an ordered list of prioritized system features and requirements that define the overall scope of this financial management system project. According to Alsaqqa et al. (2020), the product backlog is established to document user requirement which are subsequently analysed, prioritized and estimated by the product owner. Based on the user requirement analysed and derived in Section 3.3, the backlog items include core functional and non-functional requirements. The backlog items will be prioritised to ensure that core features of Spendette are implemented before advanced analytical and intelligent components.

3.2.1.2 Sprint Planning

Sprint planning will be conducted at the beginning of each sprint to select high-priority items from the product backlog for development of Spendette. During this phase, the project will define the sprint objectives, break down the task into smaller development activities and perform estimation of effort. For this project, sprint planning focuses on scheduling task related to system design,

database implementation, user interface development and machine learning model integration. This planning ensures a structured and manageable development timeline.

3.2.1.3 Sprint Execution

During sprint execution, the project will design, implement and test the selected backlog items. This phase involved implementing key system components including personal and shared expense management modules and machine learning model. System designs such as use case diagram, activity diagram, system architecture and user interface designs will be produced and refined during this phase and are presented in Section 3.4. Additionally, continuous testing and debugging will be carried out to ensure system functionality, data accuracy and overall reliability.

3.2.1.4 Sprint Review

Sprint review will be conducted at the end of each sprint to evaluate the completed functionalities of the Spendette. The implemented features will be reviewed against the defined sprint goals and user requirements. The demonstration of the functionalities will be conducted to assess system performance and usability. Feedback obtained during each review will guide the process of refining existing features and update the product backlog for subsequent sprints.

3.2.1.5 Sprint Retrospective

Sprint retrospective focuses on reflecting upon the development process to identify strength, challenge and areas for improvement. In this project, the retrospective will be evaluated through a few aspects such as time management, task prioritisation, technical challenge encountered during the machine learning integration and overall development efficiency. The insights gained from each

retrospective will be applied to improve development strategies and enhance system quality in future sprints.

3.2.1.6 Product Increment

Each sprint will produce a usable product increment of Spendette that includes new or enhanced functionalities. These incremental releases will ensure continuous progress toward the completion of a fully functional financial management system that meets user requirements and project objectives.

3.3 User Requirements Gathering

User requirements for Spendette were collected using a structured online survey. This method was chosen for its efficiency in gathering consistent data from a large group of respondents within a short period. The survey was distributed to 50 university students, who represent the target users of the system.

The online survey consisted of close-ended and open-ended questions covering demographic information, financial behavior, prior use of expense tracking applications and expected system features. The data collected were analyzed using descriptive statistics to identify key user requirements and inform the system design.

3.3.1 Finding & Analysis

This section presents the results obtained from the survey conducted to evaluate user perceptions and requirements for the financial management system. The collected data is analyzed to identify the users' requirements and to ensure it aligns with the system's design objectives.

3.3.1.1 Demographic

The section aims to provide an overview of the respondents' background and to ensure that the survey participants represent the intended target group, which is university students. This section collects basic information on respondents' level of study and gender, allowing for a general understanding of the participant's profile.

i. **Question:** Current level of study.

Type: Multiple-choice question with single selection allowed.

Description: This question identifies the academic level of respondents which are Diploma, Bachelor's, or Postgraduate. The main purpose of this question is to ensure that the survey participants represent the intended target group, which is university students. Figure 3.1 and Table 2 below show the result of the survey for this question.



Figure 3.1 Distribution of Respondents by Level of Study

Level of Study	Total
Diploma	9 Respondents
Bachelor's Degree	39 Respondent
Postgraduate	2 Respondents

Table 2 Summary of Respondents' Educational Level

ii. **Question:** Gender

Type: Multiple-choice question with single selection allowed.

Description: This question identifies the gender distribution of respondents to explore whether gender influences responses regarding financial habits or system preferences.

Figure 3.2 and Table 3 below show the result of the survey for this question.



Figure 3.2 Distribution of Respondents by Gender

Gender	Total
Female	35 Respondents
Male	15 Respondent

Table 3 Summary of Respondents' Gender

3.3.1.2 Financial Behavior and Expense Management Practices

This section aims to examine respondents' financial behavior and expense management practices, including sources of income, preferred payment methods, sharing habits and current use of expense tracking tools. The findings provide insight into the financial management habits of university students and help identify needs and opportunities for the proposed expense tracking system.

- i. **Question:** Which type of income do you usually receive?

Type: Multiple-choice question with multiple selection allowed.

Description: This question identifies the main sources of income for respondents, such as family allowance, scholarship/financial aid, part-time job income or other sources. Understanding income sources helps contextualize respondents' financial management behavior and potential reliance on expense tracking tools. Figure 3.3 and Table 4 below show the result of the survey for this question.



Figure 3.3 Types of Income Received by Respondents

Type of Income	Total
Family Allowance	42 Answers
Scholarship/ Financial Aid	30 Answers
Part-Time Job Income	10 Answers
Other: “Savings”, “Working Salary” & “Allowance”	3 Answers

Table 4 Summary of Respondents' Income Sources

ii. **Question:** Which payment methods do you commonly used for daily transactions?

Type: Multiple-choice question with multiple selection allowed.

Description: This question investigates the payment methods respondents commonly use, including cash, debit/credit cards, e-wallets or online banking. Figure 3.4 and Table 5 below show the results of the survey for this question.



Figure 3.4 Distribution of Payment Methods Used for Daily Transactions

Payment Method	Total
Cash	26 Answers
Debit/Credit Card	29 Answers
E-wallet	27 Answers
Online Banking	38 Answers

Table 5 Payment Methods Commonly Used for Daily Transactions

iii. **Question:** Do you often share expenses with friends?

Type: Multiple-choice question with single selection allowed.

Description: This question determines whether respondents commonly engage in shared expenses with others. Understanding the prevalence of shared expenses is important for including features such as expense splitting in the proposed system. Figure 3.5 and Table 6 below show the results of the survey.



Figure 3.5 Distribution of Respondents Sharing Expenses

Sharing Expenses?	Total
Yes	38 Respondents
No	12 Answers

Table 6 Proportion of Respondents Sharing Expenses

iv. **Question:** Do you currently use any expense tracking or budgeting application?

Type: Multiple-choice question with single selection allowed.

Description: This question identifies respondents who already use expense tracking or budgeting tools. The responses provide insight into user familiarity and readiness to adopt such systems, as well as potential gaps that the proposed system could address. Figure 3.6 below shows the result of the survey for this question.



Figure 3.6 Respondent Distribution by Prior Experience

There are 39 respondents that do not currently use expense tracking tools, suggesting that first-time adoption and user-friendly onboarding are important considerations for the proposed system. There are 11 respondents who have experience using expense tracking.

3.3.1.3 User With Prior Experience in Expense Tracking

This section focuses on respondents who have previously used expense tracking systems. The aim is to understand their experiences, usage patterns, satisfaction and perceived limitations. Insights from this group help identify common challenges and opportunities for feature improvements in the proposed system. There are 11 respondents who have prior experience with expense tracking system.

- i. **Question:** How frequently did you use the expense tracking system?

Type: Multiple-choice question with single selection allowed.

Description: This question investigates how often respondents used their previously adopted expense tracking systems. Frequency of use provides insight into user engagement and consistency, which are important factors in designing a system that encourages regular and effective financial tracking. Figure 3.7 and Table 7 below show the result of the survey for this question.



Figure 3.7 Respondents' Usage Frequency of Expense Tracking Systems

Frequency	Total
Daily	7 Respondents
Weekly	0 Respondent
Occasionally	3 Respondents
Rarely	1 Respondent

Table 7 Frequency of Using Expense Tracking Systems

ii. **Question:** What limitations did you encounter while using expense tracking system?

Type: Multiple-choice question with multiple selection allowed.

Description: This question aims to identify the challenges or limitations respondents faced while using expense tracking systems. By allowing multiple selections, the survey captures a range of difficulties such as complex interfaces, inadequate financial insights, limited shared expense management or lack of customization. These insights highlight areas for improvement in system design. Figure 3.8 and Table 8 below show the result of the survey for this question.

- Complex or unintuitive interface 3
- Lack of meaningful financial insights 4
- Inadequate support for shared expenses 3
- Limited customization options 6
- Other 1

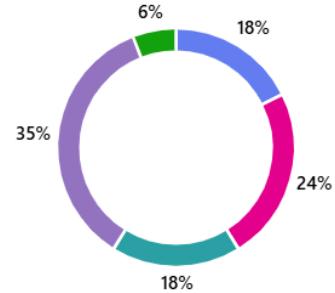


Figure 3.8 Distribution of Limitations of Existing Expense Tracker

Limitation	Description	Total
Complex or unintuitive interface	Users struggled with difficult navigation or poor design.	3 Answers

Lack of meaningful financial insights	System did not provide useful reports or guidance	4 Answers
Inadequate support for shared expenses	Difficulty managing group or shared costs	3 Answers
Limited customization options	Unable to adjust categories, budget limits, or notifications	6 Answers
Other: “Lack of ability to understand different categories of expenses and warn that some is too high from normal.”	System could not categorize expenses effectively or alert users when spending in a category was unusually high, indicating a need for smarter categorization and overspending notifications.	1 Answer

Table 8 Limitations Experienced by Users of Expense Tracking Systems

iii. **Question:** Overall, how satisfied were you with the expense tracking system you used?

Type: Likert Scale

Scale Used:

- Very Dissatisfied
- Dissatisfied
- Neutral
- Satisfied
- Very Satisfied

Description: This question assesses respondents' overall satisfaction with the expense tracking system they previously used. Measuring satisfaction helps evaluate the effectiveness and usability of existing systems and provides a benchmark for features that should be improved or maintained in the proposed system. Figure 3.9 and Table 9 below show the result of the survey for this question.

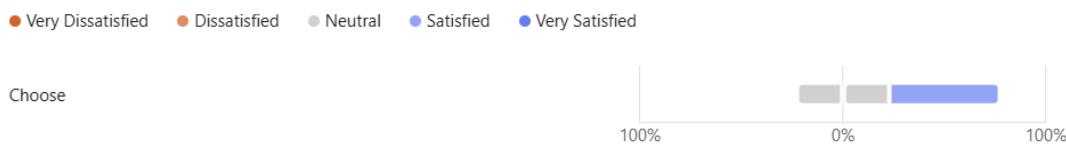


Figure 3.9 Respondents' Overall Satisfaction with Expense Tracking Systems

Level of Satisfaction	Total
Very Dissatisfied	0 Respondent
Dissatisfied	0 Respondent
Neutral	5 Respondents
Satisfied	6 Respondent
Very Satisfied	0 Respondent

Table 9 Overall Satisfaction with Expense Tracking Systems

- iv. **Question:** What improvements or additional features would you expect from an ideal expense tracking system?

Type: Open-ended question.

Description: This open-ended question gathers respondents' suggestions and expectations for an ideal expense tracking system. The aim is to identify desirable features and enhancements that address user pain points and improve usability, functionality, and engagement. The responses guide the development of a system that meets real user needs and expectations. The Table 10 below describes the findings and analysis of this question.

Item	Description
Enhanced Budgeting & Alerts	Features for budget planning and overspending alerts
User-Friendly Interface & Convenience	Easier navigation and better design.
Shared & Personal Expense Management	Features to distinguish and manage shared and personal expenses
Intelligent Categorization & Spending Insights	System recognizes expense categories and warns about abnormal spending
Bill Reminders	Receiving reminders for bills

Table 10 Suggested Improvements and Additional Features

3.3.1.4 User Without Prior Experience in Expense Tracking

This section involves 39 respondents who have no prior experience using expense tracking systems.

It aims to understand how they currently manage expenses, the challenges they face, and the features or benefits that would encourage them to adopt an expense tracking system. The responses provide valuable insights into user needs and expectations, which help inform the design of a simple, effective and user-friendly Spendette system for first-time users.

- i. **Question:** How do you currently manage your personal and shared expenses?

Type: Multiple-choice question with single selection allowed.

Description: This question investigates the current approaches adopted by respondents to manage their personal and shared expenses. It helps identify patterns in financial management practices and highlights areas where users may face difficulties, which can be addressed through the proposed system. By understanding their existing behaviors, the study can identify gaps and inefficiencies in expense management. Figure 3.10 and Table 11 below show the results of the survey for this question.

● Manual notes or receipts	17
● Spreadsheet-based tracking	1
● Do not actively track expenses	21



Figure 3.10 Respondents' Methods for Managing Personal and Shared Expenses

Method	Description	Total
Manual notes or receipts	Users record expenses on paper or keep physical receipts	17 Respondents
Spreadsheet-based tracking	Users use Excel, Google Sheets, or similar tools to track expenses	1 Respondent
Do not actively track expenses	Users do not keep records or monitor expenses regularly	21 Respondents

Table 11 Summary of Current Methods of Financial Management

ii. **Question:** What challenges do you commonly face in managing your expenses?

Type: Multiple-choice question with multiple selection allowed.

Description: This question examines the challenges faced by respondents in managing personal and shared expenses. Respondents could select multiple issues, allowing the identification of recurring difficulties and their prevalence. The findings provide insights into the most common problems users face, which can guide the design of the proposed expense tracking system to better meet user needs. Figure 3.11 and Table 12 below show the result of the survey for this question.



Figure 3.11 Distribution of Challenges Encountered in Managing Expenses

Challenge	Description	Total
Forgetting small or frequent purchases	Users often forget to record or remember minor expenses	22 Answers
Overspending	Users struggle to stay within their budget	34 Answers

Difficulty managing shared expenses	Users find it hard to track shared/group spending accurately	13 Answers
Other	Challenger mentioned by respondents	0 Answer

Table 12 Common Challenges Faced in Managing Expenses

iii. **Question:** What features or benefits would encourage you to start using an expense tracking system?

Type: Open-ended question.

Description: This question explores the expectations that would encourage first-time users to adopt the proposed system. The findings provide a valuable insight into functional and non-functional feature prioritization for the proposed system. Table 13 below describes the findings and analysis of this question.

Item	Description
Budget Control & Overspending Alerts	Features that help users monitor spending and prevent exceeding budget limits.
Automated Expense Tracking	Automation that reduces manual effort for first-time users.

Ease of use of User Interface (UI/UX)	Simple, intuitive and visually appealing design suitable for beginners
Budget Planning & Financial Guidance	Guidance features to assist users with budgeting.
Saving & Financial Goal	Features that encourage saving habits and financial discipline
Shared Expense Management	Tools to manage shared expenses accurately
Notifications & Reminders	Alerts that support consistent usage and awareness.

Table 13 Summary of Suggested Features or Benefits

3.3.1.5 User Expectations and System Requirements

This section gathers respondents' expectations regarding the features and characteristics of an ideal expense management system, specifically for the proposed system, Spendette. The questions are designed to measure the perceived importance of key system features and to collect additional user suggestions.

- i. **Question:** Please indicate your level of agreement on the importance of the following proposed features for Spendette.

Type: Likert Scale Question

Scale Used:

- 1 – Strongly Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Strongly Agree

Description: This question uses a five-point Likert scale to measure respondents' level of agreement with the importance of various proposed features in the Spendette system. Figure 3.12 below describes the findings of this question.

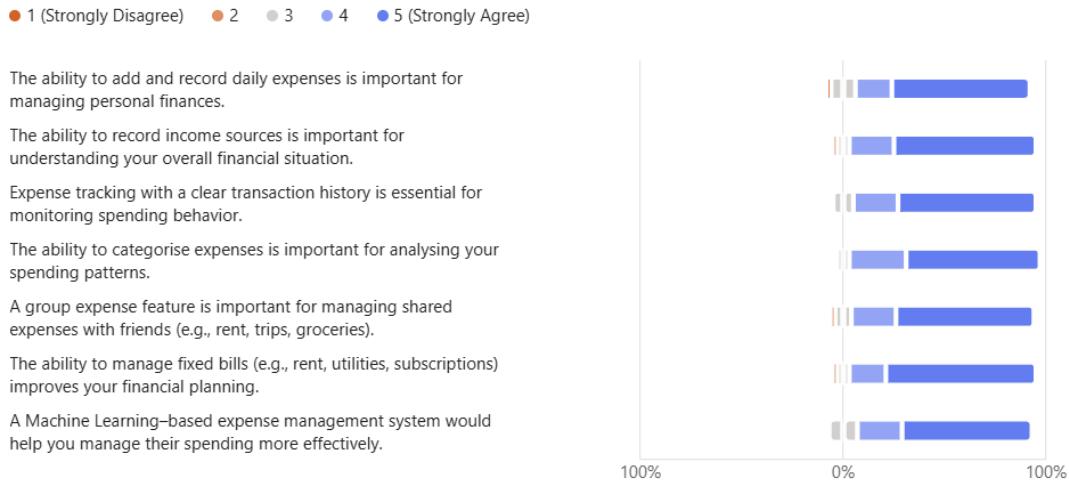


Figure 3.12 Level of Agreement on the Importance of Proposed Features

Based on the data collected, the findings indicate a high level of agreement with all proposed features of the Spendette system. Firstly, 68% of respondents strongly agreed, 18% agreed, 12% were neutral and 2% strongly disagreed that the ability to add and record daily expenses is important for managing personal finances. This indicates that basic expense entry is a core requirement. Similarly, the ability to record income sources received high agreement, with 70% of respondents strongly agreeing, 22% agreeing, 3% being neutral and 2% strongly disagreeing. This reflects the importance of understanding one's overall financial standing.

Respondents also showed strong support for expense tracking with a clear transaction history, with 68% strongly agreeing, 22% agreeing and 3% being neutral. This emphasizes the need for transparency and easy monitoring of spending behavior. The ability to categorize expenses was also highly valued, as 66% of respondents strongly agreed, 28%

agreed and 3% were neutral. This capability enables users to analyze spending patterns more effectively.

In addition, most respondents agreed that a group expense feature is important for managing shared expenses such as rent, trips and groceries. This is reflected by 68% strongly agreeing, 22% agreeing, 8% being neutral and 2% disagreeing, highlighting the relevance of this feature for university students. The ability to manage fixed bills was also rated positively, with 74% strongly agreeing, 18% agreeing, 6% being neutral and 2% being neutral. This suggests that users want better financial planning and bill management support.

Finally, responses to the Machine Learning-based expense management feature showed a high level of agreement, with 64% of respondents selecting “Strongly Agree”, 22% selecting “Agree” and 14% being neutral. This indicates strong user acceptance and confidence that intelligent features, such as automated insights and spending analysis, would enhance the overall effectiveness of the Spendette system.

ii. **Question:** Do you have any additional suggestions or expectations for the Spendette system?

Type: Open-ended question.

Description: This open-ended question was included to allow respondents to freely express additional suggestions, expectations or opinions regarding the Spendette. The purpose of this question is to capture qualitative insights into desired features, usability improvements and concerns. Table 14 below describes the findings of this question.

Item	Description
User-Friendly Interface & Navigation	Preference for a simple, clear, and non-complicated interface that supports quick usage.
Budget Alerts & Overspending Notifications	Alerts or reminders when spending exceeds daily or category limits
Reports & Visual Summaries	Visual representation of expenses and income
Cross-Device Access	Ability to sync data across devices.

Table 14 Additional Suggestions and Expectations for the Spendette System

3.3.2 Functional Requirements

Table 15 Functional Requirements of Spendette System

Functional Requirements	Description
User Registration	The system shall allow new users to create an account by providing valid registration details.
User Login	The system shall authenticate users using valid credentials before granting access.
Manage Expense Category	The system shall allow users to create, view, update and delete expense categories for organizing expenses.
Manage Expense	The system shall allow users to create, view, update, and delete expense records with relevant details and categories.
Manage Income	The system shall allow users to create, view, update, and delete income records.
Manage Fixed Bills	The system allow users to create, view, update, and delete fixed bill records and manage bill reminders.

Manage Group Expense	The system shall allow users to create, view, update, and delete group expense records and participant information.
View Transaction History	The system shall allow users to view a consolidated list of income and expense transactions.
View Financial Summary	The system shall generate and display a financial summary based on recorded transactions.
Spending Analysis	The system shall analyze user spending patterns to identify spending behavior.
Notification & Reminder	The system shall send notifications for bill reminders and overspending alerts.

3.3.3 Non-Functional Requirements

Table 16 Non-Functional Requirements of Spendette System

Non-Functional Requirements	Description
Usability	The system shall provide a user-friendly and intuitive interface suitable for university students.
Security	The system shall ensure secure authentication and protect user financial data from unauthorized access.
Reliability	The system shall ensure consistent operation and data integrity during normal usage.
Scalability	The system shall be able to handle an increasing number of users and financial records.
Performance	The system shall process user requests and display results within an acceptable response time.
Data Accuracy	The system shall ensure accurate calculation of expenses, income, and financial summaries.

3.4 System Design

This section presents the system design of the Spendette Web Application. The system design illustrates how users interact with the system and how system components are structured and connected. The design is represented by using use case diagram, activity diagram, sequence diagram, system architecture and user interface designs to ensure efficient system operation.

3.4.1 Use Case Diagram

As shown in Figure 3.13, the use case diagram for the Spendette Web Application provides a high-level overview of the system's functional requirements. This illustrates the interaction between external actors and the system itself. The use case diagram serves as a foundational artifact in understanding system boundaries and feature dependencies.

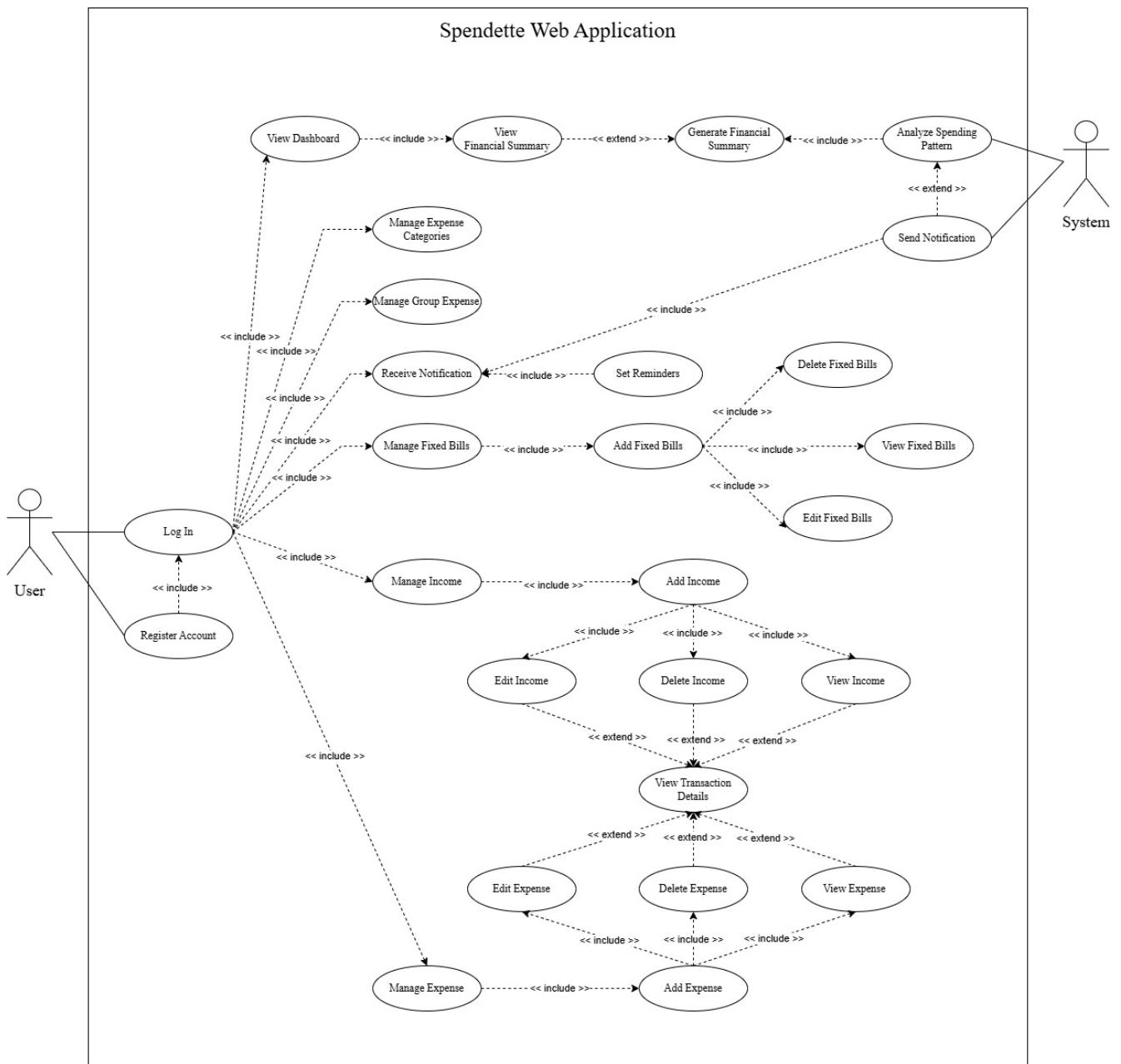


Figure 3.13 Use Case Diagram for Spendette Web Application

Actors:

- User: Represents the primary end-user who interacts with the application.
- System: An internal actor responsible for automated processes.

Use Cases:

i. Authentication and Access

- Register Account
- Log In

ii. Financial Management

- Manage Expense Categories
- Manage Group Expense
- Manage Fixed Bills
- Manage Income
- Manage Expense
- View Transaction Details

iii. Data Visualization and Insights

- View Financial Summary
- Generate Financial Summary

iv. Notification and Reminder

- Send Notification
- Receive Notification
- Set Reminders

v. Machine Learning

- Analyze Spending Pattern

Relationship:

- i. << include >> Relationship: Indicates mandatory sub-processes that are always executed as part of the base use case.
- ii. << extend >> Relationship: Represent optional or conditional behavior that enhance the base use case when certain criteria are met.

3.4.2 Use Case Table

The Use Case tables collectively describe the core features of the Spendette system from the user and system perspectives. Each use case clearly defines the interactions required to support essential functionalities, including account management, expense and income tracking, fixed bill management, group expense handling, financial summary generation and notification delivery. Overall, these use cases provide a structured representation of how the system fulfills its primary objectives and supports user needs in managing personal and shared finances effectively.

Table 17 UC01-Register Account

Field	Content
Use Case ID	UC01
Use Case Name	Register Account

Primary Actor	User
Supporting Actor	Spendette System
Goal	To allow new users to create a Spendette Account
Pre-conditions	User does not have an existing account.
Post-condition	User account is successfully created
Main Flow	<ol style="list-style-type: none"> 1. System display registration form 2. User enters registration details 3. System validates the data. 4. System creates user account. 5. System displays a success message and direct to log in page.
Alternate/Exception Flow	<p>Invalid or duplicate details</p> <ol style="list-style-type: none"> 1. System displays error message 2. User enters new data from step 2.

Table 18 UC02-Log In

Field	Content
Use Case ID	UC02
Use Case Name	Log In
Primary Actor	User
Supporting Actor	Spendette System
Goal	Authenticate user to access Spendette features and financial data.
Pre-conditions	User has a registered account.
Post-condition	User is logged into the system.
Main Flow	<ol style="list-style-type: none"> 1. System display login page. 2. User enters login credential. 3. System validates login credentials. 4. System redirects users to the homepage.
Alternate/Exception Flow	Invalid login credentials <ol style="list-style-type: none"> 1. System display an error message.

	2. User may retry from step 2.
--	--------------------------------

Table 19 UC03-View Dashboard

Field	Content
Use Case ID	UC03
Use Case Name	View Dashboard
Primary Actor	User
Supporting Actor	Spendette System
Goal	To access an overview of financial data.
Pre-conditions	User is logged in.
Post-condition	Dashboard is displayed
Main Flow	<ol style="list-style-type: none"> 1. System retrieves financial summary data. 2. Dashboard is displayed.
Alternate/Exception Flow	-

Table 20 UC04-View Financial Summary

Field	Content
Use Case ID	UC04
Use Case Name	View Financial Summary
Primary Actor	User
Supporting Actor	Spendette System
Goal	To view summarized expense and income data summary and analysis of financial data.
Pre-conditions	Expense and income data exist.
Post-condition	Financial summary is displayed.
Main Flow	<ol style="list-style-type: none"> 1. System collects income and expense data. 2. System analyzes the data. 3. System displays the financial summary.
Alternate/Exception Flow	-

Table 21 UC05-Generate Financial Summary

Field	Content
Use Case ID	UC05
Use Case Name	Generate Financial Summary
Primary Actor	Spendette System
Supporting Actor	-
Goal	To generate summarized financial information.
Pre-conditions	Financial data exist.
Post-condition	Financial summary is generated.
Main Flow	<ol style="list-style-type: none"> 1. System analyzes income and expense data. 2. System generates a financial summary.
Alternate/Exception Flow	-

Table 22 UC06-Analyze Spending Pattern

Field	Content
Use Case ID	UC06
Use Case Name	Analyze Spending Pattern
Primary Actor	Spendette System
Supporting Actor	-
Goal	To identify spending behavior.
Pre-conditions	Financial data exist.
Post-condition	Spending pattern is identified.
Main Flow	<ol style="list-style-type: none"> 1. System analyzes income and expense data. 2. System generates a financial summary.
Alternate/Exception Flow	-

Table 23 UC07-Send Notification

Field	Content
Use Case ID	UC07
Use Case Name	Send Notification
Primary Actor	Spendette System
Supporting Actor	User
Goal	To notify the user.
Pre-conditions	Notification conditions are met (Reminder or overspending detected)
Post-condition	Notification is sent through email.
Main Flow	1. System sends notification to users through email.
Alternate/Exception Flow	-

Table 24 UC08-Receive Notification

Field	Content
Use Case ID	UC08
Use Case Name	Receive Notification
Primary Actor	User
Supporting Actor	Spendette System
Goal	To receive alerts and reminders.
Pre-conditions	Notification exists.
Post-condition	Notification is received.
Main Flow	<ol style="list-style-type: none"> 1. System sends notification to users through email. 2. User receives notification.
Alternate/Exception Flow	-

Table 25 UC09-Manage Expense

Field	Content
Use Case ID	UC09
Use Case Name	Manage Expense
Primary Actor	User
Supporting Actor	Spendette System
Goal	To manage expenses.
Pre-conditions	User is logged in.
Post-condition	Expense data is updated.
Main Flow	<ol style="list-style-type: none"> 1. User selects actions which are Add Expense, Edit Expense, View Expense or Delete Expense. 2. System displays or save changes made by users.
Alternate/Exception Flow	-

Table 26 UC10-Manage Income

Field	Content
Use Case ID	UC10
Use Case Name	Manage Income
Primary Actor	User
Supporting Actor	Spendette System
Goal	To manage income.
Pre-conditions	User is logged in.
Post-condition	Income data is updated.
Main Flow	<ol style="list-style-type: none"> 1. User selects actions which are Add New Income, Edit Income, View Income or Delete Income. 2. System displays or save changes made by users.
Alternate/Exception Flow	-

Table 27 UC11-Manage Fixed Bills

Field	Content
Use Case ID	UC11
Use Case Name	Manage Fixed Bills
Primary Actor	User
Supporting Actor	Spendette System
Goal	To manage recurring bills.
Pre-conditions	User is logged in.
Post-condition	Fixed bills data is updated.
Main Flow	<ol style="list-style-type: none"> 1. User selects actions which are Add Fixed Bills, Edit Fixed Bills, View Fixed Bills or Delete Fixed Bills. 2. System displays or save changes made by users.
Alternate/Exception Flow	-

Table 28 UC12-Manage Group Expense

Field	Content
Use Case ID	UC12
Use Case Name	Manage Group Expense
Primary Actor	User
Supporting Actor	Spendette System
Goal	To manage shared expenses.
Pre-conditions	User is logged in.
Post-condition	Group expense data is saved.
Main Flow	<ol style="list-style-type: none"> 1. User selects actions which are Add Group Expense, Edit Group Expense, View Group Expense or Delete Group Expense. 2. System displays or save changes made by users.
Alternate/Exception Flow	-

Table 29 UC13-Manage Expense Categories

Field	Content
Use Case ID	UC13
Use Case Name	Manage Expense Categories
Primary Actor	User
Supporting Actor	Spendette System
Goal	To allow the user to create and manage expense categories.
Pre-conditions	User is logged in.
Post-condition	Expense category is saved and available for selection.
Main Flow	<ol style="list-style-type: none"> 1. User selects actions which are Add Expense Categories, Edit Expense Categories, View Expense Categories or Delete Expense Categories. 2. System displays or save changes made by users.
Alternate/Exception Flow	-

3.4.2 Activity Diagram

As shown in Figure 3.14, the activity diagram for Spendette Web Application illustrates the flow of user interactions and system responses. This captures both sequential actions and decision-based branching. On the user side, activities begin with logging in or registering, followed by navigating the homepage and viewing notifications. Next, users can choose to manage financial data such as expenses, income, fixed bills and group expenses. Each of these tasks involves detailed steps like entering information, selecting categories and saving records. Users can also navigate to the dashboard and view the financial summary, which provides insights into their overall financial status. On the system side, Spendette manages authorization, profile creation and data collection, while also performing automated analysis of spending behavior. This diagram effectively models operational logic making it a valuable tool for understanding workflow and system behavior.

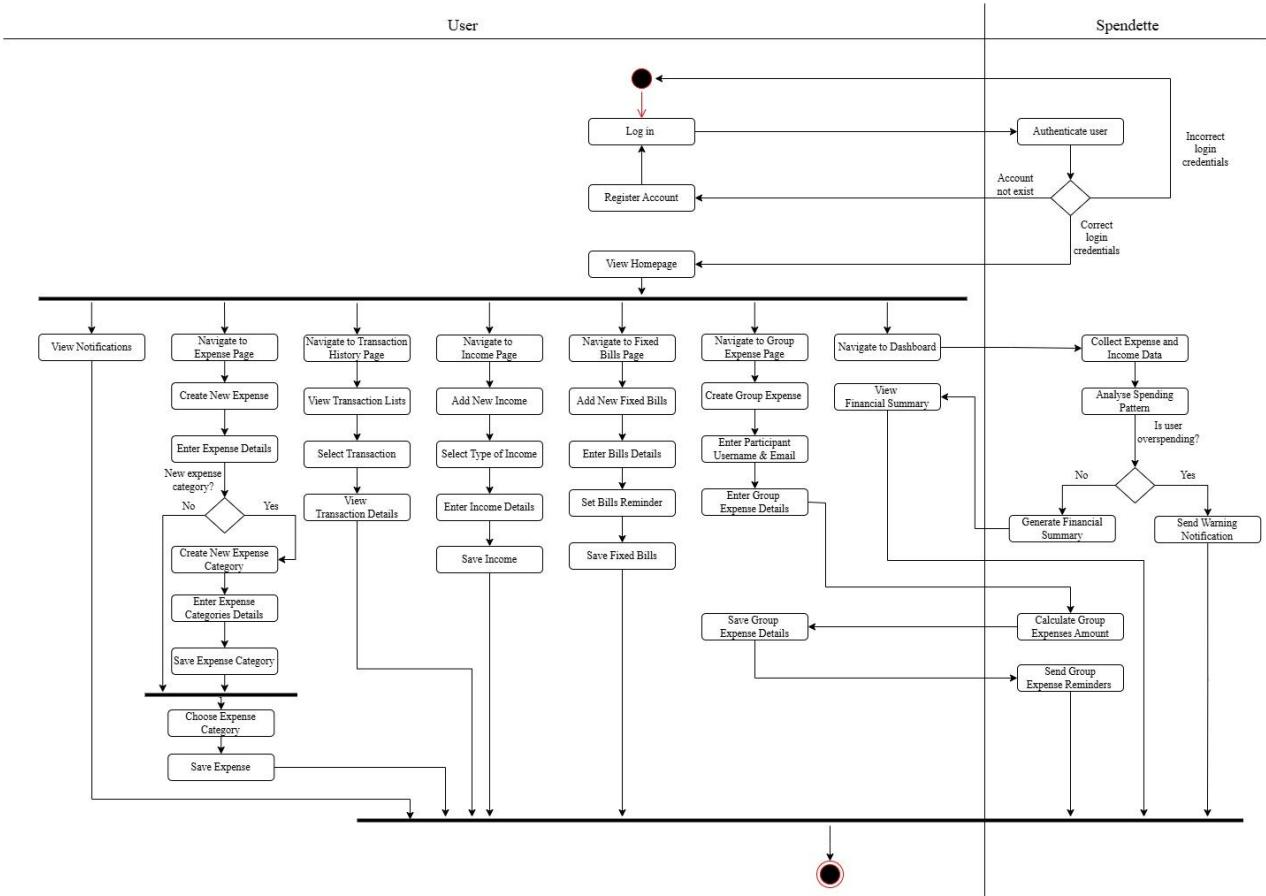


Figure 3.14 Activity Diagram

3.4.3 Sequence Diagram

Figure 3.15 is the Sequence Diagram that illustrates the interaction flow for the core feature of the Spendette system, which is managing expenses. The process begins when the user navigates to the expense page and enters expense details. The system validates whether the selected expense category exists. If the category does not exist, the user is prompted to create a new category before proceeding. Once validation is completed, the expense record is saved in the database and confirmation is displayed to the user.

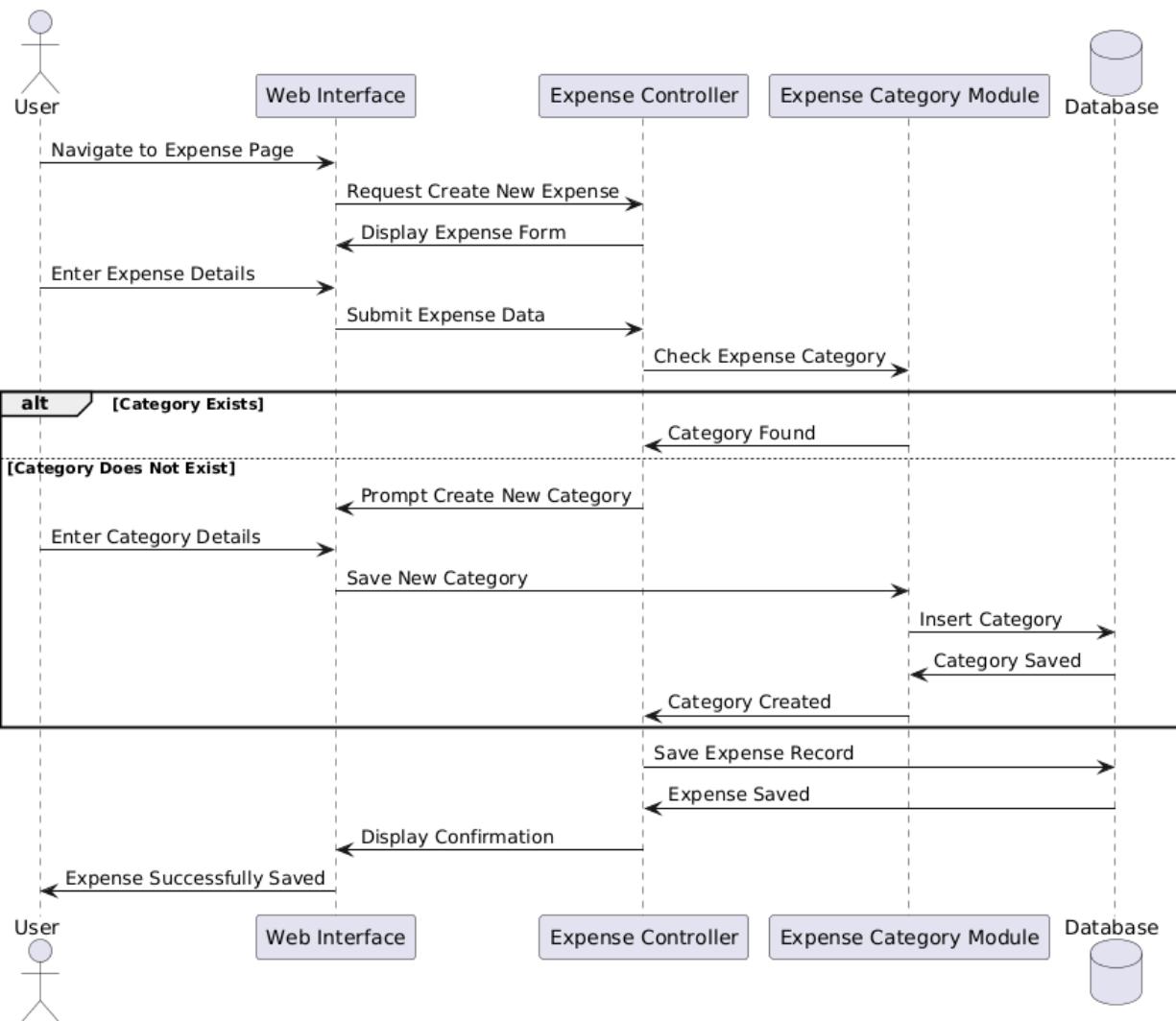


Figure 3.15 Sequence Diagram

3.4.4 System Architecture

The system architecture in Figure 3.16 describes the overall structure of the system and the interaction between its components. The proposed system adopts a three-tier architecture consisting of the presentation tier, application tier and data tier. The presentation tier includes the client-side components such as the web browser and frontend interface developed using HTML, CSS and JavaScript. The application tier handles server-side processing using PHP, web server and machine learning model. The data tier consists of database that stores user data, transaction records and historical datasets.

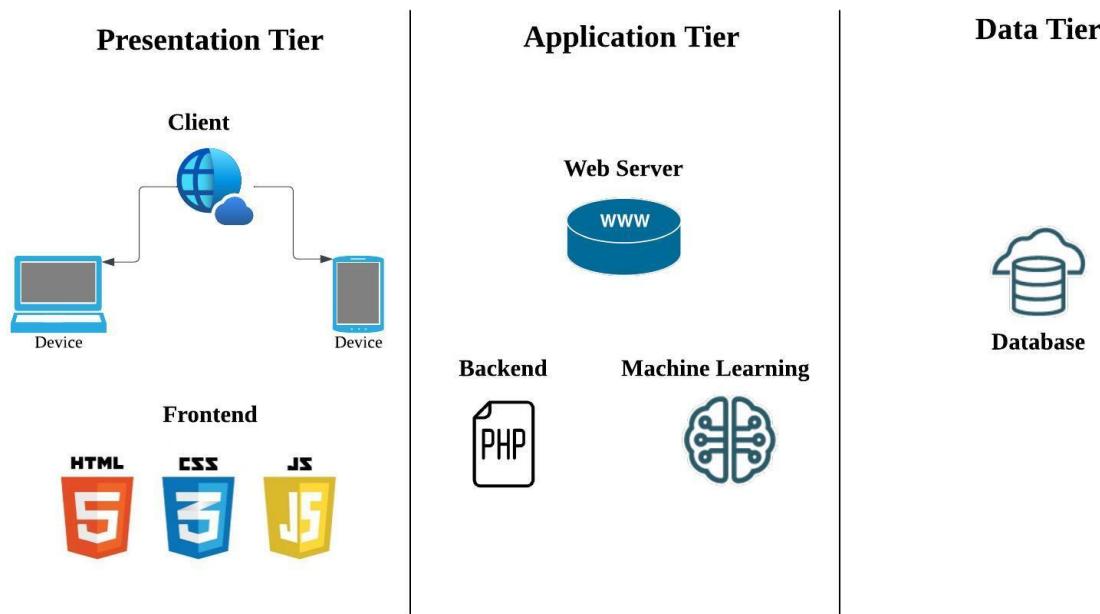


Figure 3.16 System Architecture

3.4.5 User Interface

This section describes the user interface design of Spendette, with an emphasis on usability, consistency and visual clarity. The interface is designed to be user-friendly and intuitive and allow users to navigate the system easily with minimal learning effort. Key design principles such as clear layout structure, appropriate color usage, readable typography and logical placement of components are applied to enhance overall user interaction. The figures below show the user interface for the core features in Spendette Web Application.

Figure 3.17 illustrates the login page of the Spendette web application, which allows registered users to securely access the system using their credentials.

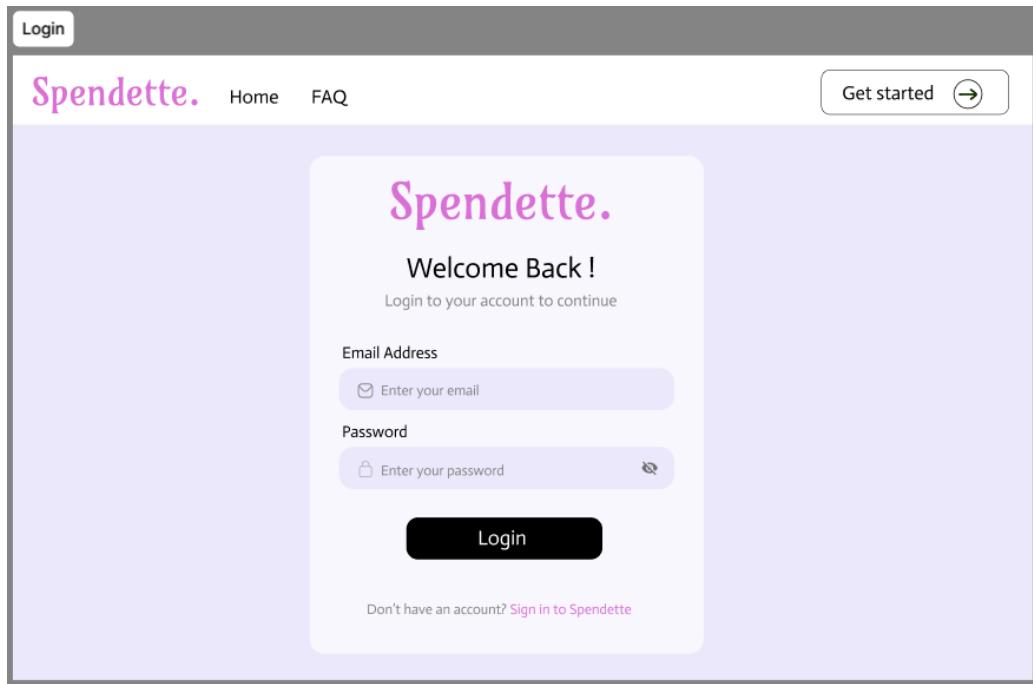
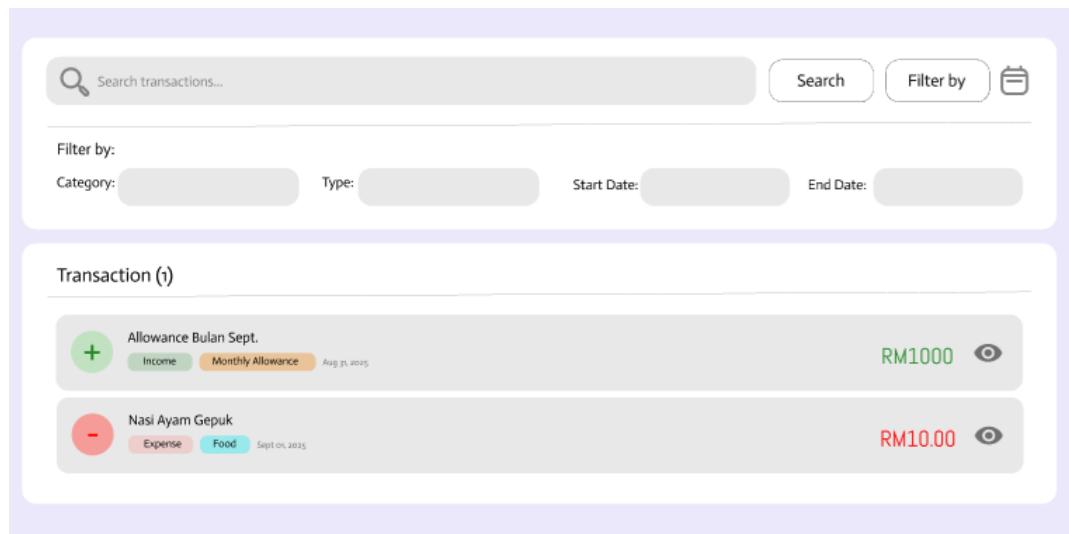


Figure 3.17 Login Page of Spendette Web Application

Figure 3.18 presents the transaction list page of the Spendette web application, displaying all recorded income and expense transactions for financial monitoring.



The screenshot shows the Spendette transaction list page. At the top, there is a search bar labeled "Search transactions..." with a magnifying glass icon, a "Search" button, a "Filter by" button, and a calendar icon. Below the search bar is a "Filter by:" section with four input fields: "Category:", "Type:", "Start Date:", and "End Date:". The main area is titled "Transaction (1)". It displays two transactions: 1) An income transaction for "Allowance Bulan Sept." of RM1000, categorized as "Income" and "Monthly Allowance", dated Aug 31, 2015. 2) An expense transaction for "Nasi Ayam Gepuk" of RM10.00, categorized as "Expense" and "Food", dated Sept 01, 2015. Each transaction has an "eye" icon to its right.

Figure 3.18 Transaction List Page in Spendette Web Application

Figure 3.19 displays the transaction details page, where users can view detailed information such as transaction amount, category, date, and description.

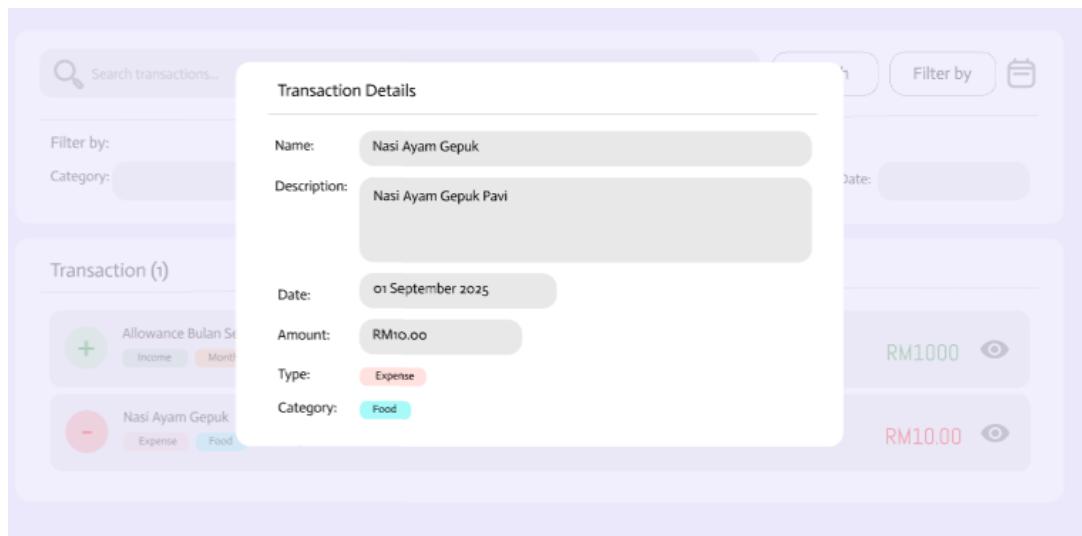


Figure 3.19 View Transaction Details

Figure 3.20 shows the add new expense form, which allows users to record expense details to support accurate daily expense tracking.

The screenshot displays a user interface for adding a new expense. The title 'Add New Expense' is at the top. Below it are five input fields: 'Expenditure' (text input placeholder 'Enter expense title'), 'Description' (text input placeholder 'Enter expense description'), 'Category' (dropdown placeholder 'Select expense category'), 'Date' (text input placeholder 'Select date' with a calendar icon), and 'Amount' (text input placeholder 'Enter amount'). At the bottom right are 'Cancel' and 'Save' buttons.

Figure 3.20 Add New Expense Form

Figure 3.21 illustrates the add new income form, enabling users to record income information for better financial management.

The screenshot shows a modal dialog titled "Add New Income". The form contains five input fields: "Income" (text input placeholder "Enter income title"), "Description" (text input placeholder "Enter income description"), "Category" (dropdown menu placeholder "Select income category"), "Date" (text input placeholder "Select date" with a calendar icon), and "Amount" (text input placeholder "Enter amount"). At the bottom right are two buttons: "Cancel" and "Save".

Figure 3.21 Add New Income Form

Figure 3.22 presents the create new expense category feature, allowing users to customize expense categories according to their spending needs.

The screenshot shows a modal dialog box titled "Add New Expense Category". It contains four input fields: "Name" (placeholder: "Enter category title"), "Description" (placeholder: "Enter category description"), "Colour" (dropdown menu with "Select colour" placeholder), and "Expense Limit" (placeholder: "Enter amount"). At the bottom right are "Cancel" and "Save" buttons.

Figure 3.22 Create New Expense Category

Figure 3.23 shows the add new fixed bills feature, which enables users to manage recurring expenses such as rent and utility bills.

The screenshot displays a user interface for adding a new bill. The title 'Add New Bills' is at the top. Below it are seven input fields: 'Bill:' (text input placeholder 'Enter bill title'), 'Description:' (text input placeholder 'Enter bill description'), 'Category' (dropdown placeholder 'Select bill category'), 'Amount:' (text input placeholder 'Enter amount'), 'Due Date:' (dropdown placeholder 'Select date' with a calendar icon), 'Recurrence:' (dropdown placeholder 'Select bill recurrence'), and 'Remind before:' (dropdown placeholder 'Select period'). At the bottom right are 'Cancel' and 'Save' buttons.

Figure 3.23 Add New Fixed Bills Feature

Figure 3.24 illustrates the create group expense feature, allowing users to manage shared expenses and split costs among participants.

The screenshot shows a mobile-style form titled 'Add New Group Expense'. It includes fields for 'Name' (with placeholder 'Enter group expense title'), 'Description' (with placeholder 'Enter group expense description'), 'No. of member' (with placeholder 'Enter number of member'), and 'Add Member' (with placeholders 'Enter username' and 'Enter email'). There is also a 'Due Date' field with a date picker icon. At the bottom right are 'Cancel' and 'Save' buttons. A green plus sign button is located on the right side of the 'Add Member' section.

Figure 3.24 Create Group Expense Feature

3.5 Summary

This chapter presented the methodology adopted for the development of the proposed system. It outlined the overall research approach, system architecture, development tools, and technologies used throughout the project. The chapter also described the system design, including database structure, functional modules, and user interface flow, to ensure the system meets the identified requirements.

REFERENCES

- Abdulla, Y. Y., & Al-Alawi, A. I. (2024). Advances in Machine Learning for Financial Risk Management: A Systematic Literature Review. *Advances in Machine Learning for Financial Risk Management: A Systematic Literature Review*, 531–535. <https://doi.org/10.1109/icetsis61505.2024.10459536>
- Alsaqqa, S., Sawalha, S., & Abdel-Nabi, H. (2020). Agile Software Development: Methodologies and Trends. *International Journal of Interactive Mobile Technologies (iJIM)*, 14(11), 246. <https://doi.org/10.3991/ijim.v14i11.13269>
- Cappelli, T., Banks, A. P., & Gardner, B. (2024). Understanding money-management behaviour and its potential determinants among undergraduate students: A scoping review. *PLoS ONE*, 19(8), e0307137. <https://doi.org/10.1371/journal.pone.0307137>
- Challapalli, S. S. N., Kaushik, P., Suman, S., Shivahare, B. D., Bibhu, V., & Gupta, A. D. (2021). Web Development and performance comparison of Web Development Technologies in Node.js and Python. *2021 International Conference on Technological Advancements and Innovations (ICTAI)*, 303–307. <https://doi.org/10.1109/ictai53825.2021.9673464>
- David, L. K., Wang, J., Cisse, I. I., & Angel, V. (2024). Machine learning algorithms for financial risk prediction: A performance comparison. *International Journal of Accounting Research*, 9(2), 49-55. <https://j.arabianjbmr.com/index.php/ijar/article/view/1226/1130>

Frisby, D. (2025). *How to manage budgeting apps when you have accounts in different currencies*. MoneyBib. <https://moneybib.com/budgeting/how-manage-budgeting-apps-when-you-have-accounts-in-different-currencies>

Gehlot, S., Gupta, P., Chavan, K., Bhavish, Pournim (2024). An expense tracker. *International Journal for Research in Applied Science and Engineering Technology*, 12(5), 4783–4788. <https://doi.org/10.22214/ijraset.2024.62268>

Irby, L. (2024). *10 simple ways to manage your money better*. The Balance. <https://www.thebalancemoney.com/ways-to-be-better-with-money-960664>

Johri, E., Desai, P., Soni, P., Jain, H., & Sanganeria, N. (2023). Expense Management System. 2023 4th IEEE Global Conference for Advancement in Technology (GCAT), Bangalore, India, 1–6. <https://doi.org/10.1109/gcat59970.2023.10353348>

Kumar, H. & Jadhav, P. D., (2025). Expense Tracker using .NET. *Peer-reviewed Journal*. <https://doi.org/10.17148/IJARCCE.2025.14812>

Kurniawan, D. E., Iqbal, M., Friadi, J., Hidayat, F., & Permatasari, R. D. (2021). Login Security Using One Time Password (OTP) Application with Encryption Algorithm Performance. *Journal of Physics Conference Series*, 1783(1), 012041. <https://doi.org/10.1088/1742-6596/1783/1/012041>

Lingayat, L., Yadav, N., Rathod, P., Durutkar, P., & Ghode, S. (2024). Design and implement of real time expense tracker using ML. *SSRN Electronic Journal*.
<https://doi.org/10.2139/ssrn.4754463>

Rajesh, P., Sai, M. D., Narasimha, Y. J. R., Prasad, K. M. S., Naveen, A., Kumar, B. J. S. S., TejVarma, G. (2025). Expense Manager: a comprehensive Web-Based solution for financial tracking. *International Journal for Research in Applied Science and Engineering Technology*, 13(4), 2031–2039. <https://doi.org/10.22214/ijraset.2025.68687>

Sabirin, S., Benius, B., Neneng, S., Nurwati, S., & Hendrayati, S. L. (2023). Importance of early financial literacy management skills. *International Journal of Business Economics & Management*, 6(2), 100–106. <https://doi.org/10.21744/ijbem.v6n2.2120>

SCRUM model for agile methodology. (2017). IEEE Conference Publication | IEEE Xplore.
<https://ieeexplore.ieee.org/abstract/document/8229928>

Srivastava, A., Bhardwaj, S., & Saraswat, S. (2017). SCRUM model for agile methodology. *2017 International Conference on Computing, Communication and Automation (ICCCA)*, pp. 864-869. <https://ieeexplore.ieee.org/document/8229928>

Trevor, R. T., Rakgwata, P. A., & Zwivhuya, D. M. (2025). Shared living, shared burdens: A case of the university of Venda exploring the impact of cohabitation on students' financial stability. *International Journal of Research in Business and Social Science (2147-4478)*, 14(6), 288–296. <https://doi.org/10.20525/ijrbs.v14i6.4058>