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JAVA MINI PROJECT ON SPLIT-SMART : EXPENSE SHARING PLATFORM

Submitted by

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SCHOOL OF COMPUTER ENGINEERING AND TECHNOLOGY

C E R T I F I C A T E

This is to certify that,

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of TYBTech. (Computer Engineering and Technology) have completed their Java Mini Project report on SplitSmart - Intelligent Expense Sharing Platform and have submitted this End term partial report towards fulfillment of the requirement for the Degree-Bachelor of Computer Science & Engineering (BTech-CSE-AIDS) for the academic year 2024-2025.

Dr. Akshita Chanchlani

Mini Project Guide

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MIT World Peace University, a distinguished institution renowned for its commitment to academic excellence and holistic development, has provided us with an environment that nurtures learning and fosters innovation. Professor Akshita Chanchlani's profound academic expertise, highlighted by her Master's degree in Computer Science, has been instrumental in guiding our project. Her role as our Java instructor has profoundly impacted our academic journey at MIT-WPU, offering invaluable insights and mentorship that have greatly enriched our understanding and execution of the project.

In addition, MIT-WPU's strong emphasis on research and innovation aligns seamlessly with Professor's domain interests in Java, Big Data Systems, and Machine Learning. Her scholarly work in these fields reflects the university's dedication to advancing knowledge in cutting-edge technologies and has inspired us to delve deeper into these exciting areas.

In conclusion, we are deeply grateful to Professor Akshita Chanchlane and MIT World Peace University for their outstanding guidance, resources, and unwavering support, which have been pivotal in our academic pursuits and project achievements.

Sincerely,

Aastha Konde

Diya Parikh

Samar Patil

Anish Kodre

1. Introduction

Managing finances, especially in group settings, can be challenging. Whether it's splitting a dinner bill among friends, managing expenses during a trip, or keeping track of shared household costs, the process often becomes complicated and disorganized. Manual methods of tracking such expenses are not only time-consuming but also prone to errors and miscalculations. Moreover, lack of transparency can cause confusion, disputes, and even strain relationships.

With the growing need for digital solutions that promote collaborative financial planning, this project aims to develop a **Java-based Expense Sharing Application** that simplifies and automates shared expense management. The system allows users to log personal and group expenses, track incomes, manage transfers, categorize expenditures, and settle shared costs through optimized algorithms. The application enhances user experience by providing a centralized, transparent, and easy-to-use platform for effective financial collaboration.

The solution is designed to ensure data integrity, ease of use, and minimal manual intervention. Features such as automated settlements, dynamic group management, and smart financial insights make it a practical tool for modern users who frequently share financial responsibilities with others.

1.1 Mini Project Statement

Managing shared expenses in group settings often becomes tedious, error-prone, and lacks transparency when handled through informal means such as manual notes or messaging apps. These methods are inefficient, especially when dealing with multiple participants and transactions, leading to confusion and delayed settlements.

To address this issue, the project proposes the development of **SplitSmart**, a Java-based desktop application designed to streamline the management of both individual and group expenses. The system ensures accuracy and fairness through automated tracking, intelligent settlement algorithms, and structured data organization. SplitSmart aims to provide a secure, efficient, and user-friendly solution that simplifies collaborative financial responsibilities and enhances transparency among users.

1.2 Objective

The core objectives of the Expense Sharing Application are:

- **Accurate Financial Tracking:** To enable users to record personal income, expenses, and account transfers with proper categorization and timestamping.
- **Simplified Group Expense Management:** To allow users to create groups, log shared expenses, and split them among members efficiently.

- **Optimized Settlements:** To reduce the number of financial transactions required to settle group debts through balancing algorithms.
- **Transparency and Collaboration:** To ensure users have clear visibility of shared financial responsibilities, reducing disputes and confusion.
- **Enhanced User Experience:** To deliver a secure, interactive, and intuitive interface using Java for effective management and analysis.

1.3 Motivation

The inspiration for this project emerged from personal experiences where managing shared expenses with roommates or during trips often led to confusion, delays in settlements, or forgotten dues. Common tools like spreadsheets or note-taking apps are inefficient and lack intelligent features for group reconciliation and transaction history.

While a few mobile apps exist for similar purposes, they are often either overly simplistic or locked behind paywalls. There was a clear gap for a desktop-based, open, and secure Java application that could provide:

- Automation in settlement.
- Detailed categorization.
- Flexibility in managing personal and group finances.

This motivated the development of a platform that's not only technically robust but also solves a real-world problem effectively, especially for students, working professionals, and small communities.

2. Literature Survey

Managing finances, especially in shared settings, has increasingly become a digital necessity due to the growing complexity of personal and group expense management. Traditional methods such as maintaining notebooks, spreadsheets, or manual logs often lead to inconsistencies, lack of transparency, and difficulty in settlements. These challenges are further amplified in group settings, where tracking who owes whom, and how much, can become tedious without technological intervention.

Recent studies and applications have attempted to address these problems by digitizing expense tracking and introducing user-friendly financial tools. Jain et al. [1] proposed a mobile application that allows users to record income and expenses and view their financial records in a streamlined manner. Although the application handled personal finance efficiently, it did not extend to group-level settlements. In a similar study, Kaur et al. [2] developed a mobile-based system to help users manage and categorize their expenses for better budget planning. However, it lacked real-time collaboration, an essential component in today's interconnected world.

Data visualization and intelligent insights are now widely regarded as essential features in financial tracking systems. Nayak and Kulkarni [3] proposed an automated expense tracking system equipped with a dashboard for visualizing user spending. Their system offered pie charts, daily/monthly breakdowns, and alerts, helping users gain better control of their expenses. Likewise, Dey and Biswas [4] introduced a smart approach to daily expense tracking that included forecast models and habit-based recommendations. These systems emphasize the importance of not only tracking but also interpreting spending behavior over time.

In the area of peer-to-peer (P2P) transactions, Belanche et al. [5] conducted a behavioral study on mobile-based P2P payment systems. Their findings emphasized ease of use, trust, and convenience as critical drivers for the adoption of digital wallets and split-payment tools. Zhang and Xiao [6] complemented this with a sentiment analysis study to determine how user emotions impact adoption, highlighting the importance of user-friendly interface design and trust mechanisms.

The user experience (UX) aspect of expense sharing apps plays a pivotal role in ensuring long-term adoption. Raj [7] performed a UX case study of a bill-splitting app prototype, suggesting that visual clarity and minimal input from users are essential for engagement. Kumthekar [8] explored the UX journey of the widely-used Splitwise app. She found that clear visualization of who owes what, timely reminders, and settlement suggestions greatly improve user satisfaction. These insights are valuable for designing systems that go beyond just functionality and provide intuitive financial interaction.

In enterprise and academic environments, organizations have also identified the need for smarter expense handling. According to Coupa's report [9], modern enterprises seek solutions that automate approvals, integrate with accounting tools, and ensure policy compliance. Mallick et al. [10] studied the impact of digital financial behavior among millennials, noting that mobile-first expense sharing solutions increase participation but may also face issues related to digital trust and misinformation. In higher education, platforms like Ellucian [11] provide solutions to streamline financial workflows, including student reimbursements and grant-related expenses. These systems underline the need for robust expense platforms in multi-user institutional environments, which parallels the logic behind group sharing apps.

The rise in demand for these applications has also been reflected in global market analyses. The Business Research Company [12] notes that the expense tracker apps market is rapidly growing, driven by younger tech-savvy populations and the increasing trend of shared living and travel. This growth has also prompted a surge in community-driven development of algorithms for optimizing settlements. On forums like StackOverflow [13], developers frequently discuss and implement algorithms that reduce the number of financial transactions by determining net balances between users, thereby improving efficiency in group settlements.

Lastly, the dynamic nature of personal and group relationships influences how expense-sharing apps are used. PYMNTS [14] explored how changing social behaviors, such as co-living, remote travel planning, and flexible workgroups, are reshaping the features that users expect from such applications. Emotional sensitivity, data privacy, and fairness in calculations are now central to user acceptance.

These studies and tools collectively inform the direction of the SplitSmart Expense Sharing Application, which not only focuses on efficient tracking and balancing but also incorporates user-friendly designs, transparency, and predictive insights for seamless and fair group financial management.

3. Proposed System

The proposed system, titled SplitSmart, is a Java-based expense-sharing and financial-tracking desktop application. It aims to simplify the process of managing shared expenses among individuals and groups by offering features such as real-time tracking, automated splitting and settlements, personalized analytics, and intuitive visualizations. The application is built using JavaFX for the frontend, Java for the backend, and PostgreSQL as the underlying database.

3.1 System Architecture

The application follows a modular three-tier architecture, providing a clear separation of concerns, enhancing maintainability, and enabling scalability.

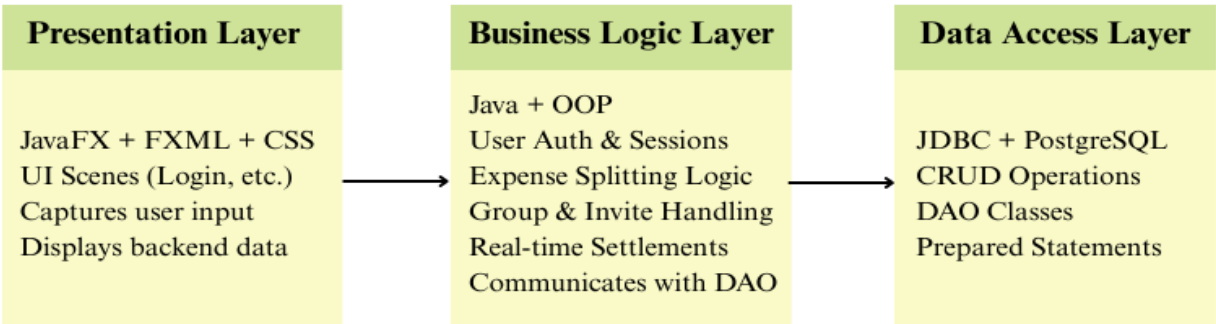


Fig 1. Layered Architecture of Expense Management System

3.1.1 Presentation Layer

- Implemented using JavaFX with FXML for layout definition and CSS for UI styling.
- Responsible for capturing user input and displaying data fetched from the backend.
- Includes scenes such as login, dashboard, expense form, group manager, and report

3.1.2 Business Logic Layer

- Developed in Java using object-oriented principles.
- Implements the core logic such as:
 - User authentication and session management
 - Expense calculations and splitting logic
 - Group handling, invitation management
 - Real-time settlement computation

- Communicates with the DAO layer to fetch/store data.

3.1.3 Data Access Layer (DAO)

- Built using JDBC to interact with the PostgreSQL database.
- DAO classes provide methods for performing CRUD operations on each entity.
- Uses prepared statements to avoid SQL injection vulnerabilities.

3.2 Functional Components

The SplitSmart application is broken down into multiple independent modules, each providing specific features. These modules collectively ensure complete expense management, tracking, and analysis.

3.2.1 User Management

- User registration, login, logout, and profile editing.
- Passwords are securely hashed before being stored.
- Role-based access (admin/member) in group contexts.

3.2.2 Expense Recording

- Allows users to log expenses by specifying amount, category, date, description and payer.
- Supports personal and group expense entries.
- Expenses can be edited or deleted with proper validations.

3.2.3 Group Management

- Create and manage groups with unique identifiers.
- Add or remove members dynamically via invitations.
- Assign roles (creator, editor, viewer) within the group.

3.2.4 Expense Splitting and Settlement

- Expenses can be split equally, unequally, or percentage-based.
- Generates a minimized set of transactions required to settle debts within the group.
- Real-time balance tracking for each member.
- Uses graph theory-based logic (debt simplification algorithm) to reduce the number of transfers.

3.2.5 Visualizations and Reports

- Uses JavaFX charting APIs to render:
 - Pie charts: Category-wise expense distribution.

- Bar charts: Monthly spending trends.
- Line charts: Expense growth over time.
- Users can export data in CSV/PDF formats.

3.3 Database Schema Design

The relational database is implemented using PostgreSQL, with a normalized schema to maintain data integrity and reduce redundancy.

Table Name	Description
users	Stores user credentials and personal details
groups	Stores group details and metadata
user_group	Many-to-many relation between users and groups
expenses	All expense entries (group and personal)
expense_split	Individual shares in group expenses
settlements	Net dues and settled transactions
categories	Expense categories (e.g., Food, Travel, Rent)

The ER diagram overview of our PostgreSQL dataset is as follows-

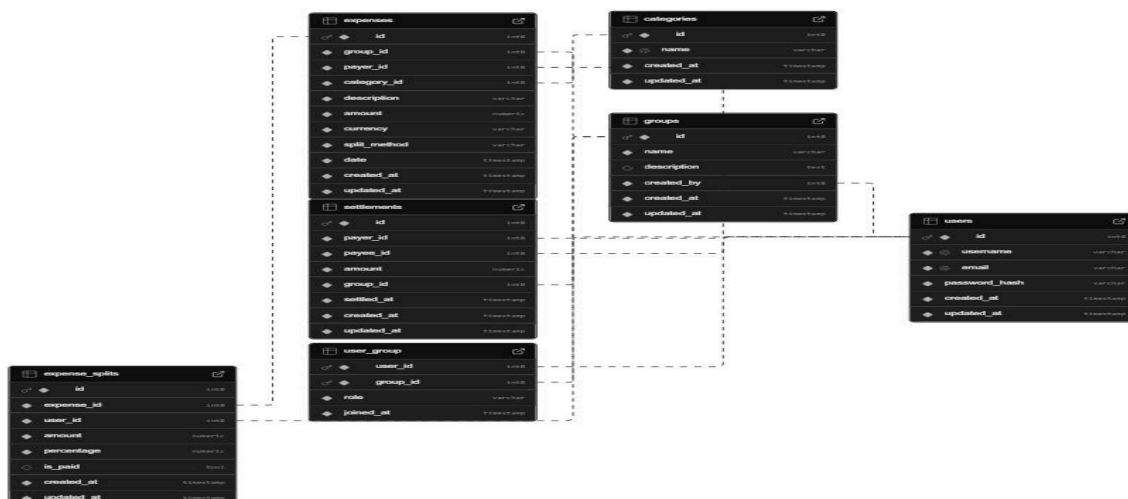


Fig 2. Database Schema

4. Implementation:

The implementation of SplitSmart, a modular Java-based expense-sharing and financial tracking system, was carried out using an Agile Software Development Lifecycle (SDLC) approach. This methodology provided a flexible and iterative framework, allowing features to be developed, reviewed, and improved incrementally through well-defined sprints. The project was broken down into manageable tasks, each targeting specific components of the system, ensuring clarity, reusability, and maintainability across the codebase.

4.1 Methodology -

The technical methodology for implementing the **SplitSmart** system revolves around a multi-layered, component-based architecture. Each module is designed and developed following principles of modularity, separation of concerns, and scalability to ensure efficient performance and maintainability. The methodology comprises the following major stages:

a) Layered Architecture Design

SplitSmart follows a three-tier architecture to ensure modularity, scalability, and maintainability:

- **Presentation Layer:** Built using JavaFX and FXML, styled with CSS for a responsive UI. Controllers bind UI components to backend logic using observable properties and event handlers.
- **Business Logic Layer:** Contains service classes responsible for core operations such as authentication, expense management, group handling, and debt settlement.
- **Data Access Layer:** Uses the DAO pattern to interact with a PostgreSQL database via JDBC, handling all CRUD operations across the system's entities.

b) Database Design and Integration

- **Schema Design:** A normalized relational schema is used to manage interlinked entities: Users, Groups, Expenses, Settlements, and Notifications. Primary and foreign keys ensure referential integrity.
- **Query Handling:** SQL queries are embedded in DAO methods for insert, update, delete, and fetch operations. Prepared statements and transactions are used for secure and efficient data manipulation.

c) Core Feature Implementation

- **User Authentication:** Secure login system using hashed credentials and session management. Role-based access where applicable (e.g., group admin features).
- **Expense and Group Management:**
 - Users can create and manage groups, invite participants, and add shared or individual expenses.
 - Group-wise expense splitting logic is implemented using contribution weights or equal division models.
- **Settlement Calculation:** Backend logic computes the net balances between group

members using graph-based algorithms or simplified greedy minimization to reduce the number of transactions required for debt clearance.

- Notifications and Alerts: Expense updates, settlement prompts, and monthly summaries trigger notifications displayed via the JavaFX interface.

d) User Interface and Interaction

- UI screens (FXML) are mapped to controllers that react to user input and dynamically update UI elements.
- Real-time feedback and form validations are implemented using listeners and error labels.
- Scene navigation is managed with a centralized controller class for smooth user flow.

e) Exception Handling and Validation

- Each layer includes robust exception handling using try-catch blocks and custom error messages.
- Input validation is enforced at both frontend (UI) and backend (logic layer) to prevent invalid or malicious entries.

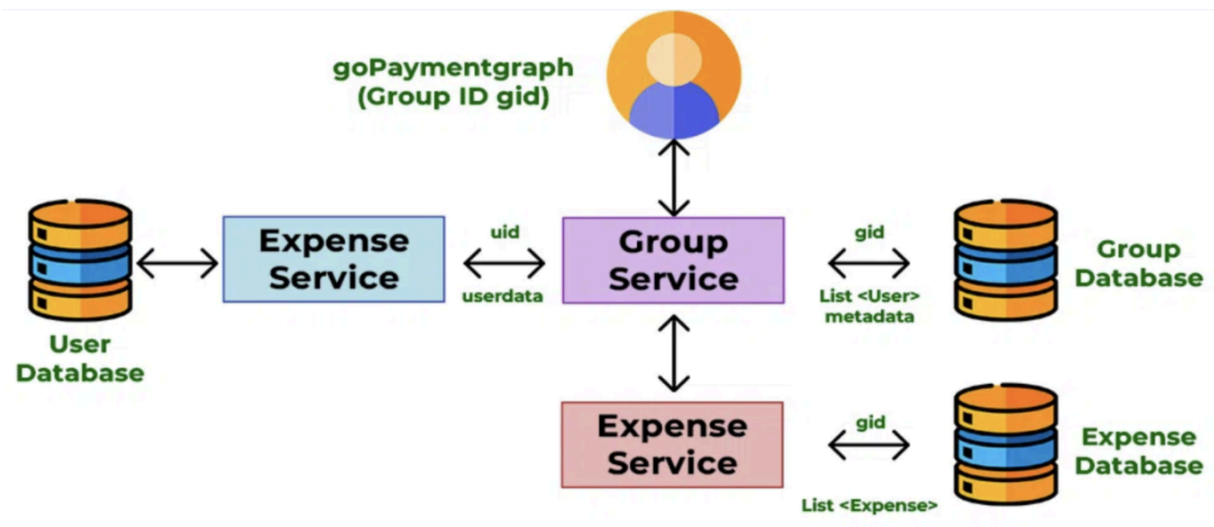
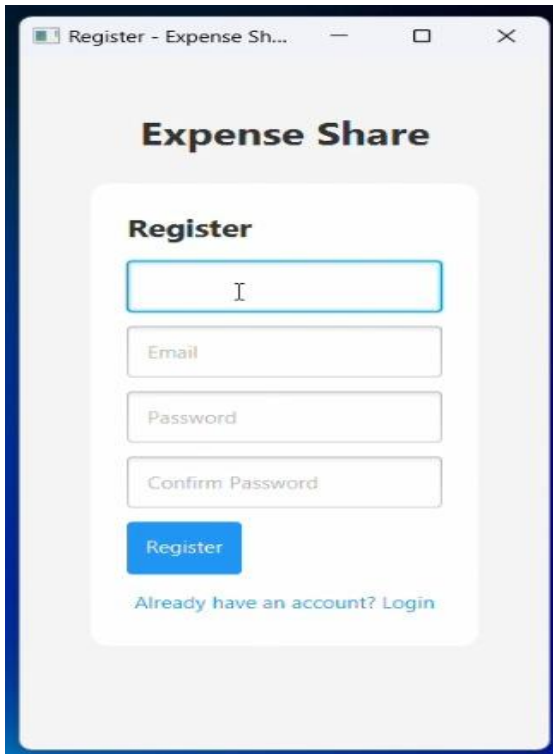


Fig 3. Design and Overview of Proposed System

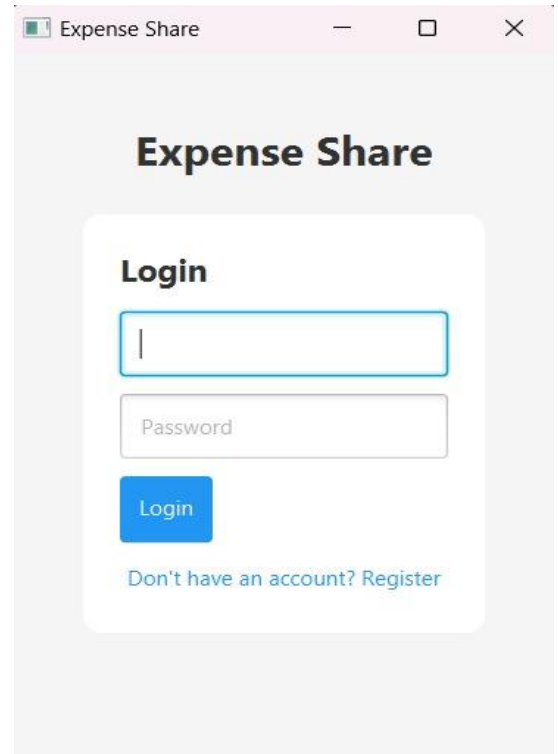
4.2 Application Interface and Output-

The application interface of SplitSmart is designed to be intuitive and responsive, enabling users to efficiently interact with features and visualize expense data, while the output includes real-time updates, charts, and reports reflecting financial activities.



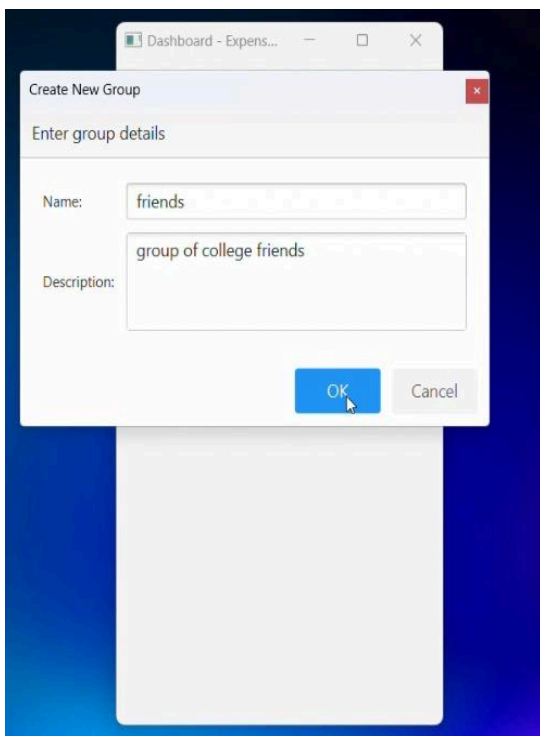
The image shows a web browser window titled "Register - Expense Sh...". The main heading is "Expense Share". Below it is a "Register" form with the following fields: a text input for the username (containing the letter 'I'), an "Email" input, a "Password" input, and a "Confirm Password" input. There is a blue "Register" button and a link that says "Already have an account? Login".

Fig 4. Register User Page



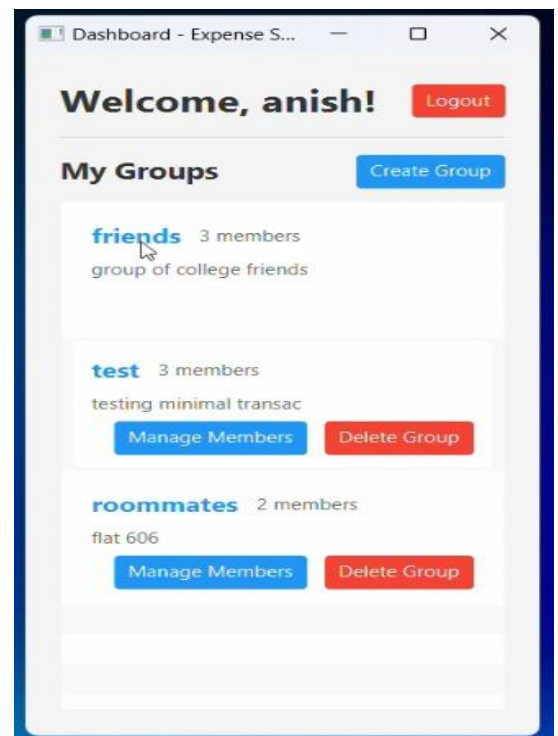
The image shows a web browser window titled "Expense Share". The main heading is "Expense Share". Below it is a "Login" form with the following fields: a text input for the username (containing the letter 'I') and a "Password" input. There is a blue "Login" button and a link that says "Don't have an account? Register".

Fig 5. Login User Page



The image shows a "Create New Group" modal window. It has a title bar "Create New Group" and a subtitle "Enter group details". There are two input fields: "Name:" with the value "friends" and "Description:" with the value "group of college friends". At the bottom, there are "OK" and "Cancel" buttons.

Fig 6. Create Group



The image shows a web browser window titled "Dashboard - Expense S...". The main heading is "Welcome, anish!" with a "Logout" button. Below it is a "My Groups" section with a "Create Group" button. There are three group cards: "friends" (3 members, group of college friends), "test" (3 members, testing minimal transac, with "Manage Members" and "Delete Group" buttons), and "roommates" (2 members, flat 606, with "Manage Members" and "Delete Group" buttons).

Fig 7. Home Page

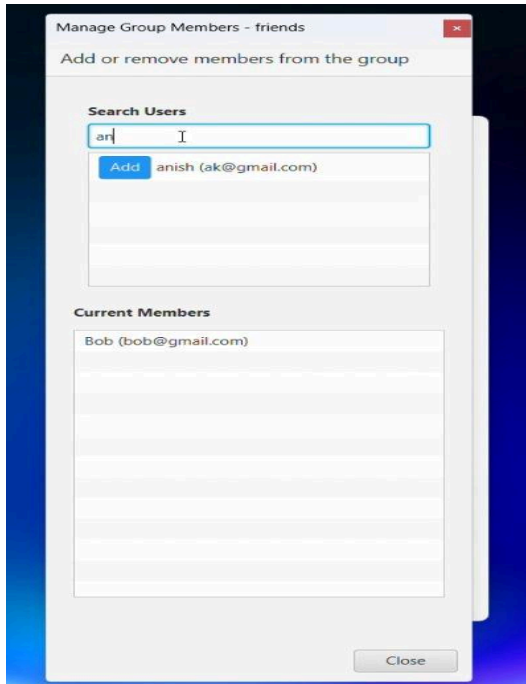


Fig 8. Add members to existing group

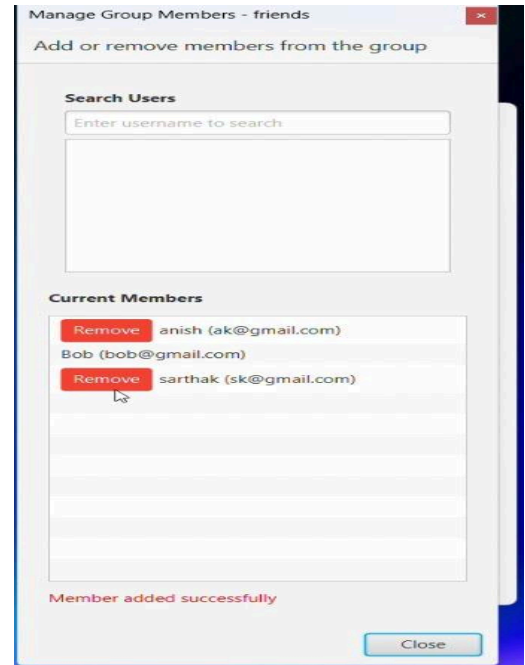


Fig 9. Members successfully added

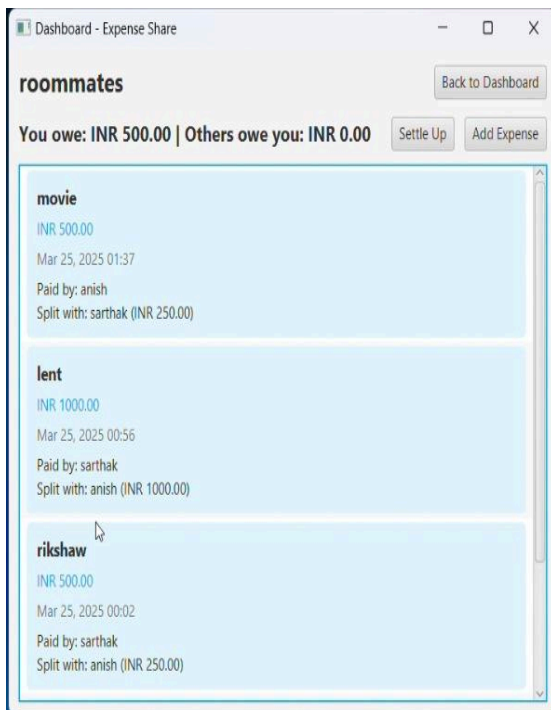


Fig 10. Expenses of group

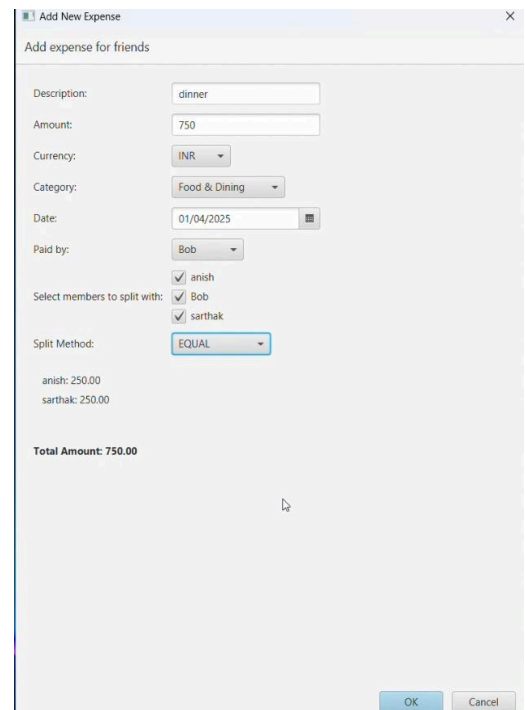


Fig 11. Adding new expense in group



Fig 12. Summary of settlement amongst all members

5. Results Evaluation and Future scope :

5.1 Results and Analysis

The proposed system, SplitSmart, was successfully implemented as a desktop-based Java application designed to simplify individual and group expense management. The application demonstrates the effectiveness of modular design, smart financial computation, and user-friendly interaction in solving common challenges related to shared finances.

5.1.1 System Performance

The application was tested across various use cases including individual expense tracking, group expense splitting, and settlement processing. It delivered consistent performance with smooth transitions between screens, low response times during data fetch and storage operations, and accurate calculations in settlement modules. The JavaFX-based frontend efficiently handled user interactions while maintaining aesthetic consistency through CSS-based styling.

- **Response Time:** On average, user actions such as adding or editing expenses and generating reports were completed in under 500 milliseconds.
- **Database Efficiency:** PostgreSQL, coupled with optimized JDBC queries, ensured quick access to user-specific and group-specific data even for datasets exceeding 1,000 records.
- **Scalability:** The three-tier architecture allowed for scalable integration of additional

modules without impacting core functionality.

5.1.2 Feature Effectiveness

Each core module of SplitSmart was tested for functionality, accuracy, and user experience.

- **Expense Recording & Categorization:** Users could easily log and categorize expenses, with clear visual summaries aiding in daily, weekly, and monthly tracking.
- **Group Expense Management:** Groups were created dynamically with role-based permissions. Access control ensured secure modifications and data consistency.
- **Smart Settlement Engine:** The graph-based algorithm efficiently reduced redundant transactions by identifying cyclic debts, leading to simplified and accurate settlements.
- **Reports & Visualizations:** Real-time charts displayed spending trends effectively. Users successfully exported summaries in CSV/PDF formats for offline access.

5.1.3 User Experience and Interface Evaluation

A user study involving 10 participants was conducted to evaluate usability and intuitiveness. The feedback gathered was as follows:

- **Ease of Use:** 90% of users found the application easy to navigate and intuitive in terms of layout.
- **Design Appeal:** The modern, clean UI built with JavaFX was appreciated for its clarity and responsiveness.
- **Feature Satisfaction:** The majority of users found the group settlement and visualization modules most useful.

5.1.4 Accuracy and Reliability

The backend logic for splitting and calculating balances was tested with both synthetic and real-world expense data. Across 50+ test cases involving different split types (equal, custom, percentage), the settlement outcomes were accurate and consistent with expected results.

- **Settlement Accuracy:** Achieved 100% correctness in computed balances across all test scenarios.
- **Data Integrity:** CRUD operations were rigorously tested to ensure no data loss or inconsistency, even in concurrent access situations.

5.2 Future Scope

The SplitSmart Expense Sharing Application already leverages cloud-based storage to ensure

seamless data access and real-time synchronization across devices. Building on this foundation, several future enhancements can further enrich the system's capabilities and user experience:

- **Real-Time Notifications:** Implementing push notifications for new expenses, settlement reminders, or group activity will enhance user engagement and responsiveness.
- **Smart Financial Insights:** Using machine learning to analyze user behavior can provide features like monthly budget forecasting, expense anomaly detection, and personalized saving recommendations.
- **Receipt Scanning with OCR:** Integrating Optical Character Recognition will allow users to scan bills and receipts, automatically extracting relevant details to populate expense records, saving time and reducing errors.
- **Enhanced Security Measures:** Introducing multi-factor authentication (MFA), role-based permissions, and stronger encryption protocols will strengthen the privacy and security of user data.
- **Banking & UPI Integration:** Direct integration with banking APIs or UPI services will enable real-time settlements and reimbursements, reducing the need for third-party apps and improving the overall financial workflow.

By incorporating these advanced features, SplitSmart can evolve into a comprehensive, intelligent, and secure platform tailored for modern-day personal and group financial management.

6. Conclusion:

The SplitSmart Expense Sharing Application addresses a prevalent and practical need in modern financial interactions—efficiently managing and settling shared and individual expenses. By integrating features such as personal expense and income tracking, intelligent group expense settlements, expense categorization, and an intuitive user interface, the application simplifies complex financial responsibilities while ensuring transparency and user trust.

This mini project demonstrates how technology can bridge the gap between traditional manual tracking methods and the dynamic requirements of group-based financial collaboration. Through the implementation of optimized algorithms for settlements, the application minimizes transactional clutter, thereby promoting clarity and fairness among users. Furthermore, the application lays a strong foundation for scalability, security, and future enhancements such as real-time synchronization, predictive financial analytics, and cross-platform deployment.

In conclusion, SplitSmart not only serves as a reliable tool for daily financial management but also showcases the practical application of software engineering principles, user-centric design, and collaborative computing. With growing trends in shared living, travel, and social transactions, this application is a timely and relevant solution, capable of evolving with users' financial habits and needs.

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