A

Mini Project Report

on

SplitSmart: Group Expense Sharing and Settlement Application

Second Year Engineering – Computer Science Engineering (Data Science)

by

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Academic year: 2024-25

CERTIFICATE

This to certify that the Mini Project report on SplitSmart has been submitted by Sanjana Naik(23107035),Rushikesh Paskanti(23107032), Samruddhi Chaudhari (23107144) and Abhishek Sali(23107004) who are bonafide students of A. P. Shah Institute of Technology, Thane as a partial fulfillment of the requirement for the degree in **Computer Science Engineering (Data Science)**, during the academic year **2024-2025** in the satisfactory manner as per the curriculum laid down by University of Mumbai.

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1.

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Date:

ACKNOWLEDGEMENT

This project would not have come to fruition without the invaluable help of our guide Ms.Ashwini Rahude. Expressing gratitude towards our HoD, **Ms. Anagha Aher**, and the Department of Computer Science Engineering (Data Science) for providing us with the opportunity as well as the support required to pursue this project. We would also like to thank our project coordinator **Prof. Rajashri Chaudhari and Prof. Vaibhav Yavalkar** who gave us his/her valuable suggestions and ideas when we were in need of them. We would also like to thank our peers for their helpful suggestions.

TABLE OF CONTENTS

Chapter 1

Introduction

Managing shared expenses can often be a tedious task, especially in group settings like trips, events, or shared households.Keeping track of who owes what and ensuring fairness in financial contributions can lead to confusion and unnecessary friction. Split Smart is designed to address this issue by simplifying expense tracking and settlement among groups. Inspired by apps like Splitwise, Split Smart allows users to effortlessly split bills, record expenses, and calculate individual shares with precision. The app streamlines the process of managing shared expenses, ensuring that everyone involved pays their fair share. By tracking expenses in real time, providing clear summaries, and offering various payment settlement options, Split Smart reduces the complexity of handling group finances.This report explores the design, development, and functionality of Split Smart. It highlights the core features, such as bill splitting, debt tracking, and seamless group management.Additionally, the report delves into the technical architecture, the user interface design, and the challenges faced during the development process, concluding with insights on future enhancements and scalability.

1.1.Purpose :

The decision to develop Split Smart was driven by the growing need for a more efficient and accessible way to manage shared expenses. In many social settings—such as group trips, shared living situations, or even casual outings—splitting expenses fairly can become a complicated and time-consuming task. While some solutions exist, many are either overly complex or lack the flexibility needed by users with varying financial habits and preferences.

Addressing a Common Pain Point

Managing group finances, keeping track of who owes what, and ensuring fair settlements are frequent challenges in daily life. The project aims to alleviate this by providing a simple, intuitive tool to handle these issues efficiently.

Technological Relevance

The project allows for the integration of key technologies such as cloud-based storage, real-time data synchronization, and mobile app development, offering valuable experience in these areas. These are essential skills for modern software development, making the project both practically and educationally valuable.

Potential for Real-World Application

With growing interest in financial management tools, there is clear potential for Split Smart to serve real users and grow into a marketable product. The app could be scaled for broader adoption by various groups, including friends, families, roommates, and colleagues, making it a practical solution with commercial viability.

User-Centered Design

The project places a strong emphasis on usability and user experience, making it an exciting challenge to design an app that is not only functional but also simple to use, even for those who may not be tech-savvy.

1.2 Problem Definition

Managing shared expenses is a frequent challenge faced by individuals in various social and financial contexts, such as group trips, shared housing, or events. These situations often require individuals to split bills and track multiple payments. Traditional methods, such as manual calculations, spreadsheets, or informal messaging, are prone to errors, confusion, and delays in payment settlements. Key problems associated with current practices include:

Complexity in Expense Tracking

In group settings, keeping track of multiple expenses, contributors, and individual payments can quickly become complicated. Manual methods often result in discrepancies, missed payments, or confusion regarding who owes what.

Inefficient Bill Splitting

Different groups may need to split expenses in various ways, such as equally, based on percentage shares, or custom amounts. Existing methods, such as dividing the total by the number of participants, fail to accommodate different expense-splitting needs.

Difficulty in Debt Settlement

Coordinating payments to settle debts often requires communication through multiple channels, such as messaging apps or emails, which can lead to delayed payments and difficulty keeping track of who has paid and who hasn't.

1.3 Objectives :

Simplify Group Expense Management

The primary objective is to provide a seamless platform where users can easily track, split, and manage shared expenses in various group settings, such as trips, shared accommodations, and events.

Enhance User Experience with Intuitive Design

To ensure the app is accessible to a broad range of users, the interface must be intuitive, simple, and easy to navigate, requiring minimal technical knowledge for effective use.

Ensure Accurate and Fair Expense Splitting

The app should offer customizable expense splitting options (e.g., equally, percentage-based, or custom shares) to accurately reflect different contribution models and ensure fairness in financial settlements.

Provide Real-Time Expense Tracking

Enable users to track expenses in real-time, updating group members instantly whenever a new expense is added, and ensuring transparency and accountability in all shared financial transactions.

Facilitate Easy Debt Settlement

Implement multiple methods for settling debts, including cash, bank transfers, or mobile payment options, making it easier for users to settle up with minimal friction.

Secure Data Storage and User Privacy

Ensure that user data is securely stored with encryption and that privacy is respected, particularly when handling sensitive financial information.

Scalability for Larger User Groups

Design the app to be scalable, able to handle both small and large groups, and adaptable for various use cases, from casual outings to long-term shared living expenses.

1.4 Scope:

The Split Smart project aims to deliver a comprehensive and scalable solution for managing shared expenses among groups. The scope of the project includes both the technical aspects of app development and the user-oriented features that ensure its functionality and ease of use. The key areas covered by the project are:

Expense Management System

The core functionality of the app revolves around tracking and managing group expenses. Users will be able to add expenses, assign them to group members, and split costs either equally or based on custom input (e.g., specific percentages or amounts).The app will track outstanding debts and allow users to view the total amount owed or paid at any time.

User and Group Management

The app will support the creation and management of user accounts, enabling individuals to join or create groups for shared expense tracking.Groups can be formed for various purposes such as trips, household expenses, or events, with the ability to add and remove members as needed.

Real-Time Syncing

The app will feature real-time synchronization so that all group members are immediately updated whenever a new expense is added or edited.

Data Security and Privacy

A strong focus will be placed on data security, with encryption for financial and personal information, ensuring user data is protected. Privacy measures will also be implemented to prevent unauthorized access to sensitive information, such as financial records and user account details.

Scalability and Flexibility

The app will be designed to accommodate small groups (e.g., friends splitting a dinner bill) and larger groups (e.g., roommates or teams sharing long-term expenses).

Chapter 2

Proposed System

The Split Smart application is designed to address the challenges of managing shared expenses by providing an intuitive, automated, and efficient platform. The proposed system encompasses several core components and features aimed at enhancing user experience and simplifying financial management. Below is an overview of the key features and functionalities of the proposed system:

User Accounts and Group Management

- User Registration and Login: Users can create individual accounts and securely log in using email or social media credentials.
- Group Creation and Management: Users can create groups for various purposes (e.g., trips, roommates) and manage group membership, including adding or removing members.

Expense Tracking and Management

- Adding and Categorizing Expenses: Users can easily add expenses to the group, specifying the amount, category (e.g., dining, accommodation), and date.
- Expense Splitting Options: Expenses can be split equally among group members or divided based on custom input, such as percentages or fixed amounts.

Debt Calculation and Settlement

- Automatic Debt Calculation: The system calculates each member's share of the expenses and tracks outstanding debts.
- Multiple Payment Methods: Integration with payment gateways allows users to settle debts via various methods, including mobile payments, bank transfers, or digital wallets.

User Interface and Experience

- Intuitive Design: The app features a user-friendly interface designed for ease of use, with clear navigation and simple expense management tools

Scalability and Flexibility

- Support for Large Groups: The system is designed to handle both small and large groups efficiently, with scalable infrastructure to support growing user bases.

2.1 Features and Functionality

Split Smart is designed to provide a seamless experience for managing shared expenses with a range of features that cater to various user needs. The app's functionality is aimed at simplifying expense tracking, ensuring accuracy, and enhancing user convenience. The following outlines the core features and functionalities:

User Management

- Account Creation and Authentication: Users can sign up with their email or social media accounts. Secure authentication methods ensure user privacy and account security.
- Profile Management: Users can update their personal information, including contact details and payment preferences.

Group Management

- Group Creation: Users can create groups for different purposes (e.g., travel, roommates) and invite members via email or direct links.
- Member Management: Group creators and admins can add or remove members, assign roles, and manage group settings.

Expense Tracking

- Expense Addition: Users can add expenses with details such as amount, description, category (e.g., food, transportation), and date.

- Categorization: Expenses can be categorized for better tracking and reporting, allowing users to filter and sort expenses based on categories.
- Expense Editing: Users can edit or delete expenses if needed, with changes automatically updated across all group members.

Expense Splitting

- Equal Splitting: Expenses can be split equally among all group members.
- Custom Splitting: Users can define custom splits based on percentages or fixed amounts, accommodating different contribution models.
- Partial Contributions: Allows for partial payments where some members contribute different amounts, adjusting the balances accordingly.

Debt Calculation and Management

- Automatic Debt Calculation: The app calculates each member's share and tracks debts and credits, ensuring accurate records.
- Payment Tracking: Users can record payments, view payment history, and check the status of settled and pending debts.
- Settlement Options: Supports various settlement methods, including bank transfers, mobile payments, and cash.
- Settle their debts, reducing the likelihood of missed payments.

Data Security and Privacy

- Encryption: All sensitive data, including personal and financial information, is encrypted to ensure security.
- Privacy Controls: Users have control over their privacy settings and can manage who has access to their data and expense records.

User Interface and Experience

- Intuitive Design: The app features a clean, easy-to-navigate interface designed for a seamless user experience.

Scalability and Future Enhancements

- Scalability: Designed to handle both small and large groups efficiently, with infrastructure to support growth.

Chapter 3

Project Outcomes

The Split Smart project aims to deliver a functional and user-centric application for managing shared expenses, achieving several key outcomes. The anticipated outcomes of the project are Streamlined Tracking where users can efficiently track and manage shared expenses in real-time, reducing the need for manual calculations and minimizing errors. The app provides flexible expense-splitting options to accommodate various group needs, ensuring fairness and accuracy in financial contributions.

The app's user-friendly design makes it easy for individuals with varying levels of technical proficiency to navigate and utilize its features. Automatic calculation of debts and credits ensures that users have accurate and up-to-date information on their financial standing within the group. Real-time syncing of expenses and payments fosters transparency, allowing all group members to stay informed about financial changes and balances.Secure

Data Handling: Implementation of robust encryption and privacy controls ensures the protection of sensitive financial and personal information, enhancing user trust in the app.Users have control over their privacy settings. The app is designed to support both small and large groups, with scalable infrastructure that accommodates growing user bases and diverse use cases. The app has the potential for commercialization, offering a practical solution for a widespread problem and appealing to a broad user base.

Chapter 4

Software Requirements

To develop and run the SplitSmart app, several software tools are required for both the development environment and deployment. Below is a list of the key software components and their purpose**:**

Java Development Kit (JDK)

- Version: JDK 11 or higher
- Purpose: The Java Development Kit is required for writing, compiling, and running Java applications. It provides the necessary libraries and tools to build the frontend for the SplitSmart app. JDK includes the Java Runtime Environment (JRE), which is essential for executing the Java application on various platforms**.**

Integrated Development Environment (IDE): Apache NetBeans

- Purpose: An IDE like Apache NetBeans is essential for coding and debugging Java programs. It offers features such as syntax highlighting, code completion, and integrated debugging, which streamline the development process.

JavaFX/Swing

- Purpose: JavaFX or Swing are used for building the graphical user interface (GUI) for the app. This includes windows, buttons, input fields, and other visual elements that make the app interactive**.**

MySQL Server

- Version: MySQL 8.0 or higher
- Purpose: MySQL serves as the backend database for the SplitSmart app. It stores user information, group details, and expense records. MySQL offers a relational database system that supports complex queries, transactions, and secure data handling.

- **JDBC (Java Database Connectivity)**

- Purpose: JDBC is an API that enables Java applications to connect to relational databases such as MySQL. It is required to execute SQL queries from the frontend and retrieve data, ensuring seamless communication between the app and the database.

Operating System

- Supported Platforms: Windows, macOS, Linux

- Purpose: The SplitSmart app is platform-independent, but the development environment can be set up on any of the major operating systems. The choice of OS depends on developer preference.

Chapter 5

Project Design

The design of the SplitSmart app focuses on providing a user-friendly and efficient way to split expenses among groups. The application is divided into three main components: frontend (Java), backend (MySQL), and the database layer, ensuring a clear separation of concerns and facilitating future scalability. The key aspects of the design are described below.

5.1 System Architecture

The SplitSmart app follows a client-server architecture, where the Java-based frontend interacts with the MySQL database through a JDBC (Java Database Connectivity) layer. The core architecture ensures that the user inputs are handled effectively in the frontend and processed in the backend for storing and retrieving data.

Components of the Architecture:

Client (Frontend): Built using Java, this layer is responsible for managing the user interface and user interactions, such as adding members to a group, creating expense records, and viewing split results. The Java program captures user inputs and communicates with the backend to perform necessary operations.

Backend (Logic & Database Access): The business logic, written in Java, processes the inputs from the user interface and connects with the MySQL database using JDBC. This layer performs operations like querying user data, calculating expense shares, and returning results to the frontend.

Database (MySQL): The MySQL database stores all persistent data related to users, groups, and expenses. It contains various tables to manage information efficiently, and SQL queries are used to interact with the data.

5.2 Database Design

The database is designed using the relational model with tables for users, groups, and expenses. The key entities and their relationships are represented using an Entity-Relationship (ER) Diagram. The main entities include:

- Users: Stores information about individuals using the app (e.g., name, email).
- Groups: Holds details about the groups created for splitting expenses.
- Expenses: Contains records of expenses associated with each group, including amounts, dates, and the user responsible for the expense.

Below is an overview of the primary database tables and their attributes:

5.3 Frontend Design

The frontend of the SplitSmart app is designed to be simple and intuitive, allowing users to easily interact with the system. The user interface is built using Java Swing/JavaFX and consists of the following key screens:

- Home Screen: Allows users to view existing groups or create new ones.
- Group Screen: Displays group members and gives the option to add new members.
- Expense Entry Screen: Enables users to input expenses, including the amount, who paid, and which group the expense belongs to.
- Split Summary Screen: Shows the result of the split calculation, detailing how much each person owes or is owed.Each screen is connected through event-driven programming, where button clicks trigger actions that interact with the backend.

5.4 Flow of Operations

- User Registration/Login: Users register or log in to the app. Their credentials are stored and verified using the MySQL database.

- Group Creation: Users create groups, add members to the group, and assign a group name. This information is stored in the database.
- Expense Management: Users add expenses to the group by specifying the amount, who paid, and the expense details. The backend performs the necessary database operations to store the expense record.
- Expense Splitting: The app calculates the amount each user owes by dividing the total expenses equally among the group members. These calculations are performed in the backend, and the results are displayed to the user.
- Database Interaction: At every step, the Java frontend communicates with the MySQL backend using SQL queries through the JDBC API to store or retrieve data.

Chapter 6

Project Scheduling

A schedule outlining planned start and finish dates, durations, and allocated resources for each task, ensuring tasks are completed on time and within budget for effective task and time management.

GANTT CHART TEMPLATE

Smartsheet Tip · A Gantt chart's visual timeline allows you to see details about each task as well as project dependencies.

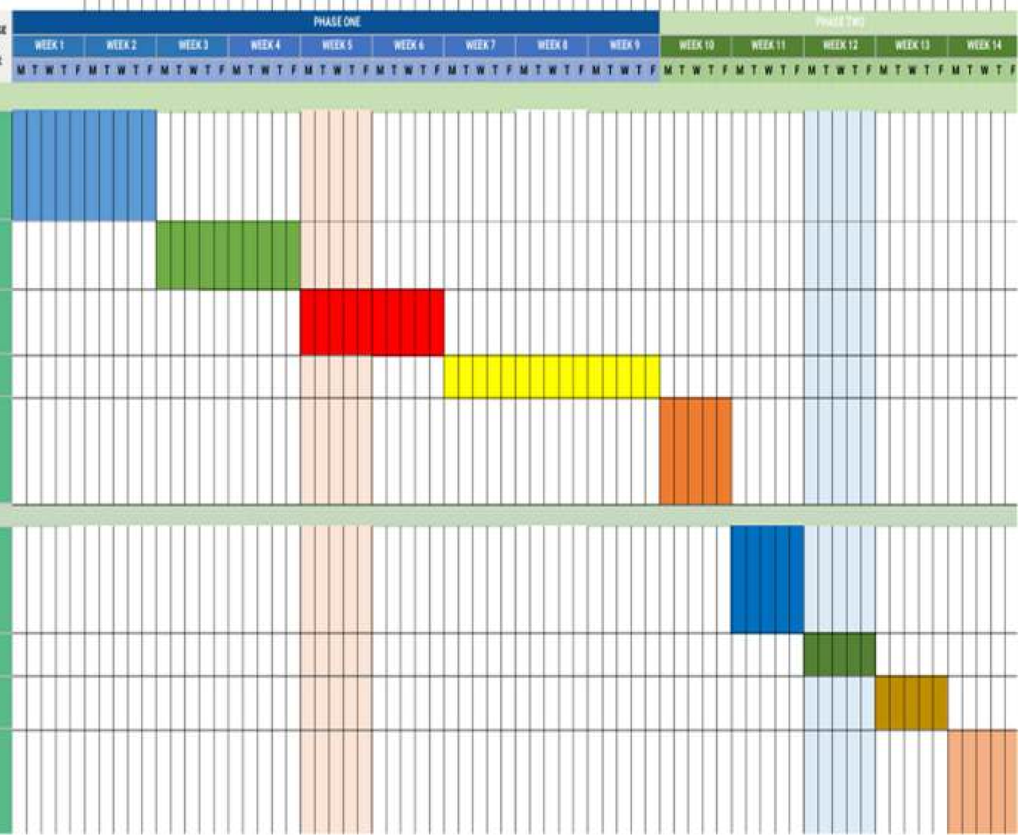
PROJECT TITLE: SPLIT SMART GROUP EXPENSE SHARING AND SETTLEMENT APPLICATION

TOPIC GUIDE : MS.ASHWINI RAHUDE

INSTUTUTE & DEPARTMENT NAME: AP SHAH INSTITUTE OF TECHNOLOGY(CSE Data Science)

DATE: 10-8-24

WBS NUMBER	TASK TITLE	TASK OWNER	START DATE	DUE DATE	DURATION(Weeks)	PERCENTAGE OF TASK COMPLETE
1	**Project Conception and Initiation**					
1.1	Group formation and Topic finalization. Identifying the scope and objectives of the Mini Project	Sanjana Naik, Samruddhi Chaudhari, Rushikesh Paskanti, Abhishek Sali	7-9-24	7-23-24	2	100%
1.2	Identifying the functionalities of the Mini Project	Abhishek Sali	7-23-24	8-6-24	2	100%
1.3	Discussing the project topic with the help of paper prototype.	Sanjana Naik, Rushikesh Paskanti, Abhishek Sali	8-6-24	8-20-24	2	100%
1.4	Designing the Graphical User Interface(GUI)	Sanjana Naik	8-20-24	9-10-24	3	100%
1.5	Presentation I	Sanjana Naik, Samruddhi Chaudhari, Rushikesh Paskanti, Abhishek Sali	9-10-24	9-17-24	1	100%
2	**Project Design and Implementation**					
2.1	Database Design	Sanjana Naik, Samruddhi Chaudhari, Rushikesh Paskanti, Abhishek Sali	9-17-24	9-24-24	1	100%
2.2	Database Connectivity of all modules	Sanjana Naik	9-24-24	10-1-24	1	100%
2.3	Integration of all modules and Report Writing	Abhishek Sali, Rushikesh Paskanti	10-1-24	10-8-24	1	100%
2.4	Presentation II	Sanjana Naik, Samruddhi Chaudhari, Rushikesh Paskanti, Abhishek Sali	10-8-24	10-15-24	1	100%



During the project timeline, the group members undertook various tasks to ensure the successful completion of the Mini Project. In the first two weeks of July, Sanjana Naik (23107035) and Rushikesh Paskanti (23107032) focused on group formation and topic finalization, identifying the project's scope and objectives. Following this, from the last week of July to the first week of August, Sanjana Naik (23107035) and Abhishek Sali (23107004) identified the key functionalities needed for the Mini Project.

From the second week to the last week of August, a collaborative effort involving Sanjana Naik(23107035),Rushikesh Paskanti (23107032), and Samruddhi Chaudhari (23107144) was made to discuss the project topic, utilizing a paper prototype to visualize ideas. Concurrently, Sanjana Naik (23107035), Rushikesh Paskanti (23107032), and Abhishek Sali (23107004) worked on designing the Graphical User Interface (GUI) during the last week of August to the first week of September, focusing on creating a user-friendly layout.

In the first two weeks of September, the team, including Sanjana Naik (23107035), Rushikesh Paskanti (23107032), and Samruddhi Chaudhari (23107144), prepared for Presentation I. Sanjana Naik (23107035) then took the lead from the second week to the last week of September, concentrating on database design, which was crucial for the project's functionality.

By the last week of September, Sanjana Naik (23107035) completed the database connectivity for all modules, ensuring seamless integration. In the first week of October, Rushikesh Paskanti (23107032), Sanjana Naik(23107035), and Samruddhi Chaudhari (23107144) worked together to integrate all project modules and began report writing, while Abhishek Sali(23107004) joined them for Presentation II in the same week. This structured approach allowed the team to efficiently collaborate and advance their project systematically.

Chapter 7

Results

The SplitSmart app successfully achieves its core objective of providing a platform for users to split expenses efficiently among group members. Below is a detailed summary of the results obtained from the development and testing phases:

7.1 **Functional Features**

The following key features were implemented and tested:

- User Registration and Login:

The app allows new users to register by entering their personal details (name, email), which are stored in the MySQL database. Registered users can log in with their credentials, and the system verifies their identity by querying the database.

- Group Creation and Management:

Users can create new groups by providing a group name and adding members (either from registered users or by manually entering details). The app saves group information in the database and links it with the members.

- Expense Entry and Management:

Users can input expenses into any group they belong to, specifying the amount, who paid, and a brief description. Expenses are stored in the database, and the app handles multiple expenses per group.

- Expense Splitting Calculation:

The app performs equal splitting of expenses within a group. It accurately calculates how much each member owes or is owed, taking into account the total expenses and the members who contributed. The results are displayed clearly on the user interface, providing a breakdown for each user.

- Data Persistence:

All user information, group details, and expenses are stored in the MySQL database, ensuring data persistence between sessions. Users can log in, create new groups, or view past group expenses at any time.

7.2 **Performance and Responsiveness**

- Data Handling:

The app handles data storage and retrieval efficiently. MySQL queries are optimized to ensure quick responses, even when dealing with large numbers of users and expenses. The JDBC connection between the Java frontend and MySQL backend performs consistently across various user actions.

- User Interface:

The user interface, built using JavaFX/Swing, is intuitive and easy to navigate. Users can easily move between the main screens (Home, Group, Expense, Summary), and actions like creating groups or adding expenses are performed smoothly with minimal delay.

7.3 **Testing Results**

- Functional Testing:

The app was tested across different scenarios to ensure that each feature works as expected. Test cases included:

- Creating multiple users and groups.
- Adding expenses with different amounts and participants.
- Correct calculations of expense splits.

All test cases passed successfully, and the app was able to manage user data, group records, and expenses without errors.

- Performance Testing:

The system was tested with a larger number of users and groups to assess the performance. The app maintained stable performance, with quick query execution times and no noticeable slowdowns.

7.4 **Challenges and Resolutions**

- Database Integrity:

During development, ensuring data integrity was a key focus, particularly in handling relationships between users, groups, and expenses. To avoid inconsistencies, database constraints such as foreign keys and validation checks were implemented, ensuring that no orphaned records or invalid data entries exist.

- Error Handling:

Various error-handling mechanisms were implemented to manage scenarios such as duplicate user registration, invalid expense entries, and database connection issues. These mechanisms provided users with helpful error messages and ensured that the system remained stable.

7.5 **Achievements**

Overall, the SplitSmart app met the following goals:

- Successfully implemented the core functionality of splitting expenses among group members.
- Built a reliable backend using MySQL for data storage, ensuring persistence and integrity.
- Designed a user-friendly Java-based frontend that allows users to easily manage groups and expenses.

ScreenShorts:

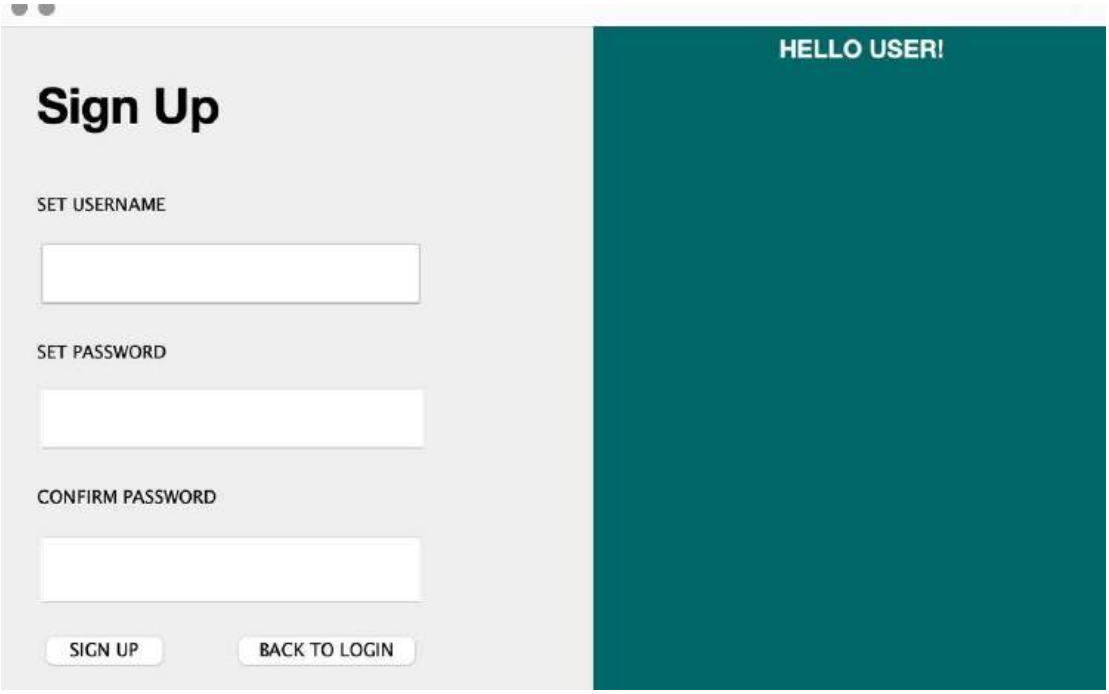


Figure 5.1.1: SignUp Page.

SignUp Page lets a user to create account.

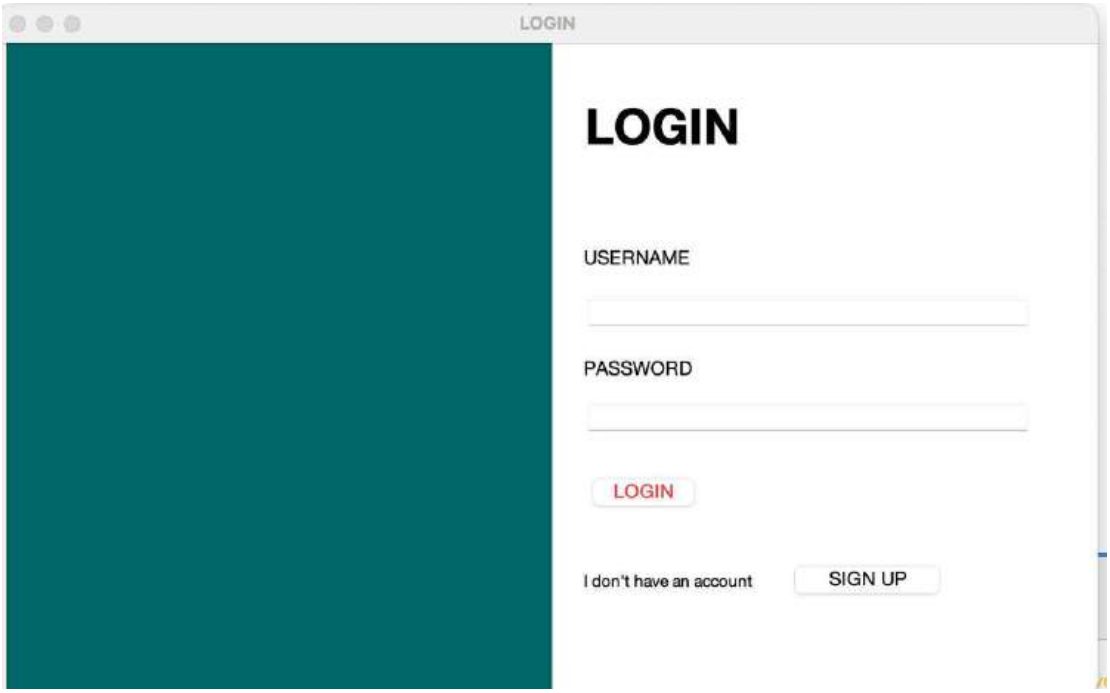


Figure 5.1.2:Login Page.

Login Page lets the signuped users login to their account.

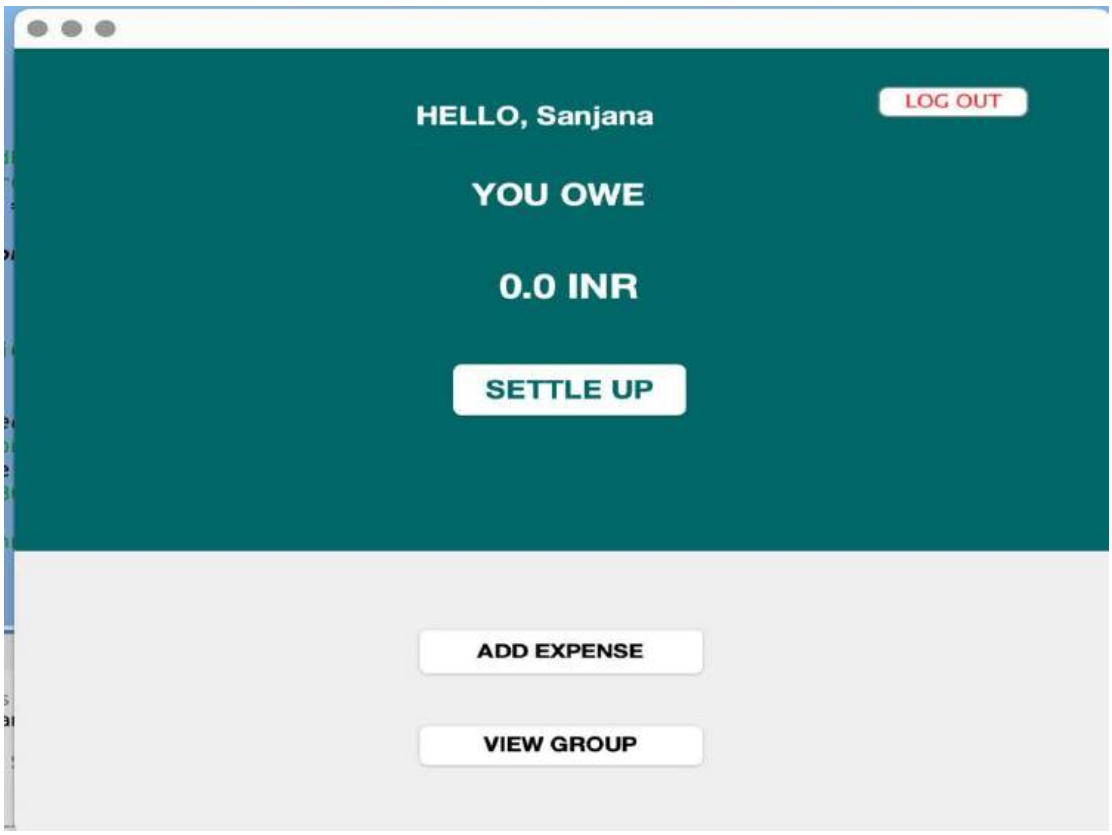


Figure 5.1.3: MAIN PAGE

Mainpage lets you to go to group page , add expense page, and displays the owed money to a particular user.

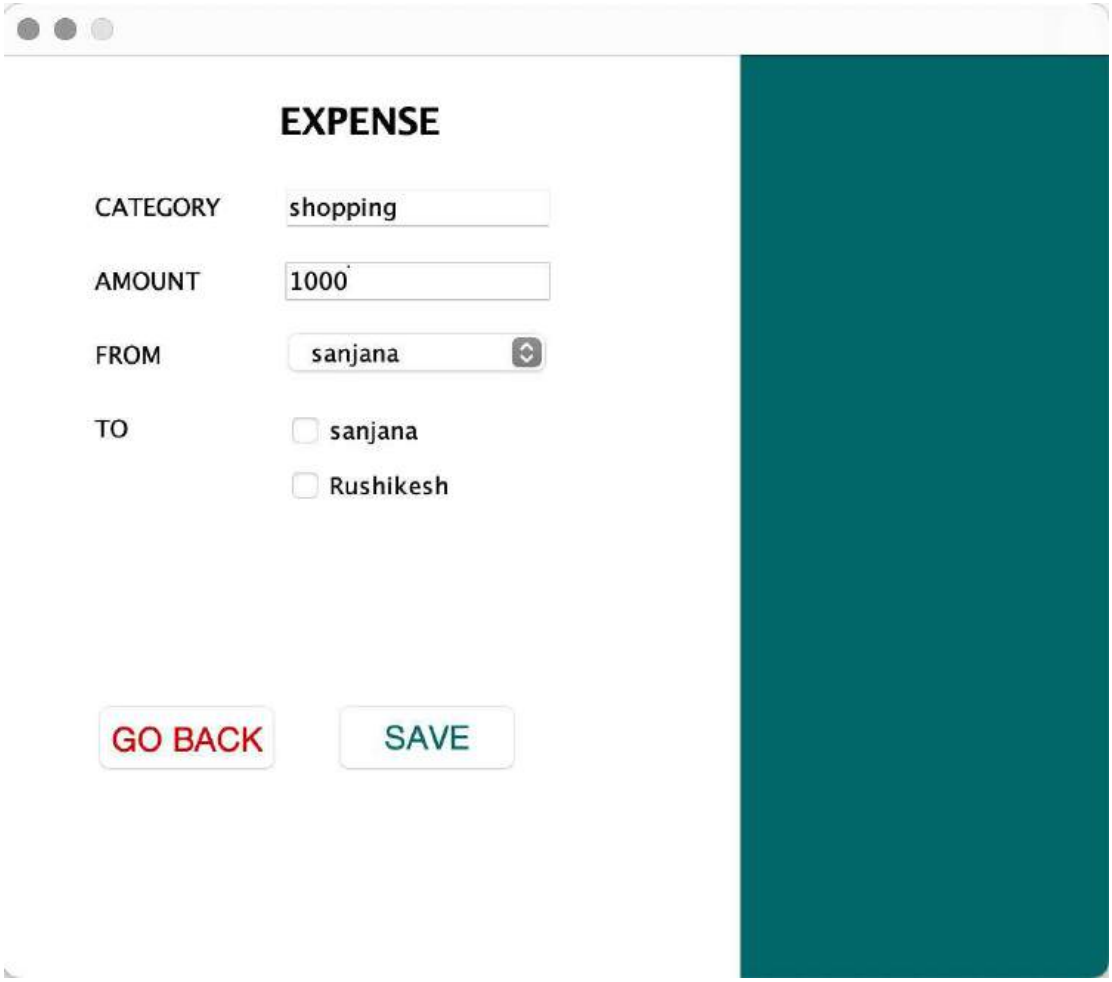


Figure 5.1.4: EXPENSE PAGE

Expense page lets you create an expense data that is need to split .

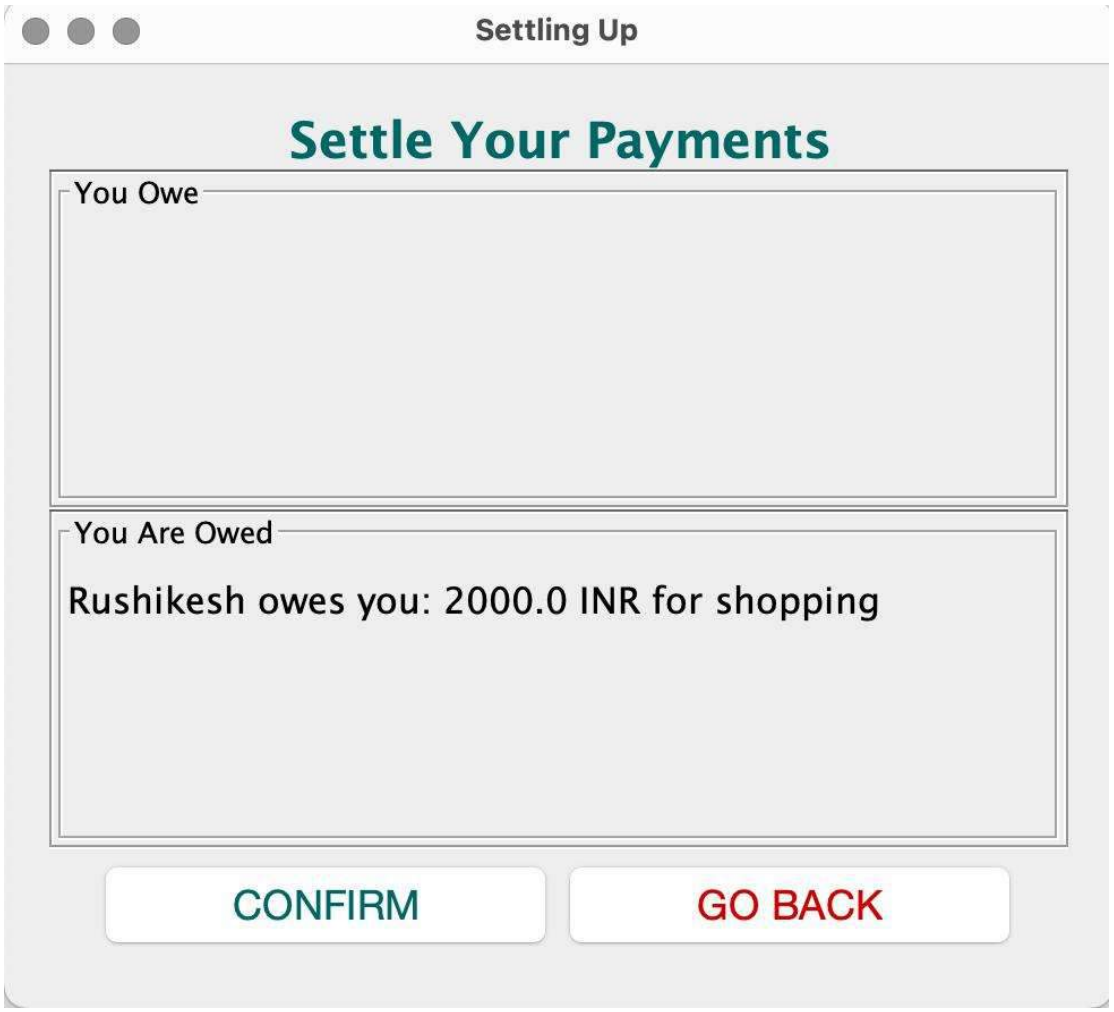


Figure 5.1.5:SETTLEUP PAGE

SettleUp Page lets you settle the due amount.

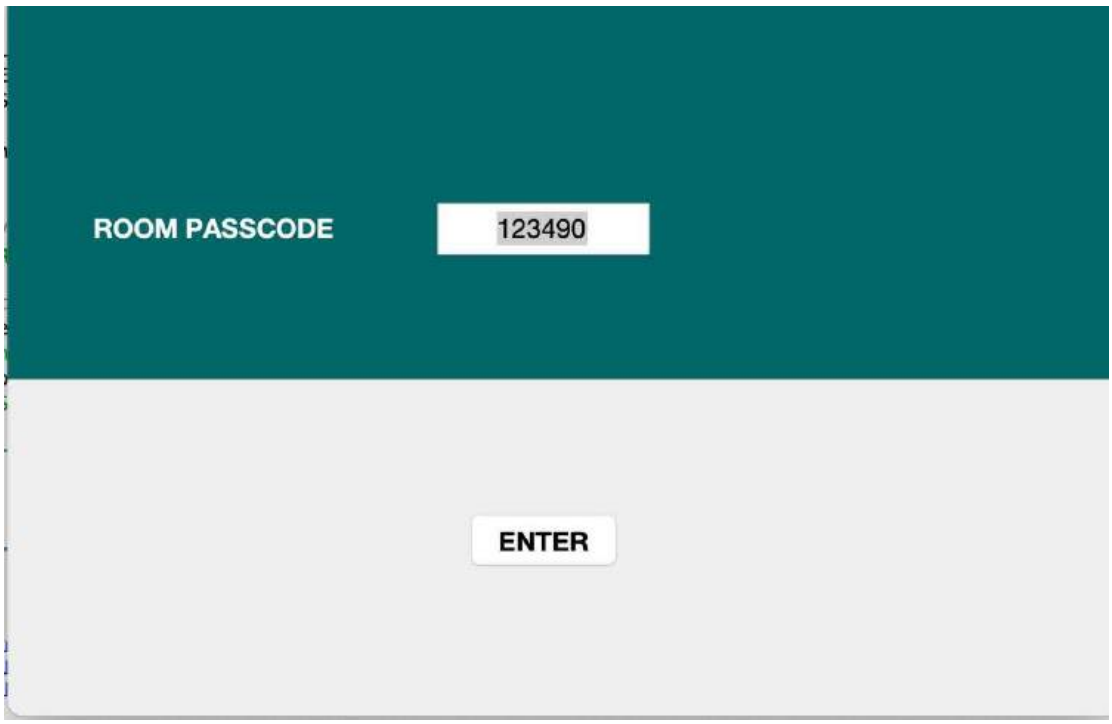


Figure 5.1.6: JoinGroup Page.

JoinGroup Page lets join a user's group to whom we have to settleup the Due amount by entering the group code.

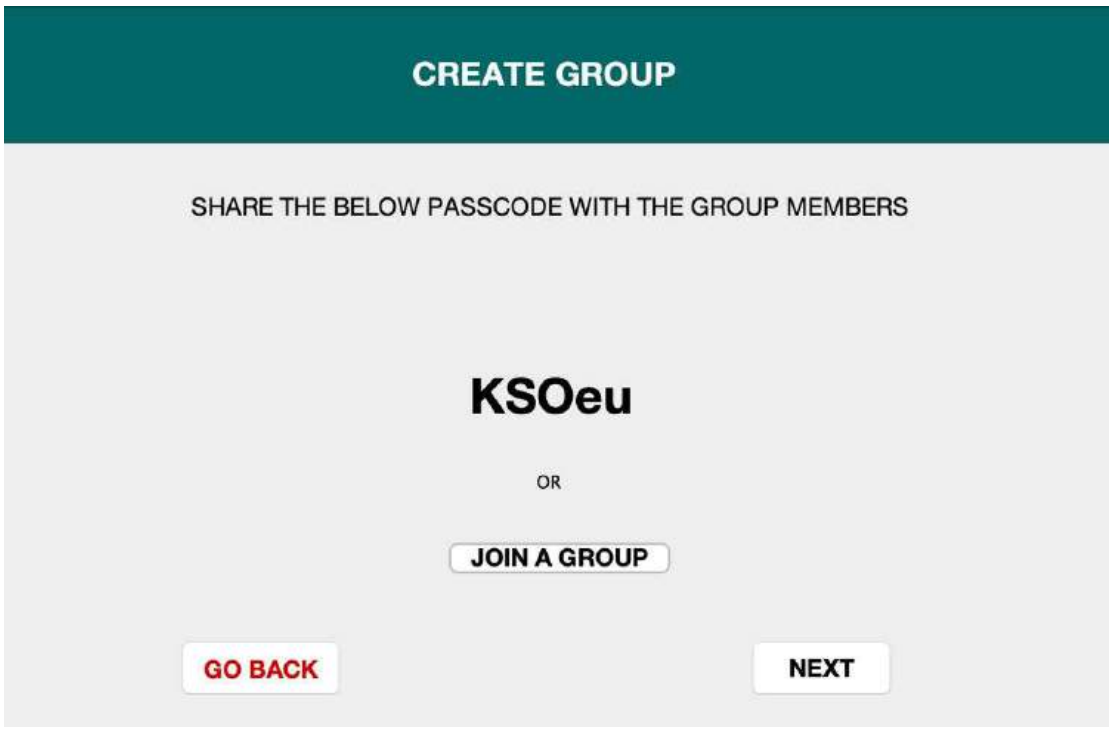


Figure 5.1.7: CreateGroup Page .

CreateGroup Page creates an unique group code for settlements for every user.

Chapter 8

Conclusion

The SplitSmart app successfully fulfills its primary objective of simplifying the process of splitting expenses among group members. Through the use of a Java-based frontend and a MySQL backend, the application provides a user-friendly and efficient solution for managing group expenses and calculating the amounts owed by each member.

8.1 Project Success

The app's key functionalities, including user registration, group creation, expense entry, and equal expense splitting, were implemented successfully. Users can interact seamlessly with the app, add group members, and input expenses, while the app performs real-time calculations and stores the data in the backend. The clear separation of concerns between the frontend and backend, combined with MySQL's data handling capabilities, ensures that user data is stored securely and efficiently.

The project has been tested across various use cases, including different group sizes and expense inputs, demonstrating its robustness and reliability in handling real-world scenarios. The system architecture and database design provide a solid foundation for further expansion and future development.

8.2 Challenges and Learning Outcomes

During development, the project encountered challenges related to database integration, particularly in ensuring data integrity between users, groups, and expenses. These challenges were overcome through the use of relational database design principles and the implementation of error-handling mechanisms to ensure a smooth user experience. Working with JDBC also provided valuable experience in managing Java-to-database communication and optimizing query performance.

8.3 Future Work

While the app currently handles equal expense splitting, there is significant potential for expanding its functionality. Future versions of SplitSmart could include:

- **Advanced Splitting Methods**: Incorporating additional expense-splitting methods, such as custom splits where users can specify unequal contributions.
- **Expense Categories**: Allowing users to categorize expenses (e.g., food, transportation) to provide better financial insights.
- **Mobile and Web Versions**: Developing mobile and web versions of the app to make it accessible across multiple platforms.
- **Notifications and Reminders**: Implementing email or push notifications to remind users of pending payments or updates in their groups.
- **Data Analytics**: Offering visual reports or summaries of group spending trends, which would help users manage their finances better.

8.4 Final Thoughts

Overall, the SplitSmart project has proven to be a valuable learning experience, combining knowledge of Java programming, database management, and user interface design. The successful implementation of the app's core features demonstrates the effectiveness of the chosen technologies and the strength of the system design. Moving forward, the app's solid foundation provides many opportunities for further development, both in terms of functionality and usability.

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