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Web-Based Group Expense Management System with Digital Payment Integration

Likitha R¹, Prashant Ankalkoti²

PG Student, Department of MCA, Jawaharlal Nehru New College of Engineering, Shivamogga, Karnataka, India¹

Assistant Professor, Department of MCA, Jawaharlal Nehru New College of Engineering, Shivamogga,
Karnataka, India²

ABSTRACT: Managing shared expenses in a group can be difficult when handled manually, which can lead to confusion, delayed payments, and incorrect records. This paper presents EzSettle, a web-based application designed to simplify expense tracking and settlement within groups. The system allows users to create groups, add members, and record expenses, after which it automatically calculates how much each person needs to pay or receive. The application is developed using a client-server architecture with React for the front end, Node.js and Express for the back end, and MongoDB Atlas for data storage. It also integrates Cashfree's UPI payment gateway, allowing users to complete transactions directly within the system. Additional features such as secure login using JWT, email-based password reset and invitations using Nodemailer are included. The system was tested using different group scenarios, and the results show that it performs accurate calculations, handles multiple users efficiently, and simplifies the settlement process. EzSettle provides a practical solution for managing shared expenses in situations such as trips, shared accommodation, and team activities.

KEYWORDS: Group expense management; digital payments; shared expenses; UPI; web application; email-based features.

I. INTRODUCTION

Managing shared expenses among a group of people is common in real-life situations such as trips, shared accommodation, and team activities. In such cases, individuals contribute different amounts, making it difficult to track who paid and who still owes money. When handled manually, this process can lead to confusion, calculation errors, delayed settlements, and misunderstandings. With the increasing use of digital payments, there is a need for systems that can simplify expense tracking and support easy payment settlement.

Several applications are available to manage group expenses. These systems help users record expenses and calculate balances. However, many of them focus only on tracking expenses and require users to use separate payment applications to settle their dues. This lack of integration can reduce convenience and may lead to delayed or incomplete payments.

To solve these issues, this project proposes EzSettle, a web-based group expense management system that combines expense tracking and payment settlement in one platform. Users can form groups, include participants, add expense details, and the system will automatically work out the balances for each member. It also integrates Cashfree's UPI payment gateway, enabling users to settle payments directly within the application.

EzSettle is developed using React for the front end and Node.js with Express for the back end, while MongoDB Atlas is used as the cloud database. The system ensures security through JWT-based authentication. It also includes features such as password reset through email and group invitations using Nodemailer.

By combining expense tracking, automated calculations, secure authentication, and direct digital payments, EzSettle provides a simple and effective solution for managing group expenses and reducing confusion in financial interactions.

II. LITERATURE REVIEW

Shaikh et al. [1] compared different expense management applications based on usability and features, showing improvements in automation and user experience. However, most systems do not include real-time payment integration. Verma et al. [2] developed the Split-It application supporting both equal and unequal expense sharing for better clarity. However, it does not support automatic settlement or integrated payments. Patel et al. [3] introduced SplitPay to help users track and analyse shared expenses effectively. However, it lacks direct payment options and advanced settlement features. Reddy et al. [4] presented the SettleUp application for tracking group expenses and balances accurately. However, users must settle payments outside the system. Kumar and Singh et al. [5] studied UPI adoption and found ease of use and trust as key factors for its growth. However, it does not focus on combining UPI with expense management. Rao et al. [6] explained the working and security of UPI transactions in detail. However, it does not address group expense management. Gupta et al. [7] proposed a decentralized payment system to improve reliability and security. However, it does not include expense tracking or bill splitting. Velmurugan et al. [8] developed an expense manager combining personal and group tracking to reduce confusion. However, it lacks real-time collaboration and payment integration. Choughule et al. [9] used OCR technology to extract expense details automatically from bills. However, it depends on image quality and lacks payment features. Singh et al. [10] created a budgeting system with alerts and reports to improve financial control. However, it does not support shared expense management. Jain et al. [11] proposed a personal finance system for tracking income and expenses. However, it does not handle group expense scenarios. Khando et al. [12] reviewed digital payment technologies and discussed their growth and challenges. However, it does not focus on shared expense systems. Khan et al. [13] analysed UPI-based peer-to-peer payment systems and their benefits. However, it does not include expense tracking features. BIS et al. [14] studied UPI as a fast and low-cost digital payment system. However, it does not support group expense management. Zhang et al. [15] showed that expense tracking improves financial discipline among users. However, it does not address group expense sharing. Patil et al. [16] developed a bill splitting system that improves transparency and reduces errors. However, it lacks direct payment integration. Sharma et al. [17] created a bill splitting assistant for basic expense calculations. However, it has scalability issues and lacks optimisation. Hu and Shum et al. [18] proposed graph-based methods to reduce the number of settlement transactions. However, it is complex and not applied in real systems. Eskandarian et al. [19] introduced a privacy-focused expense splitting system to protect user data. However, it remains theoretical without real-time payments. Stack Overflow Community et al. [20] discussed a simple method to minimize cash flow in group transactions. However, it lacks security and practical system support.

III. METHODOLOGY

The development of EzSettle follows a practical approach where the system is designed, implemented, and tested based on real-world usage. The focus is on building a working solution that can handle shared expenses efficiently while ensuring ease of use and security.

A. Research Approach

A design-based approach is used in this work. The system is developed step by step, tested with users, and improved based on feedback. The emphasis is on creating a functional application rather than only theoretical analysis.

B. Participants

A small group of users, including friends and classmates, participated in testing the application. They used the system to manage shared expenses in scenarios such as group outings and shared purchases. Their feedback helped in verifying usability and correctness.

C. System Design

The system follows a client-server architecture. The front end is developed using React to provide a responsive interface, while the back end is implemented using Node.js and Express to handle processing and calculations. MongoDB Atlas is used to store user data, group details, and transactions.

D. Core Expense Logic

The main functionality of the system is based on expense splitting. When an expense is added, the share for each member is calculated using:

$$\text{Individual Share} = \text{Total Expense} / \text{Number of Members} \quad \dots \text{Eq. (1)}$$

The balance of each user is then calculated as:

$$\text{Balance} = \text{Amount Paid} - \text{Individual Share} \dots \text{Eq. (2)}$$

A positive balance indicates that the user should receive money, while a negative balance indicates that the user needs to pay.

E. Debt Simplification

To reduce unnecessary transactions, the system identifies users who owe money and users who should receive money, and matches them accordingly. This helps in minimizing the number of payments required to settle all balances.

F. Payment Integration

The system integrates Cashfree's UPI payment gateway to enable direct payment within the application. Once a transaction is completed, the system updates balances and stores the transaction details.

G. Email Services

Nodemailer is used to handle email-based features such as password reset and group invitations. Users receive secure links for resetting passwords and joining groups.

H. Data Management

All application data, including user information, group details, expenses, and transactions, is stored in MongoDB Atlas. The database ensures consistency and supports real-time updates.

I. Procedure Workflow

The process begins with user authentication. After logging in, a group is created and members are included. Expenses are recorded, and the system calculates balances instantly. Users can settle payments using UPI, and the system updates the records accordingly.

J. Testing and Validation

The application is tested using different group sizes and expense scenarios. The results are checked to ensure accurate calculations and smooth performance. User feedback is also considered for improving the system.

K. Security Measures

Security is maintained using JWT-based authentication and secure communication between the client and server. Sensitive operations such as login and payment are protected to prevent unauthorized access.

Overall, this methodology combines system design, calculation logic, and real-time processing to provide a reliable solution for managing shared expenses.

L. Settlement Optimization Logic

To improve efficiency, the system reduces the number of transactions required to settle all balances. Instead of multiple users paying each other randomly, the system applies a simplified approach.

First, users are divided into two groups:

- Users who need to pay (negative balance)
- Users who should receive money (positive balance)

Then, the system matches payers with receivers and settles the amounts step by step until all balances become zero. This reduces unnecessary transactions and simplifies the settlement process.

M. Settlement Rule Table

Table 1: Settlement Rule Table

Balance Value	Meaning	Action Required
Balance > 0	User should receive	Wait for payment
Balance < 0	User should pay	Make payment
Balance = 0	Settled	No action required

IV. PROPOSED SYSTEM

The proposed system, EzSettle, is designed to manage shared expenses within a group by combining expense tracking and payment settlement in a single platform. The system follows a client-server architecture to ensure smooth communication between the user interface, processing layer, and external services.

A. System Architecture

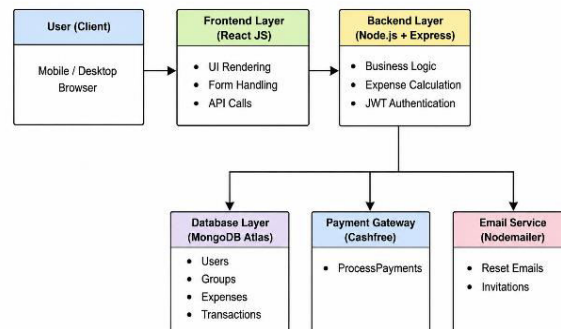


Fig. (1) System Architecture

B. Architecture Description

The system begins with users interacting through a web interface available on both mobile and desktop devices. The frontend, built using React, manages user actions such as creating groups, adding expenses, and viewing balances. It communicates with the backend through API requests to process data. The backend, developed using Node.js and Express, handles core functions like calculations, balance updates, and user authentication using JWT. MongoDB Atlas is used to store user details, group data, expenses, and transaction records, with updates happening in real time. The system also integrates external services, including Cashfree UPI for payments and Nodemailer for email features like password reset and invitations. This overall design helps the system run smoothly while maintaining security and handling operations efficiently.

V. RESULTS

The EzSettle application was tested using group scenarios with 3 to 5 users. The system recorded all expenses correctly and calculated balances automatically without manual input. When different users added expenses, the system displayed the amount each user needed to pay or receive. The UPI payment feature allowed users to complete transactions within the application. After each payment, the system updated balances and stored transaction details. The email functionality was tested for password reset and group invitations. Reset links were sent to registered email addresses, and invitation emails were delivered successfully. The system handled multiple users and expense entries without noticeable delay. Data stored in MongoDB Atlas remained consistent, and all records were retrieved correctly. The interface functioned properly on both desktop and mobile devices.

VI. DISCUSSION

The results of the EzSettle application show that combining expense tracking and payment settlement in one platform improves the user experience. Compared to manual methods or using multiple apps, the system provides a more organised way to manage shared expenses. Automatic balance calculation reduces errors and gives users a clear view of their financial status. The use of a UPI payment gateway makes the settlement process faster and more convenient. Users can complete payments directly within the application without switching between different platforms. This also supports quicker settlements, as users can act immediately after viewing balances. Compared to existing systems, EzSettle overcomes common issues such as a lack of payment integration and limited usability.

Unlike many existing systems discussed in the literature, which focus mainly on expense tracking without integrated payments, EzSettle combines both tracking and settlement in a single platform. Features like email-based password

recovery and group invitations make the system easier to access and use. However, the system depends on internet connectivity and does not yet support advanced features like analytics or multi-currency handling. Overall, EzSettle offers a practical and improved solution for managing shared expenses with better clarity and convenience.

VII. CONCLUSION

This paper introduced EzSettle, a web-based application for managing shared expenses in groups. The system combines expense tracking, automatic balance calculation, and payment settlement in a single platform. It is developed using React, Node.js, and MongoDB Atlas to ensure smooth performance and ease of use. Features such as UPI payments, email-based password recovery, and group invitations improve usability. The results show that the system reduces manual effort, improves transparency, and enables faster settlements.

This makes it useful in real-life situations where multiple people share expenses and need clear financial tracking. In the future, features like advanced analytics, multi-currency support, and better notifications can further enhance the system. Overall, EzSettle offers a practical and reliable solution for real-world group expense management.

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