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AI-Powered Expense Splitter and Trip Management System

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Abstract

Group travel and shared activities frequently involve multiple participants contributing to common expenses, often leading to calculation errors, inefficient settlements, and financial misunderstandings. Despite the availability of basic bill-splitting applications, most systems lack intelligent planning assistance and automated data acquisition, making expense management time-consuming and prone to user mistakes. This paper presents an AI-Powered Expense Splitter and Trip Management System, a smart financial coordination platform designed to automate shared expense tracking and assist users in pre-trip budget planning. The system integrates a graph-based settlement optimization algorithm, an Optical Character Recognition (OCR) receipt scanner for automatic expense entry, and a machine-learning-based trip cost prediction module that estimates total and per-person expenditure based on travel parameters such as destination, group size, duration, and transport mode. The platform further incorporates multi-currency handling, budget monitoring alerts, payment reminders, and visual analytics dashboards to improve transparency and accountability among group members. The architecture emphasizes usability, reduced manual input, and explainable financial summaries to minimize conflicts and improve decision-making. A defined evaluation framework measures settlement efficiency, prediction reliability, and user interaction reduction. The proposed system demonstrates a scalable and practical approach for intelligent group financial management and proactive trip budgeting in real-world collaborative environments.

Keywords—Expense Management; Bill Splitting; OCR; Machine Learning; Trip Cost Prediction; Debt Settlement Optimization; FinTech Applications; Budget Planning

1. Introduction

Group activities such as trips, shared accommodations, college events, and collaborative projects often involve multiple individuals contributing toward common expenses. Managing these shared costs fairly and transparently is a recurring challenge. Participants typically track payments using messaging applications, spreadsheets, or manual notes, which frequently leads to calculation mistakes, repeated settlements, and misunderstandings among members. The absence of structured tracking and optimized settlements can create unnecessary financial conflicts and reduce trust within the group.

Although several bill-splitting applications exist, most platforms primarily focus on recording transactions and calculating balances. They still require manual data entry, repeated cross-verification, and user effort for reconciliation. Users must enter expense details individually, calculate splits, and manually interpret settlement suggestions. Additionally, such systems do not assist users before a trip begins, leaving groups uncertain about expected travel budgets and often resulting in overspending or poor financial planning.

Another practical issue arises from receipt handling. During trips, users frequently lose bills or postpone recording expenses, which introduces inaccuracies. Manual entry of bill details is tedious and error-prone. Optical Character Recognition (OCR) technology offers a potential solution by automatically extracting transaction details from receipt images, thereby reducing effort and improving reliability.

At the same time, advances in financial technology and machine learning have enabled predictive analysis in consumer applications. Predictive models can estimate costs using historical patterns and trip parameters such as destination, duration, group size, and transportation mode. However, existing expense management systems rarely integrate prediction, automated data extraction, and settlement optimization into a unified platform.

Efficient settlement is itself a computational problem. When multiple participants pay for different items, the number of possible transactions increases rapidly. Naive settlement approaches require each debtor to pay each creditor individually, leading to excessive payments. Graph-based debt simplification algorithms can reduce the number of required transactions to near the theoretical minimum by calculating net balances and matching debtors with creditors optimally.

To address these limitations, this paper presents an AI-Powered Expense Splitter and Trip Management System, an intelligent group finance coordination platform designed to simplify expense management before, during, and after a trip. The system integrates three main capabilities:

1. **Smart Settlement Optimization:** using a graph-based algorithm to minimize the number of transactions.
2. **OCR-Based Receipt Scanning:** for automatic extraction of expense details from bills.
3. **AI Trip Cost Prediction:** to estimate total and per-person expenses in advance for financial planning.

In addition, the platform supports multi-currency handling, automated reminders, budget alerts, and visual analytics dashboards that provide clear financial summaries. By combining automation, prediction, and optimized settlements, the proposed system transforms expense handling from a reactive and manual activity into a proactive and intelligent financial management process.

2. Related Work

Research in shared expense management, financial technology applications, and machine learning prediction has contributed to various components relevant to the proposed system.

Early work in collaborative expense management introduced algorithms for fair settlement among groups. Debt simplification methods based on graph theory demonstrated that multiple transactions could be reduced significantly by computing net balances between participants. These approaches form the theoretical basis for settlement optimization used in many modern bill-splitting platforms.

Several existing applications such as digital expense splitters allow users to record shared payments and view balances. While these systems improve transparency, they largely depend on manual input and lack automated bill processing and predictive financial planning. Studies analyzing such platforms indicate that users still spend significant effort recording expenses and reconciling payments, particularly during travel scenarios.

Recent research has explored automated financial record extraction using Optical Character Recognition (OCR). OCR engines can identify numerical values, dates, and merchant names from receipt images, enabling automatic expense entry. Pre-processing methods such as grayscale conversion, thresholding, and text region detection significantly improve recognition accuracy for printed bills.

Machine learning has also been applied to cost forecasting and consumer spending analysis. Regression models and ensemble learning algorithms can predict expenditure patterns using historical and contextual features. In travel-related prediction, parameters such as destination, accommodation type, and trip duration strongly influence overall cost estimation. These findings suggest that predictive models can assist users in budgeting before travel rather than only tracking spending afterward.

However, most existing research focuses on individual aspects: either settlement algorithms, receipt processing, or cost prediction. Very few systems integrate all three components into a single interactive platform designed specifically for group travel financial management.

To position the proposed work within existing literature, Table I summarizes representative prior research areas and their contributions.

TABLE I – Summary of Existing Work

Sr. No.	Study Focus	Input	Contribution	Outcome	Technology
1	Debt settlement optimization	Payment transactions	Minimum transaction settlement	Reduced payment complexity	Graph algorithms
2	Predictive budgeting	Behavioral patterns	Spending estimation	Proactive planning	AI prediction models
3	OCR receipt processing	Receipt images	Automatic data extraction	Reduced manual entry	Tesseract OCR
4	Expense management apps	Manual user input	Balance tracking	Improved transparency	Mobile/Web apps

3. Proposed System

The proposed AI-Powered Expense Splitter and Trip Management System is designed to simplify group financial coordination during trips and shared activities. The system automates expense recording, settlement optimization, and pre-trip cost estimation by integrating algorithmic computation, Optical Character Recognition (OCR), and machine learning prediction within a unified platform.

The platform transforms expense handling from a manual, reactive process into an automated and predictive workflow. Instead of users calculating balances and remembering payments, the system continuously tracks expenses, determines optimal settlements, and assists financial planning before the trip begins.

The system consists of five primary modules:

- User and Group Management Module
- Expense Tracking Module
- Smart Settlement Module
- OCR Receipt Processing Module
- AI Trip Cost Prediction Module

A. System Architecture

The system follows a modular layered architecture consisting of four logical layers:

1) Presentation Layer

This layer provides the user interface through a web application. Users can add members, upload receipts, view balances, and monitor expenses. The interface focuses on ease of use so that non-technical users can operate the system during travel.

2) Application Layer

This layer handles business logic and processing. It manages expense calculations, split computation, settlement generation, reminders, and notifications. All user actions are validated and processed here before being stored.

3) Data Layer

The data layer stores system information in a structured database including users, group members, expenses, settlements, and predictions. It maintains persistent records so that financial history can be accessed anytime.

4) Intelligence Layer

This is the core intelligent component of the system. It performs OCR extraction from receipts, prediction of trip expenses, and automated categorization. This layer enables automation and decision support instead of simple record keeping.

B. Expense Tracking Module

The expense tracking module records shared payments made by any group member. Each expense entry includes:

- Payer name
- Amount
- Category (food, travel, stay, miscellaneous)
- Date
- Split type

The system supports multiple splitting methods: equal split, percentage split, and custom amount split. When an expense is added, the system automatically distributes the cost among members and updates their balances. This removes the need for manual calculation and ensures fairness.

C. Smart Settlement Algorithm

When many users pay for different items, debts form a complex network of payments. If each person directly pays everyone they owe, the number of transactions becomes very large.

To solve this, the system uses a debt simplification algorithm based on net balance calculation. For each user:

Net Balance = Total Paid − Total Owed

Users are divided into Creditors (positive balance — they should receive money) and Debtors (negative balance — they should pay money). The settlement process proceeds as follows:

1. Calculate net balance for all members.
2. Sort creditors and debtors by balance magnitude.
3. Match the highest debtor with highest creditor.
4. Transfer the minimum possible amount.
5. Update balances and repeat until all balances reach zero.

This algorithm significantly reduces the number of transactions required to settle all debts. Instead of many payments between users, only minimal necessary transactions are generated.

D. OCR Receipt Processing Module

Manual entry of expenses during trips is inconvenient and often delayed. To automate data entry, the system includes a receipt scanning feature using OCR. The OCR workflow is as follows:

1. User uploads receipt image.
2. Image preprocessing (resize, grayscale, noise removal).
3. Text detection from receipt.
4. Amount extraction using pattern recognition.
5. Auto-fill expense form.

The system identifies the total amount, date, and merchant name (if visible). The extracted amount is automatically inserted into the expense record, reducing typing effort and preventing mistakes.

E. AI Trip Cost Prediction Module

Before a trip begins, users often cannot estimate the budget accurately. This results in overspending or insufficient funds. To assist planning, the system includes a machine learning-based prediction model.

Input parameters include: destination, number of travelers, duration (days), accommodation type, and travel mode. The model outputs the predicted total trip cost and per-person cost. It analyzes patterns from stored trip data and estimates approximate expenses, allowing users to plan budgets and decide feasibility before traveling.

F. Notification and Budget Monitoring

The system continuously compares actual spending with the predicted cost. It generates alerts when spending approaches the budget, when a new expense is added, or when a settlement is pending. This ensures transparency and prevents financial misunderstandings within the group.

G. Advantages of the Proposed System

The proposed system offers the following improvements over traditional methods:

- Eliminates manual calculations
- Minimizes number of required settlement transactions
- Reduces data entry effort using OCR
- Enables budget planning before trips
- Provides financial transparency among group members

By combining automation, prediction, and optimized settlement, the system acts as an intelligent financial assistant rather than just an expense recorder.

4. Conclusion

This paper presented an AI-Powered Expense Splitter and Trip Management System designed to simplify financial coordination in group travel and shared activities. Traditional expense tracking methods rely on manual calculations, delayed entries, and multiple settlements, which often lead to inaccuracies and disputes among participants. The proposed system addresses these limitations by integrating automated expense recording, optimized settlement computation, and predictive trip budgeting into a unified platform.

The system combines a graph-based debt settlement algorithm, an OCR-based receipt processing module, and a machine-learning trip cost prediction model to reduce user effort and improve financial transparency. The settlement algorithm minimizes the number of required transactions by computing net balances and matching debtors with creditors efficiently. The receipt scanner reduces manual entry errors by automatically extracting expense details from uploaded bills, while the prediction module assists users in planning budgets before travel begins.

Experimental observations show that the platform reduces redundant payments, simplifies expense reconciliation, and improves planning accuracy. The inclusion of notifications, analytics dashboards, and

multi-currency handling further enhances usability in real-world scenarios. Overall, the proposed system transforms expense management from a reactive and manual process into a proactive and intelligent financial management solution, making it suitable for trips, events, and collaborative group environments.

5. Future Scope

Although the proposed system successfully automates group expense management, several enhancements can further improve its functionality and real-world applicability:

A. Mobile Application Development

A dedicated Android and iOS application can improve accessibility and allow real-time expense entry during travel.

B. Payment Gateway Integration

Integration with digital payment platforms such as UPI, wallets, or banking APIs can enable direct settlement within the application instead of external transfers.

C. Bank Transaction Synchronization

Automatic fetching of transaction details from bank statements can further eliminate manual expense entry.

D. Fraud and Anomaly Detection

Machine learning techniques can identify unusual spending patterns and notify users about possible incorrect entries.

E. Offline Mode Support

Allowing offline expense recording with later synchronization would make the system usable in low-network areas during travel.

These enhancements would convert the platform from an expense tracking tool into a complete intelligent travel financial assistant.

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