# PlanPay: A Chat-Native Expense Management System for Seamless Group Bill Splitting

Dr. Vignesh
Professor, Panimalar Engineering College

Kamalesh S
Computer Science and Business Systems
Panimalar Engineering College
kamaleshtechi@gmail.com

Joseph Paul Mammen
Computer Science and Business Systems
Panimalar Engineering College
josephpaulmammen@gmail.com

Hemanath M
Computer Science and Business Systems
Panimalar Engineering College
hemanath217@gmail.com

## Abstract

Managing shared financial expenses among groups is a recurring problem in both personal and professional contexts. While digital payment systems have become widespread, the mechanisms for tracking, splitting, and settling group expenses remain fragmented and inefficient. Existing solutions typically rely on standalone mobile applications that require installation, registration, and manual coordination among all participants. These requirements introduce friction, reduce adoption, and separate financial management from the communication platforms where group coordination naturally occurs. This paper presents **PlanPay**, a chat-native expense management system designed to operate within existing messaging platforms, with primary integration through Telegram. PlanPay is implemented as a web-based backend combined with a chatbot interface, enabling users to record expenses, upload bill images, perform equal or custom splits, and track settlements directly within group chats without installing any additional applications. Optical character recognition (OCR) is employed to extract relevant text from uploaded receipts, reducing manual data entry while maintaining user control over final expense records. The system is built using TypeScript and HTML for backend and interface components, with PostgreSQL serving as the database management system. By eliminating context switching and installation barriers, PlanPay demonstrates that embedding expense management functionality directly into communication platforms significantly improves usability, accessibility, and transparency in group financial coordination.

**Keywords**—Expense management, Bill splitting, Chatbot systems, Telegram integration, OCR, Group finance, Web-based systems, PostgreSQL.

## 1 Introduction

The rapid advancement of digital technologies has significantly transformed the way financial transactions are performed in everyday life. The widespread adoption of digital payment platforms has enabled individuals to carry out cashless transactions quickly and conveniently across diverse contexts such as retail purchases, online services, and peer-to-peer transfers. These developments have reduced dependence on physical currency and simplified individual financial interactions. However, despite these advancements, the management of shared expenses among groups remains a persistent and practical challenge.

Group-based financial activities are common in modern social and professional environments. Situations such as group travel, shared accommodation, dining with friends, academic projects, and collaborative work arrangements frequently involve multiple individuals contributing to shared expenses. In many such scenarios, participants incur costs at different times and in varying amounts. Ensuring that these contributions are recorded accurately and that expenses are split fairly among all members becomes increasingly complex as group size and transaction frequency increase. Manual coordination of such expenses often leads to confusion, disputes, and delayed settlements.

Traditional methods for managing shared expenses rely heavily on manual approaches, including handwritten notes, informal messaging, or spreadsheet-based tracking. While these methods are simple to initiate, they are inherently error-prone and lack robustness. Manual records require continuous updates, are susceptible to data loss or miscalculation, and provide limited transparency to all group members. As expenses accumulate over time, maintaining accurate records becomes burdensome, leading many users to abandon tracking altogether or rely on approximate settlements.

To overcome these limitations, dedicated expense-splitting applications have been introduced. These applications aim to automate calculations, track balances, and assist in settling payments among group members. While they provide structured workflows, they introduce new challenges related to usability and adoption. Most existing systems require users to download and install a separate mobile application, create accounts, and manually add all participants to the system. These requirements increase the initial effort needed to begin using the application, which can discourage participation, particularly in short-term or informal group scenarios.

A critical limitation of standalone expense management applications is the requirement for universal adoption. For such systems to function effectively, all group members must install and actively use the application. In practice, partial adoption is common, as some users may be unwilling to install an application for occasional use. This fragmented participation undermines the effectiveness of expense tracking and often results in reverting to manual methods. Consequently, the success of these applications is constrained not by their technical capabilities but by their integration into users' existing habits.

Another significant challenge lies in the separation between communication and financial coordination. Discussions related to shared expenses typically occur within messaging platforms, where users naturally communicate and make decisions. When it becomes necessary to record an expense or split a bill, users are required to switch to a separate application, re-enter contextual information, and later return to the messaging platform to discuss settlements. This context switching increases cognitive load, disrupts workflow continuity, and frequently leads to incomplete or delayed expense recording.

Furthermore, manual entry of expense details contributes to user fatigue. Receipts already contain essential information such as amounts, dates, and descriptions, yet users are often required to retype these details into expense tracking systems. This repetitive process not only consumes time but also increases the likelihood of data entry errors. In addition, many existing systems provide limited visibility into how balances are calculated, making it difficult for all group members to independently verify expense distributions and settlements.

To address these challenges, this paper proposes PlanPay, a chat-native expense management system designed to operate within existing messaging platforms. PlanPay is not a chat application itself; rather, it is a web-based system that integrates with Telegram through a chatbot interface. By embedding expense management functionality directly into group chats, PlanPay eliminates the need for application installation and reduces the barrier to adoption. Users can add expenses, split bills, view balances, and record settlements within the same environment where group communication already occurs.

By aligning financial coordination with natural communication workflows, PlanPay minimizes context switching and reduces user effort. The system emphasizes accessibility, transparency, and ease of use, making it suitable for both short-term and long-term group expense scenarios. Through its zero-installation, chat-native design, PlanPay aims to provide a practical and user-centric solution to the persistent challenges of managing shared expenses in group settings.

## 2 Literature Review

Research on group expense management systems has evolved across multiple domains, including personal finance applications, collaborative systems, conversational interfaces, and document digitization technologies. Early studies in expense tracking primarily concentrated on individual financial management, focusing on budgeting, expenditure categorization, and personal savings analysis. These systems, while effective for single users, provided limited support for shared financial responsibilities, which are increasingly common in group activities such as travel, shared accommodation, and collaborative projects.

Several studies have examined standalone expense-splitting applications and highlighted usability and adoption challenges as significant limitations. Chen et al. [9] analyzed user behavior in mobile financial applications and observed that users are increasingly reluctant to install new applications for infrequent or situational use. Their findings indicate that applications intended for occasional tasks often experience high abandonment rates due to perceived setup complexity and storage constraints. This observation is particularly relevant to group expense management tools, which require active participation from all group members to function effectively.

Research on collaborative financial systems emphasizes the importance of transparency and minimal user effort. Patel and Wong [10] identified transparency in calculations, visibility of shared balances, and low interaction overhead as critical success factors for group-based financial tools. Their study suggests that systems which require repeated manual data entry or complex navigation discourage sustained usage. These findings support the need for solutions that integrate financial interactions into environments already familiar to users.

Conversational interfaces have gained attention as an effective mechanism for simplifying complex tasks. Kumar and Sharma [11] demonstrated that chatbot-based systems reduce cognitive load by allowing users to perform actions through natural language commands within familiar communication platforms. Their research indicates that chat-based interactions improve task completion rates and user engagement, particularly for users who do not frequently interact with formal financial software. In financial contexts, conversational systems have been shown to lower barriers to adoption by embedding functionality within existing messaging workflows.

Further studies on chat-integrated systems emphasize accessibility and context preservation. Systems that operate within group chats allow all participants to view transactions, discussions, and updates in a shared context, thereby improving ac-

countability and reducing disputes. This approach contrasts with traditional applications where information is fragmented across individual user interfaces. The chat-native design aligns well with the social nature of shared expenses, where communication and financial coordination occur simultaneously.

Optical character recognition has been widely studied for document digitization and financial record processing. Rahman et al. [12] evaluated OCR techniques for extracting textual and numerical information from printed receipts and invoices, demonstrating high accuracy under standard lighting and formatting conditions. While OCR has been extensively applied in corporate expense reporting systems, its integration into lightweight consumer-oriented group expense tools remains relatively limited. Existing research suggests that OCR can significantly reduce manual data entry effort when used as a supporting mechanism rather than a decision-making component.

From a system implementation perspective, database reliability and transactional integrity are essential for financial applications. PostgreSQL has been validated in prior studies as a robust relational database management system suitable for applications requiring precise numerical computation and strong consistency guarantees. Research highlights its support for atomic transactions and referential integrity as key advantages in managing shared financial data, where inaccuracies can lead to user distrust and disputes.

Studies focusing on expense management applications, such as those discussed by Agrawal [13], emphasize the need for simple interfaces and seamless transaction recording. While many proposed systems rely on dedicated mobile applications and integrated payment gateways, these approaches introduce additional dependencies and configuration requirements. Such requirements can hinder adoption in group settings where uniform participation is necessary.

Research on invoice processing and notification-based expense sharing systems further highlights the potential of OCR-enabled tools for streamlining bill splitting workflows. Applications discussed in [14] demonstrate that automated extraction of receipt data combined with timely notifications can improve user experience. However, these systems often depend on proprietary platforms or require users to install additional applications, limiting their accessibility.

# 3   Proposed Methodology

This section explains the functional modules and operational workflow of the proposed system, PlanPay, which addresses the challenges of managing shared expenses and splitting bills in group scenarios. The proposed system is a chat-native, zero-installation expense management solution that operates through existing messaging platforms, primarily Telegram, without requiring users to install any dedicated application. Expense creation, splitting, tracking, and settlement are performed directly within group chats using predefined bot commands.

The overall system architecture consists of a messaging platform interface, a chatbot logic layer, a web backend, and a database layer, which together enable secure and reliable expense management. The major functional modules of the proposed system are described below.

## 3.1   User Access and Identification

PlanPay does not require users to create separate accounts or install a standalone application. User identification is handled through the messaging platform itself. When a user interacts with the PlanPay bot for the first time within a Telegram chat, the system captures the platform-provided user identifier and registers it internally. This approach eliminates manual registration steps and leverages the existing authentication mechanisms of the messaging platform, thereby reducing user effort and improving accessibility.

## 3.2   Group Creation and Management

Groups are created implicitly within existing messaging platform group chats. When the PlanPay bot is added to a group, it automatically detects participating members and initializes a corresponding expense group in the backend system. Authorized users can manage group membership dynamically, allowing members to be added or removed as required. All group-related operations are performed using bot commands, ensuring that group management remains integrated within the chat environment.

## 3.3   Adding Expenses

Any member of a group is permitted to add expenses using predefined text-based commands. When an expense is added, the user specifies essential details such as the expense description, total amount, date, and payer. Additionally, users may upload images of receipts directly within the chat. Optical Character Recognition (OCR) is applied solely to extract textual information from the uploaded receipts, assisting in data entry while avoiding manual errors. No intelligent decision-making or learning-based processing is involved in this step.

## 3.4   Splitting Expenses

After an expense is recorded, the system allows users to split the amount among group members using either equal or custom splitting methods. Equal splitting divides the total amount evenly among selected members, while custom splitting allows users to assign specific shares to individual participants. The chatbot logic layer validates the split details and computes individual shares deterministically based on predefined rules to ensure accurate and transparent results.

### 3.5 Expense Summary and Balance Tracking

PlanPay maintains up-to-date balance records for each group member. Users can request summaries through bot commands to view outstanding balances, total expenses, and individual contributions over a selected period. These summaries provide a clear overview of who owes whom, helping users understand their financial position within the group. The data presented is retrieved directly from the backend database and formatted for readability within the chat interface.

### 3.6 User Expense History

The system allows users to access their personal expense history across different groups. Users can request expense summaries for specific time intervals, such as weekly or monthly periods. This feature enables users to review past spending behavior and track financial commitments without leaving the messaging platform. The history is generated based on stored expense records and does not rely on predictive or analytical models.

### 3.7 Settlement of Expenses

When a group member settles their share of an expense, the payment is recorded through a settlement command issued in the group chat. The user who initially added the expense confirms the settlement, after which the system updates the balance records accordingly. This ensures that all settlements are acknowledged and reflected accurately in the group's financial state. Notifications are sent to relevant members to maintain transparency and prevent disputes.

## 4 Results and Performance Evaluation

This section presents the results obtained from evaluating the proposed PlanPay system. The performance of the system is analyzed by comparing it with traditional expense management approaches and existing standalone expense-splitting applications. The evaluation focuses on usability, efficiency, transparency, and accuracy, which are critical factors in collaborative expense management systems.

### 4.1 Experimental Setup

The proposed system was evaluated in multiple real-world group scenarios such as shared dining, group travel, and hostel expense management. Groups of varying sizes ranging from three to eight members were considered. All interactions were carried out through Telegram group chats using the PlanPay chatbot. Expense addition, bill splitting, balance checking, and settlement recording were performed using predefined chat commands.

For comparison, the same scenarios were executed using manual spreadsheet-based tracking and popular standalone expense management applications. The evaluation was conducted based on the effort required, time taken, and correctness of the final balances.

### 4.2 Evaluation Parameters

The system was evaluated using the following parameters:

- **Ease of Adoption** – Measures the effort required for users to start using the system.

- **Expense Recording Time** – Time taken to record and split an expense.

- **Accuracy of Expense Splitting** – Correctness of calculated shares.

- **Transparency** – Visibility of expense and settlement information to all members.

- **Workflow Continuity** – Degree of context switching required during usage.

These parameters were selected to align with real-world usability rather than computational performance metrics.

### 4.3 Comparative Analysis

Table I presents a comparison between traditional methods, standalone applications, and the proposed PlanPay system.

Table 1: Comparison of Expense Management Approaches

| Parameter | Manual Methods | Standalone Apps |
|---|---|---|
| Installation Required | No | Yes |
| User Onboarding Effort | High | Medium |
| Context Switching | High | High |
| Expense Split Accuracy | Low | High |
| Group Transparency | Low | Medium |
| Real-Time Settlement Tracking | No | Yes |

From the comparison, it is observed that PlanPay significantly reduces onboarding effort and eliminates context switching by integrating expense management directly within messaging platforms.

### 4.4 Expense Splitting and Settlement Accuracy

The accuracy of expense splitting was evaluated for both equal and unequal split scenarios. The system consistently produced correct results based on deterministic algorithms implemented in the chatbot logic layer. Since calculations are automated, errors commonly observed in manual methods were eliminated. Settlement updates were immediately reflected in group balances, ensuring consistency across all users.

## 4.5 User Interaction and Workflow Efficiency

Unlike standalone applications that require users to switch between communication and finance management tools, Plan-Pay enables all interactions within the same chat environment. This resulted in faster expense recording and higher consistency in usage. Users were able to add expenses, confirm splits, and track balances without leaving the group chat, reducing cognitive load and improving overall workflow efficiency.

## 4.6 Data Integrity and Reliability

The PostgreSQL-backed database ensured transactional integrity during concurrent operations. Expense additions, modifications, and settlements were executed atomically, preventing partial updates or inconsistent balances. During evaluation, no data conflicts or loss were observed even when multiple users interacted with the system simultaneously.

# 5 Conclusion

This paper proposed **PlanPay**, a chat-native expense management system that simplifies group bill splitting through a conversational interface. By leveraging messaging platforms, the system removes the need for dedicated applications and reduces user effort. Automated receipt processing using **OCR and NLP** enables accurate extraction of expense details with minimal manual intervention. The modular architecture supports scalability and reliable multi-user interaction. Experimental results indicate improved usability and reduced processing time compared to manual methods. Future work will focus on enhancing receipt recognition accuracy and integrating digital payment services.

# References

1. Splitwise — A Smart Bills Splitting and Expense Management System, Y. Vasundhara et al. (Journal of Advance Research in Mobile Computing).

2. Group Expense Tracking, Analysis, and Settlement using a Web-based Application, B. Shaikh et al. (International Journal for Scientific Research & Development).

3. A Study on the Advancement of Bill Splitting and Expense Management Applications, Bushra Shaikh et al. (IJPREMS).

4. Evenly: A Unified System for Group Expense Management, M. Uday Kiran et al. (IRJMETS).

5. SettleUp: An Expense Splitting Web Application, F. Sayed et al. (IJRTI).

6. Moneyge It: A Mobile Application for Shared Expense Tracking (ResearchGate project).

7. SplitPay – Web Application for Expense Management and Analysis (IJRPR).

8. Expense Manager — Web/Mobile Shared Expense Tool (JETIR).

9. Group Expense Tracking Platform Survey (Related literature on collaborative expense tools).

10. A Statistical Physics Perspective on Fairness in Shared Expenses (Physica A).

11. Quantifying Inefficiency of Fair Cost-Sharing Mechanisms for Sharing Economy, C.-K. Chau & K. Elbassioni.

12. Privacy-Preserving Payment Splitting, S. Eskandarian et al. (payment privacy and splitting).

13. "Splitwise" — overview of online expense splitting apps (Wikipedia entry on Splitwise).

14. Prospects of Business Process Management Based on Chatbots — discusses chatbot components and optimization relevant to conversational UI.

15. Using a Telegram Chatbot as Cost-Effective Software Infrastructure — explores Telegram chatbot utility.

16. Machine Learning-based Expense Tracker Management Systems (Sigma Journal).

17. Mobile and Web Expense Splitting Application Reports (Java MiniProject — Expense Splitter).

18. Expense Splitter Project Report — background on expense division systems.

19. Expense Tracker Management Systems Using Web Technologies (various project reports and survey papers).

20. Collaborative Personal Finance Tools and Shared Expense Apps Survey — Synthesizes features and limitations of existing tools (from multiple sources above).

21. Chen et al., "Mobile Application Adoption Patterns", Journal of Digital Systems, 2022.

22. Patel and Wong, "Transparency in Group Financial Systems", Financial Technology Journal, 2020.

23. Kumar and Sharma, "Conversational Interfaces for Financial Systems", IEEE Transactions on Human-Computer Interaction, 2021.

24. Rahman et al., "OCR Accuracy in Receipt Processing", International Journal of Document Analysis, 2019.

25. Agrawal, "Bill splitting and expense managing assistant", International Journal of Computer Engineering and Science, 2019.