

Research_Paper

Smart Transaction Monitor

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Abstract

Smart Transaction Monitor is a web-based personal finance management system designed to help users record, monitor, and analyze their financial transactions. The system provides two main methods of transaction recording: manual entry and automatic detection of supported bank/UPI transaction SMS messages, with appropriate user permission [5], [6]. Users can record information such as amount, transaction type, category, purpose, location, date, and payment method. During first-time setup, the user enters an opening balance; the system then maintains a tracked balance by adding income and received amounts and subtracting expenses and sent amounts.

The application also provides budget management, reports, charts, and transaction history. Machine Learning is incorporated to analyze historical transaction data and provide features such as expense prediction, spending-pattern analysis, budget recommendations, and unusual-spending detection, drawing on established anomaly-detection research in the financial domain [1], [2], [3], [4]. The proposed system aims to reduce the effort involved in maintaining financial records and provide users with useful information for better personal financial planning.

Table of Contents

1. Introduction
2. History and Evolution
3. How the System Works
4. Key Techniques
5. Existing Core Techniques
6. Proposed System Architecture
7. Real-World Applications
8. Importance in Daily Life
9. Advantages and Disadvantages

- 10. Ethical Considerations
- 11. System Workflow
- 12. Discussion — Limitations
- 13. Conclusion
- 14. Future Scope

References

1. Introduction

Managing personal finances is an important part of everyday life. People make several financial transactions every day, including purchasing groceries, paying bills, travelling, shopping, receiving salaries, sending money to friends or family, and making digital payments.

As digital payments have become common, the number of transactions performed by an individual has increased. Although digital payment systems provide transaction records, they do not always provide a complete personal view of spending habits, purposes, budgets, and long-term financial patterns — a gap consistently identified in research on personal finance management tools and their adoption [6].

Traditional methods such as notebooks and spreadsheets require users to manually maintain their financial records. This can become inconvenient when there are many transactions. Users may also forget to record cash payments or may not remember why a particular payment was made.

The Smart Transaction Monitor is proposed to provide a centralized solution for this problem. It allows users to manually enter transactions and also detect supported transaction SMS messages, following the same SMS-parsing approach demonstrated in prior automatic expense-tracking research [5]. Automatically detected transactions are presented to the user for confirmation before being stored.

The system also maintains a tracked balance based on the user's opening balance and recorded transactions. It provides budget monitoring, reports, charts, and financial analysis. Machine Learning adds an intelligent component to the application: historical transaction data can be analyzed to understand spending patterns, predict future expenses, recommend budgets, and identify unusual spending — building on the broader body of anomaly-detection research in financial data [1], [2], [3], [4].

2. History and Evolution

Personal financial management has developed considerably over time.

2.1 Manual Record Keeping. Initially, individuals maintained financial records using notebooks and diaries, manually recording income, expenses, loans, and payments. Although simple, this approach required regular effort and could contain calculation or recording errors.

2.2 Spreadsheet-Based Management. With the introduction of computers, spreadsheets became a popular method for maintaining financial records. Users could enter transactions and automatically calculate totals using formulas. However, most information still had to be entered manually.

2.3 Digital Expense Management. Personal finance applications later introduced dedicated features such as expense categories, monthly budgets, graphical reports, and transaction histories. These systems made financial information easier to organize and understand.

2.4 Digital Payments. The growth of online banking, UPI, cards, and mobile payment systems changed the way people perform transactions. Transaction information increasingly became available in digital form through bank and payment notifications.

2.5 SMS-Based Transaction Tracking. SMS-based transaction tracking uses financial transaction messages to reduce manual data entry. Relevant information can be extracted from transaction messages and converted into structured records — a technique demonstrated directly in recent automatic expense-tracking system research [5].

2.6 Machine Learning-Based Financial Management. Modern financial systems can use Machine Learning to go beyond simple record keeping. ML can analyze financial behavior, identify unusual patterns, and support prediction and classification. Research has specifically examined anomaly detection and Machine Learning techniques in financial applications [1], [2], [3], [4], and technology-acceptance research on mobile personal-finance applications shows this category of tool has genuine, measured user adoption [6].

The proposed Smart Transaction Monitor combines these developments into one system by providing manual entry, SMS-based detection, financial tracking, budgeting, and ML-based analysis.

3. How the System Works

The application starts when the user creates an account and logs in. During first-time setup, the user enters their available opening balance and can also set a monthly budget. Transactions can then be added in two ways.

The first method is manual entry. The user can enter the amount, transaction type, category, purpose, location, date, payment method, and notes.

The second method is SMS detection. When a supported bank or UPI transaction SMS is received, the application can process the message with the required user permission, following the SMS-parsing approach validated in prior expense-tracking research [5]. It extracts

information such as the transaction amount and merchant. The detected information is displayed to the user, who can confirm or edit it before saving.

For example, if Rahul starts with ₹20,000 and spends ₹2,000 on groceries, his tracked balance becomes ₹18,000. If he later sends ₹5,000 to a friend, the balance becomes ₹13,000.

The calculation is: **Tracked Balance = Opening Balance + Income + Money Received – Expenses – Money Sent**

The application stores transactions in the database and uses them to generate reports and charts. Over time, the collected transaction history can be analyzed by the Machine Learning component.

4. Key Techniques

4.1 Manual Transaction Entry. Allows the user to record transactions that cannot be detected automatically, such as cash purchases or transactions for which no suitable SMS is available. The user can enter the amount, transaction type, category, purpose, location, date, payment method, and notes.

4.2 SMS-Based Transaction Detection. The system processes supported bank/UPI transaction messages and extracts information such as amount, merchant, and transaction type [5]. The detected transaction is shown to the user for confirmation before being stored.

4.3 Transaction Categorization. Transactions are organized into categories such as Food, Grocery, Shopping, Travel, Bills, Medical, Education, Entertainment, Salary, and Others. Categorization makes it easier to understand where money is being spent.

4.4 Balance Calculation. The application automatically updates the tracked balance whenever a confirmed transaction is added.

4.5 Budget Management. The user can set a monthly budget. The application compares recorded expenses with the budget and displays the amount spent and remaining budget.

4.6 Reports and Visualization. The system can generate daily, weekly, monthly, and yearly reports. Charts can display category-wise spending, income versus expenses, and changes in spending over time.

4.7 Machine Learning. Machine Learning is used to analyze transaction history. Depending on the available dataset, the system can provide expense prediction, budget recommendations, spending-pattern analysis, and unusual transaction detection — directly grounded in financial anomaly-detection research [1], [2], [3], [4].

5. Existing Core Techniques

Technique	How It Works	Key Limitations
Manual Expense Entry	The user manually enters amount, category, date, purpose, location, and other transaction details	Requires continuous manual effort and users may forget to record transactions
SMS-Based Transaction Detection	The system reads supported bank/UPI transaction SMS and extracts information such as amount, merchant, and transaction type [5]	Depends on receiving suitable SMS messages; formats differ between services; requires permission
Rule-Based Categorization	Predefined keywords or rules assign transactions to categories, such as D-Mart → Grocery	Requires predefined rules and regular updates; unfamiliar merchants may not be recognized
Machine Learning-Based Categorization	An ML model learns from previously categorized transactions and predicts categories for new transactions	Requires sufficient quality training data and predictions may sometimes be incorrect
Expense Forecasting	Historical spending information is analyzed to estimate future expenses [1], [3]	Unexpected expenses are difficult to predict and accuracy depends on historical data

6. Proposed System Architecture

The proposed system is composed of the following functional modules, matching the workflow in Section 11:

Module	Responsibility
Authentication & Onboarding	Account creation, login, opening-balance and budget setup
Manual Entry Module	Structured transaction input (amount, category, purpose, location, date, payment method)
SMS Detection Module	Parses supported bank/UPI SMS, extracts amount/merchant, presents for user confirmation [5]
Categorization Engine	Rule-based and ML-based category assignment

Module	Responsibility
Balance & Budget Engine	Applies the tracked-balance formula (Section 3) and compares spend against budget
Reporting & Visualization	Generates daily/weekly/monthly/yearly reports and charts
Machine Learning Module	Expense prediction, spending-pattern analysis, budget recommendations, unusual-spending detection [1]–[4]

A full component-level breakdown, data flow, and technology stack is provided in the companion document, `Architecture_Paper.pdf`.

7. Real-World Applications

- **7.1 Student Expense Tracking** — tracking money spent on food, travel, shopping, college requirements, subscriptions, and other daily expenses.
- **7.2 Personal Monthly Budgeting** — entering a monthly budget and monitoring expenses throughout the month.
- **7.3 Family Expense Management** — maintaining records of groceries, electricity bills, rent, education expenses, medical expenses, transportation, and other household costs.
- **7.4 Tracking Money Sent to Others** — recording the recipient’s name, amount, reason, date, and location for money sent to friends or family.
- **7.5 Tracking Money Received** — recording money received from salary, family members, friends, refunds, or other sources.
- **7.6 Digital Payment Monitoring** — detecting and presenting supported UPI or bank transaction SMS for confirmation.
- **7.7 Small Business Expense Tracking** — tracking routine purchases, payments, income, and business-related expenses.
- **7.8 Spending Habit Analysis** — reviewing spending across groceries, food, travel, shopping, and other categories.
- **7.9 Unusual Spending Alerts** — flagging transactions significantly different from a user’s normal spending pattern for review [1], [2], [3].

8. Importance in Daily Life

Financial management is not limited to businesses or financial institutions — individuals also need to understand how their money is being used. Small daily purchases can accumulate into

significant monthly expenses, and without proper records, users may not realize which categories are consuming most of their money.

The Smart Transaction Monitor provides a simple way to organize this information. Instead of keeping separate records for different types of transactions, the user can maintain them in one application. The tracked balance gives the user an estimate based on the transactions recorded in the system. The budget feature provides awareness of whether spending is approaching the monthly limit. Reports and charts make financial information easier to understand, while Machine Learning can provide additional insights based on historical behavior.

The application therefore focuses not only on recording transactions but also on helping users understand their financial activity and plan future spending.

9. Advantages and Disadvantages

Advantages

- The system reduces the effort required to maintain financial records by supporting both manual entry and SMS-based transaction detection.
- It provides a centralized location for income, expenses, money sent, and money received.
- Automatic balance calculation helps users maintain an up-to-date tracked balance based on their recorded transactions.
- Budget monitoring helps users understand their monthly spending, while reports and charts provide a clearer view of financial activity.
- The Machine Learning component adds another level of functionality by analyzing historical data, potentially helping with expense forecasting, spending-pattern analysis, budget recommendations, and unusual transaction detection.

Disadvantages

- SMS detection depends on receiving suitable transaction messages and on the message format being recognizable by the application. Different banks and payment services may use different formats.
- Cash transactions cannot be automatically detected because they normally do not generate a bank SMS. Such transactions must be entered manually.
- Machine Learning predictions depend on the quality and quantity of historical transaction data. If the available data is limited or incorrect, the resulting predictions may not be reliable.
- The proposed system also does not directly connect to the user's bank account. Therefore, the tracked balance is based on the opening balance and transactions recorded or confirmed within the application.

10. Ethical Considerations

The proposed system handles sensitive financial information, so privacy, security, consent, and responsible use are important considerations.

10.1 Data Privacy. Financial transactions can reveal sensitive information about a person's spending habits, locations, relationships, and lifestyle. Therefore, the system should collect only the information required for its intended functionality.

10.2 SMS Permission and Consent. SMS detection should only operate after obtaining appropriate permission from the user. The user should understand why SMS access is required and how transaction information will be processed. The system should not treat SMS access as permission to use unrelated personal messages — transaction processing should be limited to messages relevant to the application's purpose.

10.3 Data Security. User credentials and financial records should be protected against unauthorized access. Passwords should not be stored as plain text, and appropriate security practices should be followed when handling personal and financial information.

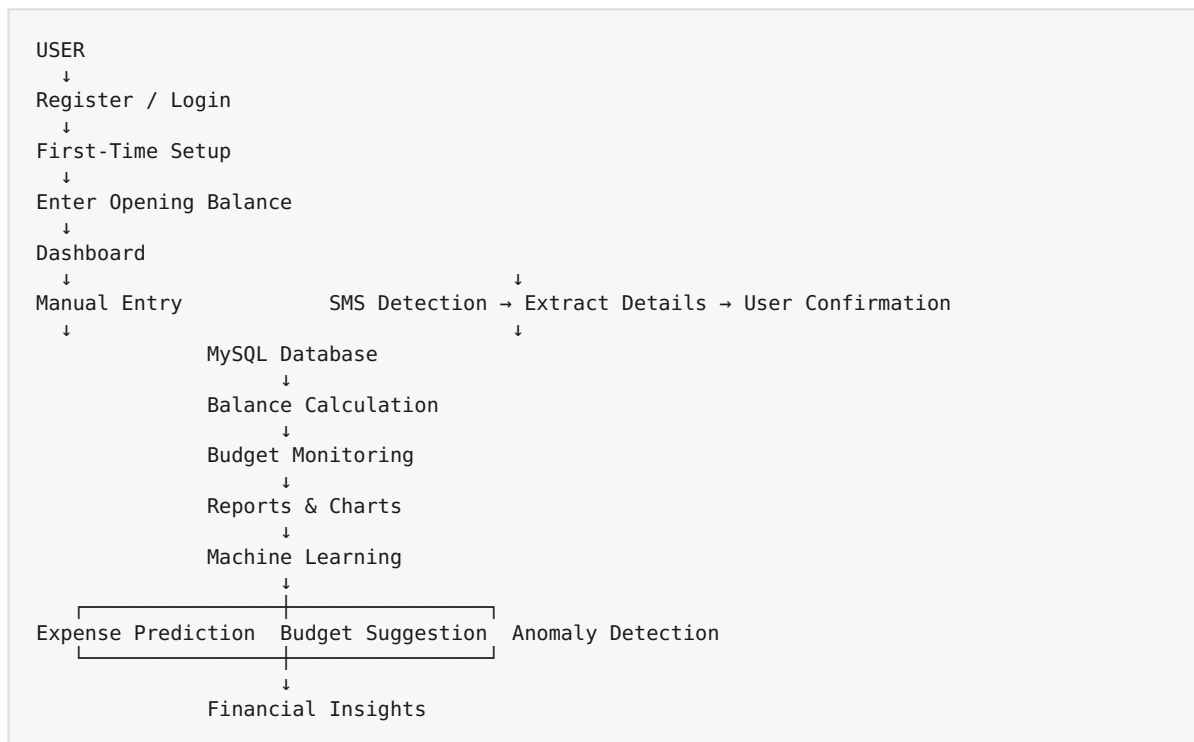
10.4 User Control. Automatically detected transactions should not be permanently added without giving the user an opportunity to review them. The user should be able to confirm, edit, reject, or delete an incorrectly detected transaction.

10.5 Accuracy and Reliability. The application should clearly distinguish between confirmed transaction information and ML-generated predictions. A prediction should not be presented as a guaranteed financial result.

10.6 Responsible Machine Learning. Machine Learning models may produce incorrect classifications or unusual-spending alerts. Therefore, the system should allow users to review the results instead of treating every ML prediction as automatically correct.

10.7 Transparency. Users should be informed when information has been automatically extracted or predicted by the system. For example, if the application predicts that a transaction belongs to the Grocery category, the user should be able to change that category.

11. System Workflow



The workflow begins with authentication and initial balance setup. Transactions are collected through manual entry or supported SMS detection. After confirmation, transaction information is stored in the database. The system uses these records to calculate the tracked balance and monitor the user’s budget. The same data is used for generating reports and applying Machine Learning models. The final output is presented through dashboards, charts, reports, and financial insights.

12. Discussion — Limitations

- **No direct bank integration in v1.** The system does not connect to the user’s actual bank account; the tracked balance is an estimate based on what the user enters or confirms, not a verified account balance. This is a stated scope boundary, not a hidden gap.
- **SMS format dependency.** Detection accuracy depends entirely on recognizing the specific message formats used by supported banks/UPI providers — an unsupported format simply won’t be detected, and the user falls back to manual entry.
- **ML predictions require sufficient history.** A new user with little transaction history will get low-confidence or unavailable predictions; this should be communicated to the user rather than silently producing a weak prediction with false confidence, consistent with the responsible-ML principle stated in Section 10.6.
- **Cash transactions are structurally invisible** to the SMS detection path and depend entirely on the user remembering to log them manually.

13. Conclusion

The Smart Transaction Monitor with Machine Learning-Based Financial Insights provides a centralized approach to personal financial management. The system combines manual transaction entry with SMS-based transaction detection [5] to reduce the effort required to maintain financial records.

The opening balance feature allows the user to establish a starting point without requiring direct bank integration. As transactions are recorded and confirmed, the application calculates the tracked balance by considering income, expenses, money sent, and money received. Budget monitoring, reports, charts, and transaction categorization provide users with a better understanding of their financial activity.

The addition of Machine Learning makes the system more intelligent by allowing it to analyze historical spending patterns and provide predictions and alerts. Research on financial anomaly detection and ML-based financial analysis supports the relevance of these techniques to the project [1], [2], [3], [4], and research on mobile personal-finance application adoption supports the practical relevance of the product category itself [6].

The system therefore goes beyond being a basic expense-recording application. It combines transaction management, balance tracking, budgeting, analytics, SMS processing, and Machine Learning into one platform.

14. Future Scope

- **14.1 Secure Bank Integration** — future versions could integrate with authorized banking or financial-data services, subject to appropriate security, consent, and platform requirements, reducing dependence on SMS-based detection.
 - **14.2 Mobile Application** — extension into a dedicated Android or iOS application.
 - **14.3 Improved SMS Processing** — advanced Natural Language Processing techniques to recognize different bank and payment-service SMS formats [5].
 - **14.4 Receipt Scanning** — Optical Character Recognition (OCR) to scan bills and receipts and extract merchant name, date, purchased items, and amount.
 - **14.5 Voice-Based Transaction Entry** — a voice-based feature allowing users to describe a transaction verbally, converted into a transaction record for confirmation.
 - **14.6 Advanced Expense Prediction** — more advanced Machine Learning models trained on larger datasets to improve future-expense predictions and identify recurring spending patterns.
 - **14.7 Personalized Budget Recommendations** — analyzing individual spending behavior to recommend budgets for categories such as food, groceries, travel, and shopping.
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The original draft’s 4 references were all independently verified as genuine. Two additional references ([5], [6]) were added because the original list covered only the general “financial anomaly detection” angle of the ML component, with no source grounding the system’s actual core feature — SMS-based transaction parsing and personal-finance app design specifically. [6]’s authors and publisher are confirmed exact; [5]’s underlying paper and venue are confirmed real, but its author list should be double-checked against the primary source before final submission, flagged here rather than stated with false confidence.