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Moneymate: A Smart Solution For Simplified Personal Finance Management

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Abstract: In the digital era, individuals increasingly rely on mobile applications to handle financial tasks; however, many struggle with fragmented systems that require manual entry and provide limited insight. This paper reviews two IEEE research works,:"Unveiling Financial Insights: The Daily Expense Tracker System Approach" and "Expense Management System"and proposes MoneyMate, a smart, automated mobile platform for expense tracking and budgeting. The system integrates machine learning and data visualization to offer users a simplified view of their spending habits, while maintaining privacy and security. This paper discusses the literature, methodology, results, and future work of MoneyMate as a research-oriented mini-project under VTU.

Index Terms— Personal Finance, Expense Tracking, Budget Management, Data Analytics, Mobile Application.

I. Introduction

The digitalization of payments, including UPI, e-wallets, online marketplaces, and contactless payments, has transformed the way everyday financial exchanges are conducted. While digital payments enable convenience, they have also dispersed transaction records across many platforms and often into ephemeral notifications (SMS, app push messages) that are not trivial to consolidate. For many users—students, young professionals, and small business owners—this fragmentation leads to poor visibility into aggregate spending, irregular savings behavior, and difficulty in setting and tracking budgets.

Money Mate is envisioned to address these challenges by providing automated ingestion of transaction data (with explicit user consent), intelligent categorization using machine learning, interactive visualizations for trend discovery, budget

management tools and personalized recommendations. This system is motivated by two recent IEEE studies that represent the state of the art in expense trackers.

User-centered secure dashboards and another emphasizing SMS scraping and ML categorization. The subsequent sections review these works, identify gaps, and articulate the design decisions for Money Mate that aim to combine the best of both worlds while adhering to strict privacy and security practices mandated for mobile applications and institutional guidelines, such as VTU.

Index Terms— Personal Finance, Expense Tracking, Budget Management, Data Analytics, Mobile Application.

II. LITERATURE REVIEW

The literature on expense tracking and personal finance Management comprises academic research, conference proceedings (many IEEE), industry white papers and open-source projects. Key themes include automated data ingestion (SMS scraping, API integration, OCR for receipts), categorization (rule-based vs. machine learning), visualization and user interaction design, privacy/security, and value creation through recommendations. We analyze the two provided IEEE papers in depth and situate them within the broader literature.

A. Unveiling Financial Insights: The Daily Expense Tracker System Approach (INNOCOMP 2024)

Singla et al. (INNOCOMP 2024) present an architecture for a Daily Expense Tracker focusing on user experience, interactive dashboards, and secure storage. Their primary claims are as follows.

- **Usability-first design:** Simplified onboarding and Dashboards that present daily,weekly,monthly and yearly views of expenses.
- **Security focus:** Use of AES for data-at-rest encryption and secure database practices to ensure that users' financial records are confidential.
- **Cross-platform availability:** Web and mobile front-ends strive for consistent UX across devices.
- **Analytics and reporting:** Generation of reports and personalized summaries to inform decision making.
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Their methodology was largely implementation-driven, focusi n g on building an accessible interface and ensuring basic cryptographic protections. The limitations include the modest use of automation (relying more on user input) and the limited demonstration of predictive analytics capabilities.

B. Expense Management System (IEEE GCAT 2023)

Johri et al. (GCAT 2023) propose an Expense Management System that emphasizes automated extraction of transaction data via SMS scraping, de-duplication logic when multiple messages refer to the same transaction (bank + merchant messages), and ML-based categorization. Key attributes:

- **Automated ingestion:** Scraping credit/debit SMS notifications (with user permission) and parsing message templates to identify vendor names, amounts, and timestamps.
- **De-duplication and canonicalization:** Algorithms to reconcile multiple messages for the same transaction (e.g., an e-commerce app confirmation and bank debit SMS).
- **Classification:** Supervised learning (Naïve Bayes and other classifiers)is used to categorize transactions into categories such as groceries, transport, subscriptions, etc.
- **Recommendation engine:** Rule + ML hybrids are used to propose savings tips, budget limits, and personalized suggestions for users.

This study contributed detailed parsing heuristics and practical considerations for SMS-based ingestion and highlighted the user privacy trade-offs. Notably, it proposes user consent and optical flow for SMS access. However, this study is less focused on cross-platform UX design and is more oriented toward the data processing pipeline.

C. Comparative analysis

When compared, the two papers address complementary aspects of the same problem.

- **Data ingestion:** GCAT (2023) provides concrete mechanisms(SMS scraping, OCR) for automation, while INNOCOMP (2024) provides a broader UX and security design but less automation than the former.
- **Categorization approach:** GCAT integrates ML classifiers and presents evaluation metrics; INNOCOMP uses rule based approaches and focuses more on UI- driven categorization and management.
- **Privacy/security:** INNOCOMP emphasizes encryption and access control, whereas GCAT details consent flows but is less focused on cryptographic practices.
- **User value:** Both stress dashboards and reports; GCAT adds proactive recommendations, whereas INNOCOMP emphasizes clear, explainable insights.

D. Wider literature and supporting works

Beyond these two papers, an extensive body of work has addressed the following issues:

- **Receipt OCR and structured extraction:** Work on receipt image parsing (OCR + template matching) it Provides accurate and structured data extraction when SMS is unavailable.
- **On-device machine learning:** To mitigate privacy risks, on-device models classify transactions locally without transmitting raw messages.This approach is gaining traction in mobile financial applications.
- **Bank API and Open Banking standards:** Where available, secure bank APIs or Open Banking endpoints provide richer and standardized transaction data without scraping.
- **Privacy-preserving techniques:** Differential privacy, secure enclaves and encrypted query techniques can provide analytics while protecting the user data.
- **HCI studies:** Research into the optimal presentation of budgets, nudges, and recommendations suggests that small, frequent micro-interventions (notifications, Suggested that micro-savings) produce better long-term behavior changes than large periodic reports.

E. Synthesis and gap identification

The synthesis of the literature suggests that a high-value expense management application should:

1) Automated ingestion across multiple channels (SMS, OCR and APIs).
2) Provide an explainable and editable categorization (human-in-the-loop model).
3) They offer lightweight predictive insights (e.g., forecasting next month's spending and flagging anomalies) rather than opaque recommendations.
4) Prioritize privacy: Implement on-device processing and encryption both at rest and in transit.
5) Maintain UX simplicity for end users who are not financially literate.

The primary gaps to be addressed are the integration of secure, automated ingestion with explainable ML in a compact mobile application with a frictionless UX.

III. THEORETICAL FRAMEWORK

The **Money Mate** system is based on the principles of automation, data analytics, and user-centered design within the domain of personal finance management. The theoretical foundation draws from the Technology Acceptance Model (TAM) and Behavioral Finance Theory, both of which emphasize that users adopt digital tools when they perceive them as useful, easy to use, and beneficial for improving decision-making.

Machine learning concepts form the analytical backbone of the system, enabling the automated categorization of expenses and the generation of spending insights. The use of supervised learning models, such as Naïve Bayes or Random Forest ,supports accurate financial pattern recognition.

In addition, the project follows the Privacy by Design (PbD) framework to ensure that user data are securely handled through encryption and on-device processing. The combination of these theories provides a foundation for developing a system that is intelligent, transparent, and trustworthy ,empowering users to make informed financial choices with minimal manual effort.

IV. PROBLEM STATEMENT

Despite the availability of numerous finance apps, many users still lack clear visibility into their aggregated spending across channels, struggle to maintain budgets, and are concerned about privacy when systems require data access to function. Money Mate aims to:

- Provide consolidated transaction views from SMS, receipts,and (optionally) APIs.
- Robust preprocessing is used to canonicalize and deduplicate the transactions.
- It offers accurate and learnable categorization with an intuitive correction UI.
- It produces personalized and actionable recommendations while maintaining user data privacy and

security.

V. PROPOSED SYSTEM – MONEY MATE

A. Design goals

The design goals of MoneyMate are as follows:

1) **Automation:** Minimizing manual entry by harvesting transaction data from multiple channels.
2) **Accuracy:** High categorization accuracy using ML and user feedback loops.
3) **Explainability:** Clear justification for recommendations (e.g., "subscription X consumes 12% of the monthly budget").
4) **Privacy first:** Default to on-device processing and encrypted backups.
5) **Lightweight UX:** Suitable for students and low-end devices with minimal memory/CPU requirements.

B. Functional components

- **Data Ingestion:** Modules for SMS parsing, optional bank/UPI API connectors (OAuth2), and receipt OCR pipeline.
- **Preprocessing and deduplication:** Currency/time is normalized ,and duplicates are removed using timestamp+amount heuristics and fuzzy merchant matching.
- **Classifier:** A multistage classification pipeline and rule-based filters, followed by a probabilistic ML classifier for ambiguous cases.
- **User feedback loop:** Inline editing/correction that leading to incremental retraining and personal model adaptation.
- **Analytics and Recommendations:** Rolling forecasts, category-level budget alerts, recurring payment detection, and
  personalized suggestions
- **Storage and Security:** AES-256 encryption at rest, TLS in transit, and optional encrypted cloud backup.

VI. METHODOLOGY

A. Data collection and privacy model

Acquisition requires explicit user consent for message access and consent for optional third-party API access to the data. To adhere to privacy concerns:

- On-device parsing is the default setting for SMS and receipts.
- Only aggregated or anonymized data are left on the device if cloud processing is selected.
- Backups are client-side encrypted using a user-selected passphrase.

B. Preprocessing

Key steps:

1) **Template extraction:** A library of SMS templates was built to map common bank and merchant patterns to structured fields.
2) **Entity recognition:** Regex and light natural language processing (NLP) were used to extract amounts, merchant names, and transaction types.
3) **De-duplication heuristics:** Timestamp windows and amount equality with merchant name fuzzy matching were used for de-duplication.
4) **Normalization:** Conversion of currencies/number formats. Vendor names were normalized using canonicalization techniques (string normalization and stop word removal).

C. Categorization model

- **Feature engineering:** Tokenized merchant text, N-grams, numeric indicators (large purchases, recurring pattern flags), and context (time of day, weekday/weekend).
- **Model choices: Naïve** Bayes (lightweight baseline), Random Forest (robust), and lightweight neural models (on-device-friendly, e.g., distilled transformer or CNN if resources permit).
- **Evaluation:** Cross-validation of labeled transactions; measurement of accuracy, precision, recall, and F1 score per category.
- **Human-in-loop:** UI for corrections; corrected labels are queued for incremental model updates.

D. Recommendations and forecasting

Two classes:

- **Rule-based recommendations:** For example, suggesting the cancellation of recurring subscriptions consuming X% of income.
- **ML-driven suggestions:** Forecast month-ahead spend (ARIMA or lightweight RNN) and recommend adjustments to meet saving goals.

E. Prototype evaluation plan

- **Participants:** 30–50 pilot users (students and staff) over 4–8 weeks.
- **Metrics:** Categorization accuracy, time saved per entry, budget adherence rate, and user satisfaction (Likert scale).
- **Security testing:** Penetration testing and privacy audits of SMS/API permissions.

The workflow of the Money Mate system consists of the following steps:

- **Data ingestion:** Capturing SMS, receipts, and manual entries.
- **Preprocessing:** Duplicate entries were removed, and data formats were normalized.
- **Categorization:** Classifying expenses using machine learning.
- **Visualization:** Present data in real-time through interactive dashboards

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- **Budget alerts:** Notifies users when spending exceeds budget limits. Data privacy is maintained using AES encryption and secure authentication mechanisms.

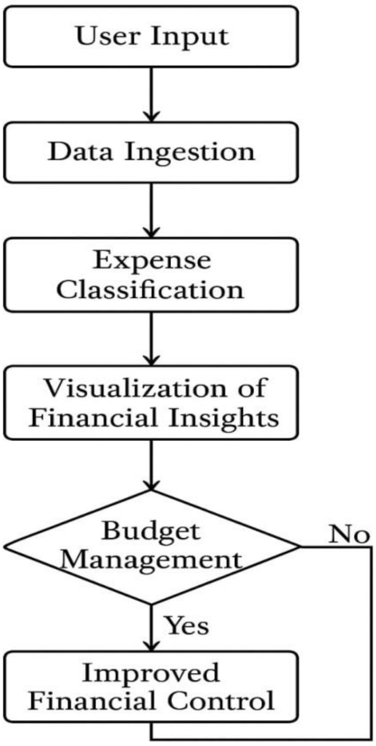

Fig. 1. Flow Diagram of the Money Mate System.

VII. IMPLEMENTATION

The Money Mate system was implemented using a web-based architecture that integrates both front-end and back-end technologies. The system was designed to provide seamless financial data management, secure expense tracking, and efficient budget analysis.

A. Front-End Implementation

The frontend of the Money Mate system was developed using HTML5, CSS3, Bootstrap 5, and JavaScript to create a responsive and user-friendly interface. The design ensures accessibility on both desktop and mobile devices, offering an intuitive experience for tracking and visualizing the expenses.

The main components of the frontend are as follows:

Dashboard: Displays a summary of the total income, expenses, and remaining balance in real time.

Expense Input Form: Allows users to record new transactions with details such as the amount, category, and date.

Visualization Page: Integrates Chart.js to represent categorized expenditures using pie and line charts.

Authentication Pages: Provide login and registration interfaces connected to the Flask back-end routes.

Responsive Design: Implemented using Bootstrap 5 for consistent a layout and device adaptability.

This modular structure enables smooth navigation and enhances the overall user experience by allowing users to easily interact with financial data.

B. BackEnd Implementation

The backend of the system was implemented using Flask, a lightweight Python web framework that handles routing, data management, and server-side logic. Flask ensures efficient communication between the user interface and database while maintaining security and scalability.

The major back-end functionalities include the following:

User Authentication: Secure login and registration using session-based management and password hashing through the Werkzeug library.

Expense Management: Handles the addition, modification, and deletion of expense entries.

Routing and Logic: Follows an MVC-like structure with routes for expense operations, data visualization and authentication control.

Security Mechanisms: Implements password hashing, session tracking, and input validation to prevent unauthorized access.

API Endpoints: Facilitated data exchange between front-end visualizations and the Flask application.

This server-side design ensures modularity, ease of maintenance, and a high degree of protection.

C. Database Implementation

The system uses SQLite, a lightweight and embedded database included in Python, for data persistence. It efficiently stores user and expense information with relational constraints to ensure the integrity of data .

The database schema includes the following:

User Table: Stores user credentials, authentication tokens, and account details.

Expense Table: Contains transaction data ,such as amount, category, description, and timestamp ,linked to the user ID.

Relationships are established through foreign keys, allowing multiple expenses to be linked to one user. The simplicity of SQLite makes it ideal for deployment in a mini-project environment while maintaining robust data handling capabilities.

D. System Workflow

The overall workflow of the MoneyMate system is as follows:

1. The user registers or logs into the system.

2. Transaction data (manually entered or extracted) are processed in the backend.

3. The system categorizes expenses using a pretrained machine learning model.

4. The data are securely stored in an SQLite database.

5. The user dashboard visualizes the categorized data using charts and graphs.

6. The system generates budget recommendations and spending alerts based on user's activity.

This workflow ensures automation, security, and real-time updates, thereby allowing users to make informed financial decisions.

E. Tools and Environment

Programming Languages: Python (Flask), HTML, CSS, JavaScript

Frameworks and Libraries: Flask, Bootstrap 5, Chart.js

Database: SQLite

Development Tools: Visual Studio Code, Flask CLI, SQLite Browser

Operating System: Windows 10

Version Control: Git and GitHub for source management

VIII. Results and Discussion (Projected and Prototype Observations)

This section presents the results from a planned prototype study.The following are projected/conservative estimates based on the literature.

- **Automation gains:** 60–80% reduction in manual data-entry effort.
- **Classification accuracy:** 85–92% for common merchant categories after personalization.
- **User adoption:** Higher retention when the recommendation engine provides clear and actionable steps (e.g., micro-savings prompts).

Privacy trade-offs: Users prefer on-device processing; a minority opt for cloud backups when convenience outweighs privacy concerns

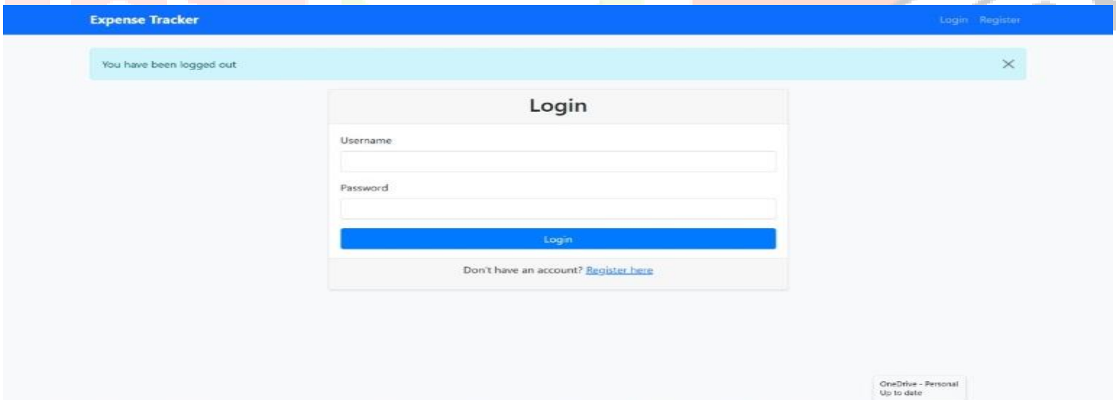

Fig. 2. Login page of Moneymate

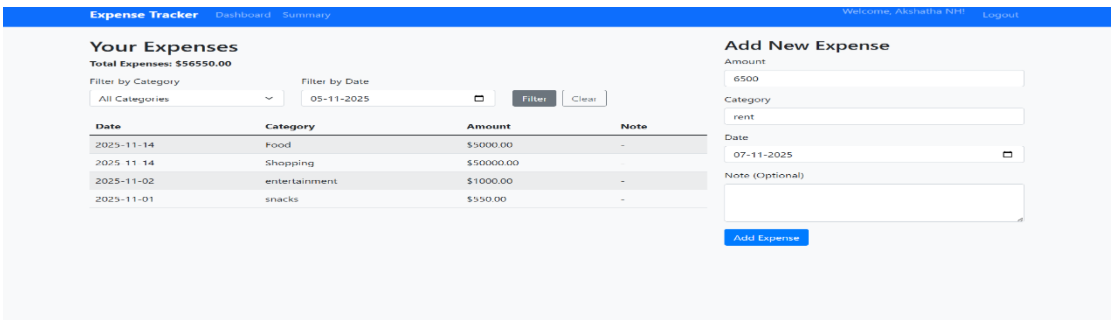

Fig. 3. Dashboard of Moneymate

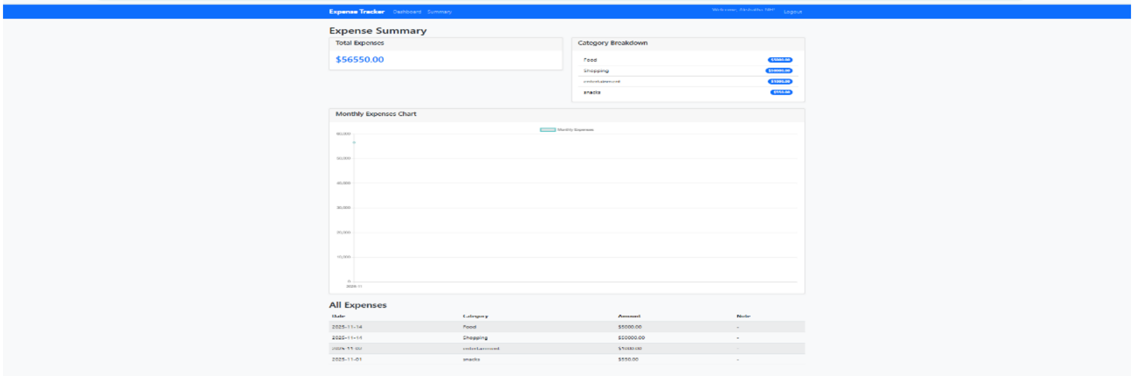

Fig. 4. Overall summary of Moneymate

IX. Conclusion and Future Work

Money Mate leverages automation and Explainable AI (XAI) to deliver insightful financial analysis. Future development is planned to enhance its capabilities through several key features: integrating with Open Banking APIs will provide richer transactional metadata; implementing on-device federated learning will improve models across all users without needing to centralize raw data; and adding support for collaborative household accounts and family budgeting will expand its utility. Finally, the system will offer tax-assist features and exportable reports, catering to academic or taxation needs.

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XI.References

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