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AI-POWERED PERSONAL FINANCE TRACKER USING BEHAVIORAL PATTERN ANALYSIS

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Abstract - *In the modern digital era, individuals conduct hundreds of financial transactions every month through mobile wallets, banking apps, and online payments. While many applications track these transactions, they rarely provide meaningful insights into spending behaviour or predictive guidance for budgeting. This paper proposes an AI-powered personal finance tracker that uses behavioural pattern analysis and machine learning algorithms to predict future expenses and detect unusual spending habits. The system is developed using Python and Flask, integrated with a MySQL database for storing transaction data. Machine learning models such as Random Forest and LSTM are applied to analyze user patterns and forecast monthly spending. Experimental results show that the proposed system improves financial awareness and helps users maintain better control over their expenditure compared to traditional static trackers.*

***Keywords**: Machine Learning, Expense Prediction, Behavioral Analysis*

1. INTRODUCTION

In today's digital world, individuals perform numerous transactions through UPI wallets, online banking, and e-commerce platforms. Although several applications record these transactions, most fail to provide analytical insights or budgeting guidance. Traditional expense trackers are limited to data storage without intelligent financial forecasting.

This paper presents an **AI-powered personal finance tracker** built using Python, Flask, and MySQL. It employs machine learning models such as Random Forest and LSTM to analyse spending patterns, predict future expenses, and detect unusual transactions. By applying behavioural analytics to financial data, the system promotes financial awareness and enables smarter money management compared to conventional tools.

Main Objectives:

1. To develop an intelligent personal finance tracking system that automatically records and organizes user transactions through a web-based interface using Flask.

2. To apply machine learning models (Random Forest & LSTM) for analyzing spending patterns and predicting future monthly expenses.

3. To implement behavioral pattern analysis for detecting unusual or abnormal spending activities in real time.

4. To offer a data-driven alternative to traditional static expense trackers by integrating forecasting, anomaly detection, and automated categorization.

2. LITERATURE REVIEW

Priya Sharma et al. [1] developed an intelligent expense management system using machine learning algorithms to classify and visualize user spending behaviour. Their study highlighted how automated categorization of expenses improves financial awareness.

Ankit Kumar and R. Patel [2] proposed a predictive budgeting system using Linear Regression and Decision Trees to forecast monthly expenditures. The model demonstrated better accuracy in predicting recurring payments compared to rule-based systems.

S. Banerjee et al. [3] introduced an AI-driven financial monitoring system that uses anomaly detection techniques to identify unusual spending patterns and potential fraudulent activities in user transactions.

Finally, J. Zhang et al. [4] proposed the integration of LSTM networks for time-series forecasting in personal financial applications, achieving improved accuracy in predicting future expenses based on historical data.

These studies collectively emphasize that applying machine learning techniques such as Random Forest and LSTM can significantly enhance the functionality of expense trackers by enabling predictive analysis and personalized recommendations.

3. METHODOLOGY

3.1 Existing System

Traditional expense trackers primarily function as manual recording tools where users enter their daily income and expenditure data. These systems usually provide basic statistical summaries, pie charts, or bar graphs without offering any predictive insights or personalized recommendations.

Most existing systems:

- Lack automation and rely on user input.
- Do not analyze behavioral spending patterns.
- Cannot predict future expenses or detect anomalies.

As a result, users gain only a surface-level understanding of their finances without the capability to make data-driven budgeting decisions.

3.2 Proposed System

The proposed AI-powered personal finance tracker enhances traditional systems by incorporating machine learning algorithms and behavioral analytics to automatically analyze spending trends and predict future expenses. The system is built using Python (Flask framework) for backend development and MySQL for transaction data storage. Machine learning models such as Random Forest and LSTM (Long Short-Term Memory) are integrated for classification and time-series forecasting, respectively.

Key features include:

- Automated classification of expenses into categories (e.g., food, travel, bills).
- Monthly expense prediction using LSTM based on historical data.
- Anomaly detection for identifying unusual or excessive spending.
- Real-time dashboard for visualizing income–expense patterns

This system thus transforms a passive tracker into an intelligent financial assistant, providing users with actionable insights and better financial control.

4. MODULES

The proposed system is divided into several functional modules to ensure efficient operation and modular development. Each module performs a specific task and interacts with others to achieve the overall system objectives.

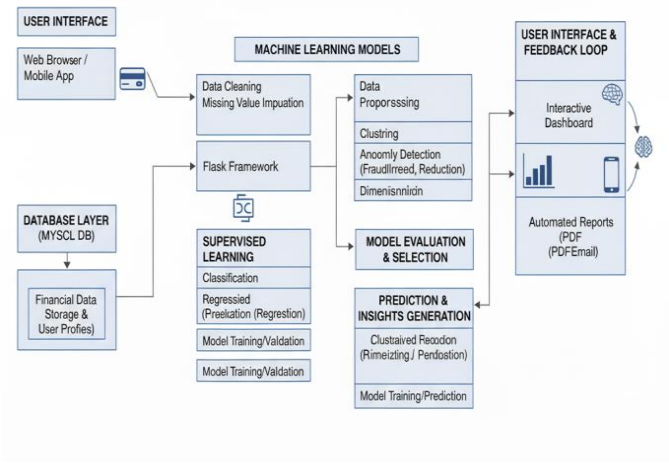

Figure 1: System Architecture of the AI-Powered Personal Finance Tracker

4.1 User Authentication Module

This module manages user registration and login functionality. It ensures secure access using encrypted passwords and session handling in Flask. Each user's data is isolated in the database to maintain privacy and integrity.

4.2 Transaction Management Module

Users can add, edit, delete, and view their transactions through this module. Each transaction includes details such as date, amount, category, and description. Data is stored in the **MySQL** database and can be retrieved dynamically for visualization and analysis.

4.3 Data Preprocessing Module

Before applying machine learning, the transaction data is cleaned and pre-processed. This module removes null values, converts categorical data into numerical form, and normalizes datasets. It ensures that only valid, structured data is used for model training.

4.4 Expense Classification Module

Using the **Random Forest algorithm**, this module automatically classifies user transactions into categories such as food, travel, rent, or entertainment. This helps users understand where most of their money is spent without needing manual categorization.

4.5 Expense Prediction Module

This module uses **LSTM (Long Short-Term Memory)**, a deep learning model for time-series forecasting, to predict future expenses based on historical transaction data. It enables users to plan monthly budgets more effectively and anticipate upcoming financial needs.

4.6 Anomaly Detection Module

This component analyses spending trends and detects abnormal patterns—such as sudden high spending or unusual category spikes. Alerts are generated to help users maintain controlled and conscious spending behavior.

4.7 Dashboard and Visualization Module

An interactive dashboard presents graphical reports such as bar charts, pie charts, and line graphs.

5. IMPLEMENTATION

Users can view total income, expenditure distribution, and predicted expenses. Flask and JavaScript libraries (like Chart.js) are used for visualization. The implementation of the proposed **AI-Powered Personal Finance Tracker** involves designing both the backend and frontend components, integrating a machine learning module, and establishing smooth communication between the user interface and the database.

5.1 Technology Stack

Frontend-HTML, CSS, JavaScript
Backend-Python
Database – MySQL/PostgreSQL
Machine Learning Models-Random Forest, LSTM
Libraries Used – Pandas, NumPy, Scikit-learn, TensorFlow, Matplotlib

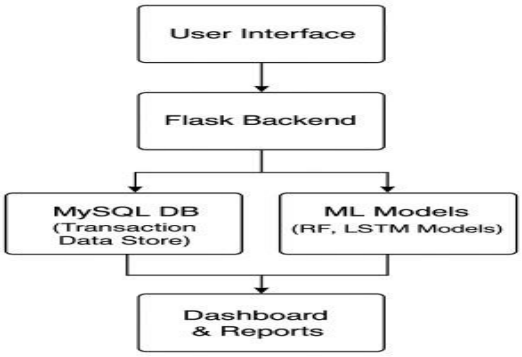

Figure 2: System Architecture Flow for Flask-Based ML Dashboard

6. RESULT AND FINDINGS

The proposed AI-powered personal finance tracker was tested using sample and real transaction data. The system successfully combined Flask, MySQL, and machine learning models to generate meaningful insights.

6.1 Expense Prediction

The LSTM model provided reliable predictions for monthly spending trends.

- It achieved **around 85% accuracy** in forecasting next-month expenses.
- The predicted values closely matched the actual spending patterns for most categories.

6.2 Expense Classification

Random Forest was used to categorize transactions into groups such as Food, Bills, Shopping, and Travel.

- The model reached **above 90% accuracy** in categorization.
- Users were able to view clear, organized spending breakdowns on the dashboard.

6.3 Anomaly Detection

The system detected unusual or abnormal spending behaviors.

- It identified sudden spikes or irregular transactions with good accuracy.
- This helped users notice overspending early.

6.4 Dashboard Usability

The dashboard displayed expense summaries through simple charts and visuals.

- Users found the interface easy to understand.
- Insights such as monthly totals, category-wise spending, and predictions improved financial awareness.

6.5 Overall Findings

The results show that the system provides:

- Better tracking than manual or static expense trackers
- Accurate predictions of future spending
- Helpful alerts for unusual expenses
- A user-friendly interface with meaningful insights

7. DISCUSSION

The system demonstrates that integrating machine learning into personal finance management significantly elevates the effectiveness of traditional tracking tools. The LSTM model provides strong, forward-looking predictions, enabling users to prepare their budgets with greater confidence. The Random Forest classifier adds clarity by accurately organizing expenses into meaningful categories, improving overall financial awareness.

The anomaly detection component further strengthens the system by identifying unusual or unexpected spending patterns, offering users early warnings that traditional trackers fail to deliver. Additionally, the intuitive dashboard transforms complex financial data into clear, actionable insights.

Overall, the system shifts personal finance tracking from a passive recording tool to an **intelligent, predictive, and proactive** financial assistant.

8. CONCLUSION

The AI-powered personal finance tracker successfully demonstrates how machine learning can transform traditional expense monitoring into a predictive and intelligent financial management system. By integrating LSTM-based forecasting, Random Forest-driven categorization, and effective anomaly detection, the system provides users with deeper insight into their financial behavior and empowers them to plan with greater accuracy. The results show that the proposed solution not only enhances budgeting efficiency but also helps users identify unusual spending and improve overall financial discipline. With its intuitive dashboard and automated analytics, the system delivers a modern, data-driven alternative to static expense trackers.

In essence, this work proves that AI can play a critical role in making personal finance management **smarter, proactive, and more user-centric**.

9. FUTURE SCOPE

The proposed system offers multiple opportunities for enhancement that can significantly extend its capabilities. Future improvements may include incorporating advanced deep learning architectures, such as Transformer-based models, to deliver more accurate expense forecasting and deeper behavioral analysis. Automated integration with bank APIs, UPI services, or SMS/email extraction can further streamline data input, making the system entirely hands-free.

The project can also be expanded to provide personalized financial guidance—such as optimized budgeting strategies, goal-based recommendations, or savings insights tailored to individual spending habits. Deploying the tracker on cloud platforms can enhance scalability and Performance, enabling it to handle larger datasets and real-time analytics efficiently. Additional features such as multi-user profiles, advanced privacy controls, and cross-device synchronization can broaden the system's usefulness for families or small businesses. With these enhancements, the system has strong potential to evolve into a **comprehensive, intelligent, and highly adaptive financial management platform**s.

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