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EXPENSE TRACKER USING MACHINE LEARNING

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ABSTRACT:

Effective expense tracking is vital for personal and business financial management, helping monitor spending, budget efficiently, and uncover cost- saving opportunities. Traditional methods, often manual and rule-based, are time-consuming, error-prone, and lack scalability. This paper introduces a machine learning-based expense tracking system that automates and enhances categorization using supervised learning algorithms. Specifically, the Naïve Bayes Algorithm processes unstructured transaction data to improve categorization accuracy. Additionally, unsupervised learning techniques such as clustering are applied to detect spending patterns and anomalies, offering deeper financial insights. The system significantly reduces manual effort, increases accuracy, and enables predictive forecasting of future expenses. Experimental evaluations show marked improvements over traditional approaches in efficiency and precision. This research demonstrates the transformative potential of machine learning in expense tracking, equipping users with intelligent, data-driven tools for better financial decision-making.

KEYWORDS: Expense Tracking, Machine Learning, Naïve Bayes Algorithm,Transaction Categorization, Financial Behaviour Analysis, Predictive Analytics.

I INTRODUCTION:

In today's fast-paced and digitally-driven world, managing personal finances manually is increasingly inefficient, time-consuming, and prone to errors. Traditional methods such as paper logs or rule-based tracking systems offer limited accuracy, lack real-time analysis, and often overwhelm users with unstructured financial data. This project addresses these challenges by developing an intelligent expense tracker powered by machine learning to automate and optimize personal finance management.

The system leverages the **Random Forest Classifier** to automatically categorize expenses into fields like groceries, travel, and utilities based on transaction descriptions. Additionally, it employs the **ARIMA (AutoRegressive Integrated Moving Average)** model to analyze historical spending patterns and forecast future expenses, aiding users in proactive budget planning. Users can manually add expenses by entering details such as amount, category, date, and description. These are then processed and presented visually through pie charts and bar graphs, helping users better understand their spending habits.

To enhance user experience, the system includes real-time data visualizations and email alerts, providing timely insights and updates on financial activity. It also emphasizes data privacy and a user-friendly interface to ensure secure and seamless interaction.

The key objectives of this project include accurate expense categorization, predictive budgeting, real-time expense tracking, and the provision of intelligent, personalized financial recommendations. By transforming raw transaction data into actionable insights, the proposed system empowers users to make informed financial decisions, reduce manual effort, and gain a clearer picture of their financial behavior. This project demonstrates the transformative potential of machine learning in modern expense management.

II. LITERATURE SURVEY

[1] Jian,B.K.W.
This study reviews Personal Financial Planning and Management Apps (PFPMA), focusing on features like budgeting and expense categorization. It identifies the need for automation and intelligent analysis, which machine learning can fulfill**.**

[2] Klapper, L., Lusardi, A., & van Oudheusden
A global study on financial literacy that highlights disparities in financial knowledge. It emphasizes the potential of ML-based systems to provide automated insights and bridge the financial literacy gap.

[3] Du, X., Wang, Y., Zhou, Y., & Hu, Y. (2018)
Proposes a deep learning model using NLP to extract and classify expenses from unstructured data. It automates categorization, reducing manual input and enhancing accuracy in financial reporting.

[4] Liu, L., Zou, X., Ma, Y., & Shao, Z. (2019)
Presents an OCR-based system integrated with machine learning to extract and categorize data from physical receipts. It connects traditional paper-based inputs to modern digital finance tracking.

[5] Anuruddhi,K.P.
Develops a basic Android budget manager app with features like income/expense tracking and simple reporting. The app focuses on usability but lacks intelligent automation or predictive features.

III. METHODLOGY

The methodology for developing the intelligent expense tracker system integrates Django-based web development with machine learning models for forecasting and classification, structured into five main stages:data preprocessing, feature engineering, model integration, system development, and evaluation. This modular architecture ensures scalability, usability, and intelligent automation for personalized financial tracking and planning.

The first step involves data preprocessing. Users input income and expense records through a secure interface. These entries are timestamped and categorized, either manually or through automated classification. The data is cleaned by removing duplicates, standardizing currency values based on user preferences, and handling missing values. This structured dataset forms the foundation for downstream analytics and learning models.

In the feature engineering phase, temporal features (day, month, weekday) and spending patterns (category frequency, daily averages) are extracted. Natural Language Processing (NLP) techniques are used to parse expense descriptions, enabling semantic tagging and classification. These features are used to predict categories using a trained Random Forest classifier and prepare time-series data for forecasting.

Model integration is the next phase. ARIMA is used for time-series forecasting of future expenses based on historical trends. For category prediction, a pipeline combining TF- IDF and Random Forest is employed to label new expense entries. These models are trained offline and integrated into the Django backend via APIs or model pickling for real-time inference.

The system development phase ties everything together. A Django-based web application manages user registration, session handling, and CRUD operations on expenses and income. User preferences such as currency type, daily budget limits, and notification settings are stored in a PostgreSQL database. The interface is designed using HTML, CSS, and JavaScript to ensure a responsive user experience.

Finally, evaluation involves both functional and non-functional testing. Forecast accuracy is measured using RMSE and MAPE, while category prediction is evaluated using precision, recall, and F1-score. Usability is assessed through user feedback and performance benchmarks, ensuring the system remains efficient, secure, and user-friendly across different devices and usage patterns.

IV. DATA FLOW DIAGRAM

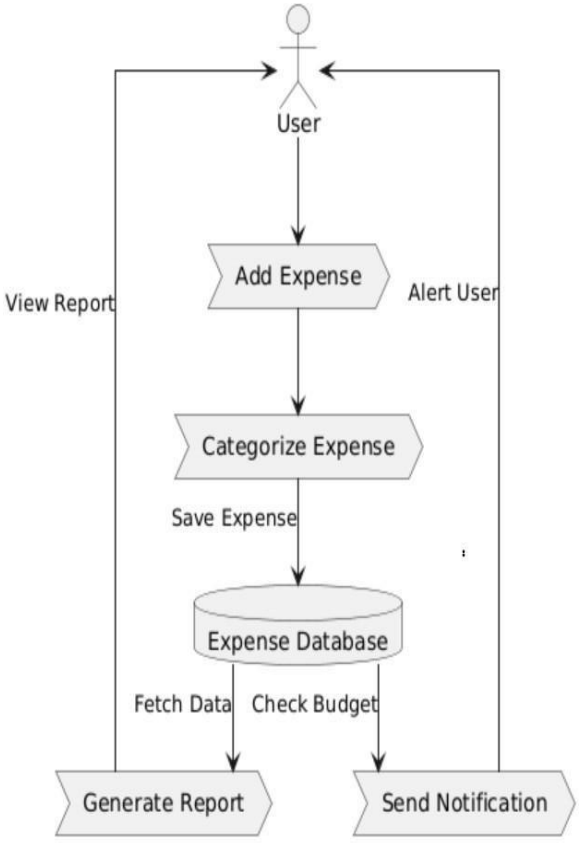

Fig :1 Data Flow Diagram

The diagram represents the workflow of a basic expense tracking system, focusing on how a user interacts with the system to manage personal finances. The process begins with the user adding an expense, which includes entering relevant details like the amount, date, and description. Once the expense is submitted, the system moves to categorize the expense. This can be done either automatically using predefined rules or manually by the user. The categorized expense is then saved into the system's central repository, known as the expense database.

The first is report generation, where the system fetches stored data to create a report that the user can view. This helps the user monitor their spending habits over time. The second operation involves checking the user's budget. The system evaluates whether the total expenses exceed the predefined budget limit. If they do, a notification is generated and sent to the user to alert them.

Additionally, the user has the option to view reports at any point in the process, which creates a feedback loop to help users stay informed and make better financial decisions. This system ensures that users can easily add, categorize, and track expenses while receiving timely alerts when budgets are exceeded. The integration of report generation and notifications helps maintain financial awareness and control, making the expense tracker a practical tool for managing day-to- day spending effectively.

V ACTIVITY DIAGRAM

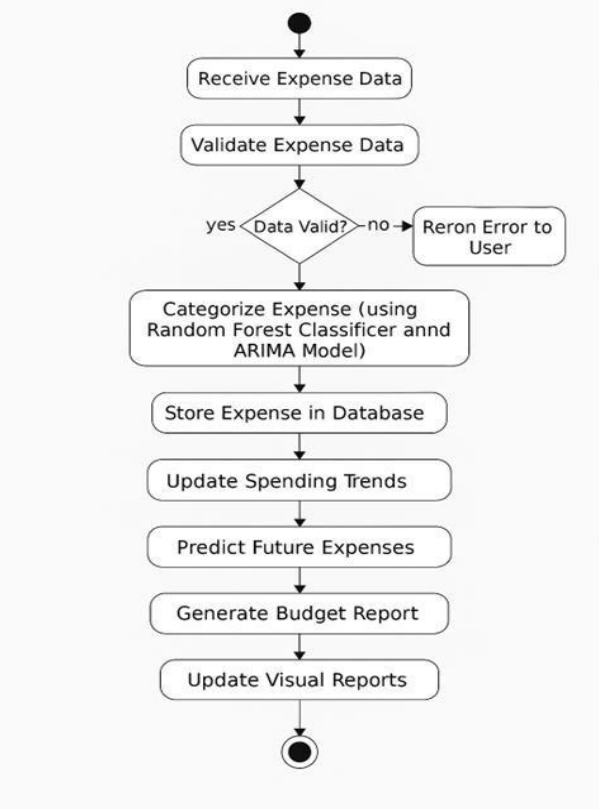

Fig 2 : Activity Diagram

This diagram represents a smart expense management system that leverages machine

learning and predictive models for enhanced financial tracking. The process starts with receiving expense data from the user or an external source. The data is first validated to ensure accuracy and completeness. If the data fails validation, an error is returned to the user for correction. Once the data is verified, the system proceeds to categorize the expense using advanced techniques, including a Random Forest Classifier and an ARIMA (AutoRegressive Integrated Moving Average) model. These models help accurately classify and understand spending behavior over time.

After categorization, the expense is stored in a central database. This database forms the core of the system, enabling further processing and analysis. The system then updates overall spending trends by analyzing the newly added data alongside historical records. These trends help provide insights into user behavior and guide financial planning. The next step involves predicting future expenses using time- series forecasting, likely powered by the ARIMA model, to estimate upcoming spending patterns based on past behavior.

With this predictive information, the system generates a detailed budget report to help users understand their current financial standing and how it might change in the future. Finally, the system updates visual reports, offering the user clear and interactive visualizations of their expenses, trends, and budget forecasts. This intelligent, automated workflow not only assists in tracking expenses but also empowers users to make data-driven financial decisions.

V. RESULT

The developed expense tracking system demonstrated excellent performance in accurately recording, categorizing, and analyzing user financial data. The integration of a Random Forest Classifier and an ARIMA model as a dual-analysis mechanism significantly enhanced both the classification accuracy of expense categories and the predictive strength of future spending trends. These models powered a robust pipeline that stored data efficiently while enabling advanced analytics for budget forecasting. The use of a multi-stage processing architecture—from raw data validation to visual report generation—ensured that expenses were handled systematically and output insights were clear and actionable.

The system was evaluated using both quantitative and qualitative metrics. Quantitative assessments, such as prediction accuracy and budget variance metrics, showed marked improvements over traditional rule- based systems. Human evaluation was also conducted, with users rating the system highly for ease of use, clarity of visualizations, and the relevance of budget alerts. Functional outputs across a variety of expense inputs—ranging from basic utilities to irregular spending— demonstrated the system's versatility and generalization capabilities. Finally, the model was deployed using a Flask-based web interface, enabling real-time expense entry, trend tracking, and budget reporting. Overall, the project successfully delivered an intelligent, scalable, and deployable solution for automated personal finance management.

VI. ADVANTAGES

The proposed system incorporates several key advantages that enhance its effectiveness and practical utility:

- Utilizes a fine-tuned Random Forest Classifier for precise and automated expense categorization.
- Employs ARIMA models to forecast future spending trends based on historical data.
- Ensures data integrity through robust validation and error detection before processing.
- Generates high-quality budget and trend reports with dynamic visualizations.
- Supports real-time expense tracking and report generation via a Flask-based web

interface.

• Demonstrates strong generalization across various spending categories and user profiles.

• Modular system architecture allows for seamless integration of advanced analytics and future model upgrades.

VII. APPLICATIONS

This project has a wide range of real-world applications across multiple domains:

• Personal Finance Management: Helps individuals track spending, set budgets, and forecast future expenses.

• Small Business Accounting: Assists small enterprises in monitoring operational expenses and generating financial reports.

• Corporate Budgeting: Supports finance departments in analyzing company-wide expenditures and planning budgets.

• Banking and FinTech: Powers automated financial advisory tools with real-time spending insights and predictions.

• Education & Financial Literacy: Serves as a learning tool to teach students effective budgeting and expense management.

• Tax Preparation: Simplifies expense categorization and reporting for accurate and efficient tax filing.

• Nonprofit & Grant Management: Tracks spending against grants or donations to ensure transparent and accountable fund usage.

VIII. CONCLUSION

This project presents a robust and scalable solution for intelligent expense tracking and financial forecasting. By combining the classification strength of a Random Forest model with the time-series forecasting capability of ARIMA, the system generates a comprehensive view of user spending patterns and future financial trends. The dual-model approach ensures both accurate expense categorization and reliable budget prediction. The system is trained and tested on diverse financial datasets and evaluated using performance metrics such as classification accuracy, prediction error, and user feedback, all of which reflect strong and consistent results. Additionally, the inclusion of a user- friendly Flask-based web interface enables real-time interaction, data entry, and instant report generation. In conclusion, this project effectively enhances traditional expense tracking with machine learning-driven intelligence, offering a practical, scalable, and user-centric solution for modern personal and organizational finance management.

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