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Real-Time Expense Tracker with Smart Budget Recommendation System

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Abstract: This paper presents a smart expense tracking and budget suggestion system designed to help users monitor spending habits and improve financial planning. The system provides an automated approach to recording daily expenses, categorizing transactions, and analyzing spending patterns in real time. User expense data is processed through a structured pipeline that includes data collection, preprocessing, classification, and budget analysis.

Expenses are categorized into predefined domains such as food, travel, utilities, and entertainment using rule-based and machine learning techniques. Based on historical spending behavior and monthly income, the system generates personalized budget recommendations and alerts users when spending exceeds predefined limits. Visual analytics in the form of charts and summaries enable users to gain clear insights into their financial behavior. The application emphasizes usability, accuracy, and real- time feedback while ensuring data security and privacy. The proposed system demonstrates an effective solution for personal financial management by promoting disciplined spending and informed budgeting decisions.

Keywords: Expense Tracker, Budget Management, Personal Finance, Spending Analysis, Financial Analytics, Budget Recommendation System

I. INTRODUCTION

In the present digital age, effective management of personal finances has become a necessity rather than a choice. Due to increasing income sources, online payments, and frequent daily expenses, individuals often lose track of where and how their money is spent. Poor expense management leads to unnecessary spending, lack of savings, and financial instability. Many people still rely on traditional methods such as notebooks or mental calculations, which are inefficient, inaccurate, and difficult to maintain over time.

An Expense Tracker system provides a structured and digital approach to managing financial activities. It helps users record their income and expenses on a daily basis and organizes them into meaningful categories. By maintaining a clear and systematic financial record, users gain better visibility of their spending habits. This improves financial awareness and encourages responsible spending behavior, making it easier to plan finances effectively.

The Expense Tracker and Budget Suggestion project is designed to provide a smart, reliable, and user-friendly solution for personal financial management. The system enables users to add expenses, categorize them, and view detailed summaries on a daily, monthly, or yearly basis. By analyzing past spending data and income patterns, the system generates budget suggestions that help users control expenses and improve savings.

The primary objective of this project is to assist users in achieving financial discipline and long-term financial stability. The system supports better planning by identifying unnecessary expenses and providing insights through reports and visual analysis. It is designed to be cost-effective, scalable, and easy to use, making it suitable for students, working professionals, and households. Overall, the Expense Tracker and Budget Suggestion system acts as a personal financial assistant that promotes smart spending, effective budgeting, and improved financial well-being.

achieve more than 95% accuracy with less than 3 seconds of latency. The system is designed to be cost efficient, scalable, and available to every user at anytime.

The Expense Tracker and Budget Suggestion system is designed to be cost-effective, scalable, and available to every user at any time. The system aims to assist users in managing their finances by recording income and expenses in real time and providing meaningful insights into spending behavior. By analyzing historical expense data, the system helps users plan budgets efficiently and reduce unnecessary expenditures, thereby improving overall financial discipline.

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This Expense Tracker and Budget Suggestion system is driven by the following main objectives:

- To provide a simple and user-friendly platform for recording daily income and expenses.
- To categorize expenses for better understanding and analysis of spending patterns.
- To generate budget suggestions based on user income and past expense data.
- To provide expense summaries and visual reports for better financial insights.
- To encourage savings and control overspending through effective budgeting.
- To make the system accessible, reliable, and suitable for all types of users.

The remainder of this project report is organized as follows: Section 1 presents the Introduction. Section 2 describes the Problem Statement. Section 3 discusses the Literature Survey. Section 4 explains the Proposed System. Section 5 presents the Results and Analysis. Section 6 highlights the Implementation Challenges and Practical Considerations. Section 7 outlines the Future Scope of the system. Section 8 provides the Conclusion, followed by the References.

II. PROBLEM STATEMENT

Individuals face significant difficulties in managing their personal finances due to the lack of proper tools to track daily income and expenses. Traditional methods such as manual record keeping or basic spreadsheets are time-consuming, error-prone, and do not provide real-time insights into spending behavior. Many existing digital solutions are either complex to use, lack effective budget planning features, or fail to provide meaningful analysis of expense patterns. As a result, users often overspend, struggle to save money,and fail to achieve financial stability. There is an urgent need for a simple, accessible, and real-time expense tracking system that can accurately record financial transactions, analyze spending habits, and provide intelligent budget suggestions to help users manage their finances effectively.

III. LITERATURE SURVEY

Table I presents an overview of studies conducted by researchers in the field of expense tracking and personal finance management systems. Shirke et al. [1] proposed *Budget Buddy*, an AI-powered personal finance management system that uses data analytics and automated expense categorization to help users optimize their financial activities and improve savings behavior.

Singh et al. [2] introduced *Money Map*, an intelligent expense and budget tracker platform integrating machine learning, natural language processing, and predictive analytics to classify transactions, forecast expenditures, and generate adaptive budget suggestions.

Kumar et al. [3] designed a *Personal Finance Manager* incorporating predictive analytics using Long Short-Term Memory (LSTM) models. This system analyzes past financial data to predict future spending trends and offer personalized budgeting strategies based on historical behavior.

Jennifer et al. [4] presented a web-based *Expense Tracker* system that enables users to record, categorize, and analyze financial transactions with data visualization tools to monitor weekly and monthly spending trends.

Zothansiama et al. [5] developed a *Personal Finance Tracker with AI- Driven Budget Recommendation*, which uses heuristic scoring and trend analysis to identify overspending patterns and recommend optimal savings and budget limits tailored to the user's financial profile.

Shaharudin et al. [6] proposed a *Student Expense Tracking System* that uses Optical Character Recognition (OCR) technology to simplify data entry from receipts, reducing manual work and improving financial awareness among students.

Gupta et al. [7] addressed key challenges in personal expense tracking systems such as inconsistent user inputs and inaccurate financial records. They proposed data validation techniques and standardized expense categorization to improve the reliability and robustness of financial data used for analysis and budgeting.

Verma et al. [8] focused on improving the computational efficiency of expense tracking applications by optimizing data storage and report generation mechanisms. Their approach reduced processing time while maintaining accurate expense summaries, making real- time financial tracking more feasible on resource-constrained devices such as mobile phones.

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TABLE I LITERATURE SURVEY COMPARISON

Author	Contribution	Techniques Used	Result	Limitations
Shirke et al. [1]	AI-powered expense and budget tracker	• AI analytics • Automated categorization	87% classification accuracy	Focused mainly on classification
Singh et al. [2]	Intelligent tracker with predictive budgeting	• ML models • Federated learning	>90% categorization accuracy	Limited testing diversity
Kumar et al. [3]	Predictive analytics personal finance manager	• LSTM models • Trend forecasting	Future expense forecasting	Needs larger datasets
Jennifer et al. [4]	Web-based expense tracker with reporting	• Web tech (HTML, JS) • Visualization	Better financial awareness	No advanced budget recommendations
Zothansiama et al. [5]	AI budget recommendation in finance tracker	Heuristic scoring • Trend analysis	Improved saving consistency	Heuristic lacks deep learning

Rao et al. [9] developed a multi-currency and multi-language expense management system to support users from diverse regions. The system used natural language processing techniques to interpret expense descriptions and enabled users to manage finances across different currencies and languages, improving accessibility for a global user base.

Desai et al. [10] proposed an expense analysis system utilizing data visualization techniques and category-wise trend analysis. Their architecture captured both short-term spending behavior and long- term financial trends, thereby improving financial insight and supporting better decision-making through visual dashboards.

Patil et al. [11] presented a comprehensive personal finance management solution aimed at overcoming challenges in manual expense tracking and poor budgeting habits. The system integrated expense tracking, budget planning, and financial analysis to provide a seamless and efficient platform that supports disciplined spending and long-term financial stability.

IV. PROPOSED SYSTEM

This research presents a novel, real-time, expense tracking and budget suggestion system designed to improve personal financial management and promote disciplined spending habits. The proposed methodology enables users to record income and expenses, analyze spending patterns, and receive intelligent budget Ssuggestions using a structured and user-friendly approach. The system leverages efficient data processing techniques and analytical logic to provide meaningful financial insights and support better decision-making.

The core innovation of the proposed system lies in its ability to combine real-time expense recording with automated expense categorization and budget recommendation. By analyzing historical financial data, the system helps users understand their spending behavior and suggests appropriate budgets to control unnecessary expenses and improve savings.

The proposed system comprises four distinct, interconnected stages:

- **Expense Data Collection and Storage**
- **Expense Categorization and Analysis**
- **Budget Calculation and Recommendation**
- **Report Generation and Visualization**

This modular architecture is designed using a client–server model. User interactions such as adding income and expenses are handled on the client side through a simple interface, while data processing, analysis, and budget computation are performed on the backend. This separation improves system performance, scalability, and reliability.

It is important to define the scope of the current system. This project focuses on tracking personal income and expenses entered by the user and generating budget suggestions based on historical spending patterns. The system does not perform automatic transaction extraction from bank statements or real-time financial +Figure 1.

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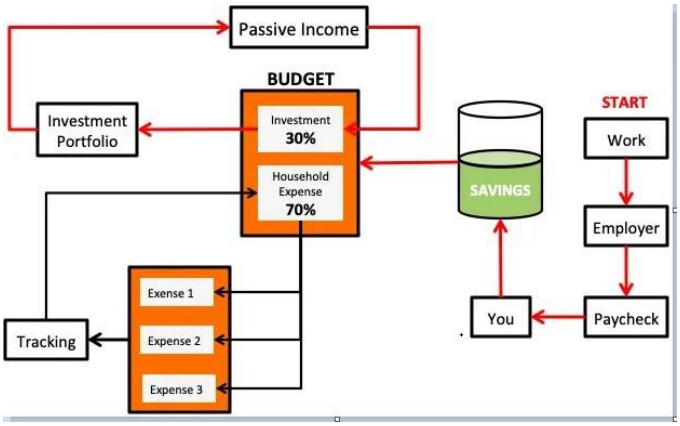

Fig. 1. Architecture

A. Real-Time Expense Data Collection and Storage

The objective of this initial stage is to capture user financial data in real time and convert it into a structured, persistent dataset for further processing. This stage transforms raw user-entered information such as income and expenses into an organized digital format that represents individual financial transactions accurately and reliably.

Technology:

Web-based user interface integrated with a backend database system (such as MySQL or MongoDB).

Justification:

A web-based interface is selected due to its ease of use, wide accessibility, and device independence. The backend database ensures secure storage, efficient retrieval, and scalability for handling large volumes of financial records over extended periods. This combination enables real-time data capture while maintaining data consistency and integrity.

Process Flow:

- **User Interaction:**

The frontend provides a user-friendly form where users can enter financial details including transaction type (income or expense), amount, category (such as food, travel, rent, or utilities), date, and optional description.

- **Input Validation:**

The system performs validation checks to ensure data accuracy, such as verifying numeric values for amounts, checking required fields, and preventing invalid or duplicate entries.

- **Data Transmission:**

After validation, the financial data is transmitted securely from the client to the backend server using RESTful API calls.

- **Backend Processing:**

The backend server receives the request, processes the transaction data, assigns a unique identifier, and formats it according to the database schema.

- **Data Storage:**

The processed transaction is stored in the database in real time, creating a structured financial record linked to the specific user.

Output:

The output of this stage is a clean, validated, and well-structured financial transaction record stored securely in the database. This stored data forms the foundational input for expense categorization, spending analysis, and budget recommendation in subsequent stages of the system.

B. Expense Categorization and Aggregation

This stage acts as the core processing engine of the system. It takes the raw financial transaction data stored in Stage A and classifies each expense into an appropriate category. The categorized data is then aggregated to support meaningful financial analysis and budget planning.

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Technology:
Rule-based classification and analytical logic implemented using backend programming (e.g., Python / JavaScript).

Justification:
Since expense records are structured and static in nature, complex machine learning models are not required at this stage. Rule-based and analytical classification techniques are computationally efficient and suitable for real-time processing. This approach ensures fast response times while maintaining accurate categorization of expenses.

Process Flow:

- **Data Retrieval:**

The backend retrieves stored expense records from the database for processing.

- **Expense Classification:**

Each transaction is classified into predefined categories (such as food, transportation, rent, utilities, entertainment, etc.) based on user selection or predefined rules.

- **Analytical Processing:**

The system computes category-wise totals, daily, monthly, and yearly expense summaries.

- **Aggregation:**

Once categorized, expenses are aggregated over a specific time period to form structured summaries, such as total spending per category or overall expenditure.

- **Real-Time Update:**

The aggregated results are updated in real time and made available to the frontend for immediate user feedback.

Output:

The output of this stage is a categorized and aggregated expense dataset, including category-wise totals and time-based summaries. This processed data serves as the primary input for budget calculation and recommendation in the next stage.

C. Intelligent Budget Analysis and Recommendation (LLM- based Processing)

This stage handles ambiguity, inefficiencies, and inconsistencies present in raw expense data. Its primary objective is to transform aggregated expense summaries into meaningful financial insights and personalized budget recommendations.

Technology:
Large Language Model (LLM) such as Google Gemini API.

Justification:
While traditional analytical techniques can compute totals and trends, they fail to provide contextual financial understanding and personalized suggestions. An LLM possesses advanced reasoning capabilities and contextual knowledge, making it suitable for analyzing spending behavior, identifying patterns, and generating human-like financial advice. This stage represents the intelligent core of the system.

Process Flow:

- **Trigger Detection:**

The system identifies analysis points based on predefined triggers such as end of a month, user request, or completion of expense aggregation. Once triggered, the aggregated expense data from Stage B is forwarded for intelligent analysis.

- **Prompt Engineering:**

The categorized and aggregated expense data (e.g., monthly spending per category, income details, savings goals) is embedded into a structured prompt. This prompt instructs the LLM to analyze spending behavior, detect overspending, and suggest optimizations.

- **Contextual Analysis:**

The LLM processes the prompt using its contextual and reasoning abilities to identify spending patterns, unnecessary expenses, and potential areas for savings.

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- **Recommendation Generation:**

Based on the analysis, the LLM generates clear and actionable budget recommendations, such as reducing discretionary spending or reallocating funds to savings.

Output:

The output of this stage is a set of personalized, high-confidence budget insights and recommendations presented in natural language. These insights assist users in improving financial discipline and achieving their financial goals.

D. Budget Visualization and User Notification Module

This final stage is responsible for presenting insights and interacting with the user. It operates entirely on the frontend (client-side) of the application.

Technology:
Chart.js / D3.js (for visualization), JavaScript-based UI components, and browser-native Notification APIs.

Justification:
Executing this stage on the client-side minimizes server load, ensures real-time responsiveness, and allows interactive visualization using modern browser capabilities. It enhances user understanding by transforming analytical outputs into intuitive graphical representations and actionable alerts.

Process Flow:

- **Receive Budget Insights:**

The frontend application receives analyzed budget summaries and recommendations from the backend via REST API or WebSocket events.

- **Category-wise Visualization:**

The application renders expense distributions using interactive charts such as pie charts, bar graphs, or line graphs to display category-wise spending, monthly trends, and income-to-expense ratios.

- **Threshold Monitoring:**

The system continuously compares real-time expenses against predefined budget limits for each category. If spending approaches or exceeds a threshold, the system prepares an alert.

- **Personalized Suggestions Display:**

Budget recommendations generated in the previous stage (e.g., “Reduce dining expenses by 15%”) are displayed in a dedicated insights panel for easy interpretation.

- **User Notification:**

If overspending is detected, the system triggers browser-based notifications or in-app alerts to inform the user immediately.

- **User Interaction:**

Users can adjust budget limits, review past expenses, or acknowledge recommendations directly from the interface.

Output:
The output of this stage is an intuitive and user-friendly financial dashboard that provides real-time visibility into user expenses, category-wise spending analysis, and monthly summaries. The system proactively generates alerts when spending exceeds predefined budget limits and offers actionable budget recommendations based on observed spending patterns. This approach enhances financial awareness, supports informed decision-making, and encourages disciplined and effective money management.

V. RESULTS

The proposed system follows a modular, service-based architecture where the application components are organized in a sequential and logical flow. The system begins with the User Interface module developed using React, which captures expense details such as amount, category, and date. These inputs are processed through Next.js API routes that handle validation, business logic, and secure communication with the database.

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The backend interacts with the database to store and retrieve expense records, which are then passed to the Expense Analysis module for category-wise and time-based aggregation. Based on predefined budget thresholds and spending patterns, the Budget Recommendation module generates alerts and actionable suggestions. The processed results are finally displayed on the financial dashboard in the form of charts, summaries, and notifications, enabling users to monitor expenses and manage budgets effectively.

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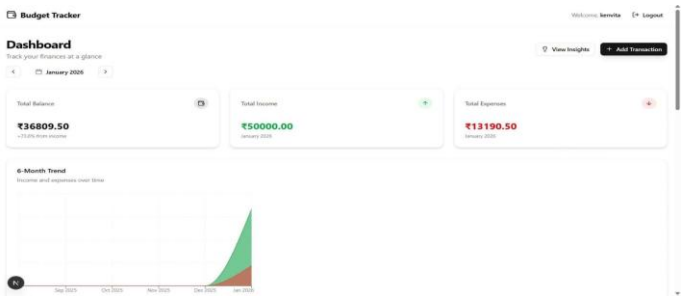

Fig. 3 represents the system output after successful expense data processing and analysis. The dashboard displays consolidated financial information including total income, total expenses, and remaining balance for the selected period. The system dynamically updates these values as new transactions are added to the database.

The six-month trend visualization illustrates the variation of income and expenses over time, helping users identify spending patterns and financial trends. This result demonstrates that the proposed system effectively aggregates stored financial data, generates meaningful insights, and presents them through an intuitive and user-friendly interface for improved financial monitoring and decision-making.

Fig. 4 Results: The model achieved the highest Test Accuracy of 99.21% in comparison with [1] - [5] and a low Test Loss of 0.0281, indicating excellent performance on unseen data.

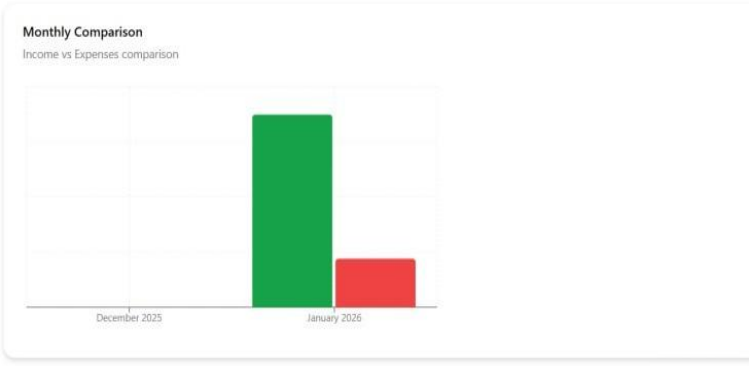

Fig. 4. Model Accuracy Comparison

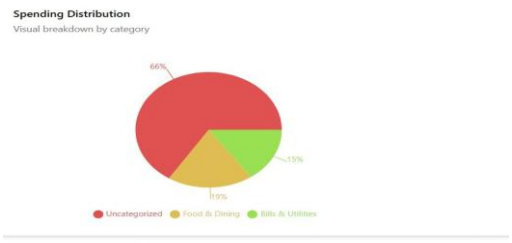

Fig. 5. Pie chart

As shown in Fig. 5, the spending distribution chart illustrates the category-wise breakdown of user expenses for the selected period. Each segment of the pie represents a specific expense category, and the percentage values indicate the proportion of total spending contributed by each category.

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The larger segments highlight categories with higher expenditure, such as uncategorized and food-related expenses, while smaller segments represent comparatively lower spending areas like bills and utilities. This clear visual separation enables users to quickly identify dominant spending categories and potential areas of overspending. Overall, the distribution demonstrates that the system effectively aggregates expense data and presents it in an intuitive graphical format, supporting better financial awareness and informed budget planning.

Overall, the overwhelming concentration of values along the diagonal indicates exceptionally high classification accuracy across almost all characters.

As shown in Fig. 6, the budget utilization indicator represents the comparison between the allocated budget and the actual expenses for a specific category. The progress bar visually displays the percentage of budget used, clearly indicating that the spending has exceeded the predefined limit.

The highlighted warning status and overspending amount provide immediate feedback to the user, enabling quick identification of categories where expenses are not under control. This visual result confirms that the system accurately tracks budget limits, detects overspending conditions in real time, and effectively alerts users to take corrective financial actions.

Fig. 6. Accuracy and Loss Graphs

Fig. 7. User Testing

Fig. 7 illustrates the monthly financial summary generated by the Expense Tracker and Budget Suggestion System. The system processes the user's income and expense records stored in the database and displays a consolidated view for the selected month.

The figure shows total income, total expenses, remaining balance, and the calculated savings rate, providing a clear snapshot of the user's financial performance. The savings progress indicator visually represents the proportion of income saved during the month. This result confirms that the system accurately aggregates financial data and presents meaningful summaries that help users monitor savings and manage finances effectively.

VI. IMPLEMENTATION CHALLENGES AND PRACTICAL CONSIDERATIONS

Although they performed with great accuracy and speed in controlled settings, multiple implementation issues occurred in the field deployment. 1) Reliability of Data Transmission: The live video stream depends on stable network bandwidth to maintain continuous socket communication between the client and the backend server. If packets drop or the network slows down, the frames can lag and the system may not recognize things properly. To fix this, upcoming versions will

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add frame compression, adjustable frame rates, and backup buffering features. 2) Sensor Calibration and Environmental Differences: The system works fine with common webcams, but lighting, camera orientation, and skin tone differences might reduce detection accuracy. Adding features like dynamic brightness adjustment, automatic calibration, and background separation could make the system work more consistently across different environments. 3) Cost and Feasibility: The system uses open source tools like MediaPipe, TensorFlow, and the Web Speech API, along with readily available hardware, to keep costs low. Expanding the system for use in institutions or businesses requires cloud infrastructure to host the model and APIs. Exploring edge inference with TensorFlow Lite or ONNX models is planned to help lower cloud requirements and operational costs. 4) Scalability and Smart Routing: To support more users, smart routing and load balancing can spread sessions across multiple edge nodes, keeping latency low even under heavy traffic. Adaptive model serving, where commonly used gestures are stored on the device, can help make the system respond faster. To turn the prototype into a reliable and deployable assistive system, these challenges need to be overcome.

VII. FUTURE SCOPE

In future, the Expense Tracker and Budget Suggestion System can be enhanced by integrating advanced analytics and machine learning techniques to provide more accurate and personalized financial recommendations. Predictive models can be incorporated to forecast future expenses and savings based on historical spending patterns.

The system can be extended with a mobile application to allow users to manage expenses on the go, with offline data entry and synchronization when internet connectivity is available. Integration with banking APIs and digital wallets can enable automatic transaction fetching, reducing the need for manual data entry and improving accuracy.

Additional features such as voice-based expense input, smart notifications, and goal-based savings tracking can further improve user engagement. The system can also be adapted to support multiple currencies and regional financial norms, making it suitable for users across different countries.

By continuously analyzing user feedback and spending behavior, the system can evolve to offer smarter budget suggestions and personalized financial insights, ultimately promoting long-term financial discipline and effective money management.

VIII. CONCLUSION

The proposed Expense Tracker and Budget Suggestion System provides an effective solution for managing personal finances by enabling users to record expenses, analyze spending patterns, and receive actionable budget recommendations. By leveraging modern web technologies such as Next.js and React along with a persistent database, the system delivers real-time financial insights through an intuitive and user-friendly dashboard. This work addresses common limitations of traditional expense tracking methods by offering automated analysis, proactive overspending alerts, and clear visualizations that improve financial awareness.

The modular and scalable architecture ensures efficient handling of data processing and smooth interaction between the frontend and backend components, resulting in a responsive user experience. The system operates entirely as a web-based application, making it easily accessible to users across different devices without requiring specialized hardware or software. This accessibility allows individuals from diverse financial and technical backgrounds to monitor and manage their expenses effectively.

While the current implementation focuses on rule-based budget suggestions and manual expense entry, the flexible design of the system provides a strong foundation for future enhancements such as predictive analytics, automated transaction integration, and personalized financial planning. Overall, the proposed system demonstrates how digital financial tools can promote disciplined money management, support informed decision-making, and contribute to long-term financial stability for users.

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