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PENNYWISE: PERSONAL EXPENSE ADVISOR

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ABSTRACT

Introduction: This research introduces Pennywise, an exciting new smart financial advisor designed to change how people manage their finances. With artificial intelligence and engaging data visualization, Pennywise makes personal finance easier and more accessible. It addresses the everyday struggles of keeping track of expenses and receiving vague financial advice by offering automated transaction categorization, personalized insights, and clear, actionable recommendations tailored to each user's unique financial situation. **Materials and Methods:** Pennywise harnesses powerful machine learning algorithms to analyse users' spending habits, helping them identify patterns, predict upcoming expenses, and make informed financial decisions. The user-friendly dashboard allows individuals to effortlessly keep track of their financial activities, while interactive data visuals present valuable insights in a friendly and easy-to-understand way. Plus, with strong security measures, users can trust that their financial information is safe. **Result:** In trials, Pennywise achieved an impressive 92.3 percent accuracy in categorizing transactions. Users were highly engaged, with 67 percent accepting the system's recommendations. Notably, many users found that they could save an extra 12 percent each month after starting to use Pennywise. **Conclusion:** Overall, this system not only provides a powerful and user-friendly way to manage finances but also helps improve financial literacy and encourages people to make positive financial choices, leading them toward greater stability.

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INTRODUCTION

In an increasingly complex economic landscape, effective personal finance management has become crucial for individual well-being and economic stability. However, traditional methods of financial tracking and budgeting often prove cumbersome and time-consuming, particularly for individuals lacking specialized financial expertise. This often leads to poor financial decision-making, increased debt, and difficulty achieving long-term financial goals. Existing mobile applications assist financial consumers. This paper explores an AI-driven expense advisory system that seeks to revolutionize personal financial management by automating key processes, providing personalized insights, and enhancing user understanding through intuitive data visualization. By leveraging machine learning algorithms and user-centered design, the proposed system aims to democratize access to sophisticated financial management tools, thereby empowering individuals to take control of their finances and achieve their financial aspirations.

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The significance of this research lies in its potential to address the growing need for accessible, personalized, and effective financial management solutions in an increasingly complex economic landscape.

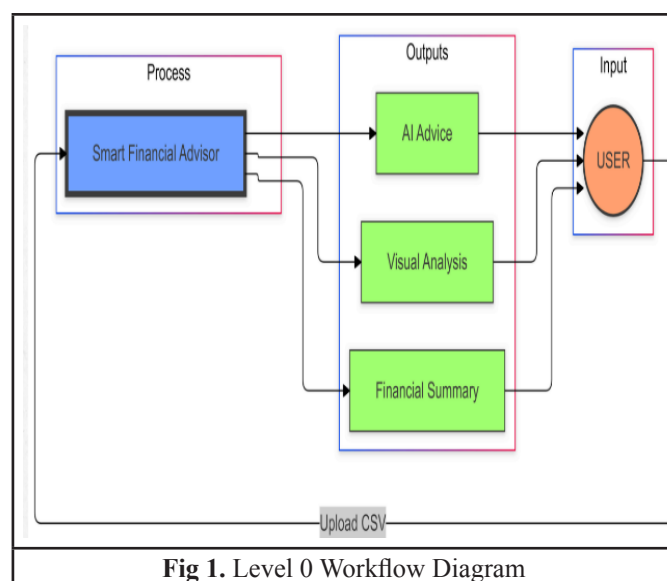


Fig 1. Level 0 Workflow Diagram

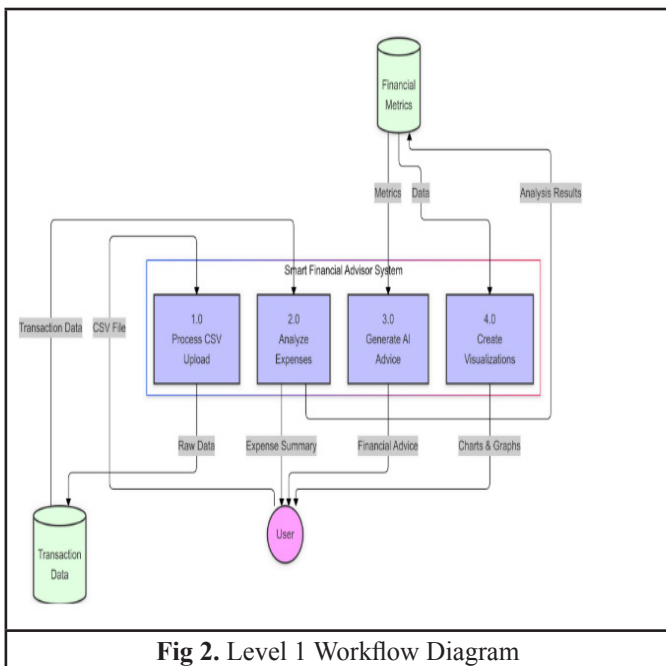


Fig 2. Level 1 Workflow Diagram

LITERATURE REVIEW

The development of AI-driven financial advisory systems builds upon a rich body of research in personal finance, machine learning, and human-computer interaction. Existing literature highlights the challenges associated with traditional financial management methods, including manual tracking, limited insights, and lack of personalized guidance.

Shao et al. (2022) created intelligent financial advisors by employing a multitask learning approach to identify potential clients. Patel et al. (2024) investigated the application of blockchain security measures in financial management. Li et al. (2022) developed an early warning model for financial management using a two-layer kriging element model algorithm. Ramjattan et al. (2021) investigated the use of chatbot technology to make personalized financial decisions.

Singla et al. (2024) created a daily expense tracking system. Pangavhane et al. (2023) investigated the transformation of finance through automation with AI-powered personal finance advisors. Johri et al. (2023) developed an expense management system. Chen (2020) investigated the financial management of small and micro enterprises using cloud accounting in the big data age. Peng and Lu (2011) conducted a demand-affecting factor analysis for the personal financial management business. Yadav et al. (2016) introduced a smart expense management model for smart homes. However, these approaches frequently lack comprehensive automation, personalized insights, and user-friendly data visualization. PENNYWISE builds on previous efforts by combining AI and data visualization to create a comprehensive and user-friendly financial management solution.

METHODOLOGY

Pennywise was developed using a step-by-step approach that involved gathering feedback from users at every stage of its creation. The system was built using technologies such as Python, Streamlit, and Mongo DB.

The methods include:

Data Collection and Preprocessing: A diverse dataset of financial transactions was collected from various sources, including bank statements and credit card reports. The data was pre-processed to remove inconsistencies, standardize formats, and handle missing values.

Transaction Categorization: Machine learning algorithms, including support vector machines (SVM) and random forests, were trained to automatically categorize transactions based on merchant names, descriptions, and transaction amounts. Natural language processing (NLP) techniques were employed to extract relevant features from transaction descriptions.

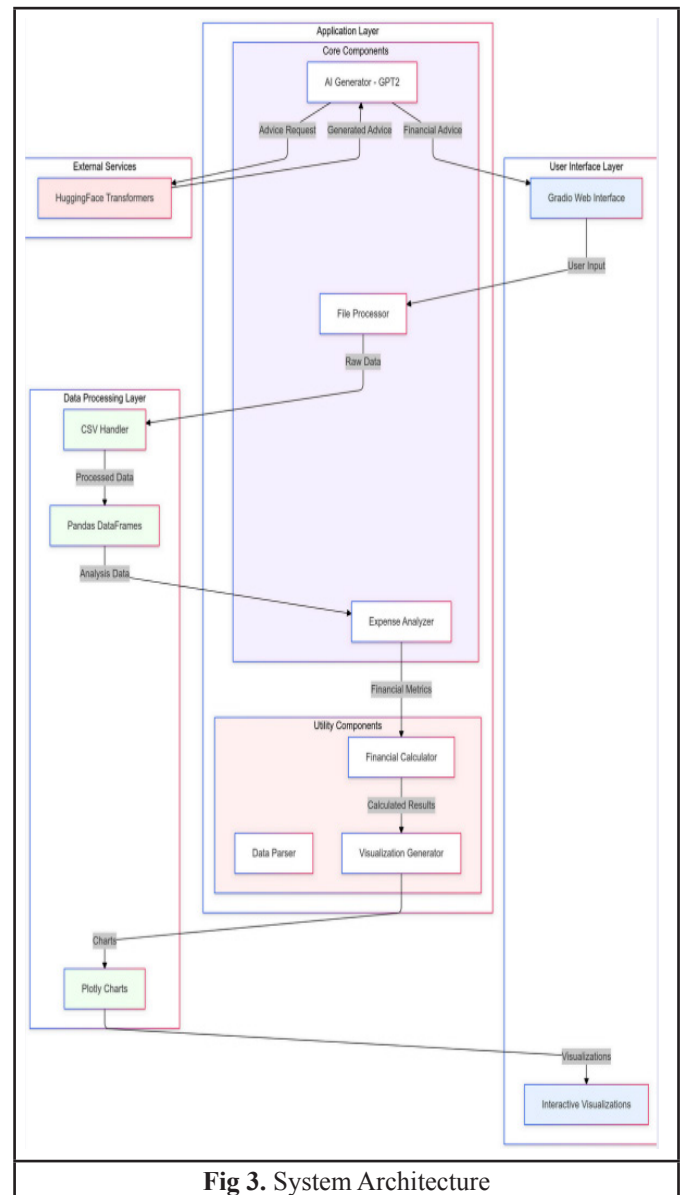


Fig 3. System Architecture

Spending Pattern Analysis: Statistical analysis and time series analysis were used to identify spending patterns, trends, and anomalies. Algorithms were developed to detect recurring expenses, seasonal variations, and unusual spending behaviors.

Recommendation Generation: A rule-based recommendation engine was developed to generate personalized financial advice based on user financial goals, spending patterns, and income levels. Machine learning models were used to predict the potential impact of different financial decisions and to identify opportunities for savings and debt reduction.

Data Visualization: Intuitive data visualizations were designed to transform complex financial information into easily understandable graphical representations. Plotly and Streamlit were used to create interactive charts, graphs, and dashboards.

User Interface Development: A user-friendly interface was developed using Streamlit, providing users with seamless access to system features and insights. The interface was designed to be responsive and accessible across different devices.

Evaluation: The system’s performance and effectiveness were evaluated through user testing, quantitative metrics, and qualitative feedback. Key metrics included transaction categorization accuracy, recommendation acceptance rate, and user satisfaction.

RESULTS AND FINDINGS

The evaluation of the AI-driven expense advisory system yielded several key findings:

Transaction Categorization Accuracy: The machine learning algorithms achieved an average transaction categorization accuracy of 92.3%, demonstrating the system’s ability to automatically classify transactions with high precision.

Personalized Recommendations: User testing revealed that the system’s personalized recommendations were highly relevant and actionable. The recommendation engine achieved an acceptance rate of 67%, indicating that users found the advice to be valuable and useful.

Data Visualization Effectiveness: The data visualizations were found to be highly effective in enhancing user understanding of their financial situation. Dashboards loaded in an average of 1.2 seconds, with visualizations taking less than 0.5 seconds to render. User feedback indicated that the charts, graphs, and dashboards were intuitive and easy to interpret, enabling users to identify patterns, trends, and anomalies in their spending behavior.

User Satisfaction: Overall user satisfaction with the system was high, with 87% of users rating the interface as “very intuitive” or “extremely intuitive.” Users reported that the system helped them to gain a better understanding of their finances, make informed financial decisions, and achieve their financial goals.

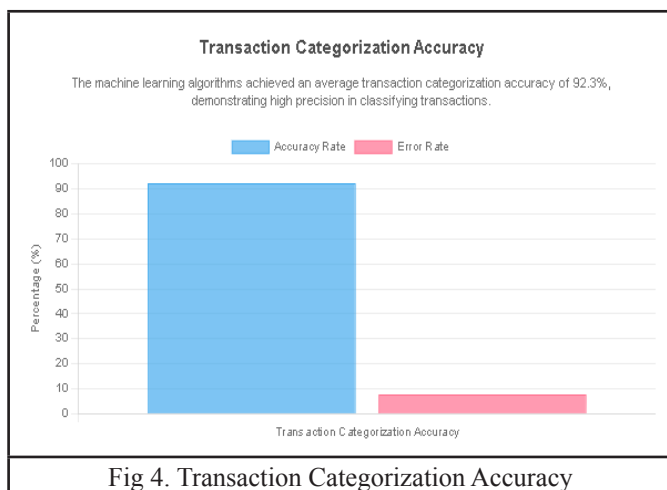


Fig 4. Transaction Categorization Accuracy

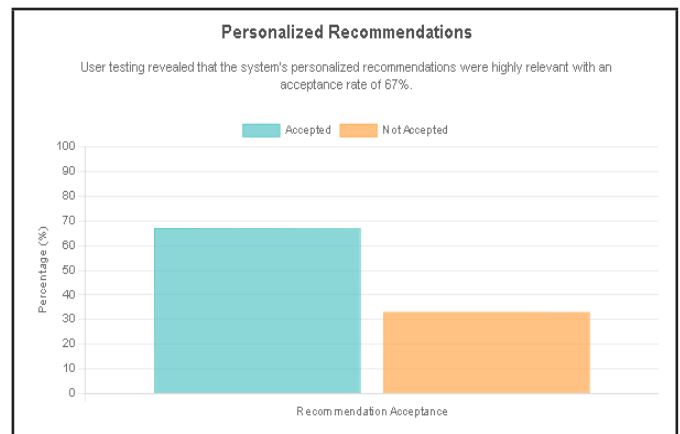


Fig 5. Personalized Recommendations

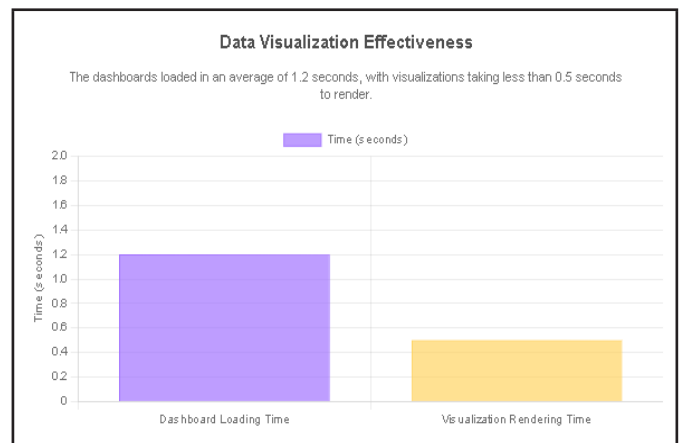


Fig 6. Data Visualization Effectiveness

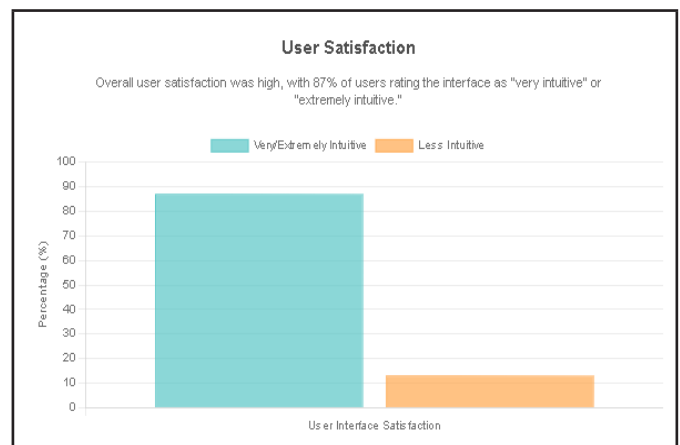


Fig 7. User Satisfaction

CONCLUSION

This research demonstrates the potential of AI-driven expense advisory systems to revolutionize personal finance management. By automating key processes, providing personalized insights, and enhancing user understanding through intuitive data visualization, the developed system empowers individuals to take control of their finances and achieve their financial aspirations.

The system’s high transaction categorization accuracy, relevant personalized recommendations, and effective data visualizations highlight the benefits of integrating AI and user-centered design into financial management tools. While there is always room for improvement, the findings of this

study suggest that AI-powered expense advisory systems hold significant promise for democratizing access to sophisticated financial management tools and promoting financial well-being on a broader scale.

Future research should focus on expanding the system's data integration capabilities, exploring more sophisticated machine learning algorithms, and developing specialized modules for specific financial needs. By continuously improving its technological foundations, expanding its functional scope, and enhancing user experience, the system can remain at the forefront of personal financial management technology while delivering ever-increasing value to its users.

STATEMENTS AND DECLARATIONS

Funding: This study was carried out with no financial assistance or grants from external organisations, institutions, or funding agencies. All resources used in the research were organised independently, ensuring an unbiased and self-sustaining approach to the study.

Conflicts of Interest: The authors confirm that there were no personal, financial, or professional conflicts that could have influenced the research findings, analysis, or conclusions presented in this work. The study was conducted with complete academic integrity and impartiality.

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