AI Powered Personal Finance Assistant

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Abstract-Personal finance is one of the challenging activities that a person may encounter because it is hard to trace the costs, budget and to invest funds. The proposed project will be an attempt to create the A.I. Powered Personal Finance Assistant that will be capable of assisting the user with smart and real-time support of financial processes. The machine learning used in the system examines the revenues and the expenses to formulate individualized budgets as well as predict the future expenditure patterns. It provides security to a vulnerable financial information with an inbuilt secure database and authentication model. The assistant predicts how a user would utilise his or her funds and possesses a chatbot powered by AIs, which provides personal financial guidance and suggestions in investments and savings. The interactive interface can also assist the user to track his or her financial goals, alerts and make more suitable decisions. Besides that, the system will be scalable and flexible as well as will be able to be extended to new financial technologies like banking APIs and tax planning modules. It is also applicable in the educational and professional sphere in the development of financial discipline, as a result of this flexibility. It is indicated that the automation, the predictive advice and personal advice demonstrate how the AI can alter the nature of the interaction between individuals and money.

Keywords : Personal Finance, Artificial Intelligence, Machine Learning, Expense Tracking, Budget Optimization.

I. INTRODUCTION

The management of personal finances is an extremely complex and an important aspect of life during the digital age. The problems are normally the cost control determination, managing the different accounts, budgeting, and making wise investments. Manual solutions and spreadsheets can be subject to human error, and can not be customized, and cannot provide real-time financial data. Thus, many people simply cannot afford the financial stability and financial literacy, and the latest advancement of the Artificial Intelligence (AI) and the Machine Learning (ML) is a chance to alter the way people will relate to their personal finances. AI-powered assistants can handle transaction data, categorise costs, predict spending patterns and make targeted recommendations with regards to the monetary goals of an individual. Unlike the current mechanisms of developing a fixed budget, the intelligent financial assistants could be designed in a more dynamic fashion to react to the consumer behavior and deliver actionable data, which will enable the users to make better financial decisions. Predictive models, anomaly detection algorithms and conversational interfaces can be used to deploy all these assistants as a digital financial advisor. Not only do they help to enhance the user experience, but also in the field of financial literacy by allowing the complex concepts to be

explained through interactive means. Since the questions of privacy and security become more legitimate, the existing AI-based project will be planned and launched as an encrypted, authenticated securely, and ethical AI-based personal finance assistant to guarantee the privacy of sensitive financial information. The proposed system will be a joint of data analytics and modeling predictors that will offer a comprehensive approach to finance management. By bridging the gap between technology and financial literacy, the system would make financial planning efficient, easy and straightforward.

II. RELATED WORKS

Traditional budget and cost tracking have been extremely manual. People were accustomed to physical ledgers or diaries or even spreadsheets as an everyday practice that could be used to record daily transactions. Although these methods provide extremely easy tracking, they are not scalable and fail to provide actionable knowledge. In addition, manual data entry will not be welcome because of the time consuming implementation process and the implementation process is not sustainable. With the enhancement of the computational methods, there has been the application of Machine Learning in the financial sectors. ML-based systems have shown positive performances in tasks such as transaction classification, fraud detection and forecasting. Such algorithms as the Random Forests have been used to classify financial data with a reasonable level of precision. Most of these applications have however been designed to serve the interests of the financial institutions and not individuals. Their functionality, therefore, is not greatly aligned to take into consideration the needs of personal finance as an individual.

AI reports are another breakthrough in the world of finance. These chat bots provide a simple way of interacting with financial systems by way of responding to natural language queries. Some of the questions that a chatbot can respond to include What were my total expenses last month. or "How much did I spend at the groceries? Even though all these tools increase the level of accessibility, most of them are reduced to a simple query processing but lack advanced predictive analysis and detection of anomalies. Academic and industrial literature has considered personal finance predictive models.

Regression, time-series models and deep learning models, such as Long Short-Term Memory (LSTM) networks, have been used to do income and expense forecasting. These models can identify trends and patterns of seasons. However, this degree of prediction technologies is barely integrated into the apps provided to the consumer, and research is not connected with the real world. As per the analysis of the provided systems, needless to say, most of the tools are focused on either the fundamental tracking or general recommendations. The majority of them are not individual, customized, or an integration of different technologies. The proposed system will address these gaps through the incorporation of the classifications of ML with anomaly detectors and predictive analytics in one system.

III. PROPOSED METHODOLOGY

System Methodology proposed. Data acquisition is the catalyst of the proposed system methodology. Different financial information sources are gathered such as bank statements (csv/pdf), SMS notifications, API provided by financial institutions and information entered by the user. All these disparate sources are made compatible such that they are processed as a single standard.

- Data preprocessing is a significant process since raw financial data is typically rife with inconsistency, duplication as well as sensitive information.
- It entails data cleaning, duplication removal and handling data that is missing in addition to transforming data that is not in an organized format to an orderly format.
- One such thing is that raw transaction information may contain merchant codes or redundant text which will require filtering with a filter.

The advanced transactions are further categorized into limited items like groceries, utilities, transport and entertainment. The confidential information such as the account numbers and user names are also guaranteed by the methods of anonymization. The system architecture can be readily scaled and highly architectured into the distinct layers of functions. In essence, the suite of machine learning (ML) model can be applied to accomplish tasks such as expense classification, anomaly detection and budget prediction.

It is grounded on an encrypted data warehouse that takes the form of a database and a user-friendly front-end interface to view the analysis results in interactive dashboard and charts. This is a modular design, which will ensure that it can be made flexible and add other AI-related functionalities to it easily in the future. The machine learning module is used as the back-bone of analysis. Expense categorization operates under the trained supervised learning algorithm such as the Random Forests algorithm and the Deep Neural Networks that have been trained on labeled data set where transactions are assigned to a certain category. Anomaly detection uses some of the models such as Isolation Forests and Autoencoders to establish an abnormal or suspicious spending activity. To predict the budget and estimate the finances, the system will involve both regression and time series model containing the ARIMA and LSTM networks that would be used to predict the future expenditure based on historical spending patterns. Among the most important advancements that the proposed system will bring about, the introduction of the Generative AI with the help of the Gemini API developed by Google can be cited.

- This API enables the system to implement automatic deployment of automatically generated smart financial reports and insights in line with the ability of natural language generation.

- After information processing and analysis with the ML models, the Gemini API in turn dynamically produces the personalised summaries, expense breakdowns and cause of anomalies in human readable format.

IV. SYSTEM ARCHITECTURE

A. Introduction to System Architecture

a client-server architecture-based system where the front-end web or mobile interface securely communicates with the back-end services through API gateways. The setup will, therefore, permit users to interact in real time with financial data through an easy-to-use user interface that is smooth and glitch-free. Thus, the proposed architecture consists of three layers: Presentation, Core Services, and Data Integration. Each of these interacts in a coordinated manner to facilitate effective data processing and system scaling.

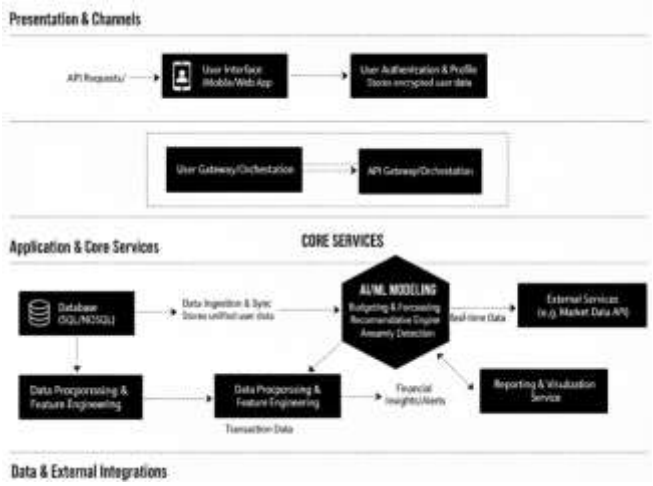

Figure 1: AI powered personal finance assistant system architecture proposal.

B. User Interface and Authentication Module

The User Interface and Authentication Module serves as the entry point to the system. The interface, developed using React (App.tsx and related components), allows users to log in, upload financial data, and request AI-generated financial reports. The authentication component (authService.ts) achieves safe entry and registration of the systems through credentials validation, session tokens, and limiting access to the system. This module is more usable without compromising on data privacy and system integrity.

Key features include:

1.Active protection of logins and token access control by each user.

2.Easy to use dashboard in handling data and reports.

3.based access to guarantee authorized interactions.

C. Data Preprocessing and Acquisition Module.

This module works with collecting and standardizing financial data of various sources, including CSVs uploads, APIs, and manual entries. The data preprocessing.py script removes, rectifies and formats the raw data to ensure consistency and higher accuracy of the analytical process. It removes duplicated records and formats features to be used in machine learning downstream models.

D. Machine Learning and AI Analysis Module.

The analytical core of the system is comprised of the Machine Learning and AI Analysis Module. It combines the ideas of the Random Forest and LSTM model situated in the back-end (random_forest_model.py, lstm_model.py) to classify, predict, and forecast financial matters. Moreover, AI based summaries and intelligent suggestions are generated with the help of the Gemini API (geminiService.ts). With predictive and generative AI, a combination of both, both quantitative and natural language are offered as explanations.

E. Data Storage and Management Module.

The Data Storage and Management Module provides data organization which is persistent, secure and structured. It stores user credentials, transactions, analytical results and report history in the form of efficient database mechanism. The backend keeps encrypted data and ensures redundancy so that it can be more quickly retrieved and to ensure data integrity.

F. Reporting and Visualization Module.

Reporting and Visualization Module is targeted at converting analytical data into understandable knowledge. It has been deployed in the React front end to create charts, summary, and dashboard to enable users to visualize spending patterns and financial projections. The output has been made clear to enable decision-making with the help of AI-driven insights.

G. Integration and Communication Module

This module is used to synchronize all the internal and external interfaces among the layers of the system. The main.py also serves as an API gateway, where it is responsible to receive requests submitted by the front end and invoke the ML models, as well as to respond to the results of processing. It guarantees synchronization, handling of errors and safe communication with external APIs like Gemini AI service.

Key features include:

- RESTful communication between frontend and backend.
- Secure API integration with Gemini and data services.
- Optimized request handling for low-latency responses.

H. System Modularity and Deployment

The system has a modular architecture that allows separate updating, testing, and maintenance of a component. Its light weight characteristic enables it to be deployed in many settings like educators, personal and financial organizations. It is flexible and scalable with minimal hardware dependency and optimal performance.

The proposed AI-Based Personal Finance Management System is a system that combines the latest web technologies, machine learning algorithms, and capabilities of generative AI to provide intelligent financial insights in real-time. The system is based on clientserver architecture and is a combination of React-based frontend and Python based backend fitted with Random Forest and LSTM models to provide accurate forecasting and trend analysis. It can also be generated through the use of the Gemini API that generates detailed financial reports in natural language and thus improves user comprehension and interaction.

By and large, the system is a full-fledged solution of financial information management, smart analytics, and AI-enabled reporting. Its innovative integration of machine learning and generative AI enables proactive decision-making, making it a valuable tool for users seeking automation, accuracy, and accessibility in financial management. Processing and failure of features of accessibility

V.RESULTS AND ANALYSIS

The system is analyzed on the basis of a number of performance indicators. In order to confirm effective classification, accuracy, precision, recall and F1-score are applied to classification processes such as expense categorization. The used models of anomalies detection are rated in accordance with the ROC-AUC scores used as all measures of the ability to distinguish the normal and abnormal transactions. The measures which are used to indicate the budget forecasting models are the means of Absolute error (MAE) and Root mean square error (RMSE). The graphics constitute an important element of the system. The system transforms the raw numbers to the information that can be understood by presenting the data as pie chart, line charts and bar charts. The user can also easily tell the categories that are dominating their budget and how costs are rising and falling and at what level the budgets are being exceeded. Predictive graphs will cause people to anticipate the financial strain they will face in the future and make wise compromises before. The practicability of the system was demonstrated by system effective pilot testing with sample users. With the access to the anonymized financial data, the user would be better informed about their spending habits. The majority of the interviewees have noticed that they are now increasingly aware of their financial habits and they are capable of reducing unnecessary expenses. It demonstrates the relevance of smart and customized recommendations in contrast to traditional tools that are not dynamic. The advantages of the suggested assistant were uncovered as compared to the available tools. Even though the classic applications use is often mainly premised on the static tracking, the application featuring the AI-based algorithms also incorporates adaptive learning and predictive analytics, and, therefore, enables providing more personalized and emphatic suggestions that can be made in future. However, limitations remain. In the case where the description of the transactions is unconcrete or unsatisfactory, the validity of categorization decreases. In addition, massive data volumes may also be a risk to real-time performance, and the support of cross-border, or multi-currency, operations is not available at present.

VI. CONCLUSION

The artificial intelligence-based personal finance assistant offered in this paper can exhibit ML, and predictive analytics to approach the problem of managing personal finances. The system goes beyond the traditional approaches and current applications by automation of expense tracking, identification of anomalies, and customized budgeting suggestions. It gives people the financial strength to make wise financial choices and encourages a more financial discipline. This system can be further extended in the future. Incorporating investment and savings apps would enable the customers to have a complete picture of their finances. Further voice-enabled assists may also increase ease of accessibility as people can interrelate using spoken prompts. There is need to develop stronger encryption techniques in the improvement of the security of the sensitive financial details. In addition, further specific and more exact instructions can be offered based on adaptive models that are formed based on the user behavior. The system will become a full-fledged financial advisor of an individual as it progresses and this will also lead to the future sustainability and growth.

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