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AI Powered Personal Finance Tracker with Behavioral Analytics

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Abstract— Managing personal finances has grown ever more complicated especially as we witness the explosion of digital payments, online banking, e-commerce platforms and new consumer behaviors. Financial management systems have traditionally been very focused on recording financial transactions and keeping track of expenses without much help for users to understand their financial characteristics or get advice on how to spend their money wisely. This paper introduces the idea of developing an AI-Powered Personal Finance Tracker with Behavioral Analysis which is a smart and personalized way of dealing with financial transactions. The solution is a combination of the finance data manager with user behavior analytics, machine learning-generated finance reports, personalized suggestions, investment and stock advice, multi-person family financial planning, and monitoring in one single platform. Users can be allowed to provide bank account details via bank API in such a secure way so that the financial information is being accessed by only those users with a valid bank account and user permission. Behavioral analytics is able to detect the spending habits and financial habits of the users to generate the income, expenditure, and saving trends. Firebase Cloud Fire store database has been chosen by us as a very real-time, synchronized, and secure database. In addition, the system will implement Firebase authentication as only the authentic and verified users will be allowed to log in to a specified account. By making use of predictive analysis and customized advice, this innovative system will enable individuals to understand their personal money matters more thoroughly and ultimately, to make financially wise choices.

Keywords— ***Artificial Intelligence, Personal Finance Management, Behavioral Analytics, Machine Learning, Financial Recommendations, Investment Recommendations Bank API Real-Time Monitoring, Family Financial Planning.***

I. INTRODUCTION

Managing personal finances is an area which recently has generated lots of interest especially in the wake of the popularity of mobile payments, banking apps, etc. Financial activities such as purchasing goods and services with one's card, saving, investing as well as spending all take part in the financial decision-making chain of an individual. It is really hard for such individuals to keep a constant tab on their expenses, budget saving or investment strategies and overall financial wellness without some help. The very old and very common means like writing by hand and even more simplistic, one-dimensional budgeting software show the overall transaction history without going deep into the details and at the same time are unable to reveal the spending pattern or make financial personalized recommendation.

This paper proposes an **AI Personal Finance Tracker With Behavioral Analytics** which is a system that merges the tracking of financial data with machine learning that offers smart analysis and recommendations customized according to the users. This platform provides you with various financial analysis methods that rely on different branches of Machine Learning to better understand a set of transactions extracted from a bank API, customized recommenders based on the user's habits, etc.

In addition to investment and stock recommendation features, it allows family multi-user planning to be carried out and family finances are to be checked and monitored and alerts to be issued instantly in the occurrence of any financial happenings. On the other hand, the system is intended first of all to allow the users to understand the different ways their money flows, keep track of their spending more closely, plan for saving, and make investment decisions, all of which are based on knowledge and facts. By merging features of financial tracking, behavioral analysis, machine learning, and recommendation mechanisms on a single platform, the system will assist users in managing their finances efficiently over time. Besides, it has been proposed by a text-to-speech (voice-based) financial advisor as a potential direction for development to give users a more direct engagement method with their systems. A considerable number of AI-based personal finance assistants are designed such that all the user has to do is input the information while the assistant does the calculations. These apps mainly streamline tasks related to checking your spending, managing your budget, estimating your financial situation, financial planning, and the study of behavior changes. Beneath each such system, there are one or several technologies, e.g., Machine Learning, Natural Language Processing, Linear Regression, Long Short Term Memory, K-Means, clustering, and predictive methods, that the system takes into account or is based on. However, the bulk of the personal finance solutions only deal with a particular part of a person's financial life and thus, they don't have to tackle an entire financial situation of an individual as a system that integrates various aspects of personal finance management does. [6] In their work, an AI-driven personal finance agent that could use Machine Learning and Natural Language Processing to monitor spending, manage budget, offer investment advice, and generate personalized financial insights.[5] On the other hand, in their experiment, put investment strategies of ChatGPT and robo-advisors to risk-based investor profiles. [4] Lakshmi and co. built a financial tracker that uses Linear Regression to predict budget and graphically analyzes the financial situation. [2] this paper implemented LSTM and K-Means clustering for forecasting expense and modeling consumer clusters [1] while the group, used the combination of LSTM, K-Means and sentiment analysis to predict, optimize, the financial market and investment decisions.[3] this paper have suggested AI-assisted a system that includes an automatic categorization of expenses, a budget tracking tool with a brain, risk-based forecasting via advanced analytics, and the use of behavioral finance principles. The role and capabilities of AI and Machine Learning have been well-established by research especially in the banking industry. This led to AI systems that handle financial predictions, manage personal finances, investment analysis, and recommendations. Some papers in academia are indicating that artificial intelligence is able to advise people how they should handle money affairs, put their financial affairs in order, control budgets, etc.

II. METHODOLOGY

After several research steps involving data collecting and handling as well as data mining and interpretation, the authors of this paper have finally come up with some interesting conclusions. They have also identified five ways in which their system is built. The methods

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of the system, in this case, bank transactions, machine learning, and behavioral analytics have also played roles.
Apart from the methods, there are features like Personalization and Real-time financial monitoring that are also implemented in the solution.

Below are the different main aspects of the proposed approach as well as descriptions:

A. Data Acquisition
As a medium of bank integration, the system uses an **Setu Account Aggregator (AA) Sandbox API**. The users are given read-only access to the their financial data, and their privacy data is protected.
B. Data Preparation
The data is then cleaned and transformed into a dataset. Once it is structured and ready for analysis, it can help the system identify patterns of spending and classify different types of purchases. Machine learning methods such as a **Random Forest Classifier** are used by the system to categorize the transaction. Features which could be used for this task include the transaction amount, the description of the transaction, and many more.
C. Expense Forecasting Model
The system can also show the user his spending pattern and the prediction of how much he will spend over a long time. This feature can give an idea of how a budget will evolve as a consequence of this behavior or even warn the user about his money management if something is going very wrong. **Random Forest is a Regression technique** and is applied to calculate a person's expenses based on the person's financial features. If, in fact, the expenditure is regular over time or is closely correlated with time, then using a **LSTM (Long Short-Term Memory) Model** enables the accurate forecasting of expenses.
D. Behavioral Analytics
Using users' data like income, expenses, etc. is a great way of identifying financial behavior which the system will then use to detect. K-Means Clustering was the method through which users/groups are grouped together based on their expenditure habits or behavioral similarities so that the market can be divided into behavioral segments. Mixing machine learning based clustering patterns together with the rules based set of financial indicators will result in a deeper understanding of customers' financial habits.
E. Detection of Anomalies
The method of identifying financial irregularities in spending behavior that Isolation Forest is used for. This model is very good at identifying transactions or spending behaviors that largely deviate from what users usually do in terms of expense level. The ability to raise awareness of any unforeseen spending that users are uninformed about or spot suspicious financial behavior is the benefit of this capability.
F. Recommendation Engine
In this recommendation system, a **hybrid technique** combines **rule-based financial analysis with insights from machine learning models**(). Various criteria like income, expenses, savings, spending habits, behavior traits and a risk profile of the individual are included among many other factors in the system for generating financial suggestions.
With the help of these factors combined, the system is able to deliver financial advice which is perfectly fitting the needs of the users.
G. Investing
The system recommends how to invest in accordance with the financial situation and the risk profile of the user. Being able to give such advice implies depending heavily on a user's financial data and risk features of the users. It should be clarified that this stage of the project doesn't involve a live stock data API since it is still undecided which sources of external data will be used in stock analysis.
H. Family Financial Planning
The system allows for a multi-user **Family Mode** to facilitate family member financial planning and management of data through Firebase Cloud Firestore. This feature allows the financial information and planning activities to be handled by the entire family member in the family setting, which is the case here.
I. Real-Time Financial Monitoring
In order to deliver continuous updates of real-time nature, **Cloud Firestore on Snapshot()** are employed. The application can reflect any financial data changes through these features without the need for user-initiated refreshes thereby the ability to constantly monitor financial activities remains.
J. System Technologies
Frontend development of the system is done with **React, Vite,** and **Tailwind CSS,** whereas the backend part of the system is managed through the help of **Node.js and Express.js**. The Firebase Cloud Firestore component has all the functions of the database, while Firebase Authentication handles user-related login functions. **Recharts** are employed for showing up financial data, and **Axios**, **Fetch API** together with **REST APIs** have roles of handling communication tasks among different components of the application.

III. SYSTEM ARCHITECTURE

The system in our proposal comprises different layers that handle acquisition of financial data, cloud storage, machine learning, behavioral analytics, generation of recommendations, and live visualization.
The whole system is composed of a React-based interface, Firebase user authentication, Node.js and Express.js backend, Setu Account Aggregator for collecting bank transactions, Firebase Cloud Firestore for data storage, and Python-based machine learning service separately run.
A. User Interface Layer
User interface is based on React, Vite, and Tailwind CSS frameworks. It has a bunch of features: Login/Register, Dashboard, Transactions, Budget and Budget Progress, AI Insights/Financial Advisor, Investment Hub, Family Planner, Goals, Recent Transactions, charts, summaries, Bank Connection flow. UI displays data and recommendations from the backend modules and analytics.
B. Authentication and Security Layer
The user is authenticated with Firebase (Google Sign-In + Email/Password option).Once logged in, Firebase will supply the user with an identity token, which the React app will then use as a means of contacting the Express API for fetching user information from the latter. The Express server will validate the Firebase token with the help of Firebase Admin SDK. As a result, the records can indeed be connected to users' Firebase UIDs after authentication is established.
C. Bank Data Acquisition Layer
In the backend, we made use of Setu Account Aggregator Sandbox API for enabling financial transaction access on a user-consent basis. The user initiate the Bank Connection from the React dashboard, which is a React frontend application. Afterward, an authenticated request goes from frontend through to the backend via Express. The request also contains details required by the backend to process it. When the user's consent is obtained and after the bank account is connected, transaction data is collected from Financial Information Provider which then gives the data to processing system. After that, the information is stored in Firestore and analyzed and presented in real time.
D. Backend and Data Processing Layer
The backend is made of Node.js and Express.js. It protects the dashboard area and takes care of bank authorization consent, bank consent, bank consent Setu OAuth login, account aggregator interaction etc. Axios, Fetch API, REST-based communication are the main methods for different application modules to communicate. User token verification, user financial data processing are also done at this step.

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E. Machine Learning Layer

A separate python machine learning service is proposed for handling financial ML models. Main python-based tools for financial ML model implementation are Pandas, NumPy, scikit-learn, and TensorFlow/Keras. Architecture would include a Random Forests model for expense prediction and regression tasks, a Random Forest model to categories transactions and do classification, K means model for customer segmentation, Isolation Forest for the detection of fraud/abnormal spending, and LSTM model for the forecasting of time-series expenses.

F. Behavioral Analytics Layer

Behavioral analytics is based mostly on different financial metrics like income, total expenditure, expenditure in different categories, savings, expense-to-income ratio, number of transactions per month, monthly spending, habits of repeating one type of spending, and budget utilization. These behavioral insights mostly result from financial rule-based logic and K-means clustering is planned to enhance behavioral segmentation. This analysis will be able to reveal things like typical spending habits, savings behaviors, areas where spending is over and budget risk indicators.

G. Hybrid Recommendation Layer

Financial advice is tailored and recommended by the recommendation engine that takes into account different factors such as financial calculations, behavioral analytics, ML forecasts, and user risk levels. The financial data of the user is a necessary input to this engine besides their budget utilization, patterns of spending, clusters of behavior, expected expenses, and the risk level of investments. The engine could come up with several types of advice such as tips on saving, budget planning, alerts against overbudgeting, ways to control budget, investment suggestion, and overall health assessment of finances.

H. Family's Financial Plan

The Family Mode is connected to Firestore of Firebase Cloud to handle family member financial planning and associated data. Financial records are connected to authenticated users through the Firebase UID, so that personal user financial information can stay within the system.

I .Real-Time Data Watching and Displaying

Firebase Cloud Firestore delivers the capability for automatic data updating through onS napshot() listeners. When a financial data is modified in Firestore, React app instantly gets the new data and updates the dashboard. Thus, users can keep an eye on and get instant updates for financial transactions, summaries, budgets, etc., related to them.

IV. RESULT ANALYSIS

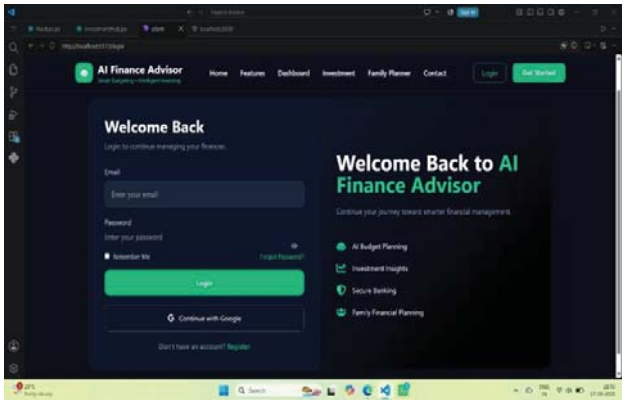


Fig-4.1 Login Page

The above Fig 4.1 shows the login page of AI Finance Advisor wherein users can access the system in a safe and secure manner with email/password or Google Sign-In. Once the authentication process is passed, the user is allowed to log into the dashboard and use the different services like setting a budget, investment advice, money security, and family budget planning.

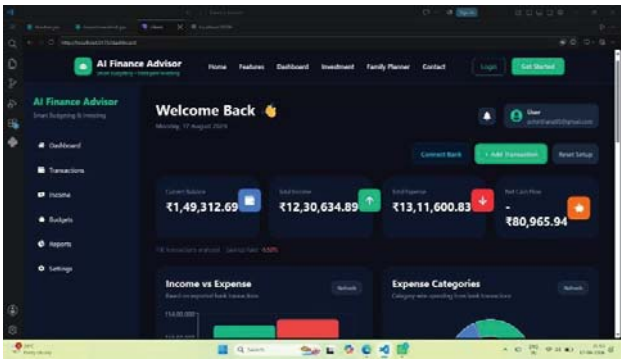


Fig 4.2 Main Dashboard

The above Fig 4.2 that gives a great idea of the main screen of the AI Finance Advisor. The user gets the chance to view their current balance, total income, total expenditure, cash flow, savings rate, and number of transactions processed and analyzed. In addition, it features the ability to set up an account with a bank or simply input your transactions by hand.

The pie chart on the left and the column of charts on the right visually show the income vs. expense trends and the breakdown of spending per category. This visualization helps users instantly perceive their financial health.

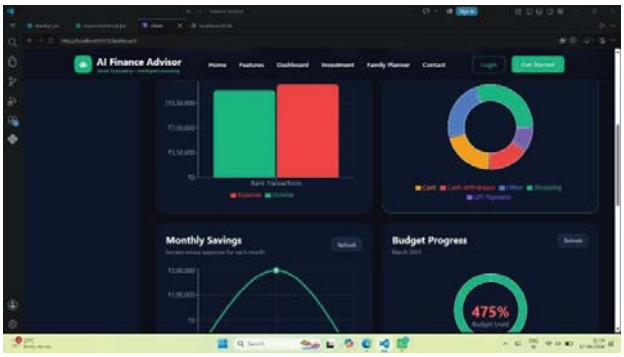


Fig 4.3 Dashboard

In the Fig 4.3 shown above, we are introduced to the financial analysis area of the AI Finance Advisor tool, where there is a comparison feature of total income and expenses, a category wise breakdown through a piechart, a chart for monthly savings patterns and one more for tracking budget usage.



Fig 4.4 Family Planner Module

This Fig 4.4 illustrates the Family Planner feature within the AI Finance Advisor, which has a number of capabilities. To begin with, users are able to introduce family members one by one. Then, the

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shared budget should be defined. Furthermore, tracking of each household member's deposits towards savings as well as management of jointly held financial goals are part of the service.

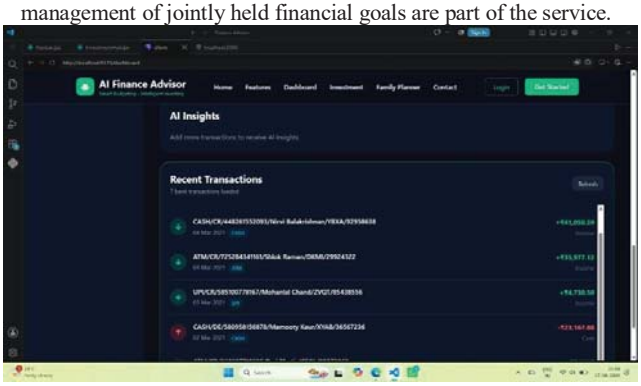


Fig 4.5 Recent Transaction

This Fig 4.5 illustrates the 'recent transactions and AI insights' part of the AI Finance Advisor.It lists the bank statements in terms of date, payment mode, brief, amount, and whether a transaction adds income or deducts expenses. These records will help in generating the user's financial reports for spending analyses, customized financial advises, and future AI-based

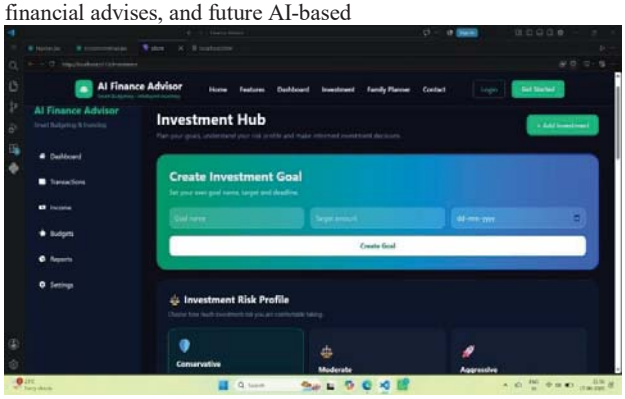


Fig 4.6 Investment Hub

This Fig 4.6 shows that the Investment Hub is one of several components of the AI Finance Advisor which allows users.

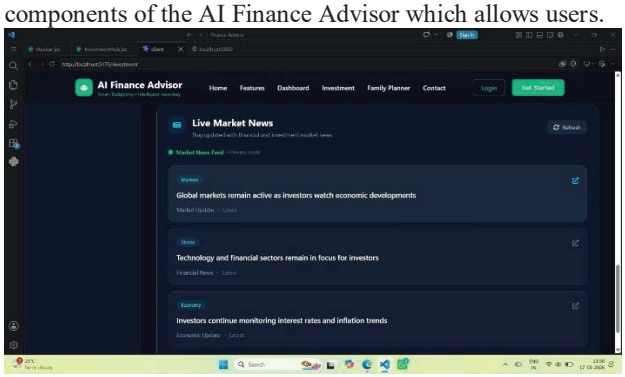


Fig 4.7 Live Market News Section

This Fig 4.7 features the Live Market News segment of AI Finance Advisor , through which users can check market , stock and economic updates. Apart form being informative , such a functionality enables users to learn financial events timely enough to affect their investment decisions and know the future market trend .proposals.

V .CONCLUSION

The AI Personal Finance Tracker equipped with Behavioral Analytics is quite helpful in providing a total financial solution. It merges functions such money tracking, analysis of the user's spending habits and giving them suggestions as well as investment directions that are personal to the user, it also helps with planning of a family's financial needs, and continuous monitoring of financial features in real-time is all that it does. By analyzing the spending habits and the behaviors of individual users with regard to money matters, The AI system could not only supply users with valuable information but also be a consultant in making life wise financial decisions. Introducing a system for real-time synchronization and cloud-based data management has made it so much easier for users not only in the area of using the system but also in accessing it conveniently. In addition, it is this coupling of a bank API with a machine-based financial analysis system that really paves the way for fully automatic data entry and, as such, producing smart financial advice.

It is further expected that the software will be able to provide more functionalities by adding a voice command financial assistant that will give users the choice of engaging the app via very natural speaking commands. We have also the intention of combining and employing Deep Learning with State of The Art machine learning in order to enhance prediction of expenses and behavior analytics, transactions classification and financial forecasting.

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