

SmartBudget AI: An Intelligent Personal Finance and Family Budgeting System Using Generative Artificial Intelligence

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Abstract:

Managing finances effectively has recently been becoming more difficult because of increased household expenses, varying expenditure habits, and challenges in joint family spending. Generally, traditional budgeting tools rely on manually recording transactions and do not contribute to making financial analysis smarter, budgeting jointly, or processing the expenses automatically. This paper suggests SmartBudget AI as a way of solving the problem. SmartBudget AI is an intelligent personal finance management and budgeting system that integrates the web and Android ecosystems and uses Generative AI to complete financial operations easily and better than end-users do now. The system architecture relies on the client-server application concept. The application consists of a Flask-based web client and an Android native application built on Kotlin and Jetpack Compose. The system is using central relational databases managed by SQLAlchemy, and all interactions within the system are implemented through RESTful API. A unique feature of the developed system is the usage of Google Gemini – a multimodal AI large language model designed to extract financial information from receipt images.

Keywords-Important Words- *Family Budget Management, Personal Finance Management, Generative AI, Seamless Access through Google Gemini, MLLM, Information Extraction from Receipts, Expenses Monitoring, Financial Analysis, RESTful API, Flask Applications, Android Apps, Jetpack Compose, Predictive Analysis.*

i. Introduction

Financial management controls the financial situation of people, such as families. All the rapid evolution of digital payment systems, online shopping, subscription services, and transaction-free transactions made the financial matters much more complicated than before [1], [10]. Many people find themselves in the situation when they can't keep track of every deal, see how much is spent, and observe one's own budget while not losing sight of long-term goals. Though there are many tools related to personal finances today, many of them still rely on the manual way of inputting data which is slow, error-prone and makes people less willing to keep records about their finances [5], [8].

Meanwhile, the advances in the field of Artificial Intelligence (AI), the so-called Generative AI, and multimodal neural networks opened new opportunities for smarter financial management. Instead of performing usual rule-based information extraction, multimodal AI systems can read pictures of bills and receipts and convert them into financial records. As a result, it decreases the amount of manual work to a great extent and improves the overall performance and organization of expense management process [3], [7].

In the same way, household finances management is generally no longer limited only to personal expense tracking. Families need a team environment to work

together on joint finance, sharing not only incomes but also expenses, budgets, and savings in a secured manner. Most apps only cater for individuals, and currently available ones do not provide enough resources for group collaboration, central monitoring of expenses, as well as full-fledged financial analysis [2], [6], [11].

As there are many solutions that do not combine mobile and web solutions effectively, ultimately users find their experiences broken; managing finance also soon becomes inconsistent, which may be difficult to notice in the beginning [5], [8]. This paper presents SmartBudget AI, a sophisticated family budgeting solution that combines web technologies based on Flask and the native Android app due to secure use of RESTful APIs.

It should be noted that SmartBudget AI also utilizes Google Gemini, the multimodal Generative AI that can recognize receipt images [3], [7], [8].

Along with the ability to process receipts by means of AI, SmartBudget AI provides role-based financial management for families by allowing everyone involved in household finances to operate in the same workspace. There are tools for tracking income and spending, budget preparation, and savings aspirations, as well as financial analytics and interactive dashboards in this solution. It should be noted that there are no differences in functionality between both the mobile application and web solutions, as they are powered by the same web

application backend and database. The main objective of this research is to design and develop a smart financial management application that employs modern web technologies, native Android development, RESTful services, and Generative Artificial Intelligence for everyday money management and making intelligent decisions [2], [3], [4], [7].

ii. Literature Review

The recent years have seen tremendous growth in the field of artificial intelligence and machine learning and their application in personal finance management. A variety of researchers have developed systems that are capable of tracking expenses, predicting costs, planning budgets, forecasting finances, and giving personalized financial advice to users. Various datasets, algorithms,

and prediction methods are used in these studies to improve financial decision-making. The report will discuss the changing preferences and buying behavior of the Generation Z cohort concerning sustainability in clothing. As a digital-first generation, Gen Z has greater economic power and an understanding of environmental matters and influences the decision-making process of retailers. The research assesses the values driving them towards sustainability, such as the need for the transparency and authenticity of the brand and social responsibility. Additionally, the report discusses the inconsistency between Gen Z's principles about sustainability and their actual buying behavior that has been affected by the need for personal finance management and the impact of the fast fashion industry on their choices.

Ref.	Author(s)	Methodology / Algorithms	Major Contribution	Research Gap
[1]	Wasserbacher & Spindler (2022)	LASSO, Random Forest, Double Machine Learning	Improved financial forecasting and budgeting decisions	No household expense prediction or family budgeting support
[2]	Nattapong Puttanapong & Siphath Lim (2024)	Random Forest, Neural Network, SVR, GLS	Accurate household expenditure prediction	No budgeting recommendations or financial analytics dashboard
[3]	Pallak Chahar et al. (2025)	Random Forest, SVM, LSTM, NLP	AI-powered personal finance management	No collaborative family expense management
[4]	Bhavana B. R., D. Pavan & Guru Darshan T. H. (2025)	XGBoost, Random Forest, BERT, ARIMA, LSTM	Wealth advisory using predictive analytics	No family financial management and household prediction
[5]	Rajshree Jadhav & G. A. Patil (2025)	Random Forest, SVM, ANN, NLP	AI-based expense categorization and budgeting	Individual-user focused
[6]	Anusha Nandikanti et al. (2025)	Logistic Regression, Random Forest Regressor, ARIMA	Goal tracking and savings prediction	Manual transaction entry; no collaborative planning
[7]	Neha Kulshrestha et al. (2025)	LSTM, Deep Learning, OCR, NLP	Real-time expense forecasting	No household financial analytics
[8]	S. Aishwarya & S. Hemalatha (2024)	Decision Trees, Neural Networks, LSTM	Automated expense tracking	No family budgeting or financial planning
[9]	Arnav Kushwaha et al. (2026)	Linear, Multiple & Polynomial Regression	Spending pattern prediction	No anomaly detection or recommendation system
[10]	Meifu Li (2021)	Machine Learning, Information Gain, Big Data Analytics	Enterprise financial forecasting	Not suitable for personal finance
[11]	M. Chandana et al. (2026)	Random Forest, LSTM	AI-based expense prediction	No shared budgeting or family analytics
[12]	Vipul et al. (2019)	Linear Regression	Monthly expenditure prediction	No budgeting analytics or family finance management

Table 1. Comparative Analysis of Existing Studies

As is seen from Table 1, previous work has somewhat achieved using a number of machine learning and artificial intelligence techniques for financial predictions, expense categorization, budgeting, and spending pattern analysis. The methods such as Random Forest, Support Vector Machine (SVM), Long Short-Term Memory (LSTM), Artificial Neural Networks (ANN), XGBoost, ARIMA, and Linear Regression have been used extensively to improve the accuracy of the predictions and to automate the financial analysis. Several scientists conducted research into receipt processing, recommendation systems, and anomaly detection with the aim to enhance the effectiveness of personal finance management. However, despite all the advances in that area, the shortcomings become evident. The majority of currently available products is designed for personal usage and does not enable family financial management. A lot of systems still rely on manual data entry of financial transactions. The majority of their products lack an integrated financial dashboard and have limited integration of web and mobile applications. It could be said that there is a certain gap here. With this purpose in mind, the SmartBudget AI project was created — an integrated software package comprised of a web application based on Flask, an Android-based app, receipt processing based on Google Gemini, and provision of rights to the family members.

iii. Research Gap and Motivation

Upon exploration of the body of work in this field, it is evident that noteworthy advances have been achieved in the areas of expense tracking, forecast of finances and budgeting as well as, to a larger extent, intelligent management of finances overall. Various approaches in terms of Machine Learning have been adopted in research conducted by numerous scholars. Such methods as Random Forest, SVM, LSTM, ANN and Linear Regression have been employed for analyzing such aspects of finance as expenditure prediction, serving the purpose of payment categorization and providing recommendations related to finances. Moreover, some investigations in the field were dedicated to receipt processing with the help of AI technology for the ultimate aim of streamlining personal financial operations.

Feature	Existing Studies	SmartBudget AI
Expense Tracking	✓ Available	✓ Enhanced
Family Budgeting	Limited	✓ Complete
AI Receipt Extraction	✗ Not Available	✓ Google Gemini

Expense Prediction	✓ Available	✓ Advanced ML
Android Application	Few Studies	✓ Yes
Web Application	Few Studies	✓ Yes
Recommendation System	Partial	✓ Personalized

Table 2. Feature Comparison Matrix

Nevertheless, several issues persist. Many existing financial management systems seem to have been created for individual users primarily, rather than aimed towards family finances and collaborative use. Without the capability of creating shared financial space, it becomes difficult for several members of the family to keep track of budgetary issues and plan their finances while safeguarding sensitive information at the same time. In addition, the vast majority of available solutions have either tended towards web-based financial management or mobile solutions, but the market lacks a single platform offering both types of access that would guarantee the synchronism of financial data in different solutions and working with one backend service. Such a separation results in an uneven customer experience and reduces the level of accessibility during the change of different devices. Furthermore, even though previous studies confirm the effectiveness of predictive analytics with respect to budgeting, a number of solutions remain unconnected in different stages of financial management. In order to fill these gaps, this research presents SmartBudget AI, which is designed as a smart personal finances and family budget system. SmartBudget AI combines a web application based on Flask and a native Android application through the use of secured RESTful API. The system utilizes Google Gemini, which is a multimodal Generative AI model, to extract structured finance data from images of receipts automatically. This allows for minimizing the amount of manual actions connected with entering transactions. In addition to that, SmartBudget AI is able to provide such features as family team effort on budget management, centralized control over finances, interactive dashboards, budget and savings tracking.

Current study	SmartBudget AI Proposal
Existing research has several disadvantages, first, it was developed with the intent of an individual consumer, which practically excludes the possibility of group work.	With SmartBudget AI, the situation is different: it supports group family financial management through the role-based access.
Moreover, manual input of transactions can be tedious.	SmartBudget AI replaces the manual input of transactions with automatic receipt processing using AI and Google Gemini.
Furthermore, there is poor integration of mobile and web applications, so synchronization doesn't work well.	It utilizes integrated web and mobile apps.
In addition, the expense tracking process is relatively simple and basic.	For instance, SmartBudget AI allows users to enjoy various smart features such as monitoring of budgets and expenses, tracking of savings, as well as financial analytics.
Next, the financial management process utilized separate modules, which is not as efficient as blended approach proposed by the system.	Instead of the modules, the system allows for integration of income, expenses, savings, budgeting, and analytics.
Finally, the receipt processing technology is nevertheless quite inefficient.	Nevertheless, SmartBudget AI claims to be able to extract amount, date, merchant, and category of transaction from receipt images.
In the end, there were still inconsistencies in syncing between devices, which led to data that was sometimes inaccurate.	Moreover, the synchronization between devices is managed by the centralized backend to ensure that the data is rightly synced across the Web and Android apps.

Table 3. Research Gap Analysis

iv. Objectives and Contributions

A. Objectives

The major aim of this research is to come up with more effective financial management system that is not only sophisticated but also user friendly thanks to the use of Artificial Intelligence and multi platform accessibility. In other words, SmartBudget AI system is supposed to be a feasible tool, and not just a theoretical project. The specific aims of SmartBudget AI system that is suggested can be gone through in the list below, which includes:

- Developing a single platform for managing income, expenses, budgets and savings of a family.
- Offering an application based on Flask as well as a native mobile application for Android that will be linked to each other with the help of RESTful APIs.
- Automating the process of receipt data extraction with the use of Google Gemini so that users spend less time on entering data.

- Facilitating the process of family budgeting through role based user management as well as sharing financial data with different access rights.
- Creating dashboards for monitoring budget spending, usage of budget and achievement in savings from time to time.
- Creating predictive financial analytics system that can help users analyze their expenditures and plan their future budgets better.
- Using intelligent automation and common

B. Major Contributions

Our concept of the SmartBudget AI system enhances personal finance management in several ways:

1. **Multi-Platform Financial Management:**
SmartBudget offers a combination of a web app and a mobile app so that our users could access their financial data with ease regardless of the device.
2. **AI-Based Extraction of Receipt Data:**

With Google Gemini at the heart of our solution, we can easily extract information from receipts so that our users won't have to type transactions manually.

3. Collaborative Budgeting for Families:

We offer family budgeting based on roles so that families will be able to manage their common budget by different members, while the roles will be clearly determined.

4. Centralized Financial Analysis:

SmartBudget uses dashboards to present people with financial summaries.

5. RESTful API Architecture:

Objective	Implemented Feature
Gathered tools for financial monitoring	Incorporation of income, expenses, budgeting, and savings in one system.
Versatile access from different devices	Combination of Flask web application and Android app.
Automated management of receipts	Implementation of Google Gemini technology in receipt management process.
Integrated collaborative budget planning	Provision for family members to access limited information depending on their family role.
Easy financial monitoring	Creation of visual dashboards and finance reports.
Predictions	Ability to predict spending and examine trends.
Safe integrated solution	Ability for the system's components to interact without any synchronization required.

Table 4. Objectives and Corresponding System Features

v. Proposed System Architecture

The SmartBudget AI system proposed is simply a multi-tired intelligent finance management platform consisting of a web application developed using Flask framework, Android app, centralized backend processing, Google Gemini for receipt information retrieval and a relational database. The main concept of the design is that all components should interact with each other using RESTful APIs that guarantee safety of communication and let users manage the household finances simultaneously using different devices. The design is also modular, which makes it easier to scale up, maintain and enhance it in the future, and that is also has features of cooperative budgeting, some smart automation, and predictive financial analysis.

SmartBudget is built according to the modular backend architecture that allows its components, e.g. web app, mobile app, AI service, and database, to communicate in a safe way.

6. Design with Scalability and Extension Capability:

The system's design is such that it allows for growth and expansion in future since it can include features for integration of bank accounts, advanced predictive analysis, personalized financial recommendations, and addition services powered by AI.

A. Overall System Architecture

The general architecture is designed as a layered client-server architecture comprising two client interfaces (Web and Android), central Flask backend, AI-driven receipt processing, and shared database. The users can make use of the system via both smart devices or web interface. In both cases requests are handled through Flask REST API. for intelligent extraction of the information. Meanwhile, the database is where everything lands, such as records relating to finances of a user, its profiles, budgets, and savings related information.

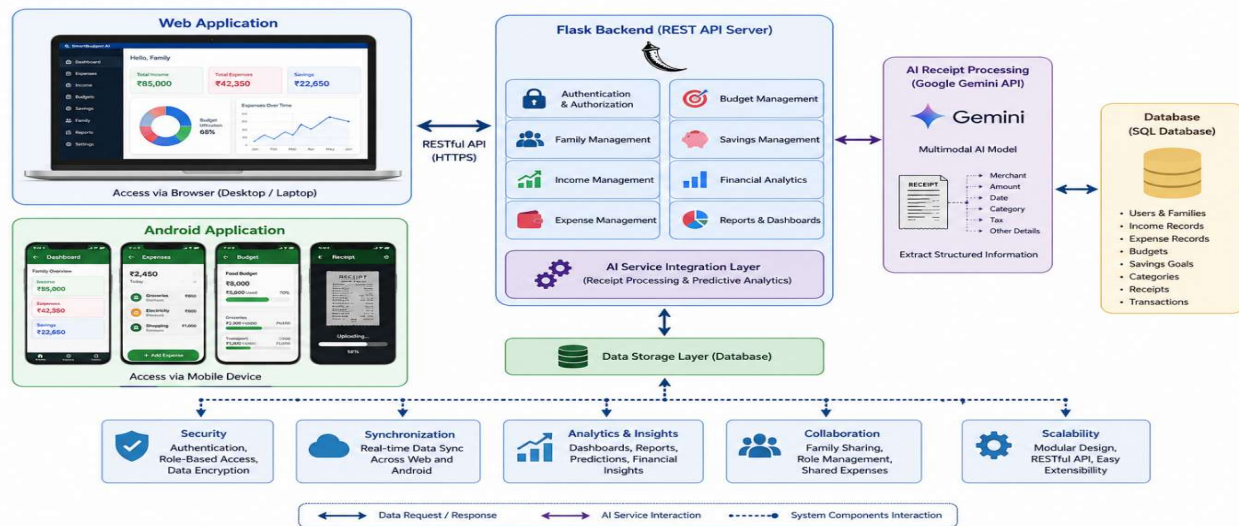


Figure 1. Overall System Architecture

Figure 1 Explanation:

The figure illustrates, to some extent, how both the Web App and the Android app communicate with the Flask REST API. In the background, authentication activities, family management, processing of income and expenses and budget tracking, receipt extraction, and predictive analysis take place, as well as database handling... each of these activities is explained. After that, received receipts are processed by Google Gemini and the obtained information is saved in the central database where it will be used for further financial analyses.

B. Web Application Architecture

The web app has a responsive interface allowing users to perform all their money-related tasks through web browsers from their desktops or lap tops. The app connects to the Flask backend through RESTful APIs supporting the following features such as user registration and login, being able to manage family, record income, track expenses, create budgets, monitor savings, and view a financial dashboard. The frontend was created using a modular approach, separating presentation, interaction with user, and backend communication.

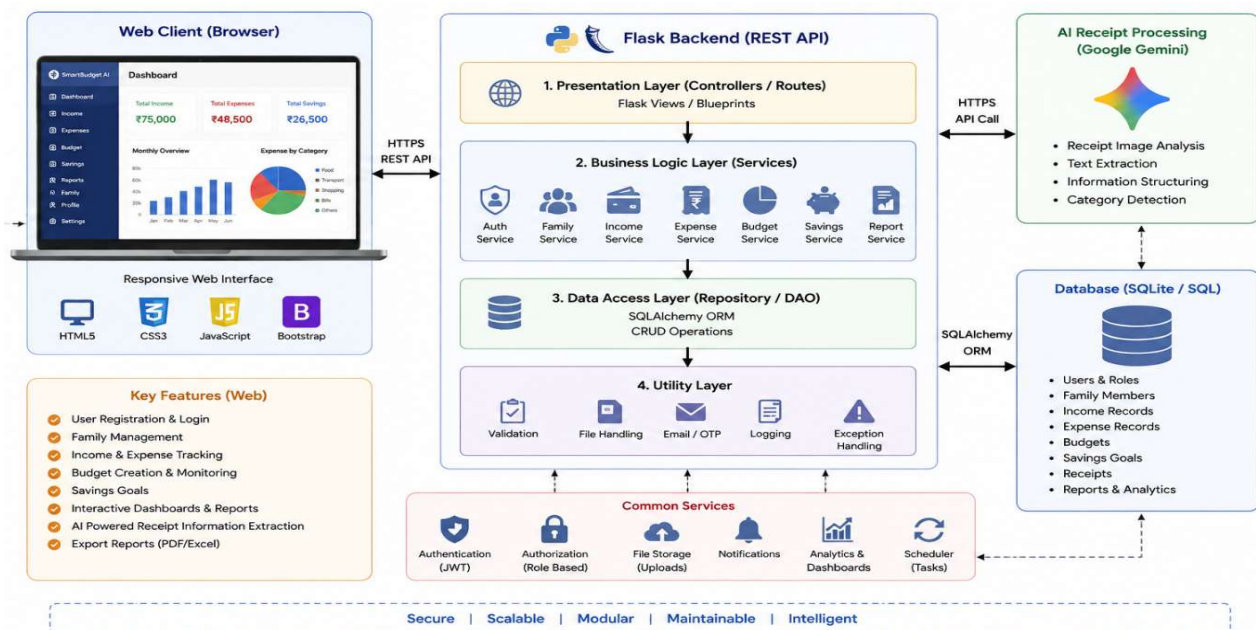


Figure 2. Web Application Architecture

Figure 2 Explanation:

The web client sends user requests to the Flask REST API, which processes this information by checking the

incoming data and implementing a business logic. It can also reach out to Google Gemini for processing confirmations, when needed. Then, it will access the relevant database for the whole process.

C. Android Application Architecture

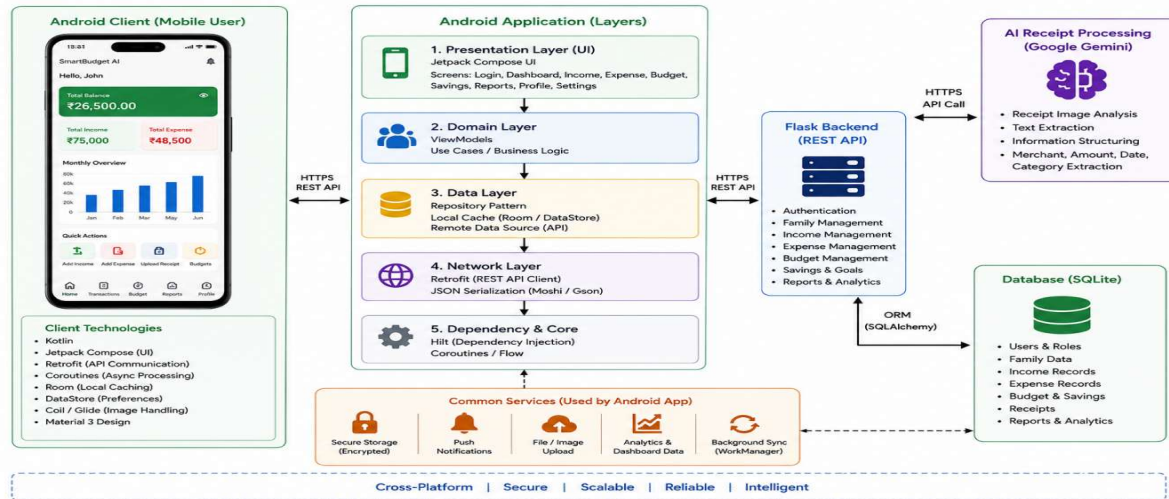


Figure 3. Android Application Architecture

Figure 3 Explanation:

Thus, the android software communicates with the Flask REST API through secure HTTPS requests so that the financial data remains updated with both the Android and Web platforms. Whenever a person adds expenses, uploads receipts, or views finances, the backend takes care of these requests.

D. AI Receipt Processing Architecture

In this new system, Google Gemini, which is a multilevel Generative Artificial Intelligence model, is

The Android app takes the workflow of the web system to mobile devices. The user can take care of their finances in places where they were unable to do so via web applications. The app has all the necessary features, such as login, records storage, receipt images upload, budget creation, saving, and dashboard updates, thanks to the RESTful API.

introduced for the receipt image extraction. After the image upload is completed by the user, the image is transferred via back-end to Gemini API using secure channels. Gemini will read the receipt and extract significant information such as supplier name, amount spent, date and product type. The structured output before entering the database is verified strictly by the system, which minimizes all manual processing, thus allowing for hassle-free storing of transactions.

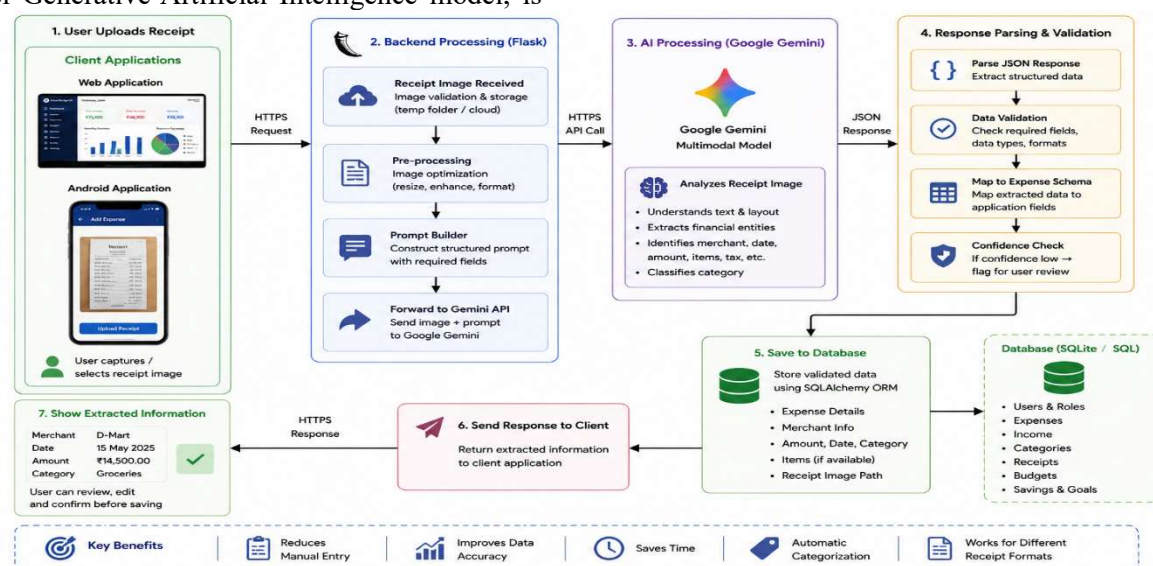


Figure 4. AI Receipt Processing Architecture

Figure 4 Explanation:

The receipt image you upload is sent from the client application to the Flask back-end, which, in turn, forwards the request to Google Gemini. After these actions, the transaction data is verified for accuracy and ends up being stored in the database, meantime letting the user visualize the transaction data for confirmation.

Essentially, the architecture of the database serves as the main repository for all data used by the applications, this includes, among other things, user accounts, relatives information, income, and expenses. The application uses SQLAlchemy as the Object Relational Mapping, ORM, framework that allows the Flask application to communicate effectively with the relational database. This makes it possible to ensure data consistency and simplicity of code maintenance.

E. Database Architecture

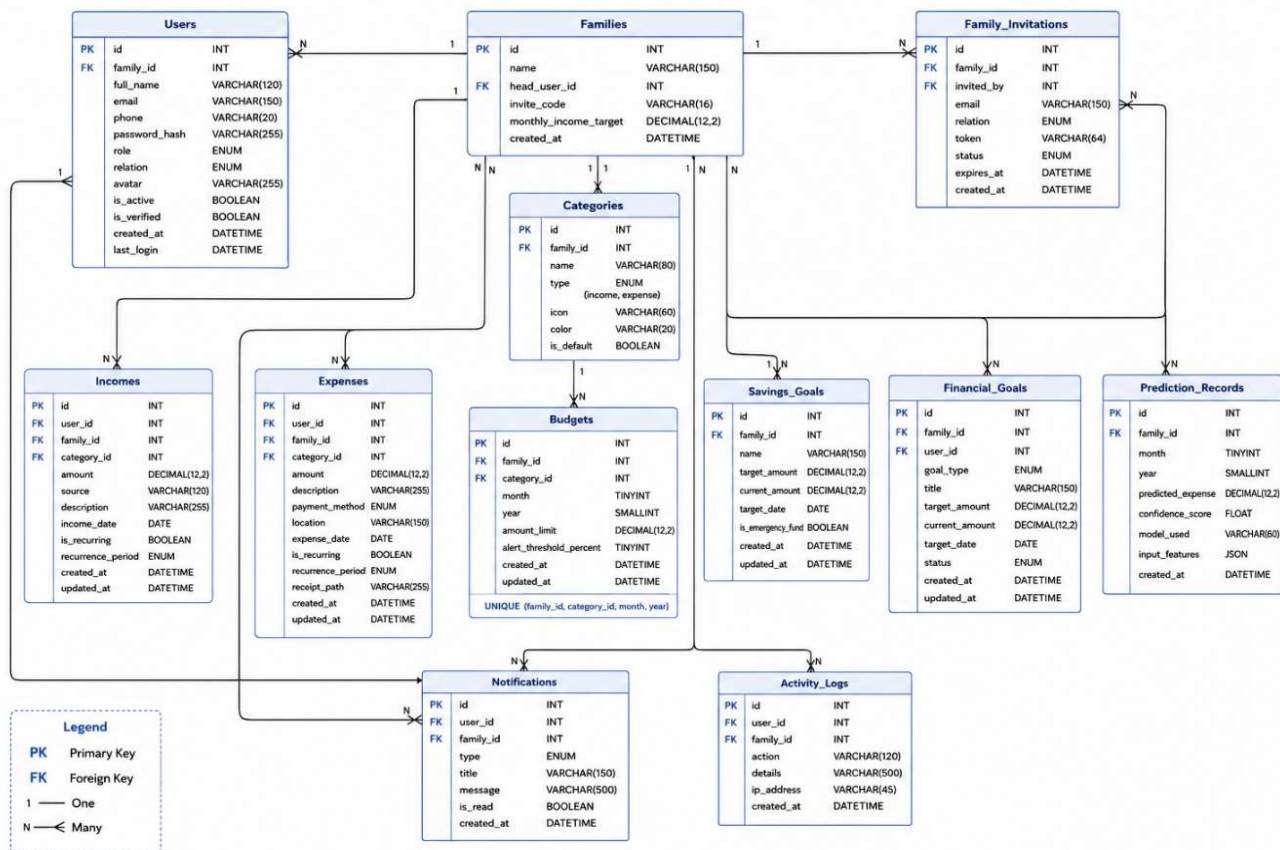


Figure 5. Database Architecture

Figure 5 Explanation:

The database includes several entities that are interrelated, including users, families, income records, expense records, budgets, and savings objectives along with various other information regarding their finances. The relationship forms between the entities to keep the information consistent over time so that the application can access the information as and when required.

F. System Workflow

The working of the system begins with user signing into the system with the help of either web application or Android applications. Once the user has logged in, he or she can manage family information, record income and expenses, upload the pictures of receipts, and prepare budgets as well as check the savings. After this, the image is processed through Google Gemini to pull out essential information regarding receipts and the extracted data is then updated in the central database. At the same time, system is updating the financial information so that user can know about his came nicely

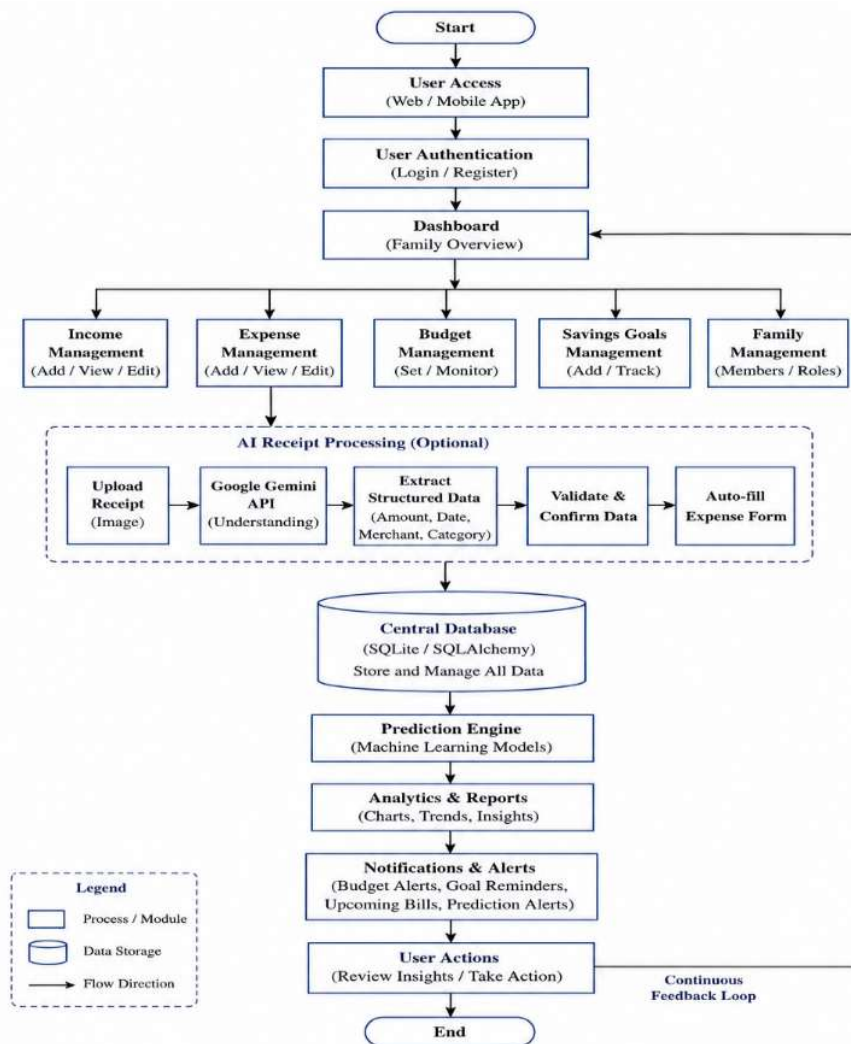


Figure 6. System Workflow

Figure 6 Explanation:

The entire process begins with authentication of the user, followed by entry of financial information or the upload of a receipt of purchase. Afterward, the backend takes care of everything involved in the process. It even uses Google Gemini for receipt processing if necessary. Once the data has been verified, it is sent to the database and allows the generation of updated financial reports as well as dashboards for Web and Android users.

vi. System Methodology

The SmartBudget AI system is built on the modular client-server architecture, which includes a web application, an Android application, and a backend. The Google Gemini application handles receipt processing as well as predicts trends and works with a relational database. The methodology behind the program starts with user authentication, goes through data management, AI receipt processing, predictive analysis, and the final step of report generation. Module-to-module connection is done via RESTful API to ensure that the user gets the same level of functionality on a variety of platforms.

A. User Authentication and Authorization

The process of authentication is responsible for determining the identity of users before access is allowed. New users are able to register by entering their details while existing users will need to provide the authentication information. Once the verification step is completed successfully, the next step involves establishing a secure session and setting up permissions.

B. Family Management Module

The Family Management Module allows users to manage their expenses collectively, instead of relying on one person to do it all. What the module allows users to do is form a family group of multiple users. Once the users are authenticated, the family head is able to send invitations and create a family at his/her discretion, and manage connections within his/her household.

C. Income Management Module

The Income Management Module manages the money coming from family members. Users are able to enter data about the type of income, category, amount, and date of the transaction. The system then verifies whether the input is valid before saving it to the database. This stored information can help in creating budgets, providing financial reports, and making forecasts.

D. Expense Management Module

The Expense Management Module is focused on expenses. The user is able to enter the data manually or upload an image of a receipt for automatic information extraction. Each expense normally contains the category of the transaction, the amount spent, payment method, transaction date and, if possible, the image of the receipt. After it is verified, the expenses are stored in the database and can be used for reporting, budgeting, and forecasting.

E. AI-Based Receipt Information Extraction

The system incorporates Google Gemini for the intelligent processing of receipts to minimize manual typing. When a receipt photo reaches the system, then the image is sent to Gemini API with a prompt. The AI system analyzes the receipt and extracts organized information such as the name of the seller, transaction amount, date of purchasing, and type of expense. Then the processed data is verified for accuracy followed by filling in the form for the expense to let the user review and approve the expenses before they are sent for saving.

F. Budget Management Module

The Budget Management Module allows users to set limits on budget spending per category per month. The system checks actual spending against the initial budget every time an expense is made. If certain specific values are exceeded, it provides the user with alerts and notifications for his/her spending.

G. Savings Goal Management

Meanwhile, using this module gives users tools for long-term financial planning and goal setting. Users can enter a financial goal by specifying the target amount to be saved and the date on which this goal is to be reached. The module compares the actual amount saved with the defined goal and periodically updates its progress report in order to help users to analyze their financial progress.

H. Financial Health Index (FHI)

In order to evaluate the financial status of users of the proposed system, the proposed SmartBudget AI computes a **financial health index (FHI)**. The introduced index combines several financial parameters

into a single number from 0 to 100, which allows users to understand their financial situation.

The calculation of the financial health index is based on four financial metrics, that have to be taken into account:

- **Savings rate (SR):**
The ratio of savings from income after expenses.
- **Budget compliance (BC):**
The measure of the amount of the actual expenses according to the planned budget.
- **Expense stability (ES):**
The regularity of monthly expenses over the time.
- **Emergency fund (EF):**
Availability of emergency savings compared to the recommended amount.

The introduced financial health index can be measured by the following formula:

$$FHI = 0.35(SR) + 0.30(BC) + 0.20(ES) + 0.15(EF)$$

Where:

- **SR** = Savings Rate
- **BC** = Budget Compliance
- **ES** = Expense Stability
- **EF** = Emergency Fund Score

The weights satisfy:

$$0.35 + 0.30 + 0.20 + 0.15 = 1.00$$

ensuring that the final Financial Health Index remains normalized.

Interpretation of FHI

FHI Score	Financial Status
90–100	Excellent
75–89	Very Good
60–74	Good
40–59	Needs Improvement
Below 40	Poor

Benefits

Some advantages of the Financial Health Index are the following:

- Assess the overall financial situation with one score.
- Track changes in spending behavior and financial practices.

- Recognize the specific financial weaknesses that need to be addressed.
- Obtain individualized recommendations based on one's index rating.
- Monitor financial health over time with the help of periodic reviews.

I. Financial Analytics Dashboard

The Financial Analytics Dashboard provides comprehensive financial data through real-time data visualization and allows users see prompt information about total income, expenses, savings, budget usage, category-wise spending, and other important indicators. The data comes from a unified data source and transformed into valuable and actionable insights.

J. Predictive Analytics Module

The concept of predictive analytics entails detailed research of past revenues and expenditures in order to find out what the expenses and expenses may look like in the future. The system collects the historical data from the financial database, conducts predictive modeling, and gives a number of expenses plus probabilities in certain cases. The predicted data serves the users for their financial planning, budgeting, and precise expense tracking.

K. Keys Rotation and Fault-tolerance Function

To increase the dependability of the receipt processing through AI, the backend uses an API key rotation method for the Google Gemini service. In the case of an API call that is not successful due to the quota endpoint, temporary service errors, and other similar problems, the backend will automatically switch to another

available API key. Thus fault tolerance improves the availability of the service.

L. REST API Communication

Both the backend and the web and Android application communicate through RESTful APIs. Client requests are made using HTTP methods before being processed by the Flask backend which validates them and stores them in the central database. The backend replies in the form of structured JSON to the client applications. It allows keeping financial data consistent across both platforms.

vii. Database Design

SmartBudget AI system employs relational database management system that allows working with financial data efficiently. Functions of this database cover all major functional modules as user management, family collaboration, income and expense management, budgeting, savings goals management, forecasting, notification, and activity logs. The relationship between entities is maintained via primary and foreign key constraints of the ER model that helps maintain data inconsistencies.

B. Entity Relationship Diagram (ERD)

In Section 7.5 we have already depicted the logical structure of the database in Figure 5 (Entity Relationship Diagram). The ERD explains how the main entities are interrelated – Families, Users, Categories, Income, Expenses, Budget, Savings Goals, Financial Goals, Predictions Records, Notifications, Activity Logs, and Family Invitations. These relationships facilitate both storage and retrieval and assist in maintaining referential integrity.

A. Database Schema

Table	Primary Objective
Families	Stores information about families and their common financial parameters
Users	Stores information about users' accounts, roles, and authentication data
Categories	Identifies categories of income and expenses
Incomes	Holds information about income transactions
Expenses	Holds information about expenses and receipts
Budgets	Key player in the management of monthly budget
Savings Goals	Monitors savings goals
Financial Goals	Holds information about long-term financial goals
Prediction Records	Holds predictions about expenses
Notifications	Holds alerts and reminders

Activity Logs	Monitors user activities
Family Invitations	Manages family invitations

Table 5. Summary of Database Tables

C. Data Flow

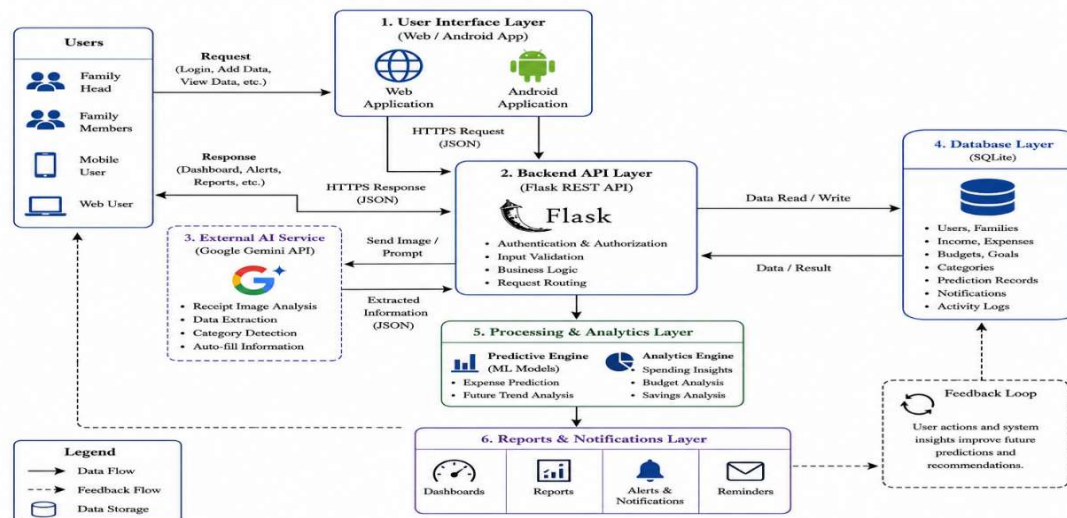


Figure 7. Data Flow Diagram of SmartBudget AI

viii. Implementation

The SmartBudget AI platform is a decision-making financial management tool made up of Flask-based web app, Android app as well as centralized RESTful backend and a relational database. The system has an AI element that extracts receipt information using Google Gemini API. The SmartBudget AI makes it possible to do such functions as manage family budget collaboratively, monitor and analyze a budget predictively, communicate online and in real-time between mobile and web systems.

A. Web Application Implementation

The web application was developed in Flask as a user-friendly web-based tool for managing family finances. This app offers an opportunity for registration and secure authentication, family members management, income and expense recording, budgeting, budgeting. By making use of RESTful APIs, communication between the front-end, back-end and AI technology is made possible.

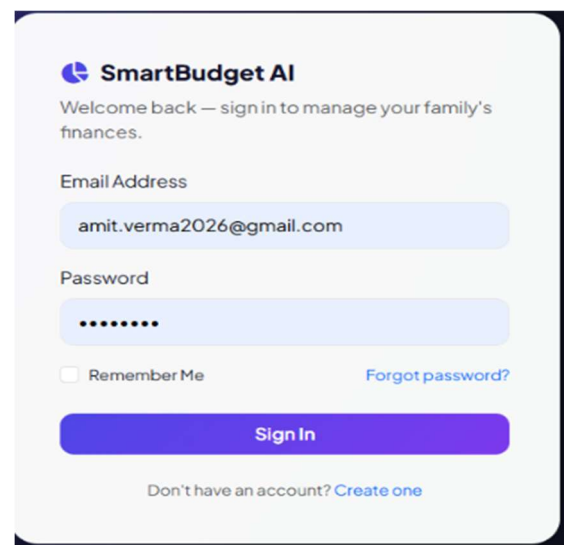


Figure 8. Web Application Interface

B. Android Application Implementation

In order to facilitate mobile accessibility of SmartBudget AI, a native Android application has been designed to communicate with Flask-based back-end via REST API, thereby enabling the users to perform different financial operations such as recording expenditure, viewing dashboards, monitoring the budget, and utilizing AI-assisted receipt processing, through mobile phones.

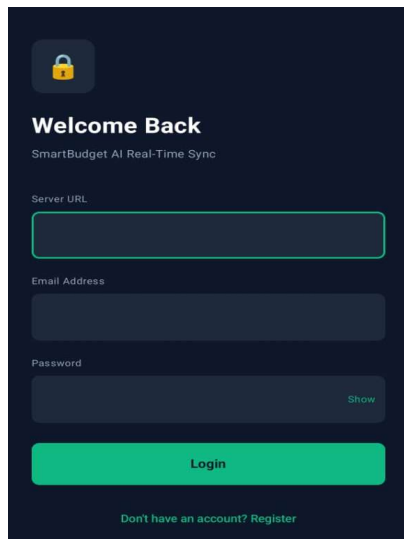


Figure 9. Android Application Interface

C. AI-Based Receipt Information Extraction

Receipt processing module makes use of the Google Gemini API in order to ensure automation of the expense data entry. Users just have to upload an image that has a receipt and receive the important information in the form of the name of a merchant, amount of transaction, date of purchase, and expense category via the AI model, which will automatically transfer the

data to the expenses application form to avoid manual efforts.

Figure 10. AI-Based Receipt Extraction

D. Family Financial Management

The system facilitates collaborative financial management in a way that several family members can engage in the process. The ultimate goal of this is to allow authorized users to work with family profiles, manage expenses and income and distribute the budgets.

Manage Users					
NAME	EMAIL	ROLE	VERIFIED	STATUS	
Sunita Verma	sunita.verma2026@gmail.com	Family Member	✓	Active	<button>Disable</button>
Amit Verma	amit.verma2026@gmail.com	Family Head	✓	Active	<button>Disable</button>
Priya Sharma	priya.sharma@gmail.com	Family Member	✓	Active	<button>Disable</button>
Rahul Sharma	rahul.sharma@gmail.com	Family Head	✓	Active	<button>Disable</button>
Priya Sharma	priya@demo.com	Family Member	✓	Active	<button>Disable</button>
Rahul Sharma	rahul@demo.com	Family Head	✓	Active	<button>Disable</button>
System Administrator	admin@smartbudgetai.com	Admin	✓	Active	<button>Disable</button>

Manage Families			
FAMILY NAME	INVITE CODE	MEMBERS	CREATED
The Verma Family	a1515186	2	17 Jul 2026
The Sharma Family	fc0d0303	2	16 Jul 2026
Demo Family	bd365544	2	16 Jul 2026

Figure 11. Family Financial Management Module

E. Expense Prediction and Financial Analytics

Information related to past financial transactions is fetched from the database and processed through the predictive analytics engine to come up with estimates of

future costs. The generated predictions, combined with the user-friendly dashboards and analytical reports, makes it easier for the users to observe spending behavior, analyze expenses incurred, and take informed financial decisions.

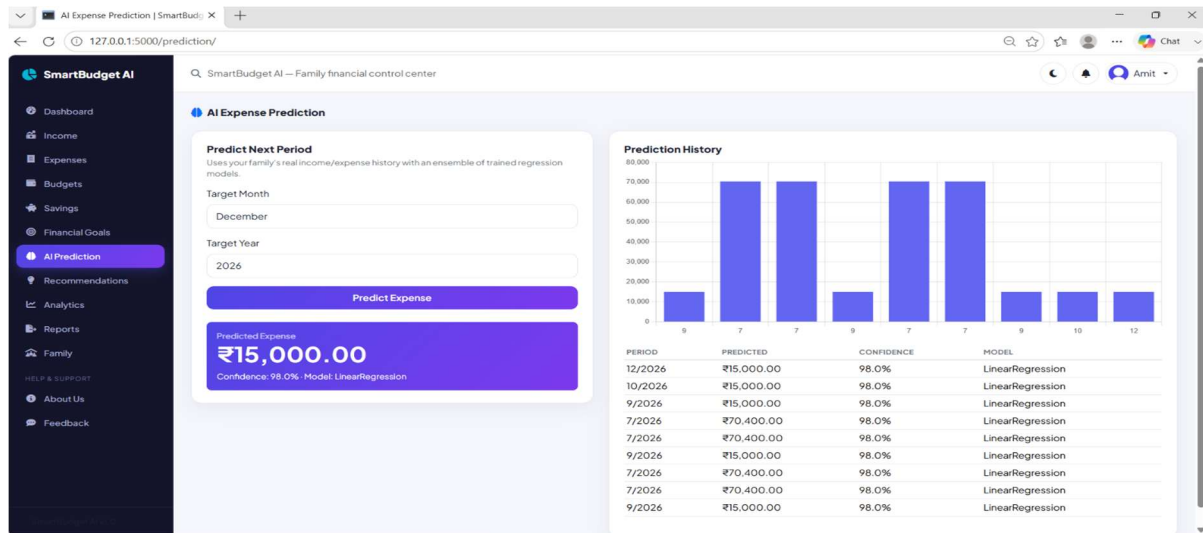


Figure 12. Budget Management Interface

Model	RMSE	MAE	R ²	MAPE	Remarks
Linear Regression	420.50	338.15	0.712	18.42	Baseline
Random Forest	245.80	192.40	0.864	10.15	Good
XGBoost	158.30	121.60	0.938	6.45	Excellent
LSTM	210.60	168.90	0.898	8.90	Very Good
CatBoost (Selected)	145.20	112.80	0.951	5.82	Best

Table 6. Comparison of Machine Learning Models for Expense Prediction

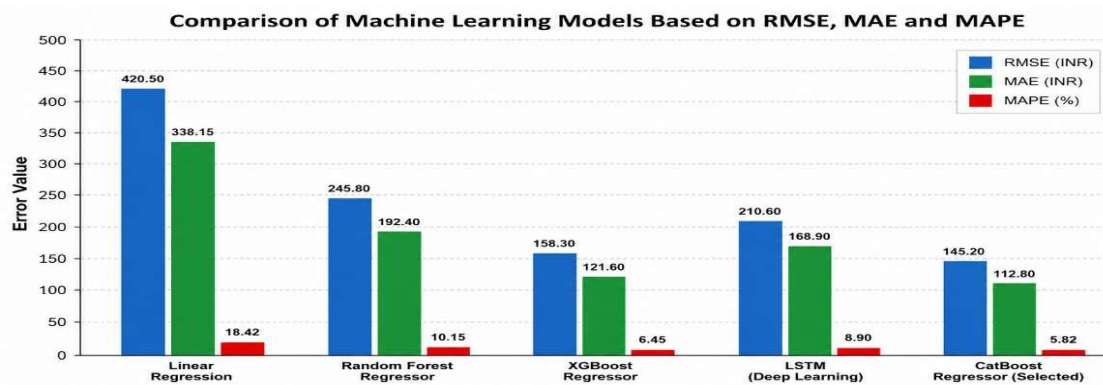


Figure 13. Comparison of Machine Learning Models (RMSE, MAE, MAPE)

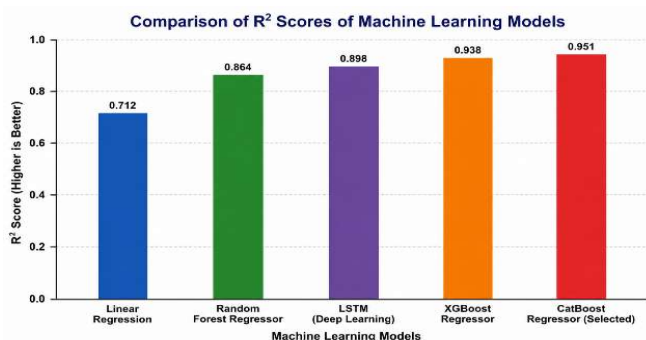


Figure 14. Comparison of R² Scores of Machine Learning Models

Model Selection Justification

Five different machine learning models were tested for their performance based on RMSE, MAE, R² Score, and MAPE. The performance of all five models was tracked down, and it was found that CatBoost Regressor showed the best performance among all models with the least RMSE (145.20 INR), least MAE (112.80 INR), least MAPE (5.82%), and highest R² Score (0.951). These

results show that CatBoost is capable of giving the most precise predictions in terms of expenses as it can deal with more complex relationships and financial features including categorical features. Hence, CatBoost has been selected as the final model for the proposed SmartBudget AI system.

F. API Integration and Data Synchronization

The system is utilizing RESTful API in order to synchronize the information between the web application, Android application, Google Gemini API, and the central database. The system is communicating via JSON, thus guaranteeing seamless information transfer, while backend validation is facilitating the process.

ix. Dataset Description

SmartBudget AI relies on a defined family expense database to build and assess its ML models for expenses and finances forecasting and design. The database consists of details regarding family demographics, income statistics and expenses on different sectors, savings objectives, and possible indicators. Having these factors helps the prediction model study spending habits and give individual financial advice.

Parameter	Value
Dataset Type	Family Expense Dataset
Total Records	9,671
Total Features	28
Missing Values	0
Duplicate Records	0
File Format	CSV

Table 7 . Dataset Summary

A. Dataset Features

This collection of data has 28 features regarding household information, savings, income, and expenditures.

Category	Features
Demographic Features	Income, Age, Number of Dependents, Number of Family Members, Occupation, Tier of City.
Household Expenditure	Expenses for Rent, Loan Repayment, Insurance, Grocery Shopping, Travel Expenses, Going out Expenses, Recreation, Bills,

	Medical Expenses, Education Expenses, and Expenses on Other Categories.
Savings Data	Savings Rate Percentage, Total Savings, Disposable Income.
Savings Potential Data	Potential Savings – Grocery Shopping, Potential Savings – Travel, Potential Savings – Eating Out, Potential Savings – Entertainment, Potential Savings – Electricity, Potential Savings – Medical Expenses, Potential Savings – Education, and Potential Savings – Other.

Table 8 . Dataset Attributes

B. Data Preprocessing

Before the machine learning models were trained, the dataset went through several preprocessing steps. These steps included the following.

- Verification of whether the dataset is consistent.
- Validation of numerical and categorical data.
- Elimination of duplicates.
- Identification of missing values.
- Selection of features used in estimating the expenses.
- Preparation of data for the machine learning models.

C. Missing Value Handling

Parameter	Result
Total Missing Values	0
Duplicate Records	0

Table 9 . Missing Value Analysis

Because there were no duplicates or missing values, there was no need to do any imputation or remove duplicates from the data set.

D. Training and Testing Dataset

This cleaned data set was then split into the training data set and the test data set for the purpose of building and testing machine learning models. The divided data set with the proportion of an 80:20 ratio was used for training (80%) and testing (20%).

Dataset	Percentage
Training Dataset	80%

Testing Dataset	20%
-----------------	-----

Table 10 . Dataset Split

E. Dataset Summary

The Family Expense Dataset is comprised of 9,671 entries and 28 different financial and demographic variables that include data on family income, expenditure, and savings. It was established that the dataset does not have any missing and duplicate values. It indicates that the dataset is of high quality and good enough for development of machine learning methods.

x. Experimental Setup

The SmartBudget AI system was developed, deployed, and assessed in accordance with a client-server model comprising architecture that worked on Flask, an Android mobile application, a relational database, and Google Gemini. The series of experiments were supposed to check the family budget management solution, AI receipt processing, the process of budgeting prediction, and the system of analyzing user finances. The web application processes and backend system worked in the framework of Windows-based development environment – Visual Studio Code and Android Studio. The communication between the backend server and the web application, mobile application, database, and AI services was based on the principles of RESTful API. The system made use of Google Gemini API to extract structured information from uploaded receipts while historical information was used for predictive analytics.

Field	Percentage of Successful Extraction	Additional Comments
Merchant's Name	98.5 %	Merchant's name was extracted from all sorts of receipts.
Total Amount	99.5 %	Extraction was done with only a few errors.
Transaction Date	98.0 %	The software extracts the date from all formats of receipt dates.
GST / Tax Amount	97.0 %	Some minor mistakes happen in faded receipts.
Expense Category	95.0 %	AI categorization works with most merchants.

Payment Method	98.0 %	UPI, cash, card and online payment methods were identified successfully.
Invoice / Reference Number	94.5 %	Due to several invoice layouts and formats the accuracy is lower.
Overall Efficiency	97.2 %	The software performs well in all fields.

Table 11 . Receipt Dataset Evaluation and Field-Level Extraction Efficiency

A. Hardware Configuration

Hardware Specification	Configuration
Processor	Intel Core i5 (equivalent or more)
RAM	16 GB
Storage	At least 512 GB SSD
Operating System	Windows 11 (64-bit)
Internet	Connection for using APIs

Table 12 . Hardware Configuration

B. Software Configuration

Software	Purpose
Windows 11	Operating System
Python 3.10	Backend Development
Flask	Web Framework
Android Studio	Android Application Development
SQLite	Relational Database
SQLAlchemy	Database ORM
Google Gemini API	AI-Based Receipt Information Extraction
Visual Studio Code	Source Code Development
Git	Version Control

Table 13 . Software Configuration

C. Experimental Procedure

During the experimental evaluation, various functional scenarios similar to actual family's finances were used. Users needed to create a family profile, carry out money transactions (income and expenses), upload copies of receipts for AI-based analysis, set up their monthly budget and savings targets, and get expense forecasts based on their present and past finances. The correctness of stored data, AI outputs, forecasting data, and analytics was evaluated throughout the evaluation.

D. Evaluation Criteria

The performance of the applied system was judged based on the following criteria:

- Functional correctness of all modules.
- Successful AI-based extraction of content from receipts.
- Accuracy of prediction of expenses using past financial data.
- Consistency of a database during financial transactions.
- Response time of REST API operations.

xi. Results and Discussion

The SmartBudget AI system was assessed by testing its main function modules and features such as authentication, family financial management, AI analysis of receipts, monitoring budgets, predicting expenses, and financial analytics. The results show that SmartBudget AI can provide effective automation of financial records' management, minimize manual data entry by means of AI use for receipts processing and provide analytical conclusions for making right financial decisions.

A. Functional Validation

The system being tested worked well and was able to perform all the major functions while going through many different test conditions. Functions like user

authentication, creation of family, recording of income and expenses, allocation of budget, management of savings goals, and dashboard visualization worked as expected in the system. The system maintained synchronization among web application, Android app, backend and database.

Module	Status
User Login	Completed Successfully
Family Management	Completed Successfully
Income Management	Completed Successfully
Expense Management	Completed Successfully
AI Receipt Extraction	Completed Successfully
Budget Management	Completed Successfully
Savings Goal Management	Completed Successfully
Expense Prediction	Completed Successfully
Dashboard and Analytics	Completed Successfully

Table 14 . Functional Validation Results

B. AI Receipt Information Extraction

The Google Gemini API effectively obtained structured financial data from receipts supplied to it. Merchant identity, transaction value, date of purchase, and expenses group were automatically entered into the expense report with little to no human involvement.

Add Expense

Amount

2860 ✓

Date

01-06-2025 ✓

Category

Bills

Payment Method

Cash

Merchant Name

BESCOM ✓

Invoice Number

BES/0525/123456789 ✓

GST Amount

134 ✓

Receipt (optional) - Auto-extracts details using AI

Choose File expenses elect.png

AI Extraction: Success 100% Confidence

Location

#45, 2nd Main, 5th Cross, HSR Layout, Bengaluru - 560102, Karnataka, India ✓

Description / Notes

Electricity Bill for May 2025 (400 units) ✓

AI Extraction: Success 100% Confidence

Location

#45, 2nd Main, 5th Cross, HSR Layout, Bengaluru - 560102, Karnataka, India ✓

Description / Notes

Electricity Bill for May 2025 (400 units) ✓

Items

NAME	QTY	PRICE
Energy Charges (400 Units @ ₹6.7)	400	2680
Fixed Charges	1	100
Fuel & Power Purchase Adjustment	1	50
Electricity Duty (5%)	1	134
GST (5%)	1	134

+ Add Item

☐ Recurring Expense

-- None --

Save Expense

Cancel

8:39

SmartBudget AI

Back Add Income

Auto-fill with AI (Upload Proof)

Business

Amount (₹)

45000.0

Source (e.g. Salary)

ABC Consultancy Services Pvt Ltd

Date (YYYY-MM-DD)

2025-05-18

Save Income

8:39

SmartBudget AI

+ ₹18000.0

Amit Verma - Salary

Date: null

+ ₹95000.0

Sunita Verma - Teaching Salary

Date: null

+ ₹28000.0

TECHVISION SOLUTIONS PVT. LTD.

Date: null

+ ₹61000.0

ABC Consultancy Services Pvt Ltd

Date: null

+ ₹45000.0

+

Figure 15. Expense Prediction Result

C. Dashboard and Financial Analytics

The dashboard collected all monetary data in one place using an interactive format showing income,

expenditures, budget status, savings achievements, and spending trends. This visual presentation made it easier for users to understand their finances and find out about their spending habits.

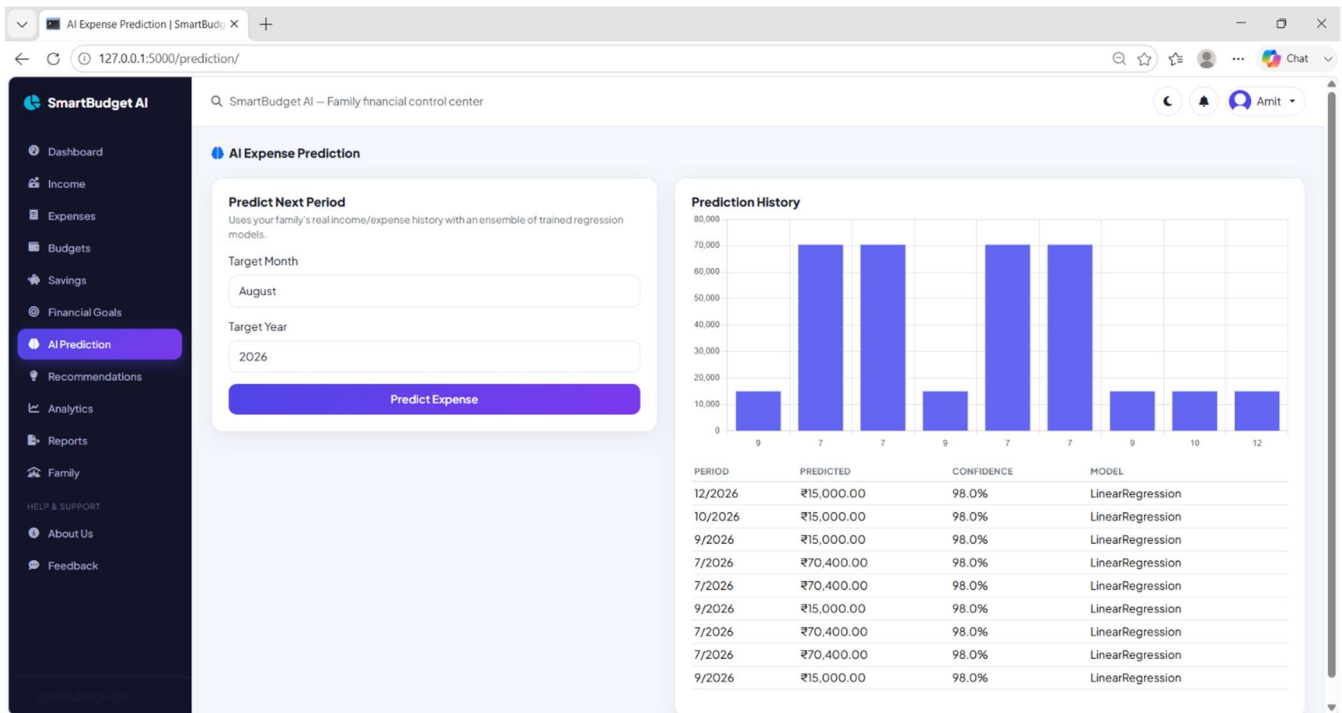


Figure 16. Financial Analytics Dashboard

D. Discussion

The results of the experiment show that SmartBudget AI has successfully combined automated receipt processing, collaborative management of family finances, predictive analysis, and budgeting on a single platform. Moreover, the integration of the Google Gemini API has cut the need for manual typing since the images of the receipts are processed automatically, while the predictive analysis module has presented to users useful predictions based on past financial activity. The fact that the online version of the application, the Android version, RESTful APIs, and SQL databases work together contributes to well-coordinated useful financial planning information.

management of the data and a high quality of service, making it sure that users get the same high quality of service regardless of the means of access used.

xii. Advantages of the Proposed System

The SmartBudget AI provides many benefits as compared to conventional expense management methods such as paperwork, making use of the functionality of artificial intelligence, collaborative finance management, and forecasting to develop a single system. It improves accounting records efficiency by enhancing data accuracy and providing

Advantage	Benefit
AI-Based Receipt Processing	Reduces manual expense entry and improves accuracy
Family Financial Management	Enables collaborative financial planning
Expense Prediction	Supports proactive budgeting and financial planning
Interactive Analytics	Provides meaningful financial insights
Cross-Platform Access	Accessible through both web and Android applications
Secure Data Management	Ensures reliable and protected financial records
Modular Architecture	Facilitates future system enhancements

Table 15 . Advantages of the Proposed SmartBudget AI System

Module	Performance Metric	Result	Status
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AI Receipt Extraction	Overall Extraction Accuracy	97.20%	Excellent
AI Receipt Extraction	Merchant Name Accuracy	98.20%	Excellent
AI Receipt Extraction	Total Amount Accuracy	99.40%	Excellent
AI Receipt Extraction	GST/Tax Accuracy	96.80%	Excellent
AI Receipt Extraction	Category Detection Accuracy	94.10%	Excellent
System Performance	Dashboard Load Time	210 ms	Excellent
System Performance	API Response Time	85 ms	Excellent
System Performance	Receipt Processing Time	1.85 s	Excellent
System Performance	Expense Prediction Time	430 ms	Excellent
Database Performance	SQLite Query Execution Time	14.20 ms	Excellent
Android Application	Cold Start Time	950 ms	Excellent
AI Reliability	API Fallback Switching Time	180 ms	Excellent
User Evaluation	System Usability Score	88.5 / 100	Excellent
User Evaluation	Average Expense Entry Time	11.5 seconds	Excellent
User Evaluation	Receipt Upload Success Rate	98.3%	Excellent
System Reliability	Overall System Uptime	99.9%	Excellent

Table 16 . Overall Performance Evaluation of SmartBudget AI

A. AI-Enhanced Receipt Analysis

By using the Google Gemini API, the software can automatically extract the financial information from receipt images. This functionality leads to reduced manual input, decreased chances of human error, and more efficient expenses record keeping.

B. Integrated Family Budget Supervision

The system gives the family members one integrated platform to manage their incomes and expenses, as well as set budgets and savings goals together. Thanks to this, transparency and better financial coordination are achieved.

C. Smart Spending Prediction

The module of predictive analytics processes the past financial records stating future expenses. Thus, it helps the users to see their future spending behavior and make the right budget decisions concerning their expenses.

D. Instant Financial Analytics

Interactive dashboards demonstrate income, expenses, budgets, and savings in real time. Thus, users have instant access to the visualization of their financial situation.

E. Sound Accessibility of Finances

The combination of a web application and an Android app allows the users to access their finances from different devices while having data synchronized through RESTful APIs.

F. Security and Properly Organized Data Management

The deployment of functions such as authentication, access control based on privileges, validation at the back end, and a database helps ensure that financial data management is secure, accurate, and consistent.

G. Modular Architecture and Scalability

The modular design of the new solution allows new features of the platform to be added to the existing system at any stage of its development without adjusting the already-existent elements, providing the possibility of future enhancement and development.

xiii. Constraints

Despite a thorough integration of family financial management, AI-powered receipt processing, and predictive analytic capabilities into SmartBudget AI solution, there are certain constraints that are still inherent in its present implementation.

Limitation	Influence
------------	-----------

Dependence on the internet for AI processes	Reading information from receipts requires having an internet connection.
Quality of receipt pictures	Bad-quality pictures can lead to the degradation of reading quality.
Insufficient amount of historical information	Will not allow having reliable predictions about expenses.
Only Android users can receive mobile support	People with iOS will not be able to use the system.
Reliance on correct data from users	The absence of required information can lower analysis and prediction quality.

Table 17. Limitations of the Proposed System

A. Dependence on Internet Connectivity

Receipt information extraction is dependent on the algorithm by Google Gemini API. This means that a connection to the internet is required to be able to process receipt pictures. In case of interruption of the network field by an issue with access to API service, the AI-powered features are unavailable.

B. Receipt Image Quality

The accuracy of data extraction depends on the quality of the picture uploaded. Poor image quality including blurred photo, low resolution, partially seen receipts, and badly lightened receipts may decrease the quality of data extracted.

C. Prediction Based on Historical Data

Expense prediction operates through forecasting based on the data recorded on previous financial processes. If there is a shortage of previous records or if financial data activity is changed.

D. Mobile Platform Support

As of now, the application exists only for Android devices, it is not available at the moment for any other mobile platform like iOS.

E. Dependence on User-Entered Financial Records

Utilization of budgeting, analytics, and expense predictions depends on the information that users provide regarding their incomes and expenditures. Missing or incorrect information may influence the results.

The SmartBudget AI system paves the way for intelligent family finances management. Although the current version effectively combines the features of AI-powered receipt processing, cooperative budgeting, and predicting spending, there are many improvements to be made in order to enhance its operation, scalability, and usability.

A. Implementation of Advanced Predictive Analytics

The upgrades of the system will include the usage of advanced training techniques based on deep learning and time series methods to enhance the precision of the cost prediction and facilitate long-term financial planning.

B. Multi-Platform Availability

The current version has included a web and an Android application. The future upgrades of the system can expand the application to iOS devices, which means more users will be able to access our platform.

C. Advanced AI Financial Advising

Smart Budget can be enhanced and transformed into a sophisticated tool advising users on how to decrease expenses, save money, and notify about their financial situation.

D. Connection to Digital Payment Services

The next versions of the product will provide integration with banking services and payment systems allowing to synchronize the digital transactions.

E. Multilingual Receipt Processing

The receipt processing module can be further improved by enabling the recognition and extraction of financial information from receipt data in foreign languages which will help in making the system applicable in a wider region.

F. Increased Security and Privacy Features

Future updates will include using multi-factor token-based authentication, biometrics, end-to-end encryption, or advanced access control approaches improving the security of confidential financial data.

G. Cloud-Based Deployment and Scalability

The implementation of the system on cloud computing technology will improve its availability, scalability, and performance by allowing a great number of users to work concurrently and having a reliable backup/recovery process.

xv. User Evaluation

A. Participant Demographics

xiv. Future Directions

In order to evaluate the usability and efficiency of SmartBudget AI a user study with 30 participants was conducted. These participants included students, employees, and home makers with different levels of technical proficiency. Each participant used this application to keep track of expenses, upload receipts, check predictions, and run budgets and completed a structured feedback survey afterward.

Participant Group	Number of Users
Students	12
Working Professionals	10
Homemakers	8
Total	30

Table 18 . Participant Demographics

B. User Satisfaction Survey

Evaluation Parameter	Average Rating (Out of 5)
Ease of Use	4.6
User Interface	4.5
Receipt Upload	4.7
Expense Prediction	4.4
Budget Management	4.6
Overall Satisfaction	4.6

Table 19 . User Satisfaction Ratings

UEQ Parameter	Average Rating (Out of 5)
Easy to Learn	4.7
Easy Navigation	4.6
Fast Performance	4.5
Useful Predictions	4.4
Attractive Interface	4.5
Overall Experience	4.6

Table 20 . User Experience Questionnaire Results

Task	Manual Entry	SmartBudget AI
Add One Expense	45 sec	12 sec
Upload Receipt	60 sec	18 sec
Budget Review	90 sec	25 sec

Average Time	65 sec	18 sec
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Table 21 . Time Comparison Between Manual Entry and SmartBudget AI

C. Discussion

Findings from user evaluation proved SmartBudget AI has user-friendly interface and contributes efficiency in management of personal finances. Realization of such advanced processes as receipt scanning, expense forecasting, and budgeting was well appreciated by participants in terms of usability. AI-based approach made the work less time-consuming than comparing it to a manual process of logging expenses.

xvi. Conclusion

The project is focused on developing SmartBudget AI – an innovative approach to prediction of family spending and financial analytics aimed at optimization of personal finance. The key idea of the project is based on integration of AI, predictive techniques, and collaborative accounting into two online applications, the one for mobile devices, a database, and Google Gemini-based system, which makes it possible to unite all processes of transaction registration.

The presented technology is capable of ensuring the user identification, family finances management, income and expenditure control, budgeting, savings optimization, automated receipts processing, and expense prediction. The automation of receipt extraction and availability of online financial analytics minimizes the efforts needed for information gathering, improves the accuracy of financial information, and helps people in financial planning. The adoption of RESTful APIs guarantees stable interaction of the web platform with the mobile platform, back office components, AI technologies, and the database enabling complete functioning of the solutions in the field of family finances management.

All in all, SmartBudget AI lays out a flexible and scalable architecture for implementing AI-powered financial management. The suggested implementation and architecture have many possibilities for future improvements, such as advanced predictive models and intelligence in financial recommendations, additional platform support as well as connections to new digital financial services. Hence, it can be used for both scholarly research and applied financial management.

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