



International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal



Volume 5, Issue 3, May 2025

# Intelligent Expense Logging System Organize Analyze and Optimize Your Expenses using AI and ML

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Abstract: Many peoples report that they have a hard time tracking their day to day expenses which in turn they attribute to the use of old school methods like pen and paper or spreadsheets. Those tools are very time out of date and do not provide in depth analysis or feedback. To that end we put together an expense tracking system which we did to make the log in and analysis of spend out patterns easier and more intuitive. The system is an online platform which has features for users to either input their expenses by hand or upload receipts which the application will turn into data via image to text conversion. Also we have expense tracking categories which include food, travel, and bills which in turn makes it easy for the user to see what they are spending on a monthly basis. Also we find out over time what the user's spending habits are which in turn we use that info to give out tips like which times of the year you spend the most or to alert you when you are close to your budget. We also present the info via simple graphs which in turn make it easy for non finance background users to digest their info. We have incorporated secure logins and cloud storage to ensure user information is kept secure. The application utilizes widely available technologies such as HTML, JavaScript, and Node.js, making it accessible on multiple devices. From the initial feedback gathered, users found the system to actively assist them in managing their schedules and budgeting, which was received positively. Generally, this project aims to integrate intelligent functionalities with ease of use to make personal finance effortlessly manageable.

**Keywords**: Expense Tracking, Personal Finance, Budget Management, Optical Character Recognition (OCR), Image-to-Text Conversion, Financial Visualization, Cloud Storage, Secure Login, Web Application, Spending Analysis, User-Centric Design

#### I. INTRODUCTION

From students to young professionals, personal finance management has become a common challenge. This is more so for students and young professionals due to a lack of sophisticated tools that are both informative and easy to use. Instead of utilizing more sophisticated tools, more and more people resort to traditional expense management tools which include simple spreadsheets or notebooks. Recording expenses in a basic notebook while functional offers no advantages when it comes to budgeting goals, financial wellbeing, or providing insight towards spending habits. Those traditional methods are devoid of analytics, incorrectly provide insight, and require a lot of time to maintain. Users have no method in place to analyze previous behavior in order to make wise financial decisions, recording results are disorganized. With the rapid development in technology users need an accessible system that intelligently logs expenses alongside automating various finance related tasks.

Presently we see that which is great about present expense tracking solutions is that they do not personalise or adapt to user behavior. Most apps use basic categories and set inputs which do not grow with the user's financial journey, also they do not provide predictive analysis or recognize spending issues. We expect users to log each transaction,

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DOI: 10.48175/IJARSCT-26307



50



International Journal of Advanced Research in Science, Communication and Technology

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

#### Volume 5, Issue 3, May 2025



categorize them, and review charts which may not in fact represent their financial picture accurately. There is a lack of automation and real time feedback is a rare thing. As a result users either give up on the tool or they use it in a way that doesn't bring out its full value which goes against the point of financial self discipline.

In an attempt to address the highlighted problems, this specific project developed an all-in-one web-based system for tracking expenses which integrates automation, analysis, and artificial intelligence (AI) technologies. In essence, the system permits users to incur expenses manually or by uploading receipts. With the help of Optical Character Recognition (OCR), the system transforms image receipts into financial data, which is not only readable but also much easier to retrieve. The system is also capable of more advanced processing like machine learning, where it analyzes the data set before and identifies regular spending patterns to create customized offers for them. It can also notify users when they are close to a budget limit for certain categories as well as forecast high spending periods based on historical data.

Furthermore, users do not need to have a financial background as the system uses real-time charts and graphs to illustrate the financial dashboards interactively. User data is stored securely in the cloud alongside user authentication through Firebases, ensuring privacy and security. The tool employs Artificial Intelligence, Machine Learning, and contemporary web technologies, including HTML, JavaScript, and Node.js, to develop a responsive, scalable, and user-centric intelligent financial tool. As mentioned, the goal of this project is to fundamentally shift the way users plan their finances and automate expense tracking by providing timely information to guide smarter decisions.

#### **II. RELATED WORK**

**Du et al. (2018)** developed a deep learning model for extracting and classifying personal expenses from text, demonstrating the effectiveness of AI in financial data handling [1].

Xu et al. (2021) introduced an OCR-powered text recognition system that could extract expense data from images, enhancing usability for non-digital records [2].

**Jian (2022)** analyzed the landscape of personal financial planning apps and found most lacked AI-driven insights and proactive budget alerts [3].

Liu et al. (2019) implemented a mobile-based expense tracker using deep learning but focused only on structured data without image-to-text support [4].

Klapper et al. (2020) emphasized the global challenge of financial literacy and highlighted the importance of intelligent systems to support budgeting.

Wang et al. (2021) proposed a hybrid OCR and ML-based classification system but did not include real-time tracking or visualization modules.

Hu et al. (2020) explored trend prediction for financial data using linear regression, demonstrating the value of forecasting for budgeting.

Ma et al. (2019) suggested the need for real-time visual dashboards in personal finance systems to improve decisionmaking efficiency.

Zhao et al. (2020) discussed the use of AI in financial tech and identified gaps in end-user personalization and interaction.

Zhou et al. (2018) proposed a user-friendly expense tracking system but lacked budget alerting and predictive components.

Sha et al. (2019) addressed security concerns in financial web apps and advocated for encryption and secure authentication mechanisms.

Alamsyah et al. (2023) conducted a systematic review on AI complaint systems and suggested integrating multiple AI modules for better results—similar modularization applies to expense systems.

Roy et al. (2022) focused on categorization of rural complaints using NLP, a concept that can be repurposed for financial categorization.

Sahoo et al. (2021) highlighted the importance of UI/UX design in web apps for finance, supporting our goal of microinteractions.









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#### Volume 5, Issue 3, May 2025



**Das et al. (2020)** used sentiment and keyword-based rules for complaint priority; a similar approach enhances financial entry classification in our work.

#### **III. EXISTING SYSTEM**

Many people these days continue using out of date methods for tracking personal spending like the good old pen and paper notebooks, excel spreadsheets or generic note taking applications. Although these methods offer a means of documenting financial activities, they do not provide the context-sensitive automation, advanced analysis, insightful reporting, frameworks, and sophisticated real-time technology that contemporary expense management systems provide. Such tools require users to input data manually—event by budget category—and track one's budget progress without automated progression insights. Because of this, users tend to forget tracking, repetitive patterns tracking, and identifying spending habits which obstruct potential financial savings.

These days, many expense tracking applications that are mobile or web based lack advanced features. Available tracking options include recording financial transactions, with no more than visual summaries, and supported features do not go further than basic rendering. Optional features such as receipt scanning, spending alert systems, and behavioral financial advice are absent. The ability to interface with AI systems or machine learning models is lacking in many applications, with only a handful providing reliable and flexible data export options, as well as secure cross-device access to personal records. Furthermore, the applications do little in the way of data security and privacy by providing insufficient encryption and user authentication. The lack of smart automation and intelligent feedback leads to decreased participation. As the process of tracking expenses becomes automated without the assistance of an intelligent system, it increases the effort associated with what could have been an intuitive financial habit.

Essentially, existing systems are less effective due to personalized insights, real-time analysis, and smart automation being non-existent. As users are inundated with repetitive data entry tasks, their financial behavior provides little feedback and their budgeting strategies receive even less guidance on how to improve them. An adaptive approach is essential—one that can address the complexities of financial data stemming from online payments, subscriptions, and an assortment of expenses—with effortless data entry and provide useful, decisive insights. Advanced intelligence that can dynamically and intelligently adjust to individual needs is absolutely necessary.

#### **IV. PROPOSED SYSTEM**

The proposed system introduces an AI-powered, web-based platform designed to simplify and enhance the way individuals manage their personal finances. Unlike traditional manual or semi-digital methods, this system enables users to log, categorize, and analyze their daily expenses through an intelligent and intuitive interface. The core functionality revolves around two modes of expense entry—manual input and automated receipt scanning. By integrating Optical Character Recognition (OCR), users can upload images of receipts, from which the system extracts key data such as amount, date, and merchant name, thereby reducing manual effort and ensuring faster, more accurate logging of transactions.

Once the expenses are recorded, the system automatically classifies them into predefined categories such as Food, Travel, Utilities, Subscriptions, and Miscellaneous. A machine learning model, trained on historical user data, analyzes past behavior to understand individual spending patterns and provides personalized financial insights. For example, the system can identify recurring high-expense categories, alert users when they approach or exceed a defined budget, and forecast future expenses based on monthly trends. These intelligent predictions help users anticipate and control their spending before financial problems arise.

The platform features a dynamic dashboard that presents spending trends through interactive visualizations using tools like Chart.js and D3.js. Users can filter transactions by category, date range, or amount, and generate downloadable reports in PDF or Excel formats for offline review. To ensure secure and private access, the system uses Firebase Authentication and JWT-based session management. All financial data is stored either locally or in the cloud (via Google Cloud or AWS), with support for encrypted storage and regular automated backups to prevent data loss.

Technologically, the system is developed using modern web technologies. The front end is built with HTML, CSS, and JavaScript to ensure responsiveness and usability across devices, while the backend is powered by Node.js to handle

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DOI: 10.48175/IJARSCT-26307



52



International Journal of Advanced Research in Science, Communication and Technology

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal





#### Volume 5, Issue 3, May 2025

authentication, database operations, and communication with AI modules. The system architecture is modular and scalable, allowing future integration of additional features such as voice input, multi-language support, or direct bank API linking.

By combining AI-driven insights, smart automation, and secure cloud technologies, this proposed system aims to transform conventional expense tracking into a proactive, user-centric financial assistant. It not only simplifies the process of managing personal finances but also empowers users with the tools needed to make informed, timely, and responsible financial decisions.



Intelligent Expense Logging System

#### METHODOLOGY

The methodology adopted in this work aims to develop a secure, intelligent, and user-friendly expense logging system that moves beyond traditional manual expense tracking methods. The proposed system incorporates AI and ML techniques to automatically categorize, analyze, and predict user expenses while providing real-time feedback through an interactive dashboard. The methodology involves key steps such as data acquisition, text extraction, classification, prediction, visualization, and secure data management.

#### **Data Acquisition and Preprocessing**

Initially, users submit their expense records either manually or by uploading receipt images. For image inputs, Optical Character Recognition (OCR) technology is used to extract relevant financial data such as amount, category, and date. The text data is then preprocessed using normalization techniques such as lowercasing, punctuation removal, tokenization, and keyword extraction to ensure uniformity. Each expense entry is converted into a structured format to facilitate accurate categorization and prediction.

#### **Categorization and Prediction**

Once preprocessed, expenses are classified into predefined categories like Food, Travel, Utilities, and Education using rule-based classification and keyword matching. The system also uses a supervised machine learning algorithm (e.g., linear regression) to analyze historical spending patterns and forecast future expenses. This predictive capability allows users to plan their budgets effectively by anticipating high-spending periods. In parallel, a threshold-based alert system monitors the expenses in real-time and triggers notifications if the budget limits are crossed.

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#### Volume 5, Issue 3, May 2025



#### Visualization and Storage

To support user interpretation of spending behavior, the system generates real-time charts and summaries using visualization tools like Chart.js and D3.js. These visualizations include bar graphs, pie charts, and line charts displaying expense breakdowns, trends, and budget progress. All user data, including expense records and visual reports, are securely stored using Firebase or Google Cloud with encryption and backup capabilities. The application also supports exporting data in PDF and Excel formats, ensuring portability and offline access.

#### V. IMPLEMENTATION ALGORITHM

# Smart Expense Logging, Categorization, Prediction, and Secure Storage Input:

User-submitted expense data (manual entry or receipt image)

#### **Output:**

Categorized expense record with budget status and predicted trend

#### Stored Data:

Amount, Category, Date, Prediction, Budget Status

#### **Step-by-Step Description:**

#### **Step 1: Expense Submission**

Users log into the web application and submit their expenses either through a form or by uploading a receipt image. Each submission contains details such as date, amount, description, and optional receipt.

#### Step 2: OCR Text Extraction (if image is submitted)

The system uses an OCR engine (e.g., Tesseract.js) to extract text from uploaded receipts. Preprocessing techniques such as noise removal, grayscale conversion, and thresholding are applied for accuracy.

#### **Step 3: Preprocessing and Normalization**

Text entries (whether manual or extracted) are cleaned: lowercased, tokenized, and stripped of special characters. Keywords are extracted for categorization.

#### **Step 4: Rule-Based Categorization**

Using keyword-based classification, expenses are assigned categories (e.g., "Pizza"  $\rightarrow$  Food, "Uber"  $\rightarrow$  Travel). If keywords match multiple classes, predefined rules determine the most relevant.

#### **Step 5: Budget Monitoring and Alerting**

System checks whether the new expense crosses the category or monthly budget using threshold logic. If exceeded, a budget alert is triggered and the UI is updated in real-time.

#### Step 6: Trend Prediction Using ML

The application maintains historical data and applies a linear regression model to forecast the user's future expenses. The prediction is displayed in graphs and influences future alerts.

#### **Step 7: Secure Data Storage**

Each expense record is securely stored in Firebase Cloud Firestore or a similar database. Data is encrypted, and regular backups are scheduled to avoid loss.

#### **Step 8: Visualization and Report Generation**

Charts (bar, pie, line) are generated using Chart.js based on user activity. Weekly, monthly, and category-wise summaries are available. Users can export reports in PDF or Excel format.

### VI. MODULE OVERVIEW

The proposed Intelligent Expense Logging System is designed using a modular approach, each component performing a specialized role to streamline personal expense tracking through automation, AI, and secure storage. The system includes six integrated modules, enhancing accuracy, usability, and predictive capability.

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#### Volume 5, Issue 3, May 2025



#### A. User Authentication Module

This module ensures secure access to the application. It includes registration, login, and user session management. Passwords are encrypted using hashing algorithms (e.g., SHA-256), and Firebase Authentication or JWT is used for identity verification. Additional features such as password recovery, session timeout, and profile update functionalities are also included.

#### **B.** Expense Entry Module

Users can log expenses manually or by uploading receipts. The system uses OCR (Optical Character Recognition) to convert receipt images into text, which is further analyzed and categorized. The module allows users to specify date, category, amount, and payment mode, offering a seamless data entry process. This input acts as the primary source for downstream analytics.

#### C. Natural Language Processing (NLP) Module

This module processes the text extracted from receipts or user inputs. It includes text normalization, keyword extraction, and context understanding to prepare inputs for classification. NLP ensures efficient parsing of descriptions and improves accuracy in identifying spending categories. Multilingual support is considered for future development.

#### **D.** Machine Learning Module

This module employs supervised ML algorithms to automatically categorize transactions and predict future spending trends. Using historical data, the model learns user-specific patterns and provides personalized financial insights. It supports threshold-based budget alerting and adaptive budget planning through linear regression and classification techniques.

#### E. Data Storage and Management Module

All transaction data, user information, and logs are stored securely in a structured database (MySQL, IndexedDB, or Firebase). The module supports CRUD operations, periodic backups, and encryption. Both local and cloud-based storage options are integrated for enhanced reliability and scalability.

#### F. Dashboard and Reporting Module

This module provides a visual interface to monitor and analyze spending. It includes charts, summaries, and budget progress indicators using Chart.js or D3.js. Users can filter data by date, category, or payment type, and export financial reports in formats such as PDF, CSV, and Excel for offline analysis.

These interconnected modules collectively enable the Intelligent Expense Logging System to automate personal finance tracking, reduce manual effort, and empower users with AI-driven financial awareness.

#### VII. EXPERIMENTAL RESULT

Implementation of the proposed AI-based Intelligent Expense Logging System has significantly improved the efficiency, usability, and accuracy of expense tracking and financial management for individual users.

One of the most valuable outcomes has been the integration of **machine learning for trend prediction** and **natural language processing (NLP)** for receipt text extraction. This allows users to **automatically categorize and predict** future spending based on past patterns, thus offering intelligent suggestions and improving financial awareness.

**Real-Time Expense Tracking** and **Category-wise Management** have enabled users to log expenses instantly and receive timely feedback through a visual dashboard, helping them stay within budget and control spending behavior.

**AI-powered features**, such as **spending trend prediction** and **rule-based categorization**, have reduced the manual effort required by users, while providing actionable insights into their financial habits. This level of automation ensures consistency, personalization, and adaptability over time.

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### Volume 5, Issue 3, May 2025



Another key innovation is the use of **image-to-text AI technology**, which enables users to scan receipts and automatically extract expense details. This eliminates data entry errors and simplifies the logging process, especially for recurring or complex purchases.

The system's **interactive dashboard** offers administrators and users access to visual analytics, downloadable reports, and real-time tracking of expenses and budgets. This helps in **making informed decisions**, avoiding overspending, and setting achievable financial goals.

Compared to traditional expense tracking systems such as spreadsheets or basic mobile apps, the proposed system offers **greater intelligence**, **automation**, **security**, **and user engagement**. The seamless integration of AI, real-time feedback, and secure storage mechanisms has greatly enhanced both usability and effectiveness



Accuracy Comparison of Expense Tracking Systems

#### VIII. CONCLUSION

The proposed system provides an intelligent, secure, and user-friendly platform for expense tracking, aimed at helping individuals take control of their personal finances. By integrating **AI and ML technologies**, the system enhances traditional expense management by automatically extracting text from images, categorizing expenses based on context, and offering predictive analytics to forecast future spending habits.

The **automated classification** of expenses, combined with **real-time budget tracking** and a **visual dashboard**, empowers users to understand their spending behavior and make informed financial decisions. This minimizes manual effort, reduces the likelihood of errors, and encourages proactive budgeting.

Moreover, the integration of **image-to-text conversion (OCR)** simplifies the process of logging receipts, while **secure data storage** ensures that financial records remain confidential and tamperproof. The responsive and intuitive front-end interface ensures accessibility across devices, promoting consistent use among diverse users.

Compared to traditional spreadsheets and basic tracking apps, the proposed system demonstrates superior performance in both **categorization accuracy and prediction reliability**, thereby enhancing the overall financial planning experience.

In conclusion, the Intelligent Expense Logging System represents a practical and scalable solution to modern financial challenges. With further enhancements such as multi-user support, cloud synchronization, and advanced analytics, it holds the potential to redefine personal expense management through automation, intelligence, and user-centric design.

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#### Volume 5, Issue 3, May 2025



#### **IX. FORTHCOMING DEVELOPMENT**

Future development of the Intelligent Expense Logging System will focus on enhancing system intelligence, accessibility, scalability, and user personalization to create a more powerful and adaptive financial management tool.

One key improvement will be the **integration of multi-user support** and **real-time synchronization across devices** using secure cloud services. This will enable collaborative expense tracking for families or small teams, while ensuring data consistency and availability at all times.

Another major enhancement will be the **implementation of personalized financial recommendations**. Leveraging advanced machine learning techniques, the system will analyze individual spending habits to offer **custom budgeting suggestions, saving tips, and alerts** for irregular spending patterns.

**Multi-language support** will also be introduced to increase accessibility for users from different linguistic backgrounds, enabling them to log and manage expenses in their preferred language.

The mobile application version of the system will be further enhanced to support **voice-based expense entry** and **AI chat support** for resolving queries and providing financial advice on the go. This will simplify the process of entering data and improve usability for users who prefer voice interactions over manual entry.

To improve data reliability and integrity, the system will incorporate **blockchain-based audit trails**, providing a secure and tamperproof log of all financial transactions and updates made within the application.

Additional development efforts will focus on **emotional profiling and financial stress detection**, using sentiment analysis on notes or descriptions entered by users. This can trigger alerts or suggestions aimed at improving financial well-being.

Finally, **export features and integrations** with third-party platforms such as Google Sheets, tax software, or digital wallets will be implemented to broaden the utility and scope of the system.

These developments are aimed at transforming the application into a **comprehensive**, **intelligent financial assistant** that not only tracks expenses but actively contributes to better financial habits and long-term budgeting success.

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