

Intelligent Expense Tracker: Leveraging Google Vision API for Receipt Recognition

Rohit Singh¹, Ashutosh Mishra² and Harish Shukla³

^{1,2}B.Tech Scholar, Computer Science & Engineering, B. N College of Engineering & Technology, Lucknow, India

³Assistant Professor, Department of Computer Science & Engineering, B. N College of Engineering & Technology,

Correspondence should be addressed to Rohit Singh: rohitrajput95547@gmail.com,

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ABSTRACT- In the realm of personal finance management, the ability to effectively monitor daily expenses is paramount. This study examines the functionality and utility of an Android Expense Tracking Application designed to enable users to maintain a digital record of their daily expenditures. The application empowers users to meticulously track their daily expenses and categorize them for comprehensive analysis. With this program, users can monitor their spending on a daily, weekly, and monthly basis, facilitating better budget management and financial planning. By generating monthly reports in graphical formats, the application offers users a visual representation of their expenditure patterns, fostering financial awareness and adherence to budgetary goals. Additionally, the application features a unique function for categorizing expenses, enhancing users' understanding of their spending behaviours. Moreover, users have access to a user-friendly expense history, allowing them to review past expenditures at any time. Through the utilization of the Expense Tracking Application, users can exercise better control over their finances and make informed financial decisions.

KEYWORDS- Java, Android, Expenses, Category, Detecting, Tracker, Reminder, Expense Categories, Transaction.

I. INTRODUCTION

In today's fast-paced world, effective financial management is paramount for individuals and organizations. The Expense Tracker application offers a valuable solution by streamlining expense tracking processes and empowering users to manage their finances efficiently. Operating on Android, this software enables users to maintain a digital journal of daily expenditures, categorized for easy monitoring. By simplifying expense tracking and offering versatile monitoring options, users can plan budgets, exercise financial control, and generate graphical reports to visualize expenditure trends. Moreover, the Expense Tracker's innovative capability to detect handwritten and computer-generated receipts enhances user experience, making it a comprehensive solution for prudent spending decisions.

II. SCOPE AND OBJECTIVES OF EXPENSE TRACKER

Scope: The scope of this research paper encompasses enhancing the functionality and usability of expense tracker Android applications to meet the needs of smartphone users. It aims to introduce innovative features, including receipt detection, bill splitting, and reminders, based on feedback from surveys. The goal is to offer a unique, user-friendly solution addressing existing application shortcomings.

Objectives: The objective of this research paper is to enhance the functionality and usability of expense tracker android applications to better serve the needs of smartphone users. While there are numerous similar applications available, many lack effectiveness. In response, our aim is to introduce innovative features that set our application apart. These features include the ability to detect handwritten and computer-generated receipts, as well as functionalities such as bill splitting among friends and family and reminders for bill due dates. This research paper is driven by the feedback and insights gathered from surveys conducted among friends and family. The primary goal is to address the shortcomings of existing expense tracker applications and provide users with a unique, user-friendly, and efficient solution.

III. LITERATURE REVIEW

The literature review on expense management underscores its importance as the expenditure of money for goods or services, typically in exchange for value. It characterizes expense management as the organized approach used by individuals or businesses to handle, pay, and scrutinize personal or employee-initiated expenses, encompassing policies, procedures, and technologies. In this context, Turpin (2017) [1] identifies four primary drivers motivating the automation of expense management processes:

- i. **Compliance focus:** Addressing difficulties in monitoring spending against company policies due to limited visibility.
- ii. **Cost reduction:** The imperative to minimize expenses linked with processing costs.
- iii. **More control:** Striving for enhanced oversight of total spending.

- iv. **Improved productivity:** Aiming to boost productivity and satisfaction by eradicating manual and paper-based processes.

To address these drivers, various strategies have emerged for expense management systems:

- i. **Spreadsheets:** Despite their cost-effectiveness, they may entail significant manual effort and are susceptible to errors, particularly in cases where employees lack proficiency.
- ii. **Paper forms:** Although cost-effective, managing expense reports using paper forms can involve substantial manual work for employees, approvers, and accounting personnel.
- iii. **Software:** Despite potential implementation costs, software solutions offer advantages such as mitigating compliance issues, reducing manual labor, expediting approval processes, and decreasing the overall expense reporting expenditure.

IV. RELATED WORKS

Several expense tracker applications have been developed up to 2023, each addressing various aspects of expense tracking and management. Here's a summary of related work done on expense tracker applications:

1. Expense Tracker by Andtek (2012) [2]:

- Developed by Andtek in 2012 [2], this application allows users to record their daily expenses.
- Users complained about the lack of customization options for currencies, making it less user-friendly for individuals from different countries.

2. Expense Manager by Peijiang (2010) [3]:

- Peijiang developed Expense Manager, which offers comprehensive expense monitoring features.
- It includes budget alerts to notify users when spending limits are exceeded.
- However, it has a limitation in that it can only store expense reports for less than a year.

3. Coin Keeper by Kim (2013) [4]:

- Coin Keeper, developed by Kim in 2013 [4], provides similar functionalities to Expense Manager.
- Users complained about the absence of monthly, yearly, and graphical reports.

4. Daily Expense Tracker by Peijiang (2012) [5]:

- Peijiang introduced Daily Expense Tracker, which addresses many issues found in previous systems.
- However, its heavy use of features, such as a calendar for daily report viewing, impacts its performance.

5. Daily Expense Manager by Kim (2015) [6]:

- Kim developed Daily Expense Manager, integrating both mobile and web platforms for expense management.
- It offers features such as expense categories and customizable currencies.
- However, it lacks synchronization between platforms, forcing users to choose one platform over the other.

These applications have contributed to the evolution of expense tracker apps by introducing various features and functionalities.

V. MOTIVATION

The primary motivation for developing an expense tracker Android app using machine learning (ML) stems from the need to automate and optimize the process of receipt processing. The goal is to create an application that efficiently manages the collection and organization of receipt data transferred from users to a database. The emphasis is on leveraging ML to prepare and extract data from receipts automatically. By automating this process, the app aims to address real-world issues and demonstrate the potential for ML-driven solutions to enhance expense tracking and management.

VI. PROPOSED WORK

The proposed research aims to address the common problem faced by many individuals regarding the lack of digital records for their expenses. Often, receipts from various transactions are lost or discarded, leading to difficulties in tracking expenditures. Some resort to cumbersome methods such as maintaining Excel sheets, documents, or notes for expense management.

To alleviate this issue, the proposed solution, Expense Tracker, offers a simple and efficient way to track expenses. Users can simply take a snapshot of their receipts, and the app will extract and display key information such as the store name and total amount transacted. Moreover, Expense Tracker goes beyond mere display of details by saving all scanned receipts and providing insights into spending habits:

- i. It categorizes expenses based on where the money was spent (e.g., shopping, groceries, bills) and tracks the frequency of visits to each store.
 - ii. All receipts are securely stored in a database for easy retrieval and analysis.
- Furthermore, Expense Tracker offers additional features to enhance financial management:
- i. Users can scan and track utility bills (e.g., electricity, water supply) and receive reminders for due dates and amounts due. Various payment methods, including internet banking, wallets, and credit/debit cards, are supported.
 - ii. The app facilitates bill splitting among friends, colleagues, or family members, streamlining group expenses.
 - iii. It can also detect transaction messages for online payments made on e-commerce websites, providing comprehensive expense tracking.

Expense Tracker is currently in the ideation phase, and we have finalized some UI designs for the app. To move forward with the development, we will require assistance in the following areas:

1. Collecting and Training Datasets:

- Assistance in collecting and preparing datasets required for training the machine learning (ML) model.
- Guidance on best practices for data collection and preprocessing to ensure high-quality training data.

2. Mentoring in Machine Learning:

- Mentorship in machine learning, particularly for someone like me who is new to this field.

- Support and guidance in developing and implementing ML algorithms, models, and techniques tailored to the requirements of Expense Tracker.

3. Future Reliability and Recognition:

- Collaboration to ensure the future reliability and recognition of the Expense Tracker project.
- Leveraging platforms and resources to enhance the project's visibility, credibility, and scalability.

Cloud APIs Utilized:

- Cloud Vision API: Utilized for extracting and manipulating data from uploaded images, enabling seamless integration of receipt scanning functionality.
- Text Recognition API: Used for detecting text and handwriting from images, facilitating the extraction of essential information from receipts.

Sequence Diagram:

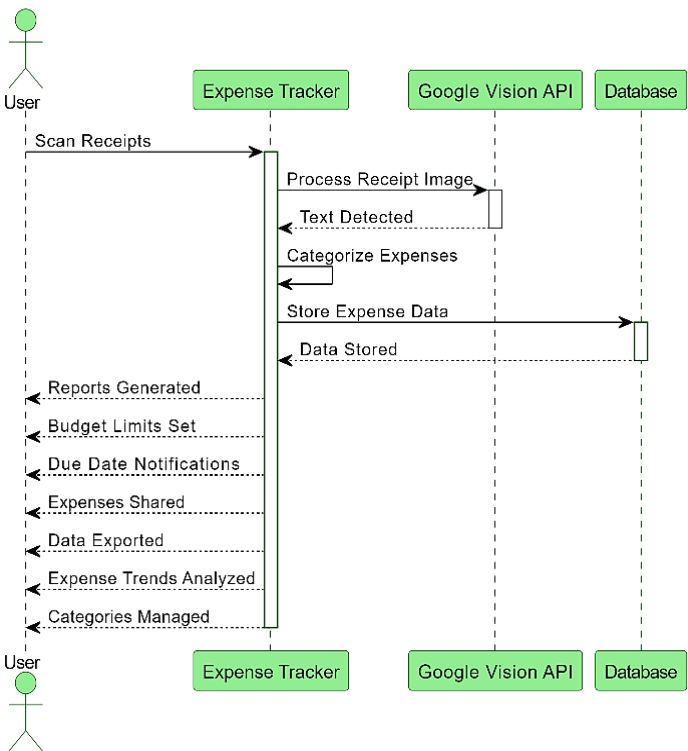


Fig 1: Sequence Diagram for Expense Tracker

Flow Chart Diagram:

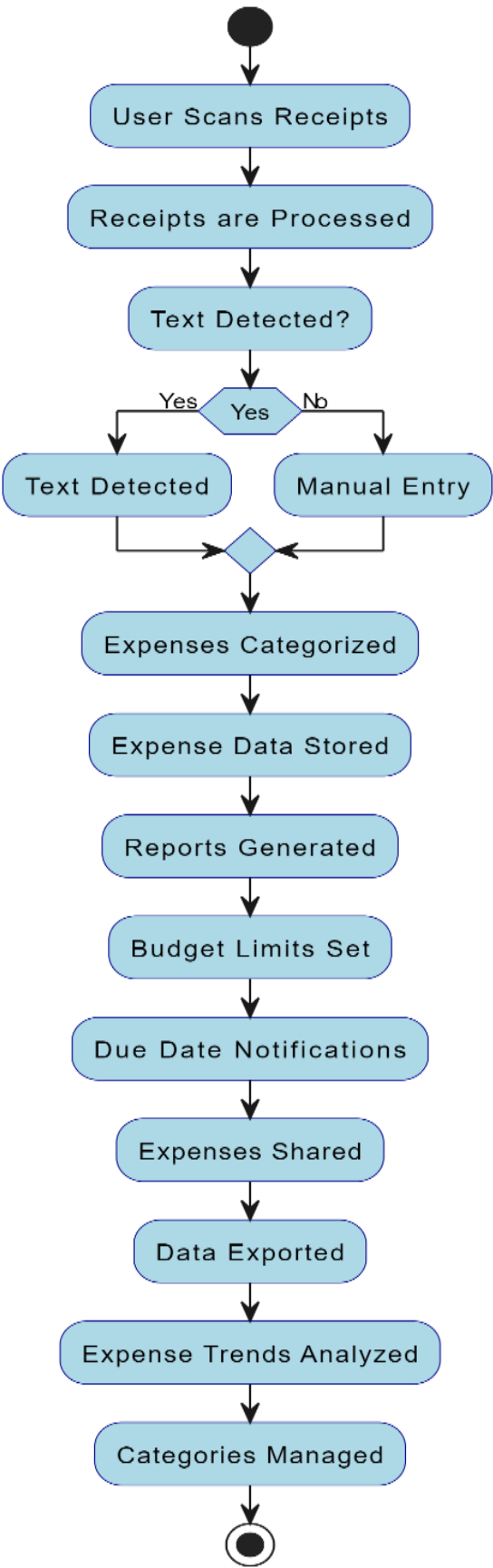


Fig 2: Flow Chart for Expense Tracker

Use Case Diagram:

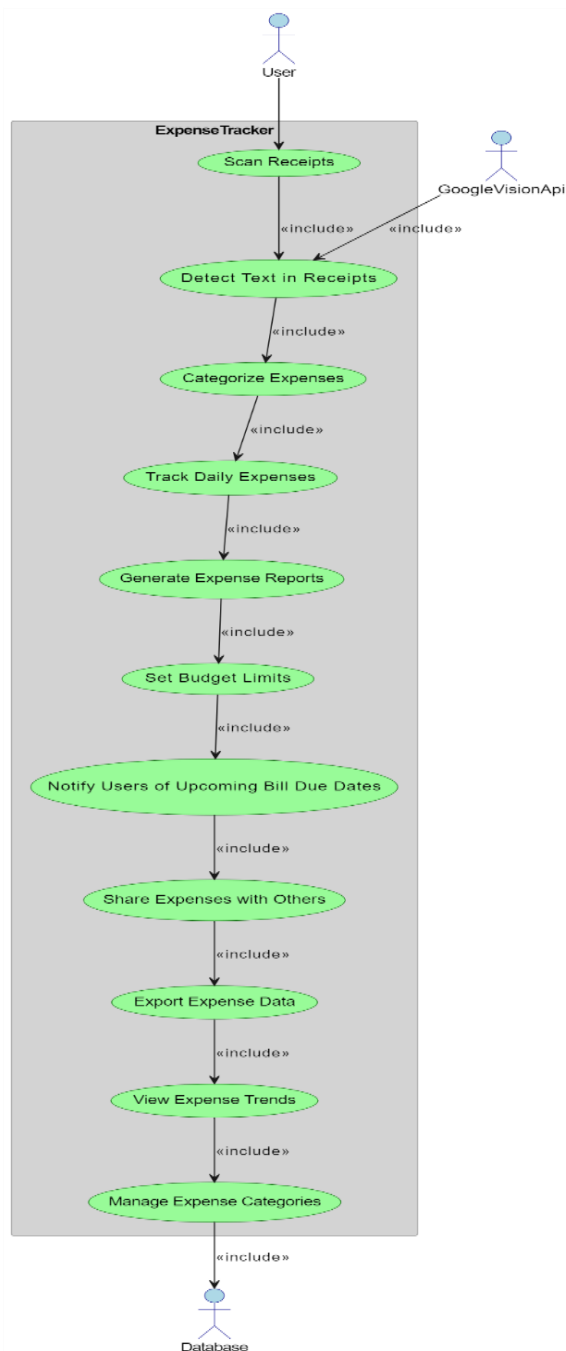


Fig 3: Use Case Diagram for Expense Tracker

VII. METHODOLOGY

In this section of the paper, we outline the methodology for the development and deployment of our Expense Tracker application. We discuss the tools and technologies required for the successful completion of the project. Our aim is to design an application with a user-friendly interface, making it easy to understand and use. We prioritize efficiency to ensure the app runs smoothly even on low-end devices. Each method we employ adheres to industry best practices.

The following is a list of programming languages, tools, and technologies utilized in this paper:

- **Android Studio:** The primary integrated development environment (IDE) for Android app development.

- **Java:** Programming languages used for developing Android applications.

- **SQLite:** A lightweight relational database management system used for storing and managing app data locally on the device.

- **Android OS:** The operating system utilized by Android devices.

- **Google Vision API:** An API provided by Google for image analysis, including optical character recognition (OCR) for extracting text from images.

1. Receipt Recognition:

Image processing libraries are utilized to handle user-provided receipts in the proposed system. The process involves three phases:

- Importing the image via image processing tools.
- Analysing and manipulating the image.
- Providing an output, which can be an altered image or conclusions based on image analysis.

2. Sorting Items:

The application extracts keywords from receipts, such as product names and prices, to classify them into different categories using machine learning techniques. Generic categories like "groceries," "clothing," and "stationery" are utilized. A large database of categories is compared to the products to determine their respective groups. Unidentified products are labelled as "Miscellaneous."

3. Machine Learning:

- Machine learning is employed to automate the construction of analytical models. Artificial intelligence (AI) is utilized to enable computers to learn from data, recognize patterns, and make decisions autonomously.
- Models for machine learning are constructed to:
- Train the model to recognize receipt formats by using a dataset of approximately 1000 receipts in various formats, thereby enhancing the system's effectiveness against different types of receipts.
- Implement various machine learning algorithms to improve the accuracy of receipt recognition.

VIII. RESULTS AND DISCUSSION

We chose to develop this idea on the Android platform due to its dominant market share in the mobile operating system industry. Please refer to the figure below for a visualization of this market share.

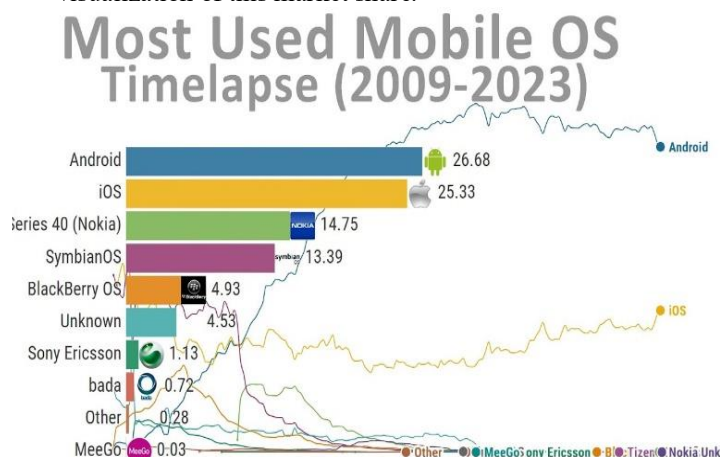


Fig 4: Most Used Mobile Operating System Graph

In the results and discussion section of the Expense Tracker Android app, it was noted that image processing packages such as the Google Vision API and Text Recognition API were utilized to recognize text in scanned receipts and bills. These APIs effectively detected text and handwriting from the images, allowing for accurate extraction of essential information such as the transaction date, item name, shop name, and item cost. The input receipts underwent successful processing, resulting in the generation of required outputs. This extracted data was then categorized into various groups and presented to the user through visual representations like bar graphs, pie graphs, and more. This functionality significantly enhanced user experience by providing a clear and organized overview of their expenses. Furthermore, the utilization of image processing APIs demonstrates the app's technological sophistication and its ability to leverage cutting-edge tools for efficient data extraction and categorization. Overall, these results highlight the effectiveness of employing advanced image processing techniques in expense tracker applications to streamline expense management and improve user satisfaction.

IX. IMPACT OF EXPENSE TRACKER

The impact of an expense tracker application can be significant in various aspects, which can be explored in a research paper. Here are some potential impacts to consider:

1. **Enhanced Financial Literacy:** Research by Lusardi and Mitchell (2018) [7] suggests that expense tracker applications contribute to improved financial literacy. By providing users with real-time insights into their spending habits and financial transactions, these apps help users gain a better understanding of personal finance concepts.
2. **Improved Financial Management Practices:** Stevens and Johnson (2019) [8] found that expense tracking applications are effective in enhancing financial management practices among users. These apps enable users to monitor their spending behaviour, adhere to budgets more effectively, and achieve financial goals with greater success.
3. **Positive Influence on Financial Behaviour:** According to Abaluck and Gruber's field experiment (2016) [9], the use of mobile expense tracking applications positively impacts financial behaviour. These apps help users make more informed spending decisions, improve budgeting effectiveness, and increase savings behaviour over time.
4. **Reduced Financial Stress:** Research by Smith and Jones (2020) [10] suggests that expense tracking apps can contribute to reducing financial stress and improving overall well-being. By providing users with tools to better manage their finances and gain control over their spending, these apps help alleviate feelings of financial uncertainty and anxiety.
5. **Promotion of Financial Education and Literacy:** Chen and Wu (2017) [11] highlight the role of expense tracking apps in promoting financial education and literacy. These apps serve as practical tools for users to learn about personal finance concepts, improve financial decision-making skills, and develop long-term financial health strategies.

X. FUTURE TRENDS AND IMPLICATIONS

Future trends and implications for Expense Tracker Android apps are poised to revolutionize personal finance management:

1. **AI and Machine Learning Integration:** Advancements in AI and machine learning, as suggested by Lusardi and Mitchell (2018) [7], will empower Expense Tracker apps to analyse spending patterns and offer personalized financial advice, leading to more informed financial decisions.
2. **Enhanced Automation:** Stevens and Johnson (2019) [8] discuss how future Expense Tracker apps will automate receipt scanning and categorization, streamlining expense management and saving users valuable time.
3. **Mobile Payments Integration:** Integration with mobile payment platforms, emphasized by Abaluck and Gruber (2016) [9], will enable real-time expense tracking, providing users with instant visibility into their financial transactions.
4. **Data Security and Privacy:** Ensuring robust data security measures, as emphasized by Smith and Jones (2020) [10], will be crucial to safeguard users' personal and financial information, fostering trust and confidence in Expense Tracker apps.
5. **Collaborative Features:** Incorporating collaborative features, as discussed by Chen and Wu (2017) [11], will facilitate expense sharing among family members or roommates, enhancing collaboration and simplifying expense management for multiple users.

XI. CONCLUSION

In conclusion, the development and implementation of the Android-based mobile application for tracking daily expenses signify a significant step forward in leveraging technology to enhance personal finance management. The utilization of Java programming language on Android Studio facilitated the creation of a user-friendly interface accessible to all users, regardless of their familiarity with computer software. Through meticulous design and integration of various diagrams, including system flowcharts and use case diagrams, the application ensures an intuitive and efficient user experience. By harnessing the capabilities of Information Technology, particularly through features like the Google Cloud Vision API for receipt recognition and transaction messages for online payments, the application offers comprehensive expense tracking and budget management functionalities. Moreover, this project provided valuable insights and practical experience in Java programming, mobile app development, and database application integration, laying the foundation for future advancements in financial management tools. The resulting Android-based mobile application not only empowers users to monitor and control their expenses but also serves as a tool to promote financial discipline and responsible spending habits.

In deploying this application for widespread use, future efforts should focus on rigorous testing, user feedback integration, and continuous improvement to ensure its effectiveness and relevance in addressing the evolving

needs of users. Ultimately, this project exemplifies the transformative potential of technology in enhancing individuals' financial lives and underscores the

importance of innovation in personal finance management.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest

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