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Research Paper**EXPENSE TRACKER - AN EXPENSE TRACKING APPLICATION
USING OCR AND RANDOM FOREST ALGORITHM**J Mohan¹, Daya Santosh Tonape², Dasireddy Bhargav³, Gayam Vinay Reddy⁴ and Katakam Akshay⁵^{1,2,3,4,5}Department of CSE(AI&ML), AVN Institute of Engineering and Technology, Hyderabad¹jmohan1214@gmail.com,²dayasantosht@gmail.com,³bhargavdasireddy2004@gmail.com,⁴gayamvinayvenkatreddy@gmail.com,⁵katakamakshay7@gmail.com

Abstract. Effective personal finance management involves tracking expenses, which enables people to monitor their spending and potentially meet their financial goals. Using intelligent tools to automate financial tracking, categorization, and analysis is essentially the only way to effectively manage spending in today's fast-paced environment. By separating and tracking each financial transaction, the Expenses Tracking Application with OCR and ML improves the efficiency of personal finance management. After taking textual data from receipts, bills, or invoices through a machine learning model for classification into user-defined categories, the program employs optical character recognition (OCR) to digitize the data. Small purchases benefit from the ability to manually enter transactions without paper receipts or invoices as it is possible to perform entry and classification. Users can do entry and categorization with few input errors. This tool is streamlined for the manual process that led to errors, simplified tracking, saved valuable hours, and provided prompt feedback regarding common trends: information on the time and manner in which user spending occurs. Users can also receive customizable spending notifications in the event of overspending, regular subscriptions, or common bills, among other expenses.

Keywords: Optical character recognition, personal finance management, automated finance tracking.

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1 INTRODUCTION

The personalized finance manager application is poised to re-engineer personal finance handling through advanced technology implementations of optical character recognition (OCR) and machine learning (ML). This was deemed necessary because personal finance management on a day-to-day basis has become a highly perplexing phenomenon for the ordinary mortal. The software rationalizes the process of digitizing and classifying financial information whereby consumers can easily track spending and budget. The manual method required customers to enter figures from their invoices, bills, and receipts into financial accounting software or spreadsheets. This is a

time-consuming procedure subject to human error. Using the OCR technology, our application scans the receipt and extracts useful data without any human intervention. OCR can be used to read the names on a receipt, date, items purchased, and total amount for further processing into a predefined class or user-defined class simply by taking a picture of the receipt. Machine learning techniques are also used in the application to refine accuracy of expense categorization in addition to the ease of OCR. With time, the learning system captures user patterns of spending and, therefore, becomes more accurate in identifying expenditures. The machine-learning algorithm assists the consumer in classifying his expendi-

tures under such headings as groceries, transportation, eating out, etc., thereby giving him an overall feel of how he is spending his money.

2 LITERATURE SURVEY

2.1 Literature Review

We conducted an in-depth survey by analyzing five research papers focusing on the financial literacy and finance management of a Family or small businesses that reduces manual efforts and does give accurate results of overall profits, losses or the wastage of money over the period which intern lets the users get the overall calculation and understanding of their spending patterns. One paper explores the efficient expense management by monitoring its timing and quantum of cash outflow [1]. The next paper has tracking regular expense as key factor to maintain a budget. These processes of storing expense require further computations and processing for these data to be used as a trackable record.[2]. Third paper encompasses of Optical Character Recognition (OCR) technology is a system that provides a full alphanumeric recognition of printed or handwritten characters from images [3]. The fourth paper is devoted to the description of creating a mobile application that helps to keep tracking of expenses and control budget. It works as follows: a receipt is scanned by a phone camera, preprocessing image. Then the text on the image is recognized, the needed data is selected and saved to database [4]. Another paper is based on the financial literacy of Sri Lankans which is relatively low, leading to difficulties in managing personal finances. This paper presents a smart solution to simplify the complexities associated with money management and assist individuals in managing their finances more efficiently to achieve better financial health without requiring a comprehensive knowledge of money management from the user [5].

2.2 Scope

The Expense Tracker application would provide an integrated space by which doing accounts at home shall be hackable through OCR and ML. The research basically targets saving manual data entry and thereafter the drawbacks of working by intuition due to conventional methods by automating and streamlining tracking, classification,

and expense management. The software will allow scanning of receipts, bills, and invoices for details such as amount spent on a particular expenditure, description, and date of expense. Thus, the burden of overseeing data entry will still lie upon its users as they actually guide the scanner for more accurate operations. Additional positive features of this algorithm machine learning for the past few decades include a general auto-classification of events poured down to individualized spending habits and further assurance in couching the sanctity of settings in financial data documentation. The application will give the user different specialized features tailored to their needs, like setting budgets on each spending alert or keeping track of recurrent expenses. In this way, users will manage finance based on their specific requirements. The application will provide a simpler, friendlier interface to work with the users of any level of financial literacy. In general, the application's overall purpose will be personal finance management, but the application itself will never make direct connections to the outside financial institutions, resuming later on the special features of investment management, tax calculations, etc. In simple technical words, cloud storage interoperability among different platforms will form the application and further offer continuous fluid experience for users working on iOS as well as on Android platforms.

2.3 Aim and Objective

It merges intricate technologies such as OCR and Machine Learning to enhance personal finance through automation of recording, classification, and expense management. The application for recording expenses is designed to free users from the painful effort of typing information into books of accounts, uneven data, tedious money flow monitoring, and a sequence of complicated realizations. Automation and intelligent features that enable intelligent decision support-giving make financial management and its aspects possible, specificity to particular spending tendencies, thereby enhancing precision while reducing manual effort. Through the application of pre-set or editable categories, users are able to gain insight into their spending patterns and identify zones of excessive spending. Personalization is

also one of the web application's primary concerns. It will inform them in real-time if they get close to or go beyond their budget, and so will have finances hassle-free and will instill accountable expenditure. Secondly, logging the one-off expenditure such as renting or a subscription may mean nobody ever has to miss a life-changing charge again. It offers real-time info and commentaries to users of their spending too.

OCR technology reduces manual data entry. Receipt scanning scans invoices and bills automatically when a receipt is viewed, digitizing them into structured, editable data. It prevents human errors like typos and/or incorrect numbers in any data entry, and it saves time. The overall gain in efficiency is made possible by the instant recall of important information from user receipts, enabling accurate tracking of costs without having to wade through spreadsheets or paper records. And it employs machine learning algorithms to classify costs into groups based on either user typed descriptions or extracted information, training the ML model to learn. Thus, the money data is kept and arranged in that manner, and over a period of time, this system will learn increasingly to adjust according to the user.

2.4 Requirements

The application model uses libraries such as OCR for character recognition and for converting human text to machine readable text, Streamlit which is an open-source python library for creating and custom web apps. Accurate and efficient receipt processing using the webcam, enabling the user to upload files and process them in case of digital receipts. An intuitive UI using streamlit that lets user enter, process and automate finances and monitor the accounts or spendings.

3 PROPOSED SYSTEM

The Expenses Tracking Application builds on the OCR's and machine learning technologies' abilities to effect an overhaul of personal finance management. With ever-increasing complexity in managing personal finances, this Application aims to automate the tracking, categorization, and analysis of expenses. This can be achieved with the ability of Optical Character Recognition, that is, it can read any text present on physical receipts, bills, and invoices. Hence, there is no need

for a manual entry, substantially reducing the chances of human error and saving a lot of time for the user. As a result, one does not need to carefully fill in all the purchase details, but just upload receipts or documents, and the system will automatically do the data entry. The Expenses Tracking Application is an intelligent solution designed to provide a streamlined and automated approach toward finance management. It comprises of various interrelated modules to give the user an overall experience toward finance management. Each one of these modules has its own purpose, and can be described as follows:

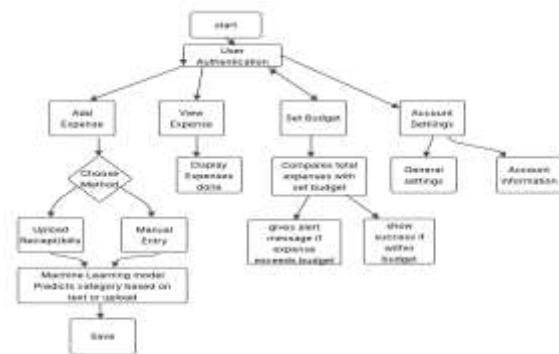


Fig. 1. Workflow of the Expense Tracking Application

This flowchart illustrates the working of a system, the process involved in managing the expenses and budget is highlighted. The user initiates the simulation via launching the application and registering for or making a profile. Successful authentication returns the user to the User dashboard which can be seen as the control center for interacting with different functionalities. On the dashboard, the user has the option to enter expenses (add expense), view expense, set budgets (create budgets), or obtain account configuration (get account settings).

If the user selects the Add Expense option, then the method of receipt scan to the system to input data using the OCR, or if the information is manually entered, then it is feasible. When the OCR method is chosen, a Machine Learning (ML) model predicts the category of the expense (e.g., "Groceries", "Entertainment", from the processed data). No matter what method it utilizes, that price is entered into the system next. In the View Expenses module, the account holder can either see a list of expenses or the summary of

expenses, so they are informed about spending patterns. The Set Budget function allows the user to set category-level budgets. At the stage of budget definition, the system compares whether the total value of the users spending is correct with the budget. If the amount of expense is higher than the budget, a warning message is presented; otherwise, the system displays a success message, telling the user that he/she is within the expenses limit. Finally, the Account Settings module enables users to change account wide settings, or change personal account information in response to the user's needs. This system flowchart highlights the system's capacity to seamlessly integrate user data with autonomous functionality, including optical character recognition (OCR) and machine learning-based classification, to deliver a natural and efficient expense management user interface.

4 SYSTEM METHODOLOGY

This application enables each part to perform a particular function and the parts to interact with each other to offer a smooth and effective user experience. The application is divided into three primary components: the frontend, the backend and the database. As flexible, hierarchical structure, the Expense Tracker Application is capable of being run smoothly with an intuitive user experience. By decoupling concerns within the Frontend, Backend, and Database the system is not only easily producible and scalable, however it also allows each section to be updated independently while providing flexibility and robustness.

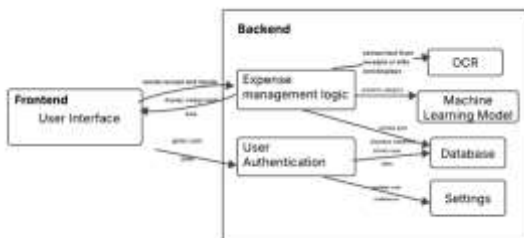


Fig. 2. System Architecture of Expense Tracking Application

4.1 Frontend

User Interface: Streamlit is a Python library for the construction of interactive web applications with a small number of lines. It is the client-side

component of the Expense Tracker Application doing the interface between the application and the user. The interface is simple, clean, and allows users to easily input and view their expense-related data. The UI consists of boxes where users enter what they spent, create budgets, and put receipts. It shows different components, such as item lists of expense, budgets summary charts, etc., providing a visual user experience.

4.2 Backend: Core Logic

The backend consists of a number of loosely coupled components that implement the business logic of the application, such as expense management, machine learning model, OCR (Tesseract), authentication, and settings management.

Expense Management Logic. This is the heart of the application which deals with all operations concerning the expenses, like registering new expenses, retrieving the old within the application, and calculating the totals. It "stores and retrieves expenses", "calculates the total" and "compares expenses" to the user budget. The Expense Management Logic guarantees the correct classification of every expense to enable users to manage their finances more efficiently.

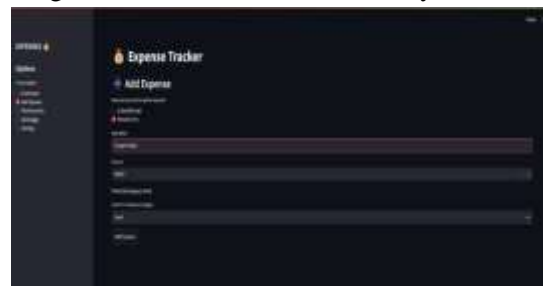


Fig. 3. Classification of expense

Machine Learning Model (Random Forest & Logistic Regression). This component classifies expenses into predefined categories based on their descriptions, using machine learning techniques like Random Forest and Logistic Regression. The model is trained to predict categories such as "Food", "Travel", "Entertainment", etc., based on the expense description. The system continuously refines the model's accuracy by updating the model with additional data.

OCR (Tesseract). Receipt photos uploaded by users are processed by OCR, in particular by Tesseract, to get the text from. Tesseract is an

open-source OCR engine that read and displays receipt images in order to extract valuable information e.g., the cost amount, date, merchant name, etc. The generated text is automatically completed with the corresponding fields in the user's expense record.



Fig. 4. OCR

Authentication & User Management. This component handles authentication tasks, such as user login, registration, and password management. The Authentication User Management module guarantees access to the system is given to only the permitted users. It manages user credentials, security questions, and password resets.

Settings Management. This part provides the user with the ability to set or change preferences, such as currency choice, notification preference, profile settings, etc. Users can update their settings through the UI, and these changes are stored in the backend. This module provides an opportunity to customize the user experience.

Database. All of the application's data is kept in the SQLite database. It provides quick and lightweight storage for budgets, user data, and spending.

SQLite Database. An embedded relational database is called SQLite. SQLite is suitable for situations requiring a light database and is a type of local storage. The database contains user information, spending logs, and budgetary specifics. Even with a comparatively modest quantity of data, SQLite provides an incredibly effective way to get and manipulate data so that application function is not impeded.

5 EXPERIMENTS

The experiments for this research were carried out to assess the precision, responsiveness, and usability of the Expense Tracking application. Application testing is simply verifying if every

one of the main features of functions in return, ensures data integrity and reliability of user interactions. Unit test is upon individual functions - adding expense, defining budget, categorizing expense in order to ensure that every feature functions correctly. Integration testing examines the interaction between components, as the OCR module or database would interact with machine learning models in terms of seamless data flow along with precision in the result. For example, the system must categorize an expense properly after the receipt image is processed via OCR. UI testing confirms that the user interface should be user-friendly and react suitably to user actions, from logging in to expense tracking. Security testing is critical, such that password hashing, session handling, and storing user information are safe. Edge case testing involves such things as invalid email addresses, null receipts, or a budget overflow. Lastly, performance testing verifies how the application responds to a load, particularly in data extraction and processing.

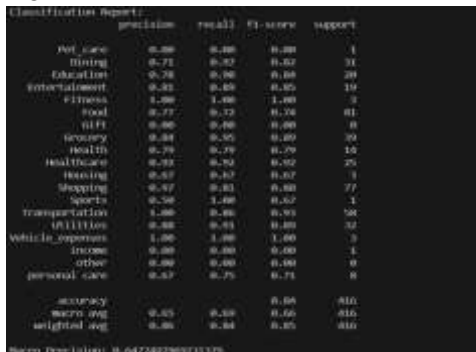
5.1 Experiment Details

The Testing on this application guarantees that all the features work correctly, reliably, and securely. Functional unit testing is carried out on individual functions (expense augmentation, budget setup and user authentication) to check their validity. These tests guarantee that each function correctly processes inputs and outputs, in turn minimizing errors of the whole system. E.g., testing guarantees that when a user attaches an expense, the right information successfully stores in the database.

1. Integration testing is crucial as it verifies the interaction of several components, such as the integration of OCR, Database, and Machine Learning model. This ensures that data passes through the system smoothly in the background, for example, while uploading a receipt, that OCR module will be able to perform the right text extraction and further classify the expense with the machine learning model.
2. UI testing verifies that the user interface is easy to use and comprehend, the testing is done. There is testing of the tools for budget monitoring, spending input forms, and login to verify that they function as required. The test-

ing of application functionality on all devices with responsive design is another aspect included in the tests.

3. The performance testing is employed to verify the behavior of the application when under a load, to ensure that it remains responsive even when a high volume of users and data are inputted. Moreover, edge case testing ensures the system offers graceful degradation in case of abnormal input or invalid input.
4. Accuracy: The program employs a machine learning algorithm (Random-Forest Classifier, initially) to categorize the type of expense from text descriptions in receipts or manual entry. Accuracy is gauged by dividing data into training and testing sets and subsequently testing the predictions against classification metrics. Training and Evaluation: Classification report offers evaluation metrics like precision, recall, and F1-score, giving a general perception of the overall performance of the model in accurately predicting the proper expense categories. Overall view of the model's performance in predicting the correct expense categories.



	precision	recall	F1 score	support
pet_care	0.00	0.00	0.00	1
dining	0.71	0.82	0.76	31
Education	0.28	0.98	0.40	20
Entertainment	0.82	0.89	0.85	19
Fitness	1.00	1.00	1.00	7
Food	0.77	0.72	0.74	81
Gift	0.00	0.00	0.00	0
grocery	0.84	0.95	0.89	30
Health	0.79	0.79	0.79	14
Healthcare	0.97	0.94	0.95	25
Travel	0.85	0.82	0.83	3
Shopping	0.87	0.81	0.84	77
Sports	0.58	1.00	0.67	1
Transportation	1.00	0.80	0.93	58
Utilities	0.00	0.71	0.00	32
Vehicle_Repairs	1.00	1.00	1.00	2
Income	0.00	0.00	0.00	1
Other	0.00	0.00	0.00	0
personal_care	0.87	0.79	0.73	8
accuracy			0.88	810
macro_avg	0.83	0.88	0.86	810
weighted_avg	0.86	0.84	0.85	810

Fig. 5. Classification Report of training and evaluation of Dataset

6 RESULTS AND DISCUSSIONS

Testing conditions are required to validate the application function for all potential conditions in various scenarios. The testing conditions consider realistic and boundary-value (edge-case) conditions so that it can be determined which conditions can cause or break a system. Valid user inputs into the system, including properly formatted email address, description for an expense, and budget parameters, etc. Test the system's handling for invalid data, including incorrect email formats, empty fields, or negative amounts for

expenses. To guarantee that the system is not broken, test using data that can push the boundaries of the system, e.g., extreme values for expenses or budgets of numerical quantities, instead of testing against synthetic data only. Test for illegitimate login attempts and confirm that the system is able to correctly sustain an illegitimate password securely and withstand a brute-force attack.

To protect private information, such as passwords or financial information, from unauthorized access. Tests the application's responsiveness on different devices, browsers and screen resolutions. All of features, such as buttons, forms and navigation, need to be intuitive and perform properly. Tests that all data (including expenses, budgets, and user data) are stored, retrieved and updated correctly in the SQLite database without any issues. Tests the machine learning model's ability to handle ambiguous descriptions and assign the correct category, especially for new or uncommon expense types. Because of this testing environment, the application is guaranteed to be operator-friendly robust, and secure for any likely situation.

7 CONCLUSION

In conclusion, an application built in the research will thus effectively help a person who wants to organize his spending in a proper manner and monitor his spending in such a meaningful, organized fashion that he will be able to view his expenditure categorized and be able to determine his budget. Some of its key features include expense categorization, budgeting, receipt scanning using OCR, and machine learning that helps in auto-categorization. With such features, users will be able to understand their expense behaviour better, set budgets, and track them using predictive tools. Streamlit even offers a web interface of the application that can be accessed by a general audience. The app utilizes machine learning algorithms such as Random Forest and Logistic Regression to automate the categorization of expenses through the use of the description that is found within the transaction. Additionally, the OCR feature enables users to extract text from receipts, making the inputting of expenses easier. This fusion of AI and manual ex-

pense management solutions makes the app a smarter and more effective solution for day-to-day users. In summary, since this expense tracker application already has so many useful features in it for managing personal finance, there certainly does exist room for development.

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