

Application for Predictive Recommendation and Visualization of Personal Expenses

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Abstract : We prefer to spend money on all kinds of stuff in our lives every day. It is possible to recall a large amount and also aid in the final tallying of the expenditures and profits. But the smaller expenditures go unattended and these small sums inevitably contribute to the spending of a significant sum of money. As a result, A total comprehension of individual finances is getting progressively significant as the normal people's disposable income has diminished because of a changing financial atmosphere. The aim of this project is to develop an application that will help the consumer keep track of even the smallest of the smallest financial expenditures and revenues. The project also aims to remind the user of payment dues before the due date so the user need not worry about overdue. As it is important for the user to also see where his/her money is being spent unnecessarily, the application would also help to visualize the various cost areas in various graph formats and ultimately demonstrate to the user which area of expense must be reduced.

IndexTerms - Expense tracker, Predicting expenses, visualizations, payment reminder, recommender system.

I. INTRODUCTION

Traditionally the management of personal finances is performed by viewing bank statements provided by the user's bank. However, these statements also do not reflect the small number of transactions that were not carried out through the bank. This project sets out to build an application that eventually solves the user's problem of finding where the money is being spent unknowingly and also to help the user plan his expenditure accordingly.

The application is going to be designed keeping in mind the multiple requirements of the user. The very basic is to keep track of the expenses and income. This will be done in the following ways; firstly, the user enters manually the amount of expense or income and its source which gets stored in the database for further processing. Secondly, any online transaction made by the user from the app will be stored in the database automatically for further processing which makes the life of the user easy as he/she need not enter it manually. Thirdly, the application will detect the transaction details from the SMS alerts of banks or other financial companies and that data would be used for further processing. Lastly, the application will allow the user to scan bills via OCR which will be automatically entered into the database. The application will display these transaction entries on the home screen. Based on the entered data, the application will also generate various graphs that will help in visualization. These visualisations will help the user to know which area of expense is increasing exponentially to help the user plan their finances accordingly.

The user should also be able to set a reminder for bill payments and when the deadline is near. The application will remind him/her of the due payment to avoid overdue. The app will also keep a track of this payment. We also plan to make a recommendation system that recommends the user the recommended budget for the next month. This can happen only after a certain period as the app needs to get the user's income and expense data to learn from it and thereby perform the recommendation. As the data is collected every month, the system can then predict the expenditure of the next month using Machine Learning algorithms and thereby alert the user as to not go beyond the predicted amount. As a result, all these functionalities should help the user plan his/her expenditures accordingly and therefore help in financial planning.

II. LITERATURE SURVEY

Every day in our lives we tend to spend money on different kinds of things. A huge amount can be remembered and also helps in the final tallying of the expenses and income ^[11]. But the smaller expenses go unattended and those small amounts eventually lead to a big amount of money being lost or spent ^[4]. As a result, A total comprehension of individual finances is getting progressively significant as the normal people disposable income has diminished because of a changing financial atmosphere ^[7]. For the best OCR results, multiple training and testing images would be required with manual efforts to correct the text fetched from the receipts with no fix/universal format ^[9]. In comparison to the several present apps available on the Play Store and App Store for iOS, we defined some base parameters based on their detailed analysis with the add-on of the prediction models to set it unique in the market. In the view of our proposed application, we need to consider certain measures to select the best Machine Learning algorithm to learn about the expense patterns of the user and predict the expense or budget of the user and recommend him for the best ways to minimize the expenses for better savings ^[8]. In Table no 1, Apps numbered 1 to 5 are apps that are highly used globally ^[13] by several users and don't have an Indian origin. Whereas apps numbered 6 to 12 are highly used apps amongst Indian Users ^{[10] [11] [12]}. The various parameters mentioned on the top of the table helps us to determine what drawbacks of which existing system does our proposed application overcome. After the analysis, we find that none of the existing systems have a prediction system as we propose whereas several apps don't provide shortcut and alerts to the user to enter the recurring expenses from time to time.

III. COMPARATIVE ANALYSIS*Table 1: comparative analysis of existing Systems*

Sr. no	App Name	Manual Transaction Entry	Categorize Expenses	Import Bank Statements	Payment Reminders	Retrieve Data From SMS	Low Balance Alert	Set a budget	Visualizations	OCR	Shortcut for Recurring Expenses	Predict expenses	Suggest budget w.r.t to past data
1	Quickbooks	Yes	No	Yes	Yes	No	No	Yes	No	No	No	No	No
2	Mint	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No
3	YNAB	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	no
4	Shoeboxed	No	Yes	No	No	No	No	Yes	Yes	Yes	Yes	No	No
5	Expensify	No	Yes	No	No	No	No	Yes	No	Yes	Yes	No	No
6	Walnut	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	No	No	No
7	Monify	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	No	No
8	Andromoney	Yes	Yes	No	No	No	No	Yes	Yes	No	No	No	No
9	Fudget	Yes	No	No	No	No	No	Yes	Yes	No	No	No	No
10	Wally	Yes	Yes	No	No	No	No	Yes	Yes	Yes	No	No	No
11	Proposed System	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2: comparative analysis of machine learning algorithms

Ref.no.	Title	Author name	Technique	Dataset	Algorithm	Accuracy
[1]	Linear regression model for predicting medical expenses based on insurance data	Akhil Alfons Kodiyan, Kirthy Francis	Linear Regression, Multiple Regression	Medical cost personal dataset	Linear Regression Models & Analysis of Variance (ANOVA)	0.75
[2]	Prediction of Accrual Expenses in Balance Sheet Using Decision Trees and Linear Regression	Chih-Yu Wang, Ming-Yen Lin	Decision tree, Regression models		C4.5 algorithm (Decision Tree generator Algorithm)	0.84
[3]	Enhancing cash management using machine learning	Zineb Moubariki, Lahcen Beljadid, Mohammed El Haj Tirari, Mohammed Kaicer, Rachid Oulad Haj Thami	Decision tree		Decision tree, Random Forest, Neural Network	0.9
[4]	Expenditure Predicting using Machine Learning	Vipul, P Vinoth Kumar, Divyansh Dimri, Mayank pathak	Linear Regression	Bank Statements	Linear Regression	0.8

IV. PROPOSED SYSTEM

Our main aim is to make the life of the user easy in tracking their expenses. The user must be able to easily add in the expenses and incomes. Therefore, keeping that in mind we will have two methods of data entry:

1. The user should be able to manually enter the transaction amount. Attributes such as Date, amount, description and category of the transaction would also be needed to be filled during data entry.

2. The second method of data entry is where the application if permitted by the user, will scan the messages of the user and see if there are any online transactions. If there are, they will be automatically added to the application.

Normally, when an online transaction happens, the person receives a message on the phone with the amount debited or credited. Leveraging this for text recognition could be helpful in the second method of data entry. Visualizations are a very important part of any expense tracking application. It helps the user to get an idea that which area of expense is high and what is the condition of the overall finances. Therefore, upon receiving data, the application will form 4 graphs. They are:

1. A pie chart that will breakdown the contribution of each category of expense towards the overall expense.
2. A horizontal bar graph that would act as the secondary medium for viewing the contribution in more detail.
3. A line graph that will show the balances of each month. This graph will help the user understand if their balances have been constant, depleting, or increasing for each month.
4. A vertical bar graph that shows the overall expense of each month. This graph will be helpful in understanding that in which month the expense was extremely high.

In order to make the app more user friendly, we also plan on making a reminder system. The user will have to set a date for the recurring expenses. These expenses could be bills, rent, insurance, etc. The application will then remind the user to pay these recurring expenses before the due date hence making sure the user will not have to pay the late fees.

Also, the application will have a budget limit. The user can enter the limit amount. If the balance of a particular month drops lower than the entered amount, the application will send an alert to the user notifying that the balances for a particular month are depleting and they should reduce their expenses.

We also want the user to be able to see if the expense is a necessary expense or a luxury expense. This category will help the user to understand if their expenditure is more towards the necessary expenses or if they are spending more on luxury expenses. Lastly, we plan on making a prediction system. As more and more data is received into the application, this system will predict the expenditure of the next month and this expenditure will be set as the recommended budget for the next month. We can set the limit as to how much historical data the app will need to consider to make the necessary predictions. These prediction systems will breakdown the recommended budget into 3 categories of daily, weekly and monthly recommended budget.

V. IMPLEMENTATION

We developed a mobile application using the Flutter framework. Firebase is used as a back-end database. The user is supposed to log in to the application for the first time after registering. After that, they need not login again and again. The necessary fields for logging in is an Email address and Password. The Password should contain the following:

- At least one uppercase letter
- At least one lowercase letter
- At least one numeral
- At least one special character

Every new user to the application is supposed to create an account. The required fields for creating an account are Email address and password. Upon clicking the Register button, the backend Firebase services will send a verification link to the entered email address. The user should click on the verification link to verify their account with the application. Once verified the user can login to the application with their credentials. Figure 1,2.

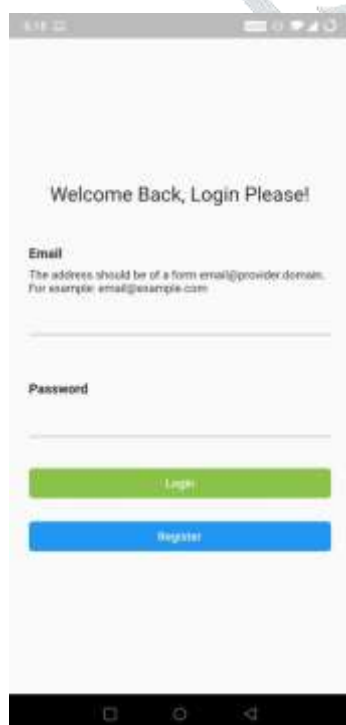


Figure 1: Login Screen

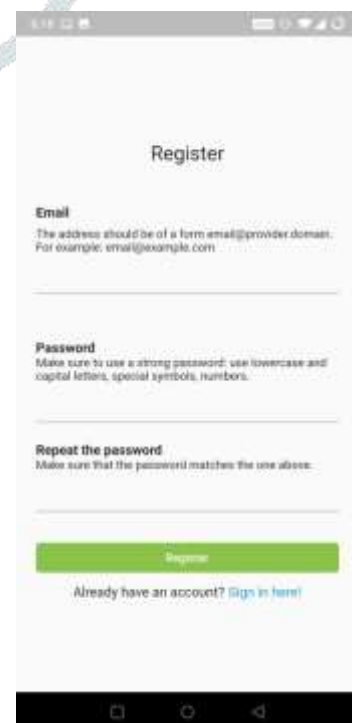


Figure 2: Registration Screen

The Home screen as shown in figure 3 is the first screen that the user will see after logging in. The screen gives an overview of all the expenses and incomes. The expenses are shown by the red down arrow and the incomes are shown by the green up arrow. Each entry is clubbed together as per day, so at the end of the day, the user can see if he has gained money or has, he spent excessively. On the very top is the summarization of the entire month. This card will show the total income, total expense and the total balance of the on-going month. Below the summarization card is the card for the recommended budget which will show the recommended budget to the user for the upcoming month. The recommended budget system is designed in such a way that as more and more data is added into the application, the system will calculate the probability of expenditure in each category of expense. For example, if there are 3 categories Food, Medical and Insurance, and out of these 3 categories if the expenditure was the most in the Food category, the algorithm understands that Food is the category that has the highest probability of expenditure. It then checks the next category with the second highest probability and based on the probabilities of expenditure in the categories, it recommends the budget for the next upcoming month. This ensures that if there was an extremely high expenditure in the previous month, for example, let's say festivals, but there is a consistent expenditure in other categories since past months, the system will not just predict a higher budget based on the expenditure on Festivals but instead it will recommend the budget based on other categories that have a consistent history of expenditure because their probabilities will always remain high. The algorithms tried and tested have been discussed in the next section.

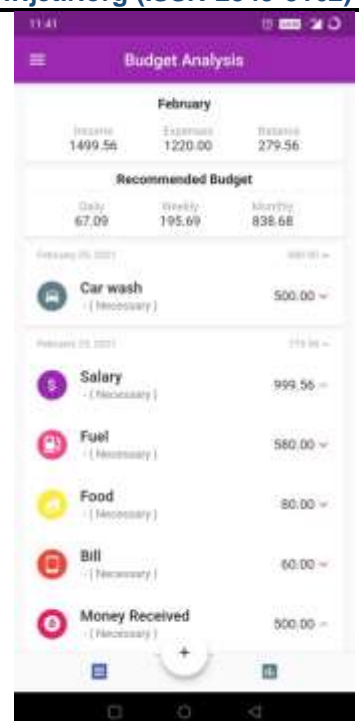


Figure 3: Home Screen

The Data Entry Screen as shown in figure 4 handles the input. At the top, you have the date picker, which pre-selects today's date, the user can also select any date that he/she wants. Below, there is the amount field where the user can enter the amount. Below is the description box for more information regarding the Amount. After that, is a selector where the user can select if the transaction was a necessary transaction or a luxury transaction. The type of transaction selected will be reflected on the Home screen as well. Lastly, the next field is selecting different categories, to help the user segregate his/her expenses and income properly. These categories are not predefined. The user can create their own categories based on their transactions. Once all the fields are entered, the user can click the top right button and the transaction will be saved.

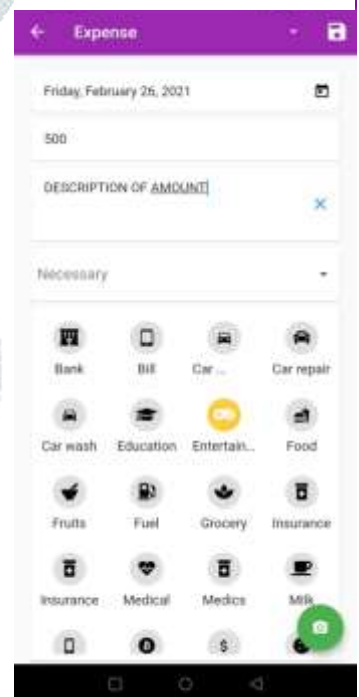


Figure 4: Data Entry Screen

Once the data is entered, the system generates 4 graphs as follows:

1. Pie Chart
2. Horizontal Bar Graph

These two graphs as shown in figure 5 play a very crucial role in breaking down the percentage of expenses in each category for every month. With the help of this breakdown, the user can easily see which category has the most expenditure for each month.

3. Vertical Bar Graph: (Figure 6) This graph plays a crucial role in helping the user understand which months had the most expenditure. For example, there are some months where we tend to spend a lot due to festivals or vacation months and so this graph can easily help the user in understanding that.
4. Balance Line Graph: (Figure 7) At the top of the graph, it will show the cumulative income, expense and balance of the entire year. The graph is meant to plot the balance of every month. This graph helps the user understand how good his/her savings have been throughout the year.



Figure 5: Pie Chart and Horizontal Bar Graph

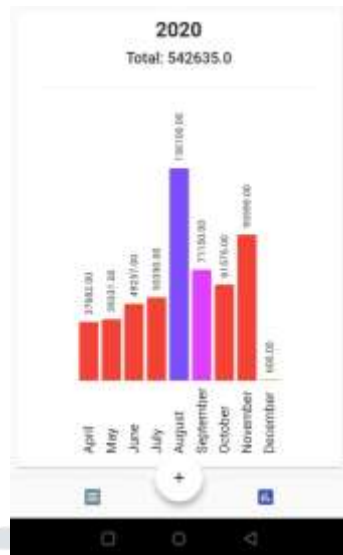


Figure 6: Vertical Bar Graph

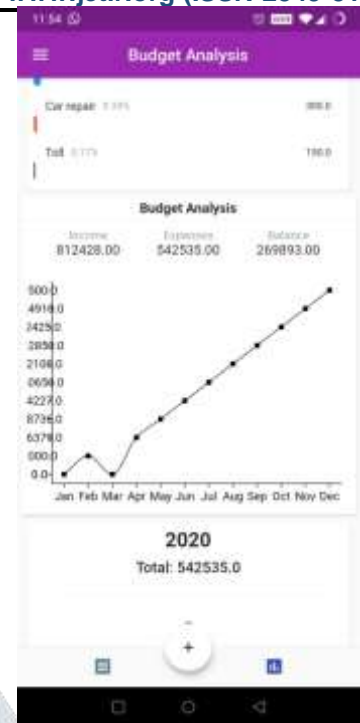


Figure 7: Balance Line Graph

The settings page is where the user can set a balance limit. If the balance goes below the assigned limit, the application will send a push notification to the user through Firebase alerting the user that the balance for the particular is very low.



Fig 8: Settings page

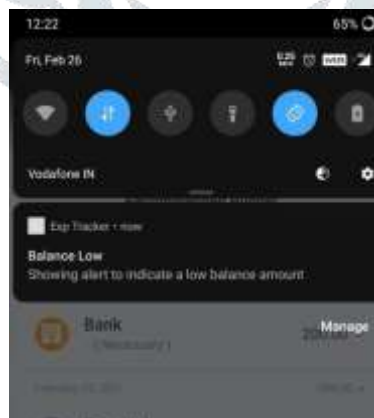


Fig 9: Notification for low balance

VI. COMPARISON OF ALGORITHMS

We initially tried a clustering technique where clusters of different categories are formed and as new data is entered into the application, the transaction will be allocated the suitable category and whichever cluster has the most entries, that cluster will be considered as the cluster which has the highest transaction rate and based on the cumulative amount of that cluster, the recommended budget will be set. We tried different clustering algorithms but all of them resulted in giving a fixed ratio with the balance amount. The clustering algorithms tried and tested were KNN Classifier, agglomerative clustering, agglomerative clustering. We also tried using Linear Regression and Random Forest Classifier but these algorithms also failed. Then we thought of considering the probabilities of expenditure in each category and based on those probabilities we should predict the recommended budget. We decided to use Convolutional Neural Networks and received better accuracy than all previously tested algorithms. As the user enters more data into the system, the model will gain more data to learn and find patterns and thereby suggest a much better-recommended budget. The data is first categorized into different categories of transactions. Upon using the categorical function from the Keras library, the library gives the probability of a transaction happening in a category. If the probability is high, it is assumed that there are chances that the user is likely to perform an expenditure in the same category for the upcoming month as well. Using CNN also didn't cause a fixed ratio with the balance amount. Currently, the model is integrated with the application but it still requires more tuning to achieve better accuracy in recommending the budget.

VII. CONCLUSION

Therefore, our application aims to help the user not lose track of his/her expenses and hence helping them properly manage their finances. We have discussed about the important features that our application will support. We have also researched on existing applications and what flaws they have and how our application will try to overcome those flaws and provide all the features to the user. By tuning the CNN model, we aim to achieve the best possible results for the prediction which will eventually help the user keep a check on his expenses. People are obsessed with completing tasks in lesser time and our system is an approach serving this purpose. Nowadays, the world is leaning towards the one tap solution and our system is one of a kind. After all, automation is the way of future and our application can be a step towards it. The application still has a lot of aspects that can be improved.

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