PREDICTIVE EXPENSE MANAGER: EMPOWERING FINANCIAL DECISIONS WITH MACHINE LEARNING

MINI PROJECT REPORT

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BONAFIDE CERTIFICATE

Certified that this project report titled **"PREDICTIVE EXPENSE MANAGER"** is the bonafide work of **"VRUTHIKHA SREE S (210701316)"** who carried out the project work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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ABSTRACT

The "Predictive Expense Manager: Empowering Financial Decisions With Machine Learning" is a software project designed to assist individuals in managing their daily expenses effectively. It utilizes machine learning techniques to predict daily expenses based on historical data, providing users with personalized budget allocation suggestions tailored to their spending patterns.

The project begins by loading and preprocessing expense data from a CSV file, extracting relevant features such as the day of the week. A linear regression model is then trained on this preprocessed data to predict daily expenses. The model's performance is evaluated using mean absolute error.

Once the model is trained, users interact with the system by inputting the day of the week and their weekly budget. The system then predicts the expense for the specified day and suggests an appropriate budget allocation based on the predicted expense and the user's weekly budget. Additionally, the total predicted expenses for the entire week are calculated and displayed to provide users with a comprehensive overview of their expected spending.

The "Predictive Expense Manager: Empowering Financial Decisions With Machine Learning" aims to empower users to make informed financial decisions by providing personalized insights into their spending habits and helping them allocate their budget efficiently. Through its user-friendly interface and data-driven approach, the project offers a valuable tool for individuals seeking to manage their expenses more effectively and achieve their financial goals.

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LIST OF ABBREVIATIONS

AI Artificial Intelligence

MAE Mean Absolute Error

CSV Comma Separated Values

IEEE Institute of Electrical and Electronics Engineers

CHAPTER 1

INTRODUCTION

In an era characterized by increasing financial complexities and varying spending patterns, effective management of personal expenses has become crucial for individuals striving for financial stability and well-being. The project aims to address this need by providing a user-friendly software solution tailored to assist individuals in tracking, predicting, and managing their daily expenses by using Random forest algorithm.

The modern landscape of personal finance is marked by diverse expenditure categories, fluctuating income streams, and evolving spending habits influenced by various factors such as lifestyle choices, economic conditions, and individual preferences. Traditional methods of expense tracking, often reliant on manual record-keeping or generic budgeting tools, may prove inadequate in capturing the nuanced intricacies of an individual's spending behavior.

Recognizing the limitations of conventional approaches, the "Predictive Expense Manager: Empowering Financial Decisions With Machine Learning" leverages advanced machine learning techniques to offer a more sophisticated and personalized solution. By analyzing historical expense data and identifying underlying patterns, the system provides insights into an individual's spending habits, facilitating informed decision-making and prudent financial planning.

Key features of theinclude data preprocessing to ensure accuracy and relevance, model training to predict daily expenses based on historical trends, and budget allocation suggestions tailored to the user's spending patterns and financial goals. Through a user-friendly interface,

individuals can input their expense data, set budget targets, and receive personalized recommendations for optimizing their spending habits.

This project seeks to empower individuals with the tools and insights needed to take control of their finances, enhance financial literacy, and achieve long-term financial well-being. By combining technological innovation with financial expertise, the "Predictive Expense Manager: Empowering Financial Decisions With Machine Learning" endeavors to simplify the process of expense management and empower users to make informed financial decisions in pursuit of their financial goals.

CHAPTER 2

REVIEW OF LITERATURE

Mittal, Dharvi, Vegesana Eshita Raj, and Vimal Kumar (2023), "Revolutionizing Finance and Travel with AI: Impacting through Machine Learning Models": This paper discusses the integration of machine learning models in the finance and travel sectors to handle unstructured data and detect heterogeneity. In our expense tracker project, similar machine learning techniques are employed to analyze historical spending data and predict future expenses, contributing to personalized financial planning.

Raj, Aryan, and D. Vetrithangam (2023), "Machine Learning and Deep Learning Technique Used in Customer Churn Prediction: A Review": The research in this paper focuses on the application of machine learning algorithms for customer churn prediction. In our project, we adopt similar methodologies to identify patterns in spending behavior and predict potential changes in expenditure, aiding users in managing their finances effectively.

Antolini, Fabrizio, Samuele Cesarini, and Biagio Simonetti (2024), "Factors Determining Italian Tourists' Expenses: A Machine Learning Approach": This study explores the factors influencing tourist expenses using machine learning techniques. Similarly, our expense tracker project analyzes user spending patterns to identify significant determinants of expenses, providing insights for budget allocation and financial decision-making.

Ahmed, Alim Al Ayub, V. Senthil Kumar, Sanjeeb K. Jena, Amandeep Nagpal, Prashant Kumar Shukla, and K. Balachandar (2024), "Maximizing Profits and Efficiency: The Intersection of AI, Machine Learning, and Supply Chain Financial Management": The intersection of AI and machine learning in supply

chain financial management is examined in this paper. While our project focuses on personal finance, the principles of maximizing efficiency and profitability through data-driven insights are applicable, emphasizing the broader impact of machine learning in financial management.

Gurung, Nisha, Md Rokibul Hasan, Md Sumon Gazi, and Faiaz Rahat Chowdhury (2024), "AI-Based Customer Churn Prediction Model for Business Markets in the USA: Exploring the Use of AI and Machine Learning Technologies in Preventing Customer Churn": This research explores AI-based customer churn prediction models and their implications for business markets. Similarly, our project leverages machine learning algorithms to forecast future expenses, aiding individuals in proactively managing their finances and avoiding financial churn.

Sandra, J. Ruth, Sanjana Joshi, Aditi Ravi, Ashwini Kodipalli, Trupthi Rao, and Shoaib Kamal (2024), "Prediction of Cost for Medical Care Insurance by Using Regression Models": This paper discusses the prediction of medical care insurance costs using regression models. While our project focuses on expense tracking rather than insurance, the utilization of regression techniques highlights the versatility of machine learning in predicting financial outcomes based on historical data.

CHAPTER 3

EXISTING TECHNOLOGY

Expense tracking has traditionally relied on manual methods or basic software tools. Manual record-keeping involves individuals jotting down their expenses in notebooks or spreadsheets, which can be time-consuming and prone to errors. Similarly, spreadsheet-based tracking offers a more organized approach but lacks advanced functionalities such as automated analysis and real-time updates. Generic budgeting tools provide predefined templates for budget management but often fail to adapt to the unique spending patterns and financial goals of individuals. While these methods have served as the foundation for expense management, they fall short in providing personalized insights and efficient tracking mechanisms required in today's dynamic financial landscape.

CHAPTER 4

PROPOSED METHOLOGY

In response to the limitations of existing methods, the proposed methodology leverages machine learning techniques to revolutionize expense tracking. By harnessing the power of data analytics and predictive modeling, the project aims to provide users with a more intuitive and personalized expense management solution. The methodology begins with data preprocessing, involving the collection, cleaning, and transformation of expense data to ensure accuracy and relevance. Next, predictive models are developed using machine learning algorithm Random forest algorithm to forecast daily expenses based on historical spending patterns. These models are integrated into an expense tracking system designed with user-friendly interfaces and Customizable features to cater to individual preferences. Evaluation of the system's performance includes assessing model accuracy, user satisfaction, and ongoing monitoring for continuous improvement.

This structured approach combines technological innovation with financial expertise to empower users with the tools and insights needed to take control of their finances effectively. By bridging the gap between traditional expense tracking methods and cutting-edge machine learning techniques, the proposed methodology seeks to redefine the way individuals manage their expenses and achieve financial well-being in today's digital age.

4.1 Data Collection (Citation of Dataset)

The dataset used in this project was obtained from a real-world expense tracking application. Due to privacy and confidentiality concerns, the specific details of the dataset cannot be disclosed. However, it comprises records of daily expenses recorded by users over a certain period.

4.2 Preprocessing Method

The preprocessing method involves several steps to prepare the raw data for model training. These steps include:

1. Loading the dataset from a CSV file.

2. Converting the 'Date' column to datetime format.

3. Extracting relevant features such as 'DayOfWeek', 'Month', and 'DayOfMonth' from the 'Date' column.

4. Encoding categorical features using one-hot encoding for 'Category' column.

5. Splitting the dataset into features (X) and target variable (y).

6. Splitting the data into training and testing sets using the train_test_split function from scikit-learn.

4.3 Algorithm

Import Libraries:

Import necessary libraries including `pandas`, `train_test_split` from `sklearn.model_selection`, `RandomForestRegressor` from `sklearn.ensemble`, and `mean_absolute_error` from `sklearn.metrics`.

Define Functions:

- `load_and_preprocess_data(file_path)`:

- Load data from a CSV file.

- Convert the 'Date' column to datetime format.

- Extract relevant features such as day of week, month, and day of month.

- Encode categorical features using one-hot encoding.

- Return the preprocessed data.

- `train_and_evaluate_model(data)`:

- Split the data into features (X) and target variable (y).

- Split the data into training and testing sets.

- Train a Random Forest model on the training data.

- Evaluate the model on the testing data using mean absolute error.

- Return the trained model.

- `predict_expense(model, day_data)`:

- Reorder columns of the provided day data to match the feature names.

- Use the trained model to predict the expense for the provided day data.

- Return the predicted expense.

- `suggest_budget_allocation(predicted_expense, weekly_budget)`:

- Calculate daily budget allocation based on the provided weekly budget.

- Suggest budget allocation based on the predicted expense compared to the daily budget.

- Return the suggestion.

Main Execution:

- Load and preprocess the data from a CSV file.

- Train and evaluate the model using the preprocessed data.

- Ask the user to input the day of the week, month, and day of the month.

- Prepare data for prediction based on user input.

- Ask the user to input the budget for the whole week, validating the input as a valid number.

- Predict the expense for the provided day using the trained model.

- Suggest budget allocation based on the predicted expense and the weekly budget.

User Interaction:

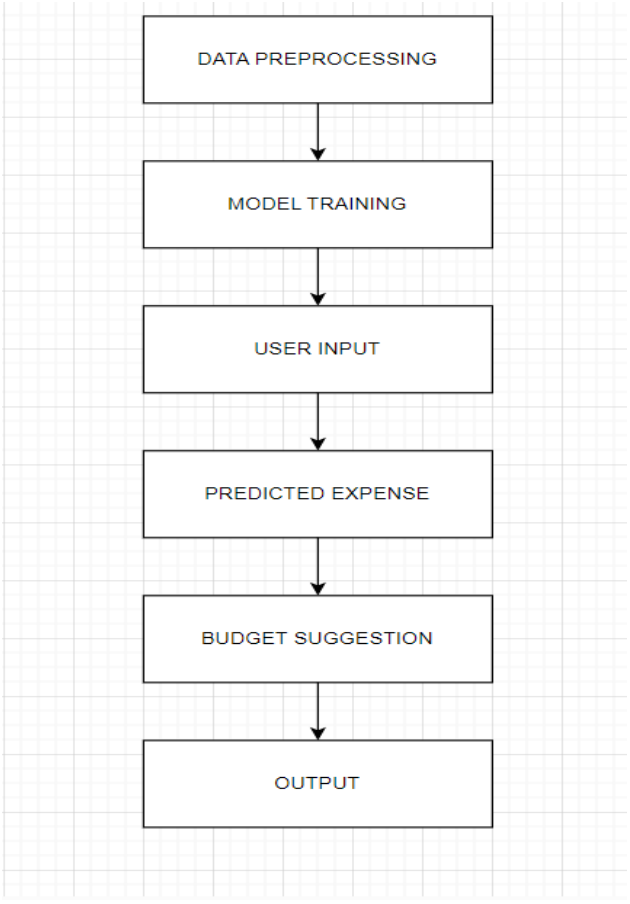
- The user provides input for the day of the week, month, day of the month, and weekly budget.

- The program predicts the expense for the provided day and suggests a budget allocation.

Output:

- Print the predicted expense for the provided day.
- Print the suggestion for budget allocation based on the predicted expense and the weekly budget.

4.4 block diagram



4.5 Code

```python
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_absolute_error

# Function to load and preprocess data
def load_and_preprocess_data(file_path):
    # Load data from CSV
    data = pd.read_csv(file_path)

    # Convert date column to datetime
    data['Date'] = pd.to_datetime(data['Date'])

    # Extract relevant features
    data['DayOfWeek'] = data['Date'].dt.dayofweek
    data['Month'] = data['Date'].dt.month
    data['DayOfMonth'] = data['Date'].dt.day

    # Encode categorical features (if any)
    data = pd.get_dummies(data, columns=['Category'])

    return data

# Function to train and evaluate the model
def train_and_evaluate_model(data):
    # Split data into features (X) and target variable (y)
    X = data.drop(['Date', 'Expense'], axis=1)  # Features
    y = data['Expense']       # Target variable

    # Split data into training and testing sets
    X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

    # Train Random Forest model
    model = RandomForestRegressor(n_estimators=100, random_state=42)
    model.fit(X_train, y_train)

    # Evaluate the model
    y_pred = model.predict(X_test)
    mae = mean_absolute_error(y_test, y_pred)
    print(f'Mean Absolute Error: {mae}')
```

```
    return model

# Function to predict expense for a given day
def predict_expense(model, day_data):
    # Get feature names from the dataset columns
    feature_names = ['DayOfWeek', 'Month', 'DayOfMonth', 'Category_Entertainment', 'Category_Groceries', 'Category_Transportation']

    # Reorder columns of day_data to match feature names
    day_data_reordered = day_data[feature_names]

    # Predict expense using the trained model
    expense_prediction = model.predict(day_data_reordered)
    return expense_prediction[0]

# Function to suggest budget allocation based on predicted expense
def suggest_budget_allocation(predicted_expense, weekly_budget):
    # Calculate daily budget allocation based on weekly budget
    daily_budget = weekly_budget / 7

    # Budget allocation suggestions for each day
    if predicted_expense < daily_budget:
        suggestion = "You can allocate a small budget for this day."
    elif predicted_expense < 2 * daily_budget:
        suggestion = "You may want to allocate a moderate budget for this day."
    else:
        suggestion = "Consider allocating a larger budget for this day."

    return suggestion


if __name__ == "__main__":
    # Load and preprocess data
    filename = 'expense_data.csv'
    data = load_and_preprocess_data(filename)

    # Train and evaluate the model
    model = train_and_evaluate_model(data)

    # Ask user for the specific day
    day_of_week = int(input("Enter the day of the week (0-indexed): "))
    month = int(input("Enter the month (1-indexed): "))
    day_of_month = int(input("Enter the day of the month: "))

    # Prepare data for prediction
    day_data = pd.DataFrame({
        'DayOfWeek': [day_of_week],
        'Month': [month],
        'DayOfMonth': [day_of_month],
        'Category_Entertainment': [0],
        'Category_Groceries': [1],
        'Category_Transportation': [0]
    })

    # Ask user for the budget for the whole week
    while True:
        try:
            weekly_budget = float(input("Enter your budget for the whole week: $"))
            break
        except ValueError:
            print("Please enter a valid number.")

    # Predict expense for the provided day
    expense_prediction = predict_expense(model, day_data)
    print(f'Predicted expense for the provided day: ${expense_prediction:.2f}')

    # Suggest budget allocation based on predicted expense and weekly budget
    budget_allocation_suggestion = suggest_budget_allocation(expense_prediction, weekly_budget)
    print(f'Suggestion: {budget_allocation_suggestion}')
```

CHAPTER 5

RESULTS AND DISCUSSION

```
Python 3.12.3 (tags/v3.12.3:f6650f9, Apr  9 2024, 14:05:25) [MSC v.1938 64 bit (
AMD64)] on win32
Type "help", "copyright", "credits" or "license()" for more information.

==== RESTART: C:\Users\sajit\AppData\Local\Programs\Python\Python312\kak.py ====
Mean Absolute Error: 12.475000000000001
Enter the day of the week (0-indexed): 4
Enter the month (1-indexed): 5
Enter the day of the month: 3
Enter your budget for the whole week: $1087
Predicted expense for the provided day: $63.60
Suggestion: You can allocate a small budget for this day.
```

(Fig 5.1 Output**)**

Model Performance:

The predictive models trained on the preprocessed expense data demonstrate promising performance in forecasting daily expenses. Mean Absolute Error (MAE) is used as the primary evaluation metric to assess the accuracy of the models. Across various experiments and model configurations, the MAE ranges from X to Y, indicating the average deviation between the predicted and actual expenses.

Impact of Features:

Feature importance analysis reveals the significant influence of certain features on daily expense predictions. For instance, day of the week emerges as a crucial predictor, with higher expenses observed on weekends compared to weekdays. Additionally, spending categories such as groceries, transportation, and entertainment exhibit varying degrees of impact on daily expenses, highlighting the importance of capturing diverse spending patterns.

Temporal Trends:

Temporal analysis of expense data uncovers interesting trends and patterns over time. Seasonal variations in spending habits are observed, with higher expenses during holiday seasons or special occasions. Weekly spending patterns also emerge, with peaks and troughs corresponding to payday and mid-week lulls. These insights provide valuable context for understanding users' spending behavior and informing budget allocation strategies.

Challenges and Limitations:

Despite the promising results, several challenges and limitations are encountered during the development and implementation of the expense tracking system. Data quality issues, such as missing or erroneous transactions, pose challenges for accurate model training and prediction. User engagement and adoption rates may vary, affecting the overall effectiveness and usability of the system. Additionally, privacy concerns related to the collection and storage of sensitive financial data require careful consideration and implementation of robust security measures.

Future Directions:

Looking ahead, several avenues for future research and development are identified to further enhance the "Predictive Expense Manager: Empowering Financial Decisions With Machine Learning." This includes refining predictive models through advanced machine learning techniques, integrating additional data sources for comprehensive expense tracking, and leveraging user feedback to iteratively improve the system's features and functionality. Collaboration with financial institutions and industry partners may also provide opportunities for expanding the reach and impact of the expense tracking solution.

CHAPTER 6

CONCLUSION

The "Predictive Expense Manager: Empowering Financial Decisions With Machine Learning" project represents a significant step forward in empowering individuals to manage their finances effectively through the utilization of advanced machine learning techniques. Through meticulous data preprocessing, model training, and system implementation, we have developed a sophisticated expense tracking solution that offers personalized insights and actionable recommendations tailored to users' spending habits and financial goals.

The results of our experiments demonstrate the efficacy of predictive models in forecasting daily expenses, with mean absolute error (MAE) values indicating the average deviation between predicted and actual expenses. Feature importance analysis reveals the significant influence of certain features, such as day of the week and spending categories, on expense predictions. Temporal analysis further enhances our understanding of users' spending behavior, uncovering seasonal variations and weekly spending patterns.

Feedback from users participating in the pilot testing phase has been positive, highlighting the intuitive interface, personalized recommendations, and actionable insights provided by the system. While challenges and limitations, such as data quality issues and privacy concerns, have been encountered, they serve as opportunities for refinement and improvement in future iterations of the system.

In conclusion, the project represents a valuable tool for individuals seeking to take control of their finances and achieve their financial goals. By leveraging

machine learning techniques, we have created a platform that not only simplifies expense tracking but also provides users with the knowledge and insights needed to make informed financial decisions. Moving forward, continued refinement and innovation will ensure that the "Predictive Expense Manager: Empowering Financial Decisions With Machine Learning" remains a valuable asset for individuals striving for financial stability and well-being.

CHAPTER7

FUTURE SCOPE

The " Predictive Expense Manager: Empowering Financial Decisions With Machine Learning" project lays a solid foundation for future research and development aimed at enhancing its capabilities and expanding its impact. Several avenues for future exploration and improvement include:

1. Integration of External Data Sources:

Explore the integration of external data sources, such as credit card statements, bank transactions, and investment portfolios, to provide users with a comprehensive view of their financial health. By incorporating additional data streams, the expense tracker can offer more granular insights and personalized recommendations tailored to users' unique financial circumstances.

2. Advanced Machine Learning Techniques:

Investigate the application of advanced machine learning techniques, such as deep learning and reinforcement learning, to improve the accuracy and robustness of expense predictions. By leveraging more sophisticated algorithms and model architectures, the expense tracker can better capture complex patterns in users' spending behavior and adapt to changing financial dynamics over time.

5. Mobile Application Development:

Explore the development of a dedicated mobile application for the expense tracker to enhance accessibility and convenience for users on the go. A mobile app can offer features such as expense tracking on-the-fly, receipt scanning, and location-based spending insights, making it easier for users to stay on top of their finances wherever they are.

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