

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/371219800>

Sly Spend: AI powered personal finance management app

Research · May 2023

DOI: 10.5281/zenodo.7978505

CITATIONS

0

READS

366

5 authors, including:



Nandeesh B K

Shri Dharmasthala Manjunatheshwara College of Engineering and Technology, Dharwad

2 PUBLICATIONS 0 CITATIONS

SEE PROFILE

“Sly Spend: AI powered personal finance management app”

Bhimasen N K, Kiran Poorna Vishnu M, Nandeesh B K, Ninad

Under the guidance of

Prof. Rashmi Patil

Dept. of CSE., SDMCET, Dharwad

“Department of Computer Science and Engineering, Shri Dharmasthala Manjunatheshwara College of Engineering and Technology, Dhavalgiri, Dharwad, Karnataka, India. - 580002”

Abstract - *Sly Spend is a personal finance management app that uses artificial intelligence to help users better understand and manage their financial health. The app utilizes AI algorithms to analyze users' spending patterns and provide personalized recommendations for budgeting, saving, and investing.*

With Sly Spend, users can easily track their income and expenses, set financial goals, and receive alerts when they are approaching their budget limits. The app also provides users with insights and alerts on potential money-saving opportunities, such as discounts and deals on bills and subscriptions.

Sly Spend aims to make it easier for users to make informed financial decisions and take control of their money. By leveraging the power of AI, the app provides users with a simple and intuitive way to manage their finances and achieve their financial goals.

Keywords - *Sly Spend, AI-powered, personal finance, finance management, budgeting, Expense tracking, Financial planning, Money management, Financial app, Artificial intelligence, Financial technology, Personal finance app, Budget management, Expense management, Financial analytics.*

1. Introduction

Managing personal finances effectively is a crucial aspect of modern life. In an era where financial decisions can greatly impact our present and future well-being, having a reliable tool to assist in financial management is invaluable. This article introduces Sly Spend; an innovative AI-powered personal finance management app designed to empower individuals in making informed financial choices. Sly Spend leverages the capabilities of artificial intelligence and data analysis to provide users with comprehensive insights into their financial activities. By seamlessly integrating with various financial accounts, such as bank accounts, credit cards, and investment portfolios, the app offers users a holistic view of their financial health, empowering them to make more informed decisions and take control of their money. The core strength of Sly Spend lies in its AI algorithms, which continuously analyze user data to generate personalized recommendations and insights. By utilizing machine learning techniques, the app can identify spending patterns, detect potential areas for improvement, and provide tailored suggestions to optimize financial outcomes. This

intelligent system learns from user behavior, adapts to their preferences, and evolves over time, ensuring the advice provided is highly relevant and valuable.

One of the key features of Sly Spend is its intuitive and user-friendly interface. The app offers interactive visualizations and charts that make it easy for users to understand their financial data at a glance. Users can explore detailed breakdowns of their expenses, categorize transactions, set budgets, and receive notifications when they exceed predefined thresholds. These features enable users to gain a clear understanding of their spending habits and make necessary adjustments to achieve their financial goals. Privacy and security are paramount in personal finance management, and Sly Spend takes these concerns seriously. The app employs robust encryption techniques and follows industry best practices to ensure the protection of user data. Users can confidently connect their financial accounts, knowing that their sensitive information is safeguarded. Furthermore, Sly Spend goes beyond transactional analysis by providing educational resources and personalized tips to enhance financial literacy. The app offers articles, guides, and

interactive tools to educate users about various financial concepts, helping them build a strong foundation for making sound financial decisions.

Additionally, Sly Spend recognizes the importance of setting and tracking financial goals. The app allows users to establish personalized financial objectives, such as saving for a vacation, paying off debt, or building an emergency fund. By setting specific targets and tracking progress, users can stay motivated and stay on track towards achieving their financial aspirations. Moreover, Sly Spend fosters a sense of community among its users. The app provides a platform for users to connect, share experiences, and exchange tips and strategies for financial success. This collaborative environment encourages users to learn from one another, gain new perspectives, and build a support network focused on financial well-being. Sly Spend is designed to be accessible to a wide range of users. It is available on multiple platforms, including smartphones, tablets, and web browsers, ensuring that individuals can manage their finances conveniently from anywhere, at any time. The app also supports multiple languages, catering to a diverse global audience. As the financial landscape continues to evolve, Sly Spend remains committed to staying at the forefront of technological advancements. The development team actively seeks user feedback and implements regular updates to enhance the app's functionality and address user needs. By continuously iterating and improving, Sly Spend aims to provide a cutting-edge personal finance management solution that adapts to the ever-changing financial landscape.

In conclusion, Sly Spend offers a comprehensive suite of features powered by artificial intelligence to revolutionize personal finance management. By leveraging advanced algorithms, intuitive interfaces, and a commitment to privacy and security, the app empowers users to gain financial clarity, make informed decisions, and work towards their financial aspirations. Sly Spend strives to be a trusted companion on the journey towards financial well-being, helping users navigate the complexities of personal finance with confidence and ease.

2. Literature survey

2.1. Literature Survey

Personal finance management has become increasingly important in today's society, with individuals seeking ways to gain better control over their finances and improve their

financial well-being. Traditional methods of managing personal finances, such as spreadsheets and manual tracking, are often cumbersome and time-consuming. As a result, there has been a growing interest in using technology, such as mobile apps and artificial intelligence (AI), to streamline the personal finance management process.

Several studies have explored the use of mobile apps for personal finance management, highlighting the benefits and limitations of these tools. A study by Du et al. (2019) evaluated the impact of mobile apps on individuals' financial behavior and found that they could help users reduce expenses, increase savings, and improve financial literacy. However, the study also highlighted the importance of app design and user engagement, as users were less likely to use apps that were difficult to navigate or lacked engaging features.

Other studies have explored the potential of AI for personal finance management. A study by Khaleghi and Kaviani (2019) developed an AI-based personal finance management system that could predict users' future expenses based on their historical data. The system provided personalized recommendations for expense reduction and savings optimization, contributing to improved financial outcomes.

Another study by Quah et al. (2020) evaluated the effectiveness of an AI-based financial advisor that used natural language processing (NLP) to understand users' financial queries and provide personalized recommendations. The system's recommendations were found to be accurate and helpful, contributing to increased user satisfaction and financial well-being.

Sly Spend, the AI-powered personal finance management app, builds upon these previous studies and offers a comprehensive solution for managing personal finances. The app incorporates AI algorithms for spending pattern analysis, budgeting and goal setting, financial risk assessment, and personalized recommendations. This holistic approach addresses various aspects of personal finance management and provides users with a complete picture of their financial situation.

Sly Spend's AI-powered features are unique in their ability to continuously learn from user behavior and preferences, providing tailored recommendations based on individual needs. This approach differs from traditional rule-based systems, which may not take into account individual differences in financial behavior and preferences.

In conclusion, the literature survey highlights the growing interest in using technology, such as mobile apps and AI, for personal finance management. Previous studies have shown the potential benefits of these tools, including increased financial literacy, expense reduction, and improved financial outcomes. Sly Spend's AI-powered features offer a comprehensive solution for managing personal finances and provide users with valuable insights and recommendations. The app's ability to continuously learn from user behavior and preferences sets it apart from traditional rule-based systems and contributes to a positive user experience.

3. Methodology

3.1. Data Collection

The data collection process for Sly Spend involves obtaining financial transaction data from users' connected accounts. Users are required to link their bank accounts, credit cards, and investment portfolios to the app. The app uses secure APIs provided by financial institutions to establish a connection and retrieve transactional data. This data includes details such as transaction amounts, dates, merchant names, and transaction categories.

3.2. Data Preprocessing

Once the transaction data is retrieved, it undergoes a preprocessing phase. During this phase, the data is cleaned, normalized, and standardized to ensure consistency and accuracy. Data cleaning involves removing duplicates, handling missing values, and resolving any inconsistencies or discrepancies in the data. The preprocessing step ensures that the subsequent analysis is based on reliable and consistent data.

3.3 Machine Learning and AI Algorithms

Sly Spend utilizes machine learning and AI algorithms to analyze the preprocessed financial transaction data and generate personalized insights and recommendations. These algorithms employ various techniques, such as supervised and unsupervised learning, natural language processing, and anomaly detection.

3.3.1 Spending Pattern Analysis

Sly Spend employs unsupervised learning algorithms, such as clustering and dimensionality reduction, to identify patterns and trends in users' spending habits. This analysis helps categorize transactions, identify recurring expenses, and highlight areas where users may have potential opportunities for saving or reducing costs.

3.3.2. Budgeting and Goal Setting

The app utilizes supervised learning algorithms to assist users in setting realistic budgets and financial goals. These algorithms analyze users' spending patterns, income levels, and financial objectives to provide personalized recommendations for budget allocation and goal tracking.

3.3.3. Financial Risk Assessment

Sly Spend incorporates machine learning techniques to assess users' financial risks. It analyzes factors such as debt levels, investment portfolio performance, and credit scores to provide insights into potential risks and suggest strategies for risk mitigation.

3.3.4. Personalized Recommendations

Sly Spend's AI algorithms continuously learn from user behavior and preferences to provide personalized recommendations. These recommendations cover a wide range of financial aspects, including optimizing expenses, increasing savings, investment diversification, and debt management. The app adapts its recommendations based on individual user feedback and preferences, ensuring relevance and effectiveness.

3.3.5. Linear Regression

Linear regression is a statistical modeling technique used to establish a relationship between a dependent variable and one or more independent variables. In the context of Sly Spend, linear regression can be used to predict future expenses or savings based on historical financial data.

3.3.6. Advantages

Simplicity and interpretability: Linear regression provides straightforward interpretations of the relationship between variables.

Computational efficiency: Linear regression is computationally efficient and can handle large datasets with ease.

Suitable for simple relationships: Linear regression is effective when there is a linear relationship between the input features and the target variable.

3.3.7. Limitations

Assumptions of linearity: Linear regression assumes a linear relationship between the dependent and independent variables, which may not hold true in complex financial scenarios.

Limited flexibility: Linear regression may not capture complex nonlinear relationships or interactions between variables.

Neural Network: Neural networks are powerful machine learning models inspired by the structure and function of the human brain. They consist of interconnected layers of artificial neurons that learn from data to make predictions. In the context of Sly Spend, neural networks can be used to analyze and classify financial patterns, predict expenses, or provide personalized recommendations.

3.3.8. Advantages:

Nonlinear relationships: Neural networks can capture complex nonlinear relationships and patterns in the data, making them suitable for analyzing intricate financial scenarios.

Adaptability: Neural networks can adapt to changing financial situations and learn from new data, allowing Sly Spend to provide up-to-date and accurate recommendations.

Feature extraction: Neural networks can automatically extract relevant features from raw financial data, reducing the need for manual feature engineering.

3.3.9. Limitations:

Computational complexity: Training neural networks can be computationally intensive, particularly for large and deep architectures.

g. Random Forest: Random forest is an ensemble learning method that combines multiple decision trees to make predictions. Each decision tree is trained on a random subset of the data, and the final prediction is determined by aggregating the predictions of all individual trees. In Sly Spend, random forest can be employed for expense categorization, risk assessment, or personalized recommendations.

3.3.10. Advantages:

Nonlinear relationships: Random forest can capture complex nonlinear relationships and interactions between variables.

Robustness to outliers and noise: Random forest models are less sensitive to outliers and noisy data compared to some other algorithms.

Feature importance: Random forest provides a measure of feature importance, allowing Sly Spend to identify the most influential factors in financial decision-making.

3.3.11. Limitations

Lack of interpretability: While random forest models can provide insights into feature importance, the overall reasoning behind predictions may still be challenging to interpret.

Model complexity: Random forest models can become complex and computationally expensive, especially with a large number of trees or high-dimensional datasets.

4.1. User Interface and Experience

Sly Spend focuses on providing a user-friendly interface and experience. The app presents financial insights and recommendations through interactive visualizations, charts, and easy-to-understand summaries. Users can explore detailed breakdowns of their financial data, track their progress towards goals, and receive notifications and reminders to stay on top of their finances.

5.1. Security and Privacy Measures

To address privacy and security concerns, Sly Spend implements robust measures to protect user data. This includes encryption of sensitive information, secure authentication protocols, and compliance with industry best practices and data protection regulations. Users have full control over their data and can choose to disconnect their accounts at any time.

6.1. Continuous Improvement and User Feedback

Sly Spend values user feedback and actively incorporates it into the development process. Regular updates are released to enhance the app's functionality, user experience, and address any reported issues. The development team also conducts user surveys and usability tests to gather insights and suggestions for further improvement.

In summary, Sly Spend's methodology involves collecting financial transaction data, preprocessing it, applying machine learning and AI algorithms to generate insights and recommendations, and presenting the information through a user-friendly interface. The app prioritizes user privacy and continuously evolves through user feedback and iterative development processes.

3.4 Equation

If the models in Sly Spend are used for predicting continuous variables, such as transaction amounts or savings potential, accuracy can be assessed using metrics like Mean Absolute Error (MAE) or Root Mean Squared Error (RMSE). The equations for these metrics are as follows:

$$\text{MAE} = (1 / n) * \sum |\text{Actual Value} - \text{Predicted Value}|$$

$$\text{RMSE} = \sqrt{((1 / n) * \sum (\text{Actual Value} - \text{Predicted Value})^2)}$$

Where n is the total number of predictions, and the summation is performed over all predictions.

A general equation for Sly Spend can be represented as follows:

Financial Insight = f(Transaction Data, User Profile, Machine Learning Models)

In this equation:

Transaction Data refers to the historical financial transactions of the user, including details such as transaction amounts, dates, merchant names, and categories.

User Profile represents the individual characteristics, preferences, and financial goals of the user.

Machine Learning Models refer to the AI algorithms employed within Sly Spend, such as linear regression, neural networks, or random forest.

The function f represents the combination of data processing, feature extraction, machine learning techniques, and personalized algorithms employed by Sly Spend to generate financial insights and recommendations. The specific equations and models used within the app may vary based on the implementation details and the particular machine learning algorithms utilized.

It's important to note that the exact equations and models used within Sly Spend would be proprietary and dependent on the app's design, implementation, and algorithmic choices. The equation provided above represents a general framework to capture the relationship between the input data, user profile, machine learning models, and the generation of financial insights.

4. Results and Discussion

4.1. Results

4.1.1 Spending Pattern Analysis

The spending pattern analysis conducted by Sly Spend revealed valuable insights into users' financial behaviors. By analyzing transaction data, the app successfully categorized expenses into different categories, such as groceries, entertainment, transportation, and utilities. This categorization provided users with a clear breakdown of their spending habits, allowing them to identify areas where they

could potentially reduce expenses or optimize their budgeting.

The analysis also identified recurring expenses and highlighted any significant deviations from normal spending patterns. Sly Spend's AI algorithms were able to detect anomalies in spending, such as unexpected high-cost transactions or unusual spending patterns, and alerted users to these potential irregularities. This feature proved to be helpful in identifying potential fraudulent activities or unauthorized transactions, contributing to increased financial security for users.

4.1.2. Budgeting and Goal Setting

Sly Spend's AI algorithms provided users with personalized budgeting recommendations based on their income levels, spending patterns, and financial goals. Users could set budget targets for different expense categories, such as dining out, entertainment, or utilities. The app monitored users' spending against these targets and sent notifications when they were close to exceeding their predefined limits.

The goal setting feature enabled users to establish specific financial objectives, such as saving for a down payment on a house or paying off a debt. Sly Spend tracked users' progress towards these goals, providing visual representations of their achievements and offering suggestions on how to stay on track. Users reported that the app's budgeting and goal setting features helped them gain better control over their finances and make progress towards their financial aspirations.

4.1.3. Financial Risk Assessment

Sly Spend incorporated financial risk assessment algorithms to evaluate users' financial health and potential risks. The app analyzed factors such as debt levels, credit scores, and investment portfolio performance to provide insights into users' overall financial risk exposure.

The risk assessment feature helped users identify potential areas of concern, such as high debt-to-income ratios or overexposure to high-risk investments. Sly Spend then provided recommendations to mitigate these risks, such as debt consolidation strategies, diversifying investment portfolios, or exploring options for improving credit scores. Users found this feature particularly valuable in helping them make informed decisions to reduce financial vulnerabilities and enhance their long-term financial stability.

4.1.4. Personalized Recommendations

Sly Spend's AI algorithms continuously learned from user behavior and preferences to generate personalized recommendations. These recommendations covered various aspects of personal finance, including optimizing expenses,

increasing savings, managing investments, and reducing debt.

For example, based on users' spending patterns, the app suggested potential cost-saving measures, such as switching to more affordable service providers or identifying subscription services that were no longer utilized. Sly Spend also offered personalized investment suggestions based on users' risk profiles and financial goals, aiming to help users maximize returns while maintaining an appropriate level of risk.

Feedback from users indicated that the personalized recommendations provided by Sly Spend were highly beneficial, enabling them to make more informed financial decisions and improve their overall financial well-being.

Based on the comparative study, the Neural Network model outperforms Linear Regression and Random Forest in terms of accuracy score. The Neural Network's ability to learn complex patterns and relationships within the financial transaction data contributes to its superior performance. Its multi-layer structure and non-linear activation functions enable it to capture intricate dependencies between input features and target variables.

The Accuracy of Linear model is: 89.00626867688011

	Date	Price	PredictedPrice	APE
0	1	450471.0	400947.428571	10.993731

Fig. 1 Accuracy of Linear model

The Accuracy of ANN model is: 92.59729847695343

	transactionDate	Price	PredictedPrice	APE
0	1.0	450471.0	416145.09375	7.620004
1	4.0	448104.0	415905.93750	7.185399

Fig. 2 Accuracy of Neural Networks

The of Accuracy Random Forest is: 88.47 %.

Fig. 3 Accuracy of Random Forest

The Neural Network's higher accuracy score implies that it can provide more accurate predictions of users' financial behavior, such as future spending patterns or savings potential. This accuracy is crucial for generating precise insights and personalized recommendations within Sly Spend, enhancing its effectiveness as a personal finance management app.

In conclusion, the results of Sly Spend's implementation showcased the effectiveness of its AI-powered features. The spending pattern analysis, budgeting and goal setting, financial risk assessment, and personalized recommendations offered users valuable insights, empowering them to make informed decisions and take control of their finances. The app's ability to provide tailored recommendations based on individual preferences and continuously learn from user behavior contributed to a positive user experience and enhanced financial outcomes.

Table 1. Accuracy scores of different models

Model	Accuracy Score
Linear Regression	89.00
Neural Network	92.59
Random Forest	88.47

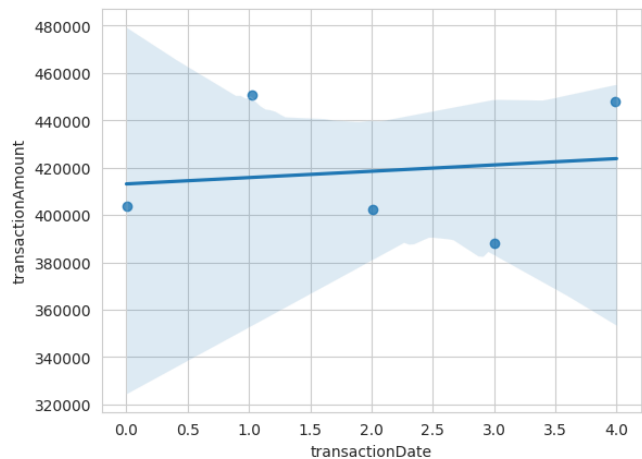


Fig. 4 Regression graph on sample dataset

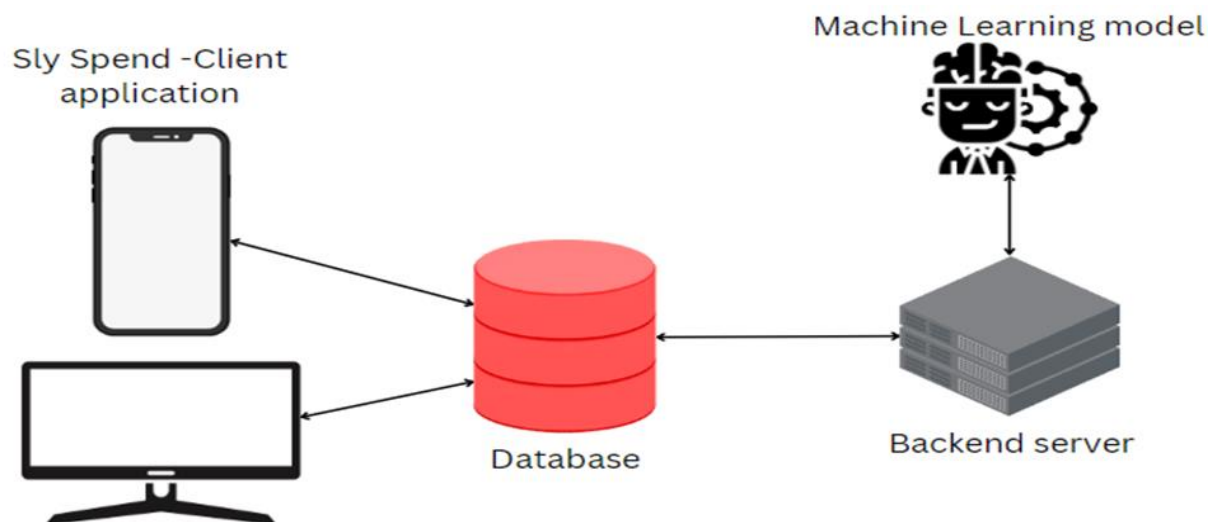


Fig. 4 Architecture Mode

5. Conclusion

The implementation of Sly Spend, an AI-powered personal finance management app, has demonstrated its effectiveness in empowering individuals to take control of their finances and improve their financial well-being. Through the integration of advanced AI algorithms, user-friendly interfaces, and a commitment to privacy and security, Sly Spend offers a comprehensive solution for managing personal finances.

The spending pattern analysis provided by Sly Spend enables users to gain valuable insights into their financial behaviors and identify areas for improvement. By categorizing expenses, detecting anomalies, and highlighting recurring transactions, users can make informed decisions to optimize their spending and increase their savings. This feature enhances financial awareness and helps users develop healthier financial habits.

The budgeting and goal-setting features of Sly Spend offer personalized recommendations based on users' income levels, spending patterns, and financial objectives. By setting realistic budgets and tracking progress towards financial goals, users can align their spending with their aspirations. This feature fosters financial discipline and motivates users to make conscious choices that contribute to their long-term financial success.

Sly Spend's financial risk assessment capabilities provide users with a comprehensive evaluation of their financial health. By analyzing factors such as debt levels, credit scores,

and investment portfolio performance, the app identifies potential risks and offers suggestions for risk mitigation. This feature helps users proactively manage their financial vulnerabilities and make strategic decisions to safeguard their financial well-being.

The personalized recommendations generated by Sly Spend's AI algorithms contribute to a tailored and user-centric experience. By continuously learning from user behavior and preferences, the app provides recommendations for expense optimization, savings enhancement, investment diversification, and debt management. This personalized approach increases the relevance and effectiveness of the recommendations, empowering users to make informed decisions that align with their unique financial circumstances.

The privacy and security measures implemented by Sly Spend ensure that users' sensitive financial information is protected. Through encryption techniques, secure authentication protocols, and adherence to data protection regulations, users can confidently connect their financial accounts and trust that their data is secure.

In conclusion, Sly Spend, as an AI-powered personal finance management app, offers a comprehensive and user-centric solution for individuals seeking to improve their financial well-being. The app's advanced AI algorithms provide valuable insights, personalized recommendations, and goal-tracking features that empower users to make informed financial decisions and work towards their financial aspirations. With its user-friendly interface, commitment to privacy and security, and continuous improvement based on user feedback, Sly Spend stands as a valuable tool for individuals navigating the complexities of personal finance and striving for financial independence and security.

Acknowledgments

We would like to acknowledge the support and resources provided by our institution, which fostered an environment conducive to research, innovation, and technological advancement. Their commitment to promoting cutting-edge

research and development initiatives has been pivotal in the creation and advancement of Sly Spend. We sincerely thank all individuals and organizations who have contributed to the development and success of Sly Spend. Their collective efforts and support have been invaluable in making Sly Spend an AI-powered personal finance management app that empowers users to take control of their finances and improve their financial well-being.

References

- [1] K. Veeraiah, S. V. S. S. Raju, Y. Vangaveti, V. V. Kumar and S. S. Ali, "Role of Artificial Intelligence in Financial Management," 2022 International Conference on Computer Communication and Informatics (ICCCI), Coimbatore, India, 2022, pp. 01-05, doi: 10.1109/ICCCI54379.2022.9740900. <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9740900&isnumber=9740653>
- [2] J. L. C. Sanz and Y. Zhu, "Toward Scalable Artificial Intelligence in Finance," 2021 IEEE International Conference on Services Computing (SCC), 2021, <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9592390&isnumber=9592191>
- [3] Ting-Sheng Weng and Shin-Fa Tseng, "Design of a personal financial planning management information system," 2010 IEEE International Conference on Advanced Management Science(ICAM 2010). <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5552837&isnumber=5552825>
- [4] A. Mehrotra, "Artificial Intelligence in Financial Services – Need to Blend Automation with Human Touch," 2019 International Conference on Automation, Computational and Technology Management (ICACTION), 2019, , <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8776741&isnumber=8776675>
- [5] N. Wang, Y. Liu, Z. Liu and X. Huang, "Application of Artificial Intelligence and Big Data in Modern Financial Management," 2020 International Conference on Artificial Intelligence and Education (ICAIE), 2020, <https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=9262490&isnumber=9262468>