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Digital Economy and Smart Financial Management: Using AI Tools for Financial Literacy

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Abstract. The article analyses the impact of digital technologies, particularly artificial intelligence (AI), on consumer behaviour in the financial services sector, with a focus on improving financial literacy and decision-making through personal financial trackers. The study explores how AI-based applications, such as adaptive learning and gamification, can enhance users' financial literacy. Key outcomes include a significant improvement in users' ability to manage personal finances, with AI tools offering personalized recommendations, automatic expense categorization, and forecasting. Additionally, the study identifies challenges related to data security, ethical concerns, and algorithmic transparency. The research concludes that while AI-powered financial tools can greatly enhance financial literacy, their effectiveness depends on user engagement and the resolution of ethical and regulatory challenges.

Keywords. digital economy, personal financial tracker, artificial intelligence, financial planning, financial literacy, web applications, financial technologies

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1. Introduction

The digital revolution is transforming not only the way we live, but also the way we approach finance. We live in an era where smartphones have become an integral part of everyday life, and online banking and electronic payments have become the norm. These changes have created new opportunities for managing personal finances, and one of the most important tools in this process has become a personal financial tracker - an innovative tool, usually in the form of a mobile application or web service, that allows you to track all your income and expenses in one place. But modern trackers go much further, using artificial intelligence to analyse financial data, predict expenses, and provide personalized recommendations. A personal financial tracker helps you understand where your money goes, plan your budget, and achieve your financial goals. The article explores the impact of the digital economy on personal finance and presents an overview of modern financial trackers that use artificial intelligence. We will consider the functionality of such trackers, their advantages and disadvantages, as well as the prospects for the development of this area. We also analyse the issues of financial data security and ethical aspects of using AI in personal finance.

2. Literature Review

The digital economy is characterized by the active use of the Internet, digital products and services, automation of business processes, and analysis of large amounts of data to make more informed decisions [1-6]. Smart financial management is a set of measures aimed at effective financial management using digital tools [5-11]. It includes: online banking (convenient access to accounts, money transfers, payment for services in a few clicks, etc.), mobile applications (mobile banking, financial trackers, investment platforms, etc.), fintech services (payment systems, cryptocurrencies, crowdfunding, etc.), artificial intelligence (personalized financial recommendations, automatic budgeting, etc.) [12].

Advantages of smart financial management are automation of routine operations; precise control over expenses and income; increase in income; reduction of risks; accessibility of financial services (even in remote regions) [13].

Despite all the benefits, the digital economy and smart financial management also pose new challenges [4]: Cybersecurity (protecting personal data from fraudsters), digital literacy (the need to understand digital technologies), adapting legislation to new realities.

Prospects for the development of the digital economy [14]:

- blockchain development – decentralized finance, smart contracts;
- spread of artificial intelligence – personalized financial solutions, automatic investments;
- integration of financial services into everyday life – finance as part of the Internet of Things.

There is different area, where the digital economy has the most significant impact on financial management [15]:

1. Fintech (Financial Technology). Contactless payments, mobile wallets, and cryptocurrencies have greatly simplified transactions. Online loans, P2P lending, microcredit have made financing more accessible. Online insurance, microinsurance, and the use of data for risk assessment are changing traditional insurance models.

2. Investments. The ability to invest in stocks, bonds, and funds via the Internet has democratized investment. Algorithms that manage an investment portfolio based on data allow you to invest with minimal knowledge. A new asset class that offers decentralized finance and new investment opportunities.

3. Personal finance. Applications that help to track income, expenses, and budget. Systems that automatically pay bills, invest money, and optimize taxes.

4. Blockchain. Self-executing contracts that provide transparency and security in financial transactions. Digital assets that represent ownership of assets or rights to participate in projects.

A personal financial tracker is a tool that helps you keep track of your income, expenses, savings, and investments in one place. It gives you a complete picture of your financial situation, allowing you to easily analyse your money spending and where it can be invested most effectively. A financial tracker is not just a tool, it's a personal financial advisor that's always at your fingertips [16]. It provides [17]:

1. Control over expenses – the user will always know where the money goes. This will allow you to identify unnecessary expenses and optimize your budget.

2. Planning for the future – the tracker helps to create realistic budgets and plan large purchases or travel.

3. Achieving financial goals – the user will be able to track progress towards their goals, whether it's buying their own home, creating passive income, or simply saving for a vacation.

4. Reduced stress – understanding your financial situation reduces anxiety and stress related to money.

5. Increased financial literacy – studying your financial data, you better understand how money works and how to make more informed financial decisions.

Most financial trackers work on a simple principle [17, 18]: the user enters information about all their income (salary, dividends, gifts, etc.), records all their expenses (food, clothing, entertainment, etc.), enters each transaction into a specific category (food, housing, transportation, etc.); the tracker automatically generates reports, graphs, and charts that allow you to visualize your finances.

There are four types of financial trackers [19]:

1. Mobile applications. The most popular option, as it allows you to track your finances anytime and anywhere.

2. Web services. Online platforms that provide a wider range of functionality but require access to the Internet.

3. Excel spreadsheets. A simple and free option for those who like to control everything on their own.

4. Specialized software. Paid programs with advanced functionality for professional financial management.

A personal financial tracker with artificial intelligence (AI) is a tool that not only records your income and expenses, but also analyses them using machine learning algorithms [19, 20]. AI allows the tracker to: predict spending, identify trends, provide personalized recommendations, automate routine tasks. Based on previous spending, AI can predict how much a user will likely spend next month. AI detects patterns in finances, helping the user to understand what they spend the most money on and when. Advantages of financial trackers with AI [21]:

- higher accuracy;
- a more personalized approach;
- automation;
- proactive financial management.

Ways of using AI in financial trackers were explored [21, 22]:

- "Mint". one of the most popular trackers that uses AI to automatically categorize transactions and provide personalized recommendations.
- "YNAB". Although YNAB doesn't have the same level of automation as Mint, it offers powerful tools for budgeting and financial planning.
- "Personal Capital". This tracker is aimed at investors and uses AI to analyse investment portfolios.

AI financial trackers offer a wide range of features that go far beyond simply recording income and expenses [23-27]. Some of the most interesting and useful features that such trackers can offer are [22, 24, 25]:

1. Forecasting expenses and income. AI can predict how much a user is likely to spend next month based on previous habits. The tracker can take into account seasonal spending fluctuations, such as increased spending on gifts during the holidays.
2. Automatic categorization of transactions. AI uses machine learning to automatically determine the category of each transaction (food, housing, transportation, etc.). Over time, AI becomes more and more accurate in its predictions by learning from specific data. Users can easily customize categories and add their own.
3. Identification of patterned expenses. AI can detect recurring payments such as subscriptions, utility bills, etc. An AI tracker can highlight expenses that can be optimized, such as excessive spending on entertainment.
4. Personalized financial advice. Based on the user's risk profile and financial goals, AI can suggest investment options. A financial web app can help find tax breaks and discounts for the user. AI can recommend necessary types of insurance.
5. Integration with other financial instruments. Most trackers integrate with bank accounts, allowing for automatic data updates. Integration with investment platforms allows you to get a complete picture of the user's financial situation. Integration with payment systems helps to track all expenses.
6. Financial health analysis. AI can assess the user's credit rating and suggest ways to improve it. A financial tracker can assess the user's financial stability and identify potential risks.

Although there is still a lack of research on this topic, there is some evidence to support the positive impact of AI trackers [24, 26, 27]:

- increased savings: users of AI trackers often report an increase in their savings due to more efficient spending management.
- reduced financial stress: feeling confident about the future can help reduce stress related to finances.
- improved financial literacy: AI trackers provide users with access to information and tools that help them better understand financial concepts.
- more informed financial decisions: AI trackers help users make more informed financial decisions based on data and analytics.

In the process of data analysis and application of artificial intelligence algorithms for financial trackers, several key assumptions were made that affect the results of the study: accuracy and completeness of data, the versatility of algorithms, stability of algorithms, level of user engagement. These assumptions define the scope of the study and must be taken into account when interpreting the results, as changing them may affect the accuracy of the estimates.

3. Results and Discussion

The use of artificial intelligence (AI) in financial trackers opens up new opportunities for effective personal finance management, but at the same time raises a number of important issues related to data security and ethical aspects [25, 28-30].

Key regulatory challenges in the field of AI financial instruments

1. Transparency of algorithms:
- the “black box”: many AI algorithms are complex and difficult to understand, even for their creators. This makes it difficult to assess the fairness and objectivity of the decisions made;
- explanatory AI: the need to develop algorithms that can explain the logic behind their decisions is critical to ensuring the credibility of AI-based systems.
2. Algorithmic bias:
- reproduction of social biases: algorithms can inherit the biases present in the data they are trained on, which can lead to discrimination against certain groups of people;
- unfair decisions: biased algorithms can make unfair decisions about lending, insurance rates, etc.
3. Data protection:
- privacy: financial institutions collect large amounts of personal data that must be protected from unauthorized access;
- security: AI systems can be targeted by cyberattacks, which can lead to the leakage of confidential information.
4. Liability:
- who is responsible: in the event of failures or errors related to the use of AI, determining responsibility is a difficult task;
5. Stability of the financial system:
- systemic risks: the widespread use of AI in the financial sector could pose systemic risks if algorithms fail or infrastructure is attacked.

Potential solutions

- Regulatory framework: develop a clear and transparent regulatory framework for the use of AI in the financial sector.
- Audit of algorithms: regular auditing of algorithms for bias and compliance with regulatory requirements.
- Algorithm transparency: requirement for algorithm developers to provide an explanation of their work.
- Data protection: strict requirements for personal data protection and cybersecurity.
- Liability: defining clear rules of liability for damage caused by the use of AI.
- Cooperation between regulators and industry: creation of platforms for dialogue between regulators and representatives of the financial sector to develop effective solutions.

Despite the challenges, the use of AI in personal finance has enormous potential. Through the joint efforts of developers, regulators, and users, a safe and ethical environment for the development of financial technologies can be created.

Important aspects for further research include:

- Developing mechanisms for verification and validation of data used to train AI models.
- Creating tools to detect and eliminate bias in algorithms.
- Developing standards for the ethical use of AI in the financial sector.

The main functions of a financial tracker have been studied:

- Tracking income and expenses: recording all financial transactions.
- Categorization of transactions: automatic or manual assignment of each transaction to a specific category (food, housing, transportation, etc.).
- Budgeting: creating a monthly or yearly spending plan.
- Financial data analysis: visualize data in the form of graphs and charts for easy understanding.
- Payment reminders: the tracker will remind you of important payments to avoid delays.
- Integration with banks: automatic updating of account information.

AI-based financial trackers are not equally effective in different cultural and economic contexts. The effectiveness of AI-based financial trackers depends heavily on the cultural, economic, and social characteristics of the region in which they are used.

Hisabi, an innovative personal financial tracker for tracking personal finances, has been launched. It is designed to help users take control of their income and expenses and achieve financial stability. Thanks to the use of advanced artificial intelligence technologies, the web application provides users with a unique financial planning experience, the ability to analyse SMS transactions and generate very useful information about income and expenses. It is powered by ChatGPT (figure).

Artificial intelligence is used to create personalized training programs that automatically adapt to the user's level of knowledge and financial goals. Interactive simulations and financial games help users practice decision-making skills in a safe virtual environment, which contributes to a deeper understanding of financial concepts.

This approach combines theory and practice, making learning more effective and engaging [24, 28, 30-33].

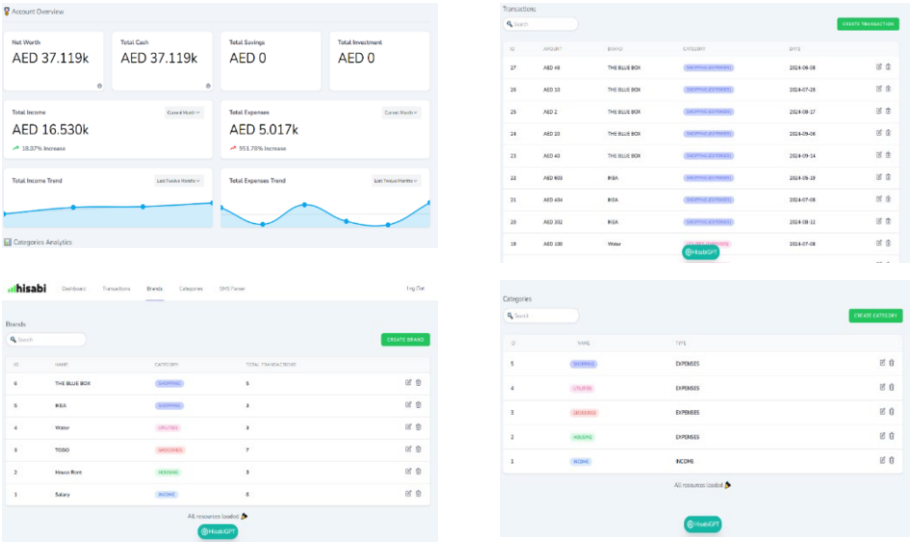

Fig. 1. Screenshots of the Web Application of a Personal Financial Tracker Based on Artificial Intelligence

The basic functionality of the created application is provided:

- Bank integration: synchronization with various banks and payment systems to automatically update transaction data.
- Automatic categorization: Thanks to machine learning algorithms, each transaction is automatically categorized into the appropriate category (food, accommodation, entertainment, etc.), which significantly saves user time.
- Cost forecasting: Based on the analysis of historical data, the system is able to predict future expenses, helping the user to plan the budget more efficiently.
- Personalized recommendations: Artificial intelligence analyses the user's financial behaviour and offers individualized recommendations on how to optimize spending, invest, and achieve financial goals.
- Budget creation: A simple and intuitive tool for creating and managing a budget, allowing the user to control their expenses and achieve their financial goals.
- Financial Health Analysis: A systematic analysis of the user's financial condition, identifying potential risks and providing recommendations for their elimination.
- Mobile application: Access to all tracker functions from any device, allowing the user to control their finances anytime and anywhere.

The following advantages of the created personal financial tracker are highlighted:

- Saving time – automation of routine tasks frees up the user's time for more important things.
- Increased financial literacy – due to a detailed analysis of financial data, the user better understands their financial behaviour and makes more informed decisions.

- Reducing financial stress – control over finances helps reduce anxiety and stress related to money.
- Achievement of financial goals – personalized recommendations and planning tools help the user achieve their financial goals faster.
- Privacy of personal data.
- Financial reporting and visualization.

4. Conclusions

The development of the digital economy and the introduction of innovative technologies, including artificial intelligence, have a significant impact on personal finance. It has been shown that AI financial trackers open new opportunities for effective financial management. They help to save time, make more informed decisions, and achieve financial goals. The authors consider the possibilities of teaching financial literacy using computer technologies, in particular, adaptive learning and gamification. It is established that AI-based web applications of personal financial trackers have great potential for transforming the field of personal finance. However, for the successful development of this technology, a number of challenges related to security, ethics, and regulation need to be addressed. It was experimentally developed *Hisabi*, web application, which uses artificial intelligence to track personal finances with the ability to create a budget, forecast expenses, and integrate with banks. As a result, it was found that the development of standards for the ethical use of AI in the financial sector is a priority for research.

The field of AI-based financial trackers is extremely promising and actively developing. Here are some potential areas for future research:

1. Deeper personalization: creation of algorithms that can adapt to changes in the user's financial behaviour.
2. Predicting future spending: developing models that can more accurately predict a user's future spending based on seasonality, trends, and other factors.
3. Expanding functionality: support for new financial instruments such as cryptocurrencies and decentralized finance (DeFi).
4. Improving the interface and interaction: development of voice interfaces and algorithms that can recognize user emotions.
5. Ethical aspects and data protection.
6. Automation of financial transactions: creation of systems that automatically make payments, investments, and other financial transactions based on data received from IoT devices.

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References

[1] Anna Warchlewska, Rafał Iwański. Personal Finances in the Era of Modern Technological Solutions, 2021 Finanse i Prawo Finansowe, 1(29), p. 155-174.

[2] Sun, L., Qin, H., Przystupa, K., Cui, Y., Kochan, O., Skowron, M., & Su, J. A hybrid feature selection framework using improved sine cosine algorithm with metaheuristic techniques, *Energies*, *15*(10), 2022, 3485.

[3] Jiang, K., Zhang, C., Wei, B., Li, Z., & Kochan, O. Fault diagnosis of RV reducer based on denoising time–frequency attention neural network. *Expert Systems with Applications*, *238*, 2024, 121762.

[4] Pohrebennyk V., Dzhumelia E. Environmental assessment of the impact of tars on the territory of the Rozdil state mining and chemical enterprise "Sirka" (Ukraine), Studies in Systems, Decision and Control, 2020, 198, pp. 201–214. 10.1007/978-3-030-11274-5_13

[5] Bernatska N., Dzhumelia E., Dyakiv V., Mitryasova O., Salamon I. Web-Based Information and Analytical Monitoring System Tools – Online Visualization and Analysis of Surface Water Quality of Mining and Chemical Enterprises, Ecological Engineering and Environmental Technology, 2023, 24(3), pp. 99–108. 10.12912/27197050/159885

[6] Bernatska N., Dzhumelia E., Typilo I., Kochan O., Salamon I. Neural Networks for Environmental Monitoring: A Web Application for Image Recognition, Advances in Transdisciplinary Engineering, 2024, 48, pp. 3–15. 10.3233/ATDE231310

[7] Zhengbing Hu, Ihor Tereikovskyi, Denys Chernyshev, Liudmyla Tereikovska, Oleh Tereikovskyi, Dong Wang. Procedure for Processing Biometric Parameters Based on Wavelet Transformations, International Journal of Modern Education and Computer Science, Vol.13, No.2, pp. 11-22, 2021.

[8] Zhengbing Hu, Ivan Dychka, Mykola Onai, Yuri Zhykin. Blind Payment Protocol for Payment Channel Networks, International Journal of Computer Network and Information Security, Vol.11, No.6, pp.22-28, 2019.

[9] Zhengbing Hu, Igor A. Tereykovskiy, Lyudmila O. Tereykovska, Volodymyr V. Pogorelov. Determination of Structural Parameters of Multilayer Perceptron Designed to Estimate Parameters of Technical Systems, International Journal of Intelligent Systems and Applications, Vol.9, No.10, pp.57-62, 2017.

[10] Zhengbing Hu, Ivan Dychka, Yevgeniya Sulema, Yevhen Radchenko. Graphical Data Steganographic Protection Method Based on Bits Correspondence Scheme, International Journal of Intelligent Systems and Applications, Vol.9, No.8, pp.34-40, 2017.

[11] Febrian Wahyu Christanto, Victor Gayuh Utomo, Rastri Prathivi, Christine Dewi. The Impact of Financial Statement Integration in Machine Learning for Stock Price Prediction, International Journal of Information Technology and Computer Science, Vol.16, No.1, pp.35-42, 2024.

[12] Mohammad Enamul Hoque, Mabruk Billah, Md Rafayet Alam, Brian Lucey. Does news related to digital economy and central bank digital currency affect digital economy ETFs? Evidence from TVP-VAR connectedness and wavelet local multiple correlation analyses, Global Finance Journal, 2024, Volume 61, p. 45-58

[13] Wided Dafri, Reema Al-Qaruty. Challenges and opportunities to enhance digital financial transformation in crisis management, Social Sciences & Humanities Open, 2023, Volume 8, p. 32-45.

[14] Jinfang Tian, Yunjing Wang & Siyang Sun. Two Sides of a Coin: Digital Economy and the Supply of Basic Public Services, Journal of the Knowledge Economy, 2024, p. 90-112

[15] Ya Zhou. The Application Trend of Digital Finance and Technological Innovation in the Development of Green Economy, J Environ Public Health, 2022, p. 43-67.

[16] Xiongfei Zhao, Shansong Wu, Bin Yan & Baoliu Liu. New evidence on the real role of digital economy in influencing public health efficiency, Scientific Reports, 2024, Volume 14, 7190.

[17] Tengwei Cai, Zexin Hong. Exploring the structure of the digital economy through blockchain technology and mitigating adverse environmental effects with the aid of artificial neural networks, Front. Environ. Sci., 2024, Volume 12, p. 12-18.

[18] Rodrigo Polanco. The Impact of Digitalization on International Investment Law: Are Investment Treaties Analogue or Digital?, German Law Journal, 2023, Volume 24, p. 574 – 588.

[19] Declan French, Donal McKillop, Elaine Stewart. Personal finance apps and low-income households, Strategic Change, 2021, 30(4), p. 367-375.

[20] Bhimasen N K. Kiran Poorna Vishnu M. Nandeesh B K. Sly Spend: AI powered personal finance management app, Personal Finance, 2023, p. 98-123.

[21] Niraj Kumar, Rimjhim, John Cheriyan. Adoption of AI enable tools for personal finance, International Journal of Creative Research Thoughts, 2024, p. 178-186.

[22] Edouard Ribes. Transforming personal finance thanks to artificial intelligence: myth or reality? Financial Economics Letters, 2023, 2(1), p. 11-21.

[23] I. de Zarzà, J. de Curtò, Gemma Roig, Carlos T. Calafate Optimized Financial Planning: Integrating Individual and Cooperative Budgeting Models with LLM Recommendations, Artificial Intelligence Applications in Financial Technology, 2024, 5(1), p. 91-114.
[24] Wilhelmina Addy, Adeola Ajayi-Nifise, Binaebi Bello. Transforming financial planning with AI-driven analysis: A review and application insights, International Journal of Science and Research Archive 2024, 11(01), p. 240-257.
[25] Hui Zhu, Olli Vigren, Inga-Lill Söderberg. Implementing artificial intelligence empowered financial advisory services: A literature review and critical research agenda, Journal of Business Research, 2024, Volume 174, p. 89-98.
[26] Md. Asaduzzaman Masum, Md. Rishad Istiak Sachcha, Abu Nayem. Security Analysis of Government & Financial Websites of Bangladesh, International Journal of Education and Management Engineering, Vol.12, No.2, pp. 21-29, 2022.
[27] Muhammad Zulqarnain, Rozaida Ghazali, Muhammad Ghulam Ghouse, Yana Mazwin Mohmad Hassim, Irfan Javid, Predicting Financial Prices of Stock Market using Recurrent Convolutional Neural Networks, International Journal of Intelligent Systems and Applications, Vol.12, No.6, pp.21-32, 2020.
[28] Mahtab Ebrahimi. Knowledge Extraction and Analysis to Evaluate the Financial Performance of an Organization Using OLAM, International Journal of Modern Education and Computer Science, Vol.10, No.12, pp. 20-27, 2018.
[29] Pradeep Kumar M. Kanaujia, Manjusha Pandey, Siddharth Swarup Rautaray. A Framework for Development of Recommender System for Financial Data Analysis, International Journal of Information Engineering and Electronic Business, Vol.9, No.5, pp. 18-27, 2017.
[30] Boyko T., Ruda M., Dzhumelia E., Kochan O., Salamon I. Mathematical Modeling of States of a Complex Landscape System with a Wind Farm, Lecture Notes on Data Engineering and Communications Technologies, 2023, 181, pp. 788–802. 10.1007/978-3-031-36118-0_69
[31] Hamid Reza Erfanian, Mahshid Hajimohammadi, Mohammad Javad Abdi. Using the Euler-Maruyama Method for Finding a Solution to Stochastic Financial Problems, International Journal of Intelligent Systems and Applications, Vol.8, No.6, pp.48-55, 2016.
[32] Yuchen Fu, Yuanhu Cheng. Application of an integrated support vector regression method in prediction of financial returns, International Journal of Information Engineering and Electronic Business, vol.3, no.3, pp.37-43, 2011.
[33] Oishi Chowdhury, Md Al Samiul Amin Rishat, Md. Al-Amin, Md. Hanif Bin Azam. The Decentralized Shariah-Based Banking System in Bangladesh Using Block-chain Technology, International Journal of Information Engineering and Electronic Business, Vol.15, No.3, pp. 12-28, 2023.