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Capabilities and Application of Blockchain-Based Artificial Intelligence

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ABSTRACT

Technologies have a profound and far-reaching influence on numerous aspects of human life, shaping industries, societal interactions, and economic structures. As the pace of technological advancements accelerates, the convergence of two of the most transformative technologies - blockchain and artificial intelligence (AI) - holds great potential to drive innovation and create unprecedented opportunities for various sectors. This paper delves into the synergy between blockchain and AI, examining the unique advantages that their integration can offer. Blockchain provides a decentralized and secure framework, while AI adds advanced data processing and decision-making capabilities. Together, these technologies can enhance security, transparency, and efficiency in various applications. This research explores real-world examples of how blockchain-based AI systems are being applied across industries and how they illustrate their potential to revolutionize business processes and societal interactions.

Keywords: blockchain, artificial intelligence, innovations.

INTRODUCTION

In contemporary settings, technologies are characterized by their high societal significance, as they are an integral part of daily life. They are developing at an extraordinary pace, unveiling new opportunities for their application and enhancement. Two rapidly evolving technologies are artificial intelligence (AI) and blockchain (BC).

Artificial intelligence relies on the correct dataset to function effectively. Blockchain technology is based on distributed information storage, which provides data security and reliability. Combining these two technologies can pave the way for innovations across various fields. This highlights the relevance and importance of the topic.

Artificial intelligence is the focus of this paper, while the subject is blockchain-based artificial intelligence (AIBC). The goal of this paper is to investigate and examine the advantages and applications of blockchain-based artificial intelligence. To achieve this goal, the following tasks were undertaken: Describe the essence of artificial intelligence; Examine the characteristics of blockchain technology; Investigate the advantages and applications of

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combining the two technologies; Summarize findings and draw conclusions.

Artificial intelligence

Today, many people use artificial intelligence in their daily lives, making the development of this technology highly significant for society. According to a European Parliament news article, AI is defined as "the ability of a machine to display capabilities inherent to humans - to reason, learn, plan, or create" [1].

AI is mainly divided into two types: software-based and physical form. The former is widely known, with examples including online search engines, facial recognition software, and image recognition. Robots are the most prominent example of AI in physical form. Regardless of the type, AI's effectiveness is limited to the availability of precise, clear, complete, and accurate information.

AI has wide applications in many areas of human and economic activity, including healthcare, education, public administration, entertainment, commerce, and more. Continuous research in the field leads to innovations and an expansion of its applications.

A study highlighted that the number of drugs and vaccines discovered through AI has increased in recent years, underscoring the technology's significance in human health [2].

Undoubtedly, AI improves efficiency, creativity, and productivity across various fields. To achieve the desired results, the information stored in AI systems must be reliable, accurate, and up-to-date.

Blockchain technology

Blockchain gained popularity with the emergence of the first cryptocurrency, Bitcoin. Since then, the technology has continuously evolved, characterized by four main stages. The first stage is associated with cryptocurrencies. The second generation is marked by the development of smart contracts. The third and fourth stages involve the application of blockchain in the public and private sectors.

The core of blockchain technology is decentralized information storage. This underpins its key characteristics: security, reliability, immutability, and transparency. Another important feature is accessibility, allowing users to access the system regardless of their physical location.

Today, blockchain technology finds applications in various sectors, such as healthcare, education, public administration, e-government, and multiple aspects of the private sector. One of the author's reports explores the implementation of blockchain in the food industry, examining how the technology can positively impact trade in this sector and what might hinder its successful adoption [3].

Blockchain technology can work in conjunction with other modern technologies, such as the Internet of Things (IoT). A study on the integration of edge computing and blockchain in IoT highlights potential opportunities in blockchain-enhanced edge IoT [4]. Ongoing research in blockchain continues to expand its possibilities and applications.

This paper examines the combination of two of the most advanced technologies: blockchain and artificial intelligence.

RESULTS AND DISCUSION

Blockchain-based artificial intelligence - advantages and applications

The essence and characteristics of both technologies have been discussed in previous sections. Their combination can expand their applications and enable innovative projects.

Blockchain technology can be integrated into AI systems for data storage, leading to the following changes in information management and control:

✓ Decentralization – Blockchain allows the entire database to be stored in a distributed network, ensuring no central authority for control and management, thereby providing data privacy

and security.

✓ Security - Data stored in a blockchain-based network is encrypted, offering higher levels of data protection, immutability, and enhanced defense against misuse.

✓ Smart Contracts - Using blockchain for data storage in AI systems can facilitate some processes through smart contracts, executing specific actions based on predefined rules.

✓ Transparency - Stored information can be verified and traced by anyone with network access, enhancing data transparency and user trust in blockchain-based AI.

✓ Traceability - Blockchain-based AI can store data about information sources used in AI model training, ensuring the security and legitimacy of the data.

✓ Communicativeness - A system combining blockchain and AI can enable different AI systems to communicate and collaborate within a decentralized network, allowing for autonomous and dynamic real-time learning systems.

The advantages described are summarized by the author in Fig. 1.

AI uses a large database to train models. Ensuring the security, origin, immutability, and safety of this data can significantly positively impact the technology's development. Blockchain-based AI offers numerous advantages over other AI systems.

The primary advantage of AIBC is achieving higher information management control than centralized AI systems. This way, the users' confidence in the system can be increased.

Various studies in the literature explore the combination of these two technologies. One study after a literature review of over 1300 documents from two of the largest and most famous databases with scientific literature (Scopus and Web of Science), summarizes that AI can securely access information through blockchain while maintaining source confidentiality [5]. Another

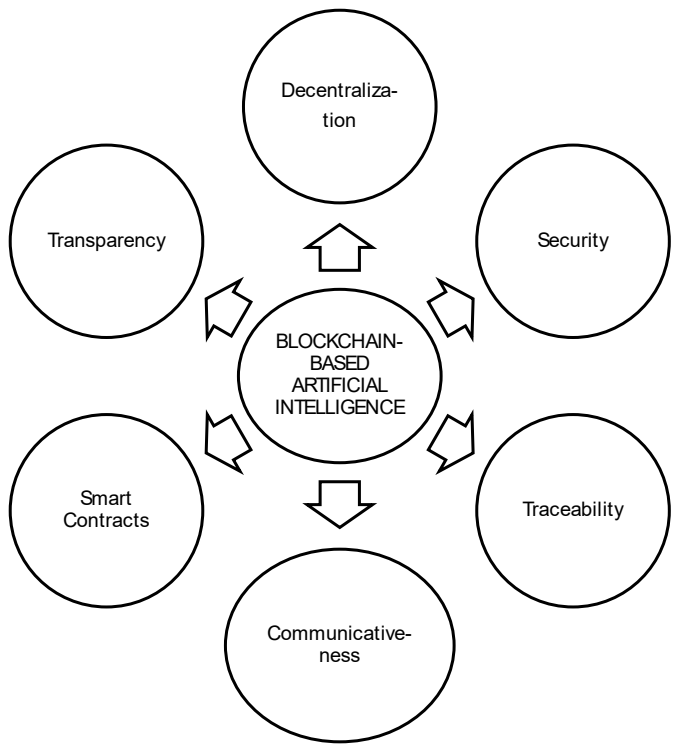

Fig. 1. Author's summary.

study proposes a blockchain-based system to address security and trust issues between AI and Industrial IoT (IIoT) [6].

Blockchain-based AI can be used in software development. One study proposes a decentralized blockchain system using AI for software testing, automatically detecting and preventing vulnerable code without manual input [7].

A study describes using AI to analyse large databases generated by blockchain systems, providing crucial system status information and aiding operators in making informed decisions [8].

Blockchain-based AI can be applied in various sectors, depending on the project's needs, such as:

- Energy: A framework for implementing such a system in energy trading systems [9].
- Healthcare: A system for robotic surgery achieving higher performance and prediction accuracy than AI-supported telesurgery systems [10].
- Construction: A study demonstrating blockchain-based AI effectiveness in evaluating construction costs for road projects [11].

Blockchain-based AI can facilitate the sharing and storage of health data, ensuring data privacy and aiding doctors and patients in improving diagnostic accuracy and treatment efficiency.

A review concluded that using blockchain-based AI in Industry 4.0 can extract practical information for rational decision-making, enhancing efficiency and reducing costs [12].

A system based on these advanced technologies can be applied in various private sector aspects, such as optimizing production chains, verifying data origin and quality, tracking supply chains, managing personal data, and more. Depending on the company's needs, adapting blockchain-based AI can improve data transparency, security, and accuracy.

A study considers blockchain-based AI as a foundation for unprecedented innovation and efficiency in the industry [13]. The key advantage of blockchain-based AI is higher data management control, enhancing traceability, security, and reliability. Both technologies are rapidly evolving, significantly expanding blockchain-based AI's future possibilities and applications.

CONCLUSIONS

Technological advancements significantly impact many aspects of the economy and society. Combining two rapidly developing technologies blockchain and AI can offer innovative solutions to various problems. These technologies complement each other, providing a system that is more reliable, secure, transparent, and efficient than centralized AI data storage.

Blockchain-based AI can find applications in public and private sectors, including energy, healthcare, production chains, personal data management, construction, and more. This paper discusses examples of such systems being developed and tested. There are relatively few implemented projects for blockchain-based AI, but as both technologies continue to develop, their applications are expected to increase significantly.

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