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The Integration of Blockchain and Artificial Intelligence for a Smart City

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Abstract: *Smart city can be transformed into a smart society by adopting emerging technologies. This paper provides a comprehensive literature review on the security issues affecting the deployment of smart city blockchain systems. This paper discusses solutions of blockchain security enhancement in detail and summarizes key points that can be used to develop various block-based intelligent management systems. In addition, future research directions are explored, including new security recommendations and future guidelines for sustainable smart city ecosystems.*

Keywords: *Blockchain, Artificial intelligence, Smart city, Intelligent management*

1. Introduction

The rapid urbanization of the world's population has created many economic, environmental and social problems that seriously affect the lifestyle and quality of life of many people[1]. The concept of building sustainable smart city is expected to help raise awareness and promote best practices for minimum consumption of green energy[2]. It is predicted by the United Nations that 66% of the world's population will soon live in large cities, which means we will confront major challenges in terms of social sustainability[3]. In addition, the form of modern cities is seen as a social and environmental issue. About 70 per cent of the world's resources are consumed by municipalities, which poses major challenges in allocating these resources through cutting-edge technologies. Rapid urbanization and advances in information and communication technologies are the two most important phenomena that affect urban safety planning and governance today. In particular, the latter has formed the concept of a smart city, and the implementation of smart city technology is hailed as a solution to many urban challenges, such as transportation, waste management and environmental protection. Although these issues are the focus of an increasingly heated debate about smart city development, security and crime prevention issues are often overlooked.

Emerging technologies such as blockchain technology and artificial intelligence are endowed with many advantages, such as trust-free, automation, decentralization, democracy and security. Information and communication technology plays an important role in the implementation of smart cities. A blockchain is a decentralized public ledger of all transactions in a distributed network. Transactions are signed using public and private keys that are mathematically related to each other, and these transactions are logged so that participants can track transactions (i. e. , digital currency) rather than using intermediate record maintenance[3]. Blockchain has an important key feature of distributed databases: each computer represents a node in the blockchain, and copies of transactions can be downloaded from the network. However, this creates privacy and trust issues. In this paper, we discuss these issues and propose solutions. A key attribute of interest in blockchain is that it provides security, anonymity, and data integrity without the need for third-party regulators to control transactions. This creates a particularly exciting area of research for addressing related technical challenges and limitations. For smart city management agencies, public safety is crucial whether it is to prevent cyber crime, traditional crime, natural disaster or terrorism. When predicting smart city security and privacy issues, it should be noted that while many of the same issues still exist today, they don't occur as often as they did when these technologies were fully interconnected.

2. Principles for building a smart sustainable city society

2.1. Design requirements in smart cities

To build a safe, scalable, efficient, and sustainable city supported by artificial intelligence, the

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following requirements need to be met.

Resilient environment: The convergence of globalization and urbanization has brought unprecedented challenges to cities. Therefore, their infrastructure should be resilient to external shocks and ensure the sustainability of smart cities. Interoperable and flexible: In order to achieve the interconnection of each physical object, the communication technology should be interoperable. For example, an IoT platform for smart home appliances that can be controlled from anywhere, and home data can also be provided to cloud infrastructure.

Decision support system: a smart city composed of complex and diverse systems, seeking a balance between economic development, industrialization and environmental factors. This has become a challenge for policy makers, so highly adaptive decision-making methods should be used to determine the optimal solution.

Behavior monitoring: In smart cities, computer simulations are needed to simulate adaptive behaviors. Due to the existence of the network, the interrelationship cycle generates pattern behavior data, which represents the interaction between the economic, social and physical systems of the network.

Source and distribution of energy: The quality of energy supply and renewable resources have become important requirements that must be guaranteed. Therefore, distributed technology should be adopted in the power grid system and other fields.

Smart infrastructure: To build a sustainable smart city, all individuals need to work collaboratively through smart systems.

Scalability: Smart cities consist of a large amount of hardware and software, many of which provide citizens with the ability to collect and process real-time data in infrastructure. Therefore, distributed IoT-blockchain cloud infrastructure is necessary for sustainable cities.

Smart healthcare: As the Internet combines big data, smart systems, and state-of-the-art critical analysis, global cities can help the healthcare industry.

Security infrastructure: In order to protect the network and data from various risks, network control policies such as malicious activity monitoring, entity authentication, and authorization should be formulated to ensure and protect sustainable smart cities.

2.2. Smart infrastructure in smart cities

Traffic management: This includes automated vehicle location technology and computer-aided dispatch systems to help vehicles stay on time and improve service. Assistance based bus systems with traffic light systems at urban intersections, these methods use routing generation design algorithms to generate different sets of routes, corresponding to the different trade-offs required to reduce travel time. Artificial intelligence search algorithms for designing and analyzing traffic networks. Artificial intelligence search techniques offer the advantage of expressing transport network design problems and using tabular data structures for efficient searches. The development of artificial intelligence, especially machine learning, has greatly promoted the application of smart cities. Smart infrastructure is an important part of smart city, which is equipped with wireless sensor networks that automatically collect, analyze and communicate structural data, known as smart monitoring. AI algorithms can process large amounts of data and detect patterns and features that traditional methods cannot.

Traveler information: The travel information system is used to report traffic information updates to travel users. These systems have multiple modes of communication and provide real-time information such as travel time, travel speed, dial-up service delays, traffic accidents, route changes, curves, work area conditions, etc. , through on-board computers. Smart systems provide travelers with effective route information that can be used in public and shared transit areas.

Commercial vehicle based operation: To simplify vehicle registration, safety inspection, tax collection, transport of dangerous goods and other commercial vehicle processes. The electronic screening system automatically screens roadside documents. Vehicle types can be identified through image processing, allowing frequent inspections, so commercial trucks can travel quickly. Freight management system increases mobility and customer value. The system reduces noise, traffic jams and pollution. New research is looking at new technologies and developing new applications for freight management systems. Software such as decision support software, vehicle clearance procedures and automated transfer systems can play an important role in the infrastructure.

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3. Security issues and challenges in building smart cities

Infrastructure security: Due to various vulnerabilities and risks, network physical infrastructure is facing the challenge of city intelligence. However, modern infrastructure systems are so diverse that there is no satisfactory overall understanding of their vulnerabilities and threats. Deliberate and accidental threats to the security of smart city infrastructure can have different serious consequences depending on the maturity and wisdom of the city. Security threats are being faced by physical components such as: transportation management, where a serious attack on traffic or air control systems could cause huge congestion and a lot of time loss. Designers, developers and engineers ignored security-related issues, leaving building management systems weak and vulnerable to exploitation.

Threats to data integrity and privacy: In smart cities, smart grids can be made especially with the completion of data integrity, such as sensor values and control commands. The main goals of maintaining integrity include defense mechanisms for information modification through message injection, message replay, and network latency. These things have the potential to cause a lot of problems in smart city network infrastructure. In injection attacks, attackers can gain control of grid system configuration by injecting malicious data into the monitoring center. Privacy is important as a major consumer concern and right in these smart city systems.

Legal issues: The Internet of Things is subject to national laws and regulations on data privacy, such as data protection directives. Most of these laws are outdated, and revisions are necessary due to the emergence of new disruptive technologies such as blockchain. The development of new laws and standards will help to certify the security features of devices, thereby helping to build the most secure and reliable IoT network possible. Information privacy and processing is a major problem that the Internet of Things must solve, and it is a difficult task to combine the Internet of Things with the blockchain. Lack of supervision can be disadvantageous because it is impossible to obtain or reset the private key and return the transaction. IoT applications assume a unique global device blockchain, but it is not known whether these types of networks are managed by manufacturers or open to users.

Smart contracts: Smart contracts have been identified as an important application in blockchain technology, but as mentioned earlier, there are still some challenges. While AI can benefit from the use of smart contracts, there are a variety of ways to be compatible with AI applications. Using smart contract applications for enterprises is complicated by the complexity of using blockchain. Blockchain networks can be complex and difficult for first-time users to understand. In addition, the architectural design of blockchain technology is unacceptable for many enterprise processes. Intelligent accident prevention contract, automatic reporting system activated by emergency system after incident. It automatically calls the integrated rescue System's emergency response unit. The emergency system uses satellite communications, just like cell phones. The system warns passengers that it is unsafe and helps avoid crashes. The system provides warnings of vehicles approaching dangerous curves, driveways, highway railway intersections, intersections, as well as warnings of pedestrians, cyclists and animals. The sensors are used to monitor vehicle speed frequently and also include environmental sensors to monitor road conditions and visibility. Event management includes dynamic message displays to alert people to accidents or to stop vehicles while they are on the move. Accident detection, verification, response and communication using a variety of cameras and road sensors are considered useful tools by professionals. These tools are conducive for quick identification of incidents, alert emergency services and direct them to the scene.

4. The construction of a smart city management system

As time goes by, transportation is faced with many problems, such as high accident rate, carbon emissions, air pollution and traffic congestion. In addition, the public nature and its use of wireless communication technology lead to many security and privacy issues. These challenges cover issues on integrity, confidentiality, location privacy authentication, non-repudiation, identity privacy, anonymity, certificate revocation, and certificate validation. Many researchers have given their focuses on challenges on smart contract vulnerabilities, and related security. The continued development of socioeconomic digitisation has created a vision of smart cities that aspires to connect all aspects of urban life. The foundation of smart city connecting all aspects of urban life is built around contemporary and emerging technologies such as cloud computing, Internet of Things and information physics systems, representing the latest chain of the industrial revolution, known as Industry 4. 0.

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Intelligent transport management systems: Blockchain is undergoing rapid change and has the potential to innovate continuously in the application of intelligent transport systems for sustainable smart cities. By using blockchain to build a safe, reliable and decentralized ecosystem of autonomous transportation systems, we can make more efficient use of existing intelligent transportation system infrastructure and resources. In the near future, intelligent transportation systems will form a huge network of autonomous vehicles in smart cities. Demand for IT services is also increasing, as the convenience of private transport comes at the cost of consuming road resources. Intelligent transportation systems will change dramatically in all areas of technology, including vehicle control design and traveler information management.

Infrastructure management systems: With the emergence of smart networks such as smart homes and smart cities, artificial intelligence has become a potential are with great influence. Over the past few years, blockchain has played a role in effectively improving connectivity through artificial intelligence. Distributed ledger systems are monitored by tracking devices connected together and performing operations in each interaction. AI based devices can interact with each other and connect to the Internet using smart contracts, so there is no need for a central authority to validate every interaction between two parties. AI and blockchain can be used to improve the security infrastructure of large enterprises, as well as for data extraction and analysis. Through block chain solution of artificial intelligence, open ledgers can drive intelligent network connection failure prevention in the integration, eliminate such as data transparency and the end-to-end process automation and validation data real-time tracking, trading exchange, across the artificial intelligence platform based on the cloud network restrictions, such as: pressure extensibility, data analysis and artificial intelligence network problems.

5. Building future development strategies for smart cities

There is a high degree of interdependence between urban problems and sustainable development strategies. However, so far, the complexity of the system from different perspectives fails to be comprehensively analyzed for construction of the city. For example, mobility in smart cities is related to infrastructure technology and the provision of efficient transportation. Accessibility with good connectivity is also the main focus of smart cities. Similarly, city governments are focused on open data, smart infrastructure, smart administrative and political strategies, and smart decision-making. In addition, the government should consider social, economic and environmental factors. Similarly, sound environmental practices and procedures should be adopted, which require an effective combination of economic and environmental considerations. In addition, the measures taken should be cost-effective and proportionate to the problem being addressed.

To address the security and privacy issues faced by smart cities, stakeholders must address them holically to ensure that certain issues do not continue to plague other parts of the smart network. To achieve this ambitious goal and build smart city future development, security experts and smart city planners are required to leverage projects and current sustainable cities to encourage the building of the smart systems needed. The rapid adoption of blockchain technology has led to a paradigm shift in a new digital smart city ecosystem. A wide range of blockchain applications promise to solve problems, from risk management and financial services to cryptocurrencies, and from the Internet of things to public and social services. In addition, the fusion of artificial intelligence and blockchain technology is revolutionizing smart city network architectures to build sustainable ecosystems. However, in achieving the goal of creating a sustainable smart city, these technological advances lead to smart city future development strategies.

6. Conclusion

The integration model of blockchain and artificial intelligence is transforming smart cities, bringing together companies, governments and even countries. Blockchain and AI technologies are widely recognized and highly valued for their decentralized and point-to-point nature. In this study, various security issues and challenges that hinder the adoption of blockchain and artificial intelligence technologies are presented, and various challenges in different aspects of sustainable smart cities are explored. It also examines the development status of various blockchain-based and artificial intelligence infrastructure. Finally, some future directions of smart city technology are discussed.

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