Akıllı Şehir ve Akıllı Turizm İçin Blockchain Teknolojisinin Kullanımı

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Öz

Blockchain teknolojisinin turizm sektöründe yaygınlaşması ile hem destinasyonlar ve turizm işletmeleri hem de turistler için maliyet ve zaman tasarrufu sağlamaktadır. Akıllı sözleşmeler ve merkezi olmayan uygulama (DApps) araçları, halen gelişim aşamasında olmasına rağmen, turizm sektöründe gösterdikleri faaliyetlerle hâlihazırda önemli bir etkiye sahiptir. Bu çalışmada akıllı şehirler ve akıllı turizm bağlamında blockchain teknolojisinin temel özelliklerine değinilmek ve teknolojinin gelecekte turizm sektörünü nasıl geliştireceğinin incelenmesi amaçlanmaktadır. Bu amaçla blockchain veri tabanlarında turizm, akıllı turizm ve akıllı şehir ile ilgili uygulama alanları incelenmiştir. Sonuç olarak akıllı turizm ve akıllı şehir uygulama alanlarında blockchain teknolojisinin kullanımının giderek yaygınlaştığını ve gelişime açık olan bu teknolojinin farklı sektörlerle birleşerek kullanımının güçlenebileceğini göstermektedir.

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Using Blockchain Technology for Smart City and Smart Tourism

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Abstract

The widespread use of blockchain technology in the tourism industry provides cost and time savings for businesses and tourists. Although still in development, smart contracts and decentralised application (DApps) tools are already having a significant impact on the operations of tourism operations. This study it is aimed to touch on the basic features of blockchain technology in the context of smart cities and smart tourism and to examine how technology will develop the tourism sector in the future. For this purpose, the application areas related to tourism, smart tourism and smart city in blockchain databases were examined. As a result, it shows that blockchain technology in smart tourism and smart city application areas is becoming more widespread. This technology, open to development, can become stronger by combining different sectors.

Keywords
Blockchain, Smart City, Smart Tourism

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Introduction

Blockchain technology can potentially revolutionise how cities and the tourism industry operate by providing a secure and transparent way to manage data and transactions (Dutta et al., 2020). Recently, there has been an increasing interest in applying blockchain technology to smart cities and smart tourism (Nam et al., 2021). Smart cities aim to improve the quality of life for citizens through the use of technology and data. In contrast, smart tourism aims to enhance the visitor experience through technology (De Guimarães et al., 2020). Research has shown that blockchain technology can improve various aspects of smart cities and tourism. Thakur et al. (2020) suggest that blockchain can improve the transparency and accountability of city management by providing a way to track and record data in a tamper-proof manner. Another study by Sladić et al. (2021) suggests that blockchain can enhance the security and privacy of smart tourism by providing a secure way to manage and share data among different stakeholders.

Furthermore, blockchain can enable the sharing economy in smart cities and tourism. Baralla et al. (2021) highlight that blockchain enables peer-to-peer transactions and shares resources such as transportation, accommodation, and energy. Blockchain technology can make smart cities and tourism more efficient, secure, and transparent. However, more research is needed to fully understand the potential and limitations of blockchain technology in these areas, and the technology is still in its early stages of development.

In addition to the potential benefits highlighted in the previous response, blockchain technology can improve other aspects of a smart city's art tourism. One application of blockchain technology in smart cities is in the area of digital identity management. Zwitter et al. (2020) suggest that blockchain can provide citizens with secure and decentralised digital identities, enabling them to easily access and use city services. This can improve the efficiency and convenience of city services while increasing the privacy and security of citizens' data. Another application of blockchain technology in smart tourism is in the area of destination management. A study (Rashideh, 2020) suggests that blockchain can provide a secure and transparent way to manage and share data among different stakeholders in the tourism industry. This can improve coordination and collaboration among different parties, leading to more efficient and sustainable tourism practices.

Moreover, blockchain technology can create digital tokens for smart cities and tourism, incentivising or rewarding citizens and tourists for engaging in sustainable and responsible behaviour. For example, a study by (Calandra et al., 2022) suggests that blockchain-based digital tokens encourage citizens to reduce their carbon footprint and encourage tourists to participate in conservation efforts. It is worth mentioning that the implementation of blockchain in smart cities and smart tourism is still in its early stages. Some challenges remain to be addressed, such as regulatory, technical and adoption challenges.

While there has been a growing interest in applying blockchain technology to smart cities and smart tourism, there is still a lack of comprehensive research examining this technology's potential and limitations. Although several studies have highlighted the benefits of blockchain technology, such as improving transparency, accountability, security, and privacy, more research is still needed to fully understand its potential and limitations. Additionally, various challenges must be addressed for successful implementation, such as regulatory, technical, and adoption. Thus, a research gap needs to be filled to provide a better understanding of the potential of blockchain technology in smart cities and smart tourism.

1. Blockchain

Understanding blockchain technology's theoretical framework can be delineated into several fundamental concepts. First, it is essential to understand the concept of a distributed ledger. A distributed ledger is a database spread across a computer network rather than stored in a central location (Liu et al., 2020; Nair and Sebastian, 2017). This decentralisation of data storage is a crucial characteristic of blockchain technology and contributes to its security and transparency. Second, blockchain technology uses cryptography to validate transactions and create a chain of blocks. Each block contains a unique identifying code, called a "hash," based on its preceding block (Nakamoto, 2008). This allows for more accurate data tracking and helps ensure the ledger's security (Nørfeldt et al., 2019). Third, blockchain technology can be classified into three generations: the first is the creation of Bitcoin, the first digital currency (Anwar et al., 2020); the second is the development of smart contracts, which are blockchain-based code that facilitates self-executing, self-enforcing contracts (Dimatteo and Poncibó, 2018; Ethereum, 2018); and the third being the current generation of decentralised applications (DApps), which allow for more regular and familiar interactions with blockchain technology. In order to understand the potential implications and applications of blockchain technology, it is crucial to stay up to date with the latest research and developments in the field. In conclusion, the theoretical framework for understanding blockchain technology includes understanding the concept of a distributed ledger, using cryptography to validate transactions, and classifying blockchain technology into three generations. To stay current on the latest research and developments, it is vital to consult up-to-date resources such as journals, websites, and news outlets specialising in blockchain technology (Gomber et al., 2018).

Another critical concept in understanding blockchain technology is the concept of a consensus mechanism. A consensus mechanism is a process by which the participants in a blockchain network agree on the state of the ledger (Sri and Bhaskari, 2020). A commonly used consensus mechanism in the blockchain is "proof of work," which involves solving complex mathematical problems to validate transactions (Nakamoto, 2008). This consensus mechanism helps to ensure the integrity and security of the ledger by making it difficult for malicious actors to manipulate the data. Another essential concept is the concept of

smart contracts (De Caria, 2018). Smart contracts are self-executing contracts with the terms of the agreement written directly into lines of code (Handayani et al., 2020). These contracts are stored and replicated on the blockchain network and can be automatically executed when conditions are met. Smart contracts can revolutionise various industries by streamlining processes and reducing the need for intermediaries (Kakavand et al., 2017). In addition, another important concept is that of Decentralized Autonomous Organizations (DAOs). This decentralised entity can be programmed to operate autonomously and make decisions based on predefined rules and conditions (El Faqir et al., 2020). DAOs can help automate decision-making processes, reduce the need for intermediaries, and increase transparency and accountability.

It is also worth mentioning that blockchain technology is still in its early stages of development, and its potential applications are still being explored. Researchers and industry experts are working to improve blockchain technology's scalability, interoperability, and regulatory compliance (Adams et al., 2017; Chen et al., 2018). Despite these challenges, many experts believe blockchain technology can transform various industries and improve our lives and work (George et al., 2021). Overall, the theoretical framework for understanding blockchain technology includes understanding the concept of a distributed ledger, the use of cryptography to validate transactions, the concept of consensus mechanisms, the concept of smart contracts, the concept of Decentralized Autonomous Organizations (DAOs) and the classification of blockchain technology into three generations. It is also essential to be aware that blockchain technology is still in its early stages of development, and its potential applications are still being explored.

1.1. Blockchain Issues

The theoretical framework for understanding blockchain technology's significant issues can be divided into several key concepts. First, scalability is a major issue facing blockchain technology. As more users and transactions are added to the network, the time and resources required to validate and process them can become a bottleneck, limiting the potential use cases for blockchain (Croman et al., 2016; Sund et al., 2020). Second, interoperability is another major issue facing blockchain technology. With multiple blockchain platforms and networks, it can be challenging to ensure they can work together seamlessly and share data (Chelladurai and Pandian, 2022). Third, regulatory compliance is a significant issue for blockchain technology. Governments and regulatory bodies are still figuring out how to regulate and control blockchain-based systems and cryptocurrencies (Sun Yin et al., 2019; Yadav et al., 2022). Fourth, security is a significant concern for blockchain technology. Despite its decentralised nature, blockchain is not immune to hacking and malicious attacks (Abduljabbar et al., 2021; Xu, 2016). In order to understand the current issues surrounding blockchain technology and its potential solutions, it is essential to stay up-to-date with the latest research and developments in the field. In conclusion, the theoretical framework for understanding blockchain technology's major issues includes scalability, interoperability, regulatory compliance, and security.

1.2. Blockchain For Smart City and Smart Tourism Destination

The utilisation of blockchain technology in smart cities and tourism can be comprehended through a theoretical framework of several key concepts. First, blockchain technology can create secure and transparent systems for managing and tracking data in smart cities. For example, blockchain-based systems can be used to track the use of electric vehicles, monitor energy consumption, and manage the distribution of renewable energy (Bao et al., 2020; Bhaskar et al., 2022). These systems can also be used for tracking data about the citizens and their activities and creating more efficient and effective governance, allowing for better allocation of resources and more accurate decision-making processes (Shrier et al., 2016). Second, blockchain technology can create secure and transparent systems for managing and tracking data in smart tourism. Blockchain-based systems can be used to track the history of a hotel room, verify the authenticity of a tour guide, and ensure the safe and secure transfer of payments (Barkel et al., 2021). These systems can also be used for tracking tourist data and activities and creating more efficient and effective management of the tourism industry, which allows for the better allocation of resources and more accurate decision-making processes (Jin et al., 2014). Third, blockchain technology can also create decentralised platforms for sharing data and resources, such as creating a sharing economy for tourism activities. (Ertz and Boily, 2019).

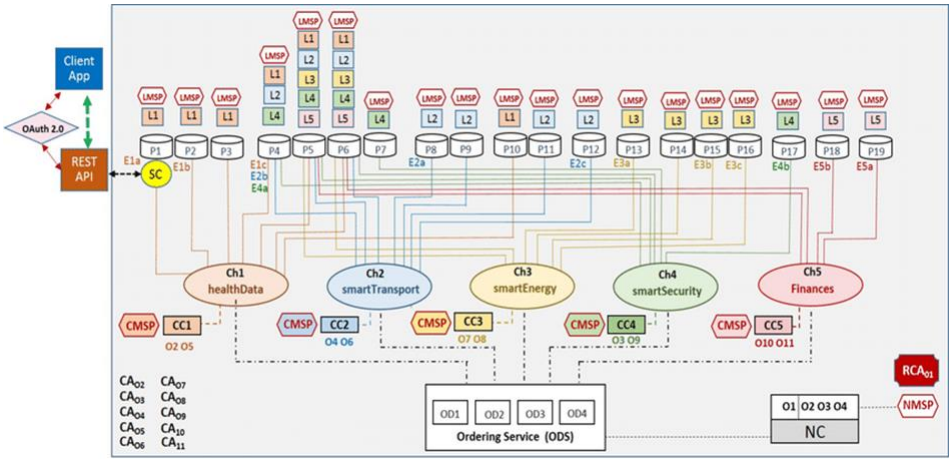

Figure 1: Smart city usage map via blockchain technology

These platforms enable more efficient use of resources and empower citizens and tourists by giving them more control over their data and activities. It is important to note that while blockchain technology can revolutionise the way smart cities and smart tourism operate, many challenges still need to be addressed before they can be fully realised (Nam et al., 2021; Zhang et al., 2021). Some of these challenges include issues related to scalability, interoperability, and regulatory compliance. Additionally, there is a need for more robust security measures to protect against potential attacks and to ensure the integrity of data. In conclusion, the theoretical framework for understanding the potential use of blockchain

technology in smart cities and smart tourism includes the use of blockchain technology to create secure and transparent systems for managing and tracking data, creating decentralised platforms for sharing data and resources, and the potential challenges that need to be addressed.

1.3. Smart Contracts and Smart Tourism

Smart contracts have gained attention as a potential tool for improving various processes in the tourism industry. By automating and streamlining processes, smart contracts can enhance efficiency and reduce costs (Khatoon, 2020; Rashideh, 2020). Several key concepts should be considered to conceptualise the potential use of smart contracts in smart tourism. Firstly, smart contracts can automate the booking and payment processes for hotels and tours, making them more efficient and secure while ensuring compliance with regulations and laws (Raskin, 2016). Secondly, smart contracts can create decentralised platforms for sharing data and resources within the tourism industry (Fiorentino & Bartolucci, 2021). This includes peer-to-peer sharing of resources such as cars, bikes, and accommodation (Gatteschi et al., 2018). Thirdly, smart contracts can promote transparency and trust in the tourism industry. For instance, smart contracts can provide transparent and verifiable information about service providers, such as tour guides and hotels, and ensure that customer reviews are genuine and not tampered with (Bodkhe et al., 2019). While smart contracts have the potential to revolutionise the way smart tourism operates, several challenges need to be addressed before they can be fully realised (Antoniadis et al., 2020). One major challenge is how to build trust within the system. Despite the transparency and verification capabilities of smart contracts, it is unclear how they can build trust among participants in the tourism industry. This is particularly important because trust is a fundamental element in the tourism industry. Tourists are likely to choose destinations and services based on trust, and a lack of trust can negatively impact the industry's growth and development.

To address this challenge, it is essential to recognise that building trust is a complex and multifaceted process that requires various approaches. One potential approach is to design smart contracts that are transparent, auditable, and accessible. Smart contracts should be designed to provide verifiable information about service providers and their credentials. This information should be accessible to all participants, including tourists, regulators, and service providers, which can promote transparency and accountability. Smart contracts should also be auditable to comply with regulations and laws. Auditing can promote trust by ensuring the system operates as intended (Zhu et al., 2011). Another approach is to leverage technologies that can enhance trust in the system. For example, blockchain technology can create a decentralised and secure system resistant to tampering and manipulation. Blockchain can enable transparent and immutable records of transactions, which can help to build trust among participants. Additionally, digital identities and reputational systems can enhance trust by providing participants with verifiable and reliable information about service providers.

In conclusion, smart contracts can potentially improve efficiency and reduce costs within the tourism industry. However, their potential use in smart tourism requires careful consideration of the challenges involved. Building trust is a significant challenge that needs to be addressed. While there is no one-size-fits-all approach to building trust, it is essential to design smart contracts that are transparent, auditable, and accessible. Additionally, leveraging technologies such as blockchain, digital identities, and reputational systems can enhance trust in the system.

1.4. Record and Rights Management

The theoretical framework for understanding the potential use of record and rights management in smart tourism can be divided into several key concepts. Record and rights management systems can be used to ensure the security and privacy of the personal data of tourists, such as passport and identification information, travel itineraries, and payment details. This can be achieved using secure and tamper-proof systems, such as blockchain-based systems, which provide a secure and transparent record of transactions and data storage (Zhang and Zhao, 2018). Record and rights management systems can also ensure compliance with regulations and laws related to data privacy and protection (Jing et al., 2021). Such systems can ensure that personal data is not shared without the consent of the tourists and that data is deleted when no longer needed (Eirinaki and Vazirgiannis, 2003). Record and rights management systems can also create transparency and trust in the tourism industry (Negi et al., 2021). Such systems can provide transparent and verifiable information about service providers, such as tour operators and hotels, and ensure that customer reviews are genuine and not tampered with (Bodkhe et al., 2019). It is important to note that while record and rights management systems have the potential to revolutionise the way smart tourism operates, many challenges still need to be addressed before they can be fully realised. Some of these challenges include issues related to scalability, interoperability, and regulatory compliance. Additionally, there is a need for more robust security measures to protect against potential attacks and to ensure the integrity of data (Li et al., 2017).

Furthermore, record and rights management systems can also be used to improve the overall customer experience in the tourism industry (Gopalan and Narayan, 2010). By providing tourists with secure and transparent access to their data and travel itineraries, record and rights management systems can enable them to easily manage their bookings and reservations and make necessary changes or cancellations (Dogru et al., 2018; Verma, 2021). Record and rights management systems can also be used to improve the efficiency of the tourism industry. Automating and streamlining various processes, such as booking and payment and record and rights management systems, can help to reduce costs and improve profitability for service providers (Barkel et al., 2021). However, potential challenges must be addressed to fully realise the benefits of the tourism industry's record and rights management systems. For example, there is a need for more robust security measures to protect against potential cyberattacks and privacy concerns related to the

collection and storage of personal data. There is a need for more standardisation and interoperability among different record and rights management systems to ensure seamless integration with existing systems and processes (Tan et al., 2022).

In conclusion, record and rights management systems have the potential to significantly improve the security, efficiency, and customer experience in the smart tourism industry. Potential challenges also need to be addressed, such as security and privacy concerns and the need for standardisation and interoperability. By staying up-to-date with the latest research and developments in the field, it is possible to fully realise the benefits of record and rights management systems in smart tourism.

1.5. Dapps For Smart Tourism

The theoretical framework for understanding the potential use of decentralised applications (DApps) in smart tourism can be divided into several key concepts. DApps can create decentralised platforms for sharing data and resources in the tourism industry (Leiponen et al., 2022). This can include using DApps to facilitate the booking and managing of travel itineraries, sharing customer reviews and ratings, and sharing information about service providers such as hotels and tour operators (Bhuiyan et al., 2022). DApps can also create transparency and trust in the tourism industry. By providing a transparent and tamper-proof record of transactions and data storage, DApps can help ensure that customer reviews are genuine and not tampered with. That service provider is held accountable for their services (Javaid et al., 2022). DApps can also be used to improve the overall customer experience in the tourism industry. By providing tourists with secure and transparent access to their data and travel itineraries, DApps can enable them to easily manage their bookings and reservations and make changes or cancellations as needed (Hassan and Avi, 2022). It is important to note that while DApps have the potential to revolutionise the way smart tourism operates, many challenges still need to be addressed before they can be fully realised. Some of these challenges include issues related to scalability, interoperability, and regulatory compliance. Additionally, there is a need for more robust security measures to protect against potential attacks and to ensure the integrity of data.

In conclusion, the theoretical framework for understanding the potential use of DApps in smart tourism includes the use of DApps to create decentralised platforms for sharing data and resources, create transparency and trust in the tourism industry, and improve the overall customer experience.

2. Discussion

Blockchain technology has the potential to revolutionise the way smart cities and smart tourism operate. By providing a secure, transparent, and tamper-proof record of transactions and data storage, blockchain can help to improve efficiency, security, and trust in various applications and processes. One potential application of blockchain in smart cities is in the area of record and rights management. Blockchain-based systems can

ensure the security and privacy of citizens' data, such as identification and passport information, and compliance with regulations and laws related to data privacy and protection (Bennacer et al., 2022). Blockchain can also create transparency and trust in government and public services by providing a transparent and verifiable record of transactions and data storage (Bustamante et al., 2022).

Similarly, in smart tourism, blockchain technology can be used to improve the security and privacy of the personal data of tourists, such as passport and identification information, travel itineraries, and payment details (Gamidullaeva et al., 2023). This can be achieved using secure and tamper-proof systems, such as blockchain-based systems, which provide a secure and transparent record of transactions and data storage (Zafar et al., 2022). Furthermore, blockchain can create transparency and trust in the tourism industry by providing transparent and verifiable information about service providers, such as tour operators and hotels, and ensuring that customer reviews are genuine and not tampered with (Raluca-Florentina, 2022). However, it is essential to note that while blockchain technology has the potential to revolutionise the way smart cities and smart tourism operate, challenges must be addressed. Some of these challenges include issues related to scalability, interoperability, and regulatory compliance. Additionally, there is a need for more robust security measures to protect against potential cyberattacks and to ensure the integrity of data.

Blockchain technology's potential implications and applications in smart cities and tourism are numerous and varied. Another area where blockchain can be applied is in the use of smart contracts for smart tourism. Smart contracts are blockchain-based codes that facilitate self-executing, self-enforcing contracts and automate processes such as booking and payment (Balasubramanian et al., 2022; Ethereum, 2018). This can reduce costs and improve service providers' profitability and customer experience. Furthermore, DApps or Decentralised Applications are also emerging as a potential solution for smart tourism. By providing tourists with secure and transparent access to their data and travel itineraries, DApps can enable them to easily manage their bookings and reservations and make changes or cancellations as needed (Stringer and Treiblmaier, 2022).

In conclusion, the potential benefits of blockchain technology in smart cities and tourism are clear. From the security and privacy of personal data to creating transparency and trust in various industries, blockchain can revolutionise how we operate and interact with technology. However, it is essential to note that challenges must be addressed to fully realise the benefits of blockchain technology, such as scalability, interoperability, and regulatory compliance. With continued research and development, it is possible to overcome these challenges and fully realise the potential of blockchain technology in smart cities and smart tourism.

Blockchain technology can potentially revolutionise various industries, including smart cities and tourism. However, there are also misconceptions about the capabilities and

limitations of blockchain technology that need to be addressed. One major misconception is that blockchain technology only applies to financial transactions and cryptocurrency. In reality, blockchain technology can be used for various applications, such as record and rights management, supply chain management, and smart contracts, in various industries, including smart tourism (Liang, 2022; Puri et al., 2023). Another misconception is that blockchain technology is completely secure and immune to cyberattacks. While blockchain technology provides a high level of security through its decentralised and tamper-proof nature, it is still vulnerable to potential attacks, such as 51%. It requires robust security measures to protect against them (Wenhua et al., 2023). A third misconception is that blockchain technology is not scalable and cannot handle large amounts of data or transactions (Zhao, 2022). While it is true that current blockchain technology may have scalability issues, research and development are ongoing to address these limitations and improve scalability (Bhubalan et al., 2022). It is important to note that these misconceptions about blockchain technology can lead to a lack of understanding and adoption. It is essential to stay up-to-date with the latest research and developments to understand blockchain technology's capabilities and limitations fully.

Conclusion

In conclusion, as blockchain technology continues to evolve and mature, it is becoming increasingly apparent that it has the potential to impact significantly various sectors, including smart cities and smart tourism destinations. These developments have the potential to change current business practices and make a significant impact on the way these industries operate. Through an analysis of existing decentralised applications (DApps), it has been identified that cost reduction, adoption of cryptocurrencies, and the development of new, all-encompassing ecosystems are some of the critical characteristics these DApps possess. However, it is essential to note that the study has certain limitations, such as the sample size of companies analysed, which may only be representative of some of the market. Despite these limitations, the study provides valuable insights and highlights the need for further research. In particular, further investigation into the determinants of adopting a cryptocurrency using various technology adoption theories would be of great value. This research is particularly relevant and timely in light of the increasing number of blockchain solutions developed and adopted in the market.

Additionally, it is essential to consider the implications of blockchain technology for privacy and security and the potential challenges related to regulatory compliance and interoperability (Singh et al., 2022). Furthermore, more research is needed to understand the potential of blockchain technology in areas such as sustainable and ethical sourcing and its impact on the overall customer experience (Noor, 2022; Parmentola et al., 2022). In order to fully realise the potential of blockchain technology in smart cities and smart tourism, it is essential to stay up-to-date with the latest research and developments in the field. It is also important to involve stakeholders such as industry players, government

entities and academics to collaborate and work together to address any challenges and fully realise the potential benefits of blockchain technology.

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