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Secure-reliable smart contract applications based blockchain technology in smart cities environment

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Abstract

Over time, our lives turn to digitization and technology and its multiple applications and uses. The smart city, its technologies and the services provided during it have become a way of life. The idea of smart cities relied on different mechanisms to provide reliable services. One of the important technologies is the blockchain that has proven to be extremely reliable and has a high security level technology. This paper presents a mechanism to explain the application of blockchain technology in smart contracts, how to increase reliability, data security, and many positive benefits as part of the multiple services provided by the smart city environment. This paper also provides important details about this technology and its impact on the overall administrative system of any service provided by smart governments. The paper dealt with an example of how to manage the real estate rental file electronically to explain the advantages of blockchain technology through which we overcome existing problems in this type of contract and service.

*Keywords:*Smart city; blockchain; smart contract

1. Introduction

We in the twenty-first century are now experiencing a pure technology atmosphere. Everything around us began to evolve and gradually move into a technological trend. Energy, economy, services, security, transportation, banking, administration, and other aspects of life are based on the technology environment, with its various forms,

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forms, and applications. The need for increased modernization in different aspects of life leads to people being urged to accept new technologies that have gone through different stages of using a remote control for the purpose of controlling different home appliances to using voice notes to give directions; Modern technology has made space in our regular lives [1]. The emergence and discovery of technologies such as Augmented Reality and the Internet of Things that have gained pace in the past decade and now there is a new addition to the package, such as Blockchain technology [2].

2. Blockchain Technology

This modern technology has gained importance because it enables so-called distributed general ledger technology. Great features of this technology and the most important of which is the high level of security, as it maintains the unchangeable data in a safe and encrypted manner, ensuring that it is not changed, manipulated, or even attempted spontaneous tampering [3].

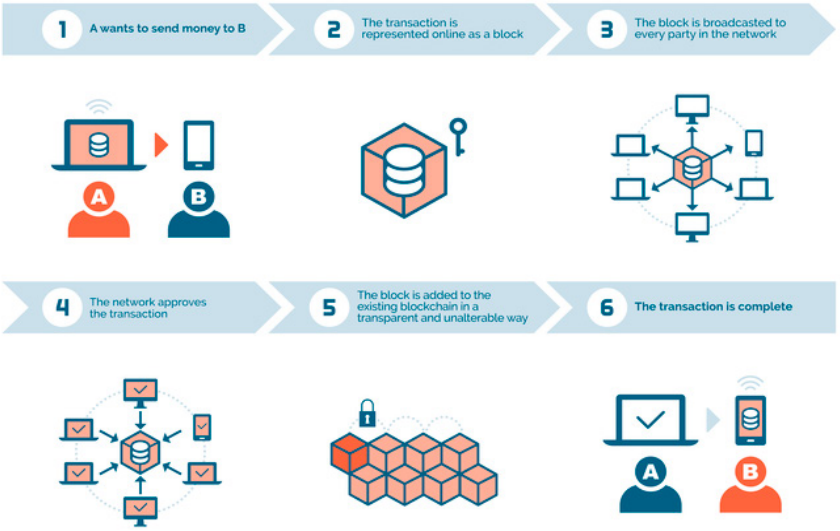

Fig. 1. Process of blockchain transaction

Several examples are currently available as important technology applications or applications based on a blockchain. Bitcoin and other cryptocurrencies are the most popular examples of blockchain use. Another set of uses is based on Distributed Ledger Technology such as data storage, financial transactions, real estate, asset management and many other uses. Figure 1 illustrated the steps of blockchain technology and how to add a new transaction [4].

3. Smart contracts

Smart contracts are one of the applications that are based on the characteristics of block technology. Indeed, it is almost the real secret of the wide range of uses of this technology. Basic blockchains features such as record data stability and the ability to reduce the likelihood of collective failure contributed to smart contracts. With calls, smart contracts also interact with each other, which is another positive feature. Its procedures are not dependent on intermediaries, but rather direct action through peer-to-peer strategy, unlike traditional paper contracts. Reducing routine procedures, enhancing the possibility of direct interaction between the parties, and improving the administrative approach, other additional features of smart contracts that contribute to archiving transactions

electronically, thus providing an approved database of all contract details. Figure 2 illustrates the differences between classical and smart contracts [5].

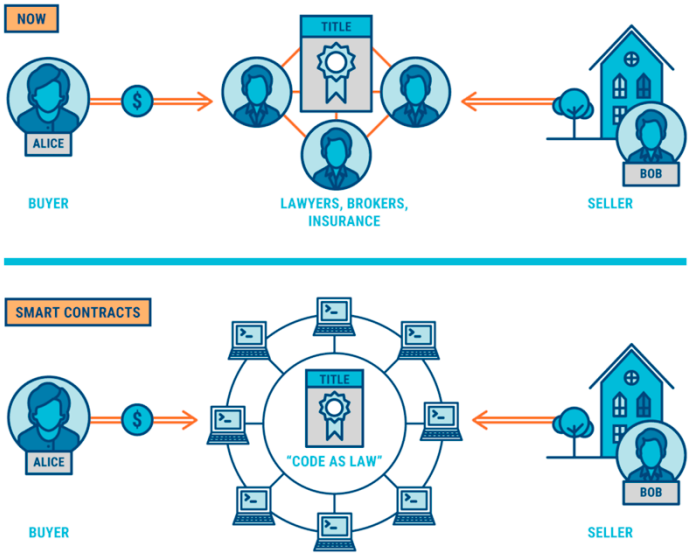

Fig. 2. Classic and smart contracts

4. The proposed work

This paper provides a comparative analytical study of the problems facing customary systems built according to the principle of the third authority in concluding electronic transactions in the environment of electronic governments and smart cities. This authority is characterized by full control over decisions that would pass or reject transactions with an absolute type of centralization. It will be compared to systems that perform the same purposes, but are built according to the peer-to-peer principle, which made the need for third power completely unnecessary. The electronic services that can be provided through the smart city environment are varied according to its purpose and type of network.

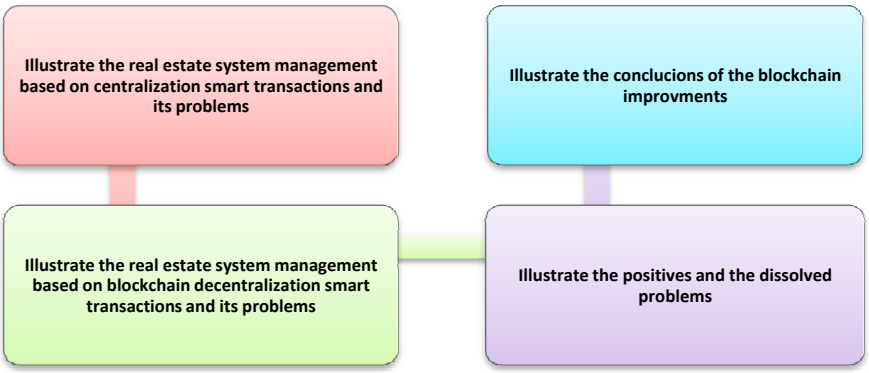

Fig. 3. Methodology of paper

Due to the principles of Blockchain technology based on the concept of a peer-to-peer distributed system, a practical example that suffers from these central problems have been discussed. This example is the real estate management and rental sector through the smart city environment and technology applications. For explaining the

mechanism of completing real estate transactions and the conclusion of smart contracts, and how to document and manage them government through the relevant institutions that own. We will try to clarify what matters have become when blockchain technology is applied. Most countries in the Middle East, including Iraq and Saudi Arabia, adopt a central system for managing the file of rentals and real estate management, as it is a very sensitive file and because these areas are religious tourist attractions that need remote real estate rental management systems that precede millions of religious events with sufficient time. Therefore, this paper presents a study of real estate file management systems and highlights its most important problem. The methodology of the proposed work illustrated in Fig. 3.

4.1. Centralization schemes Real Estate System Management

The real estate system works to manage the real estate rental process between the tenant, the lessor and the middleman. This system is connected with the following bodies National Card Center, Chamber of Commerce, Ministry of Justice, the notary and other government departments .Next sections illustrate and summarize the three most important stages of the centralization system as follows [6].

First stage: At this stage, the broker registers in the system and obtains the approval of the real estate brokerage, as shown in Fig. 4 below.

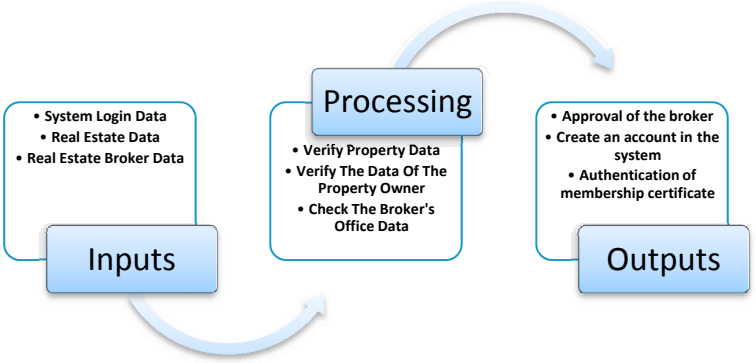

Fig. 4. First stage

Second stage: At this stage, the system works to conclude an agreement between the broker and the lessor to rent real estate, as shown in Fig. 5.

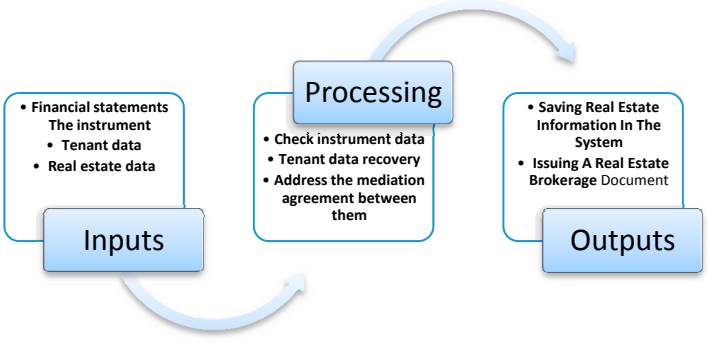

Fig. 5. Second stage

Third stage: At this stage, the system works to conclude the lease agreement between the lessor and the lessee by the broker as shown in Fig. 6.

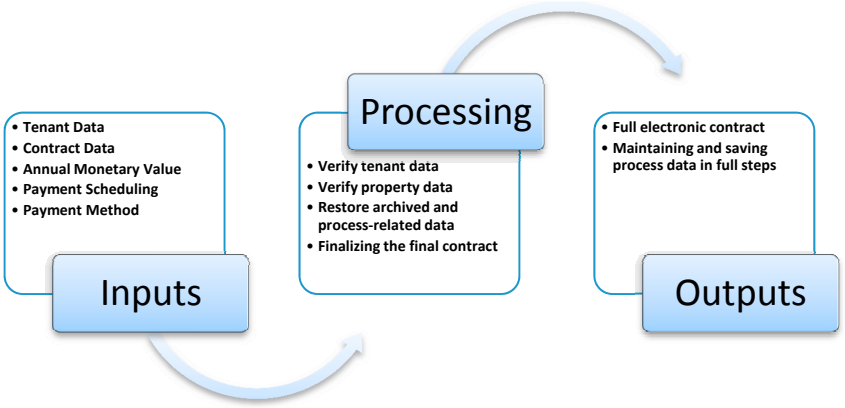

Fig. 6. Third stage

4.2. The problems of The Real Estate System Management Based on Centralization Smart Transactions [7]

a. Transparency: Managing the process through the real estate broker. The system does not operate without a real estate broker, as it relies entirely on the broker, meaning that it is the centre of the process rent, which is the input to the data, and it is documented and approved for the validity of the data, and there is no control over the real estate broker to ensure the correctness of the data entered, and the current mechanism's lack of transparency, the process is done through one broker;
b. The process of searching for available units and real estate and validity of data: The system does not allow the process of searching for available real estate units, and the tenant depends on data and information about the real estate unit obtained through the real estate broker or the lessor himself, may this information be incorrect, or incomplete;
c. Financial payment procedures: The problems of financial payments and the troubles that occur in addition to the lack of transparency and the failure of the two sides to see unified details that make this type of system full of bumps that hinder transactions.

4.3. The Proposed Blockchain Based Framework

For the same system, the proposed framework is relying on blockchain technology, which will be effective in eliminating important problems suffered by the previous system. The positives of relying on blockchain technology leads to strengthen the system and provide reliable service and enrich the level of data security in it. This type of technology leads to the cancellation of the role related to the real estate broker or any third party and achieves great transparency for the process in all its stages. Blockchain technology is a distributed network, which means that there are a certain number of devices that confirm and maintain transactions, and this feature ensures data validity and difficulty to modify, due to the multiplicity of copies in more than one device [8]. The following points will explain in details the positives and how it can affect the overall system services:

- Blockchain technology is a peer-to-peer network and the presence of a new party in the process, depends on the devices in the network. Among these devices are the competent authorities to confirm the correctness of the data entered and transactions that take place within the network of transactions and the conclusion of contracts and financial transfers;
- Blockchain technology requires confirmation of 51% of all devices within the network, this feature ensures the correctness and transparency of operations without a third party agreeing and documenting this process;

- Thus, blockchain works without an intermediary between the lessor and the lessee as it is transparent, it is not possible to amend or delete the data entered, and in case one of the devices exceeds the limits of its powers to amend the data that is identified and the device that did this, which facilitates the process of monitoring the operations that take place within the blockchain, therefore this technology is considered one of the most secure, reliable and information-security technologie;
- The process of checking and verifying and giving approvals goes through several filtering and auditing stages to maintain the privacy of the process, application and information.

Figure 7 shown below shows all the stages of verification and investigation that occur within the technology of blockchain before approving the transaction and adding it as a block to the rest of the blocks.

The proposed treatment of the first problem by relying on the advantages of blockchain technology begins with finding digital IDs of the lessor, the lessee, and the housing unit .The management of the digital ID data through control availability and encryption, so some data is provided from the digital identity of the residential unit such as: the age of the property, unit evaluation, rental price, and other data the tenant needs when searching for units, and encryption data that do not need to be presented to the public such as: the landlord's data, instrument data, tenant identity data, and others. The tenant searches for units and selects them, then sends a request to rent and negotiate. After approval of the request, he visits the site, then the identity of the unit, the property, the lessor, and the tenant are completely displayed to both parties. After that, a request to sign a lease contract is sent according to the agreement between them. The contract is sent to both parties for viewing and signing, and blockchain devices verify the signatures. After that the smart contract is created, add the block to the blockchain and start the payment process, so that the lease process can be completed without [9].

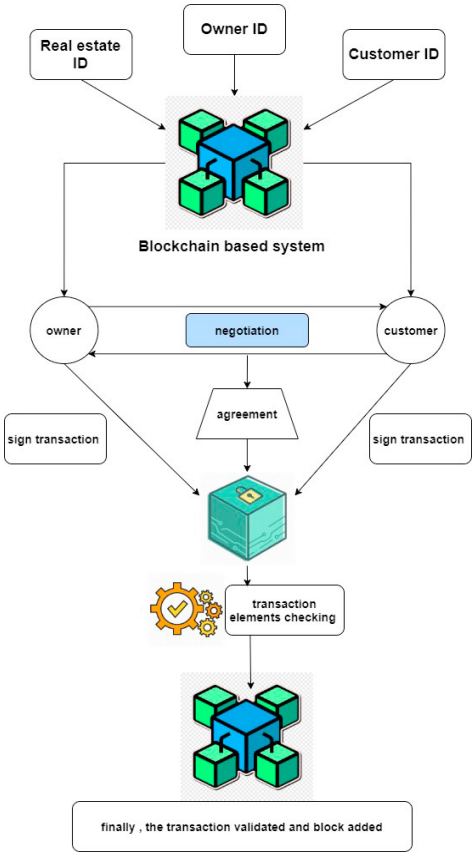

Fig. 7. The steps of proposed framework

The second mentioned problem in the centralization systems which related with the process of offering real estate unit and make it available for searching by the customers, also eliminated by depending on the positives of blockchain. Blockchain technology allows unit data to be added by the lessor in a way that allows management of that data and control in accessing it with a guarantee of trust and reliability [10]. The data that is initially displayed to the tenant before the contract can be controlled, while ensuring the reliability of the displayed data such as the age of the property, the address, etc. Fig. 8. shows all the stages of verification and investigation that occur within the technology of blockchain before approving to add a new unit and appear it for all.

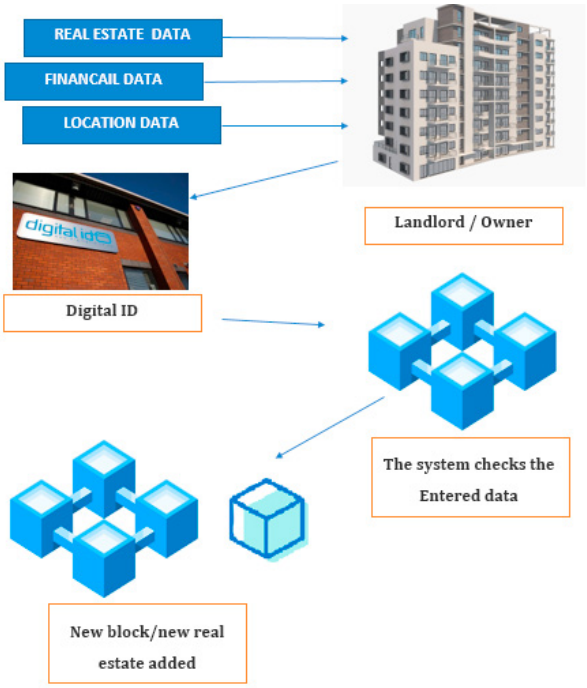

Fig. 8. Add new block steps

And since one of the properties of the blockchain that it is not allowed to modify the data, it shows the tenant the actual data about the unit [11]. The proposed treatment based on the positives of blockchain. This technological platform allows the landlord to enter all the required data related to the property [12-14]. The system checks all information entered and is approved after making sure of that. At this stage, the tenant can be allowed to view the information entered and search it for the appropriate real estate units. The system displays reliable and previously verified evidence as shown in Fig. 9. Based on blockchain technology, the process of collecting the rental amounts automatically creating a lease through blockchain that allows the automatic collection of monies according to the agreement mentioned in the smart contract (rental value, payments, and payment dates).

The amounts are automatically transferred from the tenant to the lessor. Not only are the rental amounts but insurance amounts can be managed, so that the insurance amount is collected from the tenant with a private key and keeping the amount as an insurance, and when the contract ends, in the case that there is no damage to the unit, the ban will be lifted and return it to the tenant. In the case of damage, it is deposited to the lessor, and in the case of renewing the contract the amount is kept, the process here is similar to the process of blocking the amounts in credit cards. The steps of money transfer process illustrated in Fig. 9.

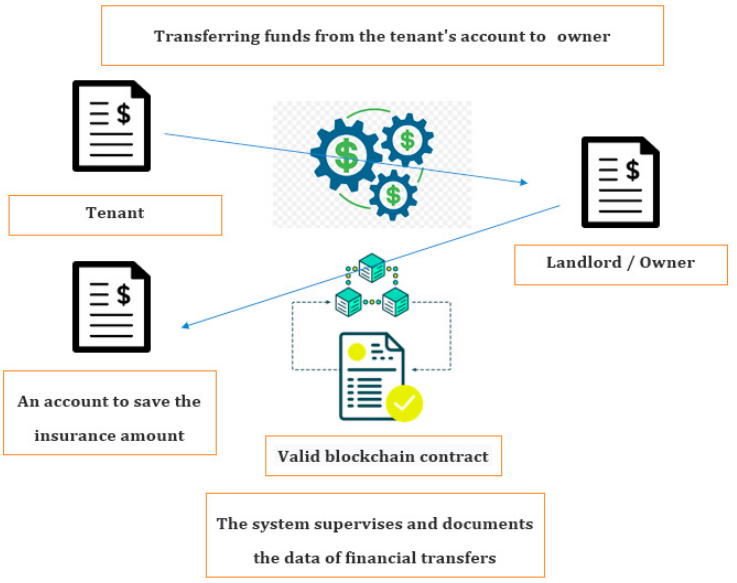

Fig. 9. Payments process

5. Conclusion

The example that was relied upon in this study is a realistic example that clearly shows the possibilities that the blockchain can provide for different applications in the smart city environment. Addressing previous problems through innovative solutions according to blockchain technology demonstrates their reliability and high safety level, and this is the main goal of the study. The reliability, information security, and privacy management of smart city services represent an important challenge through which the validity and realism of that service are judged and the positives of its results judged. So blockchain technology is ideal for increasing these important parameters

References

[1] Samih, H. (2019). Smart cities and internet of things. *Journal of Information Technology Case and Application Research*.
[2] Ammar, M., Russello, G. and Crispo, B. (2018). Internet of things: A survey on the security of IoT frameworks. *Journal of Information Security and Applications*, 38. pp.8727.
[3] Dai, F., Shi, Y., Meng, N., Wei, L. and Ye, Z. (2017). From Bitcoin to cybersecurity: A comparative study of blockchain application and security issues. In: *4th International Conference on Systems and Informatics. ICSAI*. Hangzhou, China: IEEE.
[4] Alketbi, A., Nasir, Q. and Abu Talib, M. (2018). Blockchain for government services - Use cases, security benefits and challenges. In: *15th Learning and Technology Conference. L&T*. Jeddah, Saudi Arabia: IEEE.
[5] Daniel, F. and Guida, L. (2019). A service-oriented perspective on blockchain smart contracts. *IEEE Internet Computing*, 23(1), pp.46-53.
[6] Mire, S. (2018). *37 Startups using blockchain to transform real estate [market map]. Retrieved from Disruptor Daily*. [online] Available at: https://www.disruptordaily.com/blockchain-market-map-real-estate/.
[7] Zyskind, G., Nathan, O. and Pentland, A. (2015). Decentralizing privacy: Using blockchain to protect personal data. In: *IEEE Security and Privacy Workshops*. San Jose, CA: IEEE.
[8] Mulár, O. (2018). *Blockchain technology in the enterprise environment*. [online] Available at: https://is.muni.cz/th/gdgl0/masters-thesis-final.pdf.
[9] Norta, A., Fernandez, C. and Hickmott, S. (2018). Commercial property tokenizing with smart contracts. In: *International Joint Conference on Neural Networks. IJCNN*. Rio de Janeiro, Brazil: IEEE.
[10] Wang, L. (2019). Cryptographic primitives in blockchains. *Journal of Network and Computer Applications*, 127, pp.43-58.
[11] Manzoor, A., Liyanage, T.M., Braekeni, A., Kanhere, S.S. and Ylianttila, M. (2019). Blockchain based Proxy Re-Encryption Scheme for Secure IoT Data Sharing. In: *IEEE International Conference on Blockchain and Cryptocurrency. ICBC*.
[12] Ines, S., Ubacht, J. and Janssen, M. (2017). Blockchain in government: Benefits and implications of distributed ledger technology for information sharing. *Government Information Quarterly*, 34(3), pp.355-364.
[13] Golosova, J. and Romanovs, A. (2018). The advantages and disadvantages of the blockchain technology. In: *6th Workshop on Advances in Information, Electronic and Electrical Engineering. AIEEE*. Vilnius, Lithuania: IEEE.
[14] Graglia, M. and Mellon, C. (2018). Blockchain and property in 2018: At the end of the beginning. In: *Annual World Bank Conference on Land and Poverty*.