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A RESEARCH VISION

Blockchain model to increase the transparency of public sector processes

Modelo Blockchain para incrementar la transparencia de los procesos del sector público

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ABSTRACT

In Colombia, the lack of transparency in the administration of public sector resources allows corruption to steal billions of pesos from the country, this causes Colombia to be among the countries with the highest rate of perception of corruption according to surveys carried out among its citizens by international organizations. This problem challenges the Colombian public sector to implement new strategies that provide transparency in public resource transactions, with new actors that the different parties can trust, which is why this project aims to offer a model based on blockchain computing technology as a tool to increase the transparency of public sector processes, omitting the use of third parties that can manipulate said processes. The chain of blocks (blockchain) will fulfill the role of a shared digital ledger of immutable transactions, maintained within a distributed, decentralized and cryptographically protected network, serving as an irreversible and incorruptible information repository for public sector transactions, thus providing, transparency in its processes and seeking to improve the rates of perception of corruption in Colombia.

RESUMEN

En Colombia la falta de transparencia en la administración de los recursos del sector público permite a la corrupción proferida por algunos funcionarios y contratistas acometer delitos como el peculado por apropiación causándoles pérdidas de billones de pesos al país, esto provoca que Colombia se ubique entre los países con mayor índice de percepción de corrupción según encuestas realizadas a sus ciudadanos por organizaciones internacionales. Esta problemática reta al sector público colombiano a implementar nuevas estrategias que brinden la transparencia en las transacciones de recursos públicos, mediante mecanismos en los que las diferentes partes puedan confiar. Esto proyecto pretende ofrecer un modelo basado en tecnología computacional blockchain como herramienta para

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incrementar la transparencia de los procesos del sector público, omitiendo recurrir a terceros que puedan manipular dichos procesos. La cadena de bloques cumplirá el rol de libro digital compartido de transacciones inmutables, mantenido dentro de una red distribuida, descentralizada y protegida (criptografía), un depósito de información irreversible e incorruptible de las transacciones del sector público, brindando así, transparencia en sus procesos y un mejor indicador de percepción de corrupción en Colombia.

1. Introduction

The lack of transparency in the management of public sector resources has been one of the problems causing corruption and this corruption is one of the main reasons for the dissatisfaction of citizens with their countries. Colombia is not free from this social dissatisfaction due to the high levels of corruption; Transparency International (2022) conducted the CPI (Corruption Perceptions Index) for the public sector of 180 countries in 2021, where Colombia appears with a score of 39 points out of 100 - being 0 very high corruption and 100 absence of corruption, as shown in Figure 1. Transparency International's analysis indicates that most of the countries evaluated do not show improvement, and some even worsen, keeping democracy in a state of permanent crisis, [11].

Figure 1. Perceptions of the level of corruption in the public sector in 180 countries and territories around the world by 2021, [11].

Likewise, the lack of transparency in the administration of public sector resources robs its inhabitants of 50 trillion Colombian pesos annually [4]. Portafolio magazine made a calculation of the usefulness of public sector money lost annually due to corruption due to the lack of transparency, where it shows that with only 28.2 billion pesos it would be possible to cover "twice the total amount of money allocated to the portfolios of transportation, agriculture, justice, social inclusion, trade, industry and tourism, environment and development, foreign affairs, science and technology, sports and recreation, planning, communications and culture" among other calculations that report the possible usefulness of this money, [8].

The map of Figure 1 shows through colors, the corruption score according to the points for the country/territory, shown in the table.

This problem prompts the Colombian public sector to implement new strategies that provide transparency in their transactions, introduce new actors that the different parties trust, ensuring their incorruptibility, thus, a blockchain model (blockchain, technology that demonstrates to exchange the need for trust with a cryptographic proof [6], offering integrity and reliability in its structure itself and not in a corruptible third party) as a technological tool for the public sector to deliver public services in quantity and quality, efficiently and transparently to its citizens [10].

Therefore, the following research question is proposed in this paper:

How will the use of a model based on blockchain computing technology serve as a tool to increase the transparency of public sector processes?

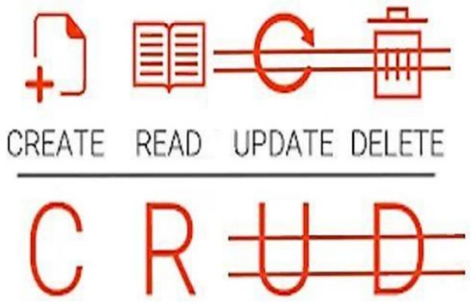
2. Background

Blockchain technology, according to [3], has amply demonstrated its reliability for handling transactions, since one does not really need trust in specific transaction managers per se, but trust in the structure of the Blockchain technology which provides 3 main features:

2.1 Immutability:

By moving away from traditional globalized databases where information can be easily modified and deleted (CRUD) for malicious acts by the participants administering it, see Figure 2. Instead, it uses a shared digital ledger comprising a list of blocks connected and stored in a distributed, decentralized and protected network by cryptography, where only new blocks can be created and queried, serving as an irreversible and incorruptible information repository, [5].

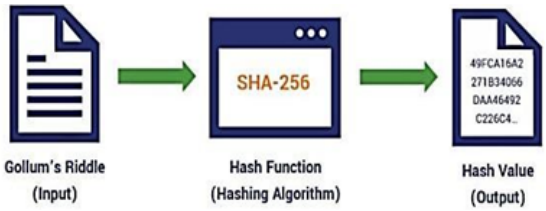
Figure 2. Removal of Update and Delete of CRUD operations.



Source: Own.

Each block receives a unique identifier generated from its content (transaction information and identifier of the previous block to which it is connected) thanks to the cryptographic hash function, note Figure 3, which is the cryptographic method par excellence used in Blockchain technology due to its immutability, i.e. "if applying the algorithm to the referred file returns a hash identifier different from the initial one, it means that the file has been modified" [7].

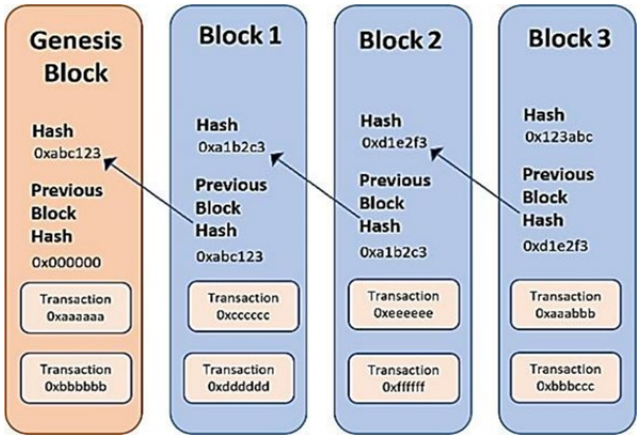
Figure 3. How the Hash works.



Source: Own.
Note: It is not possible to obtain the content from the hash identifier.

But using only the hash function alone would not allow this immutability, since with enough computational power someone could randomly create content until they get the hash identifier of the block they want and even validate the blockchain flow, Figure 4, again with fraudulent information, to mitigate this it is necessary to implement a Proof-of-Work, a mechanism that slows down the creation of new blocks.

Figure 4. Blockchain flow. Source: own elaboration

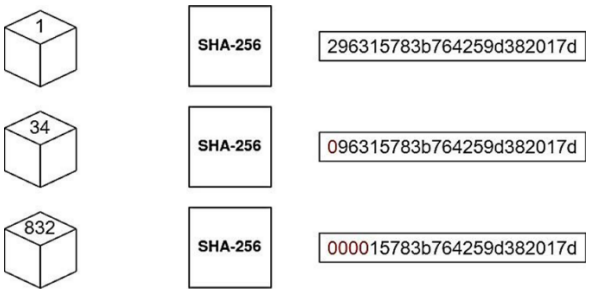


Source: Own.

Note: The first block is known as the Genesis block because it cannot point to a previous block.

The proof of work slows down the creation of blocks by asking to modify block content data until a defined number of zeros at the beginning of the generated hash identifier is achieved, see Figure 5.

Figure 5. Proof-of-Work.

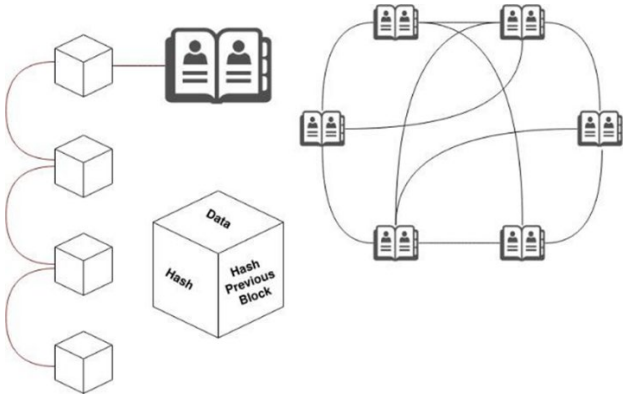


Source: Own.

Note: The numbers in the block on the left represent the value that is modified in the block content. The more zeros are defined to achieve the proof of work, the more computation the proof of work will need.

Joining these strategies in a distributed and decentralized peer-to-peer network, see Figure 6, provides with security the immutability of the data, since each participant that joins the network gets a complete copy of the digital book, when a new block is created everyone in the network receives this update and verifies that it has not been altered with fraudulent data before accepting it and then a consensus takes place, where the decision taken by half plus one of the participants of the network wins.

Figure 6. Distributed and decentralized Peer-to-Peer network of digital books (blockchain).



Source: Own.

Thus, for a network of considerable size it is computationally impossible to manipulate all the blocks in the chain and do the proof of work for each block of half plus one of the participants' digital ledgers.

2.2. Transparency

The information repository can contain any type of value. The network participants will have a copy of the transactions made by the other participants with this type of value, allowing everyone to know the unit of value that corresponds to each participant at all times. These transactions cannot be modified without altering all the subsequent blocks of the ledger, thus making every transaction credible and avoiding malicious activities, thanks to a consensus in the network, where half plus one of the participants must accept the transaction if they consider it consistent with the information repository [13].

In the event that the entire blockchain is modified to accept the transaction, when it is submitted to consensus, the other participants will identify the inconsistency with their copy of the ledger and it would be rejected, i.e., to carry out an alteration in the information repository, all the participants' ledgers would have to be modified, which, at present, is computationally impossible for a Blockchain network of a considerable size [14].

Allowing all this, blockchain will provide us with a history of all interactions and transactions that will be available to all participants thanks to its distribution in the network, which in other words will be a high level of transparency, traceability and trust on the processes in the public sector.

2.3. Automation

Having a distributed and decentralized network helps us not to depend on a third party that centralizes all the information, since it is the participants of the

same network who are in charge of decision making and maintenance, minimizing human intervention.

Finally, we talk about smart contracts or "blockchain code", they function as a trusted distributed application that derives its security and trust from the blockchain and the underlying consensus among peers. This is the business logic of a blockchain application [1]. These contracts will automatically execute when rules/conditions of a business are met, which avoids the intervention of third parties such as notaries, lawyers and so on.

In accordance with the above, the general objective of the research will be to offer a model based on blockchain computational technology as a tool to increase the transparency of public sector processes, without resorting to third parties that can manipulate these processes.

And specifically:

a. Conduct technical and specific scientific literature reviews on the use of blockchain in public process transparency systems.

b. Develop a model based on blockchain technology as a technological tool to increase the transparency of public sector processes.

c. Test the blockchain model with data from a public entity.

3. Materials and Methods

The general methodology will be based on the Scrum framework that will allow the research team to work through a series of interactions where the requirements gathering, the definition of roles for team members and their responsibilities within the project will be sought [2]. The methodology will follow a cascade model according to the order of the specific objectives of the project, where first the design of the blockchain model will be done according to the results of the scientific literature review, then the development of the blockchain model based on the design and finally the corresponding tests of this model with data from a public entity.

To carry out the technical and specific reviews of the scientific literature on the use of blockchain in the project approach, a data collection method will be used that involves a defined systematic process, where the sources and how they were accessed must be cited so that all team members have access to a repository with the information contributions made [12].

The documentary research will be carried out through the consultation of documents where its central theme will be the use of blockchain in transparency systems of public processes to obtain all the parameters and variables that enrich the model and its infrastructure.

To test the model we are looking to recruit a public sector entity interested in comparing the results of their currently used system with the results provided by our blockchain model.

The results of the model based on blockchain computational technology will be compared in parallel with the system used by the public sector entity thanks to the real data it provides for testing.

The results of the comparison with the recruited public sector entity will be socialized and the model can be adjusted if required.

4. Expected impacts from the use of the results

In the short term it is expected to compare the results of the model based on blockchain computational technology in parallel with the traditional system

currently used in a public sector entity in Manizales and include new variables to adjust the model as required, in the medium term it is expected to implement the model in a Colombian public sector entity and in the long term it is expected to perform mass production for possible commercialization at national and international level increasing the transparency of public sector processes.

In this sense, experiences related to Blockchain - or alternative techniques - are current and available for contrasting, [15-28].

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