Blockchain for baccalaureate examination sheets protection in Iraq

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ABSTRACT

Due to their unique qualities, including data integrity, security, decentralization, and dependability, blockchain technologies have drawn a lot of interest from both academia and business. In order to effectively handle the adoption problems of blockchain technologies, it is important to identify what influences their use and adoption. In order to protect the exam sheet (as image format) for the baccalaureate examination in Iraq. This paper article sought to construct a private blockchain powered by a variety of algorithms, After that, with this concern about privacy and fear of private information leaking, and in order to ensure that that image will only be seen by the specific person you want, the technology is full of many encryption features that achieve this end, we encrypt the image before sending it as a transaction in the Blockchain network. Also, we obtained speed smart contact verifications compared with traditional systems due to the proposed system is private and has simple complexity.

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1. INTRODUCTION

These days, the term "blockchain" is used in both business and academia. One of the really successful cryptocurrencies, Bitcoin, has made remarkable strides, with its financial system topping $10 billion during 2016 [1]. If a created specialized data storage infrastructure was utilized, transactions in the Blockchain may occur alone without relying on a third party. Blockchain, the primary technology utilised construct cryptocurrency, was originally proposed in 2008 and put across it in 2009 [2]. The majority of confirmed transactions are kept in a series of blocks, which is akin to a shared ledger. As more blocks are added to this chain, it keeps growing. Asymmetric cryptography and consensus mechanism techniques have been used for data security and ledger consistency. Distributed ledger technology is fundamentally based on decentralization, consistency, privacy, and integrity. With all of these features, blockchain may greatly enhance productivity while lowering expenses.

Because it enables payments to be made though without the participation of a lender or an intermediary, blockchain might be used in a number of banking and finance applications, involving cryptoassets, transmission, and payment services [3], [4]. Smart contracts [5], public services [6], the internet of things (IoT) [7], reputation systems [8], and security services [9] or many of the other areas where it could be used. Various areas benefit from blockchain in a variety of ways. To begin with, blockchain is unchangeable. Whenever a transaction is stored through into blockchain, it could be tampered with. Blockchain could be used to build a customer base for needing qualities required and transparency. Furthermore, because blockchain is decentralized, it can prevent a central point of failure.

Blockchain aids in the detection and confirmation of stepwise transactions that need to be traced and verified. Blockchains accelerate up details transmission processes simultaneously lowering the cost of legal representation. The greatest advantage of using blockchains may be the increased security provided to people when doing transactions. This technology increases individual and corporate partner trust, protects personal data, and enhances the accuracy of transaction monitoring. Given the immense potential of blockchain technology, their implementation along a wide range of industries is yet limited [10].

Its low acceptance rates are due to a lack of understanding of the elements that influence their use [11]. So ought to know the hypotheses in which these criteria are formed from in order to get a comprehensive understanding of the factors influencing blockchain adoption. In order to accurately use blockchain solutions across a variety of industries, scholars and practitioners will be able to design forthcoming laws and practices with the help of this understanding via the lenses of these hypotheses. Examining current blockchain evaluations, it was discovered that there is a lack of understanding of the key research methodologies utilized in Blockchain adoption, as well as the main industries employing blockchain technology. This systematic study intended to present a holistic view of implementation via the spectacles of based on the technology acceptance models and theories in order to better comprehend these difficulties.

The use of blockchain is truly revolutionizing the financial trading industry. It goes even further than that, becoming a thorough technology that can serve as the foundation for creating a full technical system like the one utilized today for the Internet. Peer-to-peer systems, on which the blockchain technology depends, imply that transactions between its users take place without the involvement of a third party. Since it is a decentralized system, nobody can oversee or regulate how business is done using it: neither a government agency nor a private firm could do so [12]. Practically, a blockchain provides a distributed, extremely secure database for transaction ledgers [13]. Blockchain is reliant on the idea of decentralized storage. Decentralized data storage refers to the utilization of several servers or databases operating simultaneously to process client request as rapidly as feasible, which describes how internet applications have evolved to operate at ever-increasing speeds [14].

There seem to be a lot of approaches that offer a way to use blockchain's advantageous features to improve evaluation in educational institutions. This essay was meant to fill up this research problem and pave the way for more in-depth investigation in the future. Due to the important issue of exam questions leaking just a day or a few hours before the exam, one of the main goals of this research is to safeguard the exam sheet for the baccalaureate examination in Iraq by contracting a private blockchain.

2. RELATED WORK

During 2008, Satoshi Nakamoto developed a distributed ledger known as the blockchain for cryptocurrencies. Bitcoin was introduced in October 2008 [15]. Smart contracts for assets and confidence deals were introduced in the second version. One of the most well-known blockchain-based software systems, Ethereum, started it. Blockchain technology' upcoming wave will concentrate on scalability, dealing with data processing delays, and solving bottlenecking issues. Public, proprietary, and permissioned blockchains are the 3 major types of blockchains.

Because the blockchain network is decentralized, self-governed, and authority-free, everybody can participate, exit, submit, read, and verify it. Public blockchain is illustrated by Bitcoin. Contrarily, the private Blockchain is a private network with an application that has been authenticated and is already accessible to chosen and authorized individuals. This indicates that the only person with the permission to modify, eliminate, or overrule blockchain entries is the owner of the blockchain.

Permissioned blockchain, the third kind, allows anybody to participate once their authentication has been validated. Also on network, each user is assigned particular permissions to carry out particular tasks. For example, in the distribution chain, providers could administer a permissioned blockchain for their clients and business partners with various levels of access. Conversely, suppliers and wholesalers have access to update information regarding the items and delivery, while customers can only read product documentation.

Blockchain has attracted a lot of interest from numerous businesses due to its inherent qualities in ensuring transaction transparency across various entities. The application of cryptocurrencies in finance is the main illustration [16], [17]. Other non-financial industries that have quickly adopted and used blockchain applications include the medical, transportation, origin-to-consumer, litigation, and regulation sectors [18], healthcare sector [19], [20]. Additionally, new uses for blockchain have been discovered in the chemical industry [21], big data [22], and Blockchain technology is seen as a key element of the fourth industrial revolution, which has made it possible to alter the global economy's structure and increase prospects for creativity, growth, and a higher standard of living.

The cryptography, peer-to-peer networking, distributed storage, and consensus procedure aspects of the decentralized blockchain technology, and smart contracts, have been studied in some evaluations [23]-[25]. The regulations and restrictions controlling this technique were a topic of attention in other studies [26]. A few of the assessments concentrated on the advantages and implementation challenges of the educational applications created utilizing blockchain solutions [27]. Inside another study, organizational theories were established and their use in implementing blockchain solutions in logistics services was examined [28].

3. BLOCKCHAIN

A blockchain is a distributed database that only a select few computer network nodes may access. A blockchain serves as a virtual database for the electronic storage of data. In cryptocurrency systems like Bitcoin, the top-tier blockchain is known for serving the primary purpose of maintaining a reliable and decentralized transaction file. The blockchain's novelty is in its ability to guarantee that the data file is immutable, safe, and generates revenue no need for a third party to be relied upon.

The way data are organized is one of the key distinctions between a conventional database and a blockchain. The blockchain gathers data in the form of blocks, also known as blocks, which store units of data. Blocks have demonstrated storage capabilities, and when a block's storage is complete, it is closed and joined to the block that was filled earlier to create the data chain known as a blockchain. Following that newly entered block, new data is gathered into a fresh-fashioned block so that, when it has been stacked, it can be supplied further into the chain.

The blockchain, as its appeal suggests, arranges its information into parts (blocks) that can be combined together, whereas the database typically organizes its information in tables. When implemented in a decentralized manner, this type of information automatically creates an irreversible information timeline. When a block is completed, it is finalized and added to the timetable. While being served up in the chain, each block is assigned an accurate timestamp. Cryptographic protocols, maths, algorithms, and consensus mechanism techniques are just a few of several techniques that make up blockchain technology [29]–[31]. A blockchain is made up of the following essential components [32].

- Free software: the majority of blockchain systems are public, enables users to alter the technology and programming anyway they see fit. This would not, therefore, imply anybody can alter an active blockchain system. Any alteration to a working solution implies that almost all associated nodes have publicly accepted the alteration.
- Consensus mechanism: all nodes are qualified to send and modify data securely, offering a consensus foundation to the network, because nodes are globally accessible on blockchains and modifications could only occur when a network participants adjust to change.
- Immutable: Any files are saved forever and cannot be updated except if over than 51% of nodes are taken over together.
- Unknown: data is scrambled before transmission just use a secure technique to ensure the transactions are untraceable. Transparency: the block's contents is dispersed across network participants and is visible to each node, resulting in transparency between them.
- Decentralized: blockchain no longer needs to depend centralized node, such as a main server; instead, every node may store, record, and modify the ledger; these nodes work together to build the blockchain Figure 1.

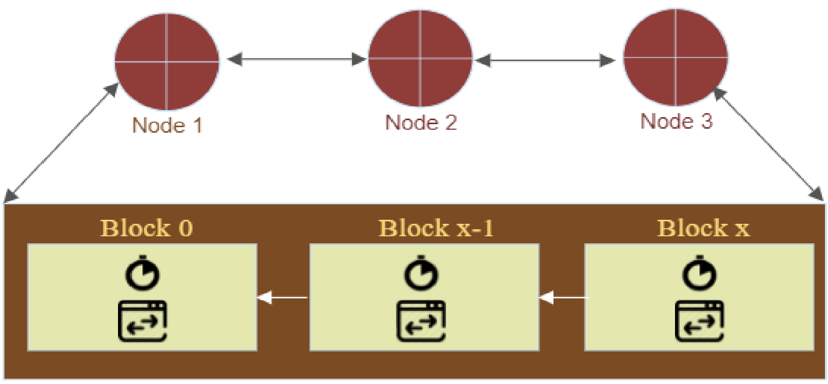

Figure 1. Architecture of the blockchain [14]

4. METHOD
4.1. Blockchain procedure
Due to the advantages of private blockchain, which would be addressed in more detail in the following section, the proposed framework depicted in Figure 2 is suggested to be built on this technology. The suggested framework's process consists of the following:
- To confirm that they are exam center managers, user can login at the network front-end of the blockchain.
- We enable clients to use methods that produce and distribute public and private key pairs once we have confirmed that they are, in fact, exam center managers. This enables them to communicate with the blockchain. Using a special code that was assigned to them during proper validation, the key is created.

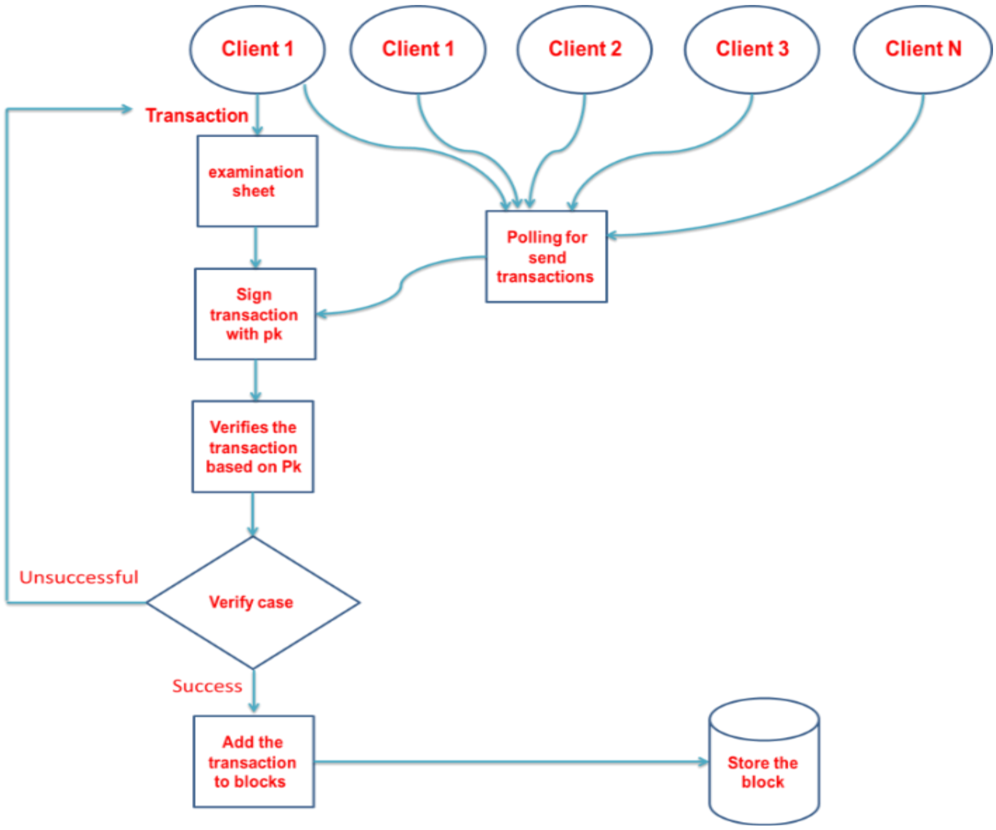

Figure 2. Proposed system

4.2. Exam questions procedure
4.2.1. Algorithm AES
The advanced encryption standard (AES) technique uses three alternative cipher key sizes with lengths of 128, 192, or 256 bits to process images with blocks of 128 bits. The algorithm goes through 10, 12, or 14 implementation rounds, depending on the key size length that was utilized. Block size in the present scheme is 128 bits, and key size is 256 bits. The approach is used for simultaneously decrypting and encrypting images. It will require 14 cycles because the key size is 256 bits.

a) Image encryption with AES

Since the image is encrypted using AES and the key is only known to the sender and receiver, only the recipient can view it. The image is more secure than data encryption standard (DES) and triple DES because it is encrypted using AES. Image encryption is the process of converting a plain, actual image into a cipher, encrypted form. Figure 3 depicts the round for picture encryption, which comprises of the subsequent step:
- Sub bytes transformation
- Shift row transformation
- Mix columns transformation
- Add round key

b) Sub bytes transformation

Every byte is replaced with some other byte in just this phase. The S-box, another name for the lookup table used, is employed. This replacement is carried out in such a way that a byte is never replaced both by itself and by that other byte that complements the present byte.

c) Shift row transformation

This step is exactly what it says it is. The number of shifts for each row varies.

- There is no shift in the first row.
- One shift to the left moves the second row.
- Two times to the left, the third row is moved.
- Three times to the left, the fourth row is moved.

d) Mix columns transformation

Mix Columns, the forward mix column transformation, works on each column separately. A column's four bytes are combined to create a new value that maps each byte into. The matrix multiplication on State that follows can be used to define the transformation. That process essentially involves multiplying matrices. Every column is multiplied by such a particular matrix, which changes the order of every byte in the column.

e) Add round keys

A round key is added to the data through the use of an XOR operation in the Cipher and Inverse Cipher transformation. A round key's length is equivalent to the size of the block; for example, if Nb is 4, a Round Key's length is 128 bits (16 bytes). The initial stage application is now XOR with the relevant round key to produce the result. AES is used to encrypt the exam sheet, and only the sender and recipient have access to the key as shown in Figure (3).

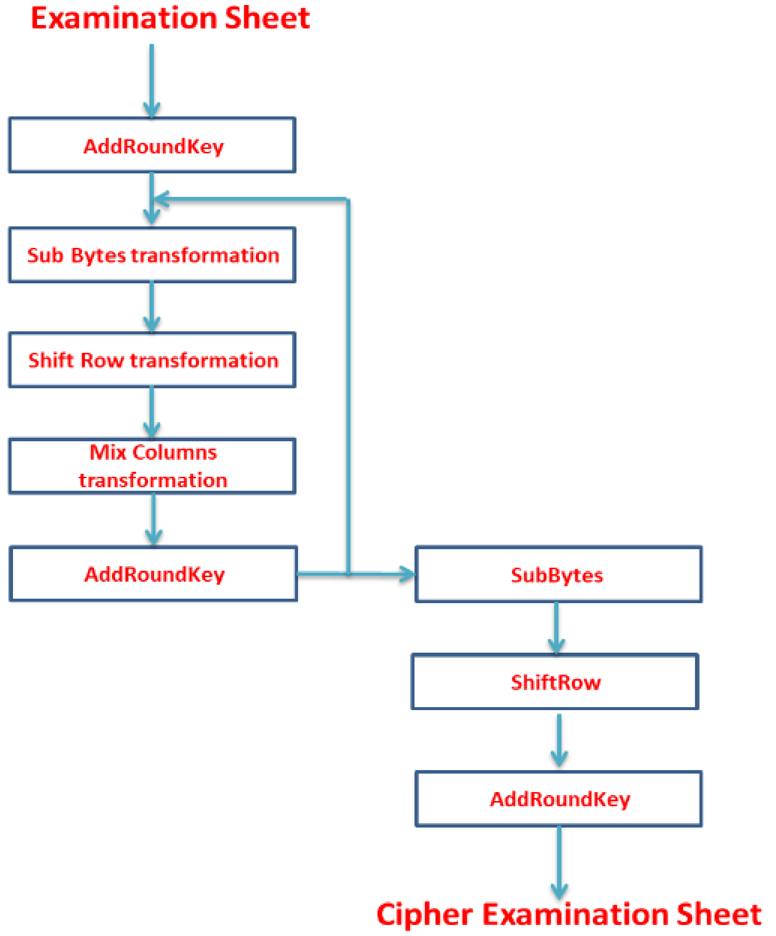

Figure 3. Encryption of AES images

4.2.2. Image decryption with AES

Since methods to provide secrecy must be specifically created to maintain multimedia and meet the security criteria for a multimedia system, a variety of encryption strategies for visual data types have been provided algorithms for encryption like "rivest-shamir-adleman (RSA), AES, etc.".The steps in the rounds are fully reversible because they each have an inverse that, while used, undoes the modifications. Depending on the key size, each of the 128 blocks is processed via 10, 12, or 14 rounds. Following are the steps of every round of decryption:

- Add round key.
- Inverse MixColumns.
- ShiftRows.
- Inverse SubByte.

a) Inverse mix columns

The inverse transformation (necessary for decrypt) can be programmed to execute on the 16 bytes of the state simultaneously for the mix column as well. At some point, each value in a column is multiplied by each Galois matrix value. A ciphered column is created by XORing the results of a column multiplication. The only difference between this stage and the encryption's mix columns stage is the matrix that is utilized to perform the process.

b) Inverse subbytes

Also called inverse substitute byte transformation. The bytes are changed while decryption via employing the inverse S-box like a lookup table. The opposite of SubBytes transformation is called Inverse SubBytes transformation. Start with the inverse round key to decode data. The method then does each subsequent operation (shift rows, byte substitution, and later column mixing) backwards until it is able to interpret the previous exam sheet as shown in Figure 4.

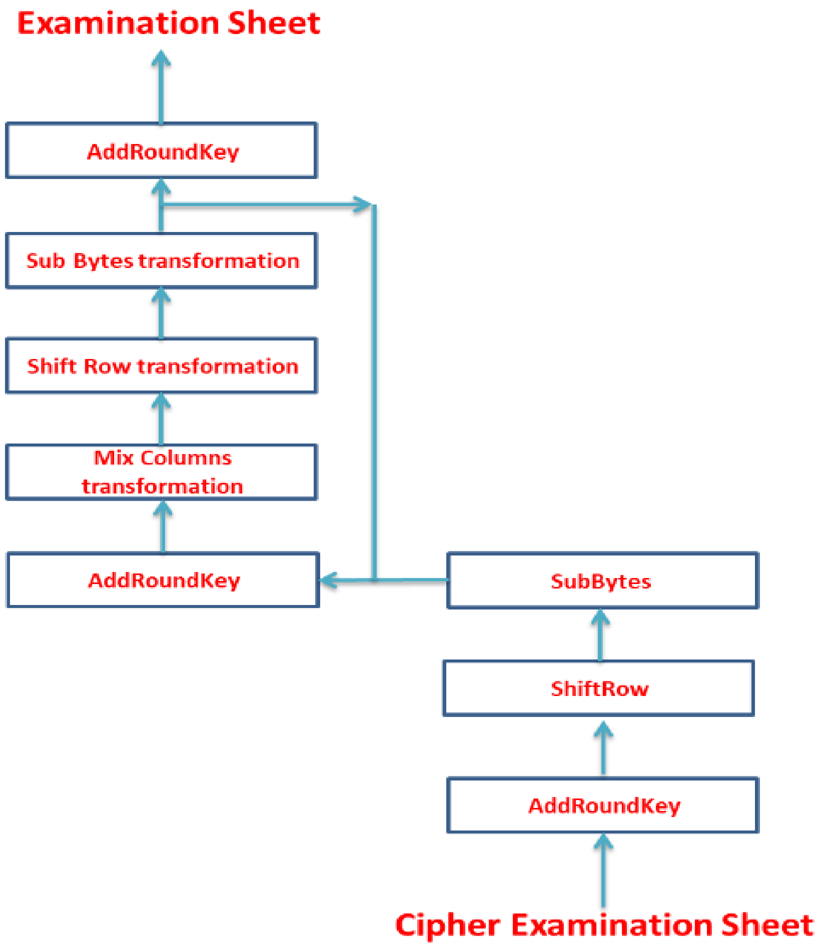

Figure 4. Decryption of AES images

5. Evaluation metrics and results
5.1. Active address
This statistic is determined by combining and recording a large number of unparallel active nodes over a set time period, such as per day, so as to appear to be active nodes. In a trustless distributed ledger, growing a number gives the impression that more nodes have entered the working area and that a blockchain program is unremarkable. The importance of the active node is mostly perceived by all participating nodes as achievable.

5.2. Transaction throughput
The transaction throughput, which is stated as a number of transactions per second, is typically used to gauge how quickly a database system operates. In a transactional system, the underlying database files and the log file are typically the two gating considerations for Berkeley DB performance. Both are factors as a result of the need for disk input/output, which is sluggish in comparison to other system resources like Central Processing Unit (CPU). The time it takes for standing records to be added to the stored blocks is measured using this metric. The complete number of records that have been validated and committed is divided by the total time (in seconds) required to verify and preserve those records.

5.3. Latency
The length of time it takes for a blockchain network to validate that a transaction has been accepted is known as network latency. The transaction gets more definitive after the first confirmation as additional blocks are added after the original confirmation. The response time for each activity is referred to as latency. Using blocking transactions, the driver waits for one transaction to complete before beginning second.

5.4. Smart contract
A smart contract is an auto contract since the terms of the agreement between the clients are directly encoded into lines of code. The fundamental code and agreements are dispersed across a decentralized blockchain network. By making the metadata file and source files available via the application programming interface (API) or User Interface (UI), a contract may be verified. In the Table 1, an ideal time was obtained for the verification of the smart contract, which depended on the complexity of the system, and here we mean by complexity the number of nodes, the type of algorithms. We used three lengths of keys with different types and similar results were obtained despite the different keys as in the Table 2.

Table 1. Smart contract (SM) time verification

Complexity	Proposed system SM (ms)	Traditional SM (ms)
20%	7	15
50%	60	150
70%	90	210
100%	120	300

Table 2. Result of AES encryption

Image Type	Mode	Key size	Output Format	Secret Key	AES Encrypted Output
JPG	ECB	128	Base64	1234567891234567	1331072 character
JPG	ECB	192	Base64	123456789123456789123456	1331072 character
JPG	ECB	256	Base64	12345678912345678912345678912345	1331072 character

6. CONCLUSION
In this paper, a private blockchain network was designed and used for the purpose of sharing exam questions for baccalaureate students. The AES algorithm is suggested as image encryption and decryption that could also execute with a data block of 128 bits as well as cipher key length of 256 bits on examination sheets. 256-bit cipher keys are used to obtain higher protection since they are challenging to crack. This makes it feasible to transmit examination sheet images securely.

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