Secure Blockchain for Admission Processing in Educational Institutions

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Abstract— **Blockchain technology with its secure mechanism of maintaining data and transactions in shared, immutable, distributed ledgers has become very relevant today and is increasingly used for financial applications. This paper proposes the use of consortium blockchain and smart contracts for secure, transparent and automated processing of student applications received by educational institutions. The students applying for admissions in educational institutions need assurance of a safe, secure and transparent platform that does not compromise their privacy. On the other hand, educational institutions too need assurance about the authenticity of the documents and the applicant. The use of consortium blockchain and smart contracts incorporating business logic for validating, verifying and filtering of valid applications provides a safe and secure platform for processing student applications. This paper looks at blockchain application beyond finance and explains how the student registration and admission process can be made safe and secure for all stakeholders. It promotes a seamless mechanism with reduced turnaround time and increased security and transparency.**

Keywords— blockchain; smart contract; admission processing; education

I. INTRODUCTION

Blockchain Technology whose emergence is generally associated with bitcoins is now employed for secure, immutable applications in the sectors like finance, healthcare, governance and business operations. This technology has attracted attention as the basis of cryptocurrencies such as Bitcoin, but its capabilities extend far beyond that, enabling existing technology applications to be vastly improved and new applications that was not considered practical earlier to be now deployed [1].

This paper proposes a secure, smart contract-based autonomous system of student admission processing that leverages the inherent security of blockchain technology to provide a secure and transparent system of processing student applications.

Blockchain has been already applied in a few fields in the education sector such as:

a) A record keeping system for certificates and degrees.
b) A system to enhance transactions and payments with security between two parties.
c) A system promoting collaboration between universities.

We propose a blockchain based system for registering, validating and selecting the student applications for various university courses. Student applicants belong to different countries which may have different educations systems. Besides, different countries may have their own rules pertaining to student visa and the required procedure and documents. Students applying for admissions are required to submit/upload various forms and documents. While students need assurance of a safe and secure platform that does not compromise the privacy of their data, the educational institutions too need assurance about the authenticity of the documents and applicant. This paper examines the possibility of using blockchain for a secure, automated smart contract which streamlines the admission process and assures both student and university of an unbiased, secure and authenticated process.

The paper is structured as follows. Literature review and the background of blockchain technologies is discussed in section II. Section III discusses the proposed methodology. Section IV and V discuss the advantage and limitations of the proposed system of admission using blockchain respectively. Section VI examines the future scope of blockchain in the education sector and section VII concludes the paper.

II. BACKGROUND OF BLOCKCHAIN

Blockchain is the core technology used by cryptocurrency, bitcoin, through the maintenance of immutable distributed ledgers in thousands of nodes. This was the definition given by Satoshi Nakamoto [2]. As the name suggests, blockchain is a single list of chained blocks in which each block contains various transactions or some kind of data/information [3]. A blockchain network is known for its safety and security of data. Each block in the blockchain network mainly contains its own hash value, the data/information and hash value of the previous block. Any change made to the data inside a block, results in change of its hash value. This feature makes tampering of data virtually impossible. Broadly speaking, blockchain technology also refers to distributed accounting techniques based on blockchain structure, including distributed consensus, privacy and security protection, peer-to-peer (P2P) communication, network protocols and smart contracts [4]. It has been known to have the ability to transform the current

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Internet from "The Internet of Information Sharing" to "The Internet of Value Exchange" [5]. Over the past years, Blockchain Technology has garnered much attention in the fields like finance, healthcare, governance and business operations. The reason blockchain technology has piqued the interest of researchers, industry and programmers around the world is the distinct security features it offers. Blockchain technology maintains its data in the form of distributed, decentralized ledgers. This key attribute of the technology promotes trust and reliability. It guarantees no third-party interference and provides a great amount of transparency to all the parties involved. Essentially, it is a peer-to-peer network which provides traceability and security as all nodes are connected to the adjacent nodes by a cryptographic hash function.

There are two general high-level categories for blockchain approaches that have been identified: permissionless, and permissioned. In a permissionless blockchain network, no authorization is required; anyone can read and write to the blockchain. Permissioned blockchain networks limit participation to specific people or organizations and allow finer-grained controls. Based on their requirements and applications, an organization can decide which subset of blockchain technologies they need to apply [6].

Blockchains could be of different types like public, private, consortium and hybrid. Public blockchains are not owned by anyone. They are open to the public, and anyone can participate as a node in the decision-making process. Private blockchains are just that – private; i.e. they are open only to a consortium or group of individuals or organizations who have decided to share the ledger among themselves [7]. M. SWAN in his work "Blueprint for a new economy", says that the growth of blockchain technologies could be divided into three generations – 1) Blockchain 1.0 2) Blockchain 2.0 3) Blockchain 3.0. Blockchain 1.0 relates to development of cryptocurrencies. Blockchain 2.0 widens its scope to include applications based on loans, smart contacts, property and bonds. Blockchain 3.0 explores the possibility of leveraging blockchain technologies for applications other than finance, such as healthcare, governance and education [8]**.**

III. METHODOLOGY

The consortium blockchain network can be considered as a hybrid between the highly transparent and decentralized public blockchain, and the centralized private blockchain. It provides decentralization of ledgers while also preventing the public access or update/modifications to the ledger. The main difference between a consortium and private blockchain network is the method of consensus. In a private network, consensus is managed by a centralized body while in a consortium network consensus is managed by a set of nodes [9]. This paper proposes the use of consortium blockchain, smart contracts, and verifiable credentials to streamline the process of student admission to educational institutions.

A. PROBLEM STATEMENT

Universities around the world go through the elaborate and time-consuming task of sorting the applications, validating them against the criteria norms, verifying their credentials for authenticity and ensuring that these applications are not tampered with. The entire process is not only tedious and time-consuming but is also prone to errors. Along with this there is concern among the applicants about the maintenance of their privacy and the safety of their documents. This necessitates the use of a secure, transparent and tamper-proof platform for information exchange and validation.

B. PROPOSED SOLUTION

In this paper, we address the issue of a secure, transparent, tamper-proof and automated admission processing by proposing a consortium blockchain based autonomous system. We propose to exploit the autonomous feature of smart contract to automate the process of application validation. The business logic in smart contract validates each stage of application processing such that each stage in the process is automatically triggered on the occurrence/completion of a task/stage. This system makes the admission process efficient and secure by addressing the following key problems:

i) How can we streamline the entire process making the process more meticulous and efficient?
ii) How can we authenticate documents received?
iii) How can we filter out applications based on specific criteria?
iv) How can the stakeholders i.e. the applicants and the institution be assured about the security of the data?

Student Application processing typically involves the following steps:

- Applicants apply online for admissions to educational institutions. They do so by registering/filling in the requisite online application form. They are required to provide personal details, academic/educational data, recommendations, digital credentials [1] issued by the qualifying universities, financial statements and proof of payment of application fees.

- The consortium blockchain gets notification of this application or transaction. The smart contract which works on the *'if-this-then-that'* logic filters and selects the valid applications. Since smart contracts are *deterministic* in nature, they can be run on any node and

[1] Many institutions around the globe are issuing digital credentials (verifiable credentials) to the students. Digital credentials are digital certificates issued by institutions and typically include degrees, diplomas, skills and other certifications. Digital credentials ensure that a certificate cannot be tampered or forged and can be instantly verified without any additional procedure. These credentials are virtually impossible to duplicate and can be beneficial to our needs.

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they yield *the same output for the same input*. The filtering of applications takes place on the basis of the criteria defined, for example the number (correct number) of documents submitted, the nationality of the applicant, financial standing and minimum score/grade. Smart contracts have the feature of being automatically executable and enforceable. The completion of one task/step automatically triggers the next step, thereby resulting in the execution and fulfilment of the smart contract.

- The application is filtered/selected according to the criteria specified in the smart contract. The verified and filtered application, upon receiving a consensus[2] from the nodes in the network, is added to the blockchain. Once added on the blockchain, the institution can access the applications and take appropriate decisions. The student too receives an update of the status of his application. The steps involved in the blockchain-based student application processing system are depicted in Fig. 1.

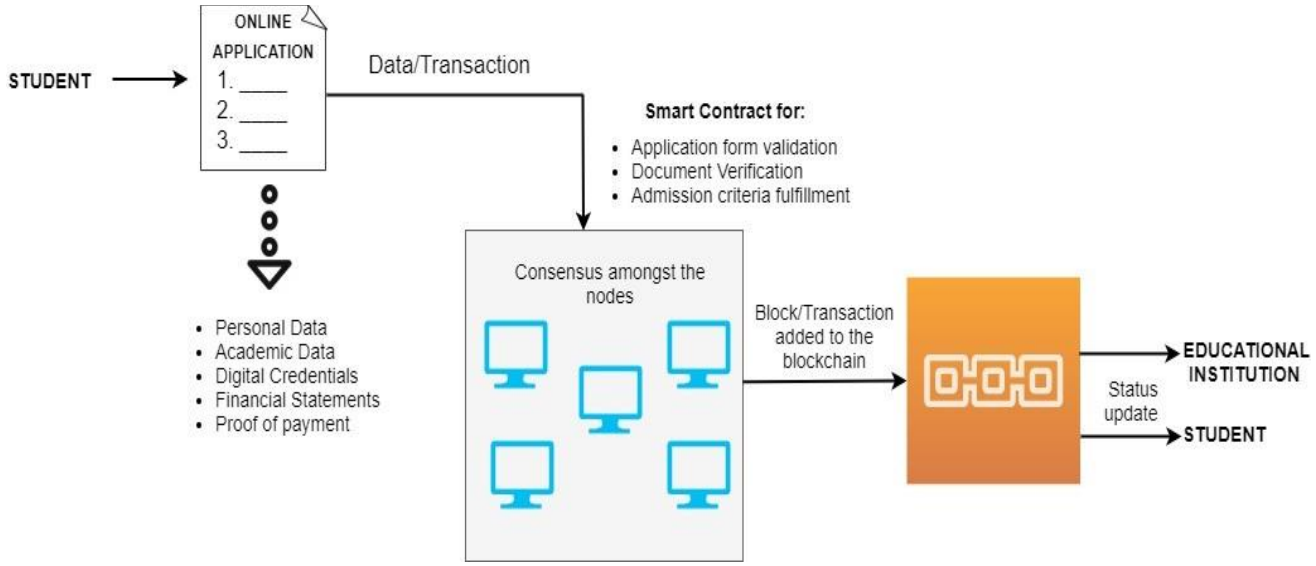


Figure 1. Blockchain-based Student Application Processing

Smart contract incorporating business logic for admission criteria automates student application filtration and streamlines the admission process. This benefits both: the educational institution and the student; the institution is assured of a seamless autonomous processing of authentic, un-tampered data and the student is sure of fair processing with assured privacy. This education processing task becomes process-oriented without third party involvement and interference. This optimized processing reduces human effort and turnaround time.

IV. ADVANTAGES OF THE BLOCKCHAIN-BASED ADMISSION PROCESSING SYSTEM

a) Security is one of the main features on a blockchain network which ensures data protection and integrity. Each block in a blockchain network is connected to the previous block via a hash-function. If data on a block is tampered with, the hash value of block would change and hence the hash values of the interconnected nodes would also have to be changed to be clear of suspicion. This feature of blockchain makes information interchange between the student and institution secure, transparent and tamper-proof.

b) Blockchain network increases the transparency and hence students remain updated about the status of the application.

c) Third party involvement is eliminated; this in turn reduces the turnaround time.

d) Replication of data on the nodes and the maintenance of a decentralized, distributed, ledger results in secure storage of data with no fear of data loss.

e) The autonomous, smart contract-based processing results in a robust, process-oriented and secure system of admission processing.

[2] Consensus is a process of agreement between distrusting nodes on the final state of data. To achieve consensus, different algorithms are used. It is easy to reach an agreement between two nodes (in client-server systems, for example), but when multiple nodes are participating in a distributed system and they need to agree on a single value, it becomes quite a challenge to achieve consensus. This process of attaining agreement common state or value among multiple nodes despite the failure of some nodes is known as distributed consensus.

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V. LIMITATIONS OF THE BLOCKCHAIN-BASED ADMISSION PROCESSING SYSTEM

a) The feature of immutability in blockchain can be detrimental in student admission processing system. Rectification or update of student data is difficult to achieve because of the inherent immutability of block chain technology.

b) Blockchain technology and skills in writing smart contracts is still in its infancy. Bugs in writing of business logic can have cascading effects which are difficult to trace and detect.

c) The costs involved in implementing a blockchain solution can be a deterrent. These costs include the following: (1) the cost of power required for running the high-end computing infrastructure that is necessary, (2) the cost to re-architect the underlying legacy technical infrastructure to meet the pre-requisites for deploying blockchain, (3) the cost of managing the large amount of data that gets generated and (4) the cost of network latency and the need for multiple stakeholder consensus can slow down a transaction leading to opportunity costs.

VI. FUTURE SCOPE OF BLOCKCHAIN IN EDUCATION

The scope of this paper is limited to blockchain based application for admission processing. In this section, we examine the possibility of extending the scope and leveraging the blockchain technology for a complete, secure and transparent education solution.

1. Blockchain in the field of education, till date, has only focussed on record keeping and transactions. The actual revolution would happen only by changing the entire business model and using smart contracts for information exchange between learners and educators.
2. The quote "LEARNING IS EARNING" could be applied practically, by incentivizing the students by rewarding them with digital assets. This process promotes learning and opportunities in various areas of education [10].
3. An application which focuses on promoting students to publish their research work with the sense of security and transparency.
4. An application which enables students to buy/rent books based on cryptocurrency.
5. A student academic record-keeping system that enables storage of student data, his academic performance and his credentials during the term of study.

VII. CONCLUSION

Consortium blockchain for student application processing provides a secure, transparent, autonomous and process-based platform for admissions to educational institutions. The proposed blockchain-based student application processing system takes advantage of the inherent security features of consortium blockchain, and proposes the use of smart contract for automating the different steps involved in the validation and verification of applications. This paper also examines the potential benefits and limitations of such a system.

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