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Research Report

Advancing the security of record management of record management in education using blockchain technology

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ADVANCING THE SECURITY OF RECORD MANAGEMENT IN EDUCATION USING BLOCKCHAIN TECHNOLOGY

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Abstract:
Blockchain technology has gained considerable attention due to its unique features including decentralization, security, reliability, and data integrity. Despite this, much is yet to be known about the current state of knowledge and practice regarding using blockchain technology in education. This paper highlight the use cases of blockchain technology in Record management, discuss the major components of Block-chain-based Educational Record management, and then propose a system architecture for advancing the security of result/record database in education using a consortium system to create certificate records on the network. Comparison to related work has shown that block-chain-based record management offers better possibilities for advancing the security of student database record management and transferring information, certificate, or credentials at lesser cost and time.

Keywords: *blockchain; blockchain applications; consortium, educational technology; decentralized . Block-certs*

1.0 Introduction

Blockchain is a digital-ledger-based technology developed to change the perspective of the digital transactions, or specifically, to replace them. Blockchain is defined as a distinct, decentralized distributed ledger that includes all transactions records related to participating members. Blockchain transactions are created and stored in chronological order allowing digital assets (such as digital currency and digital data) to be tracked by participants without central record-keeping [1]. One of the key features in blockchain is that participating nodes in the network will hold a copy of the full blockchain. All transactions on the blockchain must be approved because transactions are only valid under the consensus agreement of the participating members. In addition, all transactions must be trackable making fraudulent transactions impossible to bypass [2]. When a user (user A) wants to make a transaction to another user (user B) using blockchain, a new block is created to include the transaction. Each transaction is broadcasted across network nodes to verify it. If the new transaction is verified, the new block is added to the blockchain and distributed across network nodes so that other nodes will update their blockchain. Finally, the transaction is received by another user (user B).
The full process is depicted in Figure 1.

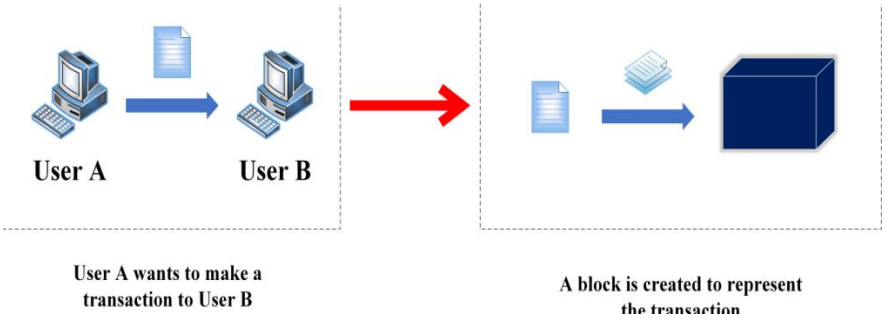

Figure 1. Blockchain process.

Presently, blockchain technology has been applied in various fields such as cryptocurrencies in the financial area, which includes Bitcoin, Ethereum, and Zcash (Zerocash), etc. Bitcoin is the first peer-to-peer payment network of electronic cash based on the blockchain technology. One of the crucial features of blockchain technology is how many nodes in a distributed blockchain network maintain consensus and the Bitcoin blockchain network adopts a hash-based Proof-of-Work (PoW) distributed consensus algorithm [4]. Ethereum is an open-source, public, blockchain-based distributed computing platform featuring smart contract functionality using proof-of-stake consensus algorithm [13]. Zcash is a decentralized and open-source cryptocurrency like Bitcoin. The development of blockchain applications could be divided into three stages; Blockchain 1.0, 2.0 and 3.0. Blockchain 1.0 simply implies the disposition of cryptocurrencies as a peer-to-peer cash payment system. On the other hand, Blockchain 2.0 connotes the widespread applications of blockchain other than simple cash transactions, including stocks, bonds, loans, smart property and smart contacts. Whereas, Blockchain 3.0 entails the development of blockchain applications further than currency, finance, and markets, such as in the areas of government, health, science, literacy, culture and art [5].

The great value of this new technology lies in its decentralized architecture, which promotes the redistribution of power from central actors to the peers of a community. Through blockchain, data produced through the web is not processed and stored into a central server.[8] Several studies focused on how blockchain technology can be applied in education. Using blockchain assures the security and privacy of data/transactions exchanged between the intended parties. The nature of peer-to-peer topology in the blockchain helps reduce the security risks in education field. [3]. The remainder of this highlight the use cases of blockchain technology in record management and present a proposed system architecture for record management.

2. Related Work

In recent years, blockchain technology has been widely used as the basic construct for cryptocoins such as Bitcoin [9]. MIT has a system for building Blockchain-based applications that issues and verifies official records called "Blockcerts Wallet". It allows, for instance, the creation of a certificate wallet for students to receive virtual diplomas via their smart devices. MIT Blockcerts Wallet system is a building application platform that has a similar target in terms of allowing educational records creation and dissemination using Blockchain. New promisingly Blockchain-based solutions include 'intelligent contracts'[10]. Blockchain based certificates have already been issued in the following instances:

- The MIT Media Lab in its course “Lab’s 30th Anniversary” of 2015.
- Learning Machine, which has provided certificates in Human Resources to its staff.
- The field of Global Entrepreneurship work (Global Entrepreneurship Bootcamp) held in Seoul in March of 2016

3.0 Use cases of Blockchain technology in Record Management

Beyond its conventional use, blockchain is being implemented across various industries and fields. Among these fields is education, where blockchain is beginning to be used in the most surprising and innovative ways most especially in securing record and database of institutions.

1. Transcripts, Diplomas, Certifications

It is estimated that in the United States alone, 200,000 fake diplomas are sold each year by fake diploma mills. Some degrees can be purchased for as little as $100 dollars, and the price can go up to $50,000, depending on what university diploma and transcript is being faked. Surprisingly, the United States has not taken drastic measures to combat this issue, which leaves it prevalent in the current educational landscape. To this day, verification of diplomas, transcripts, and other important documents is pretty much a manual process. To combat this issue, there are companies who propose to store these credentials on the blockchain. Learning Machine, a 10-year-old software startup, has collaborated with the MIT (Malta's Institute of Tourism) Media Lab to launch Blockcerts – an open infrastructure for creating, issuing, viewing and verifying blockchain-based certificates. Also, the University of Nicosia has issued blockchain-based academic certificates for their DFIN-511: Introduction to Digital Currencies course. The authenticity of the document can be verified on the Bitcoin blockchain.

2. Trust:

Blockchain network makes the trust decentralized too. Unlike the centralized trust we take for granted, such as central governments issuing currencies and commercial banks, blockchain network acts as new trust bearers with decentralized ledgers. These ledgers are shared among a network of tamper-proofed nodes.

3. Security and File Storage

Without a doubt, it is important for schools to protect their networks and student information. As education institutions store more and more data, Distributed Ledger Technology (DLT) cloud storage could offer a safer alternative to conventional options that are currently being used. Referring to themselves as the "Airbnb for file storage," Filecoin allows the hosting of files with flexible options. This could potentially be a great option for educational institutions to store student information in a safer way- without the risk of information being tampered or lost.

4. Standardization

Standardization is required among industry organizations to determine what success looks like. This is for the benefit of students, educators and administrators and set expectations for how data should be secured and accessed. There's a real need for a unified approach to tracking and managing student certificates from educational institutions, professional societies, trade associations, state examination boards and corporations. A single database that's easily and digitally accessed from anywhere in the world creates a standard for verified credentials, providing a universal method for storing, retrieving and sharing data. Blockchain technology leverages cryptography for the security and verification of data. Cryptography allows instant verification of a student's education records, matching a public and private key for public access and private ownership authentication. This method of encryption is called Public Key Infrastructure (PKI), and protects user data from theft and tampering. But record security doesn't need to be confined to education records like university degrees; any type of personal data or records can be stored on a digital ledger.

5. Identity Management

Here lies another use case for blockchain in education: a student's identity data can be stored on a secure, public blockchain and instantly provided to their educational institution. The use of public/private key cryptography methods ensure that a user's identity information remains confidential on the blockchain and can only be decrypted when a user provides an institution with their private key. Some public blockchains are interoperable, meaning they can 'talk' to each other and securely share a user's data at the user's request. This technology can significantly streamline many of the manual processes currently in use to share data and verify sources.

6. **Transparent and Decentralized Records**

If you've ever made the effort to obtain a copy of your personal education transcript from a university or college, then you're familiar with the unfortunate headache that's involved. Many forms are required, sometimes needing to be physically mailed, payment made via old fashioned check, with an open-ended wait period for receiving your transcript and no guarantee of success. In a worst case scenario, your educational data could be lost or misfiled and be gone for good.

While blockchain technology does face some of its own developmental issues, like scaling, the great benefit of storing data on the blockchain is that the data is instantly and universally accessible. Many organizations, like ODEM, are leveraging file storing solutions, like the Interplanetary Filing System (IPFS), which supports storing and sharing in a distributed file system. This technology allows for easy peer-to-peer data sharing and content-addressing thus reducing the size of data files stored on the blockchain. Storing data across many computers also ensures that educational data can't be modified without validated permissions.

7. Credentials Beyond University Degrees

Perhaps the greatest advantage of blockchain in education is that it facilitates inclusion. Anyone who has their educational data stored on a blockchain can instantly provide proof of their education credentials. But when we talk about inclusion, this doesn't need to be limited to degrees from major universities. This application of blockchain in education expands beyond just storage for public or private educational institutions. Records secured on-chain could include industry certifications, vocational and apprenticeship records, corporate training records and certifications from professional societies.

4.0 A BlockChain -Based Educational Record Management (BERM)

The Proposed Blockchain-Based Record management will adopt the consortium system since only authorized persons are able to create certificates records on the network. On the other hand, anyone can verify their authenticity. Thus, when registering an educational record, for example, those responsible for creating the record writes in the registry or in the database using its own private key. Users who want to check the veracity of the record must have a corresponding identifier number to be inserted into the system. The Blockchain consortium is a semi-private and partially decentralized chain system, in this scenario the nodes are responsible for the validation of the transactions and how this happens depends on the implementation of the consensus methods. The form of access and consultation of the records can be public or private and the owner of the network is responsible for its configuration.

4.1 Blockchain-based Educational Records Management Components

The components of the BERM illustrated in figure 2 below reflect the business network to be adopted which is suitable for an educational records repository that registers, manages and provide access to them. The "asset information" component contains information related to the educational record being managed by BERM. This component is responsible for asset's definition and consistency. The "Business Model Information" component contains information related to the process involved in the asset management. It defines basically the participants and transactions involved in the process. The "Transaction Process Function" component contains the information concerning the specific functions invoke in the business model to manage the asset.

The "Access Rules" component contains the rules guiding the transactions and all priorities among participants involved in the business model adopted.

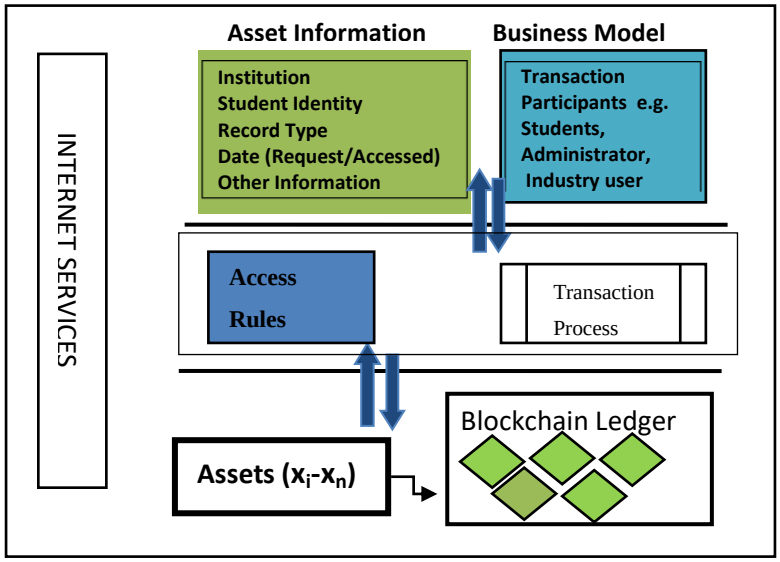

Figure 2: BERM Basic Operational Components

4.2 Proposed System Architecture for Record Management

The BERM structure uses the basic steps and operation flow of a blockchain-based application which are Transaction, Request and verification.

i) A transaction is requested by someone who has prior authorization and needs to create an educational record;

ii) The request record transaction is sent to the nodes belonging to the BERM system;

iii) The educational record transaction is verified by the ledger; and

iv) A new block of data corresponding to the educational record transaction is accessed or created and annexed to the ledger becoming permanent and immutable completing the transaction. The creation of a record transaction is executed as illustrated in Figure 3.

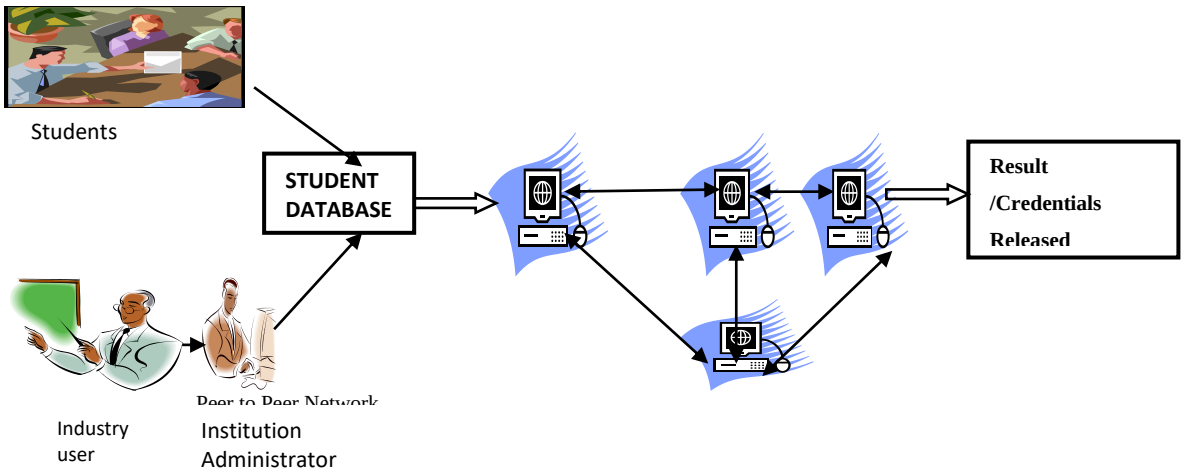

Figure 3: creation of record transaction

i) An administrator proceeds to write a record to the Blockchain account; the record is saved and time-stamped in a block using arithmetic operations; the block is subsequently validated by network pre-selected nodes through cryptography techniques; and the block is dated and added to the block chain, so that all users can have access to the same chain since each node builds its own exemplary independently. Once these steps have been executed, we can access educational records with authenticity and integrity by simply using a credential (ID Card) through a web browser.

5.0 Conclusion

Blockchain is being used in a number of security applications, ranging from record-keeping to acting as part of the active data infrastructure. Nowadays a lot of malpractices are practiced regarding manipulation of the results of university exams and in forgery of the final result or certificate issued. Block chain itself has been used in the Bitcoin system known as the decentralized Bank system, with a series of its application in education and also in other sector such health institutions. This paper proposes and aims to implement a system for secured and transparent management of results and issuance of certificate using block chain algorithm. We have outlined the system architecture, the basic operational components and how transaction record can be created. By comparison to previous work, we have shown that the blockchain technology offers a new possibility for democratic countries to advance from the pen and paper selection scheme, to a more cost- and time-efficient result handling scheme, while increasing the security measures of the today's scheme and offer new possibilities of transparency.

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