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Blockchain Based Academic Credit Verification System

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***Abstract*— Academic certificates are very significant for employment, thus making them vulnerable to forgery and fraud. It is hard to detect a skilfully generated fake certificate, jeopardizing the credibility of certificates. In this paper, we propose and implement an Ethereum based academic certificate verification system to solve the counterfeit certification problem.**

***Index Terms*— Blockchain, counterfeit certification, education certificate verification.**

I. INTRODUCTION

Blockchain technology is nearly about a decade old now. This technology has changed the way of storing and distributing data. The other name given to blockchain is Distributed Ledger Technology (DLT). Blockchain is "a decentralized, distributed database that manages a digital ledger of continuously growing ordered blocks".

Academic qualifications are very significant for employment since they assure talents, reliability and devotion of a person along with their human capital [1]. Human capital includes knowledge, competency, skills and abilities developed through education [2]. A positive correlation is found between educational accomplishments and economic security and finer employment opportunities [3]. Academic qualifications awarded by legally authorized universities are considered genuine and legitimate [4]. As academic qualifications are important assets for employment, people often use fake bogus certificates by 'Degree Mills' to lie about their qualifications. The increase in counterfeit certification is creating difficulties all over the world in differentiating the original and fake certificates. This problem is seriously alarming and needs to be addressed immediately. These issues can be avoided if more transparent and effective technology like blockchain technology is used. The important feature of using blockchain technology is high level transparency and excluding intermediaries. Keeping in view the potential and advantages of blockchain to solve counterfeit certification, we propose a simple blockchain to issue and verify certificates. The main focus is to prevent bogus certification in education sector and provide tamper-proof, valid and secure method for certification verification.

In the next section, we provide brief description of related work on blockchain technology in education sector. Section 3 gives insight of the system architecture and implementation. Then we conclude the paper with discussion in section 4.

II. RELATED WORK

A verification application developed by Elva Leka et. al [5], to overcome the limitations of depending on third party verification systems. It is an Ethereum based smart-contract application for distributing, storing and verifying academic credentials. This application focuses on avoiding administrative hurdles and makes verification and validation process more efficient and secure. Moreover, it uses AES encryption algorithm to ensure data confidentiality. A framework to authenticate verifying of documents proposed by Omar S. Saleh et. al [6] aims to tackle document forgery and misuse. It focuses on identifying research gaps in current blockchain based solutions for educational systems. This framework uses Hyperledger Fabric Framework to authenticate, authorize and provide confidentiality and privacy to the owners of the records.

A prototype was developed by Axel Curmi et. al [7] for registration of institutions, faculties and students and issuing of certificates. Thus, an interface is developed for students to access their certificates. Blockchain is used to store the certificates thus eliminating the need to rely on third party verification systems. An Ethereum based network is used to store the certificates. A proposal of blockchain based architecture for transparent certificate handling [8] has been proposed to manage diploma certificates called University of ZuricH Blockchain (UZHBC) for University of ZuricH. This architecture ensures authorization of diplomas, confidentiality of student data and allows verification of authenticity of diplomas using diploma hash.

A permissioned blockchain system for academic record verification has been developed by Ahmed Badar[9]. It allows institutions to reliably and securely verify academic records on request of students. This framework consists of Hyperledger Composer to store hash of records on blockchain with Hyperledger Fabric on back end and a web interface to enrol and request transfer of students. Unicert, a

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certificate issuing and verifying model is proposed and implemented by Trong Thua Huynh et. al [10]. It uses Merkle tree hash algorithm to store hashed certificates. SHA-256 is also used to hash certificates then merkle tree is created. The ultimate goal of Unicert application is to prevent frauds in issuing certificates in education sector.

A novel education record verification solution based on blockchain proposed by Meng Han et. al [11], aims to create an secure environment for students to have authority of their educational records. This solution incorporates advanced blockchain features to allow institutions to issue certificates as proof of achievement and students can collect the certificates or share with anyone directly. Almunichain [12], a records verification service based on blockchain, is a ledger of student records. It aims to make recruitment easy and simple for universities as well as recruiters. It proposes an immediate and direct verification of background of students, signed by institution and stored on a secure and immutable ledger, Almunichain. Every student is provided with a unique code that can be added to their respective CVs. This code is then scanned by recruiters to get the student details verified immediately. Hyperledger Fabric is used to implement this framework.

Cerberus, an accreditation and degree verification system has been proposed by Aamna Tariq et. al [13]. A considerably more structured, coherent and easy to use credential verification solution effectively reduces widespread manifestations of counterfeit certification. It uses on-chain smart contracts for revocation of credentials. It guarantees data integrity and privacy. Every student's credential details are separately stored in a transaction and the transaction is digitally signed by university Registrar and then propagated on Cerberus network where it is verified by nodes of the accreditation body. QR-code is added to the front side of physical certificates that can be scanned to verify the credentials. Another solution using permissioned blockchain includes CredenceLedger [14]. It uses multichain streams to store record hashes within blockchain. It operates with a mobile application front end for students to manage credentials. EduCTX grading platform is a peer to peer global network that stores credits and enables transfer of students between higher educational institutes [15]. It aims to automate and optimize transparent administrative process.

III. SYSTEM ARCHITECTURE AND IMPLEMENTATION

This section gives overview of the proposed framework. It outlines the blockchain-based platform for issuing and verifying educational certificates. It gives brief description into inner workings of the system architecture and implementation. We will start with architecture, followed by description of implementation and then discuss scalability.

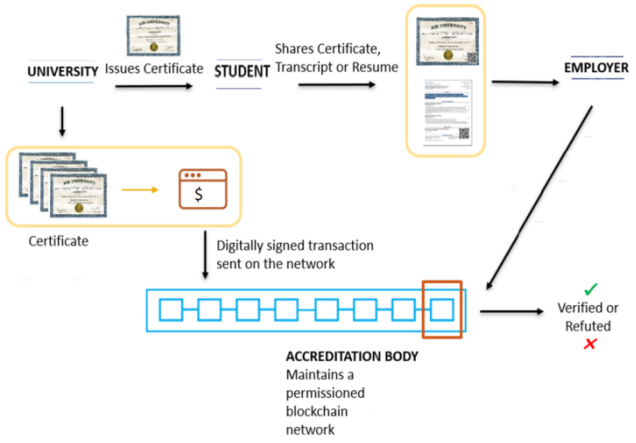

Fig.1 Framework architecture

A. Architecture:

The whole process of system architecture is depicted in figure 1. The blockchain network is operated and maintained by the accreditation body. Transactions containing validation information of student credentials is issued by the university. The accreditation body collects the transactions periodically and adds them into blockchain in the form of blocks. University registers the students, provides IDs and collects all the information required for formulating certificates. Finally, certificates are stored on the blockchain where the student can access them securely. Students are the recipients of the certificates. Students can access the certificates by entering certificate holder's ID and certificate ID, invoking a smart contract to retrieve the particular certificate. Verifier can be any other institution or any employer that need to verify the certificates provided by a student. Verifiers can verify the certificate by entering the IDs provided by the student. If an empty response is returned then the certificate is invalid. For a valid certificate, the certificate will be displayed.

B. Implementation:

The system constitutes of two main components- Blockchain layer and web application layer. Blockchain layer consists of Ethereum network. Web application layer provides an interface to students/ recipients and verifiers/employers. User can interact with the system through front end React Application Interface. Application interface is different for institution and students. Institution interface constitute of functions to create, sign and issue certificates. It also includes securely encrypting and sending data and certificate distribution. Student application interface includes managing of academic certificates and sharing the certificates with employers or other institutions. It decides the actions an entity can perform.

Interplanetary File System (IPFS) is used to store the actual data and the address of the data stored is placed on the blockchain. The data is securely stored on IPFS, by generating hash of the whole data and then the hash value is

appended to the data and is again encrypted. The hash value is also stored along with the address on blockchain. Two smart contracts are deployed. One smart contract is responsible for adding and retrieving certificates on the network. Second smart contract manages accounts on the network. Smart contracts are on the backend to handle the inner functions and permissions.

C. Scalability:

To accommodate increasing number of students and academic records, the system has to be scalable. To support the additional load on the system, we have added some components. Certificates are stored on IPFS, as scalability and size are major limitations of blockchain itself. We can accommodate abundant number of participants and transactions without instigating too much resource utilization. The participants are allowed to perform transactions on the system without directly being part of Ethereum network. Thus, every participant does not need to run client on their system.

IV. CONCLUSION

Certificates are open to vulnerability and fraud. It has become important to differentiate between original and bogus certificates. We have proposed a blockchain based certificate verification system that has advantages over previous technologies because of its distributed nature. Security themes required for blockchain based certificate verification are authenticity, privacy, ownership and confidentiality. Our framework incorporates advanced features of blockchain technology to allow educational institutions to issue certificates as proof of achievement. These certificates can be directly shared with employers as official authentic documents.

In future, we can add a scan code to physical certificates that can be scanned to check the authenticity of a certificate.

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