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Revolutionizing Verification and Management of Educational Certificates with Self-Sovereign Student Identities using Blockchain

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Abstract - *Educational Institutions have come a long way in transforming education systems, but they still require a better and fraud-proctored system to address the issues that exist even today.The need of a single secure platform for all educational stakeholders such as, e-learning platforms, academic institutes, universities and students to avoid re-verification and maintaining immutable record of a student's digital assets are a driving fuel to significantly transform current system. The main objective of the work is to highlight the existing issues of fraudulent degrees, redundancy in verification process of documents, lack of validation for authenticity of certificates in the current education sector, lack of single authorised identity for students and resolve themusing decentralization, immutability, traceability, consensus mechanism and other features of blockchain. The existence of third parties between Universities, institutions and students gets eliminated by the distributed nature that blockchain offers. The consensus mechanism employed will make sure that only authenticated data is put on chain, quelling the fraud certificates that often end up getting amassed at the employer's desk. The intent is to design a prototype to test the applicability of blockchain in solving above stated issues.*

Key Words: **Blockchain in Education, Education System, Hyperledger Fabric, Decentralized Education System, Self Sovereignty in Education System**

1.INTRODUCTION

According to [3], academic certificates are highly esteemed as they serve as an indicator of the human capital of their bearers. Human capital refers to the skills, competencies, knowledge and aptitudes achieved through education. Academic qualifications are particularly important in employment situations as they serve as a guarantee of not just the knowledge, expertise and skills of the holders but also of their abilities, reliability and dedication. Because of their importance people lie about their educational credentials. In the United States there are currently 2 million fake degree certificates in circulation and 300 unauthorized universities operating, United Kingdom which has about 270 fake institutes, Healy (2015) found that up to 35% of candidates in Australia falsified their academic credentials for the sake of employment.

Currently students identify themselves through various academic institutes like schools, colleges, universities etc.[20] There is no single identity offered to students which will ultimately encapsulate these separate institute specific identities. The field of education is moving into a digital era where digital certificates and identities will play the most crucial role. This will only increase the creation and usage of fraud and fake educational certificates [4].

The verification of the academic documents is normally carried out in two ways,either the concerned person gets their documents verified themselves by an authority, or the entity requiring verification directly contacts the verifying authority[8]. The verifying authorities can also be of two kinds, either the institute that has issued the academic certificates can act as the verifying authority, or a third party, like a government agency, can verify records on its authority. All of the above mentioned cases involve varying degrees of manual procedures and in person or electronic communication between personnel, leading to a time consuming process[8].

Considering the above findings and fastly changing nature of the Education system, urgent tackling of these issues is needed. Blockchain is essentially a distributed and decentralized data storage scheme providing transparency, data integrity and immutability[1][5][16]. These features enable the Blockchain technology to have use cases in domains like Identity management, Document Notarization, Document Verification and Management, Work History Verification, Proof of Origin and many more [16].

2. Blockchain in education system

The blockchain technology is a transformative technology with an enormous potential. The Joint Research Centre (JRC), the European Commission's science and knowledge service, published a report on Blockchain in Education (Grech & Camilleri, 2017) highlighting the potential and proposing some scenarios, including issuing certificates, verifying accreditation pathways, lifelong learning passports, intellectual property management, and data management. According to (Gräther et al., 2018), blockchain is highly suited for storing fingerprints of certificates or other educational items, due to the fact that each transaction is permanently recorded and verified[4].

Blockchains can empower individuals to design their own pathways over a lifetime of learning and work. They also introduce trust, transparency, and efficiency into an education system that can be difficult to navigate and use. These benefits are multiplied by the power of blockchain to create secure and connected networks of education institutions, education technology (edtech) companies, employers and learners. Enabling the secure sharing, verifying, management and exchange of data, in a self-sovereign framework, shifts control of learning to the individual, and away from the institution.[7]

The key areas in education system with ideal use cases of blockchain are discussed in this section:

2.1 Re-Verification of same document in different scenarios :

Some educational certificates are a very crucial asset in activities such as scholarship, placement activities, application for higher studies etc. Hence, in order to check the integrity of the certificate and the authenticity of the university/ institute that issued the certificate, the verification process is required. This verification process(as discussed in the introduction section) is carried out by every stakeholder who wishes to have the verified document resulting in redundant operations at different ends. An authentic and completely transparent blockchain system can overcome these concerns.

2.2 Student Self-sovereignty:

The student identities and data associated with them are owned by the central authorities like Universities, Educational institutes, Agencies etc. Students are identified through these entities, there is no student identity system going beyond these entities by encapsulating them all under a single umbrella and student himself being the owner of his umbrella.

The concept of a self-sovereign and inalienable digital identity is critical to society in general and to students in particular. It means that our identities and data are neither bestowed nor revocable nor owned by any central administrator. Education institutions and companies must put ownership of student data into the hands of students (and their parents) and employees. Blockchain enables learners to own and control their own data but not alter their grades or degrees or certifications[7].

2.3 Tackling fake certifications

As discussed above, fake certifications are a major problem in the education space. The increasing frauds in educational credentials requires urgent attention in attempts to stop theses malpractices.There are 5 sources of fake certificates,"Degree Mills" where bogus certifications are generated and sold,"Fabricated Documents" that represent fictitious degree or institute, "Modified Documents" that are alterations to legitimate Documents,"In-House Produced" which are fake documents printed by employees of legitimate institutions printed on authentic paper with seal,stamps and signature,"Translations" the documents inaccurately translated to match requirements[3].The consensus mechanism, traceability, immutability and transparency features of the blockchain have the potential to address and solve these practices.

3. Proposed Framework

The aim is to make a decentralized system for all the educational stakeholders who will facilitate the transparent and secure management and verification of degrees and professional certificates. The structure of the system is discussed here:

There will be two Governing Entities involved in the system, Department Of Human Resource Development(DHRD) and Department Of Youth Welfare and Recruitment (DYWR). The Certificate/Degree issuing entities like Universities, Colleges, Schools, External Learning Platforms(MOOCS) can be enrolled in the network by the system admin but they will be accepted in the network only when the majority of the existing organizations endorse this step. Thus the "Degree Mills'' source of fake certificates will be eliminated. Following will be the tasks performed by these departments -

I. Department Of Human Resource Development:

DHRD Department will be responsible to provide the Identities to the students. A Student shall be registered with DHRD for being a part of the system. Registering students with DHRD ensures that, student is not associated with any one Institute/University. Once Registered a student can be a part of any number of Institutes/Universities. This will contribute towards a single self-sovereign student identity.

II. Department Of Youth Welfare and Recruitment:

All the Recruiters, Scholarship Providers and Institutions who require the student information for some purpose will have to register themselves with this department. It puts in place a governance mechanism for the system to enable us to validate and track the operations performed by these institutions.

The students enrolled in the network can sign up for a course with any university/Institute and then register for an exam through the system. The focus will be placed on management and verification of documents using a more full proof method. The typical flow of the system can be as follows:

- Once the student requests to register for the exam, the college will review his/her request and approve it if valid, this will be an on-chain transaction.

- This approval will change ownership from student to university so that the university can add / update the document on behalf of the student.

- After the examinations are done, a grant certificate operation will be performed by the university. Here, the university will grant the certificate to the student and add it on Blockchain. Granting will again change the ownership from university to student. Thus students will have complete ownership of their certificates/degrees.

- A Student can then share the certificate/degree with third parties like employer/scholarship providers, etc. Thus the security of the student data will be ensured. The third-parties can verify this data through the system and thus the transparency and trust relationship can be established.

- Students shall have a profile section containing all their certificates at a single place with proof of their Authenticity and Integrity.

This structure and flow is depicted in Fig. 1

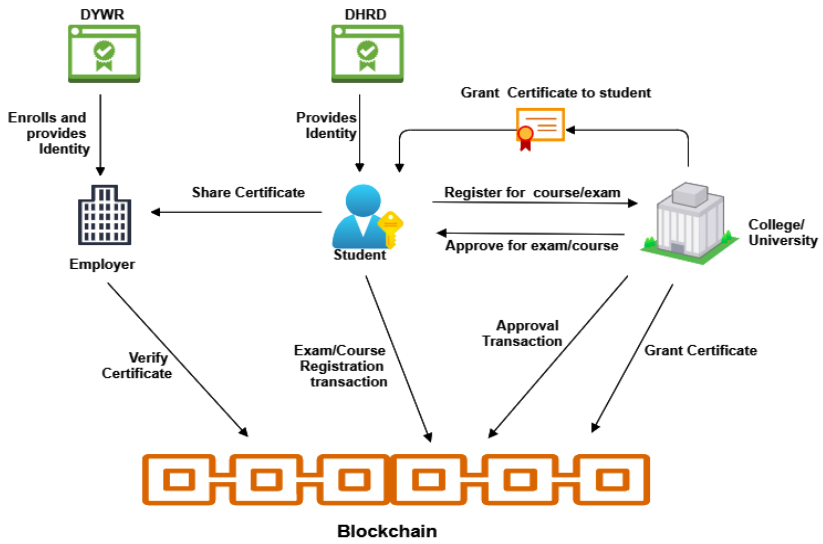
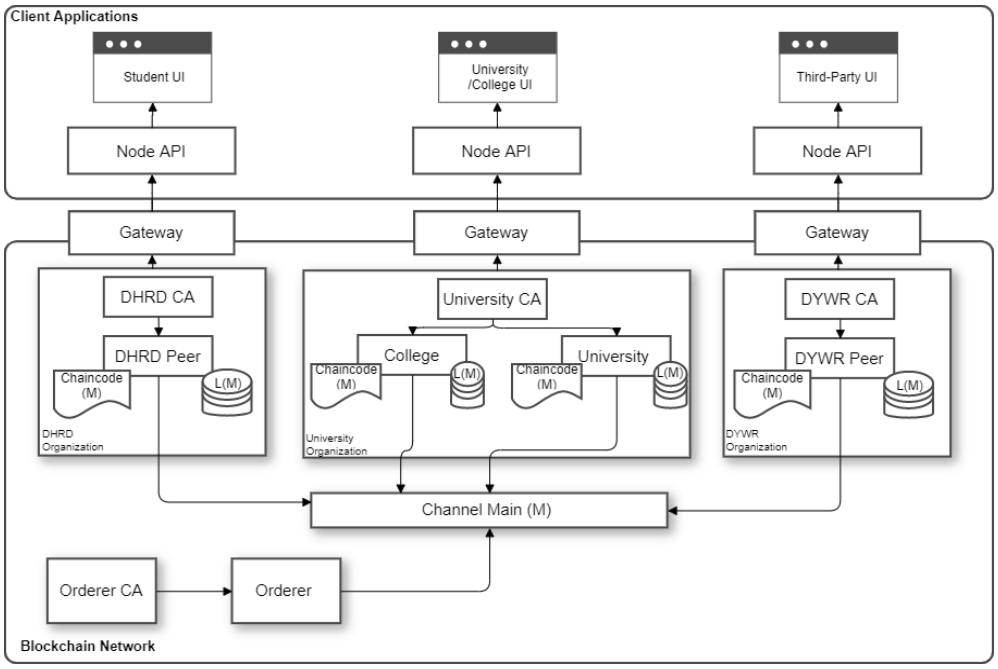


Fig. 1 Proposed System structure

4. Architecture of the system

This proposed framework can be implemented using the Hyperledger Fabric Sdk which is a open source project by The Linux FoundationHyperledger will be an ideal choice for our framework due to its inherent privacy and role based access mechanism to access documents[C].HLF is a private blockchain and access levels can be customized as per requirements as it is role based. HLF comprises six core components which are 1) Membership Service Provider (MSP), 2) Chaincode , 3) Peers , 4) Channels, 5) Shared Ledger, and 6) Gossip Network Protocol[3].

Fig 2. shows the architecture of the education system using the HLF. The DHRD and DYWR will act as base organizations, responsible to provide identities to respective users. Educational institutions like Universities, Colleges, Schools will form different organizations in the network. Here, only one University organization is depicted for simplicity.



5. Implementation

The prototype system has been implemented for the proposed solution. It contains the HLF Network , Node Sdk and HTML/CSS for the User Interface. Implementation code can be found on the link: https://github.com/bhosaleharshita/Educhain

6. Future Scope

This network can be a potential module in a complete universal identity system implemented on blockchain. The system can be considered as a module which will provide the educational details of the person and it can be expanded to include the personal documents and details of the person. This network can be used as the base infrastructure to build various applications on top of it. Educational social platforms can be built over this network utilizing all the benefits of the system. Multiple such vertical applications can be built on top of this network.

7. Conclusion

The paper discusses various problems faced in the current educational system and how using blockchain based solutions can solve them. We describe a potential structure of the system with its implementation details.

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Author Contributions

HSB has developed the architecture, performed analysis on it and built the HLF network for the implemented system(75%),RMK and GSJ have worked on the User Interface of the implemented system(25%).

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