Blockchain-Based certification verification for professional and academic credentials

[1]Mrs.Chepuri.Deepti, [2]Ms.Telukutla lavanya,

**[1]Assist Professor, Department of Computer Science and Engineering,
QIS College of Engineering & Technology, Ongole, Andhra Pradesh, India**

**[2]PG Scholar, Department of Master of Computer Applications,
QIS College of Engineering & Technology, Ongole, Andhra Pradesh, India**

Abstract: This paper proposes a solution to the longstanding challenges associated with traditional paper-based educational documents and certificates through the implementation of blockchain technology, specifically utilizing the Ethereum platform and smart contracts. The conventional issuance and verification processes are prone to inefficiencies, delays, and susceptibility to forgery, leading to significant setbacks in career progression and fostering educational scams. By leveraging blockchain, these issues can be addressed comprehensively. The proposed system involves the conversion of paper certificates into digital certificates upon student request. These digital certificates are then securely stored on the blockchain, with their authenticity verified through cryptographic hash functions. Each certificate is assigned a unique identifier and transaction hash value, ensuring tamper-proof verification through a centralized platform. This innovative approach not only streamlines the verification process but also enhances security and transparency, mitigating the risks associated with forgery and manipulation. By harnessing the power of blockchain technology, educational institutions, employers, and third-party verifiers can seamlessly authenticate credentials, fostering trust and efficiency in the professional landscape.

Index Terms: Blockchain, Smart contracts, Ethereum, Document verification, Decentralized process, Hashing, IPFS

1. INTRODUCTION

Blockchain technology, originating from the visionary work of Stuart Haber and W. Scott Stornetta, gained prominence alongside the advent of Bitcoin in 2009, attributed to the enigmatic Satoshi Nakamoto. Initially confined to the realm of cryptocurrencies, blockchain technology has rapidly transcended its origins, permeating diverse sectors, including education, where it offers innovative solutions to entrenched challenges [1]. Within the educational sphere, the issuance and authentication of documents, such as degrees and certificates, have long been mired in inefficiencies inherent to traditional paper-based systems [2].

The prevailing approach to document issuance and verification within education is emblematic of bureaucratic inertia, characterized by cumbersome administrative processes and manual validation mechanisms. This antiquated system relies heavily on paperwork and human intervention, leading to protracted verification timelines and operational bottlenecks [2]. Furthermore, the reliance on physical documentation exposes educational institutions and employers to vulnerabilities, including the risk of loss or damage to certificates, necessitating the laborious process of reissuance [2].

Beyond administrative inconveniences, the shortcomings of traditional document verification extend to the very fabric of professional ecosystems. Instances of document forgery perpetrated by unscrupulous individuals have profound repercussions, ranging from financial losses to compromised organizational integrity. Research indicates that companies incur substantial costs, averaging $15,000, due to the unwitting employment of individuals wielding falsified credentials [2]. Moreover, studies suggest that over 30% of credentials claimed by individuals are obtained through fraudulent means, underscoring the pervasiveness of this issue [3].

High-profile cases of credential fabrication, such as that of a court clerk falsifying qualifications to secure employment, and the resignation of Marilee Jones, the former Dean of Admissions at MIT, following revelations of misrepresented credentials, underscore the prevalence and impact of credential fraud [4][5]. These incidents not only tarnish the reputation of affected institutions but also erode public trust in the validity of academic qualifications.

Ezell and Bear shed light on the lucrative industry sustaining fraudulent practices, estimating its worth to be in the billions. The proliferation of counterfeit credentials not only undermines the integrity of educational institutions but also fosters a climate of skepticism, wherein legitimate achievements are overshadowed by doubt [6].

Against this backdrop of systemic challenges and institutional vulnerabilities, blockchain technology emerges as a transformative force poised to revolutionize the educational landscape. By leveraging blockchain technology, educational institutions and employers can transcend the limitations of traditional paper-based systems, ushering in an era defined by efficiency, transparency, and accountability [1]. The immutable nature of blockchain networks ensures that digital credentials are securely stored and authenticated with unparalleled accuracy, mitigating the risks associated with fraud and forgery [1].

In conclusion, the convergence of technological innovation and educational imperatives underscores the urgent need for blockchain solutions in the realm of credential verification. By embracing blockchain technology, stakeholders can streamline administrative processes and safeguard the integrity of academic qualifications, fostering a climate of trust and accountability in the professional landscape.

2. LITERATURE SURVEY

Blockchain technology has garnered significant attention in recent years for its potential to revolutionize various sectors, including education. This literature survey explores the diverse applications of blockchain in the educational domain, focusing on

credential verification, document management, and academic integrity.

Arenas and Fernandez (2018) present CredenceLedger, a permissioned blockchain platform designed for verifiable academic credentials. The system employs blockchain technology to ensure the immutability and integrity of academic records, facilitating seamless verification processes [8]. Similarly, Oliver et al. (2018) propose a business model leveraging blockchain for tracking and verifying official degrees. Their study underscores the transformative potential of blockchain in enhancing the transparency and reliability of academic credentialing [9].

Kanan et al. (2019) advocate for the adoption of SmartCertBlockChain, an imperative framework for managing educational certificates. By harnessing blockchain technology and smart contracts, the system offers a secure and decentralized platform for issuing and verifying certificates, thereby mitigating the risks associated with fraud and forgery [10]. Likewise, Cheng et al. (2018) explore the integration of blockchain and smart contracts for digital certificate management. Their study highlights the potential of blockchain to streamline certificate issuance and verification processes, ensuring trust and transparency in academic credentialing [11].

El-Dorry et al. (2020) propose a novel model for digital certificate verification in Egyptian universities using blockchain technology. Their research underscores the applicability of blockchain in enhancing the efficiency and reliability of credential verification processes, thereby addressing longstanding challenges in the educational sector [12].

In addition to credential verification, blockchain technology offers innovative solutions for document management and academic integrity. TruScholar (2022) identifies eight key use cases of blockchain in education, including document authentication, secure storage of academic records, and plagiarism detection. By leveraging blockchain, educational institutions can enhance data security, streamline administrative processes, and promote academic integrity [1].

Furthermore, blockchain-based platforms such as Blockcerts and Learning Machine offer standardized frameworks for issuing and verifying digital credentials. These platforms utilize blockchain technology to create tamper-proof digital certificates that can be securely stored and easily verified by employers and academic institutions [13].

Despite the potential benefits of blockchain in education, challenges remain regarding scalability, interoperability, and regulatory compliance. Scalability issues may arise due to the computational overhead associated with blockchain consensus mechanisms, while interoperability challenges stem from the lack of standardized protocols for data exchange between different blockchain networks. Additionally, regulatory concerns regarding data privacy and ownership may hinder the widespread adoption of blockchain in education [14].

In conclusion, blockchain technology holds immense promise for transforming the educational landscape by enhancing credential verification, document management, and academic integrity. However, further research and collaboration are needed to address the technical, regulatory, and institutional challenges associated with blockchain adoption in education.

..ISSN: 2040-0748 Vol-13 Issue-02 Aug 2024

3. METHODOLOGY

a) Proposed Work:

The proposed system uses BlockChain technology through the use of public Blockchain called Ethereum and smart contract along with a distributed peer to peer storage called IPFS to store the documents.

Since the current traditional process of issuing as well as verifying certificates is being digitized through this system,it is resulting in greater efficiency and increased security.

Digital certificates stored on the Blockchain[1] are secured using cryptographic hash functions, ensuring the integrity of the data. Any attempt to tamper with the information will result in a change in the hash value, making fraudulent activities detectable.

The use of smart contracts streamlines the verification process by automating the confirmation of certificate authenticity. Employers and educational institutions can access a common platform, reducing the time and effort traditionally required for manual verification.

b) System Architecture:

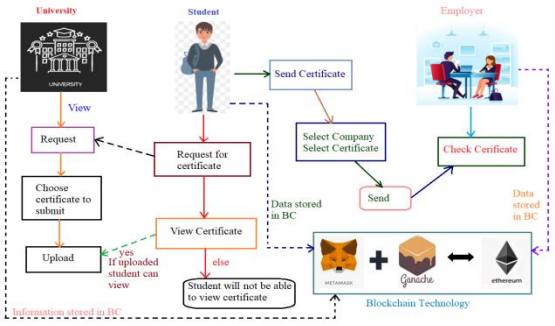

Fig1.Proposed Architecture

The proposed system architecture comprises four main components: Student, University, Employer, and Blockchain Technology.

Students can either send certificates to selected companies or request certificates from their university. Upon submission, the certificates are uploaded to the Blockchain[1], ensuring secure storage and verification. Universities facilitate the process by uploading requested certificates and granting access to students for viewing and uploading certificates.

Employers utilize the system to verify certificates uploaded by students, leveraging the blockchain's immutable nature for authenticity. Blockchain technology, powered by tools like Metamask, Ganache, and Ethereum, serves as the backbone, storing every piece of information securely. Metamask provides a bridge for students to interact with Ethereum-based applications, while Ganache offers a local blockchain environment for testing and development. Ethereum facilitates the execution of smart contracts, ensuring the integrity and transparency of certificate transactions. Overall, the system architecture streamlines certificate issuance, verification, and storage, enhancing efficiency and trust in academic credentials.

c) Modules:

To implement this project we used the following modules are Student, University, Employer.

These Modules description are given below:

A) Signup:

i) University: The University module allows institutions to register accounts within the blockchain-

based credential verification system. During the signup process, universities provide essential information to establish their identity within the network. This includes details necessary for authentication and verification, ensuring their participation in the system and enabling them to upload and manage academic credentials securely.

ii) Student: The Student module enables students to register on the platform by creating personal accounts. During registration, students provide essential details such as their name, identification information, and other pertinent data required by universities for issuing and verifying certificates. This information facilitates seamless communication and authentication processes between students and educational institutions within the blockchain-based credential verification system.

iii) Employer: The Employer module allows employers to register and access the system, facilitating the efficient verification of academic and professional credentials of potential hires. Employers provide pertinent details about their organization during the signup process, ensuring accurate identification and authentication within the system. This enables streamlined verification processes, enhancing trust and reliability in the evaluation of candidates' qualifications and credentials within the blockchain-based credential verification system.

B) Students Login:

i) Request For Certificate: The Request For Certificate feature empowers students to log into their accounts and initiate requests for digital certificates. They specify the desired type of certificate, ranging from academic transcripts to professional certifications. Through this functionality, students navigate their account interface, providing clear instructions to the issuing institution regarding their certification needs. This streamlined process enhances efficiency and ensures accurate issuance of certificates within the blockchain-based credential verification system.

ii) View Certificate: Upon the university's processing of the request, students gain access to their digital certificates by logging into their accounts. This functionality enables students to view and verify the accuracy of the information contained within the certificates before sharing them with potential employers or other entities. By providing students with the opportunity to review their certificates, this step enhances trust and confidence in the authenticity of their credentials within the blockchain-based credential verification system.

iii) Send Certificate: After reviewing and approving the digital certificate, students utilize the Send Certificate feature to securely transmit the verified certificates to employers or recipients. This ensures the authenticity of their qualifications and facilitates seamless sharing within the blockchain-based credential verification system.

C) University Login:

i) View request: Universities access the system to view incoming requests for digital certificates from students. This interface enables efficient management and processing of requests, empowering universities to maintain control over the verification workflow and ensure timely issuance of certificates within the blockchain-based credential verification system.

..ISSN: 2040-0748 Vol-13 Issue-02 Aug 2024

D) University Login:

i) Check Certificate: Within the Check Certificate module, universities authenticate digital certificates issued by their institution. Leveraging blockchain technology, universities verify the accuracy and legitimacy of presented certificates, ensuring a secure and tamper-proof method for certificate validation. This process instills confidence in the authenticity of academic qualifications within the blockchain-based credential verification system.

d) Blockchain Integration:

1. The blockchain is integrated into the project at the core of certificate issuance. When a university receives a request for a certificate, the relevant information, such as student details and academic achievements, is encrypted and stored as a block on the blockchain. This ensures the immutability and tamper-proof nature of the issued certificates.

2. Blockchain technology is employed to securely handle the request and verification process. As students request certificates and employers verify them, the information is stored in blocks on the Blockchain[1], providing a transparent and auditable trail of interactions. Smart contracts may be utilized to automate certain steps, enhancing efficiency.

3. To further enhance security and accessibility, the project utilizes the InterPlanetary File System (IPFS) for storing digital certificates. IPFS, integrated with blockchain, shifts from traditional location-based addressing to content-based addressing, ensuring decentralized and efficient storage of certificates.

4. When an employer or any other entity needs to verify the authenticity of a certificate, the blockchain is accessed. The hash values stored on the blockchain are used to verify the integrity of the certificates, ensuring that they have not been tampered with. This decentralized verification process enhances trust and eliminates the need for a centralized authority in the verification chain.

e) Ganache:

Ganache is a user-friendly interface for monitoring Ethereum blockchain activities. It simplifies tracking of accounts, transactions, and smart contracts, making it accessible even for users without in-depth blockchain expertise. Ganache offers detailed transaction information, including sender, receiver, amounts, gas usage, and success status, aiding debugging and ensuring transaction accuracy. It also tracks smart contract deployments, confirming correct deployment and functionality. This transparency simplifies monitoring and verification processes.

Ganache lets us dive into the details of each block on the Ethereum blockchain. We can find out when a particular block was added, what transactions took place within it, and how much computing power (gas) was used. Ganache also enables data retrieval from stored blocks, allowing developers to access and analyze specific block information.

Ganache is employed to access data on the local Ethereum blockchain, encompassing information regarding report storage, system specifics, and user interaction.

f) Metamask:

Metamask is both an Ethereum wallet and a browser extension. It simplifies cryptocurrency management

"In the project, Metamask ensures secure Ethereum transactions, promoting transparency by displaying the deduction of ETH as fees. This transparency maintains accuracy and ensures confident, reliable financial interactions in the record management system."

4. EXPERIMENTAL RESULTS

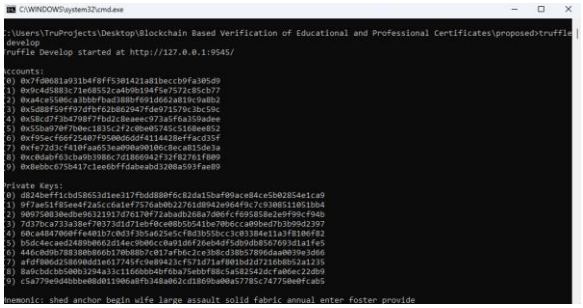

Fig 2.Hosting blockchain on the localhost

Fig 3.Compiling the smart contract file

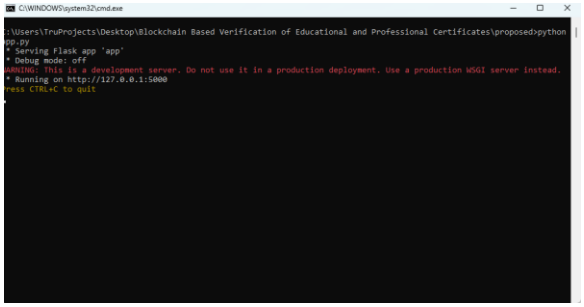

Fig 4.Hosting Flask Server

Fig 5.University Signup Screen

Fig 6.Output Screen

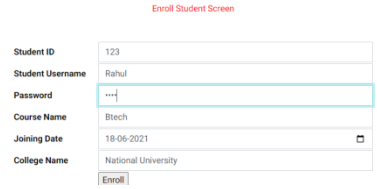

Fig 7.Student Signup Screen

Fig 8.Employer Signup Screen

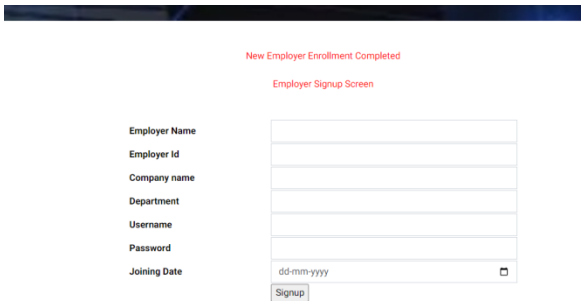

Fig 9.Output Screen

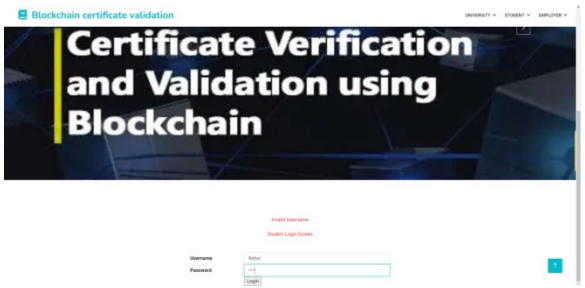

Fig 10.Student Login Screen

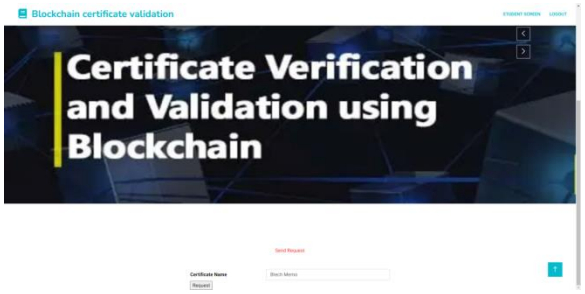

Fig 11.Send the Request for the Certificate

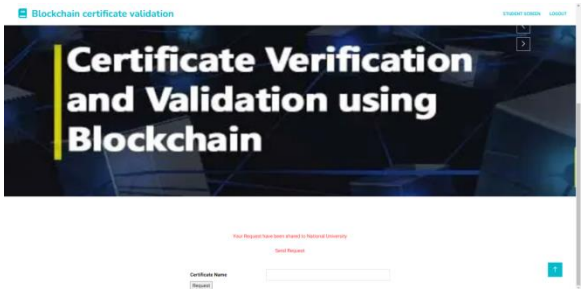

Fig 12.Output Screen

Fig 13.University Login Screen

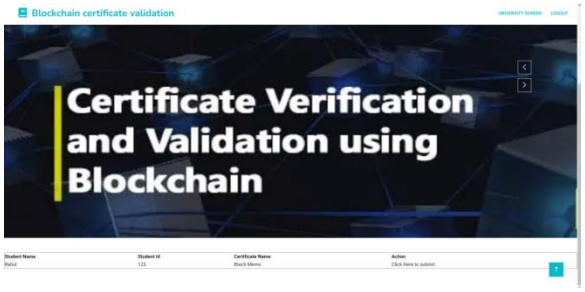

Fig 14.Output Screen

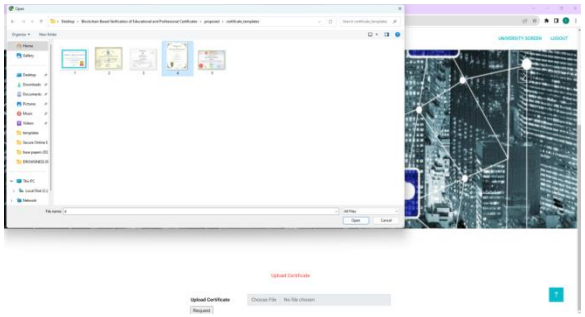

Fig 15.Upload Certificate Page

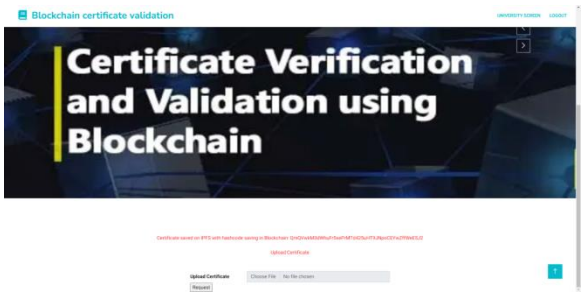

Fig 16.Output Screen

..ISSN: 2040-0748 Vol-13 Issue-02 Aug 2024

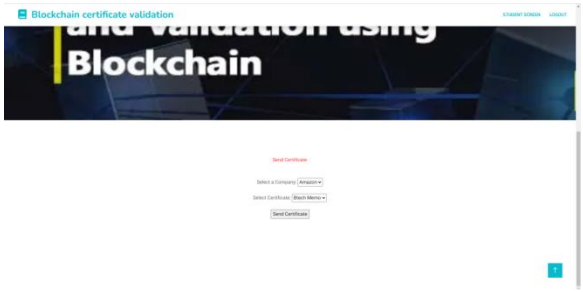

Fig 17.Student Can Login and send the certificate to employer

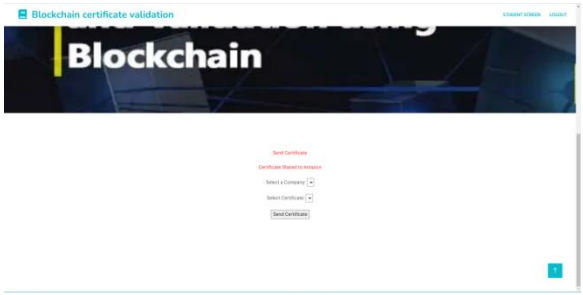

Fig 18.Output Screen

Fig 19.Employer Login Page

Fig 20.Output Screen

5. CONCLUSION

In conclusion, the project represents a significant paradigm shift in credential management, harnessing the power of blockchain technology to redefine security, efficiency, and accessibility. By leveraging Blockchain[1], the project ensures the integrity of academic certificates through tamper-proof mechanisms, mitigating the risk of fraud and manipulation. Moreover, the decentralized verification process, supported by stored hash values, instills trust in the authenticity of certificates, eliminating reliance on centralized authorities and promoting transparency.

Integration with the InterPlanetary File System (IPFS) further enhances security and accessibility by introducing decentralized storage solutions. This modern approach reflects a commitment to aligning with evolving technological standards, ensuring the longevity and scalability of the credential ecosystem.

Overall, the project heralds a departure from traditional methods, offering a streamlined and modernized approach to credential issuance and verification. By prioritizing security, efficiency, and accessibility, the project addresses longstanding challenges inherent in the current credentialing landscape. As a result, stakeholders, including educational institutions, employers, and individuals, stand to benefit from a more transparent, reliable, and inclusive credential ecosystem facilitated by blockchain technology.

6. FUTURE SCOPE

In the future, the proposed system will evolve to offer faster certificate generation and verification processes.

Additionally, the integration of QR codes could replace Certificate ID and Transaction Hash, enhancing user experience and accessibility. This advancement promises to streamline operations further, offering stakeholders a more efficient and user-friendly credentialing solution. The inclusion of QR codes will simplify the verification process, enabling instant access to certificate information. Overall, these enhancements demonstrate the system's commitment to continuous improvement and adaptation to emerging technologies, ensuring a seamless and future-proof credentialing experience.

REFERENCES

[1] "8 Use Cases Of Blockchain In Education - TruScholar." https://www.truscholar.io/8-use-cases-of-blockchain-ineducation/ (accessed Jun. 25, 2022).

[2] "The Cost of a Bad Hire to Your Business." https://resources.careerbuilder.com/recruiting-solutions/howmuch-is-that-bad-hire-costing-your-business(accessed Jun.25, 2022).

[3] P. Attewell and T. Domina, "Educational imposters and fake degrees," Research in Social Stratification and Mobility, vol. 29, no. 1, 2011, doi: 10.1016/j.rssm.2010.12.004. [4] "Dean at M.I.T. Resigns", Accessed: Jun. 25, 2022. [Online]. Available: http://www.nytimes.com/2007/04/27/us/27mit.html

[5] "Judge Jenny Lind Aldecoa-Delorino v. Marilyn de Castro Remigio-Versoza. A.M. No. P-08-2433., Supreme Court of the Philippines, September 25, 2009, ", [Online]. Available: http://sc.judiciary.gov.ph/jurisprudence/2009/september2009/ P-08-2433 .html

[6] G. A. Phillips, "Degree Mills: The Billion-Dollar IndustryThat Has Sold Over a Million Fake Diplomas by Allen Ezell, John Bear (review)," The Review of Higher Education, vol. 37, no. 2, pp. 282–284, 2014, doi: 10.1353/RHE.2014.0002.

[7] "University of Nicosia Issues Block-Chain Verified Certificates." https://www.coindesk.com/markets/2014/09/16/university-ofnicosia-issues-block-chain-verified-certificates/ (accessed Jun. 25, 2022).

[8] R. Arenas and P. Fernandez, "Credence Ledger: A Permissioned Blockchain for Verifiable Academic Credentials," 2018 IEEE International Conference on Engineering, Technology and Innovation, ICE/ITMC 2018 - Proceedings, Aug. 2018, doi: 10.1109/ICE.2018.8436324.

[9] M. Oliver, J. Moreno, G. Prieto, and D. Benítez, Using blockchain as a tool for tracking and verification of official degrees : business model. Trento: Trento : International Telecommunications Society, 2018.

[10] T. Kanan, A. T. Obaidat, and M. Al-Lahham, "SmartCertBlockChain Imperative for Educational Certificates," 2019 IEEE Jordan International Joint Conference on Electrical Engineering and Information Technology, JEEIT 2019 - Proceedings, pp. 629–633, May 2019, doi: 10.1109/JEEIT.2019.8717505.

[11] J. C. Cheng, N. Y. Lee, C. Chi, and Y. H. Chen, "Blockchain and smart contract for digital certificate," Proceedings of 4th IEEE International Conference on Applied System Innovation 2018, ICASI 2018, pp. 1046–1051, Jun. 2018, doi: 10.1109/ICASI.2018.8394455.

[12] A. El-Dorry, M. Reda, S. A. el Khalek, S. El-Din Mohamed, R. Mohamed, and A. Nabil, "Egyptian Universities Digital Certificate Verification Model Using Blockchain," ACM International Conference Proceeding Series, pp. 79–83, Nov. 2020, doi: 10.1145/3436829.3436864.

[13] Nitima Malsa; Vaibhav Vyas; Jyoti Gautam; Ankush Ghosh; Rabindra Nath Shaw, et. al., "CERTbchain: A Step by Step Approach Towards Building A Blockchain based Distributed Appliaction for Certificate Verification System" published in ieee open Access, available at https://ieeexplore.ieee.org/document/9666311.

[14] Mrs. R. Suganthalakshmi, Mrs. G. Chandra Praba, Mrs. K. Abhirami, Mrs. S. Puvaneswari, et. al., "BLOCKCHAIN BASED CERTIFICATE VALIDATION SYSTEM" published in IRJMET open Access, available at https://www.irjmets.com/uploadedfiles/paper/issue_7_july_2022/28889/final/fin_irjmets1659003745.pdf.

[15] A.Gayathiri; J.Jayachitra; S.Matilda, et. al., "Certificate validation using blockchain" published in IEEE open Access, available at https://ieeexplore.ieee.org/document/9201988.

[16] C.RASHMI, G. ARCHANA, K. RASHMIKA, K. SPANDANA, CH. MANASA, et. al., "A BLOCKCHAIN BASED SECURE AND EFFICIENT VALIDATION SYSTEM FOR DIGITAL CERTIFICATES" published in turcomat open Access, available at https://turcomat.org/index.php/turkbilmat/article/view/14172.

AUTHOR'S PROFILE:

Mrs.Chepuri. Deepti, currently working as an Assistant Professor in the Department of Computer Science and Engineering, QIS College of Engineering and Technology, Ongole, Andhra Pradesh. She did her BTech from Uttar Pradesh Technical University, Lucknow, M. Tech from JNTUK, Kakinada. Her area of interest are Machine Learning, Artificial intelligence, Cloud Computing and Programming Languages.

Ms. Telukutla lavanya, currently pursuing master of computer applications at Qis college of engineering and technology. (Autonomous), ongole, Andhra Pradesh. she completed B.sc in the stream of physics from Sri Harshini degree & PG college (ongole), Andhra Pradesh. And her areas of interest are python and block chain.