

Blockchain Enabled Marksheets and Degree Certificates

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Abstract—The certificates and grade reports are crucial records for anyone applying for a job or seeking higher education because they act as identification verification. The traditional paper-based certificate method makes obtaining such a crucial document highly time-consuming and expensive. A trusted authority issues the digital certificate, which is a document that may be used to demonstrate authenticity. Technology development has made it possible for the practice of producing fraudulent report cards and diplomas. Document fraud and forgery have gone unreported due to a lack of anti-forgery mechanisms. E-documents use digital signatures to enable authentication, integration, and non-repudiation, however forgery is possible when the key itself is compromised. In order to prevent certificate fraud and guarantee the security, legitimacy, and secrecy of diplomas, blockchain technology is deployed. Blockchain ensures correctness and trustworthiness of information and allows for quick authentication of degree certificates.

Index Terms— Blockchain, Digital Signatures, Digital Markcard, E-document.

I. INTRODUCTION

In order to demonstrate a graduate's qualifications once they successfully complete the chosen course, universities provide certificates to the graduates. The crucial records needed to apply for jobs and further education are these marksheets and degree certificates. Validation and verification of documents have grown in importance. It is important to confirm that the graduate's diploma is authentic and that the owner is the rightful owner with the appropriate authorization [1]. Traditional paper certificates need a lot of time and money. They are even susceptible to fraud brought on by blunders and forgery. Mark sheets made of paper have a long procedure, little flexibility, and are not environmentally friendly. However, the forging of certificates has increased as a result of the availability of sophisticated and affordable technologies. Both the credential bearer and the university that granted the certificate are put in danger [6] as a result of this. This study suggests a system that uses blockchain technology to digitalize both the production of degree certificates and their verification. The markcards are protected from fabrication and falsification thanks to the immutable nature of blockchain technology. [11]

More than any other invention this century, blockchain technology will significantly influence the way we live in the future. Anyone who cannot comprehend it will soon feel left behind when they awaken in a technologically advanced world that increasingly resembles magic. The development of various techniques to verify academic records such as degree markcards has confused people on which architecture is best to identify real and forged markcards. [12] As blockchain has a very interesting feature of immutability this project uses permissionless blockchain such as Ethereum as a platform to build a system that issues and validates the degree certificates [16]. Traditional paper-based degrees and mark cards are susceptible to fraud due to typos and forgeries. Markcards

made of paper have a long processing time, little flexibility, high cost, and are not environmentally friendly. Students who are seeking for jobs right after graduation, students who are going to institutions abroad with the goal of pursuing higher education, and recruiters are all having difficulty validating their marksheets because bogus marksheets and degree credentials are widely available. [13] [14] Therefore, the goal of this study is to suggest a system that makes certificate fraud impossible.

A. Objectives of Blockchain

1. Digitalizing mark cards and degree certificates using blockchain technology.
2. Easy to check and verify the markcards through online. Students can obtain their certificates online and submit to the recruiter during the interview process, and recruiter can validate certificate using digital mark cards platform.
3. Digitalized mark cards are free from forgery and falsification and are secured using blockchain technology.
4. Digitalizing with blockchain technology reduces time consumption and is available at low cost.
5. Digitalizing the degrees and mark cards using blockchain technology provides confidentiality, integrity, non-repudiation and authentication.

II. RELATED WORK

The Research Paper “Paper-based Document Authenticating using Digital Signature and QR Code” by M. Warasart and P. Kuacharoen gives us brief understanding of implementing paper based document authentication. This paper presents an implementation of paper-based document authentication. The integrity of the text message and the author of the document can be verified with the use of a digital signature and QR code. This model can be either automatic or semi-automatic [1]. When the OCR is not accurate and when it requires the user to visually compare the text message on the paper and the one obtained from the QR code the model is said to be semi-automatic; however, this method does provide convenience for the user in dealing with a large amount of documents. [2]

[3] The Research paper “Using Blockchain as a tool for tracking and verification of official degrees: business model” by Oliver, Miquel; Moreno, Joan; Prieto, Gerson; Benitez, David gives the brief knowledge of verification of degree certificates from business perspective. This paper presents two financial models balancing, the price for the service is balanced between the employer and the graduate as they are main stakeholders of that service. Students demand easy to check and less cost proof of certification, employers when recruiting demand quick and trustable verification of degrees. [4] [15]

The Research paper "A Graduation Certificate Verification Model via Utilization of the Blockchain Technology" by Osman Ghazali and Omar S. Saleh provides a theoretical knowledge of blockchain technology for issuing and verification of academic certificates [6]. The fundamental idea of using blockchain for issuing and verification of academic records closes all the gaps and difficulties in existing systems. This paper provides the knowledge of hash, public/private key cryptography, digital signatures, peer-to-peer networks and proof of work. The paper explains how to use various elements to formulate the block which is divided into two main processes, namely issuing a digitally signed academic certificate and verifying the academic certificate. [5]

[7] The Research paper "CredenceLedger: A Permissioned Blockchain for Verifiable Academic Credentials" by R. Arenas and P. Fernandez gives the knowledge of using permissioned blockchain for verifying academic records. This paper describes how permissioned Blockchain can be applied to a specific educational use case - decentralized verification of academic credentials. CredenceLedger, is a system that stores compact data proofs of digital academic credentials in Blockchain ledger that are easily verifiable for education stakeholders and interested third party organizations. [8]

[9] The Research paper “A Permissioned Blockchain-Based System for Verification of Academic Records” by Ahmed Badr, Laura Rafferty, Quassy H. Mahmoud, Khalid Elgazzar and Patrick C.K. Hun gives us the idea of implementing our system for verification of degree markcards. In permissioned blockchain the verification of academic records using hyperledger fabric is the main focus to leverage the blockchain application in education domain. Various challenges in sending and receiving the transcripts between universities and difficulties in verifying the academic records by recruiters are solved using Hyperledger fabric. [10]

III. DESIGN OF EXPERIMENT/ MATERIAL METHODS

A. Algorithm

Step 1: User Logged in.

Step 2: Admin User logged in,
 Yes, Go to Next Step.
 No, Go to Step 9.

Step 3: Display dashboard, View Certificate and Issue Certificate for all the students list.

Step 4: Logout
 Yes, end the process. Stop,
 No, Go to next step.

Step 5: Click on view certificate.

Step 6: Certificate available?
 Yes, Click on View Certificate Go to Next Step.
 No, Click on Issue Certificate Go to Step 8.

Step 7: Get url from Certificate Table & Prompt Display window to download certificate. Go to Step 2.

Step 8: Update CertificateAvailable True in Database and call enroll(id,certificateHash) to update into blockchain. Go to Step 2.

Step 9: Company User logged in.
 Yes, Go to next step.
 No, Go to Step 16.

Step 10: Display dashboard, Validate Certificate for students list.

Step 11: Logout
 Yes, end the process. Stop,
 No, Go to next step.

Step 12: Click on Validate Certificate, Upload the Certificate File & find md5sum of image.

Step 13: ImageHash == blockChainStoredHash
 Yes, Go to Next Step.
 No, Display Failed message Go to Step 9.

Step 14: Display message: Validation Success & Display Profile Page.

Step 15: Click on dashboard. Go to Step 9.

Step 16: Logged in as Student User.

Step 17: Logout
 Yes, end the process. Stop,
 No, Go to next step.

Step 18: Request for certificate

Step 19: Certificate Issued by University?
 Yes, Display the profile page. Go to Next Step,
 No, wait for the certificate to be issued.

Step 20: Logout
 Yes, end the process. Stop,
 No, Go to next step.

The modules are as follows:

1. **User Interface Design:** After the user login to user interface, the first page visible is the dashboard. In the dashboard, admin user can view the certificate, Issue certificate, able to see list of students and companies. Student user can request and view his certificate, whereas company user can validate and view certificate of the candidate. In general user interface has Student List, Company List, View Certificate, Issue Certificate, Request Certificate and Validate Certificate modules. These modules are visible based on the role of each user exists the digital certificate system.
2. **Verification:** Verification has steps to verify data from database using database connector and blockchain using web3 connector. Database connectors used to update Certificate availability in User table and Certificate URL in the Certificate table. Web3 Connector used to add student details to block chain and get student details from the blockchain. The purpose of the verification is to verify whether the uploaded certificate is valid or not using the connectors.
3. **Server:** In project, firebase database is used for storing the data. As shown in figure, User table stores student and user details like name, email id, usn number etc., each user is categorized using user role column. User role 1 is set for admin and 2 & 3 is set for company & student respectively. In the project, firebase database is used for storing the data. As shown in the figure, User ta student and user details like name, email id, usn number etc., each user is categorized using user role column. User role 1 is set for admin and 2 & 3 is set for company & student respectively. Certificate table stores the data URL

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4. **Blockchain:** Ganache is personal blockchain for Ethereum development, which can be used to deploy contracts, develop your applications and run tests. Records are stored in terms of blocks, each Ganache is personal blockchain for Ethereum development, which can be used to deploy contracts, develop your applications and run tests. Records are stored in terms of blocks, each of the records contains usn and certificate hash.

As shown in the below Fig. 4.3, Data Flow diagram for digital certification consists of three main entity. Admin, Student/Company and Blockchain. When admin click on View Certificate button, first in the system will verify in the user table, whether certificate is available is true, if its true then certificate url will be fetched from certificate table and url will be passed to admin user for download. If certificate is not available for particular student, then issue certificate will be shown to admin user. When admin user clicks on issue certificate, is puts the image url to the certificate table and update certificate available column in user table as true. And also, push's the details to blockchain using enroll methods with USN and certificate has detail. In case of company user, whenever they click on validate user, system verifies the certificate with newly uploaded certificate hash with hash available in the block chain for that particular student. If the certificate is valid then profile information of the student is displayed. In case of student user, student will request for the certificate, and wait for certificate to be issued, once certificate is issued, he will able to view and download the certificate.

B. Sequence Diagram

User Click on login button, validate user will be called for validatin g user email and password. To validate the user, emailed and password verified in the database, when credentials match with the database credentials user Login will be successful. And the dashboard will display list of students.

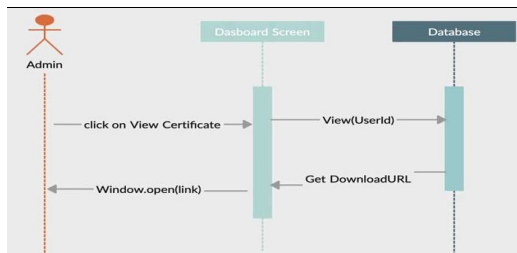


Fig. 1: Data Flow Diagram of Admin

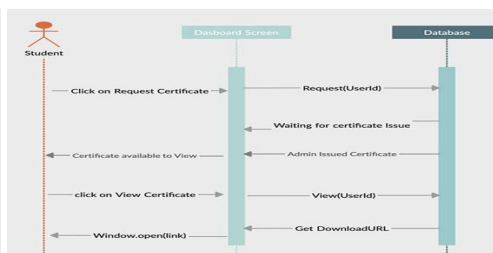


Fig. 2: Data Flow Diagram of Admin

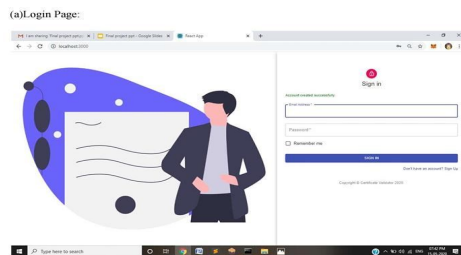


Fig. 3: Login Page

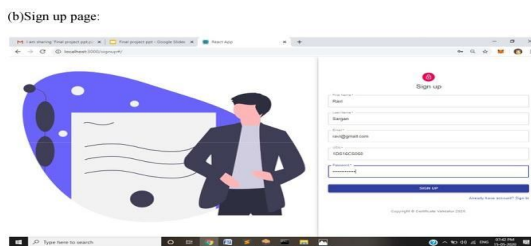


Fig 4: New User Registration

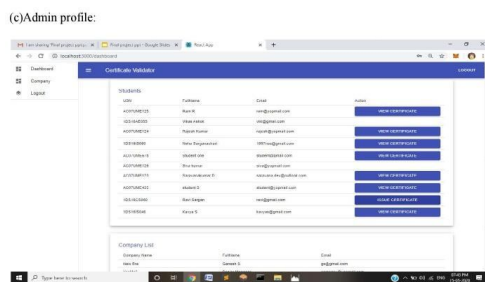


Fig. 5: Admin Profile

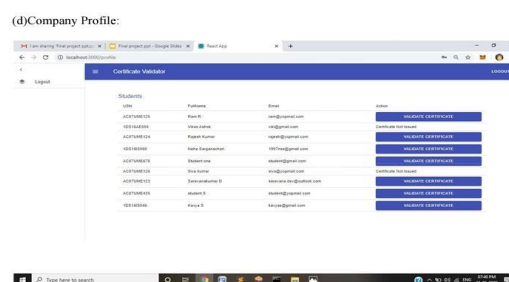


Fig. 6: University/ Company Details

(e) Student profile:

Fig. 7: Student Profile

(f) Verification Success: when original markscard is uploaded to validate.

Fig. 8: Verification status Page after the validation of marksheet

(g) Verification Failed: when modified or fake markscard is uploaded to validate:

Fig. 9: Verification Status Page for an altered marklist

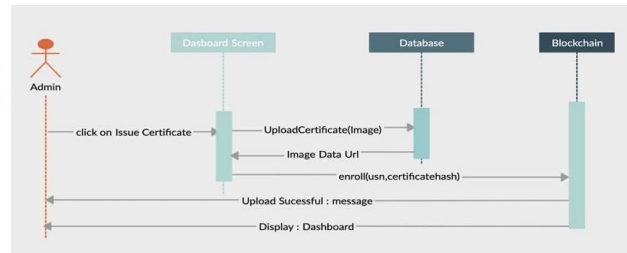


Fig. 10: Verification Data Flow

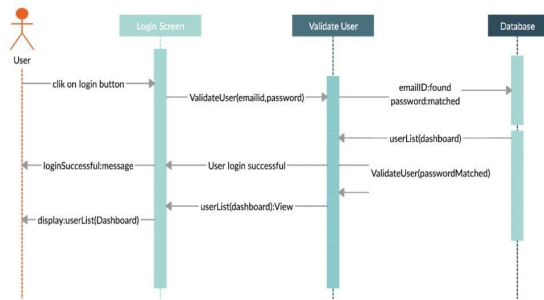


Fig. 11: User Validation Data Flow

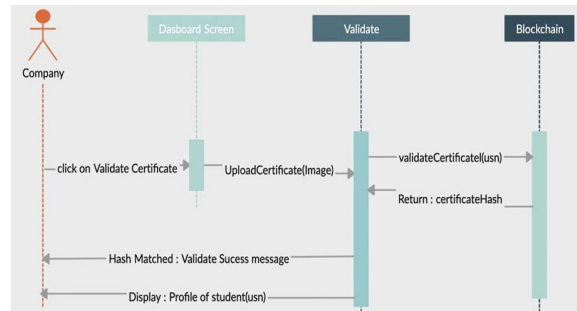


Fig. 12: University/ Company Certificate Validation Data Flow

The graphic below illustrates the five significant modules that make up the module flow diagram. The ensuing modules are combined to fulfil the needs of the suggested project. These are the modules:

1. User Interface Design
2. Server
3. Blockchain
4. Verification

The front-end web application that enables registration for students and universities through easy form filling is included in the user interface design module. Every time a user registers, the database of universities and students is updated. Only from the specific university that the student attends may they request a certificate. The university computes the hash of the certificate and uploads the requested document to the web server if the user is a legitimate student. Now the student can download their diploma. The blockchain stores the certificate's hash rather than the complete file because the valid transactions are committed to it. The certificate produced by the student may now be hashed using the same process, and prospective employers and other universities can compare the results to the hash stored in the blockchain for that specific certificate. The markscard is legitimate if the hashes of the two are identical; else, it is invalid.

IV. DEVELOPMENT AND TESTING OF THE PROPOSED SYSTEM

The project is stored in the certificate-validation folder. When the project executes it leads us to sign in page. It is having two entries: email id and password which are provided by the user during registration or sign up. If it is a new user then link to sign up page is available which takes required information. By default role 3 which means user as student is set. Whereas admin has role 1 and company has role 2. Admin user is directed to the

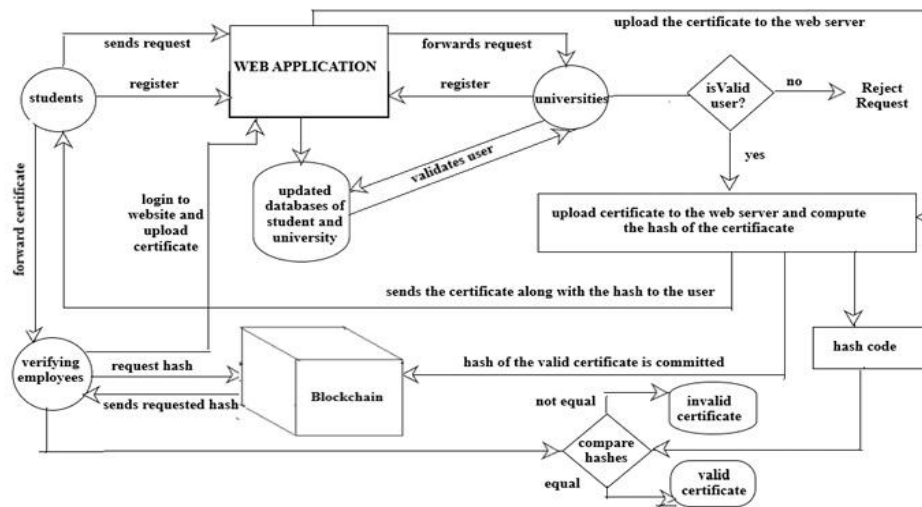


Fig. 13: Architecture Design

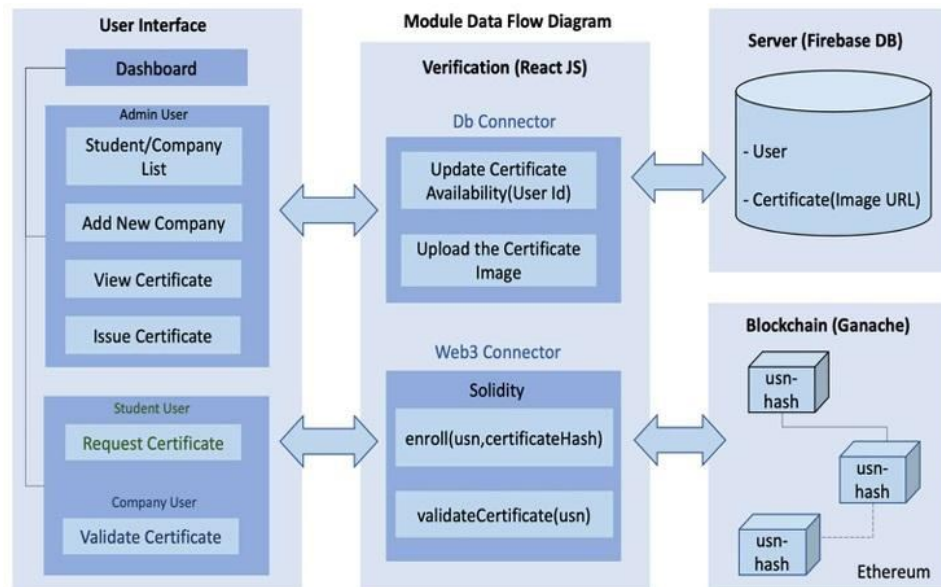


Fig. 14: Modules in the proposed architecture

dashboard comprising of student list, company list and logout option. Under the student list, the action column is either empty for particular user who just registered but not requested any certificates or if the particular user is requesting a certificate, then action column contains issue certificate button which is clicked to select the particular student certificate from the college database to upload it. If certificate is already issued to a student, then only view certificate button is visible to view certificate. The admin can add new companies by navigating to company list. Company user is directed to the dashboard comprising of student list. The student list contains a column which is either empty for student who did not have any certificates yet or contains a validate certificate button if a particular student has the certificate. When a student user log into the system then he will be having all the details given by him during registration along with a certificate row either containing a button view certificate if the certificate is already issued otherwise request certificate button to request for certificate. When a student takes his certificate to a company, then company can simply login to the system and click on validate certificate button for particular student which redirects to a validation page where the certificate given by student is uploaded using cloud. If the certificate is same as issued by the admin/college then the certificate valid message pop up in the same window otherwise shows certificate invalid indicating the certificate is either forged or altered.

TABLE 1: TEST CASES

SI No.	Description	Input Object	Expected o/p	Actual o/p	Result
1	Valid certificate uploaded by admin	Valid certificate	Validation Success	Validation Success	Pass
2	Invalid certificate uploaded by company	Invalid certificate	Validation Failed	Validation Failed	Pass
3	Proper Login details	user details	Dashboard	Dashboard	Pass
4	Signup details	Valid details	Account created	Account created	Pass
5	Improper details in login n sign up	Wrong credentials	Shows error	Shows error	Pass

V. CONCLUSIONS

Any record that is stored in the blockchain repository cannot be changed because to the immutable nature of blockchain technology. It offers security, integration, and authentication. Online access to digital degree certificates reduces costs and saves time. The ability to receive a replica of the original markcards or certificates online in the event of loss or damage to the originals offers a great deal of flexibility. Security is provided by the fact that the papers kept in the blockchain repository cannot be changed or removed. The main benefactors of this system are universities, students, and recruiters because it makes the process of creating and verifying certificates and marksheets easier. In conclusion, the suggested model avoids certificate fraud and falsification, and employers may be confident that they will receive accurate information from the blockchain repository. Digital certification also has huge scope for all the sectors of education like medical, engineering, pharmacy, law etc. which can adopt new certification and save a lot of manual work. Digital certification is essential for all the online courses, as digital certification avoid forgery so these online course certifications will be easily accepted by organisation. For example, company user creation option through online portal directly helps rather than university creating the same. So, university will only accept organisation request and allow them to use the digital certification if they match certain criteria. Using digital certificate, we can do a lot more. We may also incorporate the online test, so the student will receive their certification right away following the test's approval. Digital certificate has lots of future scope in future, as in current situation social distance has become very important aspect of life, so degree certificates and markscard can be obtained online.

REFERENCES

- [1] M. Warasart and P. Kuacharoen, "Paper-based Document Authenticating using Digital Signature and QR Code," no. Iccet, 2012.
- [2] Z. Chen, "Anti-Counterfeit Authentication System of Printed Information Based on A Logic Signing Technique".
- [3] Oliver Miquel, Moreno Joan, Prieto Gerson, Benitez, David (2018): "Using Blockchain as a tool for tracking and verification of official degrees: business model", 29th European Regional Conference of the ITS.
- [4] Juliana Nazare, Kim Hamilton Duffy, J. Philipp Schmidt "Digital Certificate Project" MIT Media Labs, 2015.
- [5] Stephen Thompson "The Preservation of Digital Signatures on the Blockchain" University of British Columbia iSchool Student Journal, vol.3 (Spring 2017).
- [6] Jayashri, N., Rampur, V., Gangodkar, D., Abirami, M., Balarengadurai, C., & Kumar, A. (2023). Improved block chain system for high secured IoT integrated supply chain. Measurement: Sensors, 25, 100633.
- [7] Osman Ghazali and Omar S. Saleh, "A Graduation Certificate Verification Model via Utilization of the Blockchain Technology", e-ISSN: 2289-8131 vol. 10 no. 3-2.
- [8] X. Technologies, "Blockchain imperative for educational certificates," Xanbell Technologies, 2017.
- [9] MIT Media Lab Learning Initiative and Learning Machine, "Digital Certificates Projects." [Online]. Available: <http://certificates.media.mit.edu/>.
- [10] R. Arenas and P. Fernandez, "CredenceLedger: A Permissioned Blockchain for Verifiable Academic Credentials." In IEEE international conference on Engineering, Technology and Innovation (ICE/ITMC). Stuttgart, Germany 2018.
- [11] Ahmed Badr, Laura Rafferty, Quassy H. Mahmoud, Khalid Elgazzar, Patrick C.K. Hung "A Permissioned Blockchain-Based System for Verification of Academic Records" in IEEE 2019.

- [12] Sharma, I., & Sharma, S. (2022, November). Blockchain Enabled Biometric Security in Internet-of-Medical-Things (IoMT) Devices. In 2022 International Conference on Augmented Intelligence and Sustainable Systems (ICAISS) (pp. 971-979). IEEE.
- [13] Neethu Gopal and Vani V Prakash, "Survey on Blockchain Based Digital Certificate System," IRJET, vol. 5, Issue: 11 | Nov 2018.
- [14] Nitin Kumavat, Swapnil Mengade, Dishant Desai, Jesal Varolia, "Certificate Verification System using Blockchain," IJRASET vol. 7 Issue IV, Apr 2019
- [15] Tyagi, S., Ansari, N., Bisht, D., Kumar, R., Memoria, M., Awasthi, M., ... & Gupta, A. (2022, May). Role of IOT and Blockchain in Achieving a Vision of Metropolitan's Digital Transformation. In 2022 International Conference on Machine Learning, Big Data, Cloud and Parallel Computing (COM-IT-CON) (Vol. 1, pp. 752-757). IEEE.
- [16] T. Keerthana, R. Tejaswini, V. Yamini, K. Hemapriya, "Integration of Digital Certificate Blockchain and Overall Behavioural Analysis using QR and Smart Contract", IJRESM vol. 2, Issue-3, March 2019.