Smart Contract Enabled Online Examination System Based on Blockchain

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Abstract*: The Smart Contract Enabled Online Examination System Based on Blockchain is a project that aims to revolutionize the traditional examination system by leveraging the power of blockchain technology. The project proposes a tamper-proof and transparent examination system that is based on smart contract technology. The system will provide students with the opportunity to take exams from anywhere in the world, without the need for a physical examination center. The proposed system will also eliminate the need for third-party examination invigilators, thereby reducing costs and ensuring integrity. The system's architecture will consist of four components: the blockchain, smart contracts, a user interface, and an authentication mechanism. The blockchain will provide the necessary decentralization and transparency required for a tamper-proof examination system. The smart contract technology will be used to create self-executing contracts that will ensure the examination process is fair and free from manipulation. The user interface will allow students to access the examination system and complete their exams, while the authentication mechanism will ensure that only authorized users can access the system. The proposed system's benefits include increased efficiency, security, and transparency in the examination process. The system will provide institutions with an efficient and secure way of conducting examinations. It will also improve the credibility of the examination system, which is essential in today's competitive educational landscape. Additionally, the system will reduce costs associated with traditional examination systems, such as the need for physical examination centers and invigilators. The project's implementation will involve the development of a proof-of-concept system to demonstrate the feasibility of the proposed system. The proof-of-concept will be developed using the Ethereum blockchain platform and will utilize smart contract technology to implement the examination process. The system's functionality will be demonstrated using a simulated examination scenario. In conclusion, the Smart Contract Enabled Online Examination System Based on Blockchain is a promising project that seeks to transform the examination system by leveraging the power of blockchain technology. The proposed system's benefits include increased efficiency, security, and transparency, which will benefit both students and institutions. The implementation of the system will involve the development of a proof-of-concept, which will demonstrate the feasibility of the proposed system.*

Keywords: Blockchain, Secure, Smart Contract, Solidity, Metamask, Examination System

I. INTRODUCTION

The emergence of blockchain technology has brought about significant changes in colorful diligence, including education. One of the areas that blockchain technology can revise is the examination system. A smart contract-enabled online examination system grounded on blockchain is a design that seeks to bring translucency, invariability, and security to the examination process. Traditional examination systems are prone to crimes, manipulation, and lack of translucency. With the perpetration of blockchain technology, the examination system can come more effective, secure, and secure. Smart contracts run on the blockchain. Thus, the code and the agreement are stored on a distributed public database and cannot be changed [1].The smart contract technology, which is a tone-executing contract with the

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terms of the agreement between buyer and dealer directly written into lines of law, will ensure that the examination process is fair and free from manipulation. The proposed system leverages the decentralized nature of blockchain technology to produce a tamper-evidence and transparent examination system. This system will enable scholars to take examinations from anywhere in the world without the need for a physical examination center. The system will also exclude the need for third-party examination invigilators, thereby reducing costs and icing integrity. Decentralized Applications are the smart systems that are executed on a distributed computer network. Blockchain enables one of the most secure applications called Smart Contract. Smart Contracts are the computerized and secured distributed ledgers that enable secure, transparent, and tamper-proof transactions [6]. The perpetration of the smart contract-enabled online examination system won't only profit scholars but also institutions. The system will give institutions with an effective and secure way of conducting examinations. It'll also ameliorate the credibility of the examination system, which is essential in moment's competitive educational geography. This design holds significant pledge in transubstantiation the examination system and paving the way for a more transparent and secure future.

With the help of machine learning algorithms, the model can provide real-time protection against phishing attacks, allowing users to browse the internet with confidence. The proposed blockchain framework improves data security and removes any potential cheating between users or third-party institutions that access applications and services. In this regard, this study provides a secured framework for conducting and evaluating subject tests to ensure consistency between student and server, and secure delivery of questionnaire from the server [2].

II. METHODOLOGY

Requirements gathering: The first step in the implementation process is to gather the requirements for the online examination system. This involves identifying the types of exams, the number of questions, the grading criteria, and the security measures to be implemented.

Technology selection: The next step is to select the appropriate technologies for the development of the system. The chosen technologies should include a blockchain platform such as Ethereum, a smart contract development tool such as Remix IDE, and a database management system such as MongoDB for storing exam-related data and MySQL for storing user data.

System architecture design: Once the technologies have been selected, the system architecture should be designed. This involves defining the data storage mechanisms, the user authentication and authorization system, and the smart contract architecture.

Frontend and backend development: The frontend and backend of the online examination system should be developed using PHP, HTML, CSS, and other web development technologies. The user authentication and authorization system should be implemented, and the blockchain components should be integrated using web3.js or other blockchain integration tools.

Smart contract development: Smart contracts should be developed using Remix IDE, Solidity, and other smart contract development tools. The smart contract architecture should be defined, including the exam question format, grading criteria, and the issuance of certificates.

System integration: The frontend, backend, and blockchain components of the online examination system should be integrated. The system should be tested for functionality, usability, and security.

Testing and deployment: The online examination system should be tested for scalability, reliability, and security. Once the system has been thoroughly tested, it should be deployed on the Ethereum mainnet or a testnet, depending on the deployment requirements.

Evaluation: The system should be evaluated for its effectiveness and efficiency in achieving the project goals. Areas for improvement should be identified, and recommendations for future development should be made.

Overall, the implementation of a smart contract-enabled online examination system based on the blockchain requires a comprehensive approach that involves the selection of appropriate technologies, the design of a suitable system architecture, the development of frontend, backend, and blockchain components, the integration of the system, testing, and deployment, monitoring and maintenance, and evaluation.

III. TECHNOLOGIES USED

Blockchain:

Blockchain is a distributed ledger technology that enables secure and transparent data exchange. It stores data in a decentralized and tamper-proof manner, making it an ideal solution for online examination systems. Blockchain provides a high level of security, as each transaction is verified and recorded in a public ledger. It also provides transparency, as all participants can view the data stored on the blockchain. Blockchain technology is the fastest and secure technology for exchanging the data & information over the network. Each block may contain a transaction record or any other data based on the application [15].

Ganache:

Ganache is a personal blockchain for Ethereum development that allows developers to create a local blockchain environment for testing smart contracts and dApps. It private blockchain that facilitates the swift development of Ethereum and Filecoin distributed applications. It can be employed at every stage of the development process, from creating to deploying and testing dApps, within a secure and dependable environment [17]. It provides a sandbox for developers to test their code and simulate real-world scenarios before deploying on the main network. Ganache offers a user-friendly interface and tools for managing accounts, transactions, and contracts.
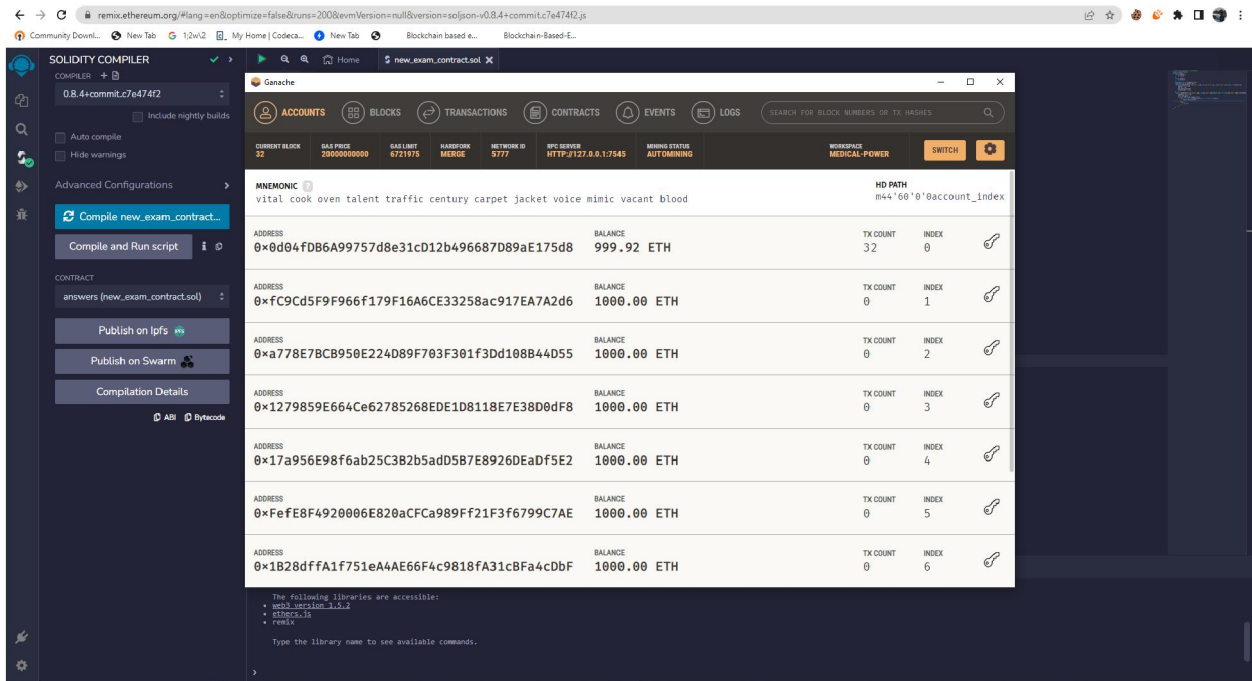

Ethereum:

Ethereum is a Blockchain network that introduced a built-in Turing-complete programming language that can be used for creating various decentralized applications(also called Dapps). The Ethereum network is fueled by its own cryptocurrency called 'ether'. The Ethereum network is currently famous for allowing the implementation of smart contracts. Smart contracts can be thought of as 'cryptographic bank lockers' which contain certain values [16].

It enables the creation of smart contracts and dApps. It is built on blockchain technology and provides a programmable blockchain that can be used to create custom applications and smart contracts. Ethereum uses its cryptocurrency, Ether, for transaction fees and incentivizes miners to verify transactions.

Remix IDE:

Remix IDE is a web-based IDE that allows developers to write, test, and deploy smart contracts on the Ethereum network. It supports multiple programming languages, including Solidity, Serpent, and Vyper. It provides a user-friendly interface and tools for debugging and deploying smart contracts. The Remix IDE provides a range of tools that

allow developers to interact with the Ethereum blockchain, debug code, and save it in a Git repository. GitHub is an open platform where developers can store their application code in the cloud. Specifically designed for Solidity dApp developers, the Remix IDE offers a comprehensive development environment [10].
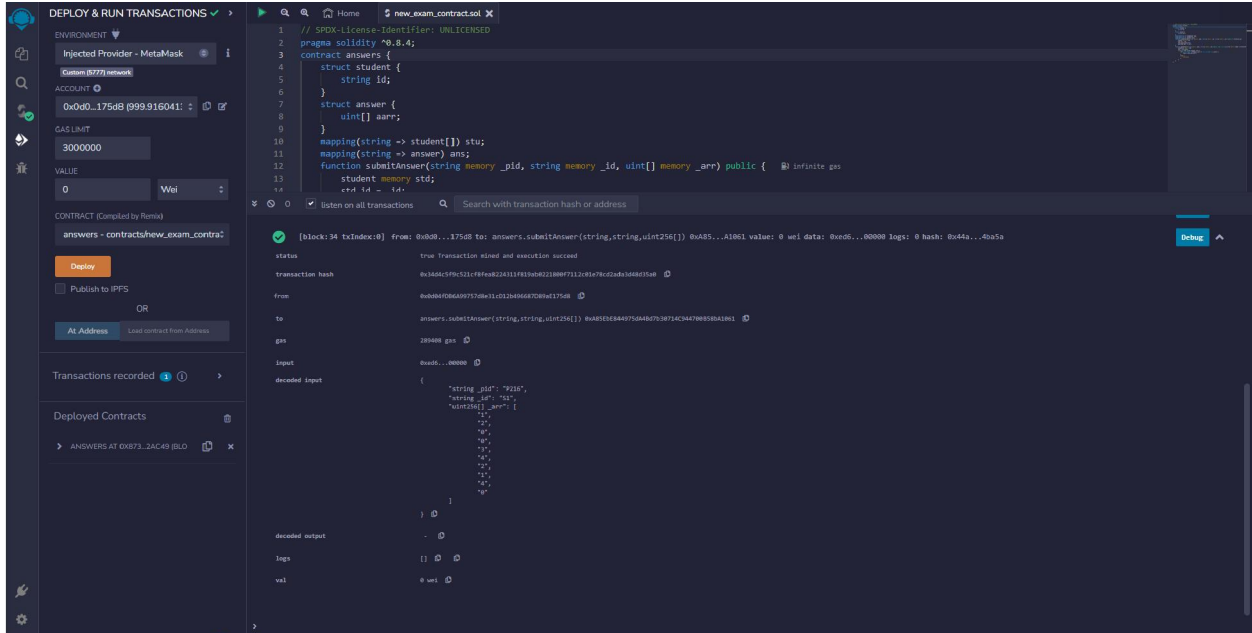
Smart Contract:

Smart contracts are considered a significant breakthrough in the field of blockchain technology. They were initially proposed in the 1990s as a transaction protocol that executes contractual terms automatically when certain conditions are met [14]. These contracts contain embedded clauses that are enforced without the need for manual intervention.

In essence, smart contracts are computer programs that reside on a blockchain and are designed to execute automatically when pre-programmed conditions are satisfied. Their primary purpose is to automate the execution of an agreement, which eliminates the need for intermediaries and reduces the time required to reach a final outcome. Smart contracts can also streamline workflows by triggering the next step in a process when certain conditions are met [3].

PHP:

PHP, which stands for "PHP: Hypertext Preprocessor," is a popular open-source scripting language that is widely utilized for general-purpose programming and web development. It is particularly well-suited for web development and can be seamlessly integrated into HTML [9].PHP is a server-side scripting language used for web development. It is often used to build dynamic websites and web applications. PHP is an open-source language that is widely used in the development of web applications due to its flexibility, ease of use, and wide availability of libraries and frameworks.

MongoDB:

MongoDB is a NoSQL database that is designed to handle unstructured data. It provides high scalability, availability, and performance for storing and retrieving data. MongoDB is an ideal solution for storing exam-related data, such as questions, answers, and results, as it can handle large volumes of data and provide high-performance access to the data. MongoDB is a type of NoSQL database that uses a document-oriented approach to store data. It includes a feature called GridFS, which allows for the storage of files of any size. MongoDB stores data using a format called BSON, which makes it fast and easy to query data. It is also highly scalable, allowing for easy expansion as needed, with low associated costs [18].

MySQL:

MySQL is a popular open-source relational database management system. It is widely used in web development for storing structured data, such as user data, login credentials, and other application data. MySQL is known for its ease of use, reliability, and scalability, making it an ideal choice for storing user data in an online examination system.

Metamask:

Metamask is a browser extension that allows users to interact with decentralized applications on the Ethereum network. It provides a secure and user-friendly interface for managing digital assets and interacting with smart contracts [11]. Metamask allows users to create and manage Ethereum accounts, send and receive ETH, and interact with dApps and smart contracts. Metamask is an ideal solution for users who want to interact with a smart contract-enabled online examination system based on blockchain.

IV. LITERATURE SURVEY

[1] A Blockchain-Based Smart Contract Towards Developing Secured University Examination System -
Ashis Kumar Samanta, Bidyut Biman Sarkar & Nabendu Chaki
Abstract:

The emergence of online examination systems has brought many advantages to the education sector, including convenience, flexibility, and cost-effectiveness. However, these systems face various security threats, including hacking, impersonation, and cheating. Blockchain technology can offer a potential solution to these challenges by providing a transparent, decentralized, and tamper-proof platform for conducting online exams [4].

This research paper proposes a blockchain-based smart contract solution for developing a secured university examination system. The proposed system utilizes the Ethereum blockchain and smart contracts to provide a decentralized and transparent platform for conducting exams. The system's design and implementation are discussed in detail, along with an analysis of its performance and security features.

The proposed system aims to provide a secure, reliable, and tamper-proof platform for conducting university exams. The use of blockchain technology ensures data immutability, transparency, and decentralization, providing a reliable platform for conducting exams. The smart contracts automate the examination process, ensuring the reliability and efficiency of the system.

The research paper evaluates the proposed system's performance and security features, including scalability, data privacy, and resistance to hacking and cheating. The analysis shows that the proposed system can provide a secure and reliable platform for conducting university exams.

Overall, this research paper provides a valuable contribution to the ongoing efforts to develop more reliable and secure online examination systems. The proposed blockchain-based smart contract solution offers a promising approach to addressing the security challenges posed by online examination systems. It can be of significant interest to educators, policymakers, and researchers in the field of education and technology [4].

[2] An advanced and secure framework for conducting online examinations using the blockchain method
Md Rahat Ibne Sattar a, Md. Thowhid Bin Hossain Efty a, Taiyaba Shadaka Rafa a, Tusar Das a, Md Sharif Samad a, Abhijit Pathak a, Mayeen Uddin Khandaker b c, Md. Habib Ullah d
Abstract:

Online examination systems have become increasingly popular due to their numerous benefits, such as convenience, flexibility, and cost-effectiveness. However, these systems face significant security threats, including cheating, hacking, and impersonation. Blockchain technology can provide a potential solution to these challenges by providing a transparent, decentralized, and tamper-proof platform for conducting online exams.

This research paper proposes an advanced and secure framework for conducting online examinations using the blockchain method. The proposed system utilizes the Ethereum blockchain and smart contracts to provide a secure and reliable platform for conducting online exams. The system's design and implementation are discussed in detail, along with an evaluation of its performance and security features.

The proposed framework offers several advantages over traditional online examination systems, including increased transparency, decentralization, and data immutability. The use of smart contracts automates the examination process, ensuring a secure and efficient system. The research paper discusses the system's scalability, data privacy, and resistance to hacking and cheating.

The proposed framework can be applied to various educational contexts, including schools, universities, and professional certification exams. It offers a practical and innovative solution to the challenges posed by online examination systems, ensuring the integrity and security of the examination process.

Overall, this research paper provides a valuable contribution to the ongoing efforts to develop more reliable and secure online examination systems. The proposed advanced and secure framework utilizing blockchain technology offers a promising approach to addressing the security challenges posed by online examination systems. It can be of significant interest to educators, policymakers, and researchers in the field of education and technology [2].

[3] BSSSQS: A Blockchain-Based Smart and Secured Scheme for Question Sharing in the Smart Education System
Anik Islam, Md. Fazlul Kader, Soo Young Shin
Abstract:

In recent years, smart education systems have become increasingly popular due to their ability to provide flexible, convenient, and efficient learning experiences. However, these systems face various challenges, including the secure sharing of educational resources, such as questions and quizzes. Blockchain technology can provide a potential solution to these challenges by providing a transparent, decentralized, and tamper-proof platform for sharing educational resources.

This research paper proposes a blockchain-based smart and secured scheme, called BSSSQS, for question sharing in the smart education system. The proposed scheme utilizes the Ethereum blockchain and smart contracts to provide a secure and efficient platform for sharing questions among educators and students. The system's design and implementation are discussed in detail, along with an analysis of its performance and security features.

The proposed scheme offers several advantages over traditional question-sharing systems, including increased transparency, decentralization, and data immutability. The use of smart contracts automates the question-sharing process, ensuring the reliability and efficiency of the system. The research paper evaluates the proposed scheme's performance and security features, including scalability, data privacy, and resistance to hacking and cheating.

The proposed scheme can be applied to various educational contexts, including schools, universities, and professional certification programs. It offers a practical and innovative solution to the challenges posed by secure question sharing in the smart education system.

Overall, this research paper provides a valuable contribution to the ongoing efforts to develop more reliable and secure smart education systems. The proposed blockchain-based smart and secured scheme for question sharing offers a promising approach to addressing the security challenges posed by smart education systems. It can be of significant interest to educators, policymakers, and researchers in the field of education and technology [19].

[4] An Innovative and Secure Platform for Leveraging the Blockchain Approach for Online Exams
Albert Manawar
Abstract:

Online exams have become increasingly popular in recent years, offering benefits such as flexibility, convenience, and cost-effectiveness. However, these exams face significant security challenges, including cheating, hacking, and impersonation. Blockchain technology provides a potential solution to these challenges by offering a transparent, decentralized, and tamper-proof platform for conducting online exams.

This research paper proposes an innovative and secure platform for leveraging the blockchain approach for online exams. The proposed platform utilizes the Ethereum blockchain and smart contracts to provide a secure and reliable platform for conducting online exams. The paper presents the design and implementation of the platform, as well as an evaluation of its performance and security features.

The proposed platform offers several advantages over traditional online exam systems, including increased transparency, decentralization, and data immutability. The use of smart contracts automates the exam process, ensuring

a secure and efficient system. The paper discusses the platform's scalability, data privacy, and resistance to hacking and cheating.

The proposed platform can be applied to various educational contexts, including schools, universities, and professional certification exams. It offers a practical and innovative solution to the challenges posed by online exams, ensuring the integrity and security of the exam process.

Overall, this research paper provides a valuable contribution to the ongoing efforts to develop more reliable and secure online exam systems. The proposed innovative and secure platform utilizing blockchain technology offers a promising approach to addressing the security challenges posed by online exams. It can be of significant interest to educators, policymakers, and researchers in the field of education and technology [4].
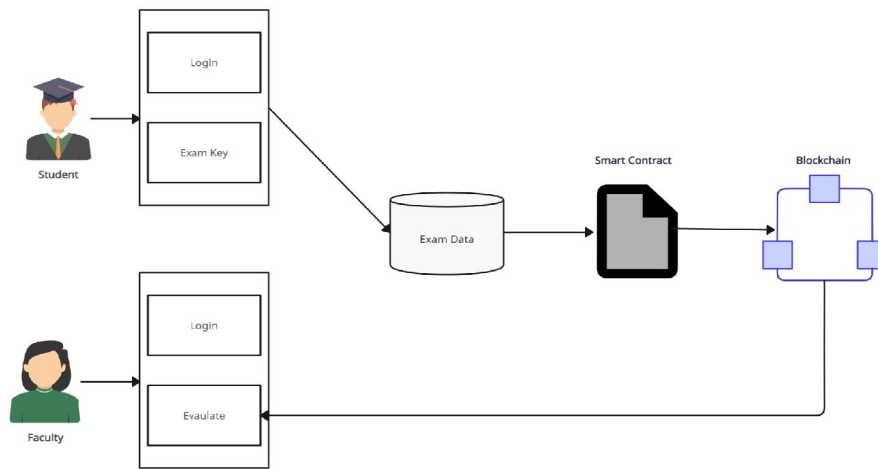
V. IMPLEMENTATION

Figure - The Process of the Proposed Method

Signup: The owner directly creates accounts for the users in the database. There are two types of accounts: Student and Faculty.

Faculty Login: When a faculty member logs in, they are prompted to enter their login ID, password, and a security phrase. After authentication, they are redirected to their dashboard where they can create an exam. A unique exam ID is generated with the creation of each exam. The faculty member can also see who has taken the exam and evaluate the answers given by the student.
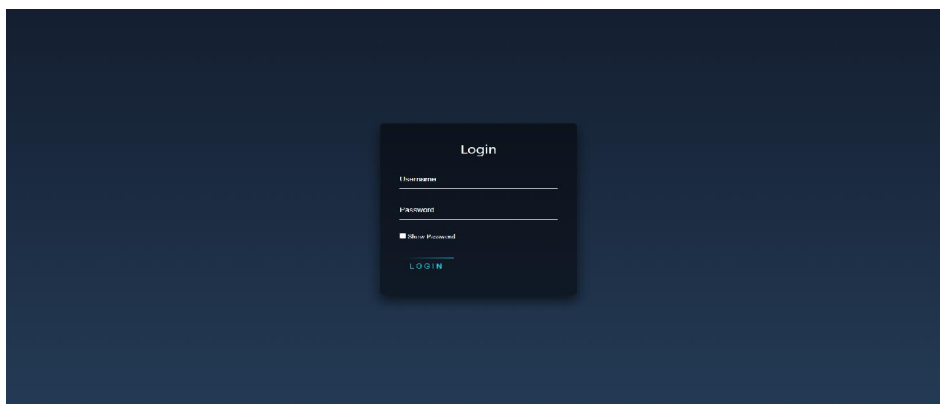
Login Page -

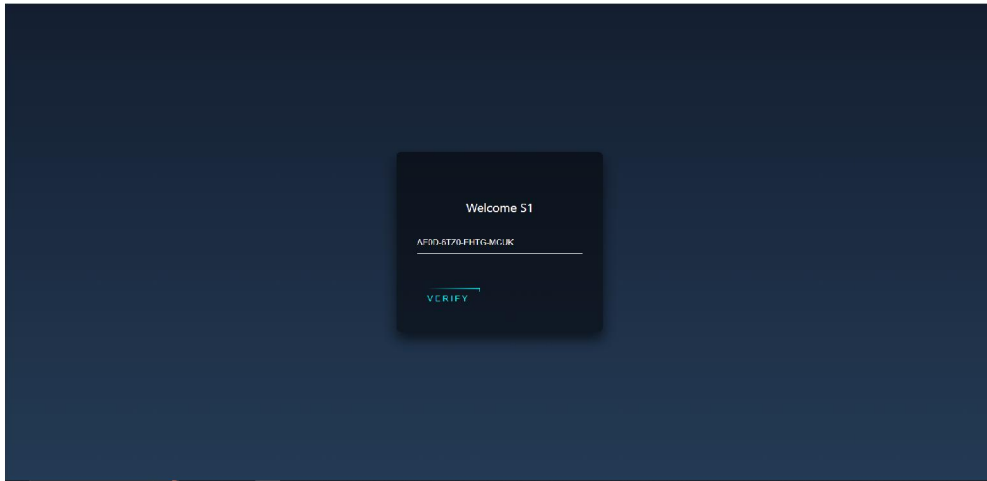Figure 1 - Student / Faculty Login page

Figure 2 - Student Exam code page

Student Login: When a student logs in, they are prompted to enter a security key and then the exam ID to access the particular exam. After entering the exam ID, the exam starts.

Faculty Dashboard - On this dashboard the faculty can create exam, Schedule them and will be able to evaluate the exams attempted by the students.
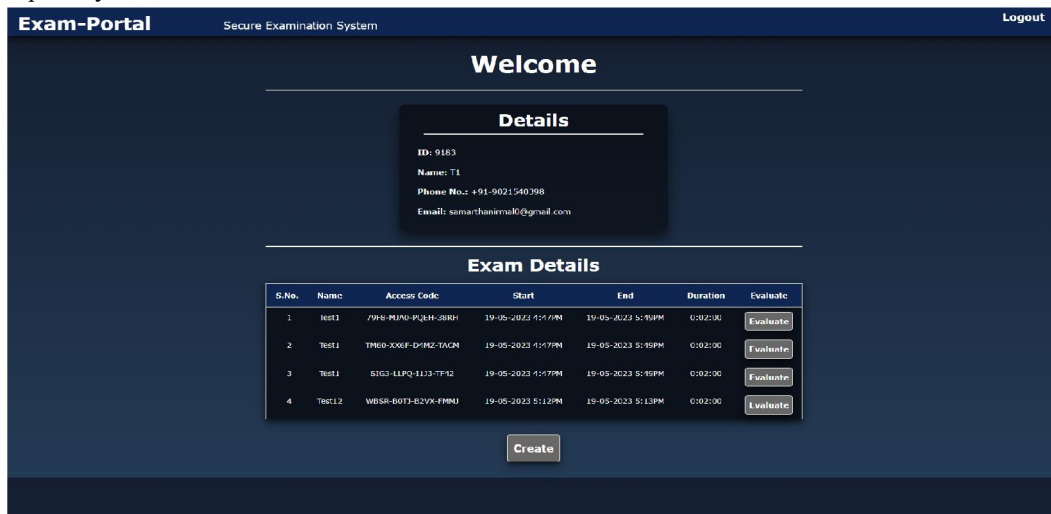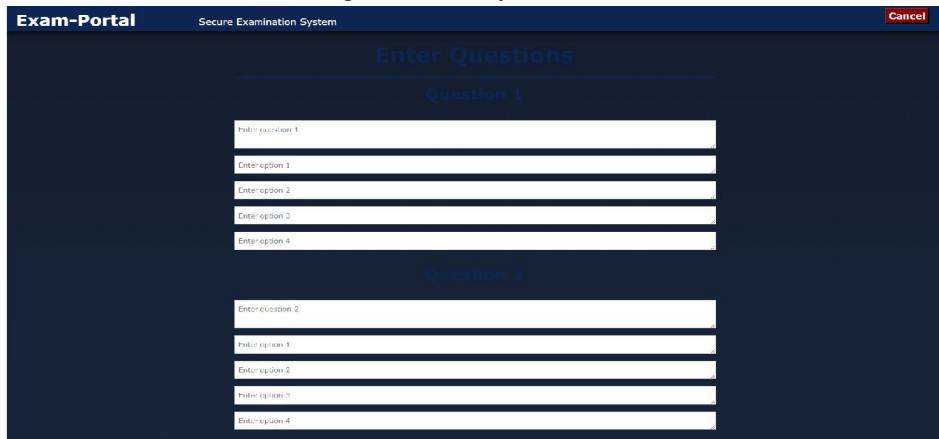

Figure 3 - Faculty Dashboard

Figure 4 - Faculty create exam page

Exam Interface: The student gets an interface for answering the multiple-choice questions. After answering all the questions, the student gets a finish button. On clicking the finish button, a Metamask wallet popup appears.
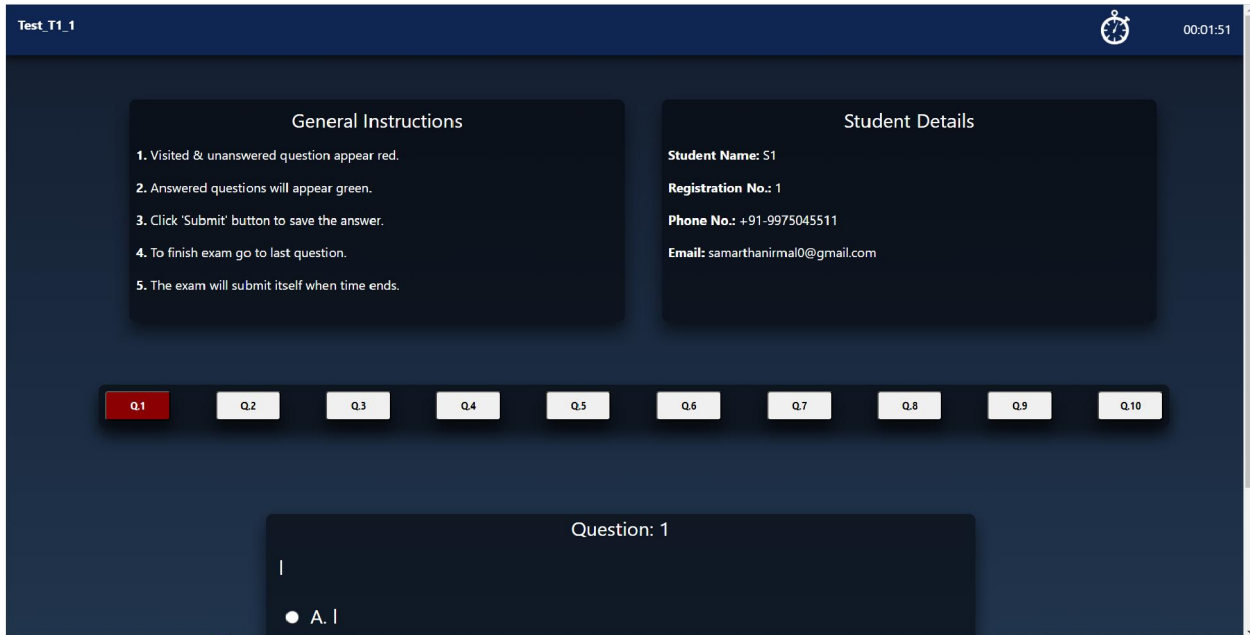

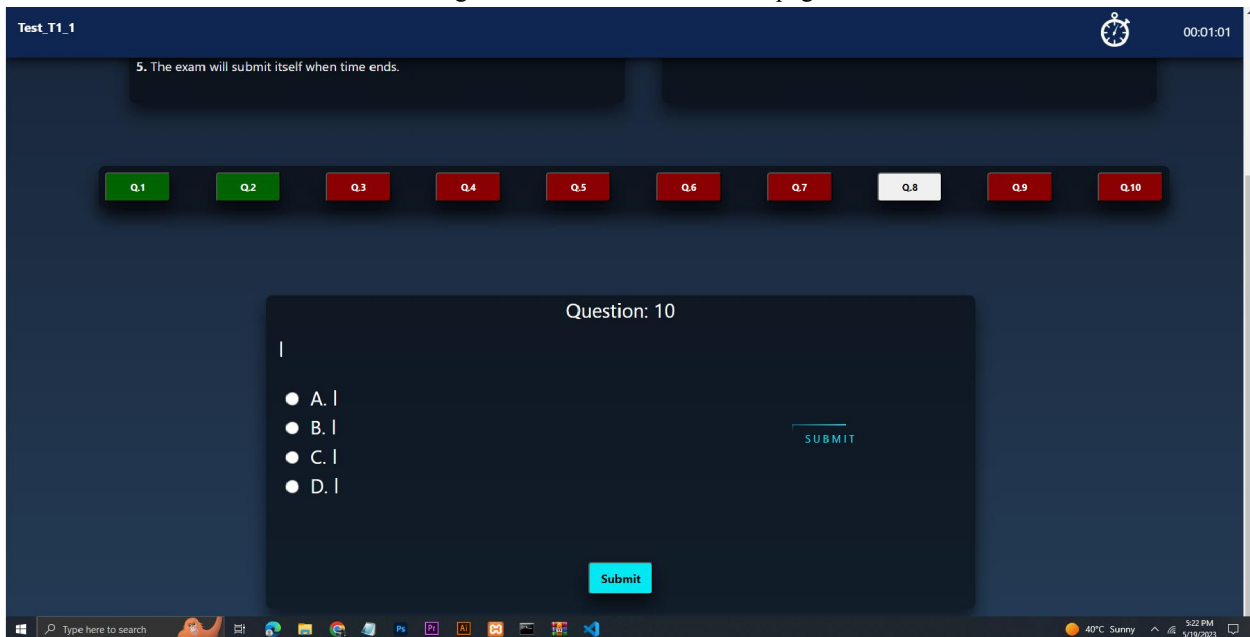Figure 5 - Student Examination page

Figure 6 - Student Examination page

Evaluation - This system incorporates smart contracts, allowing for efficient and accurate assessment of student performance. As part of the implementation, we developed an evaluation page specifically designed for faculty members. This page features a user-friendly interface that highlights ticked answers in green and displays unanswered questions in red. The color-coded system provides a visual representation of student responses, aiding faculty members in swiftly evaluating and providing feedback on student performance.

Figure 7 - Faculty Evaluation page (Answered question)

Figure 8 - Faculty Evaluation page (Skipped question)

Smart Contract Interaction: The student signs a transaction using the Metamask wallet to send the exam data to the smart contract for evaluation. Upon submitting, the Metamask popup appears again, and after signing the transaction, the data is sent to the smart contract. Once a smart contract has been deployed, it cannot be altered. The only way to remove a smart contract is if this functionality was incorporated into the contract from the outset [20].
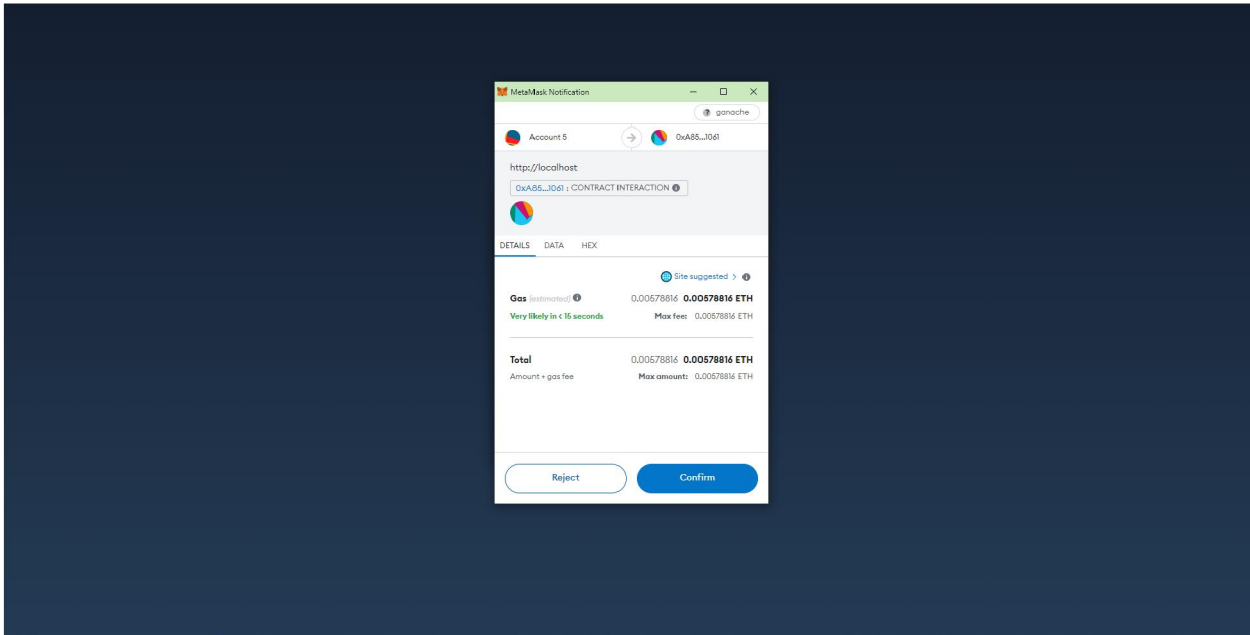
Figure 9 - Student Sign transaction window

VI. CONCLUSION

The development of a smart contract-enabled online examination system based on blockchain is a significant step towards building a fair and transparent exam process. The use of blockchain technology provides immutability, transparency, and security to the online examination system, ensuring fairness and trust in the exam process. Smart contracts provide automation and reliability in grading and issuing certificates, making the process more efficient and accurate. The online examination system developed in this project provides a user-friendly interface for both faculty and students. The faculty can create exams, view the list of exams, and evaluate the results of the exams taken by the students. The students can log in, take the exam, and view their results. The use of Metamask wallet integration provides an additional layer of security to protect the transactional data exchange between the student and the smart contract. The online examination system developed in this project has several advantages over traditional examination systems. The system eliminates the need for physical invigilation and provides a fair and transparent exam process. The system ensures the integrity of the exam results, making it difficult to tamper with or manipulate the exam data. The use of blockchain technology also eliminates the need for intermediaries, reducing the cost and time required for conducting exams. The development of a smart contract-enabled online examination system based on blockchain is not without its challenges. The system requires a high level of technical expertise in blockchain technology, smart contract development, and web development. The integration of the Metamask wallet also requires some technical expertise, which may pose a challenge for some users. Despite these challenges, the development of a smart contract-enabled online examination system based on blockchain holds immense potential for the future of online education. The system can be used to conduct online exams for various courses, certifications, and job interviews. The system can also be used to verify the authenticity of certificates and degrees, making it easier to authenticate academic credentials. In conclusion, the development of a smart contract-enabled online examination system based on blockchain is a significant step toward building a fair and transparent exam process. The system provides several advantages over traditional examination systems and holds immense potential for the future of online education. With further development and refinement, the system can be used to conduct exams for various courses and certifications, making it an essential tool for online education.

In this report, we suggest a safe public blockchain network based on Ethereum for the current educational system. Each data block must be validated by Ethereum at a very high cost. We will move the application to the closed blockchain network Hyperledger Besu in the future. An Ethereum-based blockchain platform is called the Hyperledger Besu Framework. It is capable of getting the Ethereum has a private permissioned network in addition to a public

network. Additionally, it features a test network environment that mimics all of the Ethereum protocols, concepts, and practices, such as Rinkeby, Ropsten, etc. This framework has a large capacity for storing all the data necessary to continue processing performed transactions on the blockchain network. With the help of this architecture, peer-to-peer (P2P) networking will be made possible so that Ethereum nodes may synchronize their state with one another

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