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BLOCKCHAIN-BASED FRAMEWORK FOR ENHANCING THE INTEGRITY OF ONLINE EXAMINATION RESULTS

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ABSTRACT

In recent years, Learning Management Systems (LMS) have acquired substantial appeal, notably because to the COVID-19 pandemic, delivering greater efficacy and efficiency. Within LMS, online tests have evolved as a crucial instrument for measuring students' performance and knowledge of course content, playing a vital part in deciding their development. It is critical that online test results be both trustworthy and easily accessible. Students' grades might be negatively affected by any security flaw, such as hacking. Conventional online test systems frequently store data centrally in databases like MySQL, leaving them subject to unwanted access and modification. Secure, peer-to-peer administration and assessment of academic tests is made possible in this article using a blockchain-based infrastructure. To guarantee data integrity, the framework utilises hashing algorithms. To strengthen security, it incorporates proof of stake processes. Blockchain effectively protects data integrity due to its decentralised data storage and the use of cryptographic hashing for each block. The study illustrates the usage of blockchain for designing online tests, recording each question and response directly on the blockchain. We were able to do this by developing a module that communicates with Moodle, an LMS. By comparing it to Moodle's default centralised storage, our addon alters the storage of exam results, making the data stored on the blockchain safe and impenetrable. Exam data is securely encrypted using the blockchain, which prevents tampering and ensures its integrity. Based on our findings, there are no inconsistencies when comparing data saved on the blockchain to

Moodle's conventional method. To safeguard student information from tampering, the blockchain network offers a trustworthy and unchangeable platform. Finally, our blockchain-based paradigm provides a strong answer to the problem of how to make online test scores more secure and trustworthy. We guarantee data integrity and transparency by using blockchain's decentralised and tamper-proof nature. This allows for a more reliable evaluation of academic achievement.

I. INTRODUCTION

The global spread of COVID-19 has had a profound impact on classroom practices. Online education is being considered by several colleges and universities as an alternative to traditional classroom instruction. Using digital tools to facilitate the acquisition of new information, e-learning functions similarly to a network-enabled knowledge transfer [1]. It replaces the old-fashioned paper-based methods with a number of technological options that are more advantageous to the pupils. Through this students may take their lectures in form of videos or tutorials that can be viewed by them using their own computers or laptops whenever they wish [2]. It enhances classroom engagement by making students actively engage in online tutorials to complete assigned tasks [2]. There are several benefits to e-learning for students, such as having access to lectures whenever they need them to review material or do assignments. Additionally, it facilitates contact with students and prompt resolution of their concerns via E-learning platforms, which helps both fast and slow learners, reduces stress, and so on [1]. Online tests for preliminary screening might also help

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them in a constructive manner. E-exams can have other benefits. Because it takes so much labour to correct, extract, and announce students' results on conventional printed paper examinations, these computerised exams save teachers a lot of time and make pupils safer. One of the most important ways to measure progress in online learning is via e-exams [3].

While many online tests are user-friendly, they are all hosted on central servers, which opens the door to a host of security risks. As a result, attackers may resort to hacking the stored data or erasing test material in order to cheat. Since all data will be kept in an immutable way, Blockchain technology can address the concerns of security and dependability that it must provide. Our learning management system (LMS) of choice is Moodle since it is widely used and has many useful functions, such as letting professors create online lessons, assigning homework, and administering tests. Automatically fix examinations and communicate marks to students is also a feature of this system.

The primary objective of this work is to provide a comprehensive analysis of LMSs, both old and new, contrasting the features of centralised and decentralised models. In addition, we will show you how our suggested model works, which is centred on making an exam available online. This model will ease the submission of test answers and results straight into the blockchain as a newblock, along with an explanation of the process of transaction fee deduction from the user's wallet for submitting data to the blockchain. Students will be able to access our cutting-edge model, complete their tests, and then submit their answers straight into the blockchain network. Next, the test administrator will be able to see all of the submitted answers on a dashboard.

The article primarily contributes by proposing a novel model for test digitisation that makes use of blockchain technology. With this setup, students may access their courses online,

complete their tests, and then upload their answers to the blockchain. Several benefits are offered by the suggested model. The first way the approach improves security and dependability is by using blockchain technology to store exam data in an immutable way that cannot be readily altered. Exam content modification, hacking, and cheating are addressed here. In addition, the model makes use of Moodle, a popular learning management system (LMS) that offers a number of useful features, including the ability to create exams, online lectures, and assignments. The suggested paradigm may be easily implemented using Moodle, allowing for the administration of tests inside the well-known LMS setting. Furthermore, the model offers an auto-grading system that automatically corrects examinations and communicates the marks to students. This makes it easier to grade and gives students feedback when they need it.

In conclusion, the main contribution of this article is the presentation and demonstration of a novel model that combines autograding, blockchain technology, and the Moodle learning management system. Improving the safety, dependability, and effectiveness of online tests is the main objective. To overcome the problems with centralised test systems and provide a trustworthy and safe way to administer online examinations, the suggested model makes use of blockchain technology's immutability and transparency.

II. LITERATURE SURVEY

"Evaluating the pros and cons of online education: A student perspective"

B. Al-Rawashdeh, M. Alara, A. Z. Al Rawashdeh, E. Y. Mohammed, A. R. Al Arab, and B. Al-Rawashdeh,

Though there are many different tools, the design of a learning system makes it difficult to include e-learning into a complex system that is adaptable, expandable over time, and long-lasting. With more people being able to afford it, the United Arab Emirates' higher education system is undergoing a dramatic shift right now. Finding

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out what works and what doesn't with online education in the UAE is the primary goal of this research. The participants in this descriptive research were chosen at random from among the 2018–2019 academic year students at Ajman University. A close-ended structured questionnaire was designed to obtain data from students. To examine the data gathered, percentages and frequencies were used. According to 81% of students, online science courses present complex concepts in a captivating manner. The majority of students (80%) also believe that e-learning opens more opportunities for interaction between classmates and between students and instructors. Seventy-three percent of students said they spend more time interacting with people online and via other technological methods as a result of growing social isolation. Seventy percent of the adolescents surveyed said that parents' lack of computer literacy makes it harder for them to keep tabs on their children online. Since there are benefits and drawbacks to both traditional classroom instruction and online learning, prospective online students would do well to familiarise themselves with these distinctions in order to make an informed decision about how they want to study.

"A quantitative study in higher education: Implementation of E-exams during the COVID-19 pandemic,"

M. E. Eltahir, N. R. Alsalhi, and S. S. Al-Qatawneh,

Undergraduates at Ajman University were surveyed to determine their level of comfort with taking examinations online in the midst of the COVID-19 epidemic. A descriptive methodology was used in the investigation. In all, 1986 undergraduates were given a questionnaire with 27 questions. Undergraduates indicated a moderate level of acceptability towards the use of online tests during the COVID-19 pandemic, according to the study's findings; female students were more likely to find these exams acceptable than male students. Students in the third year of college and those majoring in pharmacy and

health sciences had the greatest rate of admission, but acceptance varied by academic year and discipline. The study's implications highlight the need to remove obstacles like stringent computer technology settings that are common in online assessments.

"A survey of blockchain technology: Structure, agreement, and emerging tendencies,"

A group of researchers included Zheng, Xie, Dai, Chen, and Wang

The blockchain, which is the backbone of Bitcoin, has been in the spotlight a lot lately. Blockchain technology enables decentralised transactions by acting as an immutable ledger. Numerous industries are beginning to use blockchain technology; they include financial services, reputation systems, the Internet of Things (IoT), and many more. Nevertheless, blockchain technology still faces several unresolved issues, including scalability and security concerns. This paper provides a thorough introduction to blockchain technology. Before comparing many common consensus algorithms used by various blockchains, we provide a brief outline of blockchain architecture. In addition, there is a synopsis of the technological difficulties and new developments. Additionally, we outline potential blockchain trends for the future.

"Moogole as a tool for education: a comprehensive analysis of current trends,"

Josiah R. Ayres, M. B. Behrend, and S. H. P.W. Gamage

Background

When it comes to online education, the Moodle LMS is king, particularly in the STEM fields. However, there is a lack of cohesion in the literature on educational research on Moodle. Educators, academics, and software developers are the intended recipients of this review's summaries of the aforementioned studies. It describes (a) the locations and ways in which Moodle has been implemented, (b) the issues, trends, and gaps that should guide the direction of future research and software development, and (c)

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creative and efficient ways to enhance online education.

From January 2015 to June 2021, 155 relevant journal papers were located using the 4-step PRISMA-P procedure. These publications were published in 104 journals across 55 countries. Scopus and Web of Science were used to perform the database search. Bibliographic research using Vosviewer results and theme analysis provided light on Moodle's pedagogical applications.

Final Product

This analysis demonstrates that Moodle is very beneficial in enhancing student engagement, contentment, and performance, and is mostly used in STEM fields inside universities. Adaptive and collaborative learning, as well as the enhancement of online examinations, are among of Moodle's most popular uses. Academic integrity, ethical, and security concerns, as well as the need to improve speed and navigation and integrate artificial intelligence, are driving the fast expansion of Moodle's usage.

In summary

Moodle needs more qualitative study on its usage, especially from the viewpoint of teachers. The use of Moodle in fields outside of STEM and higher education likewise requires more investigation. When developing courses on the Moodle platform, future research should take educational theories into account.

"Delving into the connection between computational costs and transactions in a blockchain setting,"

Authors A. Jabbar and S. Dani,

For the most part, blockchain-related discussions and studies have concentrated on Bitcoin and other cryptocurrencies. Nonetheless, the technology's potential to address operational issues in supply chains for both goods and services is attracting more attention. In this research, we provide two original contributions and a novel consequence of blockchain technology. To begin, we present the idea of computational expenses as a crucial mechanism for carrying out operational transactions in a

blockchain setting, which are quantified in units of gas. Next, we'll go over how smart contracts are changing operational transactions and how they're being used. This study employs an experimental methodology to explore the connection between computational costs and blockchain transactions. In order to record, verify, and uphold transactions, we create and deploy a fully operational public virtual blockchain. The technique lays forth a procedure for calculating the computing expenses, transaction intensity, and frequency. The theoretical literature on the blockchain deployment paradigm is enhanced by this study. The use of an experimental technique and the discovery of computing costs for operational transactions are what make it innovative. From a financial standpoint, this study enlightens managers on how to construct smart contract transactions inside a supply chain.

III. SYSTEM ANALYSIS & DESIGN EXISTING SYSTEM

As an example of an e-learning platform model, Jain et al. [13] suggested a system where students pay for an exam with cryptocurrency, answer questions using the same cryptocurrency, and the results are saved as a smart contract in the blockchain network. The catch is that they have students enter their addresses, which are stored in a database and could be manipulated to display an inaccurate result.

Students may take their examinations using a web-based online method that was suggested by Yuan et al. [14]. The next step is for the system to send the questions and their answers to a server, after which the grades will be generated. In order to prevent students from cheating on online exams, Shinde [15] developed a system that detects students' faces. Once the exam is over, the system can then calculate marks and display the results. A web-based examination system was developed and suggested by Rashad et al. [16]. This system administers tests using multiple-choice and essay questions, among others, and uses these to determine the level of

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difficulty of each question. The goal of the system is to make it easier to administer tests by automatically marking submitted work and providing a report for each test. Several web technologies, including AJAX, PHP, HTML, and the MySQL database, form the basis of this system. Additionally, it has been validated at Egypt's Mansoura University, but the web-based examination system's design necessitates storing all data in a single, central location, as shown in Figure 3.

In order to facilitate the examination process and address issues with existing webapps, such as automatically logging students out when the timer goes off, Fagbola et al. [17] suggested a webapp for online exams. Supporting auto-submission, auto-marking, and the compilation of examination result reports are a few of the key areas of the examination process that it is designed to handle. The webapp that will standardise the examination process is based upon front-end web development using tools like HTML and the Microsoft Visual Studio development environment. SQL Server is used as the database. Figure 4 shows that all of the processes will be stored in one central location. However, previous systems relied on centralised databases where data could be manipulated, rendering the results unreliable. This is where blockchain technology comes in. A method to preserve students' course information and grades at the University of Glasgow was suggested by Rooksby and Dimitrov [18] and would rely on the Ethereum platform and smart contracts. Transparency is maintained in the grades kept on the blockchain network. It turns out the system is really reliable. In order to evaluate the system's validity and guarantee system results, they failed to provide a comprehensive case study. Similarly, they failed to demonstrate the system's correctness in preserving students' grades on the blockchain. Pee et al. [19] developed a blockchain-and CP-ABE-encrypted online assessment system whereby each exam has a unique set of questions created by a different instructor, who uses their

private key to limit who may access the system via the CP-ABE algorithm. After taking an exam, students may save their results to the blockchain, which will prevent them from being altered in any way. The test results are safeguarded by this technology, which is known for its enhanced security.

A novel verification methodology developed for CLDs was suggested by Yang et al. [20]. Strong external auditability and quick verification are two primary objectives of this system. Dasein verification, the central idea of this framework, creates a formalised method of ledger auditing by integrating the aspects of what, when, and who validation. Moreover, they summarise the suggested framework's system architecture and provide the results of its performance assessment.

Disadvantages

There is now a system in place that uses centralised servers to administer a number of user-friendly online tests, however these exams are vulnerable to security breaches and other problems. As a result, attackers may resort to hacking the stored data or erasing test material in order to cheat. Blockchain technology comes into play to address the dependability and security concerns, since all data is kept in an immutable way, eliminating the possibility of manipulation.

PROPOSED SYSTEM

Our goal in this research is to do a comprehensive comparison of contemporary decentralised learning management systems with classic centralised ones. We will also provide a detailed example of our suggested paradigm, which focusses on turning an exam into a web application. Together with an explanation of how transaction fees are deducted from the user's wallet in order to submit data to the blockchain, this model will make it easier to submit exam results and answers straight onto the blockchain as a newblock. Students will be able to sign up, take their tests, and then submit their answers straight into the blockchain network thanks to our novel methodology. After then, a dashboard with

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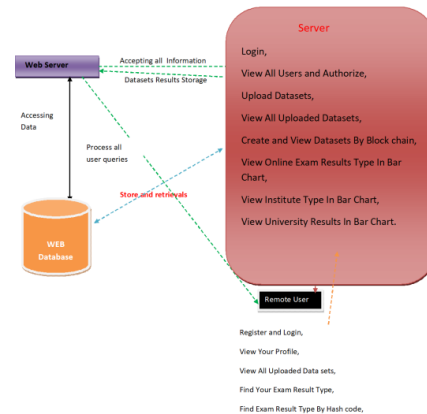
all of the submitted answers is accessible to the test administrator.

The paper's primary contribution is the suggestion of a novel model that turns tests into web applications by leveraging blockchain technology. With this paradigm, students may sign up, take tests, and upload their responses straight to the blockchain network. The suggested model has a number of benefits. First, the concept improves security and dependability by using blockchain technology to store exam data in a way that is difficult to tamper with. This addresses issues of unauthorised exam material change, hacking, and cheating. The model also makes use of Moodle, a popular learning management system that offers a number of features including online lectures, assignments, and test production. Exams may be administered smoothly in the well-known LMS environment by combining the suggested approach with Moodle. Additionally, the model presents an auto-grading system that automatically corrects tests and notifies students of their marks. This expedites the grading process and gives students rapid feedback.

Advantages

- This paper's main contribution to the suggested system is the introduction and demonstration of an innovative model that combines an autograding system, blockchain technology, and the Moodle learning management system.
- Improving the efficiency, security, and dependability of online tests is the main objective. The suggested model seeks to address the issues with centralised exam systems and offer a safe and dependable way to administer online tests by utilising blockchain's immutability and transparency.

SYSTEM ARCHITECTURE



IV. IMPLEMENTATIONS

Modules

Server

The administrator must use a working user name and password to log in to this module. After login succeeds he may conduct certain activities such as View All Users and Authorize, Upload Datasets, View Every Dataset Uploaded, Create and View Block Chain Datasets, Check out the types of results for online exams, institutes, and universities in a bar chart.

View and Authorize Users

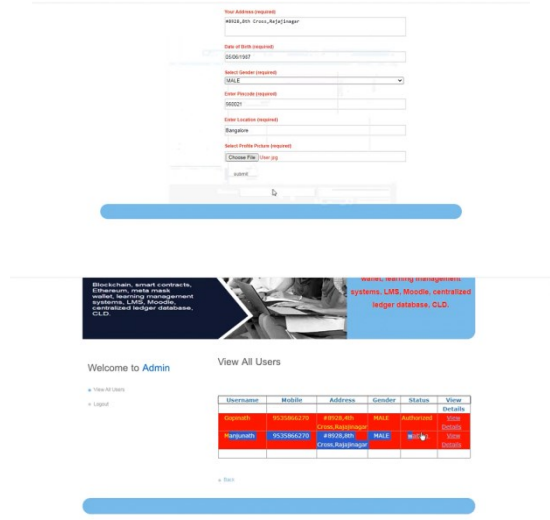
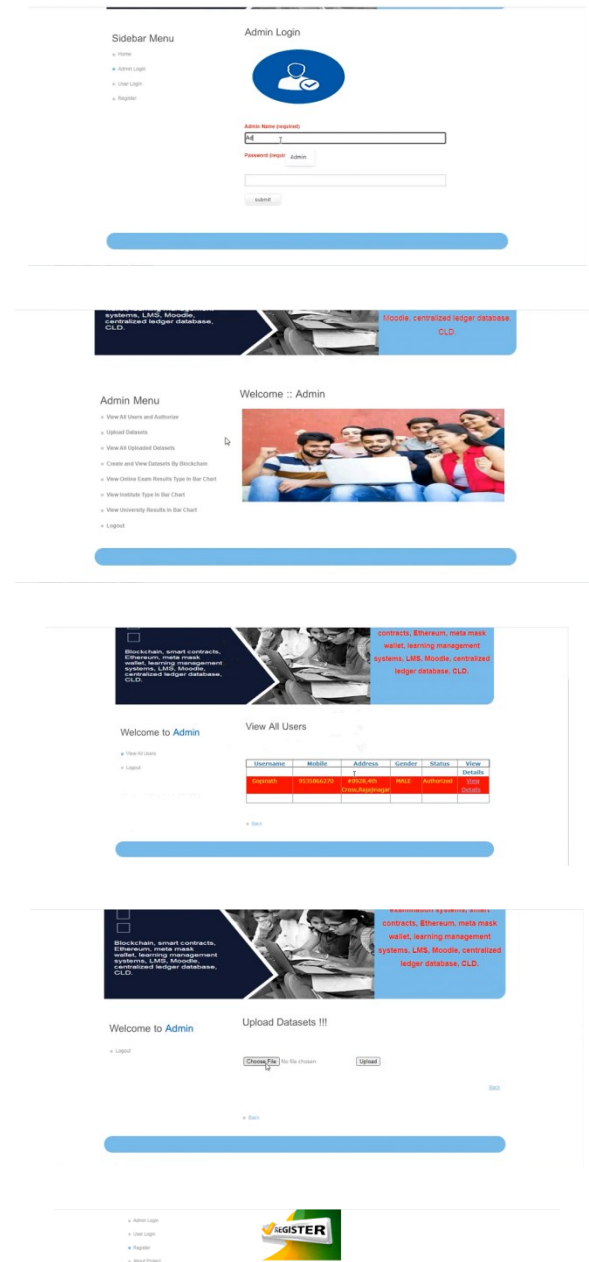
The administrator can see a list of all registered users in this module. Here, the administrator may see the user's information, like name, email, and address, and they can also grant the user permissions.

User

A total of n users are present in this module. Before beginning any actions, the user needs register. Once user registers, their information will be recorded to the database. Following a successful registration, he must use his password and authorised user name to log in. The user will do the following actions after successfully logging in: Register and log in; see your profile; view all uploaded data sets; find the kind of exam result; and find the type of exam result by hash code.

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V. SCREENSHOTS



VI. CONCLUSION

Our approach is on using the blockchain network to safely store test scores and marks. We contrasted this strategy with the built-in decentralised storage system of Moodle LMS, enhancing it with blockchain technology. Through this interface, we ensure the accessibility of clear and trustworthy data. Universities, colleges, and other organisations may easily use this data to confirm the accuracy of test results.

In order to create smart contracts that expedite the retrieval and storage of student data inside the blockchain network, we chose the Ethereum platform for our implementation. We used a powerful programming language to draft and test our contract, then we integrated it into Moodle with ease. We used Ganache Toobtain Ether cash throughout the testing process so that students may upload their responses to the blockchain network.

Data moved from the LMS to the blockchain network was successfully secured and dependably stored, as shown in our case study. This accomplishment provides strong proof that blockchain is a perfect way to improve the confidentiality and reliability of test findings.

We create a reliable and immutable record of student achievement by using blockchain technology to ensure the integrity and transparency of exam data. This method offers a

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robust remedy for the issues of data security and dependability related to test outcomes.

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