Secured Question Paper Management System


Abstract—The examination is one of the essential parts of the student’s life. After learning from an institution, the students must attend and pass various types of examinations to get their certificates. In this process, sometimes students try to pass the examination by answering the leaked questions. From the beginning of making the question papers to delivering them to the students is now at stake in the existing question management system due to question leakage. So, the traditional way of managing the question papers needs to be changed so that it can stop the leakage of question papers. To secure the question papers and making a trustworthy, physical existence free, and affordable a system is proposed in this paper. To design this model, we have used the concept of Blockchain, Digital Signature, Randomization, OTAC.

Index Terms—Blockchain; Digital Signature; Hash; Encryption; Decryption; OTAC; Randomization

I. INTRODUCTION

The examination is one of the essential aspects of the education system. It evaluates the understanding, skill, knowledge, physical fitness, or aptitude of students and forces them to study. However, Question Paper Leaking of the examination can cause the fairness issues in the examinations. Each and every year, we hear news about postponed/canceled exams due to paper leakages throughout the world from entrance examination to public examination. The situation in developed countries is getting worse [1-4]. This aspect will create a negative impact on students and will demoralize the growth of society.

In China, a teacher at the Dalian University of Technology was accused of leaking a math test ahead of China’s annual postgraduate entrance exam [5]. In Egypt, French language exam papers were posted on Facebook half an hour after the start of the exam [6], and a version of the Arabic test, was leaked on the first day of the Thanaweya Amma exam [7]. A teacher in Vietnam was accused of leaking questions of a final examination to a neighbor’s son [8]. A number of cases related to paper leakage have occurred in Pakistan [9-13], India [14-16] and Nepal [17], [18], respectively. In Bangladesh, public examination questions were leaked [19-21]. In Korea, another high school teacher was accused of leaking English exam questions [22]. In the United Kingdom, Brighton Hove and Sussex Sixth Form College canceled the A-level physics exam, and students were sent home after discovering the question paper leak on social media [23]. ACT Inc, the most popular U.S. college entrance exam maker, said Thursday that it had canceled the ACT exam scheduled for Saturday at some of its international test centers due to a breach of the test materials [24]. The question paper was also leaked at the University of South Africa (Unisa) [25].

The above incidents show that question paper leakage happens not only within the developing and underdeveloped countries but also in developed countries. We must not forget, once an unjust examination happens, it may change the fate of tens of thousands of young people. Before the cases of leakage increase, we need to take action to secure question papers! And something needs to be done to restore the faith of society in the education system and to place it in educated, skilled hands. The sooner we take action, the sooner everything falls in place! COVID-19, ongoing global pandemic due to Corona virus caused several changes in the education sector of the world. Institutions like school, colleges and universities resume the classes and exams in different online platforms. Now, in order to establish a proper systematic approach of taking examination by securing the question papers may ensure quality of the education. The proposed model will help to fulfill the desire.

The individual parts of the paper are arranged as follows: the related works is outlined in section 2. The segment addresses the various research papers related with securing question papers management. In Section 3, after analyzing different papers our proposed solutions are covered in detail. Section 4 states the system architecture. The section shows step by step systematic approach of the system. Section 5...
II. RELATED WORKS

Question paper leaking creates a phenomenal impact on society. Some models and schemes are proposed and described in some research work to solve this unwanted problem. One of them is described as a system using automatically generated Multiple Choice Questions (MCQ) with the help of Artificial Intelligence (AI) [26]. This program includes several modules for courses, user and request management, request classification, question entry, document generation, and document management [26]. The user will specify the subject matter, the type of question, and the difficulty level [26].

Another system called Automatic Question Paper Generator deals with the selection, sorting, and management of a large number of questions relevant to various groups about specific types of levels for all the subjects [28]. The shuffling algorithm of the system means the randomization technique is used to provide a solution to the mentioned problem avoiding the repetition of the questions in the examination [28]. Automatic Question Paper Generator is used as special software that is useful for schools, institutes, publishers, and test paper makers who want to have a vast database of questions and often easily generate test papers.

A systematic way, “Randomized Question Paper Generation System,” is considered to be software that is mainly used in schools, universities, etc., to generate and check paper setters who mainly want to provide a huge record of questions in the question paper and also provides comfort [33]. It primarily supplies the assembly, classification, and coordination of queries regarding various degrees of intensity from empirical as well as non-scientific subjects relevant to several groups [33]. It presents, in particular, the practices of procedures in the Randomized Generator Question Paper System (RGQS) to overcome the above-described problem [33]. The main part of the procedures is to provide a random method in the System Group so that different sets of questions could be produced mainly without repetition and duplication [33].

This paper presents a new smart education scheme, by using the blockchain concept to share questions [38]. To shuffle questions, they used a two-phase encryption technique using timestamp, salt hashing, smart contract and a technique of random algorithms [38].

Along with these models, there are also different types of management systems proposed, and they digitally stored the exam-relevant information, and then the exam management system is implemented [27]. To obtain the required degree of safety at any examination point, a cryptographic scheme has to be implemented [27]. It defines six security criteria, such as authenticity, anonymity, correction, confidentiality, receipt, identification of the copies [27].

Considering geographical zones and different exam centers, online question paper uploading, and downloading from different locations, this paper proposed an exam management system [29]. In this proposed model, question papers are made available online in different geographical zones consisting of several examination centers where they can only be downloaded after the time stipulated [29].

This paper provides a Blockchain-based framework for conducting and assessing academic examinations in a peer-to-peer manner with auto-generating certificates upon successful completion of the examination. [30] The proposed framework for conducting a decentralized examination uses blockchain to enhance the evaluation and maintenance of examination records in such a way that the records are more accurate, reliable, and secure in accordance with the current examination system [30]. To make the test as accurate as possible, the hash-digest of every question presented and any question answered is stored directly upon this blockchain [30]. A variant of the voting-based consensus process is used, named Delegated Stake Proof, and each operation is documented as a blockchain transaction [30].

A web-based, stable, automated question paper generation system that is robust to question paper leakage as it replaces the conventional paper generation process [31]. The suggested program would provide a smart question paper generator to produce questions within seconds [31]. This initiative includes two processes:

(i) the production phase of the Question Bank and
(ii) the creation process of the Question Paper [31].

Not only digitally but also using physical accessories, the question papers can be secured. An electronic protection system with high security to avoid paper leakage in any examinations [32]. The question papers will be shipped in an electronically locked box to the test centers [32]. The box can be opened after a predefined date, time, and only by an authorized person using an RFID card [32]. Otherwise, a message will be sent to a predefined phone number. These boxes are password protected, which are sent by the Exam Controller [32]. The box will open through an electromagnetic lock, if the date, time, and password match. A buzzer is used in this system for any unauthorized interference [32].

Another solution is proposed physically-based on the fingerprint for Authentication and also uses a number lock feature, GPS Kit, to provide improved security and access control [34]. It uses a sensor to monitor and avoid interference with automatically send warning messages [34]. Tracking the machine Place that has been introduced with GPS and sends the connection to the control room using GSM [34]. Also, Solar panels are used to supply the system with electricity [34].

Moreover, a lightweight and portable solutions with a variety of designs and implemented to inspect paper leakage security system, which is a highly protected ARM processor-based device [35]. The system uses GSM technology, RFID module, key-pad, and electromagnetic lock [35].

From the related works, it is observed that there are some limitations in their solutions. Firstly, no traceability for leakage questions is described. Though the system is designed with high security, it is not mentioned about finding out the
The problems in the existing systems, to execute a login to store the questions in separate 30 blocks of blockchain and it ensures the system’s architecture. In this section we will discuss the main technologies like Blockchain, Hashing, OTAC, Digital Signature and others. Blockchain is a data storing system that is distributed and replicated among the network nodes that participate [38].

It has begun to attract attention from a wide range of individual sectors, including banking, medical departments, the supply chain in industries, land properties, personal data, education sectors, finance industry, public service sectors and delivery of digital content etc. [40-45]. When a transaction takes place in the network, the transaction must have a validation process called the consensus mechanism [38]. Transaction means adding blocks, sending, or receiving data from the nodes to nodes. Those who perform the method of consensus are called miners, and they have to execute a computationally complicated puzzle called hashing [42].

Hashing is a process of converting a key into another value which cannot be converted back to the original key. After that, a block containing the transaction is attached to the chain. Every block holds the preceding block’s hash. Therefore, it creates a chain of blocks, and it is called the blockchain. From all the blocks, the first block of the blockchain is called block genesis [38]. As this block has no previous hash block, it contains 0 or a value that is predefined by the system.

In most sections of Application on the blockchain, block genesis is hard-coded [38]. If anyone does make some changes in the blockchain, then the hash of that block changes in the transaction, which breaks the Blocks. In order to make the changes, a user must then mine other participant’s nodes in the chain, and it is very difficult. So, without mining the hash, this is impossible to add any blocks into the system for QS, QM or for anyone. Every user has two keys in the blockchain, 1) the public key and 2) the private key. Public key will be available for everyone but the private key or secret key will be kept secret [42].

Digital Signature is one of the useful and efficient features of the blockchain and it ensures the system’s authentication, credentials, privacy, and trust [27]. The digital signature is generated in the values of cryptography that rely on data and data sender [36]. So, the digital signature is used in the various transactions of data and recording data [27], [37], [38] With these various transactions, it also ensures security in web-based services [36], [39].

We used Digital Signature to secure the questions during transition and the authentication of the questions. Also, the question setters or question moderators cannot deny that these questions haven’t been sent by them. Then, after sending the questions, it cannot be modified by the sender. OTAC stands for One Time Authorization Code. One time authorization code (OTAC) refers to a code valid for authenticating a user’s identity for a single session only. Services such as online banking or ATM machines are authenticated in a very safe manner [46]. To authenticate the QSs and QMs we have used the OTAC. OTAC will generate a one time authorization code for the QSs and QMs. So, if the question setter wants to store and submit the questions then he/she must pass the OTAC verification. After that the QSs and QMs can upload the questions in the system [46].

IV. SYSTEM ARCHITECTURE

Exam Controller (EC) will choose and invite Question Setters (QS) and Question Moderators (QM) to prepare the questions. If the number of questions needed for the exam is 100, then total 3000 questions needed for generating the final question set. So there must be at least 30 QSs. To login into the system the Question Setters (QS) and Question Moderators (QM) must verify the OTAC sent from the system. This will grant the access every QS and QM into the system. After successfully, login to the system, everyone will get a public key, private key and EC will get an additional secret key as shown in Fig. 10.

Step 1: Each QS will digitally sign the question set of 100 questions using the public key of EC before submission as shown in Fig. 1. Then, the question set EC receives from the QSs will be decrypted using the private key of the EC. After that, the EC will digitally sign 3000 questions using secret key and will store the questions in separate 30 blocks of blockchain.

Step 2: Then the questions from 30 blocks will be fetched. EC will decrypt the data using the secret key as shown in Fig. 2 & 3. The system will perform randomization to remove 20 questions from each set and then EC will digitally sign these set of 80 questions and store it in another separate 30 blocks of the blockchain.

Fig. 1.
Step 3: In the next step, The EC will fetch and decrypt every set of questions using his secret key. After that, total questions will be divided based on the number of moderators chose by the EC. The EC will digitally sign each question sets using the public keys of the moderators respectively and will send it to the moderator for moderation as shown in Fig. 4 & 5.

Step 4: After that the QMs will decrypt their question sets using their private key and perform question moderation. After, the moderation the questions will be digitally signed using the public key of EC. EC will receive and decrypt the question sets by using his private key as shown in Fig. 5. He will again digitally sign the question sets using his secret key and store each set of questions in distinct blocks of blockchain.

Step 5: Then, the EC will again fetch and decrypt the question sets using his secret key to get all the questions from every blocks as shown in Fig. 6. Now, total 2000 questions will be chosen randomly as shown in Fig. 7. The questions will be stored in a single block after digitally signed by EC’s secret key as shown in Fig. 8.

Step 6: In the day of exam, the EC will fetch and decrypt the questions using the secret key just before exam starts (5-10 minutes). Now, finally the system will choose 100 questions for the exam randomly. These final questions will be sent to the printers connected with the system in classrooms of every exam centers, 5-10 minutes before the exam is started. The printers will print all the questions for the examinee as shown in Fig. 9.
V. DISCUSSION

Properly securing question papers is difficult, but to ensure a fair examination the question papers must be secured. To provide a secure system, we have used some technologies that we mentioned earlier in this paper. Though the system is designed with strong security, there might still be a chance of leaking questions by the associated persons. So, to trace the person, we will match the leaked question paper with the stored question papers in the blockchain. As the group of questions is kept secured using a digital signature, we can identify the responsible QS or QM. If all the questions are leaked, then EC will be responsible for the leakage because only EC would have the access to see all the questions.

The questions will be selected randomly and it is quite impossible to guess the final questions from the large number of questions to leak the questions. There are no physical printing options or any physical documenting options where the questions could be leaked before the examination. Moreover, the questions will be ready just 5-10 minutes before the exam starts. The printers will print the questions in front of the invigilators. It reduces the chance of leaking the questions massively and this won’t be helpful to solve the questions in such a small time. The system uses human involvement to set the questions instead of Artificial Intelligence (AI) which cannot detect whether the question is right or wrong (spelling mistakes, arithmetic, logical, graphical problems) in the questions. As we are using randomization technique in our system to select the final questions from a large quantity of the questions, it will ensure a standard question.
The significant side of the question paper management systems are securing question papers in different ways but one of the important aspects, tracing the person or people doing leakage of questions is absent in the models [26-38]. In our proposed model we represented a systematic approach to find out the responsible person. Another obstacle of securing questions is the existence of physical documenting which can be leaked [32], [34]. So, to solve this problem there is no physical documentation in our system and the only physical existence of the questions will be disclosed 5-10 minutes before the exam starts and the copies will be printed in the rooms of the examination centres. Artificial Intelligence can be used in many ways but the problem may arise when AI cannot differentiate the questions correctness [26-28]. A small change of symbol can change the whole question. For this problem, the proposed model shows the use of human involvement for making the questions and the model used the randomization technique to make the question papers more standard for the examinees.

VI. CONCLUSION

In this paper, we proposed a blockchain-based question paper management system to secure the question papers from leaking. In this model or scheme, we used some well known technologies to secure question papers as well as to trace the person who is responsible for the leakage. We used the digital signature to ensure the question papers authenticity. The involvement of question setters and moderators in making the questions and the use of randomization technique makes the question papers more standard. Moreover, there is no place for physical documenting before starting the exam. Therefore, the proposed model is better in terms of the security and the feature of tracing the responsible person of question papers leakage made the model unique from others systems to secure question papers [26 – 38]. Due to shortage of time and resources, we could not implement the proposed system though we are hopeful to implement the system in future.

REFERENCES


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