

Multi Factor Authentication and IP Address Restriction based Question Paper Delivery System for Indian Universities

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Abstract— The traditional question paper delivery (QPD) procedure in Indian institutions is discussed in this paper with a focus on its downsides, including complexity, time requirements, security issues, environmental impact, and cost. This method is manual, which makes it prone to mistakes, rigid, and open to leaks and tampering, especially when it comes to the security of the exam questions. It also looks at security issues involving question paper leaks, highlighting ongoing difficulties in preserving the integrity and confidentiality of the Indian educational system. These occurrences highlight the requirement for a more reliable and secure QPD system.

In this paper workflow of the cloud-based software system is described in detail, with examples showing how it makes it easier to distribute safe exam papers and assures stakeholder accountability. Barcodes are integrated into the system, and their improved tracking, processing, and distribution of exam papers is highlighted. A cutting-edge cloud-based Question Paper Delivery System (OQPDS), which automates and streamlines the process of generating, distributing, and giving exams for Indian colleges, is the suggested cure. Modern security elements are used by the system, including two-step authentication, barcode-based data storage, data encryption during data transfer, IP address-based access restrictions, and time-based content delivery. The incorporation of these security elements enhances the overall security and efficiency of the QPD system. The proposed system's workflow is discussed in detail along with examples that demonstrate how it facilitates the distribution of secure exam papers and ensures stakeholder responsibility. The system incorporates barcodes, and its better distribution, processing, and tracking of exam papers is praised. The system's capacity to limit access based on IP addresses is described, along with how it might help with traceability and prevent unwanted access. Additionally, the paper proposes watermarking to label test papers with the IP address of the testing facility, offering benefits including improved security, tamper detection, and traceability. It is highlighted that encryption is a key security tool for preserving data integrity, maintaining secrecy, and protecting against online dangers. Finally, the cloud-based Question Paper Delivery System is a solution to the security issues and inefficiencies of the current QPD system. This system intends to transform the examination procedure in Indian institutions by offering a more safe, effective, and transparent approach to question paper administration. It does this through contemporary security provisions and cutting-edge technology. This paper also discusses comparative analysis between traditional and proposed automated Question paper delivery system with respect to efficiency, security, cost reduction and flexibility.

Keywords- Barcode, IP address, Authentication, Watermark

I. INTRODUCTION

The traditional question paper delivery (QPD) process in Indian universities involves the manual printing, packing, and physical distribution of question papers to examination centers before the actual examination [1]. While this method has been prevalent for years, it is associated with several significant disadvantages. Managing the logistics of printing, packaging, and transporting a large number of question papers to various exam centers across the region can be highly complex and prone to errors[2]. The traditional process is time-consuming, requiring a considerable amount of time to print, pack, and

distribute question papers. Delays in any of pre-examination activity can impact the timely commencement of examinations. Physical distribution of question papers poses a significant security risk, including the possibility for question paper leaks, tampering, or theft during transportation or storage at University or Examination Centers. Well advance Printing of large volumes of question papers contributes to paper waste and has an adverse impact on the environment. Disposal of used papers also adds to environmental concerns. The cost associated with printing, packaging, and transportation of question papers is substantially high. It also involves a significant allocation of resources, including labor and material. With the existing

traditional method, making last-minute changes to question papers or customizing them for specific examination centers can be challenging due to the time and effort involved in reprinting and redistributing. The traditional process cannot provide flexibility in terms of accommodating unforeseen circumstances, such as sudden changes in the exam schedule or venue, without significant disruption to the distribution process. The manual nature of the process makes it prone to human errors, such as incorrect packaging, misplacement of question papers, or distribution to the wrong exam centers. Although measures are taken to secure physical question papers, they may not be as robust and tamper-proof as the security measures employed in digital distribution systems. Rural or remote exam centers may face even more significant challenges in receiving question papers on time due to geographical barriers and limited transportation options. The most important security concern about the traditional question paper generation and delivery process is about security of question paper and undisclosed delivery of the same considering involvement of many stakeholders in the process. The process is more prone to leakage of question paper as stakeholder may be involved in it intentionally or unintentionally [7].

Addressing these disadvantages and transitioning to modern digital systems like Online Question Paper Delivery Systems can mitigate these challenges and result in a more efficient, secure, and sustainable examination process for Indian universities.

II. REVIEW OF SECURITY INCIDENTS IN EXISTING QPD PROCESS

As of now considering the several incidents happened across the nation in maintaining the secrecy of question paper through documented physical process of question paper delivery, the question paper leaks have unfortunately been a recurring issue in the Indian education system. These incidents often involve the unauthorized distribution or publication of question papers before or during examinations. Here are some notable instances happened in different Universities are discussed.

Question paper of third semester examination of Bachelor of Commerce (B. Com) was allegedly leaked from one of the affiliated College to SU in Babra town of Amreli, Saurashtra University (SU) and University had delisted the college as an examination centre, initiated process of revoking affiliation to that college and the that enrolment of students involved in the crime was terminated [3]. The university has also decided not to recognise educational qualifications of Principal of one of the institutes alleged its involvement in Leaking the question paper. A final-year BCom examination was postponed following an alleged question paper leak during October 2020 in Bangalore University[4]. The question paper of Principles and Practice of Auditing was being circulated on WhatsApp

around noon, while the exam was to start at 2 pm. Around 40,000 students from 700-odd colleges were to take the exam at 205 centres. In another incident the Central Board of Secondary Education (CBSE) faced question paper leaks for Class 10 and 12 board examinations in 2018 and 2019 [5]. The leaks led to the re-conduct of certain examinations to maintain fairness and integrity. In 2020, question papers for the Secondary School Certificate (SSC) and Higher Secondary Certificate (HSC) exams conducted by the Maharashtra State Board were leaked on social media platforms. This resulted in re-examinations for affected subjects. In 2018, the question paper for the Rajasthan Police Constable Recruitment Exam was allegedly leaked. The exam was cancelled, and an investigation was initiated. Dibrugarh University in Assam faced a question paper leak during the BA, BSc, and BCom examinations in 2017. The incident resulted in protests and demands for a thorough investigation. In 2015, question papers for the Kerala Engineering and Medical Entrance Exam (KEAM) were leaked, leading to the arrest of several individuals involved in the leak. SKAU had to cancel the exam of the subject 'Padarth Vigyan' scheduled as per the date sheet after its paper got leaked on January 16, 2020.

Every year, a number of question paper leaks from various university exams, competitive exams, and school board exams have an influence on thousands of students, negatively affecting their life and the quality of their education after years of hard work. More than 1.5 crore students may have been impacted by the several question paper leaks that occurred in various states over the past seven years, according to estimates. Data indicates that there have been over 70 instances of question paper leaks throughout the nation over the past seven years, affecting the futures of thousands of students[6].

These incidents highlight the challenges related to maintaining the security and integrity of examination systems within Indian universities and educational boards. Authorities have been taking measures to enhance security, such as digital question paper delivery systems, stricter monitoring, and legal actions against those involved in question paper leaks. It's important to note that efforts are continuously being made to prevent such incidents and ensure a fair and transparent examination process.

III. QPD PROCESS AND STAKE HODERS

The legislative framework of Indian Universities involve several experts and staff in QPD process for secure and transparent delivery of question paper at the time of examination to the candidates appearing for examination. The process may vary and the human resources in the same may vary from University to University according to the University policies and structure of Examination Department. Figure 3.1

describes the generalized view of QPD process in Indian Universities carried out from many years.

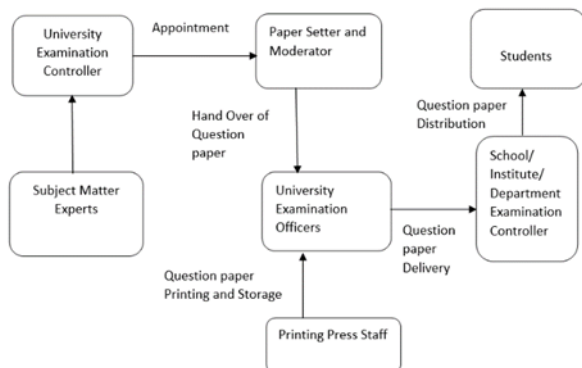


Figure 3.1: Stakeholders Involved in QPD process in Indian Universities

The University Examination Controller is completely responsible for all examination activities by ensuring secrecy of question paper and transparent procedure for secure delivery of question paper to end candidate at the time of Examination. The University Examination Controller defines scheme of examination question paper as per norms and regulations set by university authorities or expert committees like academic council, maps subject matter experts to respective subjects and appoints them as paper setter or question paper moderator or question paper approver and also ensure secure handover, storage and delivery of question paper to affiliated institutes and candidate. The paper setters, moderators and approvers ensure secure and timely handover of question paper to University examination officials. University Examination officials print, store and deliver the question papers to respective institutes affiliated to University well in advance in secure environment. Institute Examination Controller Stores the question paper and distributes it at the time of examination. The major incidents of question paper leak happened in the country is lead by compromised stakeholder. Also the existing traditional approach also has restriction of delivering question papers to the respective affiliated departments or institutes in advance which can create the issue of security of question papers and it is solely depend on the stakeholders behavior to maintaining secure environment for storing and distributing the question papers. Considering the possibilities and incidents of paper leak in past many years there is requirement of more secure and transparent environment for question paper delivery which can be accomplished through advanced secure digital platforms and software services.

IV. PROPOSED AUTOMATED SECURE QPD SYSTEM

We are proposing here cloud-based Question Paper Delivery System (QPDS) which is a digital platform or software solution designed to automate and streamline the process of preparing, distributing, and administering examination question papers for INDIAN Universities and affiliated educational Institutes. This system utilizes digital platform and authentication methods to facilitate the The Proposed system for Secure and Efficient Question Paper Delivery is developed using cloud-based services and the security provisions so as to provide efficient QPD system by maintaining utmost security and transaction logs of every activity carried out by stake holders involved in Question Paper Delivery in Indian Universities.

The Subject matter expert appointed as question paper setter physically handover sealed question paper to University Officials. The University officials then attach barcode to the question paper envelop so as to store the information about question paper with the attached barcode as unique identity for question paper. This question paper is then handed over to DPT operator who actually type the question paper so as to print the same. It is observed that use of barcode enhances the overall QPD system. Using barcodes helps track and monitor the circulation of papers to just authorized people while also ensuring the security and confidentiality of exam papers. Also Exam papers can be handled and distributed more effectively with the use of barcodes. Verifying the accuracy of the question paper being distributed can be made easier by scanning the barcodes. Barcodes helped to automate a number of examination-related steps, including the delivery of question papers to examination locations [14]. This automation boosts productivity and lowers human error. Barcodes considerably limit the possibility of human error when handling and distributing exam papers. The distribution and collection of question papers are automatically recorded when barcodes are used, which streamlines record-keeping. Systematic tracking and control of the whole examination process, from the preparation of the question paper to the processing of the results, is made possible by the integration of barcodes with examination management systems.

The University Examination officer can create IP address restricted account for examination centers over the proposed system to access examination time table, notices and download question paper at the time of examination. The Examination center head of affiliated institutes can access the contents as mentioned earlier with two step authentications ie with one time password (OTP) and Face Recognition. This multi factor authentication will provide more security for question paper access by authenticate person [10] [11]. The system also store the Face Picture of the logged in person for any further audit or inquiry about system access. The proposed system significantly

strengthens the security of the authentication process and making it harder for unauthorized individuals to access the system. This authentication process also reduces the risk due to credential theft. This process helps in increasing potential trust and confidence among stakeholders. The availability of question paper only before few minutes of scheduled examination reduces the risk of paper leak at institute as question paper is not available well in advance to examination center unlike traditional process. Use of Combination of OTP and Face recognition also Phishing attacks become less effective [9]. It also helps in execution of compliance if any required post examination.

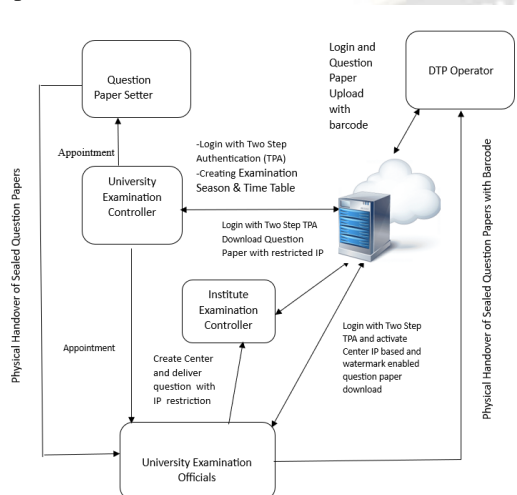


Figure 4.1: Proposed System Model for Secure and Efficient Question Paper Delivery

The question papers are safely transported from the source to the server thanks to encryption. Only authorized individuals with the proper decryption keys may access and decipher the exam papers thanks to encryption, which offers a high level of confidentiality. Uploading encrypted question papers guards against potential data interception by hostile parties. Data stays encrypted and inaccessible without the right decryption key even if it is intercepted. By preventing even authorized system users from accessing the exam materials without the required decryption keys, encryption minimizes the danger of internal attacks and lowers the possibility of data breaches or leaks. Limiting access to question paper download based on specific IP addresses adds an extra layer of security to the question paper distribution process. Unauthorized access from outside the designated IP range is effectively prevented. The possibility of unauthorized individuals gaining access to the question papers is greatly decreased by limiting transmission to approved IP addresses. This preserves the content of the exam's integrity and secrecy. Administrators can restrict access to question papers based on an IP address. The papers can only be downloaded from authorized locations, including exam centers or designated

offices, ensuring that they get to the right people. Limiting the IP addresses to which question papers can be delivered makes it impossible for users to circumvent security measures and obtain the materials from unauthorized areas by using proxy servers or virtual private networks (VPNs). The possibility of test leaks, exam paper sharing, or other types of cheating is greatly diminished by restricting access to question papers to predetermined IP addresses. It raises a barrier against potential evil intent. IP address limitations offer a way to keep track of and preserve an audit trail of who accessed the test papers and where they came from. The analysis and investigations that follow an exam may benefit from this knowledge.

Question papers are more securely marked with a watermark that includes the IP address of the testing facility. It serves to immediately identify any unauthorized copies and designates the question paper's legitimate source. The watermark enables traceability by associating each exam paper with a particular testing location [12] [13]. It aids in tracing the origin of the question paper and makes the relevant test center responsible in the event of any irregularities or misconduct. A tamper-evident feature may be provided by the watermark. The watermark will be warped or broken if someone tries to change or tamper with the exam paper, giving away any potential for wrongdoing. The watermark prevents question papers from being copied without authorization. It is more difficult for anybody to copy, distribute, or leak the exam paper when there is a visible watermark. Examining officials can readily determine where a question paper came from. The watermark makes it easier to recognize a question paper's source right away if it is discovered outside of the specified testing location. Exam administrators can track the circulation of question papers to various exam centers in real-time by using the IP address watermark. Any differences from the specified IP addresses can be highlighted right away for inquiry. Exam question papers may be precisely tracked, including their origin and distribution, thanks to the watermark's creation of an audit trail. This can be quite helpful for auditing and looking into any shady practices. The watermark might be essential evidence to prove the legitimacy and provenance of the question paper in any legal issues or forensic investigations involving exam fraud.

The proposed system uses encryption of question paper contents at the time of uploading to main server. Verifying data integrity while it is being transmitted is possible thanks to encryption. An additional layer of security against unauthorized alterations is added by the fact that if the encrypted content has been changed or tampered with, the decryption operation will fail at the receiving end. Question papers that have been encrypted can be safely saved in databases or cloud storage platforms. This makes sure that the data is encrypted and impossible to decrypt without the decryption key even if there is a breach or unauthorized access to the storage. Due to the

assurance of data confidentiality and privacy, using encryption methods increases trust and confidence in the QPD system among stakeholders, including academic institutions, faculty, students, and regulatory agencies. By rendering the intercepted data useless to the attackers without the decryption key, encryption serves as a powerful protection mechanism against cyberattacks like man-in-the-middle assaults or data breaches [8]. Encryption guarantees that the data is safeguarded independent of the upload location, allowing a secure upload process from any approved point if question papers need to be uploaded remotely or from different places. Encrypted question paper uploads improve the QPD system's credibility overall, giving it a secure and dependable platform for managing exam materials.

V. COMPARISION WITH TRATIONAL SYSTEM

The suggested cloud-based Question Paper Delivery System has a number of advantages over conventional exam administration strategies. saves on storage and transportation costs, as well as costs related to printing, distributing, and monitoring test materials. saves time for both University administrations and affiliated institutes by streamlining the entire exam process, from question paper creation to evaluation. Strong security measures are also put in place to prevent unauthorized access to the question papers, uphold the integrity of the exam, and lower the likelihood of cheating. reduces the workload on test coordinators at universities and related institutions by automating a variety of administrative activities, including the preparation and delivery of question papers. Exam data is securely stored by QPDS, lowering the risk of loss or destruction of physical records.

TABLE I: COMPARISON OF CONVENTIONAL QUESTION PAPER DELIVERY SYSTEM AND PROPOSED AUTOMATED QUESTION PAPER DELIVERY SYSTEM

Comparative Parmenter	Conventional Question Paper Delivery System	Proposed Automated Question Paper Delivery System
Number of stake-holders are involved in QPD system in Question Paper Generation	<ol style="list-style-type: none"> 1. Question Paper Setter 2. DTP operators 3. University Examination Staff 4. Printing Press Staff 5. Transportation Staff 6. University Strong Room Staff 7. Affiliated institute Examination Staff 	<ol style="list-style-type: none"> 1. Question Paper Setter 2. DTP Operators 3. Affiliated Institute Staff <p>As number of stakeholders are less the risk of question paper integrity and security is also reduced.</p>

Storage of Question Papers before printing	<ol style="list-style-type: none"> 1. Stored for few days or weeks before printing in sealed envelop 2. Physical security provisions required 	<ol style="list-style-type: none"> 1. Securely stored over Cloud Server 2. No need of Physical Security Provisions <p>Question paper is not available to anyone after submission made by paper setter until specific time before examination.</p> <p>Hence possibility of question paper tampering or leakage reduces completely in storage and printing. Also Cost on storage is reduced.</p>
Question Paper Printing	<ol style="list-style-type: none"> 1. Printing Starts few weeks before at printing press 	<ol style="list-style-type: none"> 1. Printing starts few minutes before the actual examination at examination center only <p>Overhead of printing the question papers is reduced and possibility of leakage during question paper printing at printing press is completely reduced.</p>
Transportation of Question papers and Cost of Transportation	<ol style="list-style-type: none"> 1. Question papers are transported to Examination center few days before the Examination starts 	<ol style="list-style-type: none"> 1. No need of question paper transportation to examination center <p>Cost and overhead of transportation, as well as risk of leakage in transportation is completely reduced.</p>
Security	<ol style="list-style-type: none"> 1. Provision of Physical security at each stage of Storage, Printing and transportation is required. 	<ol style="list-style-type: none"> 1. Multi factor authentication with OTP and Face recognition. Only authenticate user are allowed to access question paper. 2. Question paper is directly delivered to Examination center in encrypted form. 3. IP address restrictions don't allow access to

		question paper outside center premises. Question Paper Leaks can be eliminated using this security feature.
Efficiency	1. Few weeks or month is required from generation to delivery of question paper	1. Delivery of question paper is possible at any time after generation of question paper.
Access Records	1. Access records are manually maintained and error prone	1. Access is possible only with OTP and biometric authentication. Role based access records are maintained and can be viewed any time using software system. 2. Live & deferred audits from logs are available
Investigation in case of Leakage if any	1. Time consuming and complicated as many steps and manual records.	1. Investigation is fast and easy using question paper access audit logs. 2. IP address Water marking on question paper makes it easy to trace question paper leak location.
Corrections and Query handling Flexibility	1. Communicating corrections and handling queries is time consuming	1. Corrections can reflect to existing question paper immediately before start of examination

VI CONCLUSION

The proposed Automated Secure Question Paper Delivery System under consideration tackles the drawbacks of the conventional manual question paper delivery method that is used in Indian colleges. Regular question paper leaks serve as a reminder of how inefficient, time-consuming, and security-risky the traditional method is. The transmission of exam papers is streamlined and secured by the suggested system, which makes use of contemporary technologies including cloud computing, encryption, two-step authentication (OTP and face recognition), and barcode integration.

Barcodes improve security, traceability, and automation by guaranteeing that only authorized users can access test materials. Encryption adds an additional layer of protection,

guarding the information on the exam paper while it is being transmitted and stored. IP address limits increase security by restricting access to approved testing facilities. Face Recognition and OTP use substantially improve overall security and reduce illegal access and phishing.

Regardless of data quantity or user demand, the cloud-based architecture guarantees effective availability of examination contents. The system offers improved traceability, immediate paper source identification, and automated verification, all of which contribute to a thorough and responsible examination process. The method prioritizes examination integrity, secrecy, and fairness for all parties involved in order to provide a more secure, effective, and transparent strategy for Indian universities by combining these technologies.

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