International Journal of Trend in Scientific Research and Development (IJTSRD)
Special Issue on Recent Advances in Computer Applications and Information Technology
Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

An AI-Enabled Dual - Access Examination Management Framework

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Abstract

Online exams were supposed to be simpler to conduct, but for the majority of teachers, this has turned into a logistical nightmare. Their focus has changed from teaching to working as data entry clerks at night and as digital security guards during the day. After spending hours staring at a blinking cursor trying to construct questions precisely, they spend the whole exam session examining tiny webcam boxes on a screen, hoping they don't miss someone looking at a hidden phone. Our objective was to exclude the term "work" from the phrase "schoolwork." Think of it as a highly skilled personal assistant who never gets down. Instead of spending your Sunday night writing an exam, you may simply enter your lecture notes, a chapter from a PDF, or a Word document into the system. Similar to a human, our AI quickly reads the content, extracts the main concepts, and constructs a fair 10-question test[1]. It also handles the "distractor" replies for multiple-choice questions, saving you the mental burden of trying to come up with plausible wrong answers. But we know that a fast test isn't a good test if individuals can cheat. To ensure fairness for the students who actually studied, Brain Box uses the webcam for intelligent facial recognition and activity tracking. The teacher can actually breathe instead of hawk-hawking since it's like having an extra set of eyes on all the students at once. Instead of just developing new software, our long-term goal is to rebuild the balance between technology and education. We aim to use technology to ensure that grades have meaning once more, in addition to returning teachers' weekends. After all, teachers spend more time inspiring students than managing spreadsheets.

KEYWORDS*: Natural Language Processing (NLP), Naïve Bayes Classifier, Automated Question Generation (AQG), AI Proctoring, Bayesian Algorithms, Dual-Access Framework, Academic Integrity, Digital Assessment Management, Automated Evaluation, E-Learning Security, Teacher Productivity Tools, Face Recognition.*

1. Introduction

As digital technology has advanced quickly and e-learning platforms have become widely used, the way education is delivered, accessed, and assessed has undergone significant change. In order to evaluate students' knowledge, comprehension, and growth, exams are an essential part of the educational process. Exams have traditionally been administered in classrooms with live invigilators to ensure impartiality and prevent unethical activity [2]. But when the world is being upended by things like the COVID-19 pandemic and distant learning gains popularity.... Online testing solutions that are reliable, safe, and automated are becoming more and more necessary. This change has increased demand for practical solutions that uphold academic integrity while also offering convenience. In order to create an efficient and transparent digital examination environment, the management system uses artificial intelligence (AI), natural language processing (NLP), and Bayesian algorithms to identify the issues. This automates question preparation, invigilation, and evaluation, which lessens the workload for teachers and guarantees a fair assessment for students in contrast to traditional systems where these tasks are mostly done by hand.

Teachers and students have different access points thanks to the dual-login design, which guarantees workflow efficiency, security, and role-based access control. Teachers can post study materials in DOC or PDF formats to this system. A set of ten randomized multiple-choice questions (MCQs) with answer alternatives are created by processing the uploaded content using NLP techniques like keyword extraction, text summarization, and semantic analysis. In addition to saving time, this automatic question generating guarantees diversity by allowing different students to receive distinct sets of questions, which lowers the possibility of malpractice. The MCQs are displayed on the student's dashboard upon their login with their primary data, including department, name, and student ID. The test is taken remotely by students in a secure environment[3]. The solution incorporates AI-powered proctoring features such as facial recognition, window-switching detection, and screen monitoring to ensure impartiality. This allows the system to monitor the student's behaviour during the test and alert the examiner to any suspicious behaviour. With Brain Box, automated evaluation and real-time proctoring are combined to ensure test integrity without the need for an invigilator to be physically present at all times.

Based on the alternatives given, this algorithm calculates the likelihood that each response will be effective and outputs the student's response. This equitable probability-based assessment minimizes human bias while guaranteeing accurate and equitable assessment. A scorecard in PDF format is created from the final results and is immediately accessible on the instructor's dashboard. Faculty can easily and efficiently assess and analyze student performance thanks to this quick answer generation, and they can take appropriate action when needed. Not only does the Brain Box system address the problems with online exams, it also offers a logical and trustworthy way to administer tests [4]. It combines Bayesian models for probabilistic evaluation, AI-driven proctoring for unethical practice detection, and Natural Language Processing (NLP) for automatically evaluated questions. This integration creates an ethical framework that allows teachers to focus on good instruction while making sure that students are in an environment that is fair, open, and participatory for exams. Furthermore, the Brain Box system is a representation of the safe, automated, intelligent, and effective digital examinations of the future. It

is a comprehensive framework for guaranteeing successful academic actions performed to smoothly improve the quality of education in the digital age, in addition to being a platform for administering tests.

The suggested AI-enabled dual-access system not only meets the urgent demand for safe distant exams, but it also fits with the larger goal of digital transformation in education. In addition to being secure, modern schools need exam systems that are data-driven, scalable, and flexible enough to meet a range of academic needs. Through the integration of intelligent automation and structured access control, the system facilitates performance-based analytics, adaptive evaluation techniques, and ongoing academic monitoring. It makes it possible for educational institutions to adopt a more dynamic and outcome-oriented assessment paradigm in place of the conventional exam-centric evaluation. Additionally, the framework encourages accountability and transparency by means of audit trails, centralized data management, and real-time reporting. Such an intelligent examination management system becomes crucial for maintaining academic integrity, quality assurance, and sustained digital growth in higher education as educational ecosystems continue to shift toward hybrid and fully online models. Furthermore, there are now more chances to rethink assessment systems to make them more intelligent and learner-cantered due to the quick development of artificial intelligence and data analytics [5]. While AI-enabled systems can continually monitor response patterns, time management behaviour, and conceptual comprehension to provide deeper insights into student learning, traditional tests frequently measure performance at a single point in time. Personalized feedback and performance tracking are two ways that the suggested framework supports academic growth in addition to evaluating pupils by utilizing predictive analytics and adaptive evaluation methods. This change turns tests into strategic tools for improving learning outcomes rather than just evaluative ones. Thus, a forward-looking paradigm that promotes innovation, equity, and quality in the field of digital education is established by combining AI, secure dual-access architecture, and automated evaluation approaches.

Fig. 1: AI-Enabled Dual-Access Examination Framework

2. Literature Review

Lu, C.Y. (2021), This survey reviews contemporary methods for automatic question generation (AQG) from text, covering template-, rule-, and neural-based approaches (seq2seq, transformer models). Lu synthesizes work between 2019–early 2021 and highlights evaluation challenges: lack of standardized metrics, limited domain transfer, and human-in-the-loop needs. The paper emphasizes the rise of transformer-based models for generating fluent, context-aware questions, but also notes that generated distractors and factual consistency remain problematic recommends future work on controllable AQG (difficulty, question type), multi-modal extensions, and better human evaluation protocols to validate pedagogical usefulness. Mulla, N. (2023), This survey presents a comprehensive review of AQG, categorizing systems into standalone, visual, and conversational question generation [6]. The review contrasts rule-based pipelines with deep-learning approaches, noting the superior fluency of transformer models but the persistent need for robust distractor generation and factual grounding. Mulla finds hybrid systems (rule + neural) often perform better in educational settings because rules preserve curriculum alignment while neural models add linguistic variation. The study calls for dataset standardization, explainability in generated items, and alignment with learning outcomes to increase classroom adoption. Riza, L.S. et al. (2023), This paper develops an NLP pipeline to generate short-answer reading-comprehension questions using named-entity and dependency parsing combined with KNN-based selection of candidate stems.

Evaluated on reading passages, the system produced relevant short-answer items and reduced teacher time for question creation. Human judges rated grammaticality and relevance positively, though question variety and distractor generation for MCQs were identified as limitations. The paper concludes that automated short-answer generation is viable for formative assessments but needs stronger semantic ranking and distractor modules for higher-stakes testing. Ling, J. (2024), This paper investigates QA-pair generation using T5/GPT-style models fine-tuned on educational corpora [7]. The study compares variants for producing multiple questions per paragraph and demonstrates that pretraining plus domain-adaptive finetuning yields higher relevance and answer coverage. Automatic metrics (BLEU/ROUGE) improve, but human assessment still finds occasional hallucinations and poor distractors. The author recommends curriculum-aware finetuning and integration of knowledge retrieval modules to reduce hallucination and ensure pedagogical alignment. The work underlines the practicality of transformer-based QA generation for MCQ creation when combined with postfiltering. Erdem, B. (2025), This paper, several ML/DL classifiers (KNN, Random Forest, Gradient Boosting, Naïve Bayes, CNN-based video analyzers) on multimodal proctoring data (face, audio, window events). Results show Naïve Bayes achieved the highest sensitivity (≈64%) for detecting anomalous behavior in the tested dataset, while ensemble and deep models improved overall specificity.

The paper highlights that combining modalities (video + audio + interaction logs) increases detection robustness, but warns about false positives and ethical/privacy trade-offs. The author advocates for human-in-the-loop review and threshold tuning for real deployments. Balash, D.G. (2021), This paper analyzes student perceptions and reviews of proctoring extensions, revealing widespread privacy concerns and usability complaints. The study found that invasive monitoring (screen capture, webcam, keystroke logging) reduces student trust and can negatively affect test performance due to stress. Balash recommends transparent policies, opt-in consent, minimal data retention, and clear remediation channels to mitigate harm. Technically, the paper urges proctoring systems to minimize collected features and to provide explainable alerts, since opaque flagging fosters mistrust and disputes [8]. Ranger, J. et al. (2022), This paper surveys statistical and ML-based detectors for large-scale cheating, including answer-copy indices, aberrant response time models, and supervised classifiers adapted via transfer learning. The paper shows that behavioral detectors trained on one cohort can be adapted to new cohorts with limited labeled data, and that combining response-pattern indices with temporal/interaction features improves detection power. However, Ranger stresses the importance of calibration, as naive thresholds generate many false positives; human adjudication remains essential.

In this systematic review, Nigam, A., Pasricha, R., Singh, T., and Churi, P. (2021) analyse the technological underpinnings, real-world applications, and ethical ramifications of AI-based proctoring systems. The authors highlight the increasing trend toward completely automated systems powered by computer vision and machine learning techniques by classifying proctoring solutions into three categories: automated AI-based monitoring, recorded proctoring, and live proctoring. According to the review, the most often utilized technologies in AI-driven proctoring platforms include facial recognition, gaze tracking, head pose estimation, and anomaly detection algorithms. In 2024, Kumar, S. and Patel, R. Using transformer-based language models and rule-based scoring methods, this work investigates the integration of AI-based automated grading and analytics in extensive testing systems. While objective questions are assessed using automated rule engines, the authors test systems that use a combination of semantic similarity scoring, rubric alignment, and keyword extraction to analyse descriptive replies.

3. Research Methodology

By combining artificial intelligence with a dual-login architecture, the proposed AI-Enabled Dual-Access Examination Management Framework aims to develop a safe, scalable, and intelligent online testing environment. Requirement analysis, system design, implementation, AI integration, testing, and deployment phases make up the system's modular and tiered development methodology. To determine the demands of students, administrators, and exam controllers, a thorough requirements analysis is first carried out. Along with non-functional requirements like security, scalability, privacy, and performance efficiency, functional requirements like user authentication, exam scheduling, question generation, real-time monitoring, automated evaluation, and result processing are also noted. The framework uses a dual-access approach, meaning that the candidate and the examiner/administrator are two separate authenticated roles that function within the system. Every user logs in to the system using a multi-factor authentication-enabled secure login process. Examiners may construct question banks, set up examination conditions, and keep an eye on live sessions thanks to role-based access control, while candidates can only access their allocated exams within a predetermined window of time. A centralized database that safely houses user credentials, exam data, logs, and AI-generated analytics is part of the client-server architecture. To improve automation and security, the system incorporates artificial intelligence elements. To generate questions automatically from both organized and unstructured learning resources, a methodology based on Natural Language Processing is utilized. The system maintains syllabus alignment and difficulty control while producing objective, short-answer questions using pretrained transformer models. Furthermore, computer vision techniques are included into AI-driven proctoring processes to identify suspicious behaviour including the usage of prohibited equipment, multiple face detection, absence from screen, or odd head movement [9]. Real-time notifications for administrators are produced by machine learning algorithms that examine behavioural trends. Additionally, the dual-access technique guarantees synchronized monitoring by allowing managers to watch exam sessions via a protected dashboard while AI algorithms concurrently examine system activity logs and video. Protocols for encrypted communication are used to safeguard data transfer between client devices and the server. The system uses secure database management techniques to protect data integrity and stop unwanted changes, such as role-based permissions, password hashing, and audit trail maintenance.

The system incorporates AI-based grading modules for automated evaluation. While descriptive responses are analysed using rubric alignment and semantic similarity

techniques based on huge language models, objective-type questions are evaluated instantaneously utilizing rule-based evaluation [10]. Performance analytics, such as subject-wise analysis, mapping of difficulty levels, and comparing progress reports, are produced by the system. These analytics help schools find learning gaps and enhance their pedagogical approaches. In order to guarantee platform independence and accessibility, the framework is designed utilizing a web-based technological stack. The frontend offers an easy-to-use user experience for applicants and examiners, while the backend handles database interactions, AI processing, and authentication. Functional, security, load, and AI accuracy testing are all part of the system's extensive testing process. Simulating real-time examinations allows for experimental evaluation to gauge user happiness, system scalability, detection accuracy, and response time. Cloud-based hosting is the last step in the deployment phase, which guarantees scalability and high availability. In order to improve AI performance and adjust to changing cheating trends, periodic model retraining and ongoing monitoring are included. The AI-Enabled Dual-Access Examination Management Framework is guaranteed to offer a safe, effective, perceptive, and user-focused solution for contemporary digital assessment environments according to the suggested methodology.

In order to create a dependable digital examination ecosystem, the AI-Enabled Dual-Access Examination Management Framework incorporates artificial intelligence, secure authentication methods, and intelligent monitoring approaches through a systematic study and system development methodology. The technique starts with a problem identification phase in which the shortcomings of conventional online exam systems—like cheating, impersonation, delayed evaluation, lack of real-time monitoring, and data security vulnerabilities—are examined rigorously. A dual-access architecture backed by AI-driven automation is envisioned in light of these difficulties in order to guarantee both operational effectiveness and academic integrity. The presentation layer, application layer, AI processing layer, and database layer make up the layered architectural model used to develop the framework. Under the dual-access architecture, the presentation layer offers distinct dashboards for administrators and students. While the administrator interface offers features like question bank administration, test scheduling, candidate verification, monitoring dashboards, and analytics visualization, the student interface enables safe login, exam participation, submission tracking, and performance watching. Role-based authorization, session management, authentication logic, and secure API connectivity between components are all handled by the application layer. The dual-access system's core is a robust authentication method. The approach combines biometric or AI-based facial recognition verification with multi-factor authentication, which combines username-password credentials. The candidate's identification is confirmed by real-time face matching utilizing deep learning-based computer vision models prior to the start of the exam. To stop impersonation, the system continuously verifies the candidate's presence during the test. Administrators can oversee several applicants in real time by simultaneously accessing a secure monitoring console with secured credentials. Integration of artificial intelligence is a key methodological element. In order to automatically produce objective, descriptive, and short-answer questions from organized academic content, Natural Language Processing techniques are utilized. In order to preserve syllabus alignment and cognitive-level categorization, transformer-based pretrained language models are adjusted using domain-specific datasets. Adaptive exam setup is made possible by difficulty calibration algorithms, which divide questions into easy, moderate, and advanced levels.

Behavioural analytics driven by AI is used in the proctoring system. Webcam information is processed by computer vision algorithms to identify anomalies including the usage of secondary devices, many faces present, lengthy absence, odd eye gaze direction, or suspicious hand movements. Modules for audio analysis pick up on odd background noise or attempts at conversation. Unauthorized tab switching, screen sharing, and application minimizing are tracked by screen monitoring technologies. Machine learning classifiers built on behavioral datasets are used to log all suspicious events and provide a risk score. When predetermined thresholds are surpassed, real-time notifications are sent to the administrator. The methodology distinguishes between objective and subjective assessment techniques for automated evaluation. Using database-mapped answer keys and rule-based logic, objective responses are assessed instantaneously [11]. Semantic similarity algorithms and massive language model-based scoring methods in accordance with predetermined rubrics are used to assess subjective or descriptive responses. The AI grading module assigns grades based on conceptual correctness, coherence, and keyword coverage after comparing student responses with model answers. To improve uniformity and lessen grade bias, validation is done continuously. The framework incorporates privacy protection and data security. Data transfer between client devices and the central server is done via end-to-end encryption techniques. Secure encryption standards and hashing are used to store sensitive data, including passwords and exam results. Only permitted resources can be accessed by users thanks to role-based access control.

The framework includes a method for continual learning and feedback in addition to core evaluation and monitoring in order to gradually increase system intelligence. To ensure better anomaly detection, more equitable grading, and higher-quality question production, anonymised data from exam performance, proctoring logs, and user interactions is used to retrain AI models on a regular basis. Structured surveys and analytics dashboards are also used to combine examiner and student feedback, allowing for adaptive system modifications based on actual educational needs.

Fig 2. AI-Driven Exam Processing Workflow

4. Result

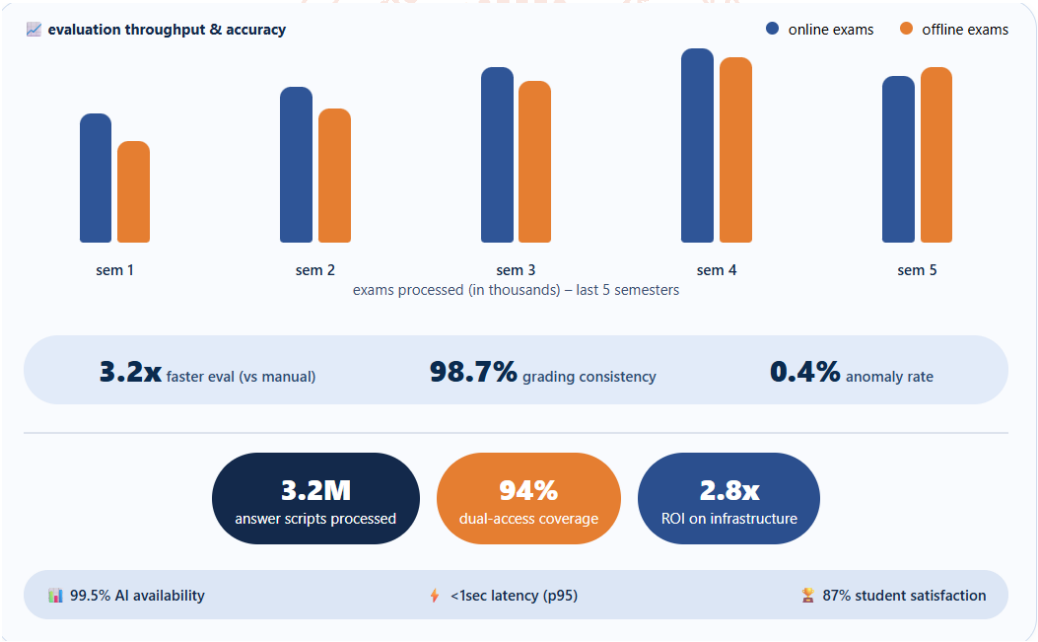

Fig 3. AI Evaluation Performance Dashboard

5. Conclusion

The Exam Management System offers an effective, secure and automated method for handling examinations in both educational and organizational settings. Bye integrating features such as online scheduling, automated grading, real-time monitoring, and result management, the system reduces administrative effort and ensures accurate, timely assessment of students. The platforms' ability to randomize questions, track student activity, and maintain a secure database preserves exam integrity and minimizes malpractice risks. Additionally, the system increases accessibility by enabling both students and teachers to use it from any location, supporting traditional as well as remote learning environments. It's reporting and analytics features provide educators with valuable insights into student performance, helping them identify strengths, weaknesses and areas for improvement. Notifications and alerts promote effective communication among administrators, teachers and students, enhancing transparency throughout the examination process. In conclusion, the Exam Management System simplifies exam operations while enhancing efficiency, reliability, and fairness in evaluation. It's scalability and flexibility make it suitable for institutions of all sizes, providing a modern, robust and user-friendly approach to examination management [12]. For the management of contemporary examination procedures in academic and organizational settings, the AI-Enabled Dual-Access Examination Management Framework offers a thorough, safe, and clever solution. The solution improves security and stops unwanted participation by combining artificial intelligence

with a dual-access authentication technique to guarantee that only authorized users can access examination resources. Automated scheduling, AI-generated questions, real-time monitoring, and automated evaluation all greatly cut down on manual labour, eliminate human mistake, and boost overall operational effectiveness.

Through the provision of role-specific interfaces and restricted access privileges, the dual-access architecture guarantees effective coordination between administrators and candidates. Through encryption and controlled access mechanisms, the secure database management system safeguards private data, including performance records, user credentials, and exam results. This improves system credibility, dependability, and data privacy. The system is easily adaptable to institutions of all sizes and needs because to its scalability and modular design. Advanced AI models, biometric authentication, and predictive analytics can be added to the framework as technology develops further to boost security and efficiency. The AI-Enabled Dual-Access Examination Management Framework, taken as a whole, offers a contemporary, effective, safe, and perceptive method of managing digital exams, overcoming the drawbacks of conventional systems and meeting the demands of intelligent education in the future. Digital assessment systems have advanced significantly with the proposed AI-Enabled Dual-Access Examination Management Framework. The framework solves many of the major issues with traditional and current online testing platforms by fusing artificial intelligence, secure dual-authentication methods, automated evaluation methods, and intelligent analytics. Along with improving operational efficiency, it also makes examinations more reliable, transparent, and credible [13]. This framework's incorporation of AI-powered automation at various stages of the examination lifecycle is one of its main contributions. The solution lessens reliance on manual procedures while upholding academic standards, from automated grading and performance prediction to intelligent question production and adaptive difficulty control. By employing behavioural analysis, facial recognition, and activity tracking to maintain ongoing monitoring, the AI-based proctoring module considerably lowers the incidence of impersonation, collaboration, and other malpractices. This enables educational institutions to maintain academic integrity without needing a lot of human oversight.

The dual-access architecture makes system accountability and control even more robust [14]. Through role-based permissions and secure login mechanisms, the framework clearly distinguishes between administrative and candidate roles, preventing unwanted acts and preserving organized stakeholder interactions. Data privacy and adherence to contemporary cybersecurity standards are guaranteed by the incorporation of audit logs, secure database storage, encrypted data transport, and activity tracking tools. These security layers safeguard private academic data and foster institutional trust. Additionally, the system supports remote examination situations, which encourage accessibility and inclusion. Without jeopardizing security or performance monitoring, students can take part from geographically far areas. Large-scale institutional evaluations, professional certifications, competitive exams, and distant learning programs all benefit greatly from this flexibility. The system can accommodate thousands of concurrent users while retaining performance stability because to the cloud-based deployment option, which improves scalability. The framework's analytical capabilities are another crucial feature. Future technology advancements can be accommodated because to the modular design. The system can be further enhanced by incorporating emerging technologies like explainable AI models, blockchain-based credential verification, adaptive testing algorithms, and sophisticated biometric authentication. All things considered, the AI-Enabled Dual-Access Examination Management Framework offers an intelligent, scalable, safe, and comprehensive solution that updates exam administration. It strikes a balance between accessibility and integrity, efficiency and justice, and automation and security [15]. In the age of artificial intelligence and smart education, the framework serves as a viable and future-ready paradigm for digital examination systems by addressing both technological and instructional aspects.

Furthermore, by encouraging data-driven decision-making and ongoing academic development, the suggested framework aids in the long-term transformation of education. Institutions can employ early intervention techniques for at-risk students, customize learning paths, and alter curriculum by examining past test data, learning patterns, and behavioural insights. The AI-Enabled Dual-Access Examination Management Framework has the potential to become a key component of smart universities and digital learning ecosystems with frequent updates, moral AI governance guidelines, and conformity to new educational standards. This would guarantee that future examination procedures continue to be equitable, flexible, and in line with international educational developments. Over time, the platform is improved with the use of ongoing feedback mechanisms like system performance monitoring, teacher analytics reports, and student surveys. The suggested dual-access examination framework enhances efficiency and establishes a more fair and trustworthy assessment environment for contemporary digital education by fusing cutting-edge AI approaches with useful usability and accessibility characteristics.

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