

Online Exam Proctoring using AI

Mr. Sudhir Ramesh Nikam¹, Prof. Miss. Chetana Kawale²

Research Scholar, Department of Computer Applications, SSBT's COET, Jalgaon, Maharashtra, India¹

Professor, Department of Computer Applications, SSBT's COET, Jalgaon, Maharashtra, India²

Abstract: The main aim of this study is to understand how Artificial Intelligence can be used to create a secure and effective system for monitoring online examinations. The proposed system uses a webcam to observe students during the exam and check their activities. Different AI methods, such as face detection, face recognition, object detection, head movement tracking, eye-gaze monitoring, and behavior analysis, can help identify unusual or suspicious activities. For example, the system can check whether the correct student is taking the exam, whether another person appears in front of the camera, or whether any restricted objects are being used. If the system notices any suspicious activity, it can generate an alert or save the details of the event for later review. This can help make online examinations more secure, fair, and trustworthy.

I. INTRODUCTION

The rapid growth of the internet, digital technology, and online education has changed the way students learn and how educational institutions conduct examinations. Online examinations have become an important part of modern education because they allow students to take tests from different locations without having to be physically present in an examination hall. Schools, colleges, universities, training centers, and certification organizations use online exams because they can save time, reduce administrative work, and make it easier to conduct examinations for a large number of students. However, conducting examinations online also creates several challenges, especially when it comes to examination security and academic integrity. One of the main concerns is making sure that students follow the examination rules and do not receive unauthorized help during the test. In traditional examinations, invigilators are physically present in the examination hall to observe students and identify any suspicious activities. They can verify students' identities, monitor their behavior, and make sure that prohibited materials are not being used. In online examinations, direct physical supervision is not possible. Students may take exams from their homes, hostels, libraries, or other locations where proper supervision may be limited. Because of this, there is a need for reliable technologies that can monitor students during online examinations and help maintain fairness and academic integrity. Online Exam Proctoring Using Artificial Intelligence (AI) is one such technology-based solution. AI-based proctoring systems use technologies such as artificial intelligence, machine learning, and computer vision to monitor students during examinations. A webcam and microphone can provide information about the student's surroundings and activities, while AI algorithms can analyze this information to identify unusual or suspicious events. For example, an AI-based system can recognize the student's face and verify their identity. It can also detect if more than one person appears in front of the camera, identify certain prohibited objects, and monitor unusual head or eye movements. When suspicious activity is detected, the system can record the event or generate an alert so that it can be reviewed later. The importance of AI-based online proctoring has increased with the growing use of remote and online learning [2]. Educational institutions need examination systems that are not only convenient but also secure and reliable. If online examinations are not properly monitored, there is a greater possibility of impersonation, unauthorized assistance, use of prohibited materials, and other forms of examination malpractice. Such activities can affect the reliability and credibility of examination results. AI-based proctoring can provide continuous automated monitoring and reduce the workload of human invigilators. It can also help educational institutions conduct examinations for a large number of students without requiring a separate invigilator to continuously monitor each student. However, AI systems are generally designed to identify events that may require attention rather than completely replacing human judgment. The motivation for selecting this research topic comes from the increasing use of online examinations and the need for better examination security. Traditional online monitoring methods often depend heavily on human supervision, which can become difficult when many students are taking an examination at the same time. Human invigilators may also find it challenging to continuously observe every student throughout the entire examination. AI provides an opportunity to automate some of these monitoring tasks and identify activities that may require further investigation. Therefore, studying AI-based examination proctoring is important for understanding how modern technologies can be used to solve practical problems in digital education. It can help improve the security, efficiency, and reliability of online examinations. An AI-based online proctoring system generally consists of several important processes. The first is student authentication, where face recognition or other methods can be used to verify the identity of the student. The second is continuous monitoring, in which the student's webcam is analyzed during the examination. Computer vision techniques can be used to detect faces and objects and to monitor the student's position and movements. The system

may also identify events such as the appearance of another person, the presence of an unauthorized object, or unusual behavior. Depending on the design of the system, audio analysis can also be used to detect unusual sounds or voices. These detected events can be recorded and presented to an authorized person for further review. In this way, AI-based proctoring can support institutions in conducting online examinations in a more secure, fair, and efficient manner.

II. LITERATURE SURVEY / LITERATURE REVIEW

Online examination proctoring has become an important area of research because of the rapid growth of online education and remote examinations. Many researchers have studied how technologies such as Artificial Intelligence (AI), machine learning, computer vision, biometrics, and automated monitoring can be used to make online examinations more secure. At the same time, researchers have also pointed out several concerns related to privacy, fairness, accuracy, transparency, and the overall experience of students.

Nigam et al. (2021) [8] conducted a systematic review of AI-based and non-AI-based online proctoring systems. They reviewed 43 research papers published between 2015 and 2021 and studied different system designs, features, trends, challenges, and future possibilities. Their findings showed that AI can help automate the monitoring process, but several challenges still exist. These include privacy and security issues, ethical concerns, trust, cost, and the need for proper training. The researchers concluded that the advantages of AI-based proctoring should be considered together with the possible risks associated with its use.

Han et al. (2024) [2] carried out a systematic review of research related to digital proctoring in higher education. Their study examined 154 publications and identified important research areas such as cheating detection, student authentication, difficulties in adopting proctoring systems, and student performance under different examination conditions. The study showed that much of the existing research focuses on technical solutions and maintaining academic integrity. However, the researchers also pointed out the need to better understand the experiences, opinions, and concerns of students and other people involved in education.

Balash et al. (2021) [1] studied students' opinions about the privacy and security of online proctoring services. They examined user reviews of proctoring browser extensions and also surveyed 102 students who had taken online proctored examinations. Only 39% of the participants agreed or strongly agreed that they preferred online proctored examinations, while 52% agreed or strongly agreed that online proctoring was too invasive to their privacy. The study shows that although online proctoring can improve examination monitoring, students may have concerns about identity verification, webcam monitoring, screen sharing, and the installation of proctoring software.

Mutimukwe et al. (2023) [6] studied privacy issues related to online proctoring systems through a review of 17 research papers. The study found that these systems can collect and process different types of personal and sensitive information. The researchers highlighted the importance of transparency, fairness, user consent, user choice, collecting only necessary information, accountability, and data security. This study is important because it shows that developing an accurate AI-based system is not enough. Student information must also be handled carefully and responsibly.

Marano et al. (2024) [5] conducted a review of 21 studies that focused on the experiences of students using remote proctoring in higher education. Their findings showed that students generally had negative experiences with online proctoring. Privacy concerns, technical problems, questions about fairness, and stress were some of the major issues reported by students. The researchers suggested that students should be involved in decisions about the use of proctoring systems and that such systems should only be used when necessary. This study provides a different perspective because it focuses mainly on the student's experience rather than only on the technical performance of the system.

Heinrich (2025) [3] conducted a systematic and narrative review of 33 online proctoring systems. The study found that modern proctoring systems use technologies such as AI and biometrics to verify student identities and identify possible examination violations. However, the research also found problems related to privacy and security. In some cases, it was not clear how AI systems made their decisions. This shows that transparency is an important factor that should be considered when developing future AI-based proctoring systems.

Malhotra and Chhabra (2026) [4] conducted a systematic review covering ten years of research and analyzed 80 peer-reviewed studies published between 2014 and 2024. Their findings showed that advanced machine learning and deep learning techniques, including CNNs and RNNs, can help detect suspicious examination behavior. These systems can analyze information such as eye movements, head position, and facial expressions. The researchers also emphasized the

importance of performance measures such as precision, recall, F1-score, sensitivity, and specificity. Their work demonstrates the technical potential of AI while also highlighting the importance of properly evaluating the reliability and limitations of these systems.

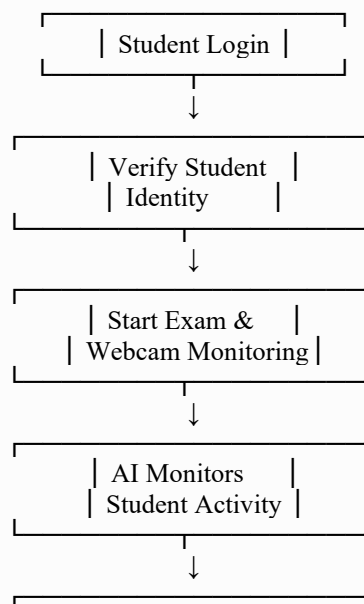
Mutimukwe et al. (2026) [7] further investigated privacy concerns related to online proctoring by interviewing teachers, students, and administrative staff. The study identified concerns about the collection of sensitive information, possible misuse of data, and unauthorized access. It also showed that there can be a balance between the benefits of online proctoring and the privacy risks involved. The researchers recommended involving students and educators when creating privacy policies and implementing online proctoring systems.

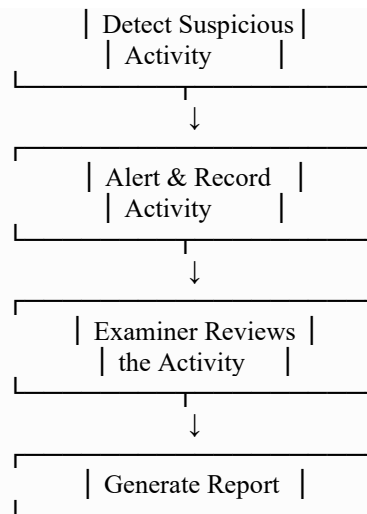
Overall Findings from the Literature Overall, the existing literature presents two major perspectives on online examination proctoring. The first is the technology-oriented perspective, which shows that AI, machine learning, deep learning, face recognition, object detection, and behavior analysis can help automate examination monitoring and detect suspicious activities. The second is the human-centered perspective, which focuses on issues such as privacy, fairness, technical problems, student stress, transparency, and trust. These concerns are important because a system that is technically accurate may still create problems for students if their privacy is not protected or if the system incorrectly identifies normal behavior as suspicious. Therefore, an effective AI-based proctoring system should not be judged only by its detection accuracy. There is a need for systems that can provide reliable real-time monitoring while also considering privacy, fairness, transparency, and human involvement. Many existing studies focus on individual detection techniques or the development of automated systems, while fewer studies provide a balanced evaluation of both technical performance and student-related concerns. Another important research gap is the need to test proctoring systems under different real-world conditions. Factors such as lighting, camera quality, background environment, and normal student movements can affect the accuracy of AI-based detection. Proper testing under these conditions can help reduce false alerts and improve the reliability of the system. Based on the findings from previous research, the present study aims to explore how AI and computer vision techniques can be combined to develop a reliable online examination proctoring system. The study will focus not only on technical performance but also on responsible implementation. In particular, it will consider detection accuracy, false-positive rates, privacy concerns, and the importance of human review when suspicious activities are identified.

III. METHODOLOGY

The main aim of this project is to develop an AI-based system that can help monitor students during online examinations. The system uses a webcam and different Artificial Intelligence and computer vision techniques to observe the student and identify activities that may be considered suspicious. The system does not make the final decision about cheating; instead, it helps the examiner by detecting and recording events that may need further checking.

Figure 1.





1. System Initialization

Before starting the examination, the student logs into the system using their registered username and password. The system checks the student's information and allows access to the examination after successful login. Before the exam starts, the webcam, microphone, and other required devices are also checked to make sure they are working properly.

2. Student Authentication

The system first verifies the identity of the student using face detection and face recognition. The webcam captures the student's face and compares it with the registered photograph. If the face matches, the student can proceed with the examination. This process helps prevent another person from taking the examination on behalf of the registered student.

3. Webcam Monitoring

Once the examination starts, the webcam continuously captures the student's video. The system analyzes the captured video using AI and computer vision techniques. This allows the system to monitor the student's activities and identify behavior that may be against the examination rules.

4. Face and Multiple-Person Detection

The system checks whether the student's face is visible in the camera view. It also checks whether more than one person is present. If another face appears in the camera frame, the system can mark the event as suspicious and generate an alert. This can help identify situations where another person may be assisting the student.

5. Head and Eye Movement Analysis

The system can monitor the student's head position and eye movements during the examination. Frequent or unusual movements away from the screen may be marked as potentially suspicious. However, normal movements should not automatically be considered cheating. Therefore, such events are recorded and can be checked by a human examiner later.

6. Object Detection

The system can also identify objects that are not allowed during the examination. For example, it may detect a mobile phone, book, or other restricted item in the camera view. If such an object is detected, the system can record the event and generate an alert for the examiner.

7. Audio Monitoring

If audio monitoring is enabled, the system can use the microphone to identify unusual sounds or voices during the examination. For example, hearing another person's voice may be recorded as a potentially suspicious event. Since audio monitoring involves personal information, it should be used carefully and with appropriate privacy protection.

8. Suspicious Activity Detection

The system combines information from different monitoring features to identify potentially suspicious behavior. Instead of depending on only one activity, it can consider several factors, such as whether the student's face is visible, whether another person is present, head and eye movements, detected objects, and unusual audio.

When the system detects an unusual event, it can generate an alert and save information about the event for further review.

9. Event Recording and Alert Generation

Whenever suspicious activity is detected, the system records important details such as the type of activity and the time when it occurred. Alerts can be shown to the examiner or stored in the system. This allows the examiner to focus on the events that require attention instead of continuously watching every student throughout the examination.

10. Examination Completion and Report Generation

After the student finishes the examination, the monitoring process is stopped. The system can then prepare a report containing the suspicious events detected during the examination along with their timestamps. The examiner can review this report and decide whether any further action is required.

11. System Evaluation

The performance of the proposed system can be tested using different measures such as accuracy, precision, recall, F1-score, false-positive rate, and detection time. The system can also be tested in different situations, such as different lighting conditions, camera qualities, backgrounds, and normal student movements. These tests help determine whether the system can correctly identify suspicious activities while reducing unnecessary alerts.

Overall Method The complete process of the proposed system can be represented as: Student Login → Identity Verification → Webcam Activation → Face Detection → Continuous Monitoring → Behavior and Object Analysis → Suspicious Activity Detection → Alert/Event Recording → Human Review → Examination Completion → Report Generation. Overall, the proposed methodology combines AI and computer vision techniques to assist in monitoring online examinations. The system is designed to support human examiners rather than completely replace them. Human review is still important because AI systems may sometimes identify normal student behavior as suspicious or miss certain activities. By combining automated monitoring with human judgment, the system can provide a more reliable and practical approach to online examination proctoring.

RESULTS

The proposed AI-based online examination proctoring system was designed to monitor students during online exams and identify activities that may be considered suspicious. The system uses a webcam and AI-based techniques to observe the student and provide useful information to the examiner. The system was able to verify the student's identity using face recognition and monitor the student during the examination. It could detect situations such as the absence of the student's face, the presence of more than one person, unusual head or eye movements, and the appearance of unauthorized objects in the camera view. When suspicious activity was detected, the system generated an alert and recorded the event along with its time. This made it easier for the examiner to review specific events instead of continuously watching the student throughout the entire examination. The system also showed that AI can reduce the amount of manual work required from examiners. Instead of monitoring every student continuously, the examiner can focus on the events that have been flagged by the system. This can be especially useful when a large number of students are taking an examination at the same time. During testing, the performance of the system can be measured using parameters such as accuracy, precision, recall, F1-score, and false-positive rate. The results may vary depending on factors such as lighting conditions, webcam quality, background environment, and student movements. Overall, the proposed system demonstrates that AI and computer vision can be useful for improving the security and monitoring of online examinations. However, the system should be used as a support tool for human examiners rather than as a complete replacement for human judgment. Some normal student activities may be incorrectly identified as suspicious, so the final decision should always be made after human review.

DISCUSSION

The proposed AI-based online examination proctoring system shows how Artificial Intelligence can be used to make online examinations more secure and easier to monitor. The system can continuously observe students through a webcam and identify activities that may require the attention of an examiner. One of the main advantages of the system is that it can automatically perform several monitoring tasks. Face recognition can help verify the student's identity, while face detection can identify when the student is not visible or when another person appears in the camera view. The system can also monitor head and eye movements and detect objects that may not be allowed during the examination. Another important benefit is the use of automatic alerts and event recording. Instead of requiring an examiner to watch every student continuously, the system can highlight unusual activities and record when they occurred. This can save time and make it easier for examiners to review important events, especially when many

students are taking an exam at the same time. However, the system also has some limitations. AI cannot always correctly understand a student's behavior. For example, a student may look away from the screen, move their head, or change their position for normal reasons. The system might incorrectly identify such behavior as suspicious. Similarly, poor lighting, low-quality webcams, background objects, or an unstable internet connection can affect the accuracy of the system. Privacy is another important issue. Online proctoring may involve collecting facial images, video, audio, and other personal information. Therefore, this information should be collected only when necessary and should be stored and handled securely. Students should also be informed about what information is being collected and how it will be used. The system should therefore be considered a support tool rather than a complete replacement for human examiners. AI can identify and record potentially suspicious activities, but the final decision should be made by a human after reviewing the available evidence. This approach can help reduce false accusations and make the examination process fairer. Overall, the discussion shows that AI-based proctoring has significant potential for online examinations. It can improve monitoring, reduce the workload of examiners, and help identify possible examination violations. At the same time, issues such as accuracy, privacy, fairness, and technical limitations need to be carefully considered. Future improvements can focus on making the system more accurate, reducing false alerts, improving privacy protection, and testing the system in a wider range of real-world examination environments.

CONCLUSION

Online examinations have become an important part of modern education, but maintaining security and preventing unfair practices during online exams can be challenging. This project explored how Artificial Intelligence can be used to develop an online examination proctoring system that helps monitor students and identify potentially suspicious activities. The proposed system uses techniques such as face recognition, face detection, object detection, and monitoring of head and eye movements to observe students during an examination. When unusual activity is detected, the system can generate an alert and record the event for further review. This can reduce the workload of examiners and make it easier to monitor a large number of students. The study also shows that AI-based proctoring has some limitations. Factors such as poor lighting, low-quality cameras, internet problems, and normal student movements can sometimes lead to incorrect alerts. Privacy is also an important concern because the system may collect personal information such as facial images, video, and audio. Therefore, AI-based proctoring should be used as a tool to assist human examiners rather than completely replace them. Human review is important for making fair and accurate decisions about suspicious activities. With further improvements in AI technology, privacy protection, and system accuracy, AI-based online proctoring can become a useful solution for making online examinations more secure, reliable, and fair.

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