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AN AI-BASED INTELLIGENT SYSTEM FOR AUTOMATED ONLINE EXAMINATION PROCTORING AND CHEATING DETECTION

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Abstract

The introduction of digital technology, as well as online education, has greatly impacted how examinations are taken, making learning and assessment more flexible, accessible, and convenient. On the other hand, besides the positive outcomes of online learning and examinations, there is an increased issue of dishonest behaviors in online examinations like the usage of mobile phones, unauthorized materials, presence of multiple people, abnormal body movement, and other suspicious actions. Traditional methods of online examination monitoring have sometimes lacked continuous and effective supervision, which makes it hard to identify any cheating activity, thus compromising the reliability of examinations. This paper proposes an AI-based Online Exam Proctoring System that is efficient in addressing the shortcomings of conventional online examination monitoring systems due to its automated nature. The system has various components such as secure authentication, examination management, video monitoring, face detection, object detection, posture analysis, eye gaze, and suspicious behavior detection, which offer simple yet user-friendly interface making it ideal for administering secure online examinations.

The whole process was approached through a comprehensive process flow, which involved requirement gathering, design, implementation, testing, and evaluation. Technologies involving artificial intelligence and computer vision such as YOLOv8,

OpenCV, MediaPipe, Python, and Django have been incorporated to continuously monitor activities of the students in the examination. Suspicious behavior detected by the system alerts and produces examination reports for review by teachers or administration. Results show that an AI-based online exam proctoring system can enhance examination monitoring, reduce the need for constant monitoring, increase integrity, and create a secure platform for online examinations.
Keywords: AI-Based Online Exam Proctoring, Artificial Intelligence, Computer Vision, YOLOv8, OpenCV, MediaPipe, Cheating Prevention, Face Recognition, Eye-Gazing Technique, Online Examination, Academic

Introduction

The increased use of the digital technology and e-learning has resulted in the emergence of the paradigm shift in how students, educators and educational institutions are learning and conducting examinations. The quick changes in internet connectivity, online learning platforms and online examination systems have made it possible to perform examinations remotely, which offers flexibility to students and institutions. Nevertheless, the digital change has resulted in the creation of issues that concern academic integrity and increased opportunities to cheat, which includes using a cell phone, using additional material, communicating with others, impersonation, presence of two people, etc. The inefficiencies of conventional supervision have made it hard to continuously monitor suspicious actions that occur during the online examinations.

In spite of the fact that online examinations have become popular, many of the existing solutions still require human and partially automated supervision, which implies continuous observation of students or watching recorded examination session, which is rather time-consuming especially when the number of participants is rather high. Moreover, many systems do not allow performing real-time suspicious activities detection and automatic report generation. This means that the cheating activities can be easily left unnoticed. In order to solve the mentioned problems, the development of the AI-Based Online Exam Proctoring System becomes critical. The proposed system is a centralized, secure and intelligent system for conducting and monitoring online examinations using artificial intelligence and computer vision. It allows detecting cheating activities by using face detection, object detection, posture analysis, eye gaze detection, and real-time suspicious activity detection.

The system also allows performing student authentication, examination management, generating automatic alerts and producing proctoring reports for teachers and administrative staff. Thus, all the monitoring information will be available for authorized users, who will be able to examine the suspicious incidents and make conclusions about examination integrity.

Problem Statement

Rapidly growing popularity of digital education and online examination platform among students and educators has led to an exponential growth in the usage of remote examinations. Nevertheless, currently available examination monitoring system is usually either manual or semi-automated. Educators or exam supervisors have to constantly check students using video calls or by analyzing recordings of those, which can take significant amount of time and be complicated in case multiple students participate in examinations at once. In addition, currently available conventional systems are often unable to identify cheating actions in real-time. These may include using mobile devices, any unauthorized materials, communication with other people, presence of multiple people during examination and strange behavior of students. The lack of intelligent system monitoring and automatic alerts makes monitoring process even less reliable and accurate. Concerns regarding privacy and security of students' data and examination monitoring are another problem of conventional systems. In addition, lack of centralized and automated examination reports makes the work of checking suspicious actions of students more complicated. In addition, current systems lack features of automated behavior analysis and decision-making, which makes it inadequate to deal with increasingly complex and massive online examinations. As a result, cheating can be hard to detect in time and, as a consequence, affect the fairness of exam results. Thus, there is a pressing need in development of centralized, safe, intelligent and convenient AI-Based Online Exam Proctoring System.

Literature Review

There are various other researches, which have brought to light the increased application of digital platforms to improve the conduct, surveillance, and management of the online examination process. The literature has also emphasized the need to use web-based examination portals, video monitoring systems, and database technology

to register, manage, and process the online examinations. The use of these digital platforms is intended to help in better student access, reduce the amount of manual work, and improve communication among the students, teachers, and educational institutes.

Some digital examination portals also include basic authentication systems using username and password with the standard database security procedures for the protection of students' and exam data. In addition, some digital platforms also offer online assessment and various services including question management, evaluation, results generation, and examinations-related to the students and teachers.

However, there are some major limitations in the existing online examination proctoring systems. Most of the current systems lack the continuous and intelligent monitoring feature, which makes it difficult to detect cheating and suspicious behaviors of the students in online examinations. In addition, the absence of real-time activity detection and automated alerts decreases the efficacy of these systems and reduces the reliability of online examination surveillance. In addition, most of these current systems are mainly based on manual monitoring and video analysis, which leads to delayed detection, ineffective supervision of the examinations and more workload on the teachers and administrative staff members. The lack of automation of the system limits its ability to identify any unauthorized objects, the presence of multiple people, abnormal postures, unusual eye movements, and other suspicious activities in the online examinations.

Various recent research studies have also recommended the use of various advanced technologies to overcome the limitations in the existing systems. Advanced technologies like the use of artificial intelligence and computer vision are suggested to be used to perform automated face detection, object detection, postures, and eye-gaze tracking, and real-time detection of suspicious behavior. Deep learning algorithms such as YOLO-based object detection algorithms have been used to detect mobile phones and other unauthorized objects during the examinations. Furthermore, technologies like OpenCV and MediaPipe have been used to perform real-time video analysis, facial landmark detection, and pose estimation. This research aims to continue with this line of research and propose the development of AI-Based Online Exam Proctoring System.

Proposed System Architecture

In the design of the proposed AI-Based Online Exam Proctoring System, several principles have been adhered to in order to guarantee scalability, security, flexibility, and maintainability. A modular design has been adopted in order to enable different modules of the system to perform independently yet interoperate with other modules. This helps in improving the reliability of the system, making future upgrades easy as well as enabling integration of advanced technologies such as artificial intelligence and computer vision into the system. The layered design has been used to separate different layers namely presentation, application, AI Processing, data and security layer in order to enhance system performance, monitoring and security control.

System Components User Interface Module

The User Interface (UI) module is the primary interaction point between the students, teachers, and the system. UI module is designed to be web-based and responsive in order to be able to support various devices such as desktop, laptop and tablet. The user interface provides students with secure login, examination instructions, question navigation, answer submission, and examination status capabilities. Teachers and administrators are able to use the user interface to manage examinations, questions, students and proctoring reports. Various visual aids such as alerts and notifications can also be used to improve the usability of the system.

Authentication and Authorization Module

The Authentication and Authorization Module provides secure access to the system using identity verification methods. The system provides separate login access to students, teachers and administrators depending on the type of role that each of them plays. Role-Based Access Control (RBAC) technique can be used to limit the functionalities of the system according to user roles in order to allow students access only examination-related functions while teachers and administrators manage examinations, students and proctoring reports. Face authentication method can also be used to verify the identity of the student before or during the examination.

Examination Management

At the center of the proposed system is the Examination Management Module which is responsible for managing the entire life cycle of the examinations in an organized manner. Using this module, teachers and administrators are able to create examinations, add and manage questions, set examination time, assign the examinations to the students, as well as monitor the status of the examinations. On the

other hand, the students are able to access the examinations assigned to them, answer questions and submit the answers during the specified time.

Database Management

Database management module of the system will be used to store the data about the students, teachers, examinations, questions, answers, results as well as proctoring data while at the same time ensuring data confidentiality and data integrity. This module will help in storing and retrieving data effectively. Data backup and recovery techniques can also be applied in order to avoid data loss due to system failures. Access controls should be put in place in order to make sure that authorized users access sensitive data.

Security and Monitoring Module

The security and monitoring module will be responsible for continuous monitoring of the student's activities in order to detect any suspicious activity and ensure the integrity of the examination. Artificial intelligence technologies such as YOLOv8, OpenCV, and MediaPipe can be used to detect various activities such as use of mobile phones, suspicious objects, multiple person detection, abnormal posture and eye/head movements. Upon the detection of suspicious activity, the system will generate alerts and proctoring information will be recorded.

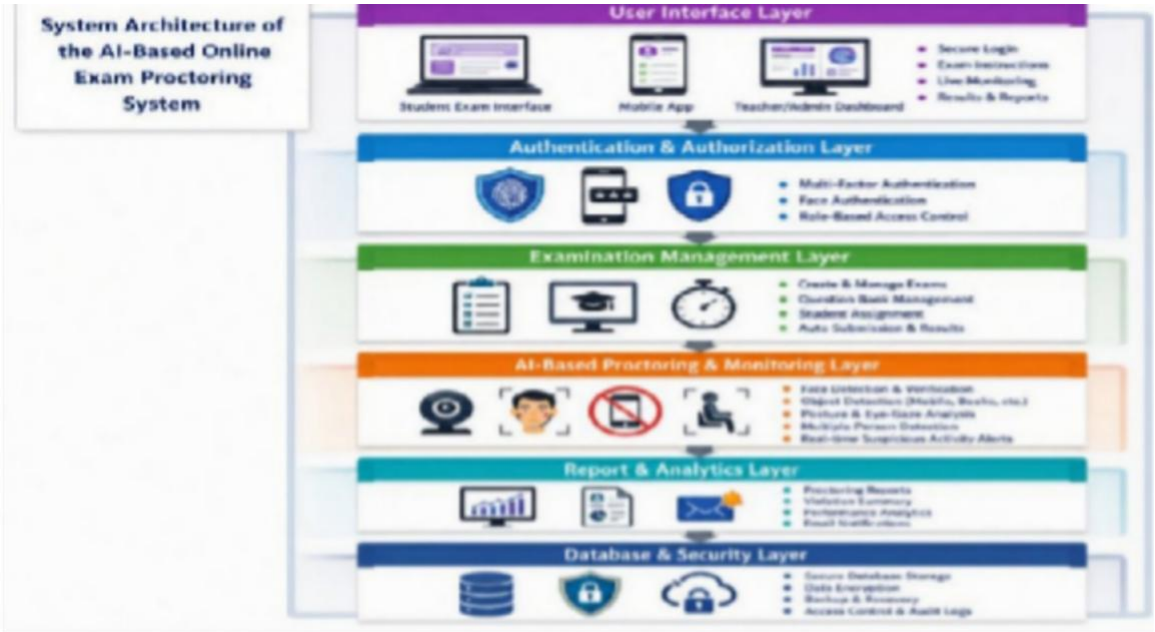


Figure 1: System Architecture of the AI-Based Online Exam Proctoring System

Methodology

The development of the suggested AI-Based Online Examination and Proctoring System is done in a systematic research methodology that includes the following stages:

Requirement Analysis: Determination of functional and non-functional requirements through analysis of current online examination and proctoring systems.

System Design: Development of the architecture of the system, its data flow diagrams, databases, and AI-based proctoring processes.

Implementation: Creation of the system via programming languages such as Python, Django, OpenCV, YOLOv8, MediaPipe, HTML, CSS, and JavaScript.

Testing: Testing for the functionality of the system, testing of AI detection capabilities, testing of system security, and performance testing of the examination and proctoring modules.

Evaluation: Evaluation of the system based on detection accuracy, usability, security, response time, and reliability.

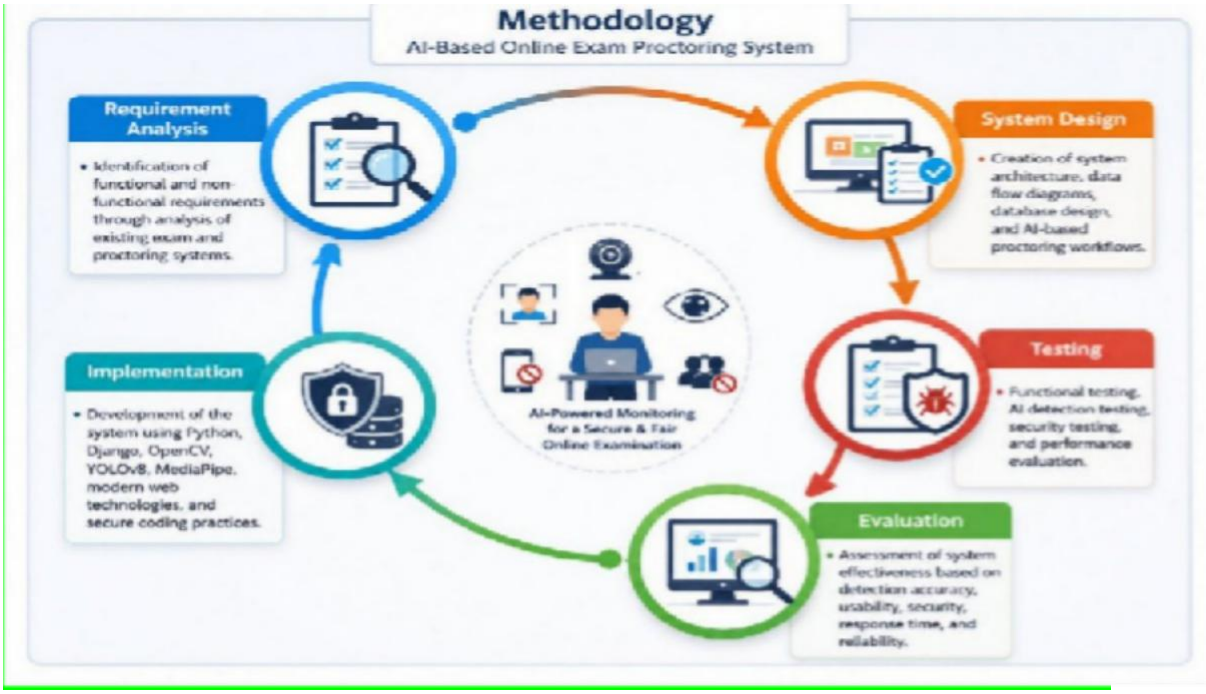


Figure 2: Methodology of the AI-Based Online Exam Proctoring System

Exam Proctoring Using Secure AI Technology

Security and privacy form the core components of the proposed system. These include the following:

Data Security: Data of the students, exams and proctoring processes is securely stored in order to ensure that they cannot be accessed or misused.

Access Control: Information about examinations and proctoring can be accessed only by those who have the authority to do so.

Authentication: Before accessing the exam, the student needs to authenticate his/her identity in a secure manner.

AI-Based Monitoring: This system constantly monitors the examination environment and detects any activity which could lead to cheating such as use of mobile phones, any other object which is not allowed in the examination environment, multiple people in one place, any unusual posture of the person taking the examination and movement of the eyes and head.

Privacy Protection: Data of the student collected through the camera as well as the exam data are safely stored and made accessible only for the purposes of the examination and proctoring process.

Limitations

- Dependence on stable network connectivity and adequate bandwidth could cause problems for students who live in areas with low network connectivity.
- The need for a computer, webcam, and necessary hardware could be a problem for students who do not have adequate access to them.
- The setup and implementation of AI models like YOLOv8 and MediaPipe might require high levels of computational power and competence in the use of such tools.
- The detection system's effectiveness could be affected by factors such as bad lighting conditions, poor camera quality, background, or incorrect camera positioning.
- False positives and false negatives could be produced during the detection of suspicious actions and thus need to be confirmed by teachers or administrators.
- The use of continuous video processing and AI could take a lot of CPU/GPU resources.

- Those students who have not been working with online exam platforms previously would face certain problems in operating the system during their first attempts to use it.
- Security and privacy issues associated with video surveillance and storage of student examination data may impact user satisfaction.
- Maintenance, security updates, and system monitoring should be implemented on a regular basis to ensure accuracy and effectiveness of the system.
- The effectiveness of the system will depend on the quality and accuracy of the recorded video and behaviour data of students.

Challenges

- Protection of privacy and confidentiality of sensitive information about the students, examination data, webcam recording, and AI-based proctoring record.
- Protection of the system from various kinds of cyber threats like unauthorized access, data breach, phishing, malware, and denial of service attack.
- Maintaining secure authentication but at the same time keeping login and examination process easy and convenient for students.
- Proper AI-based detection of cheating activities of students like using mobile phones, two-person activity, use of unauthorized objects, and any other suspicious movements.
- Minimizing false positive and false negative errors in order to ensure that normal student activity is not considered as cheating.
- Management of environmental issues such as poor lighting conditions, bad quality of camera, noise from the background, inappropriate camera placement, and instable video feed.
- Skilled management of scalability in case if lots of students are participating in the examination at the same time through online mode.
- Efficient real-time performance during continuous processing of live video feed and running AI-based detection models.
- Maintaining fairness and reliability of the process by incorporating automated AI detection as well as verification of the teacher or administrator.

- Continuously updating the system with enhanced AI models and security measures due to various changes in technology.
- Maintenance of the process in terms of addressing various technical limitations and digital literacy gap of students, teachers, and administrators.
- System availability with necessary backup and recovery mechanisms in order to avoid any interruption during the examination.
- Management of privacy and ethical issues connected with the continuous video recording of students and collection of their behavior data.
- Making sure that the system is compatible with various devices and browsers.

Outcomes

- **Secure Online Examination:** Provides a secured and controlled environment to conduct online examinations.
- **AI Monitoring:** Monitors the student through the webcam throughout the entire examination process.
- **Face Verification:** Uses the process of facial recognition to verify the identity of the student.
- **Activity Monitoring:** Recognizes activities like multiple people, usage of mobile phones, abnormal eye movements, and wrong posture.
- **Evidence Collection:** Records any abnormal or suspicious activity and saves it with the time stamps for future references.
- **Minimum Manual Monitoring:** Reduces the need for constant monitoring by humans through automation.
- **Effective Exam Management:** Helps manage the student, exam, question, and result generation.
- **Corrupt-Free Exam Process:** Helps keep the integrity of the examination by ensuring fair practice.
- **Efficient Result Generation:** Automatically evaluates and generates results for objective questions.
- **Accessible System:** Can conduct the examination via remote access with a computer, internet, and webcam.

Future Scope

- Using Artificial Intelligence to enhance automated detection of suspicious examination activities and improve real-time proctoring.
- Utilizing Machine Learning and Deep Learning algorithms to detect sophisticated cheating patterns and increase the accuracy of student behavior detection.
- Increasing the capability of YOLO-based object detection to recognize different types of unauthorized objects like mobiles, smart watches, books, notes, and other gadgets.
- Better facial recognition and verification technology to authenticate student identities during and before the online examinations.
- Enhancement of eye-gaze and head-pose tracking to spot abnormal looking-away behaviors and suspicious actions of students.
- Using NLP and AI chatbot to provide instant help to the students in relation to exam instructions, technical issues and queries related to system.
- Use of Big Data Analytics to study proctoring history data, detect common cheating patterns and gain useful insights for teachers and administrators.
- Creation of cloud infrastructure to handle large-scale examination events, increase system availability and storage capacity.
- Preserving student and examination data by utilizing advanced privacy-preserving techniques such as anonymization and secure processing of data.
- Creating adaptive AI models to learn from confirmed examination incidents and improving accuracy of detection of suspicious activities.
- Using automated risk or trust score of examinations to evaluate students' behavior and help teachers in prioritization of cases to be reviewed.
- Better support for accessibility and device compatibility to allow the proctoring system to run smoothly on different computers, webcams, browsers and networks.
- Advanced alert and notification system to notify teachers or administrator about any critical suspicious activities in real-time.
- Using Explainable AI (XAI) to give understandable explanations about flagging of certain activity to help teachers make right decisions.

Conclusion

The fast growth of online learning has raised the demand for the security and reliability of examination monitoring systems in educational organizations. The presented AI-Based Online Exam Proctoring System is a smart solution that enables monitoring of suspicious activity during the online exam. With the help of Artificial Intelligence, YOLOv8, OpenCV, MediaPipe, and Django, the system is capable of real-time monitoring, face recognition, object recognition, postural analysis, and eye gaze monitoring. Such a system decreases the need for constant human monitoring and helps teachers identify any cases of cheating effectively. The system also offers such features as secure authentication, examination management, alerts, and proctoring reports, which significantly increases the quality of the examination process. Centralized and modular architecture allows the system to be easily maintained and upgraded with more AI technologies in the future. In general, the proposed system can increase the security, reliability, efficiency, and fairness of the online exam process.

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