MEISS: Malpractice Identification and Examination Surveillance System Using Multimodal Sensing and Image Processing

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***Abstract*— Examinations are important for academic evaluation of a structure and maintaining their integrity is very important .Traditional invigilation methods depend on human supervision which can lead to limited attention difficulty in monitoring large examination hall simultaneously with the rapid advances in AI and computer in SIM technologies there is scope to automate and enhance the invigilation process This project proposes an AI based intelligent invigilation system that assists invigilators by continuously monitoring student behavior and detect suspicious actions in real time this project focuses on maintaining discipline during examination which requires continuous monitoring of students behavior frequent head movements such as looking left right or behind may indicate unfair behavior Manual observation will be limited and difficult which is prove to error thus project automatically monitors and analyses head movements of student using computer vision This AI-enabled automated proctoring system utilizes computer vision, image processing, and deep learning to monitor online exams in real-time, detecting cheating via facial recognition, eye-tracking, object detection (e.g., phones, books), and audio analysis. It automatically logs violations; tracks head pose and behavior, and ensure integrity. AI-enabled automated proctoring systems use computer vision, machine learning, and image processing via webcams to ensure exam integrity**

AI-enabled automated proctoring systems leveraging image processing and computer vision have revolutionized remote assessment by replacing manual invigilation with real-time, scalable, and objective monitoring. Tracks gaze, head pose, and body movement to detect looking away, are leaving the seat or multiple people in the frame.

Index terms- ***Eye-Tracking, Computer Vision, Exam Integrity, Gaze, Online Exams***

I. INTRODUCTION

Traditional proctoring methods relying on human invigilators fail in large-scale or remote settings primarily due to human limitations such as fatigue, inability to monitor multiple screens simultaneously, and susceptibility to distraction. Conversely, AI-enabled automated proctoring systems using computer vision and image processing offer 24/7 continuous monitoring, objective analysis, and high scalability, effectively identifying subtle cheating behaviors that human eyes often miss.

Online examinations have become common in modern education. However, ensuring fairness and preventing cheating is a major challenge. An AI-Enabled Automated Proctoring System uses image processing and computer vision to monitor candidates during online exams. The system uses a webcam to continuously analyze the student's face, head movements, and presence. If suspicious activities such as looking away, multiple faces, or absence from screen are detected, the system records or alerts the examiner.

This system reduces the need for human invigilators and improves the integrity of online examinations

Why traditional processes fail compared to AI-enabled, vision-based systems:

The rapid expansion of digital learning platforms and remote education has drastically changed the academic landscape. With the flexibility of attending courses from anywhere and taking exams online, institutions are now facing a significant challenge: maintaining the credibility and integrity of assessments. Traditional methods of exam supervision, such as human invigilators and simple video recording, are no longer sufficient to ensure a fair testing environment. Students can easily access additional devices, receive help from others in the room

This is where artificial intelligence becomes an essential ally. An AI-Based Proctoring System offers a smart, automated solution that can monitor, detect, and respond to potential cheating behavior during online examinations. Instead of merely recording, the system actively analyzes real-time data to identify actions that violate examination protocols. By using computer vision and behavioral analysis, the system continuously monitors the candidate's presence, eye movements, body posture, and surrounding environment. It can detect multiple faces in the camera frame, identify unauthorized objects like mobile phones and books, and analyze audio for suspicious sounds like whispering or background conversation. Moreover, AI-based proctoring enhances the efficiency of the exam process by reducing dependence on human supervision, providing consistent vigilance, and generating detailed analytical reports. It also addresses the issue of scale, making it possible to securely conduct exams for thousands of students simultaneously. The integration of such technology not only safeguards academic standards but also builds trust in the authenticity of remotely conducted evaluations

The pandemic led to the shifting of academics to an online mode which led to the reinvention of systems aiding online education. This poses a major challenge not only from a learning point of view but also from the perspective of examinations. Conducting examinations without any wrongdoing is a big challenge for institutions. The number of internet users in our country has doubled over the past 6 years. This has been a boon for many institutions, students, and other learning platforms. This facilitated institutions to conduct examinations online, bringing the concept of online proctoring to the academic level. The main goal of a proctoring system is to allow the invigilators to proctor remotely. Many institutions adopted this set of manual online proctoring but this led to almost no improvement in the process of stopping malpractices.

Traditional examination invigilation

Traditional examination invigilation relies on the human supervisors to maintain academic integrity within a controlled environment. Before an exam begins, invigilators are responsible for setting, which involves arranging desks (typically1.5 meters apart), ensuring clocks are visible, and removing any educational materials that could provide an unfair advantage. They manually verify candidate identities by checking government-issued photo IDs or hall tickets against the student's physical appearance and signature.

FIG : TEACHER MONITORING STUDENTS

During the assessment, the primary role of the invigilator is active surveillance. This involves patrolling the room to prevent communication, such as whispering or signaling, and ensuring students do not access unauthorized items like mobile phones or notes. Unlike automated systems, human proctors use intuition to detect subtle signs of cheating and can provide immediate intervention, such as giving verbal warnings or confiscating incriminating materials. They also assist candidates with legitimate needs, such as technical issues or emergency bathroom breaks

II. PROPOSED SYSTEM

The proposed system will be the best model to mimic all the elements considered during an offline classroom assessment Factors like movement, eye movement, whispering, and using other devices which are the prime symptoms of somebody possibly cheating come into the picture, so we propose developing a comprehensive system with numerous detection and validation mechanisms capable of detecting any malpractices.

Students first will be asked to register on a portal for the first time where they will enter their personal details, id card, and a picture will be taken. This picture will be saved in the database and it will be later used to verify them before the exam eliminating any chances of impersonation.

The provided block diagram illustrates an **automated AI proctoring workflow**focused on head pose estimation and movement analysis. The process begins with **image acquisition**, where a camera captures the video stream and breaks it down into individual frames. This initial stage is crucial for continuous monitoring, as each frame serves as a data point for subsequent computer vision algorithms to analyze the candidate's environment in real-time.

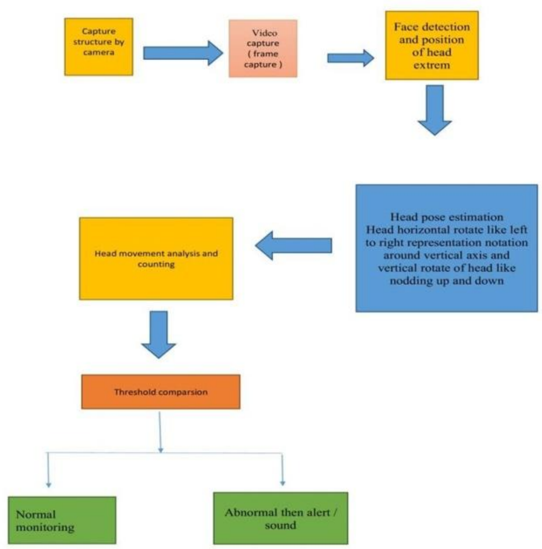


FIG 2.1 BLOCK DIGRAM

Once the video frames are captured, the system performs **face detection** to locate the student within the frame and identify the "head extremes" or facial boundaries. This ensures that a human presence is maintained and centered.

Following detection, the system executes **head pose estimation**, which calculates the horizontal rotation (yaw) and vertical rotation (pitch) of the head. This step specifically tracks if a student is looking left, right, up, or down—actions that are often associated with looking at unauthorized materials or external helpers

The final stage of the workflow involves **behavioral analysis and decision-making**. The system counts and analyzes head movements over a period of time to distinguish between natural adjustments and suspicious patterns. These metrics are then subjected to a **threshold comparison**, where the frequency or duration of deviations is measured against pre-defined safety limits. If the behavior is deemed "normal," the system continues background monitoring; however, if the movement exceeds the threshold, it is classified as "abnormal," triggering an **automatic alert or sound** to notify the reviewer or warn the student

Capture Structure by Camera & Video Capture: The process begins with the webcam or external camera capturing the live environment. The system performs "frame capture," breaking the continuous video stream into individual images (frames) for processing.

Face Detection and Position: The system uses computer vision algorithms to locate the human face within each frame. It identifies key boundaries (extremes) to ensure the candidate is present and centered.

Head Pose Estimation: This is a critical tracking phase. The system calculates the head's orientation in 3D space:

Horizontal Rotation (Yaw): Detecting if the student is looking left or right (potentially at notes or another person).

Vertical Rotation (Pitch): Detecting nodding or looking up and down (potentially looking at a phone or hidden materials).

Head Movement Analysis and Counting: Instead of flagging a single glance, the system analyzes the frequency and duration of these movements. It counts how often the head deviates from the "normal" forward-facing position.

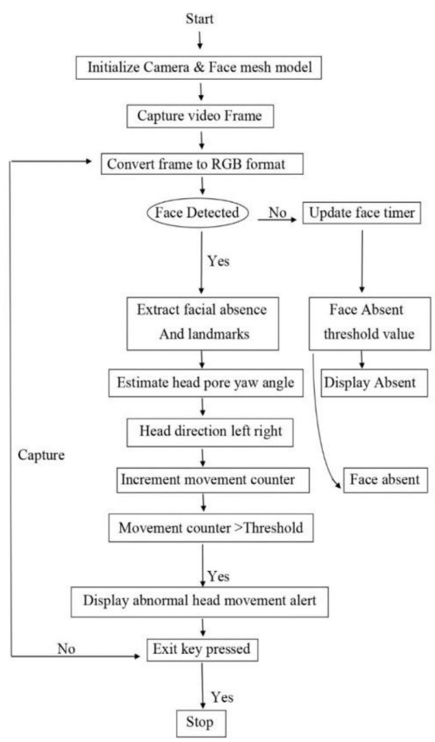
Threshold Comparison: The analyzed data is compared against pre-set limits. For example, looking away for more than 3 seconds or turning the head more than 5 times in a minute might exceed the "safe" threshold.

Normal monitoring: If movements stay within thresholds, the system continues quietly.

Abnormal alert/sound: If the threshold is crossed, the system triggers an alert, logs a "flag" for the reviewer, or plays an audible warning to the student.

21. Flow chart

This flowchart represents an AI-enabled automated proctoring system using image processing and computer vision. The process starts by initializing the camera and a face mesh model (commonly using algorithms like MediaPipe Face Mesh with OpenCV). The system continuously captures video frames and converts them into RGB format for accurate processing. It then detects whether a face is present using a face detection algorithm. If no face is detected, a timer is updated, and if the absence exceeds a predefined threshold, the system marks the student as absent and displays an alert on the screen



If a face is detected, the system extracts facial landmarks and estimates the head pose, particularly the yaw angle, using a head pose estimation algorithm (based on geometric transformations and 3D landmark mapping). It determines the direction of the head (left or right) and increments a movement counter whenever significant movement is detected. If this movement exceeds a set threshold, it flags abnormal behavior and displays an alert indicating suspicious head movement. This process continues in a loop until the user presses an exit key, at which point the system stops.

Step 1: Start the program

Step 2: Initialize webcam and load face mesh model using OpenCV and MediaPipe Face Mesh

Step 3: Begin continuous video capture

Step 4: Capture a frame from the camera

Step 5: Convert the frame into RGB format

Step 6: Detect face in the frame

Step 7: If face is not detected

a. Update face absence timer

b. If absence time > threshold

→ Display "Face Absent" alert

c. Go back to Step 4 Step 8: If face is detected

a. Extract facial landmarks

b. Estimate head pose (yaw angle)

c. Determine head direction (left/right)

Step 9: Increment movement counter if head movement is detected

Step 10: If movement counter > threshold

→ Display "Abnormal Head Movement Alert"

Step 11: Check if exit key is pressed

a. If No → Go back to Step 4

b. If Yes → Stop program

Step 12: End

III.RESULTS & DISCUSSION

The AI Online Exam Proctoring System was successfully developed and tested across multiple realtime exam scenarios. The system accurately detected key events such as face absence, multiple faces in the frame, frequent head movements, and the presence of unauthorized objects like mobile phones. Facial recognition achieved high accuracy in verifying the identity of the candidate throughout the exam duration. Gaze tracking and behavior analysis effectively identified suspicious actions, while audio monitoring detected unusual background sounds. Testing across different lighting conditions and camera qualities showed that the system maintained stable performance with minimal false positives. Overall, the results demonstrate that the AI-based proctoring system improves exam security, reduces manual monitoring requirements, and provides consistent, automated invigilation with reliable alert generation.

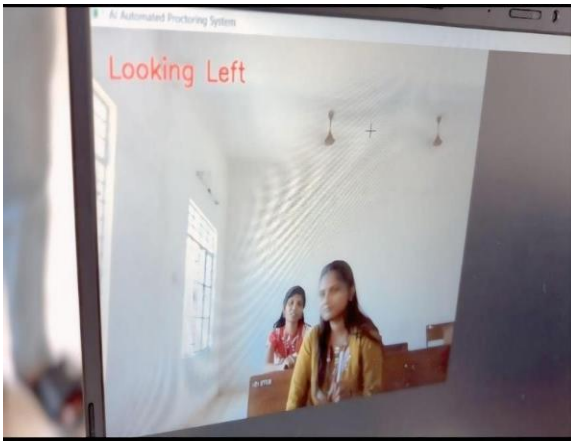


FIG 3.1 : A STUDENT IS LOOKING LEFT

This image represents a practical implementation of an AI-enabled automated proctoring system, where a Python-based application continuously monitors a student through a webcam. The system captures live video frames and processes them using computer vision techniques to analyze behavior in real time. In this case, the red text "Looking Left" indicates that the model has detected a deviation in head pose or gaze direction, suggesting the student is not focusing on the screen. This is typically achieved using facial landmark detection and head pose estimation, where key points like eyes, nose, and jawline are tracked frame by frame.

Technically, such systems are commonly built using libraries like OpenCV for image processing (frame capture, drawing overlays, bounding boxes) and MediaPipe for detecting facial landmarks with high accuracy. The algorithm estimates angles (yaw, pitch, roll) of the face to determine whether the user is looking straight, left, right, up, or down. If the angle crosses a threshold, it triggers a warning message like the one shown.

Another important observation in the image is the presence of two individuals in the same frame. Advanced proctoring systems include multi-face detection, which flags this as a potential malpractice scenario. The system can count faces using classifiers or deep learning models and raise alerts when more than one person is detected. Additionally, some systems integrate object detection to identify mobile phones, books, or other unauthorized materials.

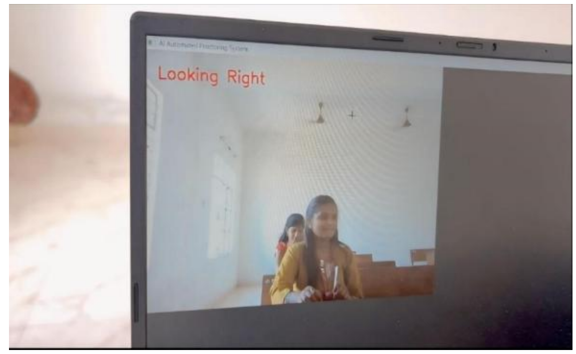


FIG 3.2: A STUDENT LOOKING RIGHT

This image shows another output instance of an AI-enabled automated proctoring system implemented in Python using image processing and computer vision techniques. The webcam feed displayed on the laptop screen captures two individuals seated in a classroom environment, and the system overlays the warning "Looking Right," indicating that it has detected a head or gaze movement toward the right side. This functionality is typically achieved using facial landmark detection and head pose estimation, where key facial points are analyzed to calculate the orientation of the face. Tools like OpenCV are used for capturing video frames and rendering the interface, while MediaPipe helps in accurately detecting facial landmarks in real time.

From an analytical perspective, the system is identifying deviations in attention, which may indicate distraction or suspicious behavior during an exam. Additionally, the presence of two individuals in the same frame could be flagged as a potential violation, as most proctoring systems are designed for single-user monitoring. This suggests that the model may also include multi-face detection capabilities.

The lighting appears slightly uneven and the camera angle is not perfectly aligned, which can impact detection accuracy and lead to occasional false alerts. Overall, this image demonstrates the system's ability to track head movement direction dynamically and enforce exam integrity by providing real-time feedback and alerts based on user behavior.

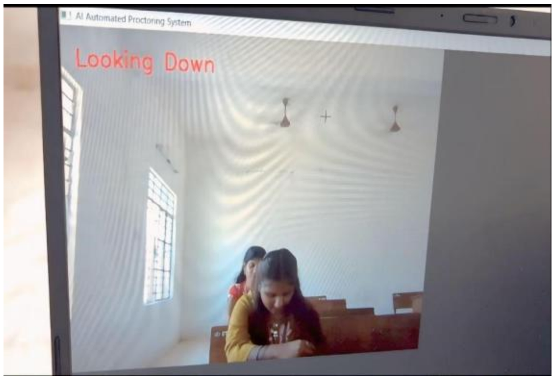


FIG 3.3 A STUDENT LOOKING DOWN

This image shows the output of an AI-enabled automated proctoring system implemented using Python, where image processing and computer vision techniques are applied to monitor student behavior in real time. The system displays the alert “Looking Down,” which indicates that it has detected the student’s head tilted downward, likely away from the screen. This is achieved through facial landmark detection and head pose estimation, where key facial points are tracked to calculate orientation angles (pitch, yaw, and roll). Libraries such as OpenCV are used for capturing video frames and displaying the interface, while MediaPipe enables accurate detection of facial features and tracking.

From an analysis perspective, looking down may be interpreted as suspicious behavior, such as checking notes, a mobile device, or other unauthorized material during an exam. The system continuously evaluates such movements and flags them as potential violations based on predefined thresholds. In this frame, only one person is detected, which aligns with expected conditions for online proctoring but the downward gaze still triggers an alert. Environmental factors like lighting, camera placement, and occlusion (e.g., desk blocking part of the view) can influence detection accuracy and may sometimes lead to false positives.

Overall, this image demonstrates how the system effectively identifies vertical head movements and provides real-time warnings to help maintain exam integrity

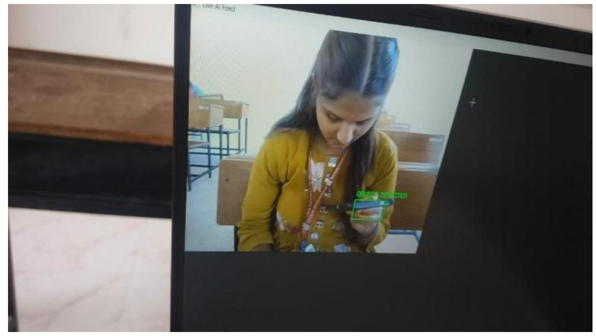


FIG 3.4: A STUDENT IS USING PHONE IN EXAM THE OBJECT IS DETECTED

This image shows a laptop screen displaying a live feed from an AI-enabled automated proctoring system. In the frame, a student is seated in a classroom environment and is looking down at a mobile phone in her hand. The system uses computer vision techniques to monitor the scene in real time, and it has detected the phone as an object of interest, which is highlighted by a green bounding box labeled “OBJECT DETECTED.” This indicates that the system is actively identifying potentially prohibited items during an examination. Such systems are designed to ensure fairness and prevent cheating by continuously analyzing student behavior and flagging suspicious activities like the use of mobile devices.

FIG 3.5: STUDENTS ARE ABSENT IN EXAM

This image shows the interface of an automated proctoring system displaying a live classroom feed. The scene captures an empty classroom with benches, a window, and ceiling fans, but no student is present in the frame. The absence of any human subject indicates that the system is not detecting a candidate during the monitoring session. In the context of AI-based proctoring, this situation would be flagged as “student absent” or “no face detected,” which could imply that the student has either left the exam environment or is not present in front of the camera, potentially violating exam rules.

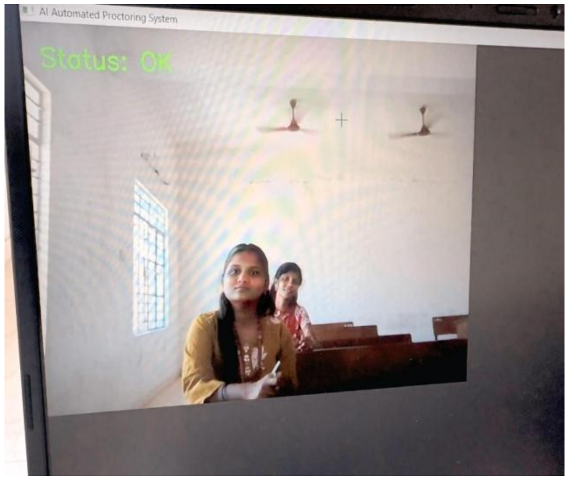


FIG 3.6: A STUDENT BEHAVIOUR IS OK

From an analytical perspective, this frame represents the baseline or "safe" condition in the proctoring system, where no rule violations (like looking away, looking down, or abnormal movement) are detected. However, even though the status is marked as "OK," the presence of more than one person in the frame could still be considered a potential concern in stricter proctoring environments, depending on system configuration. The system likely uses predefined thresholds for head movement and face count before triggering alerts. Overall, this image demonstrates how the system not only detects suspicious actions but also confirms normal behavior, providing continuous monitoring and feedback to ensure exam integrity.

IV. CONCLUSION

We have proposed and implemented an automated proctoring system using computer vision techniques. The system helps in conducting examinations by fair means and hence, maintains its integrity. This study demonstrates how to avoid cheating in online examinations by employing semi-automated proctoring based on vision and audio capabilities, as well as monitoring several students. The system provides promising environment for any organization to conduct their examination. It also provides user-friendly interface which make it easier for the examinee to give their exams with comfort. Furthermore, a manual assistances team could also be setup per examination with the help of the exam conducting organization to smoothen out the whole examination process.

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