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Artificial Intelligence Based Online Examination Proctoring System

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Abstract: ***Distance and online learning, often known as e-learning, has emerged as the new norm in training and education in light of recent technological advancements, thanks to a number of benefits like accessibility, cost, efficiency, and usability. Even though the online educational system offers advantages over the traditional educational system, preventing cheating and other improper behavior of students during classes and exams poses substantial difficulties. The 'Artificial Intelligence based Online Examination proctoring system' project offers a solution to the issues with online and distance education. The system makes use of movement detection, face recognition, and other biometric approaches to flag the student fraud during exams. As soon as the cheating or other irregularities are detected by the students, the system signals the manual proctor and also records these instances as evidence for subsequent monitoring. As a result, online exams can be administered effectively with fewer or no manual proctors present, which is more practical and affordable.***
Keywords: Artificial Intelligence, Convolutional Neural Network (CNN), YOLO V3.

I. INTRODUCTION

AI-based proctoring systems are technological solutions designed to monitor and supervise online exams or assessments. Traditional in-person proctoring methods are not viable for remote or online education scenarios, so AI proctoring has emerged as an alternative to ensure academic integrity and deter cheating.

AI proctoring systems leverage various technologies such as computer vision, machine learning, and natural language processing to monitor and analyze student behavior during an exam. These systems typically consist of two components: a monitoring component and an analysis component.

The monitoring component uses webcams and microphones to capture audio and video of the students taking the exam. It monitors activities like head movements, eye movements, keystrokes, and background noise to detect any suspicious behavior. Some systems also track facial expressions and gaze direction to identify signs of stress or distraction.

The analysis component applies AI algorithms to the collected data to identify potential cheating instances. It compares the student's actions against predefined patterns and rules, such as detecting if they are looking at unauthorized resources or collaborating with others.

When the system detects a potential violation, it typically generates an alert for human proctors or instructors to review the flagged instances manually. This approach helps minimize false positives and ensures that the final decision is made by a human evaluator.

This 'Artificial Intelligence based Online Examination proctoring system' project offers aim to strike a balance between maintaining exam integrity and respecting student privacy. Overall, it offers a scalable and efficient way to proctor online exams, providing educational institutions with tools to uphold academic honesty in remote learning environments.

II. METHODOLOGY

The brief methodology of 'Artificial Intelligence based Online Examination proctoring system' involves the following key steps:

1) *Setup and Configuration:* The proctoring system is installed and configured on the examination platform or learning management system. This involves integrating the system with the exam interface, setting up the necessary hardware (webcams, microphones), and defining the specific rules and parameters for monitoring.
2) *Exam Monitoring:* Once the exam starts, the AI proctoring system continuously monitors the student's activities. It uses computer vision techniques to analyze the video feed from the webcam and detect any suspicious behavior. This includes tracking head movements, eye movements, and gaze direction to identify if the student is looking away or at unauthorized resources. It may also monitor audio for any unusual sounds or background noise.
3) *Data Collection:* The system collects data from various sources, such as video footage, audio recordings, keystrokes, and screen activity. This data is processed and stored securely for further analysis.

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4) *Behavior Analysis:* The collected data is analyzed using AI algorithms and machine learning models. The system compares the student's behavior against predefined patterns and rules to identify potential cheating instances. For example, it may flag instances where the student is accessing external websites, copying and pasting content, or engaging in suspicious eye movements.
5) *Alert Generation:* When the system detects a potential violation, it generates an alert or flag for human proctors or instructors to review. This helps minimize false positives and allows human evaluators to make the final judgment based on the flagged instances.
6) *Human Review:* The flagged instances are reviewed by human proctors or instructors who make the final decision regarding whether a violation has occurred. They can review the recorded video, audio, and other relevant data to assess the situation accurately.
7) *Reporting and Feedback:* The proctoring system generates reports that summarize the exam monitoring results, including any flagged instances and their outcomes. This information is shared with instructors, educational institutions, or relevant stakeholders to ensure transparency and enable appropriate actions to maintain exam integrity.

III. DESIGN AND IMPLEMENTATION

The design and implementation of an AI-based proctoring system involve several key considerations to ensure its effectiveness, accuracy, and fairness. Here is a brief note on the design and implementation aspects:

1) *System Architecture:* The well-designed System architecture for the AI based proctoring system is as shown in the Figure 1. It encompasses both the monitoring and analysis components.
2) *Data Collection:* The system is capable of collecting data from multiple sources, such as video feeds, audio recordings, screen activity, and keystrokes. This data is captured securely and efficiently to ensure accurate analysis.
3) *Computer Vision Techniques:* Computer vision algorithms play a crucial role in analyzing video feeds and identifying student behavior. Techniques like face detection, facial recognition, gaze tracking, and head movement analysis are utilized to detect suspicious activities.

The camera's image input is supplied into the recognition system, where it is efficiently processed and compared. It majorly includes:

a) *Image Collection:* The suggested system's input is real-time video. The web camera on the user's PC or laptop is used to record the real-time video.
b) *Image pre-processing:* Pre-processing tries to enhance the quality of the picture data by reducing undesired distortions and boosting some image properties essential for further image processing. Greyscale conversion, noise removal, and picture enhancement are the three main steps in image pre-processing.
c) *Image Segmentation:* Post image pre-processing, the item is separated from the background image. A black and white image with its contract altered is created to enable better segmentation.
d) *Feature Extraction:* To extract information from an image, feature extraction is necessary. GLCM is used to capture the spatial dependence between picture pixels. GLCM utilizes the grey level picture matrix to capture the most prominent features. Feature extraction (glcm) tries to suppress the original picture data set by using specific values or features that assist in identifying diverse images from one another.

4) *Machine Learning Models:* AI-based proctoring systems rely on machine learning models to identify patterns and detect potential cheating instances. These models are trained on labeled data and use techniques like, pattern recognition, and classification to identify suspicious behavior.
a) A Convolutional Neural Network (ConvNet/CNN) is one of the Deep Learning techniques that can take an input image, assign different elements and objects in the image importance (learnable weights and biases), and be able to differentiate between them. Comparatively speaking, a ConvNet requires substantially less pre-processing than other classification techniques. ConvNets are capable of learning filters, but with manual techniques, filters are hand-engineered.
5) *Human Review and Intervention:* While AI algorithms play a significant role in automated detection, it's essential to involve human proctors or instructors in the review process. Flagged instances are manually reviewed to validate and determine the severity of potential violations. Human intervention ensures fairness, reduces false positives, and allows for contextual understanding.

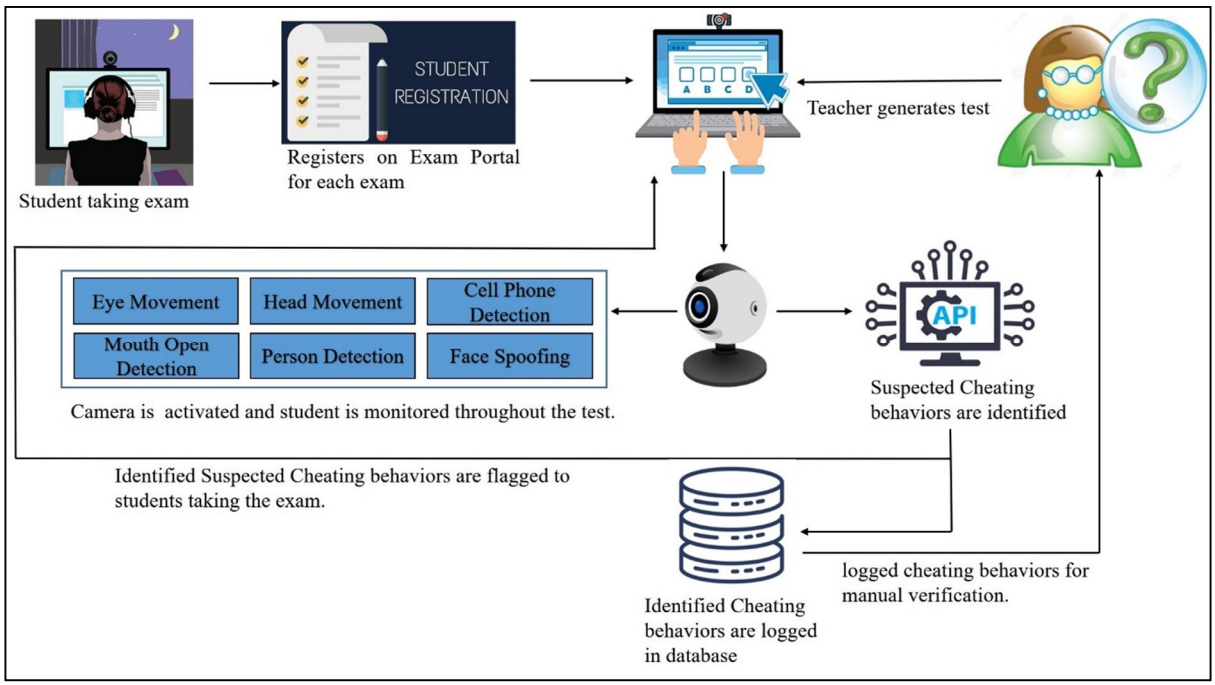


Figure 1: System Architecture.

IV. RESULTS AND DISCUSSIONS

The results of the 'Artificial Intelligence based Online Examination proctoring system' is discussed with the screenshots taken during the demo/testing of the application.

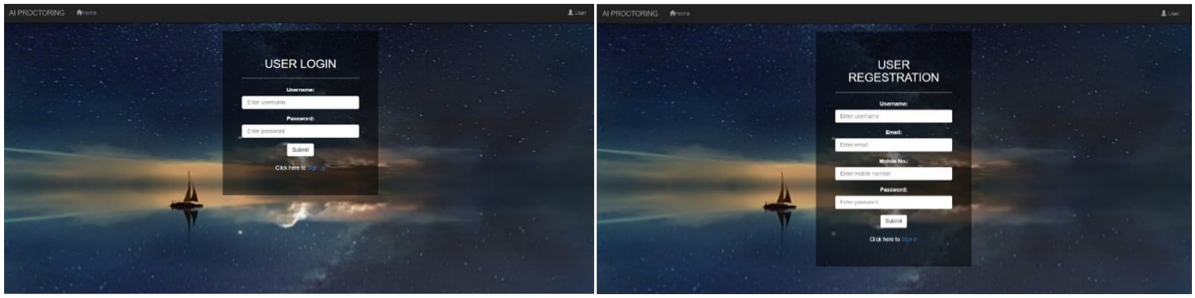


Figure 2: Snapshot of the home page/user login and User Registration page of the test.

The Figure 2 show the snapshot of the home page/user login of the system. The URL created is used to access the test at first. To take the test, the student must first sign up. The student must use the same login information given at enrolment to access the test. The AI-based proctoring is turned on once the student logs into the test and keeps an eye on them during the exam.

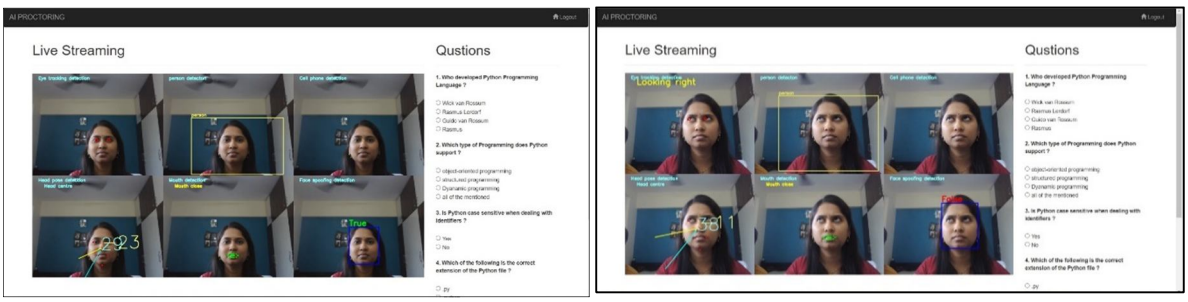


Figure 3: Snapshot showing the monitoring and flagging and alert of Eye tracking, Head pose detection, Mouth detection, Face spoofing.

The Figure 3 shows the snapshots of the monitoring, detection, flagging/alert of Eye tracking, Head pose, Mouth position and Face spoofing. Post registration and login with the registered credentials, the front-facing camera is activated and the test is launched. Through the available camera, the student is observed here during the test for signs of cheating. The cheating detection techniques Eye tracking, Additional Person detection, Cell phone detection, Head pose detection, Mouth detection, Face spoofing detection are engaged.

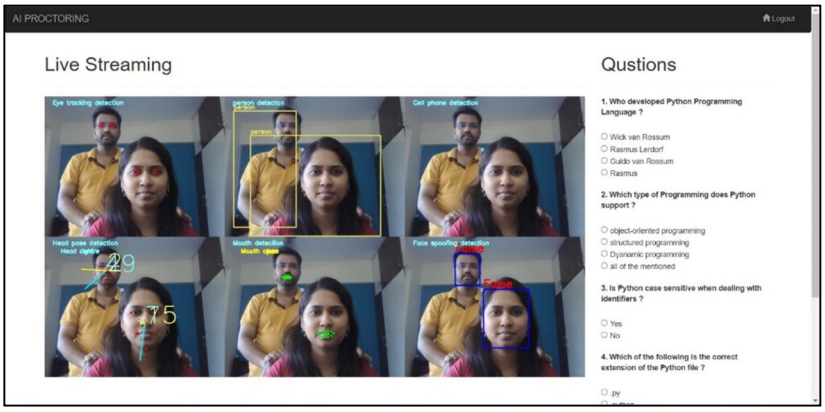


Figure 4: Snapshot showing the detection, flagging and alert of additional person during the test.

The Figure 4 shows the snapshots of the additional person detection by the system during the examination.

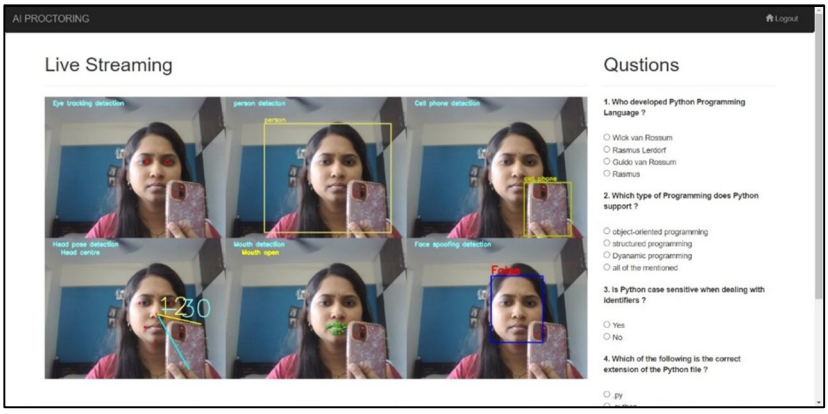
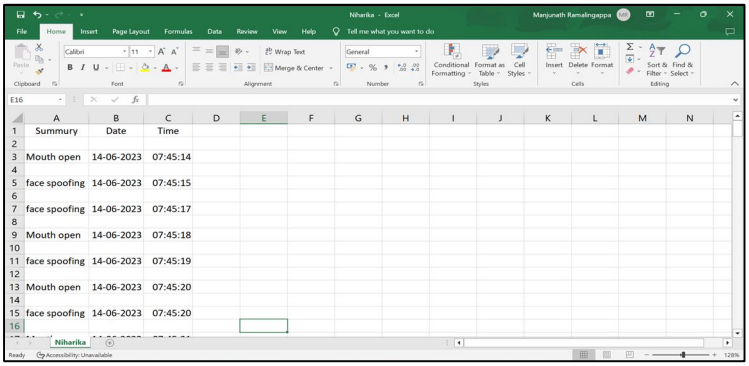


Figure 5: Snapshot showing the detection, flagging and alert of use of Mobile during the test.

The Figure 5 shows the snapshot of the Cell phone detection by the system during the examination.



	A	B	C
1	Summury	Date	Time
3	Mouth open	14-06-2023	07:45:14
5	face spoofing	14-06-2023	07:45:15
7	face spoofing	14-06-2023	07:45:17
9	Mouth open	14-06-2023	07:45:18
11	face spoofing	14-06-2023	07:45:19
13	Mouth open	14-06-2023	07:45:20
15	face spoofing	14-06-2023	07:45:20

Figure 6: Snapshot showing the sample log of suspicious cheating behavior of student.

The Figure 6 shows the snapshot of the sample log of suspicious cheating behaviors of the student identified. The student's fraudulent behaviors identified are recorded in a spreadsheet in. xl format. Each student is awarded a special spreadsheet document for each test.

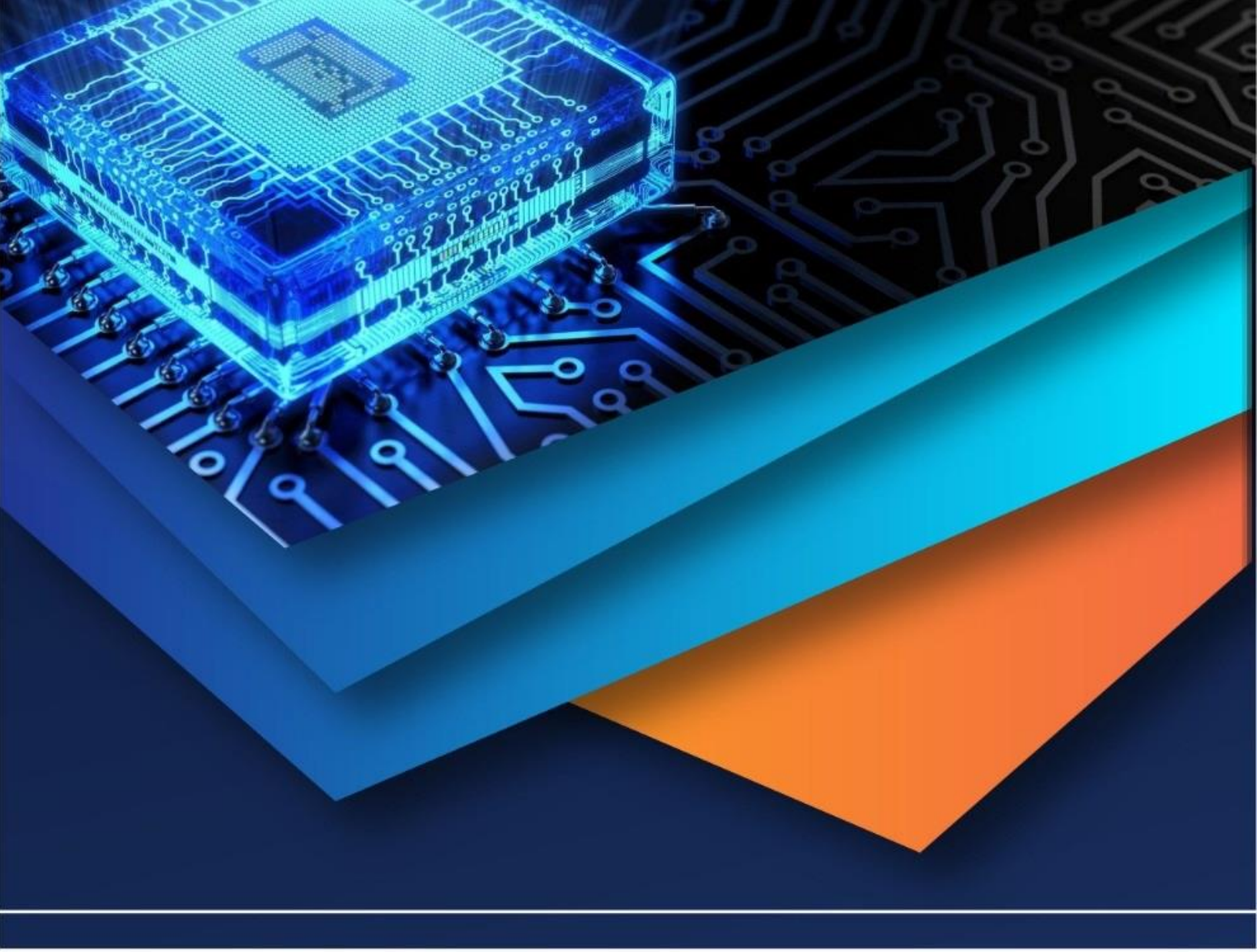
V. CONCLUSION

The suggested "Artificial Intelligence based Online Examination Proctoring system" is a user-friendly system built on Python employing the camera/web camera that is widely available with today's current computers/laptops, together with CNN, Haar Cascade, and Yolo V3 algorithms. In addition to proctoring, the system is dependable and offers students taking the exam a great user experience. Students who exhibit questionable behavior are flagged by the system. Additionally, it provides real-time feedback to instructors and students. The project also keeps track of any logs of questionable behavior for future reference. By efficiently overseeing the online exam and significantly lowering the amount of human labor required for proctoring, the suggested method will tremendously assist in the delivery of online education.

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