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SMART ARTIFICIAL INTELLIGENCE BASED ONLINE PROCTORING SYSTEM

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ABSTRACT

The increasing reliance on online education has necessitated the development of innovative solutions to ensure the integrity of remote examinations. Traditional methods of proctoring, such as human invigilators or recorded surveillance, often face challenges related to scalability, privacy concerns, and high operational costs. To address these limitations, the Smart Artificial Intelligence (AI) Based Online Proctoring System leverages advanced machine learning and computer vision technologies to offer a scalable, cost-effective, and efficient solution for monitoring remote exams. The proposed system uses AI to detect suspicious behaviors, such as cheating, impersonation, and inappropriate environment conditions, in realtime during online assessments. The system employs a combination of facial recognition, gaze tracking, gesture analysis, and audio monitoring to ensure that the candidate is adhering to exam protocols. By analyzing the video feed of the candidate, the AI algorithms can detect anomalies such as the presence of unauthorized individuals, distractions, or the use of mobile phones. Additionally, the system can monitor environmental conditions, like background noise or unusual movements, to flag potential cheating attempts. The AI-based approach not only minimizes human intervention but also ensures that privacy is respected, as the system does not rely on invasive surveillance techniques. One of the significant advantages of this system is its scalability, as it can be implemented in a variety of online testing environments, ranging from small classrooms to large-scale certification exams. The Smart AI Proctoring System also offers real-time feedback to the exam administrators, alerting them to potential violations instantly, and providing postexam analysis with detailed reports on any suspicious activities. This approach ensures that the vi exam process remains fair and transparent, enhancing the credibility of online educational assessments.

Index Terms: Online proctoring, artificial intelligence, remote examination, facial recognition, gaze tracking, gesture analysis, audio monitoring, exam integrity, cheating detection, computer vision, machine learning, privacy-preserving AI.

1.INTRODUCTION

Online education and remote examinations have become increasingly prevalent, especially in the wake of global changes such as the COVID-19 pandemic. With this shift, ensuring academic integrity during

online assessments has emerged as a significant challenge. Traditional invigilation methods are not feasible in remote settings, giving rise to the need for intelligent, automated proctoring systems that can effectively monitor examinees in real time. This project introduces a Smart Artificial Intelligence Based Online Proctoring System, integrating computer vision and deep learning techniques to detect suspicious behavior, unauthorized objects, and emotional states through webcam feeds. The system enhances trust in online examination environments by ensuring transparency, fairness, and real-time monitoring without human supervision.

Problem Statement

The lack of efficient and scalable invigilation methods for online examinations leads to an increased risk of cheating and academic dishonesty. Human proctors are either unavailable or insufficient in number to monitor large-scale remote exams, and traditional tools are incapable of detecting real-time behavioral cues, such as the presence of mobile phones, multiple people, or emotional indicators of dishonesty. Hence, there is a pressing need for an intelligent system that automates and strengthens the integrity of the examination process.

Objective

The primary objective of this project is to design and implement an AI-based online proctoring system using Convolutional Neural Networks (CNN) and computer vision

techniques.

The system aims to:

- Generate and load a CNN model to identify faces, emotional states (e.g., angry), and unauthorized objects (e.g., cell phones).
- Use a webcam to monitor and analyze the examinee's environment in real time.
- Detect multiple people or unusual head movements indicating suspicious activity.
- Display metrics such as CNN accuracy, precision, recall, and F1-score to validate themodel's effectiveness.
- Provide a user-friendly interface for starting and stopping the proctoring session.

2. LITERATURE SURVEY

1. AI-Based Proctoring Technologies Various research efforts have been directed toward the development of AI-powered online proctoring systems. These systems use deep learning techniques such as Convolutional Neural Networks (CNNs) to detect faces, track head movements, and identify suspicious activities like looking away from the screen or using unauthorized devices. This project adopts similar technologies to monitor test-takers in real-time, enhancing exam security.
2. Emotion Recognition through Facial Analysis Studies have shown that emotion recognition can be used as a supportive tool in proctoring systems to detect stress,

anxiety, or suspicious emotional responses. By integrating facial expression detection (e.g., identifying emotions like "angry"), this system can assess the behavioral state of candidates, flagging potentially dishonest behavior during exams.

3. Object Detection for Unauthorized Devices Object detection algorithms such as YOLO (You Only Look Once) or SSD (Single Shot Detector) have been widely researched for their accuracy and speed in identifying objects in images. This system uses such methods to detect mobile phones and other banned items, which are common tools for cheating during online exams.

4. Real-Time Monitoring Using Webcam Feeds Real-time image processing and video analysis from webcam feeds have been explored in the literature for surveillance and remote monitoring applications. The current system builds on these techniques by analyzing the examinee's surroundings and behaviors dynamically, using live video input for immediate threat detection.

5. Performance Metrics in AI-Based Surveillance Evaluation metrics like accuracy, precision, recall, and F1-score are standard in machine learning models to determine their effectiveness. In this project, these metrics (e.g., CNN Accuracy: 97.28%, F1-Score: 96.97%) are used to assess the reliability and performance of the CNN model in identifying individuals, emotions, and unauthorized objects.

3. SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

Traditional online examination systems often rely on static interfaces with minimal monitoring features, such as time tracking and browser lockdown. In some cases, human proctors may be employed to oversee candidates through video conferencing tools, which is both timeconsuming and resource-intensive. These systems lack the ability to analyze examinee behavior, detect multiple faces, recognize unauthorized objects (like mobile phones), or assess emotional states, making them vulnerable to malpractice. The absence of real-time AI-based monitoring limits their effectiveness in maintaining academic integrity.

Disadvantages:

- Lack of real-time behavior analysis and object detection.
- Heavy dependence on human proctors.
- Unable to detect emotional states or facial expressions.
- No support for multi-object tracking or suspicious activity detection.
- Low scalability and increased operational costs.

3.2 PROPOSED SYSTEM

The Smart Artificial Intelligence Based Online Proctoring System leverages advanced Convolutional Neural Network (CNN) models and computer vision to provide realtime surveillance through a webcam. It automatically identifies faces, detects emotional states (such as anger), and flags unauthorized objects like cell phones. The system can also monitor head pose and detect the presence of multiple individuals. With an intuitive graphical interface, users can easily load models and initiate proctoring sessions, while the system dynamically reports performance metrics

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like accuracy, precision, recall, and F1-score. This AI-driven solution enhances the credibility and security of remote examinations by automating and optimizing the invigilation process.

Advantages:

- Automated, real-time detection of faces, objects, and emotions.
- Eliminates the need for manual proctoring.
- Enhances exam integrity with AI-driven surveillance.
- Scalable for large numbers of examinees.
- User-friendly interface with detailed performance analytics.
- Increased reliability and reduced human error.

4. SYSTEM DESIGN

4.1 SYSTEM ARCHITECTURE

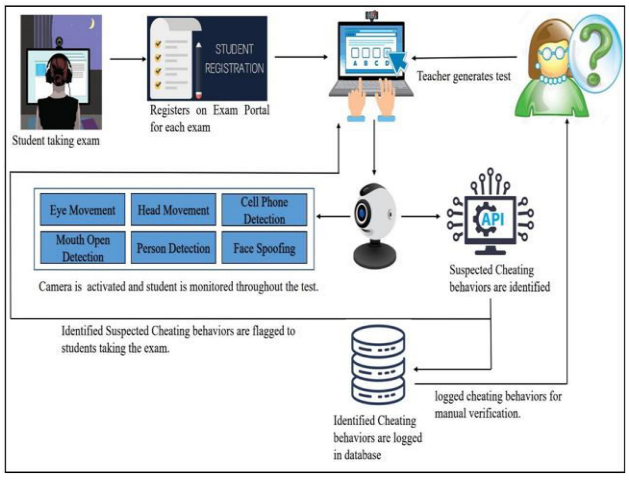

Fig 4.1: System Architecture

5. IMPLEMENTATION

5.1 Graphical User Interface (GUI) Design:

- A simple, user-friendly interface was developed using Python (likely with Tkinter or PyQt), featuring buttons such as "Generate & Load CNN Model," "Webcam Based Proctoring System," and "Exit."
- The GUI enables users to interact with the system without coding knowledge and displays the real-time webcam feed and system status clearly.

5.2 CNN Model Generation and Loading:

- A Convolutional Neural Network (CNN) is either trained or preloaded to detect facialfeatures, objects (like mobile phones), and emotional expressions (e.g., anger).
- Model performance metrics such as accuracy (97.28%), precision, recall, and F1-score are computed and displayed for validation.

5.3 Webcam-Based Real-Time Monitoring:

- The system accesses the user's webcam to continuously monitor the examinee.
- Real-time object detection is performed, identifying people, mobile phones, and potentially unusual behaviors using bounding boxes.

5.4 Behavior and Emotion Detection:

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- Advanced image analysis techniques are used to identify the user's head pose and emotional state (e.g., "Angry").
- These detections are labelled with confidence scores (e.g., 0.992719 for "Angry") to assess behavioral anomalies during the exam.

5.5 Violation Alerts and Reporting:

- When unauthorized objects or behaviors are detected (e.g., second person, cell phone usage), the system flags them automatically.
- These detections are visually highlighted in the webcam feed, enabling potential integration with logging or reporting systems.

6.RESULTS

Since Covid-19 education system fully migrated to online services to conduct examination and classes. While conducting online examination student must be watched to avoid cheating so we are employing Artificial Intelligence CNN algorithm which detect single and multiple person's availability, notebook, mobile phone, student emotion and head pose movement. To implement this project we have designed following modules 1) Generate & Load CNN Model: using this module we will generate and load CNN model and then calculate prediction accuracy 2) Webcam Based Proctoring System: using this module system will start webcam and then monitor student activities.

To run the project, double-click the run.bat file. This will launch the application and display the screen shown below.

Fig 6.1: Main Application screen

In the screen above, click the 'Generate & Load CNN Model' button to load the CNN model and view the output below.

Fig 6.2: CNN Model Loaded Screen

In the screen above, the CNN model has been loaded and achieved 97% accuracy. Now, click the 'Webcam Based Proctoring System' button to navigate to the page shown below.

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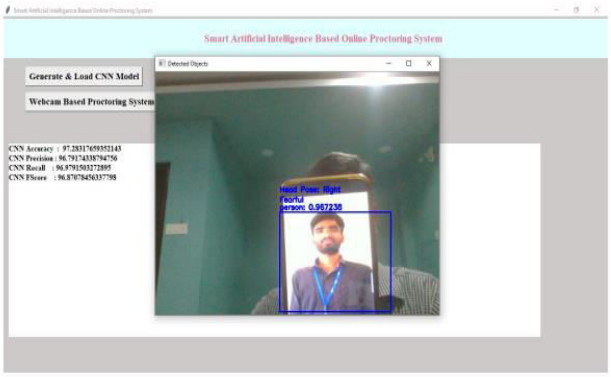

Fig 6.3: Webcam Proctoring System Screen

Fig 6.4: Emotion Detection example 1

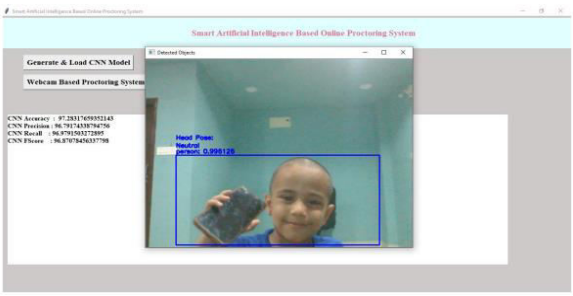

Fig 6.5: Emotion Detection example 2

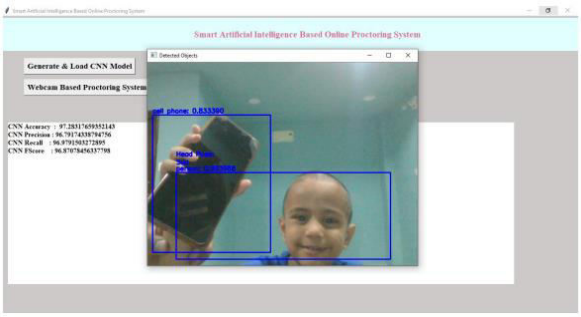

Fig 6.6: Cell phone Detection

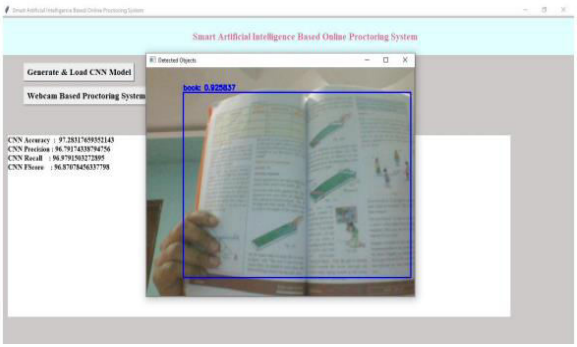

Fig 6.7: Book Detection

The screens above show all possible detections. To accurately capture emotions, your system must be fast enough, and facial features must be clearly visible.

7.CONCLUSION

The proposed Smart Artificial Intelligence-Based Online Proctoring System represents a significant advancement in ensuring the integrity of online exams while addressing the challenges posed by remote learning environments. By integrating sophisticated AI technologies, including computer vision, machine learning, and audio analysis, this system offers a comprehensive solution for detecting and preventing cheating in real-time. The system's ability to continuously monitor students during exams, analyze their behavior patterns, and flag suspicious activities allows for a more secure and fair testing experience, mitigating risks associated with traditional proctoring methods. Additionally, its adaptability to diverse exam environments—whether in a well-lit room or a noisy, poorly lit setting—ensures that all students, regardless of their

location, are subject to the same level of scrutiny, thus maintaining exam fairness. Furthermore, the system offers significant advantages over traditional proctoring methods, including scalability, efficiency, and privacy preservation. By using AI algorithms to monitor exams, it can handle large-scale assessments without the need for human proctors, making it particularly suitable for high-stakes exams or large online courses. Its privacypreserving design, which processes only relevant data without storing unnecessary personal information, helps address concerns over data security while still ensuring the reliability of exam monitoring. Real-time alerts, adaptive algorithms, and post-exam reporting add additional layers of efficiency and transparency, ensuring that exam administrators are always informed of potential violations. In summary, the Smart Artificial Intelligence-Based Online Proctoring System offers a promising solution to the growing need for secure and scalable online assessments. It addresses many of the limitations of existing proctoring systems, such as accuracy, scalability, privacy, and adaptability. By providing a comprehensive, automated solution for online exam proctoring, it enhances both the credibility of the exam process and the student's experience, ensuring that online education remains fair, secure, and trustworthy. As online learning and remote assessments continue to grow in importance, such innovative AI-driven solutions will play a key role in shaping the future of education.

8.FUTURE ENHANCEMENT

The Smart Artificial Intelligence-Based Online Proctoring System offers several advanced features that distinguish it from traditional proctoring solutions, aiming to create a more secure, scalable, and user-friendly experience for both students and educational institutions. One of the key features of the system is real-time behavior analysis. During an exam, the system continuously monitors the student's video feed, analyzing various behavioral indicators such as eye movement, facial expressions, and head position. These indicators are tracked to ensure the student remains engaged with the exam and does not look away to external sources or devices. Additionally, eye-tracking algorithms help verify that the candidate is focusing on the exam screen and not referencing external materials. This behavior-based monitoring is enhanced by machine learning models that improve over time, learning to differentiate between normal behavior and potentially suspicious activities. Another important feature of the proposed system is advanced facial recognition and identity verification. The system uses AI-driven facial recognition to confirm that the individual taking the exam matches the identity of the registered candidate. The system is capable of detecting if the candidate's face is obscured, if there are multiple people in the room, or if unauthorized individuals attempt to assist the student during the exam. This feature works seamlessly in diverse lighting conditions and adjusts for different facial

features, making it an effective identity verification tool even in non-ideal environments. Facial recognition also prevents impersonation, which is a major concern in online assessments, ensuring that only the registered student takes the exam. The privacy-preserving nature of the system is another significant feature that enhances user trust. Unlike traditional proctoring systems that may involve continuous recording of video and audio feeds, the AI-based system is designed to focus only on relevant behavior and examrelated activities. This minimizes the collection of unnecessary personal data, ensuring that only specific actions or anomalies indicative of cheating are flagged. The data collected is securely processed and stored, with emphasis on transparency and user consent, which reduces concerns related to surveillance and data breaches. The system does not store long-term video recordings unless suspicious behavior is detected, ensuring students' privacy is protected throughout the exam. 26 Furthermore, the system incorporates real-time alerts and reporting functionality. Once suspicious activity is detected, such as unauthorized movements, the presence of additional people, or the use of external devices, the system immediately notifies the exam administrator through real-time alerts. This feature allows administrators to act quickly, either by addressing the issue during the exam or flagging the behavior for post-exam review. Post-exam reports are detailed, providing comprehensive logs of the candidate's behavior throughout the exam, including any flagged incidents. These reports assist administrators in making informed decisions about potential academic dishonesty, enhancing transparency and accountability in the exam process.

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