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Online Examination And Proctoring System

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ABSTRACT:

The increasing demand for remote education and online assessments has necessitated the development of secure and reliable exam monitoring systems. This project presents an Online Examination And Proctoring System that ensures academic integrity by monitoring candidates in real-time through webcam and screen activity. Utilizing advanced technologies such as facial recognition, object detection, and behavior analysis, the system identifies and flags suspicious activities including presence of multiple faces, unauthorized device usage, and leaving the test environment. It offers a scalable and automated solution that reduces the need for human invigilators, thus enhancing accessibility and efficiency in digital examinations. The system is developed using Python, OpenCV, and machine learning models, and integrates seamlessly with popular learning management platforms.

INTRODUCTION:

With the rapid evolution of digital education, online examinations have become an integral part of academic institutions and certification bodies worldwide. However, ensuring the credibility and integrity of such assessments remains a significant challenge. Traditional online exams often lack proper supervision, leading to increased opportunities for malpractice and cheating.

To address this issue, the development of Online Examination And Proctoring System offers a promising solution. These systems leverage advanced technologies such as computer vision, machine learning, and natural language processing to monitor and analyse a candidate's behaviour during the examination. Unlike manual proctoring, AI-driven systems provide automated surveillance by tracking eye movements, detecting multiple faces, identifying suspicious sounds or objects, and ensuring that the test-taker remains focused and undisturbed throughout the exam duration.

The proposed system aims to provide a secure, scalable, and cost-effective platform for conducting online exams while maintaining academic honesty. It reduces the need for human invigilators and can be integrated seamlessly with existing learning management systems, making it highly adaptable for various educational and professional testing environments.

. LITERATURE REVIEW:

[1] Researchers Yousef Atoum and Liping Chen introduced a multimedia analysis system for detecting various cheating behaviours during online exams, called the Online Exam Process (OEP). It consists of two phases: a preparation phase and an exam phase. In the preparation phase, the test taker verifies their identity through a password and facial recognition, calibrates the system's sensors, and confirms understanding of exam rules. During the exam phase, the system uses a webcam, wearable camera, and microphone to continuously monitor the test taker. Audio-visual data is processed through six components: user verification, text and speech detection, window activity monitoring, gaze estimation, and phone detection. These generate mid-level features, which are fused over time to produce high-level features used to train and test a cheat detection classifier. By using a rich and diverse set of features, the system enhances its ability to accurately detect cheating behaviours.

[2] This paper presents a visual analytics approach to improve online exam proctoring by making the process more efficient and effective. Instead of relying solely on manual monitoring, the system uses visual data—such as webcam and screen recordings—to automatically detect and highlight suspicious behaviours. By combining data analysis with visual representations, it allows instructors to quickly identify and review potential cheating incidents without watching entire recordings. This approach streamlines proctoring, reduces workload, and supports academic integrity in online assessments.

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[3] Jadidinejad and Mahmoudi proposed an unsupervised approach for grading short-answer questions, which leverages spreading activation within an associative network of concepts. In this method, an associative network is created, linking concepts that are related semantically or contextually, such as "cell" being connected to "nucleus" and "membrane." When a student's answer contains a concept like "photosynthesis," related terms in the network, such as "chlorophyll" or "sunlight," are also activated, even if they aren't directly mentioned in the answer. This unsupervised grading approach does not require pre-labelled data

or human-provided examples of correct answers, making it more efficient and scalable. By automating the grading process, it helps reduce the time and effort needed for assessment, ensures greater consistency in grading, and removes potential human bias, ultimately enhancing the overall efficiency of evaluating short-answer responses.

[4] This study examines the role of learner support in open and online learning, with a specific focus on the Online Student Portal (OSP) at UP Open University. The research involved an online survey of 147 students, revealing high levels of satisfaction with the portal. Approximately 85% of respondents expressed contentment with the OSP, and 90% found it to be both effective and cost-efficient. The OSP is regarded as a valuable resource, significantly improving the learning experience for online students by offering convenient access to accurate and timely information, thereby supporting their academic needs in a flexible online environment.

[5] This study focuses on the creation and implementation of an online self-training system designed for a computer systems platform course. The primary goal of the system is to improve students' learning experience and performance by offering interactive and adaptive training modules. These modules are tailored to respond to individual learning needs, providing a more personalized and engaging educational experience. By using this online system, students can progress at their own pace, reinforcing their understanding of the course material through hands-on practice and adaptive feedback, ultimately enhancing their mastery of the subject.

[6] Adams and Davis examine the role of AI in education, focusing on how it enhances inclusivity and accessibility. They highlight AI's ability to personalize learning and support students with disabilities through adaptive tools like speech-to-text and intelligent tutoring, ultimately improving access and learning outcomes for diverse learners.

[7] Yong Wang and Huan Wei propose a unique visual analytics method to support online exam proctoring by analysing students' exam video footage and mouse movement data. Their system identifies and visualizes suspicious patterns in head and mouse movements, helping instructors easily spot potential cheating behaviours. By using these visual cues, the method offers a convenient, efficient, and reliable way to monitor students during online assessments. This approach enhances the overall effectiveness of digital proctoring by combining motion tracking with visual analysis to detect unusual or dishonest behaviour.

[8] This paper presents an innovative online proctoring system that leverages deep learning to continuously monitor physical spaces during online exams, aiming to improve the detection of unfair behaviour. The system is designed to identify both the presence of the student and any unauthorized items or gadgets in the environment. It demonstrates high effectiveness, achieving 97% accuracy in face detection and 99.3% in face recognition. By combining these capabilities with real-time monitoring, the system enhances the integrity of online assessments and addresses key challenges in preventing cheating.

[9] Awaghade, Bombe, Deshmukh, and Takawane developed a fully automated, human-free online proctoring system to streamline test administration. It uses a webcam to detect objects in the room and randomly captures computer screenshots to monitor for cheating. However, the proposed system improves upon this by adding features like tab switching detection, disabling copy-paste, tracking head and mouth movements, object and multi-person detection, and identifying when no one is present. These enhancements make the new system

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more effective and reliable than the original framework.

[10] This paper focuses on the growing use of mobile learning (m-learning) and remote education, highlighting the need for effective online exam proctoring to maintain academic integrity. To address challenges such as cheating, the authors propose a method that improves face verification accuracy, even under varying poses and lighting conditions. This is achieved through incremental training using data collected from m-learning online lecture sessions. By enhancing the reliability of face recognition, the proposed approach contributes to the development of a more robust and efficient proctoring system suitable for modern, flexible learning environments.

[11] Aditya Nigam et al, conducted a systematic review exploring the development, current trends, and future potential of AI-based proctoring systems in online education. The study analyses how these technologies have evolved to address the growing need for secure and scalable online assessments. The authors highlight the advantages of AI-driven proctoring, such as automation, scalability, and the ability to detect cheating behaviours in real-time. They also discuss key challenges, including privacy concerns, ethical issues, and the need for accuracy and fairness. Overall, the review offers valuable insights into how AI can enhance exam security while identifying areas that require further research and development.

[12] S.Prathish used the model-based head pose estimation method and the audio-based detection method to complete the test abnormal behaviour detection. However, the ac curacy rate of the head pose estimation of this method is not high enough, and the use of a microphone to collect sound can infringe the relevant privacy of examinees. Moreover, the abnormal behaviour detection process does not consider eye tracking and mouth movement analysis.

[13] Hu et al. proposed a system that uses an image-based head pose estimation model and mouth movement analysis to discriminate the abnormal behaviour of the examinee during the online examination. However, the system does not take eye-tracking functionality into consideration for analysing the abnormal behaviour of the examinee.

[14] Johnson et al. examine the role of proctoring technologies in maintaining the integrity of online assessments. The paper reviews a range of surveillance and monitoring tools used in virtual exams, such as webcam monitoring, screen recording, and activity tracking. The authors evaluate how effective these tools are in identifying and preventing academic dishonesty, noting both their strengths in deterring cheating and the concerns they raise regarding student privacy and stress. The study provides a balanced overview of current proctoring solutions, emphasizing the need to develop systems that are both secure and considerate of the student experience.

[15] Lee and Lee (2018) explore the application of universal design principles in educational technology, with a strong focus on fostering inclusivity in digital learning environments. They stress the importance of creating educational tools and resources that are accessible and adaptable, ensuring that learners of all abilities, backgrounds, and learning styles can engage effectively. By promoting flexible design strategies—such as customizable content formats, alternative navigation options, and supportive learning aids—the authors advocate for a more equitable approach to digital education that meets the diverse needs of students and removes barriers to learning.

[16] Piyush Sharma and Utkarsh Tripathi highlight the growing importance of remote investigation and monitoring in the context of online education, particularly as convenience, safety, and accessibility become more integral to learning environments. They argue that the increasing reliance on distance learning and online exams will not only boost the credibility of MOOCs (Massive Open Online Courses) but also enhance the validity of other credit-based certification programs. The authors focus on how online exam software, integrated with advanced artificial intelligence, ensures secure and reliable monitoring of students during exams. This technology eliminates the need for physical proctoring while maintaining exam integrity. Additionally, they discuss the advancements in online exam solutions and the supporting

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technologies that make remote monitoring more effective and trustworthy in the evolving landscape of online education.

[17] Brown and Evans (2019) explore strategies and tools for enhancing digital accessibility in online assessments. They discuss designing inclusive environments that address the diverse needs of learners, such as offering text-to-speech, captioning, and adjustable interfaces. The authors emphasize the importance of flexibility in assessment design to ensure all students, regardless of challenges, can participate equitably and demonstrate their knowledge.

[18] Percia V. Secreto and Rhodora L. Pamulaklakin discuss the institutional framework of student support, which includes teaching and advising, admonitory practices, and data management. They define student empowerment as practices and components designed to respond to students' needs, providing both emotional and targeted support throughout their educational journey. The authors highlight the growing enrolment in online programs, but also point out that students often drop out due to insufficient support services. As institutions offering Online Distance Education and Learning (ODeL) expand, their student populations become more diverse, presenting challenges in ensuring academic success. The paper also introduces OSP (Online Student Portal), an application that helps provide students with trusted access to vital information and resources, improving overall student support and engagement in online education.

[19] Aiman Kiun's presentation focuses on using Convolutional Neural Networks (CNN) for fraud detection in online exam videos. The system includes three components: an interface to upload the video, video processing, and frame classification. The video frames are analysed through a pipeline, where CNNs are trained to distinguish between legitimate and fraudulent behaviour. If suspicious activity is detected, a signalling mechanism is triggered, following guidelines to identify cheating. This method effectively detects fraud in online exams using advanced image classification techniques.

METHODOLOGY:

The development of the AI-Based Online Exam Proctoring System follows a modular approach that integrates various AI and computer vision techniques to ensure real-time monitoring and security. The methodology can be broadly divided into the following phases:

1. System Design and Architecture

- The system is designed as a client-server architecture.
- The **frontend interface** allows students to log in, access exams, and submit responses.
- The **backend** includes monitoring modules, AI models for analysis, and data storage components.

2. User Authentication

- At the start of the exam, the system verifies the identity of the candidate using **facial recognition**.
- A webcam captures a live image, which is matched with pre-stored images using a face detection and recognition model (e.g., OpenCV, Dlib, or FaceNet).

3. Real-time Video and Audio Monitoring

- The webcam feed is continuously analyzed to detect:
    - Presence of the candidate's face.
    - Multiple faces or background movement (suggesting unauthorized presence).
    - Head movement or gaze tracking (to detect distractions or looking off-screen).
- Audio monitoring detects background noises such as voices or other sound cues that could indicate cheating.

4. Screen Activity Monitoring

- The system captures screen activity to detect unauthorized apps or browser tabs.
- Periodic screenshots and mouse/keyboard activity are logged and analyzed.

5. AI-Based Behavior Analysis

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- The system uses **computer vision algorithms** to classify behaviors as normal or suspicious.
- Events such as the candidate leaving the screen, covering the webcam, or using a mobile phone are flagged.

6. Violation Detection and Logging

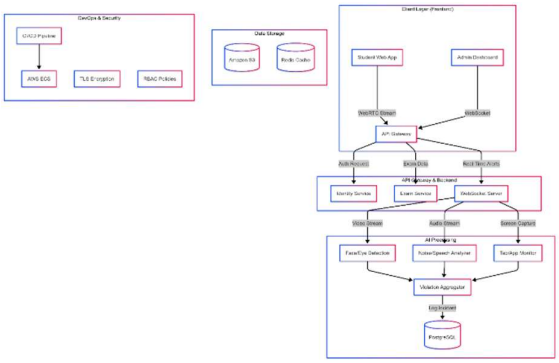
- All anomalies detected during the session are logged and timestamped.
- A violation score is calculated based on the severity and frequency of suspicious activities.
- The exam can be automatically terminated if critical violations are detected.

7. Report Generation

- After the exam, a proctoring report is generated containing:
  - Authentication results
  - Detected violations
  - Screenshot logs
  - A final integrity score

8. Data Privacy and Security

- All recorded data is encrypted and securely stored.
- The system complies with data protection regulations to ensure the privacy of candidates.



Block Diagram

IMPLEMENTATION:

1. Programming Language and Frameworks

- **Python** is the primary programming language due to its strong support for computer vision and machine learning.
- **Flask** or **Django** is used to build the backend server and APIs.
- **HTML/CSS/JavaScript** is used for the frontend interface, including live webcam access and user interaction.

2. User Authentication Module

- **OpenCV** and **face_recognition** libraries are used for facial recognition.
- At exam start, the candidate's face is matched against stored images using a feature extraction model (e.g., FaceNet or Dlib).
- If the identity check fails, the exam session is not initiated.

3. Real-Time Monitoring Modules

a. Webcam Monitoring

- The webcam feed is continuously captured using OpenCV.
- **Haar Cascades** or **DNN models** detect:
  - Presence of a single face.
  - Multiple faces (flagged as suspicious).
  - Face orientation to monitor gaze direction.

b. Audio Monitoring

- Microphone input is analysed using libraries like pyaudio or speech recognition.
- The presence of speech or abnormal noise levels triggers a suspicion flag.

c. Screen Monitoring

- Tools like pyautogui, mss, or pynput capture screen activity and monitor for:
  - Tab switching
  - Copy/paste behaviour

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- Screenshot detection

4. Behaviour Analysis Engine

- A **risk scoring algorithm** is developed to assign scores to different suspicious behaviours (e.g., looking away = 10 points, multiple faces = 30 points).
- A cumulative score determines if the session is flagged or terminated.
- The behaviour model can be trained using labelled video datasets and integrated using scikit-learn or TensorFlow.

5. Violation Detection and Response

- Each suspicious event is timestamped and logged.
- If the system detects high-severity violations (e.g., absence for >10 seconds, another person in frame), the session can be auto-terminated.
- Warnings can also be sent to users before termination.

6. Report Generation

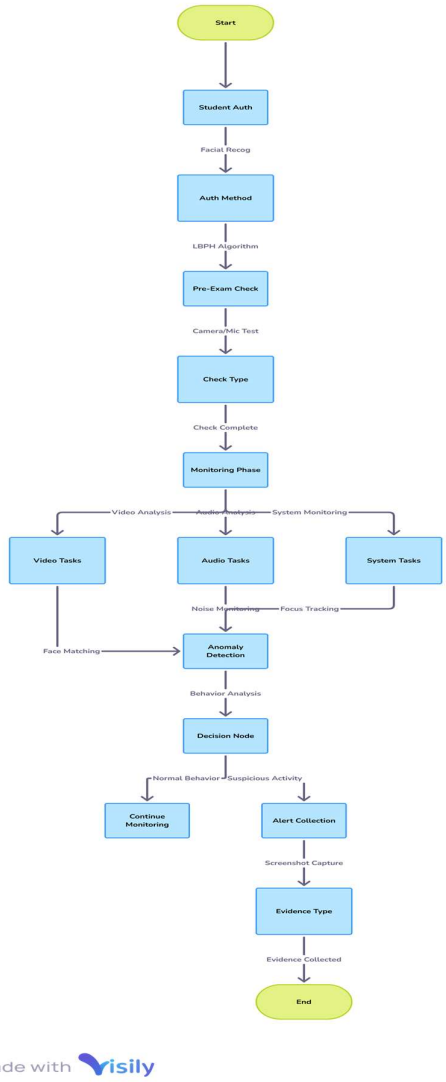
- After the exam, the system generates a detailed report including:
  - Authentication result
  - Screenshots of violations
  - Time-stamped logs
  - Final behaviour score
- Reports are stored in a database (e.g., SQLite, PostgreSQL) and sent to administrators.

7. Data Privacy and Security

- All captured data (video, audio, screen) is stored in encrypted format.
- Access to proctoring data is role-based and logged.
- Compliance with privacy policies (e.g., GDPR) is ensured.

8. Deployment

- The system is hosted on a cloud platform like **Heroku**, **AWS**, or **Azure**.
- WebRTC or getUserMedia() API handles live webcam/mic feed on browsers.
- Frontend is secured via HTTPS and authentication tokens.



Flow chart

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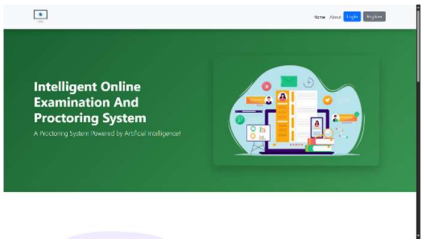
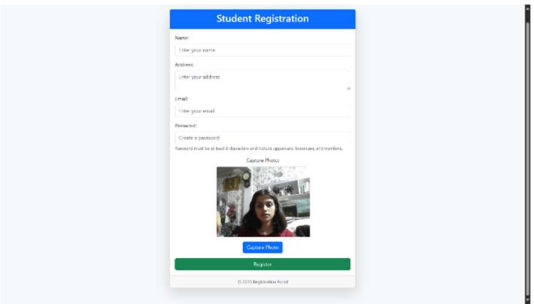
RESULTS:

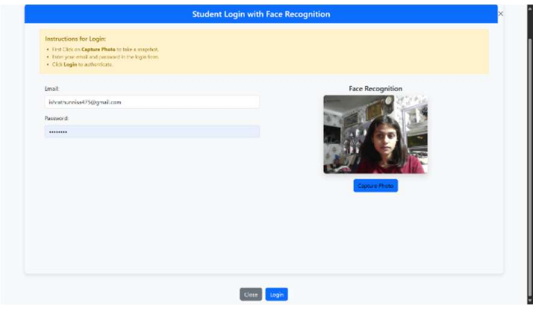
1. Home Page

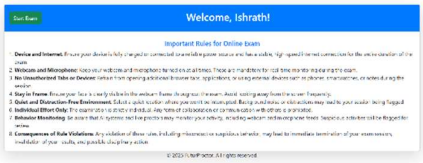


2. Student Registration Page

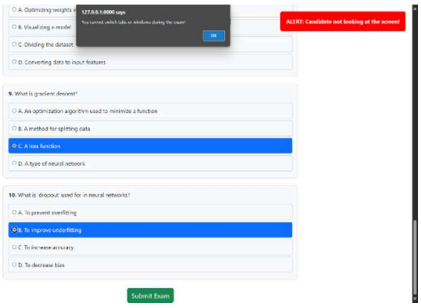


3. Student Login Page

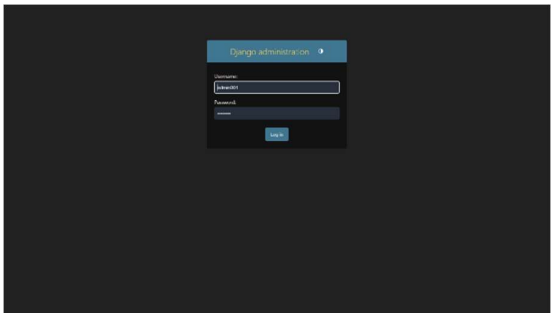




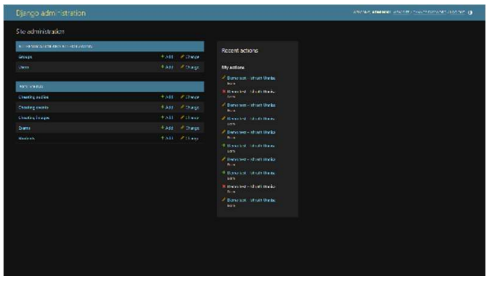
4. Cheating Detection



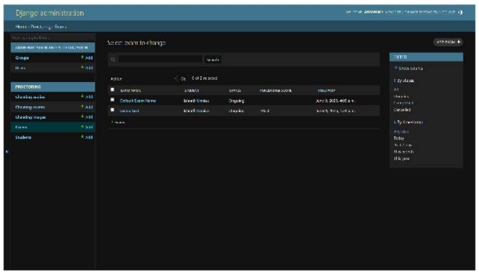
5. Admin Login



6. Admin Home Page



7. Exam List



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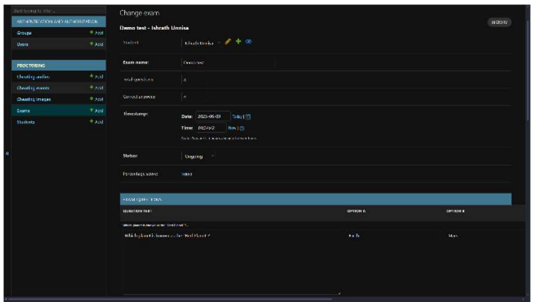
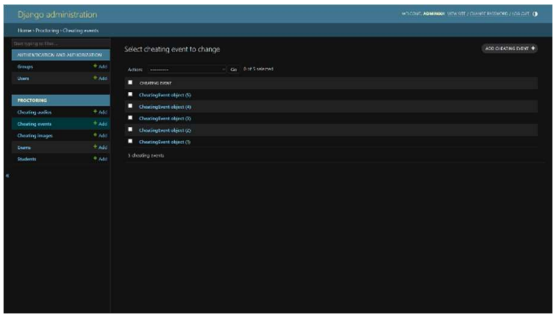
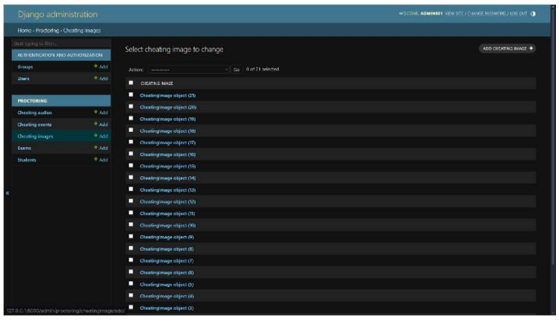
8. Create Exam



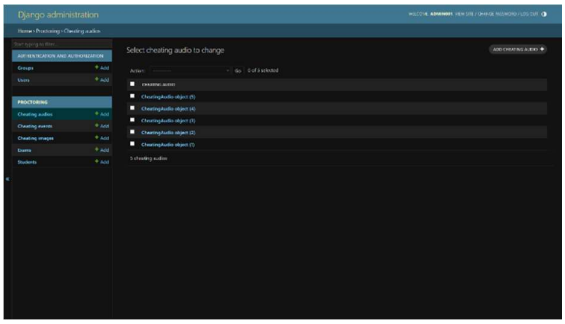
8. Cheating Events



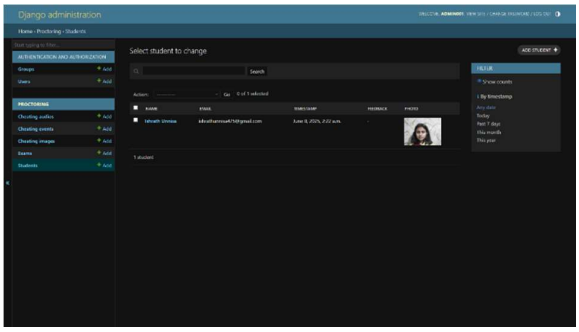
9. Cheating Image



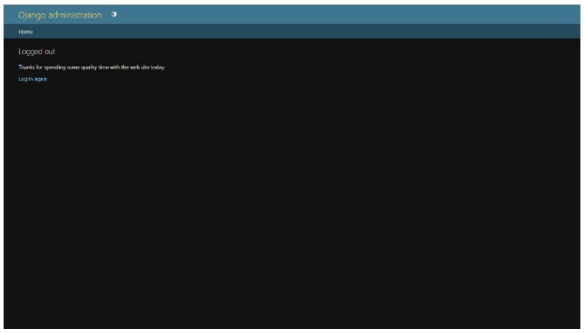
10.Cheating Audio



11. Student Database



12. Admin Logout



CONCLUSION:

The Intelligent online examination and proctoring system represents a comprehensive and intelligent solution to the growing need for secure and reliable online examinations. By integrating advanced computer vision, audio analysis, and real-time behavioral monitoring, this system mimics many of the functionalities of a human proctor while reducing the scope for human error or bias. It combines technologies like Dlib for facial landmark detection, YOLO for object recognition, and PyAudio for environmental sound monitoring to track and flag suspicious activities such as looking away from the screen, multiple faces in the frame, speaking during the exam, or detecting unauthorized objects like mobile phones. These observations are systematically logged in a centralized activity.txt file, enabling educators or administrators to review behavior either live or post-exam. The system also offers a modular architecture, making it extensible and customizable for developers or institutions with specific proctoring needs. Overall, this project serves not only as a practical tool for educational institutions and certification platforms but also as a robust foundation for further research and development in AI-powered proctoring solutions. Its open-source nature empowers developers to build

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upon its capabilities, enhancing integrity and fairness in remote assessments.

FUTURE ENHANCEMENTS

1. Integration of Biometric Authentication

One of the most valuable enhancements would be integrating biometric authentication—such as facial recognition login or fingerprint verification—to ensure that the registered candidate is the one taking the exam. While the current system performs facial detection, it does not provide robust identity verification. Using facial recognition models trained with a candidate's image during registration could prevent impersonation. This can be further strengthened with periodic re-authentication during the exam.

2. Advanced Cheating Behavior Detection with Machine Learning

The current system uses rule-based methods to detect suspicious behavior (like looking away or mouth movement). Future versions could incorporate machine learning classifiers (e.g., SVM, Random Forest, or even deep learning models) trained on real exam behavior data to identify patterns indicative of cheating. This could help reduce false positives and better differentiate between natural behavior (like adjusting posture) and actual violations.

3. Cloud Integration and Real-Time Dashboard

Currently, logs are saved locally in an activity.txt file. Enhancing the system with cloud integration—using services like Firebase, AWS, or Azure—would allow logs and video feeds to be saved securely in real time. A live admin dashboard could display multiple student feeds simultaneously, flag suspicious activity as it happens, and enable supervisors to intervene or annotate events during the exam session.

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