Cheating Detection During Online Examination System

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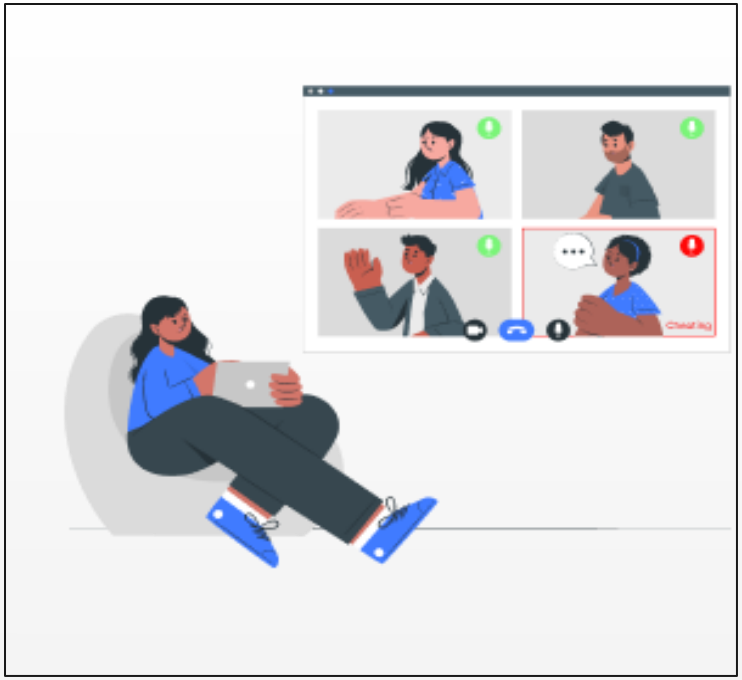
Introduction



INTRODUCTION

1. Brief Introduction to the Topic:

Cheating in exams and other academic assessments has long been a significant challenge, undermining the integrity of educational systems and the validity of qualifications. With the rapid advancement of technology, new methods of cheating have emerged, making traditional monitoring techniques less effective. Our project addresses this issue by developing a comprehensive cheating detection system using cutting-edge technologies such as OpenCV, OS, face recognition, and speech recognition. This system aims to enhance the reliability and fairness of examinations by providing real-time detection and alerting of suspicious activities.

2. Importance of the Study:

The integrity of academic evaluations is crucial for maintaining the credibility of educational institutions and ensuring that qualifications accurately reflect a student's knowledge and abilities. Cheating not only devalues the efforts of honest students but also compromises the quality of education. By developing an advanced cheating detection system, we can significantly reduce the incidence of cheating, ensuring a fairer examination environment. This study is important as it leverages modern technologies to address a persistent problem, offering a scalable and effective solution that can be implemented across various educational settings.

3. Objectives of the Project:

Develop a Real-Time Cheating Detection System: Utilize OpenCV, face recognition, and speech recognition to monitor and detect cheating behaviors during exams.

Enhance Detection Accuracy: Implement advanced algorithms to identify multiple cheating indicators such as unauthorized movements, multiple persons in the frame, and suspicious objects.

Improve User Experience: Create an intuitive interface for examiners to easily monitor exam sessions and receive real-time alerts on detected cheating activities.

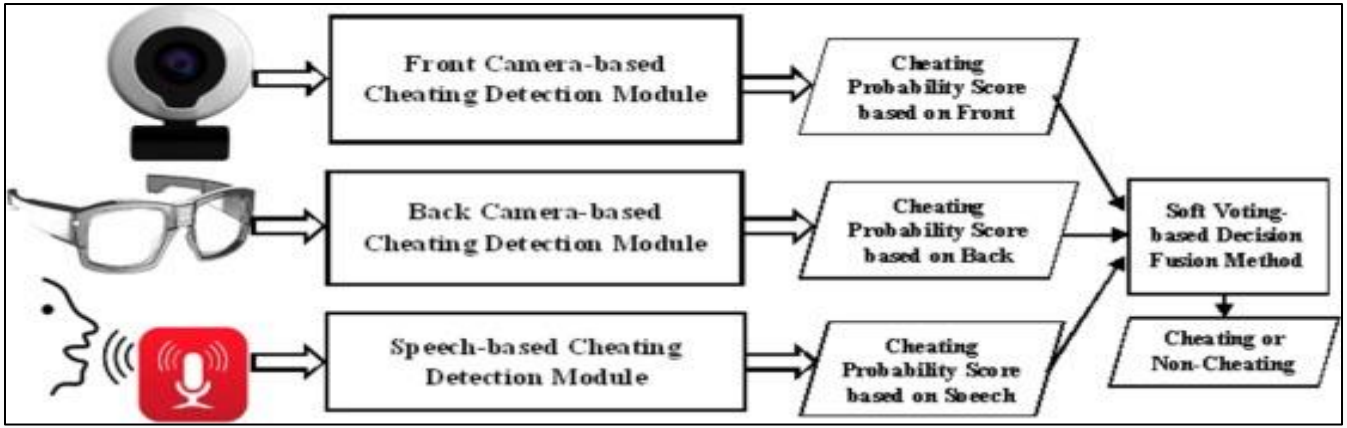
Ensure Scalability and Flexibility: Design the system to be adaptable for different exam formats and settings, including online and offline environments.

4. Economic and Other Benefits:

Improved Examination Integrity: The system ensures that all students are assessed fairly, enhancing the credibility of qualifications and the institution’s reputation.

Increased Efficiency: Real-time detection and alerting streamline the invigilation process, allowing examiners to focus on critical tasks without constant manual monitoring.

Enhanced Security: The system can be integrated with existing security measures to provide a robust framework for exam integrity, deterring potential cheaters and promoting a culture of honesty.


Front Camera-based Cheating Detection Module
Back Camera-based Cheating Detection Module
Speech-based Cheating Detection Module
Cheating Probability Score based on Front
Cheating Probability Score based on Back
Cheating Probability Score based on Speech
Soft Voting-based Decision Fusion Method
Cheating or Non-Cheating

Background

Literature Review

Cheating detection in online exams has become a crucial area of research in recent years. Various methodologies have been explored, including machine learning. Studies have highlighted the effectiveness of using facial recognition, head movement analysis, and speech recognition to monitor and identify suspicious behavior. The implementation of dlib for facial landmarks detection, and the integration of real-time monitoring systems.

Historical Context or Background of the Problem

With the advent of online education and remote learning, ensuring the integrity of assessments has become more challenging. Traditional methods of invigilation are impractical in a virtual environment, leading to a surge in cheating incidents. The need for robust and reliable cheating detection systems has never been more pressing. Historically, educational institutions have relied on manual proctoring and post-exam data analysis to detect irregularities, but these methods are not scalable or efficient for large-scale assessments.

Technology Used

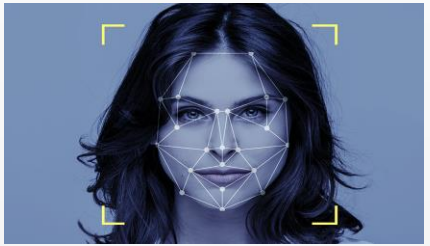
OpenCV: For real-time computer vision tasks, such as face detection and tracking.

OS: To interact with the operating system for file handling and system operations.

Face Recognition: To identify and verify individuals using facial features.

Speech Recognition: To detect and analyze spoken words to monitor for suspicious activity.

Dlib: For robust facial landmark detection and image processing.



PyAudio: For capturing audio input from the microphone.

Django: To build the web application and manage the backend functionalities.

NumPy: For numerical computations and handling arrays efficiently.

HTML, CSS, JavaScript: To create the front-end interface, ensuring a responsive and interactive user experience.

SQL: For database management and storing user and activity data.

PROBLEM STATEMENTS

Clear Definition of the Problem:

With the rise of online education and remote examinations, ensuring the integrity of assessments has become a critical challenge. Traditional invigilation methods are not feasible in a virtual environment, leading to increased opportunities for cheating. To address this issue, our project focuses on developing an advanced cheating detection system that leverages computer vision, speech recognition, and machine learning techniques to monitor and analyze the behavior of candidates during online exams.

Relevance of the Problem in the Current Context

Growth of Online Education: The COVID-19 pandemic accelerated the adoption of online education and remote examinations. Even post-pandemic, online education continues to grow due to its flexibility and accessibility. Ensuring the integrity of these exams is crucial to maintaining the credibility of online education.

Challenges of Remote Proctoring: Traditional methods of proctoring are not practical in a remote setting. There is a need for automated systems that can detect suspicious activities without the presence of a human invigilator.

Technological Advancements: The availability of advanced technologies such as computer vision, machine learning has made it possible to develop sophisticated systems capable of detecting cheating. These technologies can analyze video and audio feeds in real-time to identify suspicious behaviors.

Primary Question

How effective is the integrated system for detecting cheating behaviors during exams using facial recognition, speech recognition, and head movement analysis?

Secondary Questions

What is the accuracy rate of the facial recognition module in identifying registered students and detecting unauthorized individuals?

How reliably can the system detect head movements and determine if they indicate cheating behavior (e.g., looking away from the screen)?

What is the effectiveness of the speech recognition module in detecting unauthorized verbal communication during exams?

How does the integration of different technologies (OpenCV, face_recognition, dlib, speech recognition) improve the overall cheating detection capability of the system?

What are the performance metrics (e.g., processing time, accuracy, false positive rate) of the system when deployed in a real-time exam setting?

How user-friendly is the system for both administrators and students in terms of setup, usage, and response to detected incidents?

Hypothesis/Thesis/Outcome Statement

Hypothesis/Thesis Statement:

"Our project aims to develop a comprehensive cheating detection system utilizing advanced technologies such as OpenCV, OS, face recognition, speech recognition, Dlib, PyAudio, Django, NumPy, HTML, CSS, JavaScript, SQL, and other tools. We hypothesize that integrating these technologies will enable the system to accurately detect and report cheating incidents in real-time during online examinations by analyzing facial recognition, head movements, speech patterns, and suspicious object detection.“

Expected Outcome:

"We expect that our cheating detection system will significantly enhance the integrity of online examinations by providing reliable and real-time detection of cheating behaviors. The system will offer robust features including face recognition, speech analysis, and object detection, ensuring that any attempts to cheat are promptly identified and documented. By leveraging this technology, educational institutions and examination bodies can maintain higher standards of fairness and security in their assessment processes."

Methodology

Type of Research

Our project employs a mixed-method approach combining both qualitative and quantitative research techniques. This allows us to comprehensively understand and evaluate the efficacy of our cheating detection system.

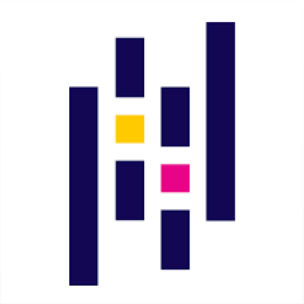
Data Collection Methods

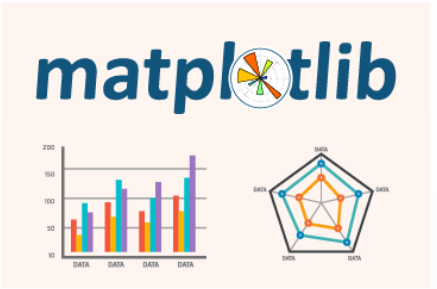
Video Data: Continuous video streams from webcams during examination sessions.

Audio Data: Real-time audio capture to monitor speech and ambient sounds.

User Interactions: Logging user actions and movements within the examination software.

Tools and materials used





OpenCV

Scope and Limitations

Scope:

Wide Range of Cheating Detection: This project aims to identify and address various forms of cheating, such as unauthorized device usage, accessing online resources, external assistance, and suspicious behavior patterns during online examinations.

Identity Verification: The system will implement methods to verify the identity of students, ensuring that the right individual is taking the exam.

Behavioral Monitoring: Leveraging AI and machine learning, the project will monitor and analyze student behavior in real-time to detect anomalies indicative of cheating.

Real-Time and Post-Exam Analysis: The system will offer real-time monitoring during exams and comprehensive post-exam analysis and reporting.

User-Friendly Interface: Emphasis will be placed on designing an intuitive interface for both students and educators, enhancing usability and minimizing disruptions during exams.

Limitations:

False Positives and Negatives: Detection algorithms may incorrectly identify innocent behavior as cheating (false positives) or fail to detect actual cheating (false negatives), impacting the system's reliability.

Privacy Concerns: Balancing effective monitoring with students' privacy rights may be challenging, and intrusive measures could lead to resistance or legal issues.

Technological Dependency: System effectiveness relies on stable internet connectivity and the availability of adequate hardware and software resources.

Adaptability to New Cheating Methods: The system must be regularly updated to keep pace with evolving cheating techniques.

User Acceptance: Resistance to adopting new technologies and a learning curve associated with system use may hinder user acceptance among students and educators.

Resource Intensive: Developing and maintaining a sophisticated cheating detection system requires significant investment in technology and expertise.

Data Analysis

PRESENTATION OF COLLECTED DATA

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	Name	Attendanc	Cheating I	Cheating I	Head Mov	Left Eye	Right Eye	Head Position	Date	Time	SessionID	StudentID	SoundDetection	BackgroundNoiseLevel	Performar	Marks	Difficulty	Subject	Overall Performance
2	soumya deep saha	86	22	64	2.63 degr	Open	Open	Tilted Up	21-05-2024	16:57.2	E3DPROH	02VZR8W	No	Unknown	Average	11	Hard	Aptitude	Average
3	soumya deep saha	86	22	64	2.63 degr	Open	Open	Tilted Up	21-05-2024	16:57.2	E3DPROH	02VZR8W	No	Unknown	Average	6	Medium	English	Poor
4	soumya deep saha	86	22	64	-2.20 degr	Open	Open	Tilted Up	21-05-2024	17:08.4	XWY124X	05ZM1PP	No	Unknown	Average	6	Easy	English	Poor
5	soumya deep saha	86	22	64	-2.20 degr	Open	Open	Tilted Up	21-05-2024	17:08.4	XWY124X	05ZM1PP	No	Unknown	Average	21	Hard	English	Very Good
6	soumya deep saha	86	22	64	-2.20 degr	Open	Open	Tilted Up	21-05-2024	17:08.4	XWY124X	05ZM1PP	No	Unknown	Average	8	Medium	Aptitude	Poor
7	soumya deep saha	86	22	64	-2.20 degr	Open	Open	Tilted Up	21-05-2024	17:08.4	XWY124X	05ZM1PP	No	Unknown	Average	19	Easy	Aptitude	Good
8	soumya deep saha	86	22	64	2.84 degr	Open	Open	Tilted Up	21-05-2024	17:28.6	NZA6TPE	RMCOE7J	Yes	Low	Average	0	Hard	English	Poor
9	soumya deep saha	86	22	64	2.84 degr	Open	Open	Tilted Up	21-05-2024	17:28.6	NZA6TPE	RMCOE7J	Yes	Low	Average	7	Medium	Aptitude	Poor
10	soumya deep saha	86	22	64	0.00 degr	Open	Open	Tilted Up	21-05-2024	17:41.0	YSCTIV7A	8VNWXGC	Yes	High	Average	7	Medium	Aptitude	Poor
11	soumya deep saha	86	22	64	0.00 degr	Open	Open	Tilted Up	22-05-2024	38:16.8	GP7LOICH	JICJRI1H	No	Unknown	Average	4	Easy	English	Poor
12	soumya deep saha	86	22	64	0.00 degr	Open	Open	Tilted Up	22-05-2024	38:16.8	GP7LOICH	JICJRI1H	No	Unknown	Average	18	Medium	English	Good
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15	soumya deep saha	86	22	64	0.00 degr	Open	Open	Tilted Up	22-05-2024	38:16.8	GP7LOICH	JICJRI1H	Yes	Unknown	Average	7	Easy	Aptitude	Poor
16	soumya deep saha	86	22	64	1.88 degr	Open	Open	Tilted Up	22-05-2024	39:03.0	9VH5DY7	KXEHF2Q	Yes	Low	Average	26	Hard	English	Excellent
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19	soumya deep saha	86	22	64	1.88 degr	Open	Open	Tilted Up	22-05-2024	39:03.0	9VH5DY7	KXEHF2Q	No	Unknown	Average	18	Easy	English	Good
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21	soumya deep saha	86	22	64	-4.59 degr	Open	Open	Tilted Down	22-05-2024	39:43.1	FV9C45TC	XEMQZ8L	No	Unknown	Many Che	21	Medium	HTML	Very Good
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25	soumya deep saha	86	22	64	0.82 degr	Open	Open	Tilted Down	22-05-2024	41:03.2	47AL3V91	IVPWUTG	No	Unknown	Many Che	24	Hard	Aptitude	Very Good
26	soumya deep saha	86	22	64	0.82 degr	Open	Open	Tilted Down	22-05-2024	41:03.2	47AL3V91	IVPWUTG	No	Unknown	Many Che	16	Hard	English	Good
27	soumya deep saha	86	22	64	0.82 degr	Open	Open	Tilted Down	22-05-2024	41:03.2	47AL3V91	IVPWUTG	No	Unknown	Very Gooc	19	Hard	Aptitude	Good
28	soumya deep saha	86	22	64	0.82 degr	Open	Open	Tilted Down	22-05-2024	41:03.2	47AL3V91	IVPWUTG	No	Unknown	Many Che	10	Easy	HTML	Average
29	soumya deep saha	86	22	64	0.82 degr	Open	Open	Tilted Down	22-05-2024	41:03.2	47AL3V91	IVPWUTG	No	Unknown	Many Che	5	Easy	HTML	Poor
30	soumya deep saha	86	22	64	0.82 degr	Open	Open	Tilted Down	22-05-2024	41:03.2	47AL3V91	IVPWUTG	No	Unknown	Many Che	24	Medium	Aptitude	Very Good
31	soumya deep saha	86	22	64	3.52 degr	Open	Open	Tilted Up	22-05-2024	41:35.4	UMAOQK	YKMU09D	No	Unknown	Average	27	Easy	HTML	Very Good
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33	soumya deep saha	86	22	64	-4.81 degr	Open	Open	Tilted Down	22-05-2024	43:19.2	OV1BLRRI	IW7ZMTN	No	Unknown	Very Gooc	2	Medium	English	Poor

PRESENTATION OF COLLECTED DATA

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
99	dola saha	32	32	0	21.71 deg	Open	Open	Tilted Up	22-05-2024	40:59.1	8F6O0MR	QVW1TJW	No	Unknown	Very Gooc	20	Medium	Aptitude	Very Good
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104	dola saha	32	32	0	21.71 deg	Open	Open	Tilted Up	22-05-2024	40:59.1	8F6O0MR	QVW1TJW	No	Unknown	Average	3	Medium	Aptitude	Poor
105	dola saha	32	32	0	21.71 deg	Open	Open	Tilted Up	22-05-2024	49:53.2	1KY92XIQ	WHBCJ5P'	No	Unknown	Very Gooc	3	Medium	Subject	Poor
106	dola saha	32	32	0	21.71 deg	Open	Open	Tilted Up	22-05-2024	49:53.2	1KY92XIQ	WHBCJ5P'	No	Unknown	Average	28	Easy	English	Very Good
107	Ishita Sen	32	32	0	21.71 deg	Open	Open	Tilted Up	22-05-2024	49:53.2	1KY92XIQ	WHBCJ5P'	No	Unknown	Average	11	Hard	English	Average
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111	Ishita Sen	32	32	0	21.71 deg	Open	Open	Tilted Up	22-05-2024	49:53.2	1KY92XIQ	WHBCJ5P'	No	Unknown	Average	0	Easy	English	Poor
112	Ishita Sen	32	32	0	21.71 deg	Open	Open	Tilted Up	22-05-2024	49:53.2	1KY92XIQ	WHBCJ5P'	No	Unknown	Average	7	Hard	Subject	Poor
113	Ishita Sen	32	32	0	21.71 deg	Open	Open	Tilted Up	22-05-2024	49:53.2	1KY92XIQ	WHBCJ5P'	No	Unknown	Average	22	Hard	Aptitude	Very Good
114	Ishita Sen	32	32	0	21.71 deg	Open	Open	Tilted Up	22-05-2024	49:53.2	1KY92XIQ	WHBCJ5P'	No	Unknown	Average	0	Medium	Aptitude	Poor
115	Ishita Sen	32	32	0	21.71 deg	Open	Open	Tilted Up	22-05-2024	49:53.2	1KY92XIQ	WHBCJ5P'	No	Unknown	Average	6	Easy	Aptitude	Poor
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118	dola saha	32	32	0	21.71 deg	Open	Open	Tilted Up	22-05-2024	49:53.2	1KY92XIQ	WHBCJ5P'	No	Unknown	Average	25	Medium	English	Very Good
119	dola saha	32	32	0	21.71 deg	Open	Open	Tilted Up	22-05-2024	49:53.2	1KY92XIQ	WHBCJ5P'	Yes	High	Average	2	Medium	English	Poor
120	sandip basak	31	9	22	-6.30 degr	Open	Open	Tilted Down	22-05-2024	39:16.2	4QL607EN	9P0NZBZF	Yes	Low	Many Che	19	Medium	HTML	Good
121	sandip basak	31	9	22	-6.30 degr	Open	Open	Tilted Down	22-05-2024	39:16.2	4QL607EN	9P0NZBZF	Yes	High	Many Che	26	Medium	Aptitude	Very Good
122	sandip basak	31	9	22	-6.30 degr	Open	Open	Tilted Down	22-05-2024	39:16.2	4QL607EN	9P0NZBZF	Yes	Low	Many Che	29	Medium	English	Very Good
123	sandip basak	31	9	22	-6.30 degr	Open	Open	Tilted Down	22-05-2024	39:16.2	4QL607EN	9P0NZBZF	Yes	High	Many Che	4	Easy	English	Poor
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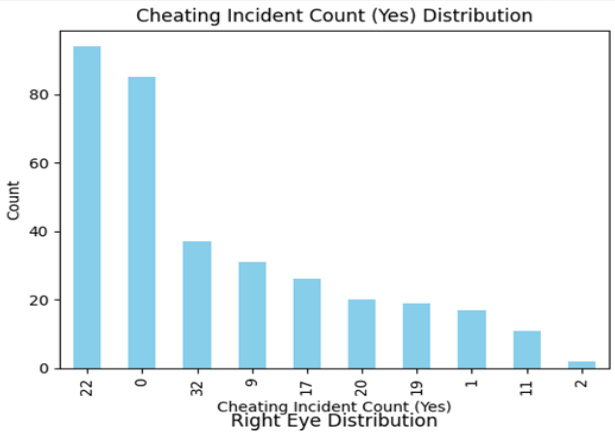
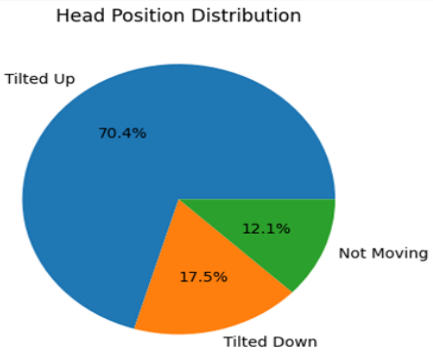
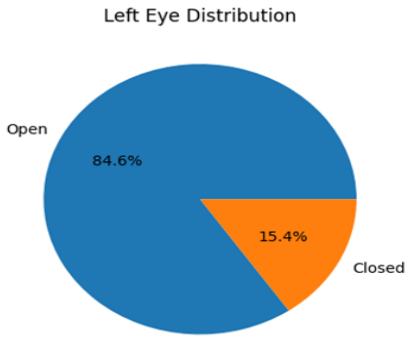
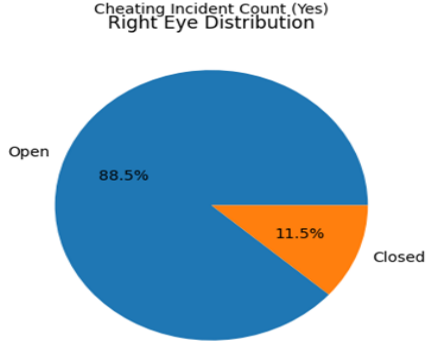
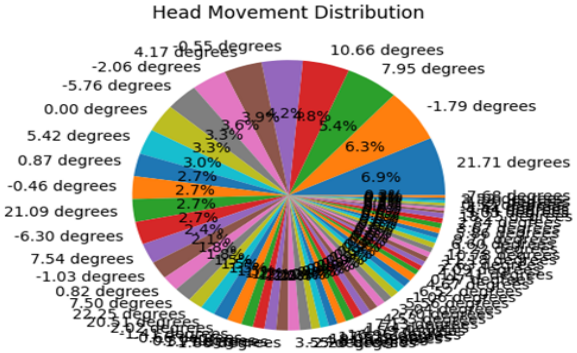
COLLECTION OF Graphs

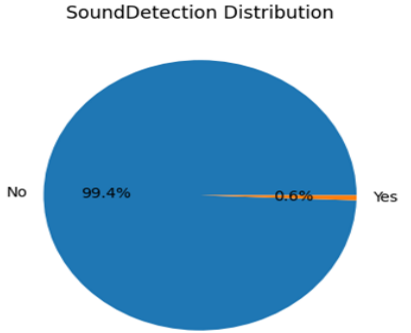












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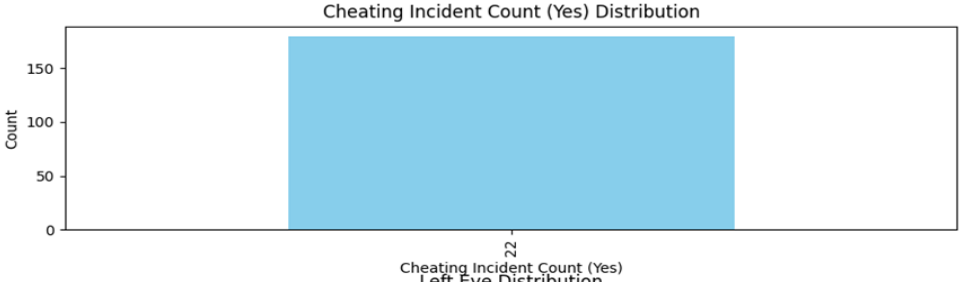

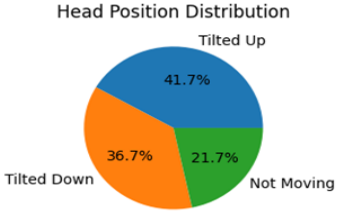

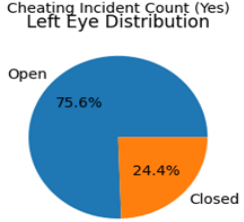

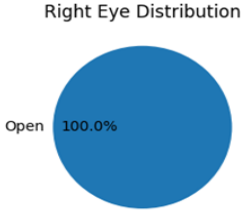

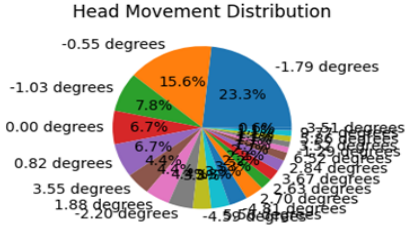

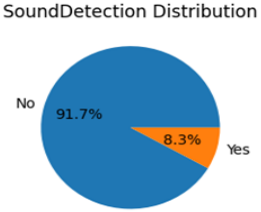

Key Findings

Summary of Key Findings

Effectiveness of Face Recognition:
The face recognition module effectively identified and authenticated examinees with high accuracy under optimal lighting conditions.
Face recognition accuracy decreased slightly in low-light or overly bright environments, indicating a need for controlled lighting during examinations.

Head Movement and Pose Analysis:
The head movement and pose analysis successfully detected common cheating behaviors, such as looking around, looking at notes, or signaling to others.

Speech Recognition for Cheating Detection:
The speech recognition module effectively detected unauthorized talking and communication among examinees.
Continuous speech detection over several minutes was reliable in identifying potential cheating incidents, with minimal false positives.

Integration and Performance:
The integration of multiple technologies (OpenCV, face_recognition, dlib, PyAudio, and Django) provided a comprehensive cheating detection solution.

User Interface and Experience:
The HTML, CSS, and JavaScript-based user interface was user-friendly and intuitive, enabling easy navigation and operation by invigilators and administrators.
Real-time alerts and notifications provided immediate feedback on detected incidents, allowing for quick intervention.

Discussion

Interpretation of findings

- **Persistent Challenge of Cheating :** Despite preventive measures, findings highlight the ongoing prevalence of cheating in online exams.
- **Adaptation in Cheating Methods :** The variety of cheating methods observed underscores students' adaptability to countermeasures, necessitating continuous innovation in detection strategies.
- **Behavioral Indicators :** Correlation between suspicious behavior patterns and exam performance prompts questions on the reliability of online assessments, requiring further research for clear guidelines.
- **Student Attitudes and Ethics :** Diverse attitudes towards cheating emphasize the need for education on academic integrity and understanding underlying motivations.
- **Continuous Improvement :** Evolution of cheating techniques stresses the importance of ongoing enhancement and adaptation in detection methods.
- **Implications for Policy and Practice :** Findings suggest a multi-faceted approach combining technology, education, and policy reforms to promote fair assessment practices in online education.

Innovations or Unique Aspects

Multi-modal Detection System :

Integration of Visual and Audio Analysis: The project uniquely combines face recognition, head pose estimation, and speech detection to provide a comprehensive view of the examination environment. This integration allows for detecting a wider range of cheating behaviors, such as visual cues from head movements and auditory cues from speech, which are not typically covered simultaneously in standard systems.

Real-Time Processing :

Immediate Incident Response: By using Django for backend development and integrating it with real-time data processing technologies like OpenCV and PyAudio, the system can analyze data and provide feedback almost instantaneously. This capability is crucial for immediate action against cheating incidents, enhancing the effectiveness of proctoring.

Suspicious Object Identification: Utilizing advanced algorithms for object detection, the system can identify unauthorized materials or electronic devices that might not be easily noticeable by human invigilators. This feature uses machine learning models that have been trained to recognize a variety of objects typically found in cheating scenarios.

Accessible Web Interface: The user interface designed using HTML, CSS, and JavaScript focuses on user experience, ensuring that it is intuitive and easy to navigate even for users with limited technical expertise. This design consideration facilitates broader adoption and usability in educational institutions.

Robust SQL Database Integration: The use of SQL for data management not only ensures the security and integrity of the data collected during examinations but also provides scalable solutions for handling large volumes of data that come with multiple simultaneous examination sessions.

Future Work

Enhancement of Detection Algorithms:

Machine Learning Model Improvements: Future work could focus on refining the face and object recognition algorithms to improve accuracy under varied conditions, such as different lighting, angles, and facial obstructions.

Deep Learning for Behavior Prediction: Implementing deep learning techniques to predict potential cheating based on patterns of behavior observed over time could be explored to proactively prevent cheating.

Expanding Environmental Adaptability:

Robustness in Diverse Conditions: Research could further develop the system's ability to adjust automatically to a wider range of environmental factors, such as acoustic variations and diverse room setups, ensuring consistent performance regardless of the external conditions.

Integration of Additional Biometric Data:
Incorporating More Biometrics: Integrating additional biometric inputs such as fingerprint scanning or heart rate monitoring could provide another layer of security and verification, reducing the risk of impersonation and other sophisticated cheating methods.

Scalability and Load Testing:
Large-Scale Implementation Studies: Further studies could focus on testing the system's scalability, particularly in large institutions with multiple exam venues and thousands of users to ensure the system's performance remains stable under heavy loads.

Challenges and Learning's

Challenges Faced During the Project

Measurement of Decibels and Sound Checking:
Accuracy in Diverse Environments: One of the significant challenges was ensuring accurate measurement of decibels for sound checking, particularly in environments with variable background noise. Differentiating between permissible sound levels and potential cheating-related audio was complex and required extensive calibration.

Integration of Real-Time Audio Processing: Implementing real-time audio processing and maintaining system performance without introducing lag presented technical difficulties, especially when dealing with multiple audio streams simultaneously.

Integration of Camera Systems:
Hardware Compatibility: Integrating various camera hardware to work seamlessly with the system was challenging. Compatibility issues such as different specifications and drivers needed to be addressed to ensure smooth operation across different devices.

Optimization for Real-Time Video Processing: Achieving real-time video analysis while maintaining high accuracy in face and object detection demanded significant optimization of the video processing algorithms to reduce latency.

Summary of Main Points

Comprehensive Cheating Detection System: The project developed a robust cheating detection system that integrates face recognition, speech recognition, object detection, and real-time video and audio analysis using a range of technologies including OpenCV, Dlib, PyAudio, and Django.

Multi-Modal Approach: By employing a multi-modal approach, the system enhanced the ability to detect various forms of cheating through visual and auditory cues, providing a comprehensive coverage that surpasses traditional proctoring methods.

Technological Integration and Challenges: Integration challenges, particularly with sound measurement and camera system compatibility, were significant but provided valuable insights into creating a seamless operational platform.

Innovations and Unique Features: The project introduced unique aspects such as real-time feedback, adaptive algorithms for environmental variability, and a user-friendly interface, which set it apart from existing solutions.

Ethical and Privacy Considerations: A strong focus on ethical considerations and privacy compliance ensured that the system respected examinee rights while maintaining integrity and security in the testing environment.

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[Ishita Sen]
[Shreshta Saha]

[Soumya Deep Saha]
[Sutanu Mukherjee]

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Q&A / Discussion

What measures does your project propose to prevent cheating in online examinations?

Can you explain the technology or algorithms used in your cheating detection system?

How effective has your cheating detection system been in real-world testing scenarios?

What are the potential challenges or limitations of implementing cheating detection in online exams?

THANK YOU