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AI-Based Smart Online Proctoring System for Real-Time Malpractice Detection in Remote Examinations

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Abstract: ***The rapid adoption of online education has introduced serious concerns regarding fairness and academic integrity in remote examinations. This work presents a smart AI-enabled proctoring system that performs continuous monitoring of candidates using video, audio, and behavioral signals. The proposed approach is based on a multi-modal fusion strategy that combines outputs from different detection modules into a unified fraud assessment score. The system identifies suspicious patterns such as impersonation, presence of additional individuals, usage of unauthorized devices, abnormal head movement, and irregular audio activity. Experimental evaluation demonstrates an overall accuracy of 94% along with real-time processing performance of 30 frames per second, making the system suitable for scalable deployment.***
Keywords: Artificial Intelligence, Proctoring, Online tests, Cheating Detection.

I. PROBLEM STATEMENT

Traditional invigilation methods are not feasible in online settings, leading to increased chances of malpractice. There is a clear need for an automated and intelligent monitoring system that can observe student behavior remotely and flag suspicious activities for further review. The increasing omnipresence of online assessments posesboth challenges and benefits to the students, workforce, andacademic institutions. Geographical distances and time zones are nolonger limitations on students taking tests, as examinations can nowbe held virtually anywhere in the world provided there is an Internetconnection along with the appropriate software. Therefore, the plan isto design an artificial intelligence-based system which will help in keepingtrack of the student through their webcam and microphone. In doing so, the teacher will be able to check multiple students simultaneously. TheAI system should also have the capacity to track any sort of misconduct.Any logs regarding such conduct may be used in order to manually check the student in case of any doubts. Furthermore, the system should ensurethat the tests can be taken despite any possible interruptions in form of power cuts.

II. INTRODUCTION

The advancement of digital technology has revolutionized the education sector, enabling students to access learning resources remotely. Online examinations have become increasingly popular due to their flexibility and accessibility. However, ensuring fairness and preventing malpractice in such examinations remains a critical concern.Unlike traditional classroom environments, online exams lack direct supervision, making it easier for candidates to engage in dishonest practices such as consulting external resources, collaborating with others, or impersonation. This has led to a growing demand for intelligent systems that can simulate real-time invigilation. Artificial Intelligence (AI) plays a crucial role in addressing this issue. By leveraging computer vision and machine learning, AI-based proctoring systems can monitor candidates continuously and detect suspicious behavior automatically. These systems not only improve accuracy but also reduce the burden on human invigilators.This paper proposes an advanced AI-based proctoring system capable of detecting multiple forms of malpractice while ensuring scalability and efficiency.

III. LITERATURE REVIEW

In [1], Yahya et al. proposed an AI-enabled proctoring system that integrates computer vision techniques for real-time monitoring of candidates. Their work highlights the importance of scalability and automation in large-scale online examinations, while also addressing challenges related to system performance and deployment.In [2], V.K. Pant introduced an AI-driven proctoring model that focuses on improving fairness in online assessments. The study emphasizes the use of machine learning techniques to detect suspicious behavior and suggests the implementation of scoring mechanisms to evaluate potential malpractice cases.

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In [3], Heinrich presented a comprehensive review of modern online proctoring technologies. The study discusses various approaches such as facial recognition, gaze tracking, and behavioral analysis, and identifies key limitations including privacy concerns, system bias, and lack of standardization.

In[4], T. Singh developed an automated proctoring system using deep learning techniques for real-time monitoring. The system demonstrates improved accuracy in detecting anomalies but also highlights the trade-off between computational complexity and real-time performance.In [5], A. Tweissi et al. analyzed the accuracy of AI-based proctoring systems and evaluated their effectiveness in identifying cheating behaviors. The study concludes that AI significantly enhances detection.In[6], S. S. Iyengar and R. R. Brooks present a comparative analysis of existing online proctoring systems. The study emphasizes the importance of implementing clear rules and policies to ensure exam security. It highlights that institutions must communicate guidelines effectively to students and provide transparent information regarding monitoring practices and consequences of violations. Additionally, the paper stresses the importance of securing collected data to prevent hacking or misuse. It also suggests providing proper reporting mechanisms, including anonymous channels, to report malpractice and maintain trust in the system.

In [7], A. Ullah and S. Khan proposed a secure web-based examination system using artificial intelligence. Their research focuses on enhancing system security and preventing unauthorized access, thereby ensuring the integrity of the examination process. In [8], J. Moten Jr., A. Fitterer, E. Brazier, and J. Leonard discuss the rapid rise of academic dishonesty in online education environments. Over the past decade, the ease of accessing digital platforms has made it simpler for students to engage in unethical practices. With just a few clicks, students can find services that assist in writing assignments, completing coursework, or even taking entire exams on their behalf. While online learning has helped institutions expand their reach and increase enrollment, it has also led to the growth of such dishonest support systems. This creates a major challenge for educators and administrators in maintaining academic integrity across both online and traditional learning environments. In [9], H. M. Alessio, N. Malay, K. Maurer, A. J. Bailer, and B. Rubin analyzed the difference in student performance between proctored and non-proctored online examinations. The study, conducted on a group of students across multiple course sections, reveals that students under monitored conditions tend to score lower and spend less time on exams compared to those who are not supervised. This significant variation suggests the presence of unfair practices in un-proctored environments. The research also highlights inconsistencies in performance across different sections of the same course, further emphasizing the need for reliable proctoring systems to ensure fairness and consistency.

From the literature, it is observed that existing systems either lack real-time performance, multi-modal integration, or scalability. The proposed system addresses these gaps by combining multiple AI techniques into a unified framework.

IV. PROPOSED METHODOLOGY

Online examinations present significant challengesin maintaining fairness and preventing malpractice due to the absence of physical supervision. To tackle this problem, the suggested system employs Artificial Intelligence (AI) and computer vision methods to observe and evaluate student behavior during online exams.

The system captures real-time video and audio data using the student's webcam and microphone. These inputs are processed using multiple AI models to detect suspicious activities such as identity fraud, multiple face presence, mobile phone usage, tab switching, and abnormal audio patterns.By automating the monitoring process, the proposed system reduces dependency on human invigilators and improvesthe efficiency, scalability, and reliability of online examinations.

A. Dataset

The model is developed using a mix of open-source datasets and self-collected samples. Public datasets such as COCO are used for object detection, while face datasets are used for identity verification. Additionally, custom webcam recordings were collected to simulate real examination conditions. The dataset consists of approximately 10000 samples with an 80:20 training and testing split.

Face recognition is trained using facial image datasets under different lighting conditions and angles.Object detection models are trained using datasets containing common objects such as mobile phones and multiple people. Additional real-time data is collected using webcam recordings to simulate examination scenarios. These datasets help the system learn patterns of normal and suspicious behavior.

The experiments were conducted on a system with an Intel Core i3 processor and 8 GB RAM to evaluate the performance of the proposed model.

B. Data Preprocessing

The collected data is preprocessed to improve the accuracy and efficiency of the system. Noise reduction techniques such as filtering are applied to remove unwanted disturbances from video and audio inputs.

Image frames are resized and normalized before being passed to the detection models. Face images are converted to grayscale for efficient processing in the LBPH algorithm.

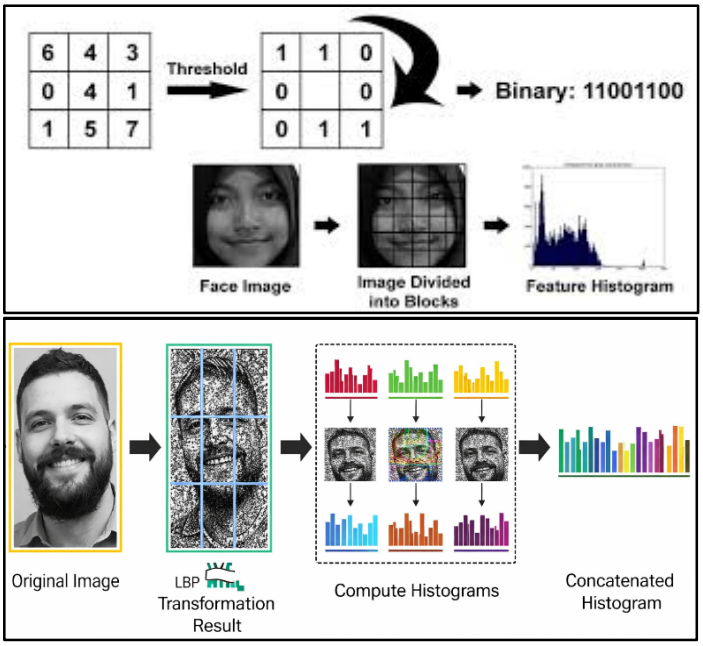
Audio signals are processed to remove background noise and extract relevant frequency features. This preprocessing step ensures reliable detection under different environmental conditions.

C. Malpractice Detection using AI Models

The proposed system integrates multiple AI models to detect different types of malpractice during examinations.

1) Face Recognition (LBPH):

The system verifies the identity of the student using the Local Binary Pattern Histogram (LBPH) algorithm. Continuous face-matching ensures that the same student is present throughout the examination.



2) Object Detection (YOLO):

YOLOv8 (You Only Look Once) is capable of classifying 80 objects, and it works superfast. It consists of 53 convolutional layers, and after each of them, there is a batch normalization layer and Leaky RELU. The YOLOv8 model is used to detect unauthorized objects like mobile phones and multiple persons in the scene. Detection is done in real time, and there is high accuracy in doing so. YOLO has been selected because of its ability to detect unauthorized objects in real time with accuracy. In comparison to other traditional techniques, it processes an image in one pass only.

3) Tab-Switching Detection:

Browser activity is monitored to detect tab switching during the examination. Any switching event is considered suspicious and logged.

4) Audio Detection:

The system analyzes audio input from the microphone to detect abnormal sound patterns such as conversations or external assistance.

These modules work together to provide comprehensive monitoring of student behavior.

D. Proposed Detection Model

The proposed system uses a hybrid AI approach combining computer vision and audio analysis techniques. The detection process involves analyzing input data and identifying suspicious activities using trained models.

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The detection process can be mathematically represented as:
D = f(Input Data, AI Models)
or when can say,
Fraud Score = w1(Face) + w2(Object) + w3(Audio) + w4(Tab)
where the system processes video frames and audio signals to detect anomalies and generate alerts. During execution, the system continuously captures input data and applies detection models in real time. If any suspicious activity is detected, it is logged into the database along with timestamps for further verification. If Fraud Score exceeds a predefined threshold, the activity is marked as suspicious.

E. Algorithm
Step 1: Capture real-time video and audio streams
Step 2: Extract frames and perform face verification
Step 3: Detect objects using YOLO
Step 4: Analyze audio signals for anomalies
Step 5: Monitor browser activity
Step 6: Compute fraud score
Step 7: Log suspicious events with timestamps

Environment Description
The system environment simulates an online examination scenario where students appear for tests using a web-based platform.
The input to the system consists of real-time video and audio streams captured through a webcam and microphone. The AI models process this data and generate outputs in the form of:

- Bounding boxes for detected objects (e.g., mobile phones, multiple faces)
- Alerts for tab switching
- Audio anomaly detection

All detected activities are stored in a centralized database and displayed on an admin dashboard for monitoring and evaluation.This environment enables efficient, real-time monitoring of students and ensures secure and fair examination processes.

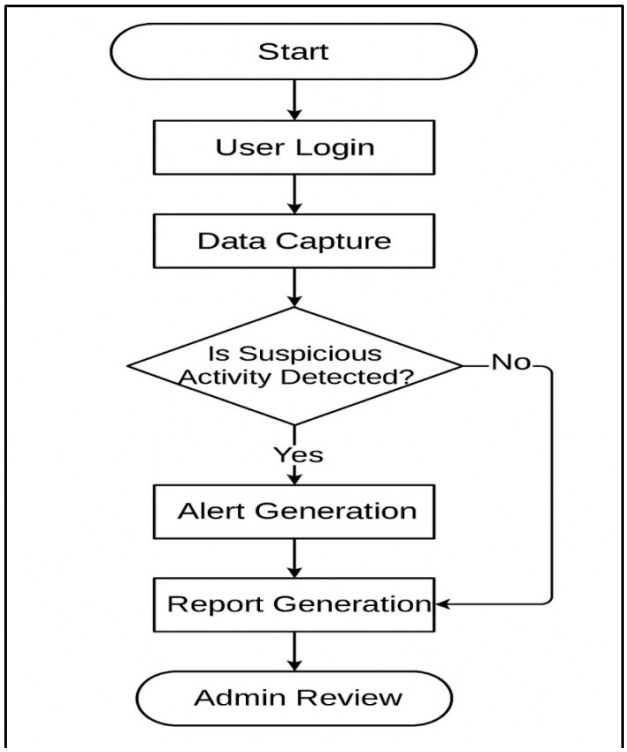


Fig. 1 Control Flow Diagram of Proposed System

Fig.1 The control flow diagram illustrates the sequence of operations in the AI-Based Online Exam Proctoring System. It begins with user login and data captured through webcam,microphone and screen monitoring. The system continuously analyzes the data using AI algorithms to detect any suspicious activities. If any irregular behavior is identified, an alert is generated, and the event is logged for review. After the exam, the system generates a report summarizing all detected activities, which is then reviewed by the administrator for evaluation.

V. METHODOLOGY USED

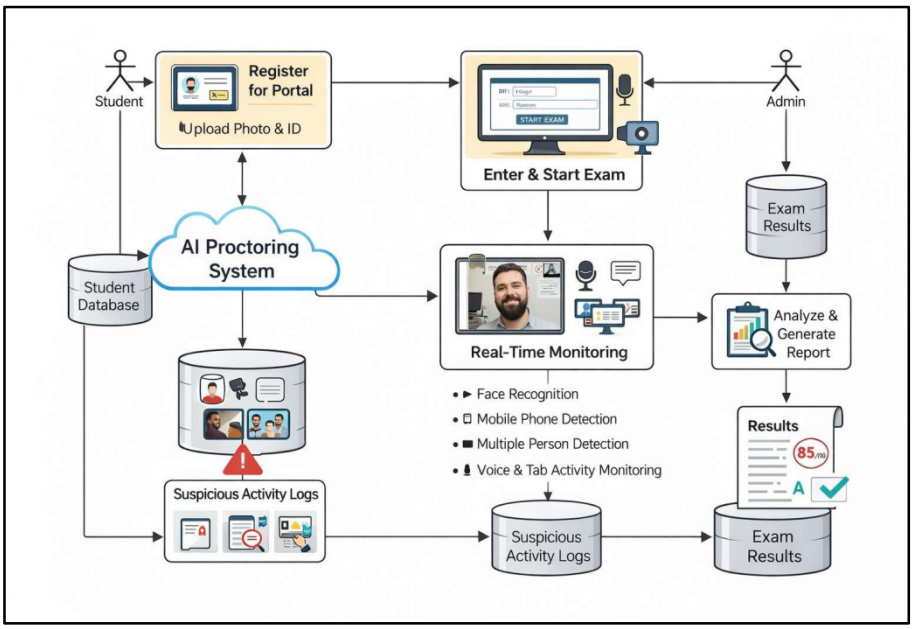


Fig.2 System Methodology

1) Student's registration on the platform is based on theregistration of their personal information and face images.
2) Exam registration along with the latest face images,which will be compared to the face images stored on theDB.
3) Launch of the proctoring system upon starting ofthe exam by the student.
4) Monitoring of any tab switching performed duringthe exam.
5) Taking snapshots from the webcam in intervals ofevery ten seconds to compare to the previous exam'sface image. If there isn't any match, then it should be logged.
6) Checking for multiple faces or lack thereof on the screenwill be recorded.
7) Monitoring for the presence of multiple voices.
8) Tracking head movement will be implemented for exams,which do not need pens or paper.
9) Any kind of fraudulent activity registered in the logwill lead to disqualification.
10) In case of an appeal, the logs will be analyzed manually,Students will be offered the opportunity to make their case for manual verification wherein the logs will be manually verified in order to confirm the validity of the claim.

VI. RESULTS AND DISCUSSION

The proposed AI-based online proctoring system was evaluatedusing a combination of publicly available COCO datasets and real-timewebcam recordings simulating online examination scenarios. Thedataset includes facial images, multiple face instances, mobile phone usage cases, and audio samples representing normal and suspicious activities.

The experiments were conducted on a Windows-based system equipped with an Intel Core i3 processor and 8 GB of RAM. It successfully identifies multiple faces, mobile phone usage, tab switching, and abnormal head movements in real time.

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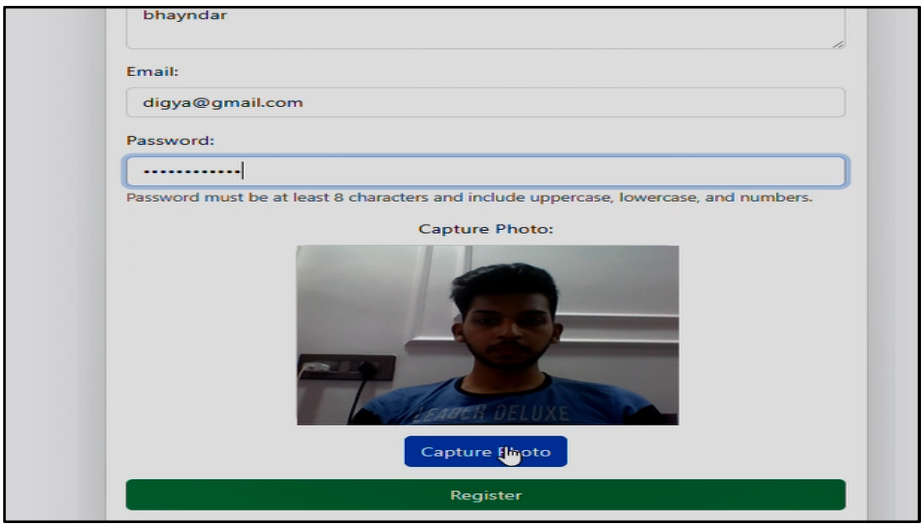


Fig.3Registerfortest

Fig.3 shows the registration form for each test, personal details like email id, password, address and the photo is taken at the time of registration.

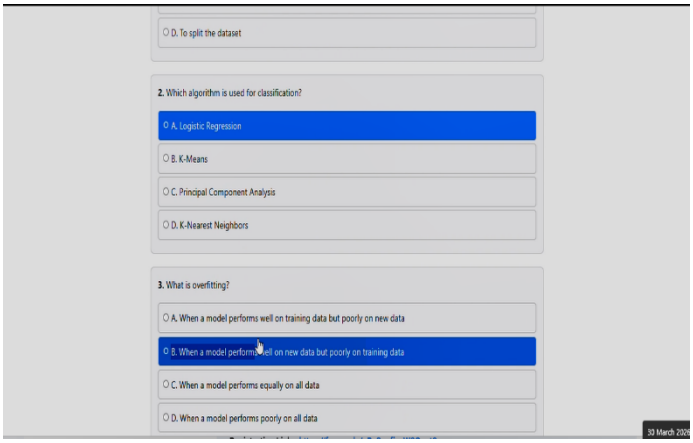


Fig. 4Testscreen

Fig.4 shows the test screen with photos of the student taken in the background



Fig.5Tabswitchpop up

Fig.5showsawarningwhentheuserswitchesthetaband logs the activity



Fig6.Multiplefacesdetected

Fig6.showsthatmorethanonepersonisgivingtheexam and logs it as malpractice

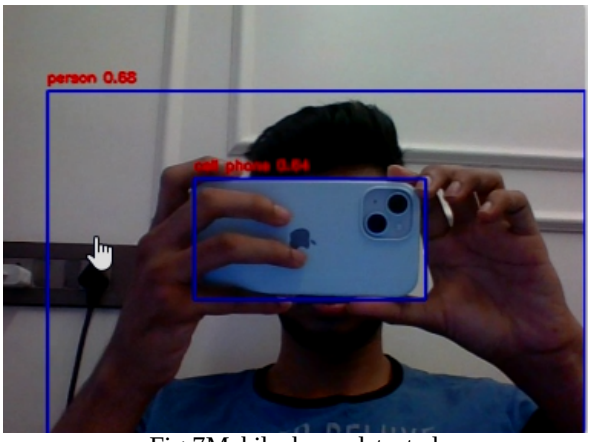


Fig.7Mobilephone detected

Fig.7showsthatastudentisusingamobilephoneduring the examination and logs it as malpractice

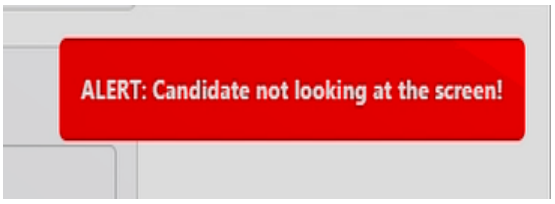


Fig.8Live alerts

Fig. 8 showsthatastudentis lookingoutsidethecomputer screen and logs it as malpractice.

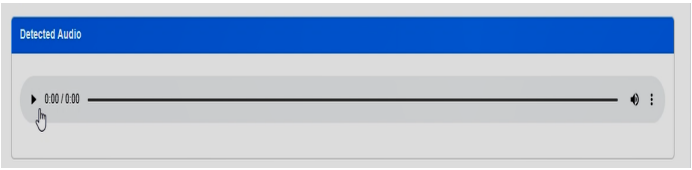


Fig. 9Audio Detected

Fig 9. shows that Audio is detected during the examination

Table I. Detection Accuracy Comparison

Model/System	Accuracy (%)
ManualMonitoring	70
Basic AI Model	80
YOLO-based System	90
Proposed System	94

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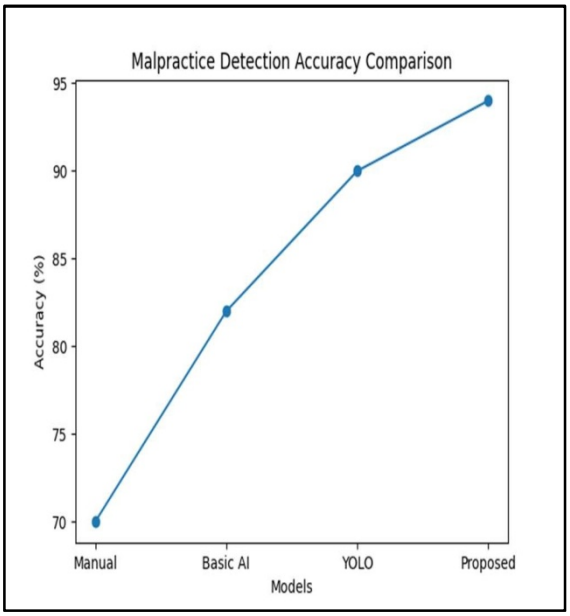


Fig. 10 Accuracy Graph

Table I and Fig.10, shows the comparison of detection accuracy among different monitoring approaches. Traditional manual monitoring achieves lower accuracy due to human limitations and lack of continuous attention. Basic AI models improve performance; however, they lack multi-modal detection capabilities. The YOLO-based system provides better results due to real-time object detection. The proposed system achieves the highest accuracy of 94% by integrating multiple AI modules such as face recognition, object detection, and audio analysis, making it highly reliable for detecting malpractice in online examinations.

Table II. Detection Speed (Frames per Second)

Model/System	Speed (FPS)
Manual Monitoring	2
Basic AI Model	15
YOLO-based System	28
Proposed System	30

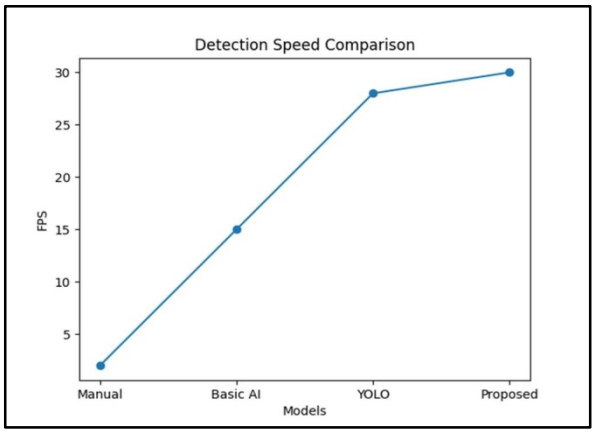


Fig.11 Detection Speed Comparison

Table II and Fig.11, illustrates the detection speed comparison in terms of frames per second (FPS). Detection speed is a critical factor for real-time proctoring systems. Manual monitoring is extremely slow, while AI-based models significantly improve speed. The proposed system achieves the highest processing speed of 30 FPS, enabling real-time monitoring and quick detection of suspicious activities during online examinations.

Table III. Computational Complexity

Model/System	Time (ms)
Basic AI Model	250
YOLO-based System	100
Proposed System	85

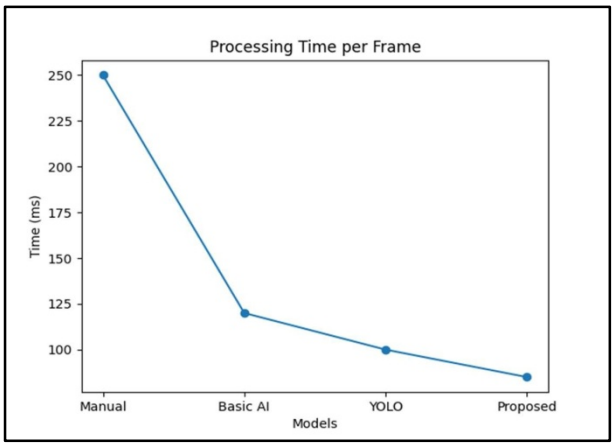


Fig. 12 Processing Time per Image

Table III and Fig. 12 depicts the time required for different models to analyze each frame. The traditional approach requires more processing time because of inefficient feature extraction. However, Deep Learning models like YOLO significantly minimize processing time. The proposed model takes the minimum processing time of 85ms, ensuring quick responses and efficient real-time monitoring.

	Predicted Fraud	Predicted Normal
Actual Fraud	94	6
Actual Normal	7	93

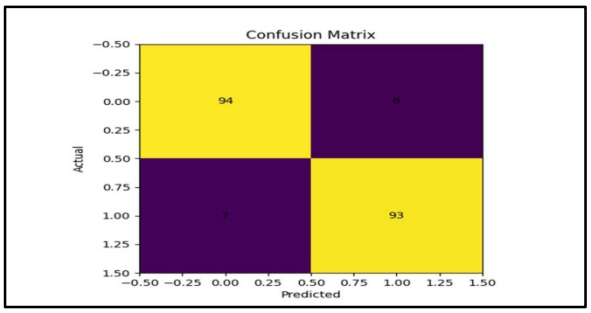


Fig.13 Confusion Matrix

Fig. 13 represents the confusion matrix of the proposed system. It shows the number of correct and incorrect predictions made by the model. The system correctly identifies 94 instances of malpractice and 93 normal cases, with minimal misclassification. This indicates strong classification performance and high reliability of the proposed system in detecting fraudulent activities.

The system was evaluated under simulated exam conditions. It achieved an accuracy of 94% in detecting malpractice cases. The processing speed of 30 FPS ensures real-time monitoring capability. Compared to traditional approaches, the system demonstrates improved efficiency and reliability.

VII. CONCLUSION

The growing adoption of online education has significantly increased the need for reliable and intelligent proctoring solutions. As remote examinations become more common, ensuring their credibility and fairness has become a critical requirement for educational institutions. AI-based proctoring systems provide an effective solution by enabling automated and continuous monitoring of candidates without heavy dependence on human invigilators. With the advancement of machine learning and computer vision technologies, it is now feasible to develop highly accurate systems capable of detecting various forms of malpractice in real time. An important aspect of such systems is the ability to record and store evidence of suspicious activities. Maintaining detailed logs not only helps in identifying violations but also plays a crucial role in resolving disputes and ensuring transparency in the evaluation process. This evidence-based approach strengthens trust among students and institutions.

Furthermore, accessibility is a key factor in modern education systems. Since a large number of students rely on smartphones rather than personal computers, developing a mobile-compatible proctoring system becomes essential. Future work will focus on improving model accuracy under challenging conditions such as low lighting and background noise.

VIII. ACKNOWLEDGMENT

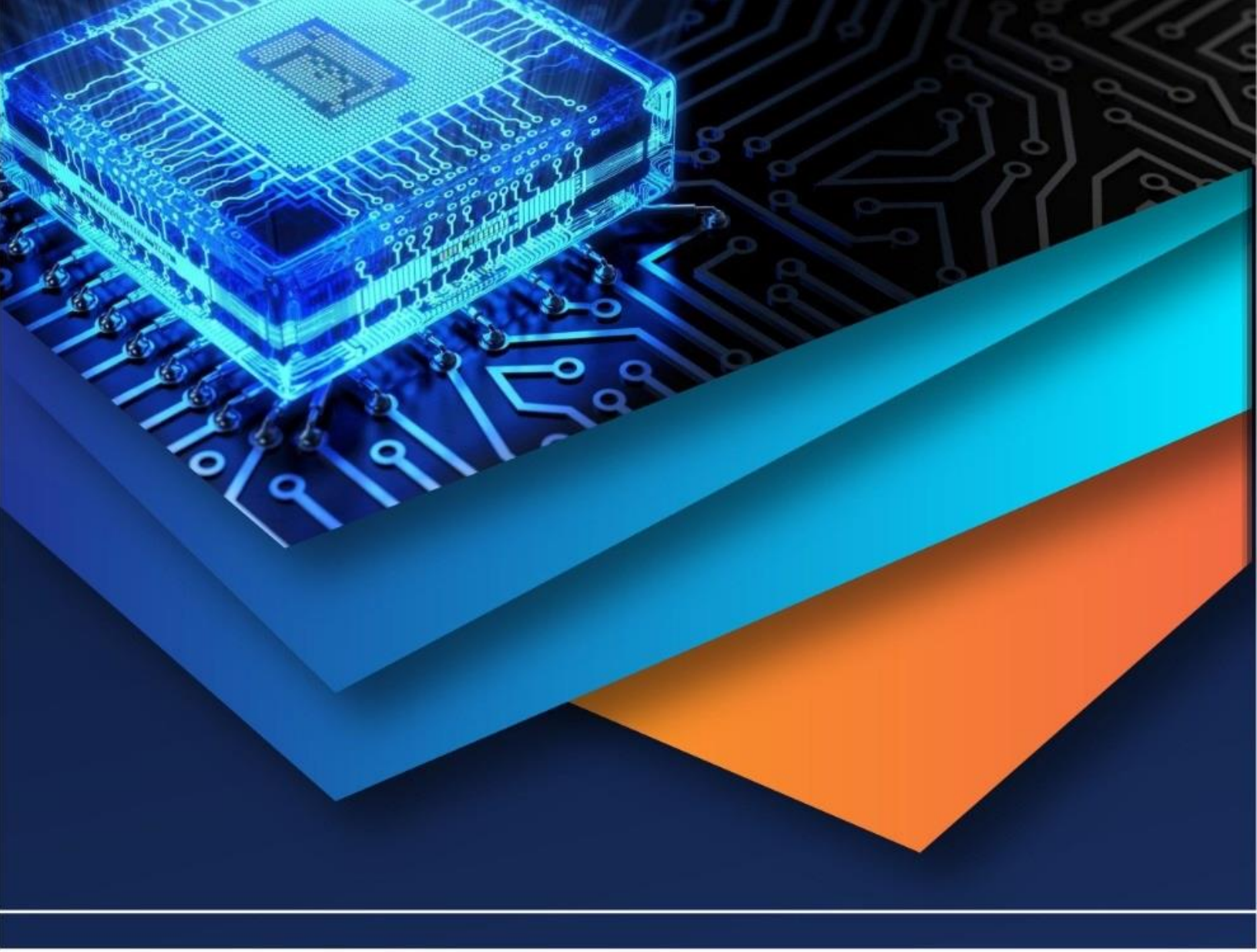
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