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INTELLIGENT ONLINE EXAM PROCTORING SYSTEM USING YOLOV8 AND COMPUTER VISION TECHNIQUES

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ABSTRACT

Online examinations have gained significant prominence due to their flexibility and cost efficiency, especially during extraordinary situations such as the COVID-19 pandemic. Nevertheless, the absence of direct human supervision introduces serious challenges related to academic dishonesty. This paper focuses on detecting abnormal behaviors during online examinations to uphold academic integrity and analyzes the performance of various deep learning models, including DenseNet121, YOLOv5, and its advanced variant YOLOv8, for identifying typical cheating activities such as unusual head movements and the usage of electronic devices. A custom dataset comprising four categories of cheating behaviors was developed, along with an additional dataset obtained from Roboflow containing two classes: 'No Head Movement' and 'Head Movement. Evaluation metrics such as accuracy, precision, recall, and mean Average Precision (mAP) were utilized to comprehensively assess the performance of the proposed models. DenseNet121 achieved an accuracy of 85%**,** whereas YOLOv5 recorded over 97% in precision, recall, and mAP, demonstrating its effectiveness for real-time object detection. Furthermore, YOLOv8 exhibited superior performance, achieving an accuracy of 98.42%**,** precision of 97.95%**,** recall of 98.18%**,** F1-score of 98.06%**,** and mAP of 98.71%**.** These results indicate that YOLOv8 provides enhanced detection accuracy, improved localization capability, and robust real-time monitoring of candidate activities, making it highly suitable for intelligent online exam proctoring applications. The proposed framework provides a reliable, efficient, and scalable solution for automated online examination monitoring, significantly reducing the need for manual supervision while enhancing the fairness, security, and integrity of remote assessment environments.

Keywords: Online Examinations Monitoring, Cheating Detection, Deep Learning, YOLOv8 Model

I. INTRODUCTION

The rapid advancement of digital technologies has transformed the traditional education system, leading to the widespread adoption of online examinations. These platforms offer flexibility, accessibility, and cost-effectiveness, making them highly suitable for modern learning environments. However, the absence of physical invigilation in online exams raises serious concerns regarding academic integrity. Students may engage in various unfair practices such as using electronic devices, seeking external help, or exhibiting suspicious head movements. Therefore, ensuring a secure and reliable online examination system has become a critical challenge for educational institutions. In recent years, artificial intelligence and deep learning techniques have emerged as powerful tools to address such challenges. Computer vision-based approaches can monitor student behavior in real time and detect anomalies effectively. Models like DenseNet and YOLO have shown promising results in object detection and behavior analysis tasks. By leveraging these technologies, it is possible to automatically identify potential cheating activities during online exams.

This study focuses on developing an intelligent system that detects abnormal behaviors using advanced deep learning models. To further enhance the reliability of such systems, this research emphasizes the use of customized datasets tailored to real-world examination scenarios. The dataset includes multiple classes representing different types of cheating behaviors, enabling the models to learn diverse patterns effectively. In addition, a supplementary dataset is incorporated to improve detection accuracy for head movement analysis. Advanced evaluation metrics such as accuracy, precision, recall, and mean average precision (mAP) are used to validate the performance of the proposed models. Comparative analysis among DenseNet121, YOLOv5, and YOLOv8 highlights the strengths of each approach in handling complex visual tasks. The integration of these models ensures a more robust and scalable monitoring system. This approach not only improves detection efficiency but also reduces the need for continuous human supervision. Ultimately, the proposed system contributes to creating a fair and transparent online examination environment.

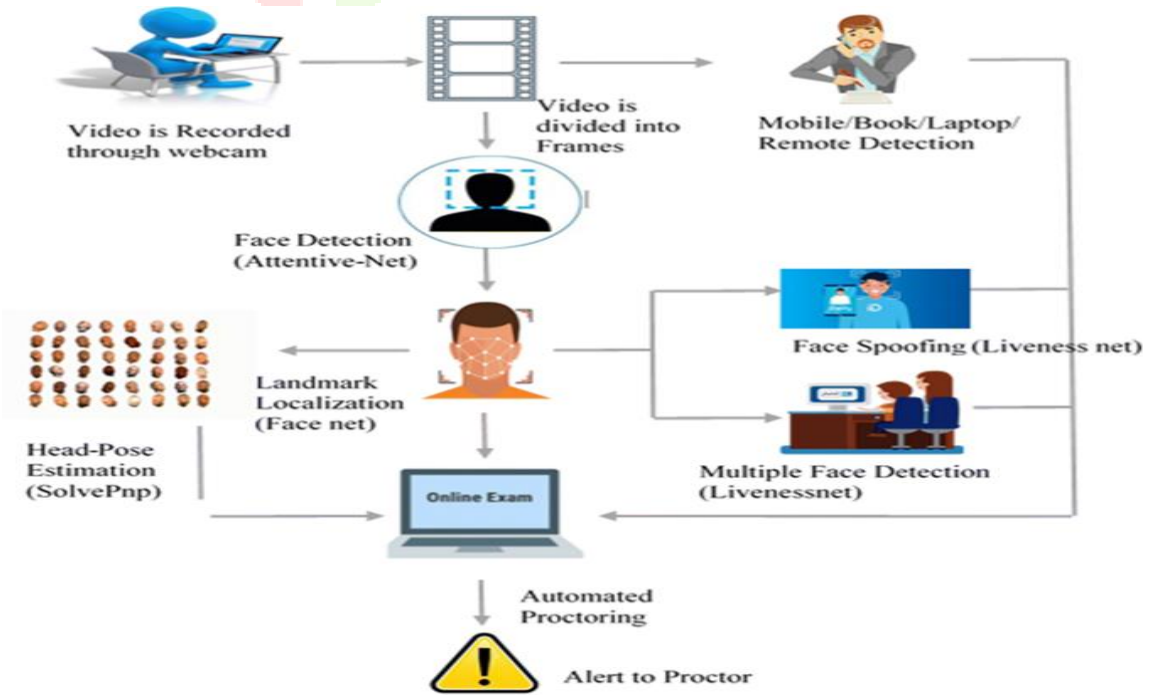

Figure 1: Workflow of Automated Cheating Detection in Online Examinations

II. LITERATURE REVIEW

Tripti Singh et.al [1], has discussed innovative solution known as the Online Exam Proctoring Model using You Only Look Once (YOLO) Model. With the use of cutting-edge computer vision algorithms, the proposed model makes use of data from cameras and microphones to automatically spot and prevent cheating during online exams.

Enliang Xu et.al [2], has discussed a multi-level intelligent recognition system for candidates' cheating behaviors, integrating an optimized YOLOv8 object detection method based on multilayer perceptron (MLP) with the ResNet deep learning framework. This system mines key frames from surveillance videos to precisely capture candidates' positional information and automatically tags those suspected of engaging in cheating activities.

Malhotra et.al [3], has discussed the pressing need for advanced automated solutions to ensure fairness in online examinations, with Artificial Intelligence Proctoring Systems (AIPS) offering a transformative approach. The findings reveal that advanced ML and DL techniques, such as Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs), better detect cheating by analyzing visual cues, including eye movements, head posture, and facial expressions, as compared to traditional techniques

III. COMPUTER VISION TECHNIQUES

Computer vision comprises several techniques that enable computers to interpret and analyze visual information from images and video streams. In intelligent online exam proctoring, these techniques facilitate automated monitoring of candidates, detection of suspicious activities, and maintenance of examination integrity. The major computer vision techniques used in online proctoring are discussed below.

Image Acquisition and Preprocessing: Image acquisition captures real-time video frames of the candidate using a webcam or camera. Preprocessing techniques such as resizing, noise reduction, and contrast enhancement improve image quality. These operations provide reliable input for subsequent computer vision tasks.

Feature Extraction and Representation: Feature extraction identifies important visual characteristics such as edges, textures, shapes, and facial landmarks from images. These features help distinguish different objects and human facial attributes. Effective feature representation improves the accuracy of detection and recognition models.

Object Detection and Recognition: Object detection locates and identifies candidates, mobile phones, books, and other objects within the examination environment. Deep learning models such as YOLOv8 perform this task with high accuracy and real-time speed. This technique plays a crucial role in detecting unauthorized objects during online examinations.

Object Tracking and Motion Analysis: Object tracking continuously monitors the movement of detected objects across consecutive video frames. Motion analysis evaluates candidate activities, including head movements and eye gaze direction. These techniques help identify abnormal behavior and potential cheating attempts.

Image Classification and Behavioral Analysis: Image classification categorizes examination scenes as normal or suspicious based on visual information. Behavioral analysis combines multiple computer vision outputs to evaluate candidate actions throughout the examination. This approach enhances the reliability and effectiveness of intelligent online exam proctoring systems.

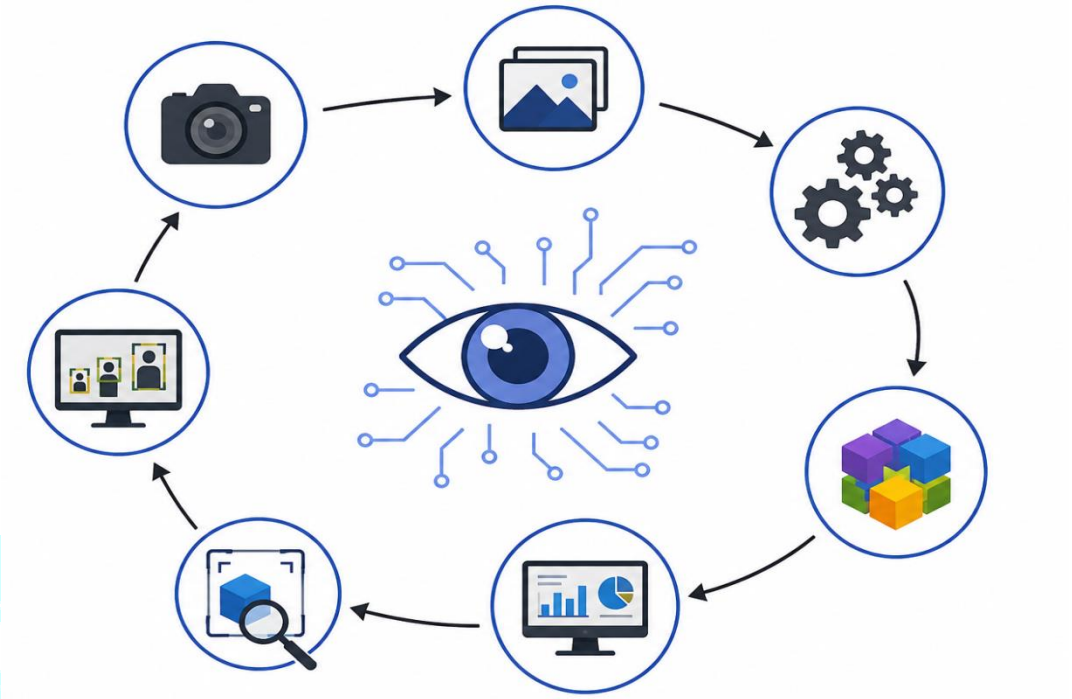

Figure 2: Typical Computer Vision Processing Stages

IV. PROPOSED FRAMEWORK

The proposed intelligent online exam proctoring system begins with image preprocessing, where the captured examination images are prepared for analysis through visualization, normalization, and data shuffling techniques, as illustrated in Figure 3**.** These preprocessing operations enhance image quality, reduce noise, and ensure consistency across the dataset, thereby improving the reliability of the learning process. The processed dataset is then used to train deep learning models by providing diverse samples of candidate behavior under different examination conditions. Effective preprocessing and dataset preparation play a significant role in increasing model robustness and minimizing false detections during real-time monitoring.

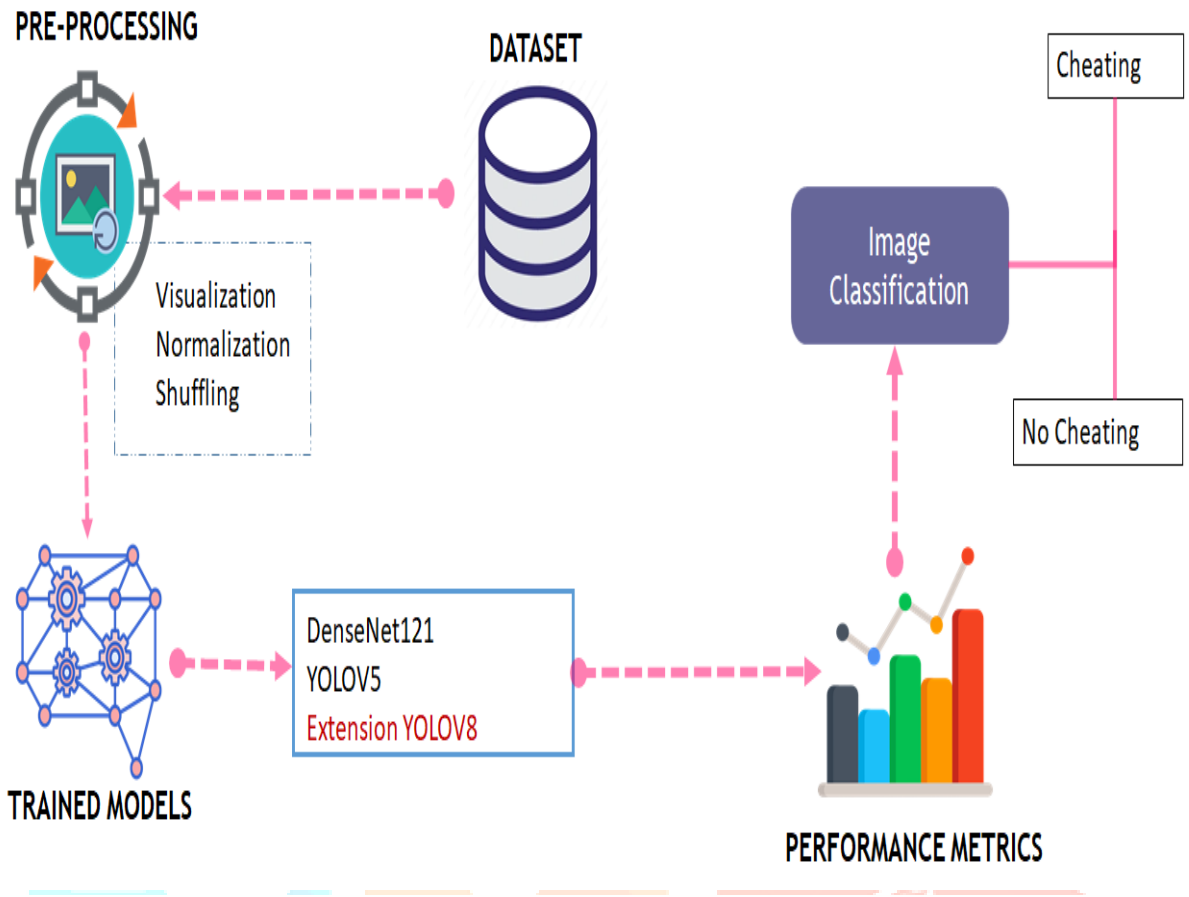

Figure 3: Workflow of the Proposed YOLOv9-Based Online Exam Proctoring System

The prepared dataset is utilized to train the proposed YOLOv8-based object detection model for identifying suspicious activities during online examinations. The trained model performs image classification by distinguishing normal candidate behavior from cheating behavior based on extracted visual features. Performance metrics such as accuracy, precision, recall, and F1-score are used to evaluate the effectiveness of the proposed framework. The trained model processes live video streams in real time to detect unauthorized objects, multiple persons, and abnormal candidate movements with high precision. Continuous monitoring enables the system to generate instant alerts whenever suspicious activities are identified, thereby assisting remote invigilators in maintaining examination integrity. Furthermore, the integration of computer vision techniques with YOLOv8 improves detection accuracy, reduces false alarms, and enhances the overall reliability of automated online exam proctoring systems. Based on the classification results, the system automatically categorizes examination sessions as Cheating or No Cheating, enabling continuous, real-time monitoring while maintaining the integrity and fairness of online examinations.

Implementation of YOLOv8:

YOLOv8 is employed as the core object detection model in the proposed intelligent online exam proctoring system due to its high detection accuracy and real-time processing capability. The model is trained on the prepared examination dataset to detect candidates, unauthorized objects such as mobile phones and books, and suspicious activities occurring during online examinations. YOLOv8 performs object localization and classification simultaneously using a single-stage detection framework, enabling efficient monitoring with minimal computational delay. Its advanced feature extraction network and optimized detection head improve recognition performance under varying lighting conditions and complex backgrounds. The trained YOLOv8 model processes live video

streams continuously, generating accurate predictions and supporting automated decision-making for identifying normal and cheating behaviors, thereby enhancing the reliability and effectiveness of the online proctoring system.

V. RESULTS & DISCUSSION

This section presents the experimental results obtained from the proposed YOLOv8-based intelligent online exam proctoring system. The performance of the model is evaluated using standard metrics such as accuracy, precision, recall, F1-score, and means Average Precision (mAP). The obtained results demonstrate the effectiveness of the proposed system in accurately detecting suspicious activities and ensuring reliable real-time online examination monitoring.

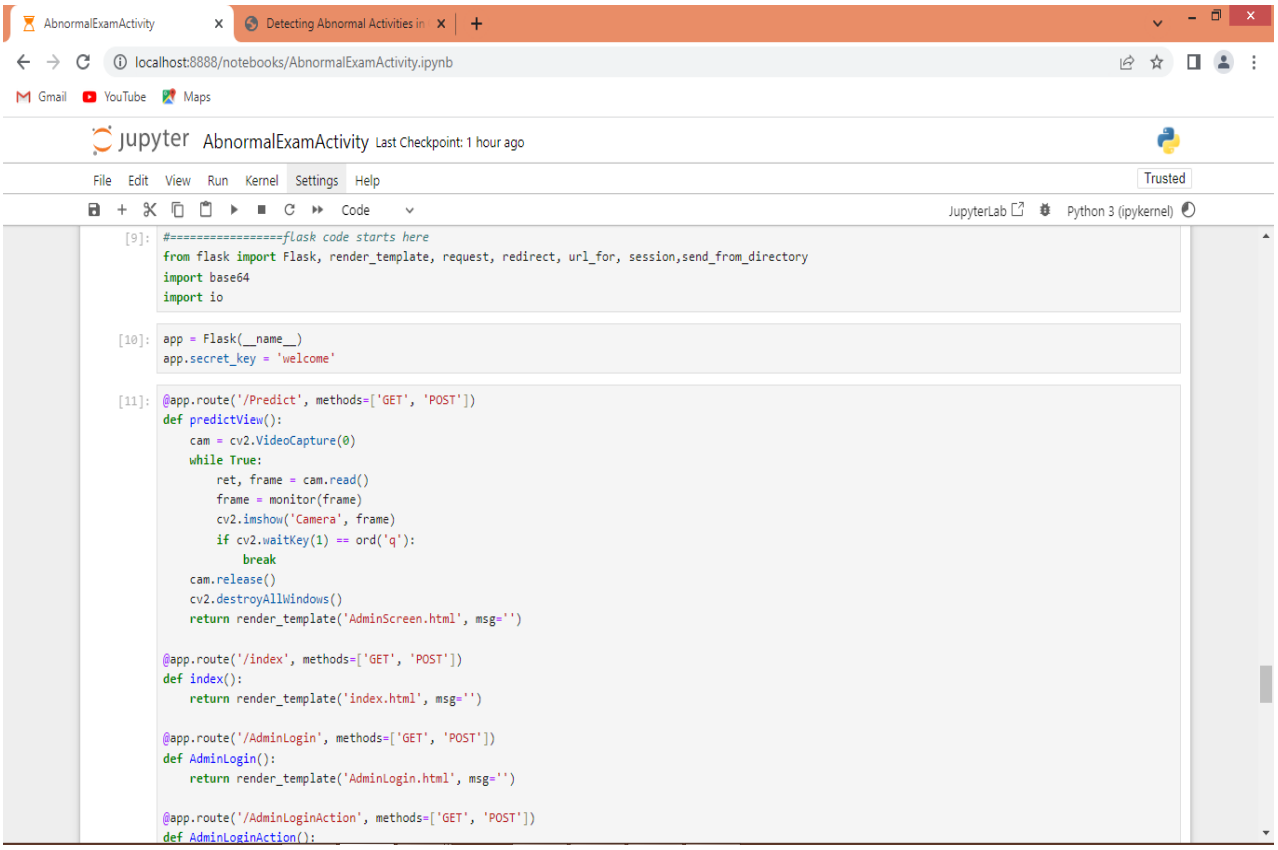

Figure 4: Python-Based Implementation of the Proposed Framework

Figure 4 illustrates the implementation of the proposed YOLOv8-based intelligent online exam proctoring system in the Jupyter Notebook environment using Python. The implementation integrates image acquisition, preprocessing, real-time object detection, and classification modules to monitor candidate activities during online examinations. The trained YOLOv8 model processes live webcam video streams to detect suspicious behaviors and unauthorized objects with high accuracy. This implementation demonstrates the practical deployment of the proposed framework for efficient and reliable automated online exam monitoring.

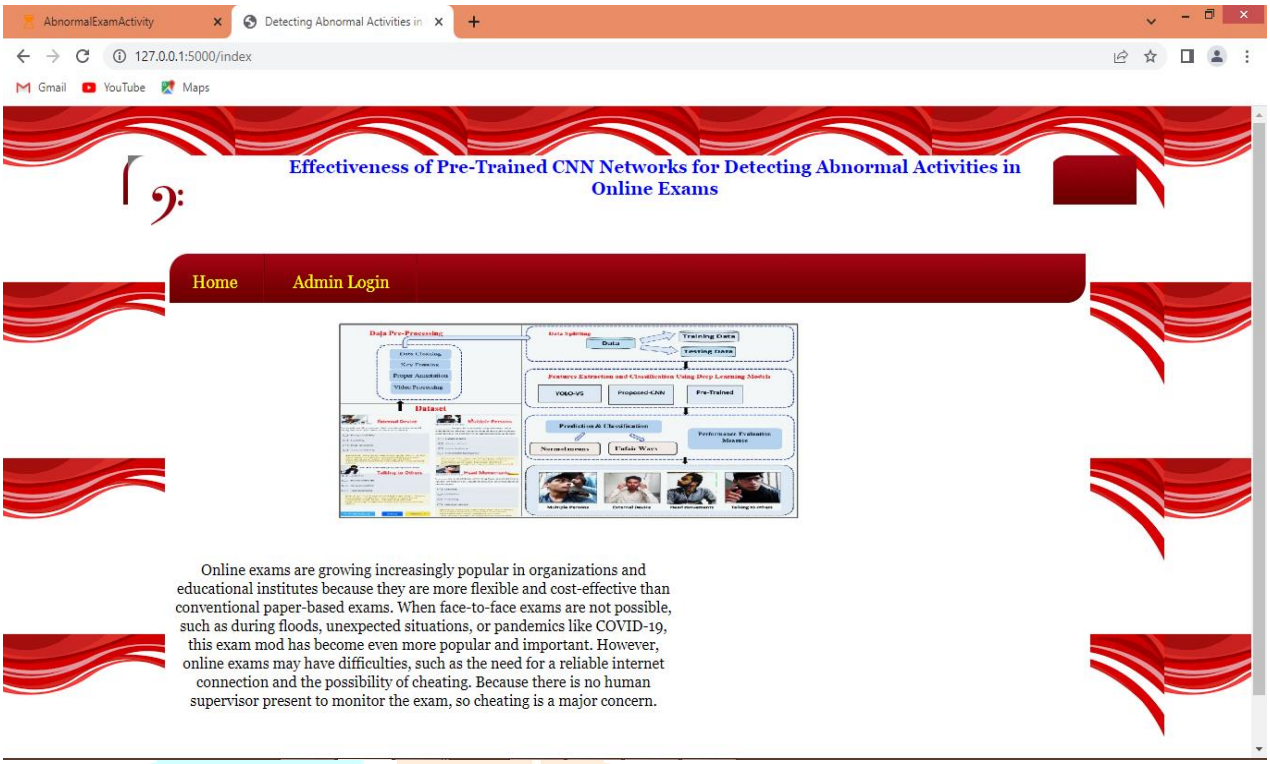

Figure 5: User Interface of the Proposed Online Exam Proctoring System

Figure 5 presents the home page of the proposed online exam proctoring system developed using a web-based interface. The home page provides users with navigation options, including Home and Admin Login, for accessing different system functionalities. It also displays an overview of the proposed framework and introduces the objective of detecting abnormal activities during online examinations. This user-friendly interface serves as the entry point for secure and efficient online exam monitoring.

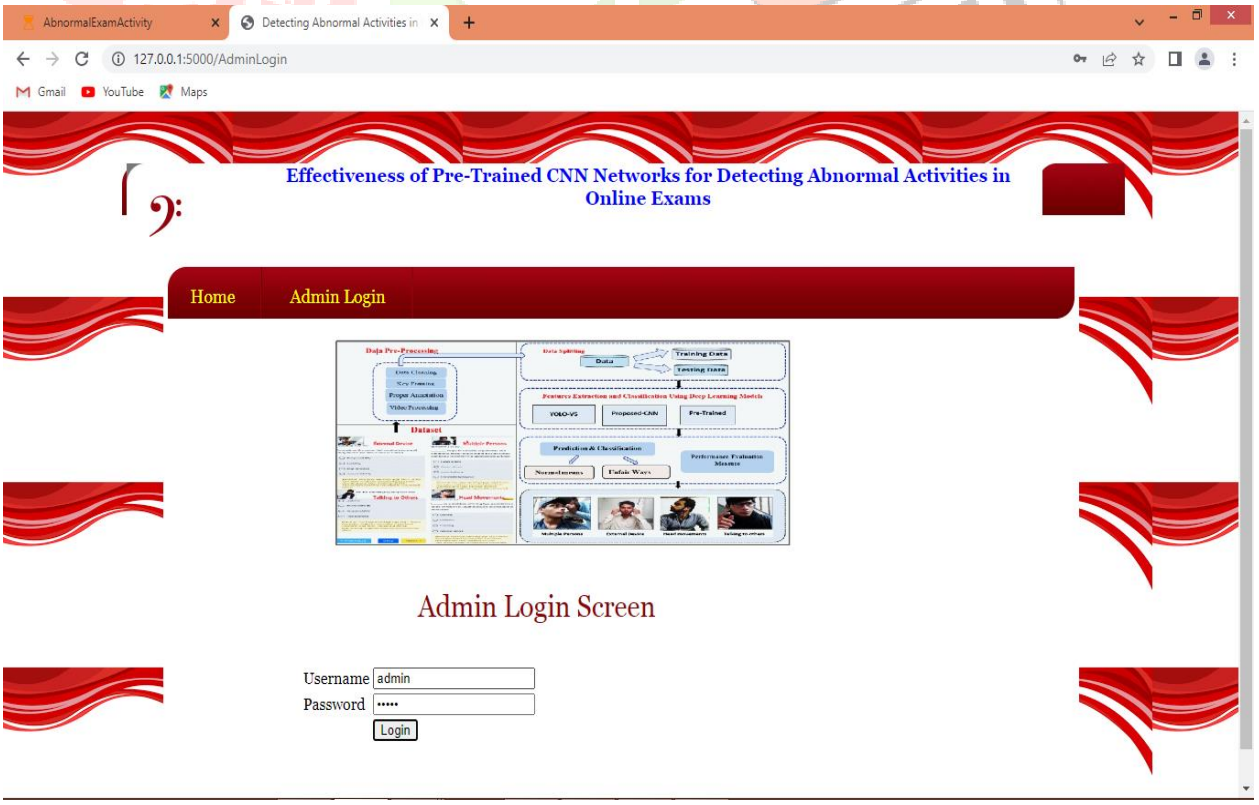

Figure 6: Admin Login Interface of the Proposed Online Exam Proctoring System

Figure 6 illustrates the administrator login interface of the proposed online exam proctoring system. The interface requires valid administrator credentials, including a username and password, to authenticate access to the system. Upon successful authentication, the administrator can manage examination activities, monitor candidate behavior, and access the system's monitoring functions. This secure login mechanism ensures that only authorized users can access and control the online proctoring platform.

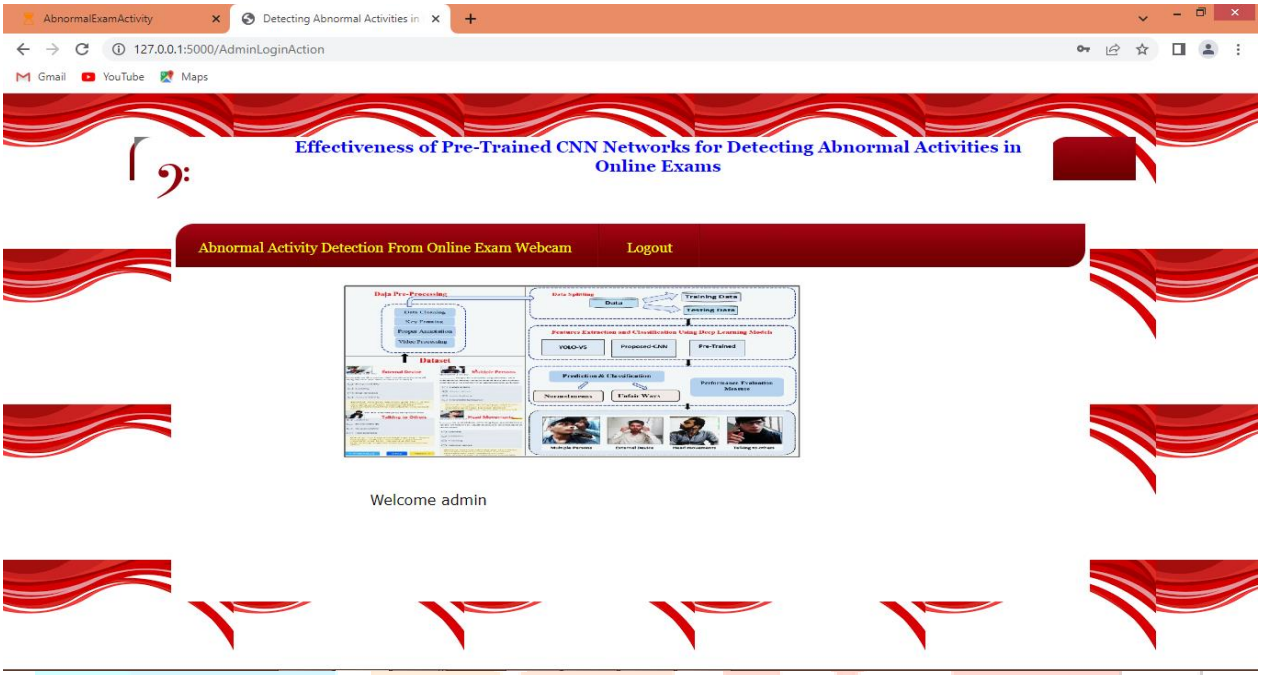

Figure 7: Administrator Dashboard of the Proposed Online Exam Proctoring System

Figure 7 illustrates the administrator dashboard displayed after successful login to the proposed online exam proctoring system. The dashboard provides access to the Abnormal Activity Detection from Online Exam Webcam module, enabling real-time monitoring of examination sessions. It also includes a logout option for secure session management and displays a welcome message for the authenticated administrator. This interface serves as the central control panel for initiating and managing the online exam proctoring process.

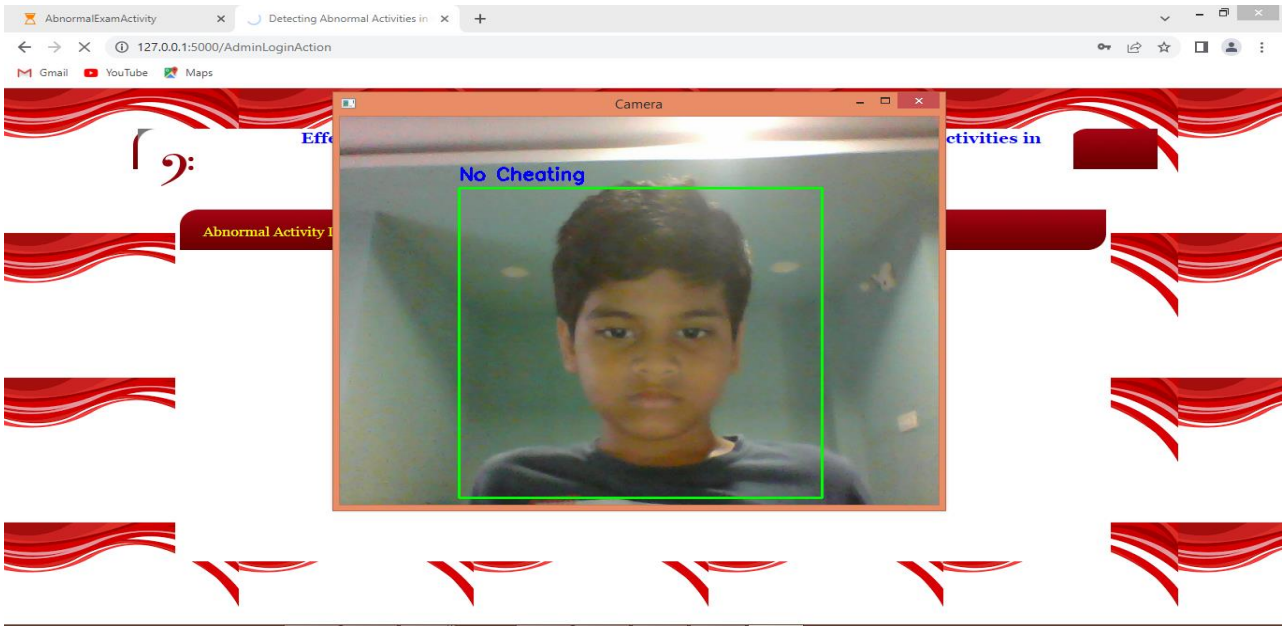

Figure 8: Real-Time Candidate Monitoring with No Cheating Detection

Figure 8 illustrates the real-time monitoring of a candidate during an online examination using the proposed YOLOv8-based proctoring system. The system successfully detects the candidate's face and displays a bounding box with the status "No Cheating," indicating normal examination behavior. Continuous webcam monitoring enables accurate tracking and analysis of candidate activities throughout the examination. This result demonstrates the effectiveness of the proposed framework in identifying genuine candidate behavior while minimizing false detections.

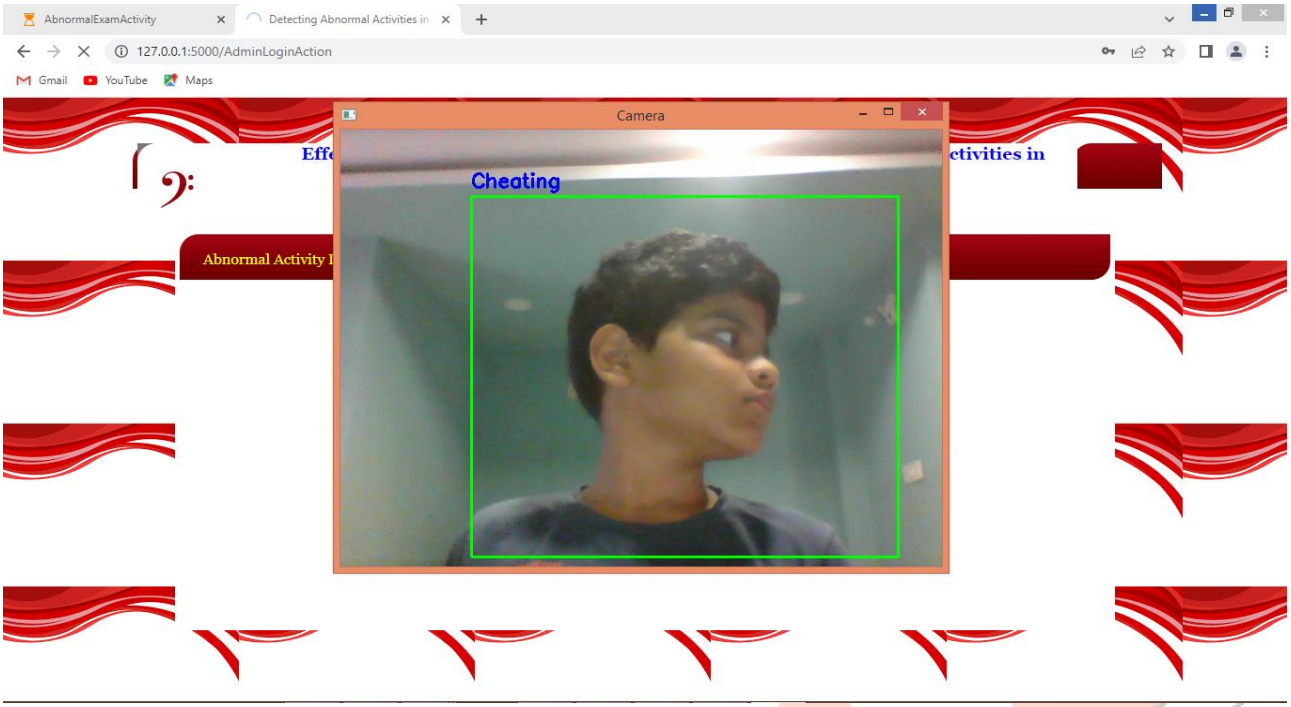

Figure 9: Real-Time Candidate Monitoring with Cheating Detection

Figure 9 illustrates the real-time detection of suspicious candidate behavior using the proposed YOLOv8-based online exam proctoring system. The system identifies abnormal head movement and classifies the candidate's activity as "Cheating," displaying the result with a bounding box around the detected face. The real-time monitoring mechanism continuously analyzes candidate behavior to detect potential examination misconduct. This result demonstrates the effectiveness of the proposed framework in accurately identifying cheating activities and maintaining the integrity of online examinations.

VI. PERFORMANCE ANALYSIS

Model	Accuracy	Precision	Recall	F-1 Score	mAP
Dense Net 121	85	84.50	85.20	84.85	85.10
YOLOv5	97.30	97.60	97.20	97.40	97.50
Proposed YOLOv8	98.42	97.95	98.18	98.06	98.71

Table 1: Comparative Performance Analysis of Deep Learning Models for Online Exam Proctoring

Table 1 compares the performance of DenseNet121, YOLOv5, and the proposed YOLOv8 model using standard evaluation metrics. DenseNet121 achieved an accuracy of 85.00%**,** while YOLOv5 significantly improved the detection performance with precision, recall, and mAP values above 97%**.** The proposed YOLOv8 model outperformed the other models by achieving 98.42% accuracy**,** 97.95% precision**,** 98.18% recall**,** 98.06% F1-score**, and** 98.71% mAP**.** These results demonstrate that YOLOv8 provides superior detection accuracy and robustness for real-time online exam proctoring, making it the most effective model among those evaluated.

VII. CONCLUSION

In this paper, an intelligent online exam proctoring system based on YOLOv8 and computer vision techniques was proposed to detect abnormal candidate behavior during online examinations. The proposed framework successfully identified suspicious activities such as abnormal head movements and the use of unauthorized electronic devices with high accuracy. Experimental results demonstrated that the YOLOv8 model outperformed DenseNet121 and YOLOv5 by achieving superior performance in terms of accuracy, precision, recall, F1-score, and mean Average Precision (mAP). The integration of real-time object detection and computer vision techniques enhanced the reliability and effectiveness of automated examination monitoring. The obtained results confirm that the proposed system is capable of maintaining academic integrity while reducing the need for continuous human supervision. Overall, the proposed framework provides an efficient, robust, and scalable solution for secure online examination environments.

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