

**“EXAM MONITORING SYSTEM”**

**A CORE COURSE PROJECT REPORT**

**Submitted By**

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**in partial fulfillment for the award of the degree of**

**BACHELOR OF TECHNOLOGY**

**IN**

**ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**



**DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**

**CHENNAI INSTITUTE OF TECHNOLOGY**

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This is to certify that the “**Core Course Project**” Submitted by **Syed Faizanullah Bahmani(Reg no: 22AD4143)** and **Sharavana Kumar S(Reg no: 22AD122 )** is a work done by him/her and submitted during **2023-2024** academic year, in partial fulfilment of the requirements for the award of the degree of **BACHELOR OF TECHNOLOGY** in **DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE**, at Chennai Institute of Technology.

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**Syed Faizanullah Bahmani(22AD143)**

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**PREFACE**

I, a student in the Department of Artificial Intelligence and Data Science need to undertake a project to expand my knowledge. The main goal of my core course project is to acquaint me with the practical application of the theoretical concepts I’ve learned during my course.

It was a valuable opportunity to closely compare theoretical concepts with real-world applications. This report may depict deficiencies on my part but still it is an account of my effort.

The results of my analysis are presented in the form of an industrial Project, and the report provides a detailed account of the sequence of these findings. This report is my Core Course Project, developed as part of my III Year project. As an engineer, it is my responsibility to contribute to society by applying my knowledge to create innovative solutions that address their changes.

**ABSTRACT**

The **Exam Monitoring System** represents a groundbreaking solution designed to enhance the integrity, security, and fairness of academic examinations by leveraging advanced deep learning technologies. One of the most pressing concerns for educational institutions today is ensuring a secure exam environment, free from cheating and the use of unauthorized items, particularly mobile phones. With the rise of mobile phone usage, students have found increasingly sophisticated ways to access information during exams, compromising the fairness of the assessment process. This project addresses this challenge head-on by developing a real-time monitoring system capable of detecting mobile phones and other prohibited items like cheat sheets, smartwatches, and tablets during exams.

The project’s significance lies in its ability to autonomously identify mobile phones during exams, offering immediate alerts when a phone is detected. This solution minimizes reliance on human invigilators, who may not always notice covert attempts to use these devices, especially in large exam settings. By automating this process, the system improves both the speed and accuracy of detection, helping academic institutions maintain strict exam standards and preserve the credibility of their evaluations.

**PROBLEM STATEMENT**

The problem this project seeks to solve revolves around the challenge of maintaining strict adherence to exam rules, specifically preventing students from using unauthorized devices like mobile phones. Mobile phones present a serious threat to exam integrity as they allow students to access information, communicate with others, or store cheat sheets without detection. Traditional monitoring methods, such as manual supervision by invigilators, are often prone to human error, especially in large-scale exam scenarios where hundreds of students need to be monitored simultaneously. Invigilators may struggle to detect subtle phone usage or may become distracted during long exam sessions. Additionally, some students have developed sophisticated ways to conceal their mobile devices, making them difficult to detect through casual observation. The ability to detect these devices automatically, efficiently, and in real-time becomes crucial in maintaining the fairness and credibility of the examination process.

**METHODOLOGY:**

The **Exam Monitoring System** employs the cutting-edge YOLOv8 (You Only Look Once) object detection model to detect unauthorized objects, with a primary focus on mobile phones. YOLOv8 is an optimal choice for this project due to its real-time detection capabilities, speed, and high accuracy in identifying small objects like mobile phones. To train the YOLOv8 model, a comprehensive dataset was created, consisting of images captured in realistic exam environments. These images include both authorized objects (e.g., pens, papers) and unauthorized objects (e.g., mobile phones, cheat sheets), simulating the typical scenarios invigilators encounter during exams.

Data augmentation techniques were employed to increase the model’s robustness. Platforms like Roboflow were used to augment the dataset, adding variations in lighting conditions, camera angles, and object positions. The images were pre-processed and labeled with specific classes such as "mobile\_phone," "cheat\_sheet," and "smartwatch" using annotation tools like LabelImg. The model was trained on a GPU-enabled platform (Google Colab), with a standard 70-20-10 split between training, validation, and test sets to optimize performance. The input images were resized to 640x640 for optimal YOLOv8 efficiency, and the model was fine-tuned using early stopping and learning rate scheduling to avoid overfitting.

The final system was deployed with a user-friendly web-based interface built using Flask, allowing real-time monitoring of exam rooms. OpenCV was used to process live video streams, where each frame was fed into the trained YOLOv8 model to detect mobile phones. Upon detecting a phone, the system immediately triggers alerts in the form of sound notifications or pop-up messages, notifying invigilators of the violation. This seamless integration of deep learning with a real-time monitoring interface ensures swift action can be taken when a violation is detected, greatly reducing the likelihood of cheating going unnoticed.

**RESULTS:**

The model demonstrated high accuracy during testing, particularly in its ability to detect mobile phones. The evaluation metrics, including mean Average Precision (mAP), precision, and recall, reflected the model’s effectiveness in distinguishing mobile phones from other objects within the exam setting. The precision of the system was particularly noteworthy, meaning that when a phone was detected, it was correct most of the time, resulting in minimal false positives (incorrectly identifying authorized objects as phones). Recall, which measures the system's ability to detect all instances of mobile phone usage, was also strong, indicating that few instances of phone usage went undetected.

The confusion matrix further validated the robustness of the model, showing minimal false negatives (instances where a phone was present but not detected). This is crucial in maintaining the effectiveness of the system since missing a phone detection could result in students cheating undetected. The system was tested under various conditions, such as different lighting and camera angles, to simulate real-world exam scenarios, and the model’s performance remained consistent.

The system was then fully integrated into a live monitoring interface, where it successfully detected mobile phones in real-time, highlighting detected objects with bounding boxes. Invigilators using the system were able to monitor the exam room through the live video stream and received immediate alerts when a phone was detected, allowing them to intervene before the student could use the device.

**Implications:**

The **Exam Monitoring System** presents a significant advancement in the field of automated exam supervision, offering a practical and scalable solution for detecting mobile phones in real-time. By automating the identification of mobile phones, the system significantly reduces the burden on human invigilators, allowing them to focus on other critical tasks during the exam. This reduction in workload improves the overall efficiency of exam supervision and reduces the likelihood of human error or oversight.Moreover, the system's real-time alert feature ensures that unauthorized activities are detected and addressed immediately, minimizing the risk of cheating. In large exam The presence of an automated monitoring system also acts as a deterrent to students, discouraging them from attempting to use mobile phones during exams.The potential for future enhancements to the system is significant. With further development, the model could be retrained with additional datasets to detect a wider range of unauthorized devices, such as hidden earpieces or advanced smartwatches. The system could also be improved to detect suspicious behavior, such as students looking at their phones under the desk or passing phones between peers during the exam. Additionally, the system could be expanded to accommodate multiple camera feeds, allowing it to monitor large-scale exams with multiple rooms simultaneously.

In conclusion, the **Exam Monitoring System** provides an innovative and effective solution to one of the most persistent challenges in academic assessment: maintaining exam integrity. By focusing on the detection of mobile phones and other unauthorized

devices, this system not only improves the fairness of exams but also sets a new standard for the future of automated exam monitoring.

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**1.INTRODUCTION**

The **Exam Monitoring System** is a cutting-edge solution developed to improve the integrity of examinations by leveraging modern artificial intelligence techniques, specifically the YOLO (You Only Look Once) object detection model. As mobile phone usage and other unauthorized devices become increasingly prevalent in examination environments, educational institutions face the growing challenge of maintaining exam integrity. Mobile phones, in particular, allow students to gain unauthorized access to information during exams, threatening the fairness of the assessment process.

Traditional methods of invigilation are limited, prone to human error, and insufficient in large-scale settings where hundreds of students are being monitored simultaneously. This system automates the detection of unauthorized devices, focusing particularly on mobile phones, to provide real-time alerts to invigilators. By integrating advanced technologies like YOLOv8, TensorFlow, Flask, and OpenCV, the system ensures that mobile phones and other unauthorized objects are detected promptly. It automates real-time monitoring, minimizing the burden on human invigilators and ensuring that exams are conducted fairly.

**2.ABOUT THE TECHNOLOGY / PRODUCT**

The **Exam Monitoring System** employs several state-of-the-art technologies that work in harmony to provide a robust and scalable solution for real-time object detection in exam settings.

* **YOLO (You Only Look Once):** A real-time object detection model known for its speed and accuracy. YOLO is designed to detect multiple objects within an image in a single pass, making it highly efficient. In this project, **YOLOv8**, the latest version of the YOLO model, was utilized for its improved detection capabilities, especially for small objects like mobile phones. YOLOv8 strikes a balance between detection speed and accuracy, making it suitable for real-time applications where object detection needs to happen instantaneously, such as in an ongoing exam.
* **TensorFlow:** TensorFlow is an open-source machine learning platform that was used to fine-tune the object detection model. TensorFlow’s ability to build and train deep learning models makes it the ideal framework for optimizing YOLOv8’s performance on the dataset of exam-related images. TensorFlow’s flexible architecture allows developers to experiment with different model configurations to achieve the best results.
* **Roboflow:** Roboflow was utilized to augment the dataset, ensuring it covered a wide range of environments, lighting conditions, and camera angles. This step was crucial in ensuring that the YOLO model could generalize well to various exam scenarios and detect mobile phones accurately, even in challenging conditions.
* **Flask:** Flask is a lightweight micro web framework that was used to create the system's user interface. The Flask application allows invigilators to monitor live video feeds from exam rooms and view real-time alerts triggered by the detection of unauthorized objects like mobile phones. Flask serves as the front end of the system, providing invigilators with a user-friendly and accessible platform.
* **OpenCV:** OpenCV is an open-source computer vision library used to process live video streams. OpenCV captures video frames from the exam room cameras, which are then analyzed by the YOLO model to detect mobile phones and other unauthorized devices in real time.

**3.PROBLEM STATEMENT**

Mobile phone misuse during exams has become a significant threat to maintaining exam integrity, as it allows students to access unauthorized information or communicate with others. The challenge of enforcing exam rules and preventing the use of mobile phones during exams is exacerbated in large exam settings, where manual monitoring by invigilators is often inefficient and prone to human error. Given that students are becoming increasingly creative in hiding phones and using them discreetly, invigilators struggle to detect violations in real-time. There is an urgent need for an automated system that can reliably detect mobile phones in real-time, allowing institutions to maintain a high standard of exam security and fairness.

**4..PROJECT OBJECTIVES**

The objectives of this project are multi-faceted, with the overarching goal of automating the detection of mobile phones in exam environments. The key objectives include:

* **To develop an exam monitoring system** that can accurately detect mobile phones and other unauthorized objects during exams, minimizing the risk of cheating.
* **To provide real-time alerts** to invigilators when a mobile phone or other unauthorized object is detected, allowing for swift action to be taken.
* **To build a robust detection model** that can handle a wide variety of exam settings, including different lighting conditions, camera angles, and diverse student behaviors.
* **To integrate the detection model** into a user-friendly web interface that invigilators can easily access and use to monitor exams in real time.

**5..LITERATURE SURVEY**

Object detection has been a well-explored area in computer vision research, with YOLO emerging as one of the leading models for real-time applications. YOLO’s architecture allows for fast and accurate detection, making it ideal for tasks like monitoring exams where multiple objects (both authorized and unauthorized) may need to be identified simultaneously.

Several key studies have contributed to the development of YOLO and its application in real-time object detection:

* **"Real-Time Object Detection with YOLO" (Redmon et al.)** – This seminal work introduced YOLO as a revolutionary approach to object detection. It demonstrated how YOLO could detect multiple objects in real time by processing an image in a single forward pass through a neural network. YOLO has since been used in a wide range of applications, from autonomous driving to security systems.
* **"Object Detection in Crowded Scenes Using Deep Learning"** – This study explores the challenges of detecting small objects in dense environments, such as crowds or cluttered spaces. It highlights the importance of robust model training and data augmentation to ensure accurate detection, particularly when objects are partially obscured or viewed from unusual angles.

YOLO remains the most suitable for exam monitoring due to its speed and ability to handle multiple detections at once.

**6.METHODOLOGY**

The project followed a systematic methodology, involving several key steps to ensure the successful development of the exam monitoring system:

1. **Data Collection:**
   * A large dataset of images depicting both authorized objects (e.g., pens, papers) and unauthorized objects (primarily mobile phones) was collected. These images were taken in realistic exam environments to capture the diverse scenarios invigilators might encounter.
   * The dataset was further augmented using Roboflow to simulate various lighting conditions, angles, and object placements, making the model more robust in real-world scenarios.
2. **Data Preprocessing:**
   * All images were manually labeled using LabelImg, with bounding boxes drawn around mobile phones and other unauthorized objects. Each object was assigned a specific class label (e.g., "mobile\_phone," "cheat\_sheet").
   * Data augmentation techniques, including image rotations, brightness adjustments, scaling, and noise addition, were applied to increase the model’s ability to generalize across diverse exam environments.
3. **Model Training:**
   * **YOLOv8**, a pretrained object detection model, was selected for fine-tuning. YOLOv8’s architecture was particularly well-suited for real-time applications due to its balance between speed and detection accuracy.
   * The dataset was split into training (70%), validation (20%), and test (10%) sets to ensure a fair evaluation of the model’s performance.
   * The model was trained in a GPU-enabled environment using Google Colab. Hyperparameters such as learning rate, batch size, and the number of epochs were optimized to prevent overfitting and ensure generalization.
4. **System Development:**
   * **Flask** was used to develop a web-based interface where invigilators could monitor live video streams of exam rooms. The Flask app provided a real-time view of the exam hall, along with visual alerts when a mobile phone was detected.
   * **OpenCV** was integrated into the system to capture video frames in real time. These frames were passed through the YOLO model, which detected any mobile phones present in the scene.
   * The system generated real-time alerts (e.g., sound notifications, pop-up messages) when a phone was detected, allowing invigilators to intervene immediately.

**7.RESULTS**

The system achieved strong results in terms of detecting mobile phones during exams:

* **Model Performance:**
  + The YOLOv8 model achieved a high **mean Average Precision (mAP)** score, which reflects its ability to accurately detect mobile phones across different exam settings.
  + Precision and recall scores were high, indicating the model’s ability to correctly detect mobile phones while minimizing false positives (incorrectly identifying authorized objects as phones).

**Confusion Matrix:**

* + The confusion matrix revealed very few false negatives, meaning that the model rarely failed to detect a mobile phone when it was present.
  + False positives were minimal, contributing to the system’s reliability and ensuring that invigilators would not be distracted by unnecessary alerts.

**8.COMPLETE ANALYSIS OF PROJECT DONE**

The exam monitoring system was fully implemented and tested in various exam environments. The key outcomes include:

* **Real-time detection of mobile phones:** The YOLOv8 model, combined with OpenCV, provided efficient detection of mobile phones, with detection happening within milliseconds of the phone appearing in the video frame.
* **User-friendly monitoring interface:** The Flask interface allowed invigilators to monitor exams via a simple yet effective platform. Real-time alerts were triggered when a mobile phone was detected, ensuring that violations were dealt with swiftly.
* **System robustness:** The system was tested under different lighting conditions, camera angles, and object positions. It consistently demonstrated high accuracy in detecting mobile phones, confirming its robustness and reliability.

**9.TECHNOLOGY USED**

* **YOLOv8:** Object detection model used for detecting mobile phones in real-time.
* **TensorFlow:** Used to fine-tune the YOLO model on the exam dataset.
* **Flask:** Provided the user-friendly interface for live monitoring of exam rooms.
* **OpenCV:** Enabled real-time processing of video frames for object detection.
* **Roboflow:** Assisted in dataset augmentation, enhancing the model’s generalization capabilities.
* **Google Colab:** Provided a GPU-enabled environment for faster model training.

**10.PROJECT PHOTOS**

**11.CONCLUSION**

The **Exam Monitoring System** successfully automates the detection of unauthorized mobile phones during exams, significantly reducing the chances of cheating. The system leverages the power of YOLOv8 for real-time object detection and integrates seamlessly with a user-friendly interface for invigilators. By providing real-time alerts, the system allows invigilators to act quickly and effectively when a phone is detected. Future improvements could include expanding the system to detect more complex unauthorized objects or scaling the solution for use in larger exam environments.

**12.REFERENCES**

* Redmon, J., et al. "You Only Look Once: Unified, Real-Time Object Detection." *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition* (2016).
* Liu, W., et al. "SSD: Single Shot MultiBox Detector." *European Conference on Computer Vision* (2016).
* Roboflow Documentation on Dataset Augmentation.
* TensorFlow Official Documentation on Object Detection.

**PO & PSOAttainment**

| **PO.No** | **Graduate Attribute** | **Attained** | **Justification** |
| --- | --- | --- | --- |
| **PO 1** | **Engineering knowledge** | Yes | Applied engineering principles in the use of YOLO, TensorFlow, and Flask to develop a functional solution. |
| **PO 2** | **Problem analysis** | Yes | Analyzed the problem of unauthorized mobile phone use during exams and proposed a viable, automated solution. |
| **PO 3** | **Design/Development of solutions** | Yes | Designed and developed a real-time exam monitoring system to detect phones using object detection models. |
| **PO 4** | **Conduct investigations of complex problems** | Yes | Investigated complex scenarios, such as detecting phones in diverse environments and conditions. |
| **PO 5** | **Modern Tool usage** | Yes | Utilized modern tools like YOLOv8, TensorFlow, Flask, OpenCV, and Roboflow for development and deployment. |
| **PO 6** | **The Engineer and society** | Yes | Created a system that benefits society by upholding academic integrity during examinations. |
| **PO 7** | **Environment and Sustainability** | No | The project did not directly address environmental or sustainability concerns. |
| **PO 8** | **Ethics** | Yes | Ensured the system complies with ethical guidelines, particularly regarding privacy and data usage. |
| **PO 9** | **Individual and team work** | Yes | Collaborated effectively to complete various aspects of the project, such as model training and interface design. |
| **PO 10** | **Communication** | Yes | Communicated the project's results and methodology through reports and presentations. |
| **PO 11** | **Project management and finance** | Yes | Managed project timelines and resource allocation efficiently to meet deliverables. |
| **PO 12** | **Life-long learning** | Yes | Learned new technologies (YOLOv8, TensorFlow, Flask) and applied them to solve real-world problems. |

| **PSO.No** | **Graduate Attribute** | **Attained** | **Justification** |
| --- | --- | --- | --- |
| **PSO 1** | To analyze, design and develop solutions by applying the concepts of Robotics for societal and industrial needs. | **Yes** | Applied concepts of computer vision and deep learning to solve a societal issue (academic integrity during exams). |
| **PSO 2** | To create innovative ideas and solutions for real time problems in Manufacturing sector by adapting the automation tools and technologies. | **No** | The project was focused on education and not directly related to the manufacturing sector. |