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Smart Traffic Monitoring and Violation Detection Using YOLO, EasyOCR, and Speed Estimation

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INTRODUCTION

- **Purpose of Vehicle Detection and Tracking**
- Essential for traffic monitoring, autonomous driving, and security surveillance.
- Involves identifying, locating, and monitoring vehicles in images or video streams over time.
- **YOLO (You Only Look Once) for Object Detection**
- Fast, efficient single-stage object detection algorithm.
- Detects multiple objects in an image in a single pass.
- **Deep SORT for Multiple Object Tracking**
- Utilizes Kalman filters and Hungarian matching for robust tracking.
- Accurately tracks vehicles even in challenging conditions like occlusions.

•**Helmet Violation Detection**

•YOLO extended to detect helmet violations, enhancing traffic rule enforcement.

•**Speed Estimation for Traffic Monitoring**

•Integrated to measure vehicle speeds, adding another layer to the monitoring system.

•**EasyOCR for Automatic Number Plate Recognition (ANPR)**

•Detects and reads number plates automatically.

•Identifies traffic violators and streamlines the process of issuing fines.

•**Comprehensive Real-Time Traffic Monitoring System**

•Combines vehicle and helmet detection, speed estimation, and ANPR.

•Provides an efficient solution for real-time traffic monitoring and rule enforcement

PROBLEM STATEMENT

The need for automated traffic monitoring is critical due to increasing violations and the inefficiency of manual enforcement. Developing a system using YOLO and Deep SORT for real-time vehicle detection, helmet violation, speed estimation, and number plate recognition poses challenges in maintaining accuracy, real-time performance, and computational efficiency, while ensuring adaptability to diverse traffic conditions.

Objective: Create an efficient system using YOLO, Deep SORT, EasyOCR, and speed estimation for real-time traffic monitoring and enforcement.

Challenges:

- Accuracy in detecting and identifying violations.
- Real-time performance and responsiveness.
- Computational efficiency for processing live traffic footage.
- Adaptability to various traffic conditions.

EXISTING SYSTEM

Existing vehicle detection and tracking systems often use traditional object detection methods like Viola-Jones or HOG (Histogram of Oriented Gradients) combined with tracking algorithms such as Kalman filters or particle filters. While these methods are effective to some extent, they face several limitations:

Limitations:

- Limited detection accuracy, especially in complex environments.
- Real-time performance challenges, making them unsuitable for high-speed traffic monitoring.
- Susceptibility to occlusions and background clutter, reducing reliability.
- Limited adaptability to varied traffic conditions.
- Higher computational requirements for achieving acceptable accuracy.

PROPOSED SYSTEM

The proposed system utilizes a combination of YOLO (You Only Look Once) for object detection and DeepSORT for multiple object tracking to achieve accurate and efficient vehicle detection and tracking.

ADVANTAGES:

- Improved Detection Accuracy
- Real-time Performance
- Robust Tracking
- Adaptability
- Computational Efficiency

AIM OF THE PROJECT

The proposed project aims to develop an efficient and accurate vehicle detection and tracking system using the YOLO (You Only Look Once) object detection framework and Deep SORT (Deep Simple Online and Realtime Tracking). This system aims to leverage the real-time capabilities of YOLO for precise vehicle detection and utilize the tracking capabilities of Deep SORT to maintain consistent and reliable tracking of vehicles over consecutive frames. The overarching goal is to create a robust solution for real-world applications, enhancing the capabilities of surveillance, traffic monitoring, and other relevant domains through advanced computer vision techniques.

OBJECTIVES

- To develop a real-time vehicle detection system using YOLO.
- To detect the presence of helmets on riders.
- To measure vehicle speed using image processing techniques.
- To implement automatic number plate recognition (ANPR) using EasyOCR.
- To integrate the detection system with a database that holds vehicle owner information.
- To automate the process of sending violation notifications and fine payment details via a mobile app.

LITERATURE SURVEY

Author	Title	Year	Publisher	Description	Merit	Demerit
Smith, J., et al.	Vehicle Detection and Over-Speed Detection Using YOLO	2023	IEEE	Describes a YOLOv5-based system for real-time vehicle detection, speed estimation, and license plate recognition. This integrated system is designed for efficient traffic monitoring and management using OCR to process license plates.	Real-time vehicle detection, segmentation, and tracking. Accurate speed and license plate recognition using OCR.	YOLOv5 performance may degrade with small or occluded objects, especially in complex traffic environments.

Author	Title	Year	Publisher	Description	Merit	Demerit
Lee, K., et al.	Helmet Detection and License Plate Recognition Using Deep Learning	2022	IEEE	Proposes a deep learning-based system using YOLOv2 for detecting helmet violations in real-time, along with OCR for license plate recognition. Aims to automate helmet violation detection, replacing manual CCTV footage inspection. This system is designed for use in traffic law enforcement, especially in countries with high non-compliance rates for helmet use.	Effective helmet detection and license plate extraction with YOLOv2 and OCR. Saves time and reduces human intervention.	Processing time for moving images can be slow, particularly in high-traffic conditions.

Author	Title	Year	Publisher	Description	Merit	Demerit
Patel, R., et al.	Enhancing Road Safety with Real-Time Helmet Detection and Challan Issuance Using YOLO and OCR	2023	IRJMETS	Describes a real-time helmet violation detection system using YOLOv5 for object detection and OCR for number plate recognition. The system generates automatic traffic tickets (challans) for violators, which are sent to the vehicle owners. The system includes a PyQt-based GUI for real-time monitoring and validation of violations.	Seamless detection of helmet violations with automatic challan generation. User-friendly GUI for real-time monitoring.	Detection accuracy may be affected by poor image quality or obstructed number plates.

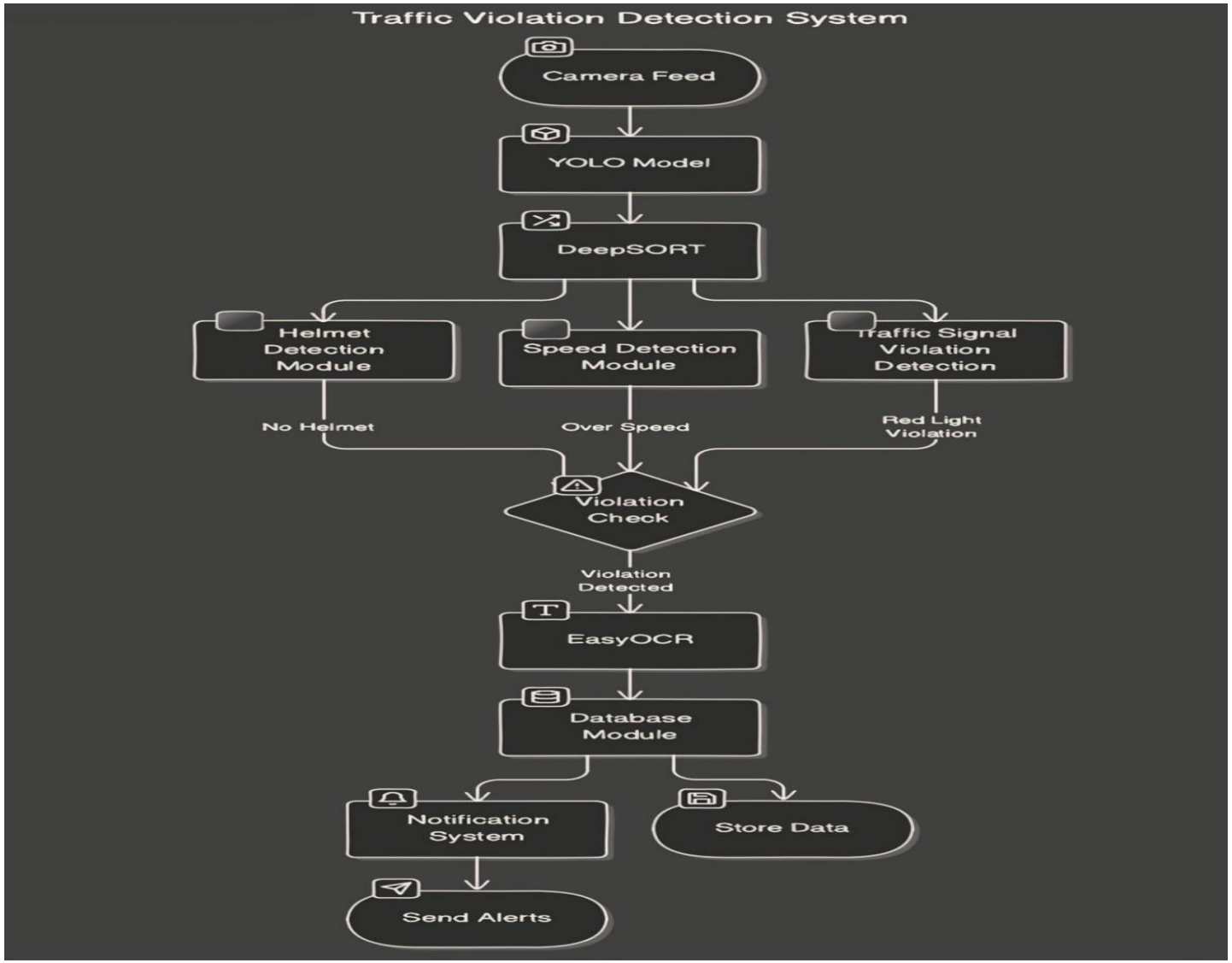
HARDWARE REQUIREMENT

- Processor : AMD Ryzen 5 3450U with Radeon Vega Mobile Gfx 2.10 GHz
- Memory : 4GB
- Disk : 40GB
- Display : 15-inch color
- RAM: At least 8 GB

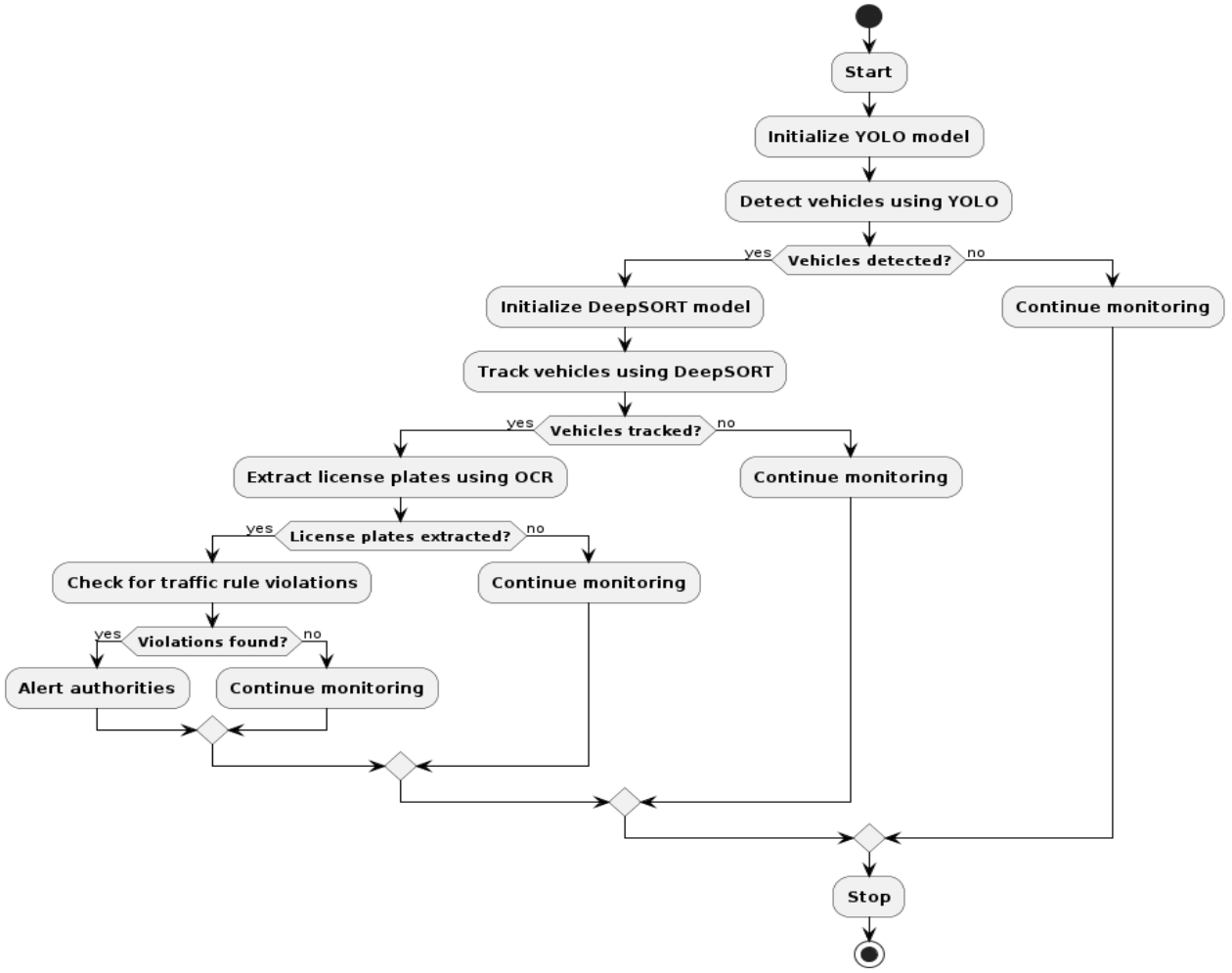
SOFTWARE REQUIREMENTS

- Coding : Python
- Operating System : Windows 11
- Platform : Python 3.12
- Tool : Visual Studio Code
- Libraries : NumPy, Ultralytics, PyTorch , OpenCV, Matplotlib

SYSTEM ARCHITECTURE



ACTIVITY DIAGRAM



SYSTEM IMPLEMENTATION

- Environment Setup.
- Download YOLO Model.
- Configuration.
- Code Implementation.
- Run the code.

UNIT TESTING

Definition: Unit testing involves testing individual units or components of the software independently.

Tools Used: Python's unit test framework or pytest for writing and running unit tests.

Test Coverage: Ensure each function/method is tested with various input scenarios (e.g., different types of vehicle images).

Example: Test YOLOv8 detection functions with mock input data to validate expected outputs.

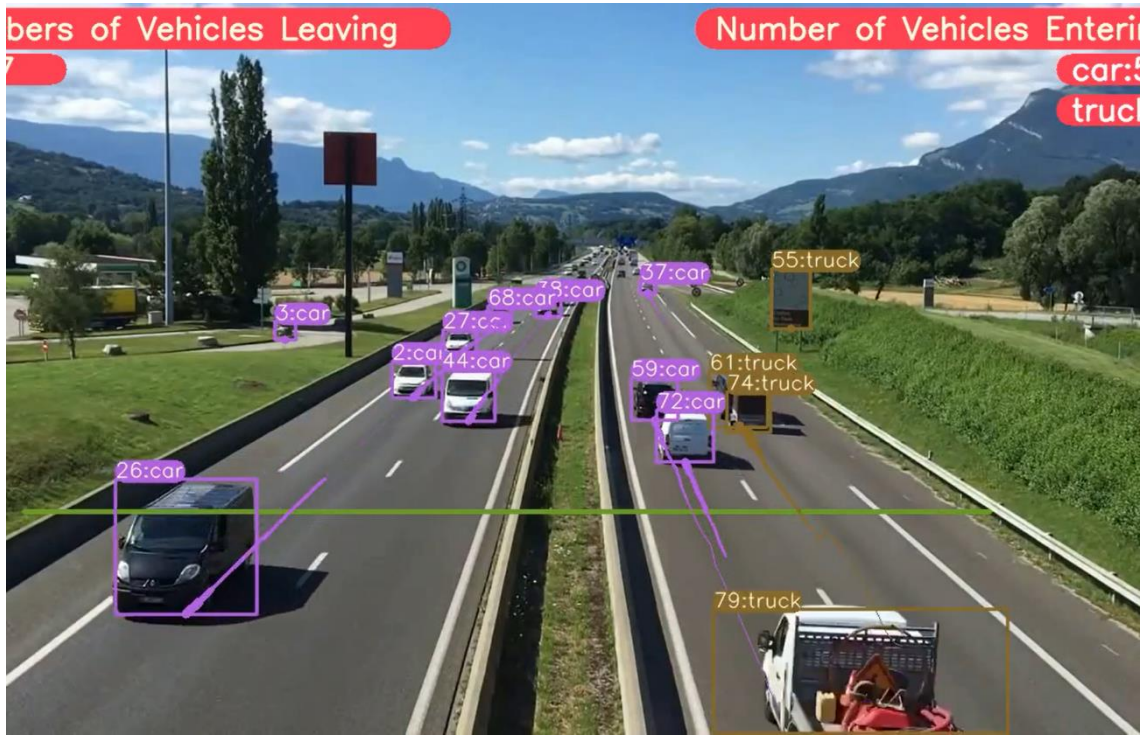
INTEGRATED TESTING

- **Definition**: Integrated testing checks the combined behavior of components working together as a system.
- **Scope**: Test interactions between YOLOv8 (vehicle detection) and Deep SORT (tracking) modules.
- **Mocking**: Use mock objects or stubs to simulate dependencies during integration testing.
- **Example**: Test YOLOv8 outputs as inputs to Deep SORT to ensure proper tracking initiation.

SYSTEM TESTING

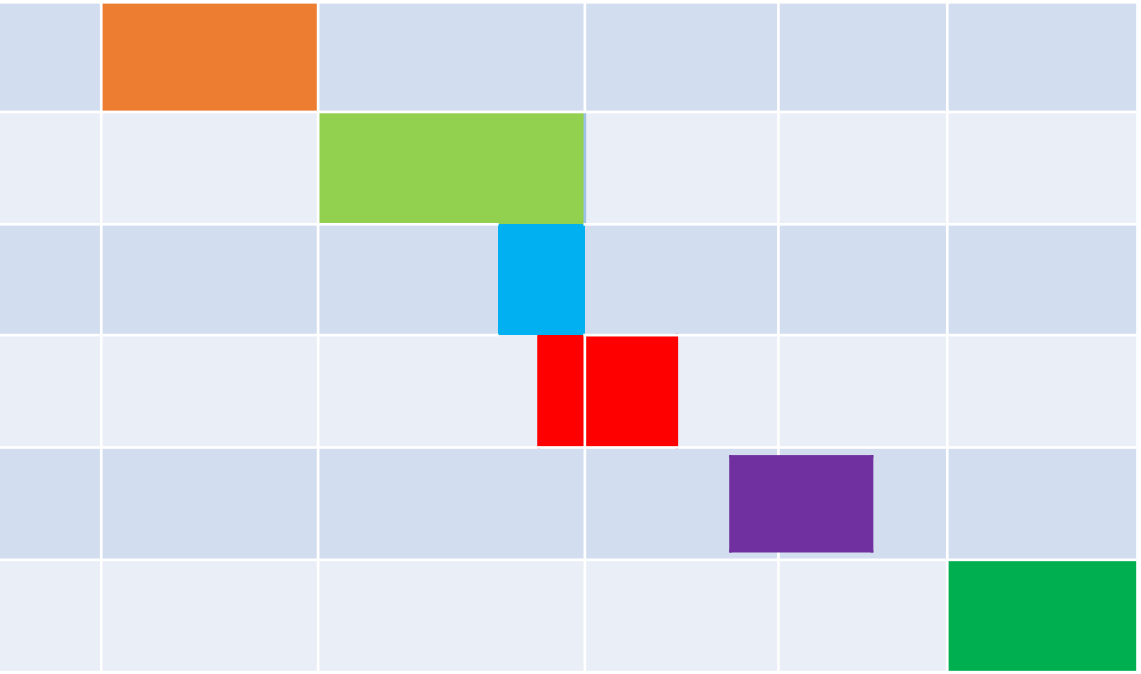
- **Definition**: System testing evaluates the overall behavior of the system as a whole.
- **Test Scenarios**: Define test scenarios (e.g., detecting vehicles in different weather conditions, tracking vehicles in crowded scenes).
- **Performance Metrics**: Measure system performance (e.g., accuracy, real-time processing speed).
- **Example**: Run the entire pipeline on a diverse dataset and assess detection and tracking accuracy.

RESULT AND RESULT ANALYSIS



PROJECT SCHEDULE

Tasks	Oct	Nov	Jan	Feb	April
Requirement Analysis					
Designing					
Test Cases					
Coding with unit testing					
Testing					
Documentation					



CONCLUSION

The integration of YOLO and Deep SORT has proven to be a powerful solution for vehicle detection and tracking. By incorporating additional features such as speed detection and helmet recognition, along with a mobile application for issuing fines or challans, the system enhances road safety and promotes compliance with traffic regulations. Its ability to operate in real-time, manage challenging conditions, and adapt to various environments positions it as a valuable tool for modern traffic management. As research progresses, we anticipate further advancements in accuracy, efficiency, and robustness, which will continue to improve the effectiveness of vehicle detection and tracking systems in real-world applications.

FUTURE ENHANCEMENT

- Enhanced Accuracy
- Real-Time Optimization
- Multi-Object Tracking
- Adaptive Learning
- Deployment and Integration
- Privacy and Ethical Considerations

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QUERIES?

THANK YOU