Traffic Elements Detection Having Explanable AI & Misclassification Image Analysis With Traffic Light Violation Detection

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ABSTRACT

This project detects vehicles and traffic elements using YOLO models, comparing the accuracy and performance of three different YOLO versions. It incorporates Explainable AI (XAI) for transparent decision-making and analyzes misclassification errors to improve detection. The system also includes traffic light violation detection based on real-time input.

METHODOLOGY

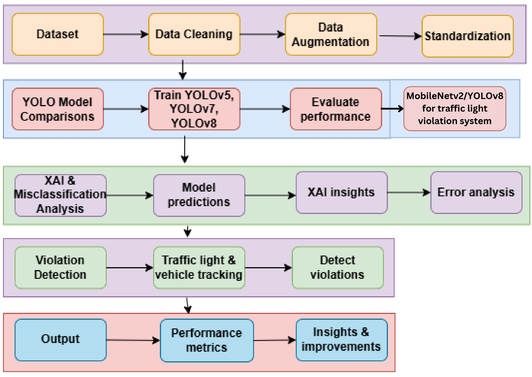

Fig 01: System Workflow

EQUIPMENTS

(If implemented with IOT)

- Cameras
- RaspberryPi
- Microcontroller
- Traffic Light Controllers
- Radar/Lidar Sensors
- Wireless Modules
- Server/Cloud Platform
- Power Supply
- Motion/Infrared Sensors
- GPS Module

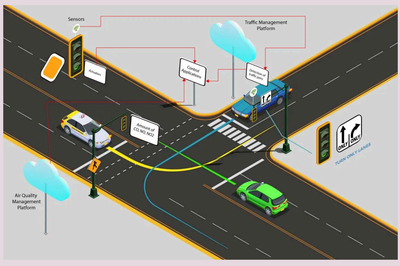

Fig 02: IOT Integrated System

OBJECTIVES

- Detect traffic elements with YOLO models.
- Compare performance of three YOLO models in detection.
- Apply Explainable AI for prediction interpretability.
- Analyze misclassification errors for insights.
- Integrate traffic light violation detection for enforcement.
- Use data augmentation techniques to improve detection accuracy in diverse traffic conditions.

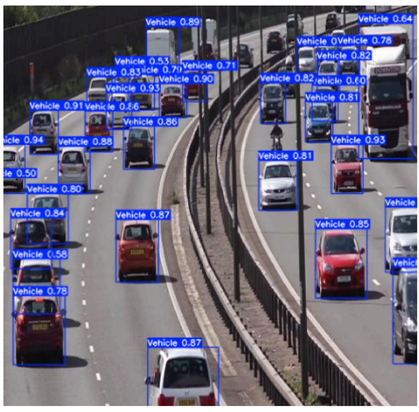

Fig 03: Vehicle Detection

WORKFLOW DIAGRAM

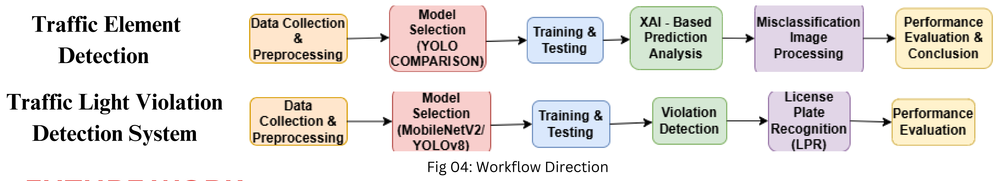

Fig 04: Workflow Direction

FUTURE WORK

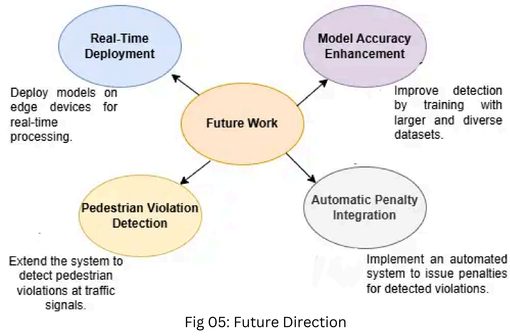

Fig 05: Future Direction

EXPECTED RESULT

- Accurate Detection – Vehicles and traffic elements detected effectively.
- Optimized Performance – YOLO models show improved accuracy.
- Transparent Predictions – XAI provides clear decision insights.
- Error Insights – Misclassification analysis enhances model reliability.
- Violation Detection – Real-time traffic light violations detected accurately.

RELATED WORKS

- Liu, S. (2025, January). Vehicle detection in different traffic scenarios based on YOLOv5. In International Conference on Computer Vision and Image Processing (CVIP 2024) (Vol. 13521, pp. 228-238). SPIE.
- Ravish, R., Rangaswamy, S., & Char, K. (2021, October). Intelligent traffic violation detection. In 2021 2nd Global Conference for Advancement in Technology (GCAT) (pp. 1-7). IEEE.
- Reddy, P. S., Nishwa, T., Reddy, R. S. K., Sadviq, C., & Rithvik, K. (2021, July). Traffic rules violation detection using machine learning techniques. In 2021 6th International conference on communication and electronics systems (ICCES) (pp. 1264-1268). IEEE

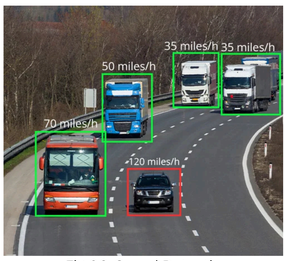

Fig 06: Speed Detection

CONCLUSION

- Demonstrates a robust system for traffic monitoring.
- Enhances explainability and reduces misclassification errors.
- Provides valuable insights for traffic management and law enforcement.