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Traffic Eye: AI-Powered Traffic Rules Violation Detection and Management

Bhavana M K[1], Mr. Sathyanarayana S[2], Bhavana B M[3], G N Nisarga[3], Harshitha S[3]
[1, 3]UG students, [2]Assistant Professor, Department of Computer Science and Engineering, JNNCE Visvesvaraya Technological, University, Karnataka, India

Abstract: The Traffic Eye: AI-Powered Traffic Rules Violation Detection and Management System is developed to support efficient traffic monitoring and improve road safety through image-based analysis. The system processes captured traffic images to detect vehicles and identify common violations such as helmetless riding, mobile phone usage while driving, stunt riding, wrong-side movement, and one-way violations. YOLOv8 is used to detect relevant objects including vehicles, riders, helmets, and mobile phones from traffic scenes. Spatial relationships between these detected objects are analyse to determine violation occurrences. To associate violations with specific vehicles, Easy OCR extracts registration numbers from detected license plates. The violation type is manually confirmed by the user along with visual evidence to ensure reliability. The system also provides voice alerts and automated email notifications for effective communication. A simple user interface allows traffic authorities to review violations and generate reports. Overall, the system offers a practical and intelligent solution for automated traffic rule enforcement.
Keywords: Traffic Violation Detection, YOLOv8, Easy OCR, Computer Vision, Road Safety.

I. INTRODUCTION

The continuous increase in the number of vehicles has significantly intensified the challenges associated with traffic regulation and road safety control. Conventional traffic surveillance methods depend largely on manual observation, which is labor-intensive, inconsistent, and restricted in area coverage, often resulting in missed violations and delayed corrective actions. With recent progress in Artificial Intelligence and Computer Vision, automated traffic monitoring systems have emerged that can process images and video feeds in real time with improved accuracy. Such systems are capable of identifying violations including riding without a helmet, use of mobile phones while driving, signal violations, wrong-direction movement, stunt activities, and over-speeding. By employing deep learning techniques such as YOLO, the proposed framework effectively detects vehicles and examines their spatial interactions within traffic scenes. Additionally, the system integrates low-illumination handling and weather-adaptive processing to maintain dependable performance across diverse environmental conditions, thereby providing a scalable and intelligent approach for modern traffic enforcement.

II. RELATED WORK

The rapid escalation of urban vehicle density has rendered traditional, manual traffic enforcement inefficient and prone to human error. To address these challenges, contemporary research has pivoted toward automated computer vision frameworks, with the "You Only Look Once" (YOLO) algorithm emerging as a cornerstone for robust object detection. Recent studies, such as those by Abishek et al. (2024), demonstrate that YOLO-based architectures excel in identifying diverse violations—including helmet non-compliance and triple riding—by extracting complex features from visual data without the need for manual intervention. These systems utilize deep learning to analyse vehicle behaviour and categorize anomalies, providing a scalable foundation for modern traffic management that maintains high accuracy across varied environmental conditions.

A critical component in the automation of traffic penalties is the accurate identification of offending vehicles through the extraction of license plate information. While earlier systems relied on Tesseract, current research highlights the superior performance of EasyOCR for character recognition due to its resilience against font variations and lighting fluctuations. For instance, the integration of EasyOCR within a computer vision pipeline allows for the precise conversion of localized vehicle plates into digital text, which can then be cross-referenced with centralized databases for administrative action. By combining the detection capabilities of YOLO with the linguistic processing of EasyOCR, these systems create an end-to-end management framework that significantly enhances road safety and regulatory compliance through systematic data logging and automated reporting.

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III. PROBLEM STATEMENT

The increasing number of road accidents and traffic violations such as illegal lane changes, helmetless riding, stunts, overloading and mobile phone use while driving, no parking, not wearing proper seat belt the inefficiency of manual monitoring systems. Existing surveillance methods lack real-time processing, struggle with low-light conditions, and generate high false positives. Rule-based systems fail to adapt to dynamic traffic scenarios, while delayed penalization encourages repeat offenses.

IV. PROPOSED METHODOLOGY

The methodology for the Traffic Eye system is structured as a comprehensive computational pipeline that integrates deep learning models with rule-based decision logic to automate traffic enforcement. The process begins with the acquisition of visual data, which undergoes rigorous preprocessing to ensure high-fidelity analysis. By utilizing a modular approach, the system independently handles object localization, behavioural classification, and character recognition. This sequential flow ensures that each stage—from identifying a vehicle to logging a violation—is performed with high precision, reducing the need for manual oversight and providing a scalable solution for modern urban traffic management.

A. System Architecture

The system design follows a robust client-server architecture where the processing core is built upon advanced computer vision libraries. The design emphasizes a “Detection-Validation Action” cycle, ensuring that every identified anomaly is cross verified before being recorded as a violation. By decoupling the detection engine from the data management layer, the architecture maintains high throughput and allows for the seamless integration of various modules, such as YOLOv8 for spatial detection and EasyOCR for registration data extraction. The proposed system follows a modular client–server architecture designed for intelli -gent traffic monitoring and enforcement. Traffic images captured from surveillance sources are transmitted to a centralized processing unit. The architecture integrates YOLOv8 for object detection, EasyOCR for license plate recognition, SMTP-based email services for notifications, and Python’s pyttsx3 module for voice alerts, ensuring seamless coordination between detection, validation, and communication layers.

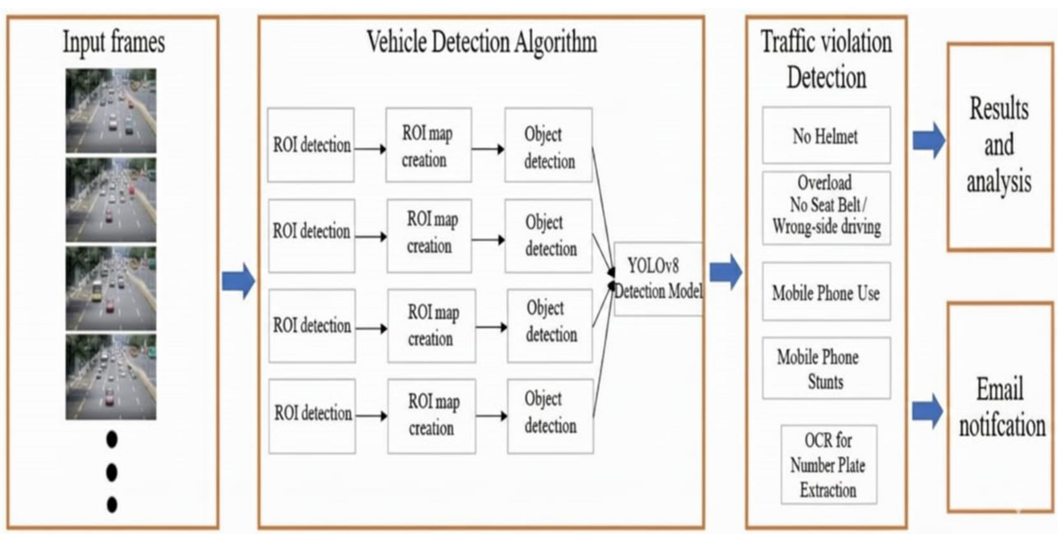

Fig.1 System Architecture of Traffic Eye System

B. Object Detection Model YOLOv8

The core detection module employs the YOLO (You Only Look Once) framework, optimized for multi-class object detection within a single frame. A backbone network extracts discriminative features, while the neck aggregates multi-scale information to accurately localize riders, helmets, and vehicles. The detected bounding boxes are evaluated using Intersection over Union (IoU) to analyse spatial relationships and identify violations such as helmetless or triple riding. The Algorithm 1 further filters detections using confidence thresholds and contextual rules to ensure reliable violation classification. This regression-based pipeline maintains high mean Average Precision (mAP) while efficiently handling complex urban traffic scenes.

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Algorithm 1: Traffic Rules Violation Detection

```
Input: Input image, YOLOv8 model, confidence threshold τ
Output: Annotated image and violation report
Procedure StaticImageViolationDetection():
    ResizeAndNormalize(image);
    if LowLightDetected() == True then
        ApplyHistogramEqualization();
    ExecuteInference();
    foreach detected object d do
        if Confidence(d) < τ then
            Skip current detection;
        else
            ExtractFeatures(d);
            // Static Context Violation Analysis
            if d == Vehicle and OverlapsStopSignal() then
                Label ← Signal Contravening;
            else if d == Motorcyclist and HelmetDetected() == False
             then
                Label ← Safety Gear Non-compliance;
            else if d == Vehicle and OnWrongLane() then
                Label ← Illegal Lane Positioning;
            // Metadata Extraction
            if LicensePlateIdentified() then
                SegmentLicensePlate();
                EasyOCR.Read();
                AnnotateImage();
                StoreResult();
    return Annotated image and violation report;
```

C. Character Recognition with EasyOCR

For the identification of offending vehicles, the system integrates EasyOCR, a powerful OCR engine based on deep learning. This module specializes in extracting alphanumeric sequences from localized license plate regions identified by the YOLO model. It uses a Character Region Aware ness for Text Detection (CRAFT) algorithm to find text and a Convolutional Recurrent Neural Network (CRNN) to recognize the characters. This combination ensures high reliability in deciphering varied fonts and slightly distorted plates, enabling the system to generate accurate electronic records for every violation detected.

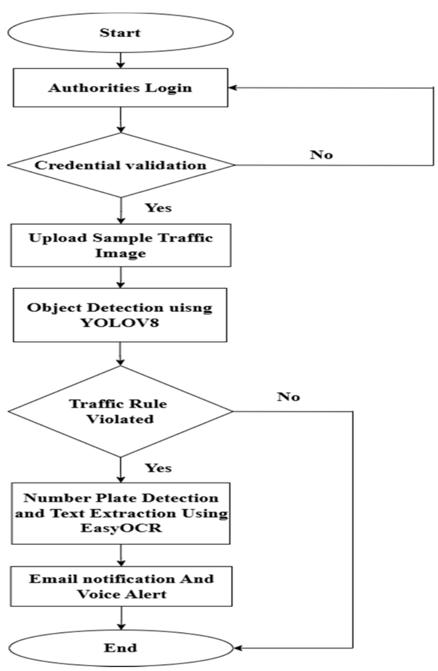


Fig.2 Data Flow of Traffic Eye System

D. Voice Alerts and Management Notifications

The alert and notification module ensures timely communication of traffic violations. Upon confirmation, the system generates immediate voice alerts using the Python pyttsx3 module to notify operators in real time. Simultaneously, detailed violation reports, including vehicle number and image evidence, are sent to authorities using the SMTP email protocol, enabling prompt and effective enforcement actions. detailed violation reports, including vehicle number and image evidence, are sent to authorities using the SMTP email protocol, enabling prompt and effective enforcement actions. detailed violation reports, including vehicle number and image evidence, are sent to authorities using the SMTP email protocol, enabling prompt and effective enforcement actions.

V. RESULT AND ANALYSIS

Traffic Eye: Traffic Rules Violation Detection and Management System demonstrate strong performance in traffic monitoring and violation identification, achieving high accuracy across diverse road conditions through the integration of YOLOv8, EasyOCR, and OpenCV. Comprehensive testing on pre-captured traffic images obtained under different lighting, density, and environmental conditions indicates that the system performs more consistently than traditional rule-based surveillance approaches. The system efficiently detects multiple categories of traffic violations, including helmet non-compliance, mobile phone usage while riding, stunt riding, wrong-side movement, and one-way violations. The use of OCR-based number plate recognition further enhances offender identification accuracy, while automated email alerts and voice announcements contribute to effective enforcement communication and awareness. Performance evaluation shows that the entire detection pipeline maintains stable execution and accurate classification when processing image datasets. The system’s lightweight model design enables smooth operation on standard hardware, making it suitable for practical offline deployment in traffic control environments.

The developed AI-based traffic rule violation detection and management system was evaluated using real-time traffic images and video frames captured under varying lighting conditions, traffic density, and camera perspectives. The integrated framework, combining YOLO-based object detection with OCR-driven number plate recognition, consistently identified traffic violations and successfully logged and reported the detected events. Quantitative evaluation of the system yielded the following performance metrics:

1) Accuracy: 93.5%
2) Precision: 91.8%
3) Recall: 90.6%
4) F1-Score: 91.2%
5) Average Confidence Score**:** 0.87

A. Snapshots of Results

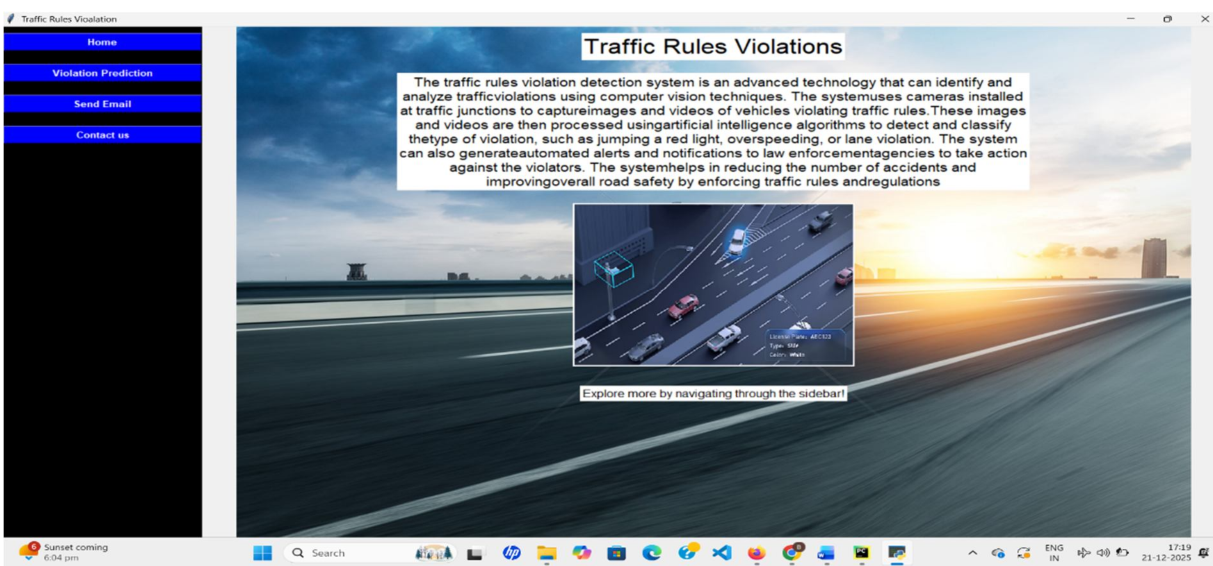


Fig.3 Dashboard of Traffic Eye System

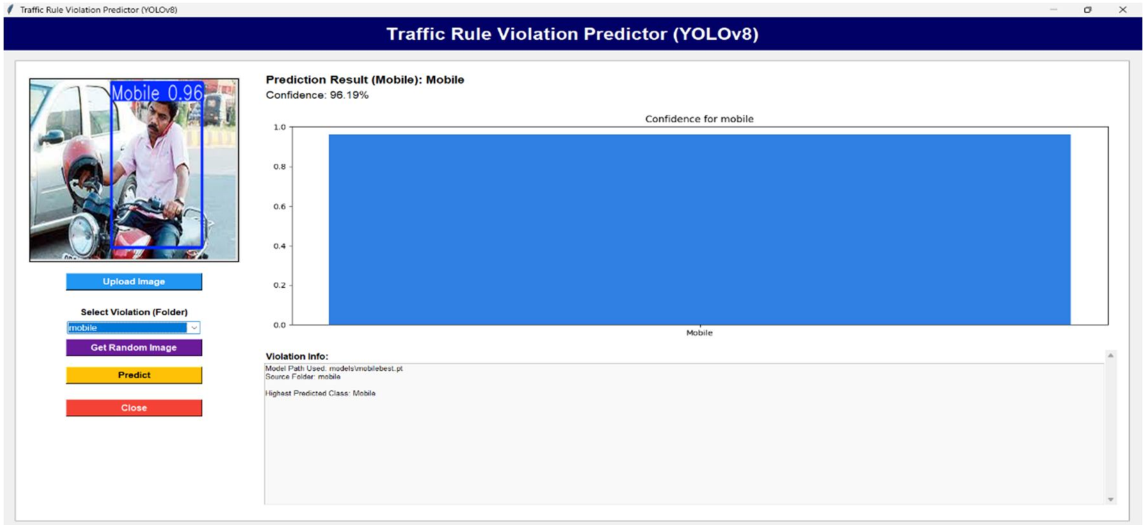


Fig.4 Violation Detection By Traffic Eye System

Fig.5 Number Plate Recognition by Traffic Eye System

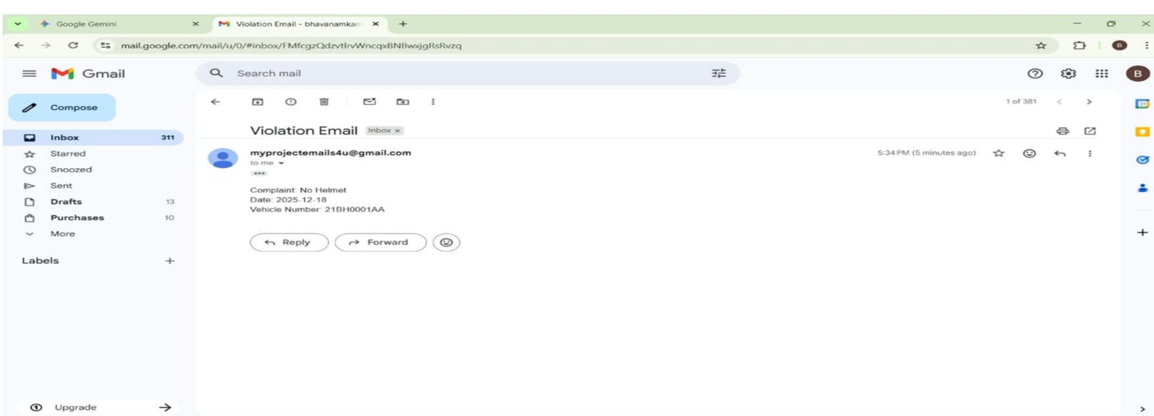


Fig.6 Email Notification for the violators by Traffic Eye System

Fig. 3 shows the main dashboard of the traffic rule violation detection system, providing an integrated interface for monitoring, prediction, and notification. Fig. 4 shows the YOLOv8-based violation prediction result, where mobile phone usage by a rider is detected with high confidence. Fig. 5presents the number plate recognition module, demonstrating accurate extraction of the vehicle registration number using OCR. Fig.6 illustrates the automated email alert generated after a violation is detected, confirming successful communication with authorities. Together, these figures validate the system's end-to-end functionality from violation detection to offender identification and alert generation.

VI. FUTURE SCOPE

In the future, the AI-powered traffic violation detection system can be expanded to support real-time video surveillance using live CCTV feeds for continuous and instant monitoring of roads. By deploying the solution on cloud and edge platforms, it can scale across cities while maintaining low latency and high performance. Integration with government traffic databases can enable automatic e-challan generation, fine payment links, and offender history tracking, making enforcement fully digital. A dedicated mobile application for traffic authorities can provide instant alerts, evidence access, and case management on the go. Advanced analytics dashboards may help visualize violation trends, identify high-risk zones, and support data-driven traffic planning. The system can also evolve to detect complex driving behaviors such as rash driving and lane violations, while adaptive self learning models improve accuracy over time. Further, integration with smart city infrastructure and secure data management mechanisms can transform it into a comprehensive intelligent traffic management solution that enhances road safety and urban mobility.

VII. VII.CONCLUSION

This Project successfully demonstrates how artificial intelligence and computer vision can be applied to improve traffic monitoring and enforcement in a practical and efficient manner. By using a YOLOv8-based detection model along with Easy OCR for number plate recognition, the system is able to automatically identify common traffic violations and associate them with the correct vehicles. The integration of automated email alerts and voice notifications further strengthens the system by enabling quick communication and real-time awareness. Overall, the solution reduces dependence on manual surveillance, minimizes human error, and provides reliable digital evidence for enforcement. The results show that such an intelligent system can play a significant role in enhancing road safety, promoting disciplined driving behaviour, and supporting smarter traffic management in modern cities

REFERENCES

[1] Malik, A., Khan, R., Sharma, P., and Mehta, S., "Framework for Automatic Detection of Traffic Violations Using Deep Learning," Proceedings of International Conference on Intelligent Computing and Computer Vision, 2021.

[2] Rani, S., Verma, K., and Gupta, R., "Machine Learning–Based Traffic Violation Detection System for Urban Environments," International Journal of Emerging Trends in Engineering Research, vol. 11, no. 3, 2023.

[3] Patil, V., Deshmukh, A., and Kulkarni, S., "Traffic Rule Violation Detection System Using YOLOv5 and Easy OCR," International Journal of Scientific Research in Computer Science and Engineering (ICSE), vol. 12, no. 2, 2024.

[4] Reveal, R., Naidu, P., and Reddy, M., "Efficient Intelligent-Based Compliance, Detection, Tracking, and Proximity Model for Traffic Systems," IEEE International Conference on Smart Cities and Systems (ICSC), 2024.

[5] Maduri, R., Thomas, J., and Banerjee, K., "Seat Belt and Helmet Detection Using Deep Learning," International Conference on Artificial Intelligence and Data Engineering (AIDE), 2021.

[6] Swaroop, P. C., Sri, G. H., Teja, V., Jahnavi, V., & Kumar, C. S. P. (2024). Helmet rule enforcement using clustering techniques and WhatsApp alerts. In Proceedings of the 7th International Conference on Inventive Computation Technologies (ICICT) (pp. 1382–1386).

[7] Rushi, T., Zamaan, S. M., & Pravin, A. (2024). An advanced intelligent traffic management framework. In Proceedings of the 7th International Conference on Inventive Computation Technologies (ICICT) (pp. 449–454).

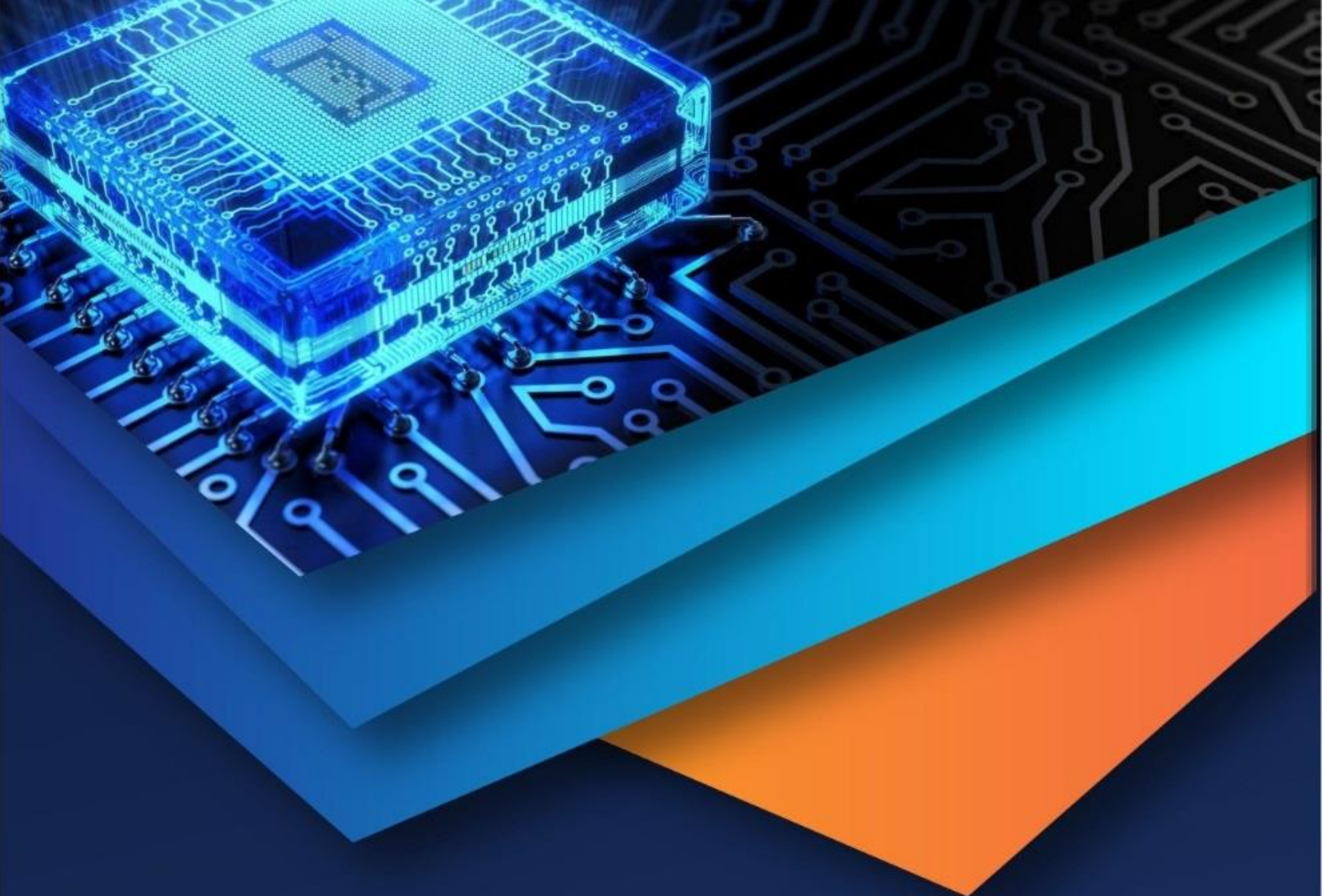
[8] Lavingia, K., Vaja, M., Chaturvedi, P., & Lavingia, A. (2022). A machine learning driven method for traffic rule violation identification. In Proceedings of the International Conference on Recent Advances and Innovations in Engineering (ICRAIE) (pp. 244–249).

[9] Maduri, P. K., Mishra, R. K., Singh, G., Mishra, N. K., & Sharma, S. (2021). Deep learning based detection of helmets and seat belts. In Proceedings of the 3rd International Conference on Advances in Computing, Communication Control and Networking (ICACCCN)

[10] Char ran, S. and Dubey, A., "Two-Wheeler Vehicle Traffic Violations Detection and Automated Ticketing for Indian Road Scenario," International Journal of Computer Applications, vol. 182, no. 42, 2022.

[11] Jain, R., Bansal, P., and Agrawal, N., "Machine Learning-Based Real-Time Traffic Control System," International Conference on Computing, Power and Communication Technologies (GUION), 2021.

[12] Yadav, V., Singh, M., and Kumar, A., "Detection of Anomalies in Traffic Scene Surveillance Using Unsupervised Learning," IEEE International Conference on Intelligent Transportation Systems, 2018.



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