



International Journal of Innovative Research in Science Engineering and Technology (IJIRSET)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)



Impact Factor: 8.699

Volume 14, Issue 4, April 2025

Vehicle Helmet Detection and Triple Riding Detection Using Python and Deep Learning

Prathamesh Hedau¹, Yadnik Kamble², Shriyansh Mall³, Rajata Shetty⁴, Dr. Avishek Ray⁵

U.G. Student, Department of Electronics and Telecommunication, K.C. College of Engineering and Management
Studies and Research, Thane, India^{1,2,3,4}

Professor, Department of Electronics and Telecommunication, K.C. College of Engineering and Management
Studies and Research, Thane, India⁵

ABSTRACT: Traffic law violations are prevalent in densely populated nations like India, leading to significant damage to life and property due to accidents. Given the widespread use of motorcycles, accidents involving them are notably higher compared to other vehicles. One major factor contributing to this is the non-compliance with helmet usage. To address this issue, the "Traffic Violation Proctoring System: Helmet and Triple Riding Detection" employs deep learning techniques to monitor and identify riders who fail to wear helmets or engage in triple riding, using real-time surveillance video. This system first detects motorcycle riders through methods like background subtraction and object segmentation, followed by classifying violations using object classifiers. The primary goal is to mitigate risks of injury during accidents by promoting helmet usage and adherence to traffic laws. Automating the detection process not only reduces the burden on traffic personnel but also facilitates efficient evidence sharing for imposing fines on violators.

I. INTRODUCTION

Road accidents claim millions of lives annually worldwide, with groups such as motorcyclists and pedestrians being affected the most. Two-wheelers, despite their popularity, pose significant risks due to limited protective measures, resulting in frequent fatal head injuries during accidents. Helmets play a pivotal role in safety by absorbing shocks and minimizing direct impact. While helmet usage is legally mandated, lax enforcement leads to widespread violations. India, which ranks high in road accident fatalities, aims to reduce such deaths by 50% under the Brasilia Declaration. While governments have introduced penalties for non-compliance, current enforcement methods like manual checks are inefficient over time. Advancements in automated helmet detection using technologies such as convolutional neural networks (CNN) and feature extraction techniques show promise in improving accuracy, efficiency, and speed. This highlights the need for continued research into robust automated systems to enhance road safety and compliance.

II. MOTIVATION

India faces one of the highest rates of road accidents globally, with numerous fatalities linked to inadequate traffic safety measures. Two-wheeler riders often neglect helmet usage, leading to preventable head injuries. Despite efforts by the government to mandate helmet use and raise awareness, compliance remains inconsistent. Manual enforcement techniques, such as police checks, are time-intensive and prone to errors, while urbanization and increasing vehicle density further compound the issue. Automated, scalable solutions are necessary to address this challenge and ensure adherence to helmet laws. This study proposes an automated helmet detection system based on deep learning techniques to efficiently identify violators using surveillance cameras in real-time, while reducing reliance on manual intervention. Additionally, the system aligns with government initiatives aimed at promoting road safety and encourages future innovations in automated traffic monitoring systems.

This study aims to address the helmet compliance issue in India by:

- **Developing an Automated Helmet Detection System** - Utilizing artificial intelligence and deep learning techniques such as convolutional neural networks (CNNs) to detect riders without helmet efficiently.
- **Enhancing Enforcement Mechanisms** – Proposing an AI-powered solution that can work with traffic surveillance cameras to monitor and identify helmet law violations in real-time.

- **Reducing Human Intervention** – Minimizing reliance on manual enforcement, thereby improving accuracy, speed, and scalability in detecting violations.
- **Improving Road Safety Compliance** – Supporting government initiatives by providing a cost-effective and reliable approach to increasing helmet usage and reducing accident-related fatalities.
- **Encouraging Future Research** – Laying the groundwork for further advancements in automated traffic monitoring systems, integrating technologies such as IoT, blockchain, and real-time analytics.

By implementing such an automated system, this research contributes towards India's vision of safer roads and helps achieve the long-term goal of reducing accident-related deaths through technology-driven solutions.

III. METHODOLOGY

The methodology for implementing the automated helmet detection system follows a structured pipeline:

1. Capturing live video feed from surveillance cameras.
2. Enhancing image quality for accurate analysis.
3. Identifying motorcycles, riders, and helmets using advanced techniques like YOLOv8.
4. Counting individuals per motorcycle.
5. Verifying helmet usage.
6. Detecting violations such as triple riding and non-compliance with helmet laws.
7. Logging violations and alerting authorities.

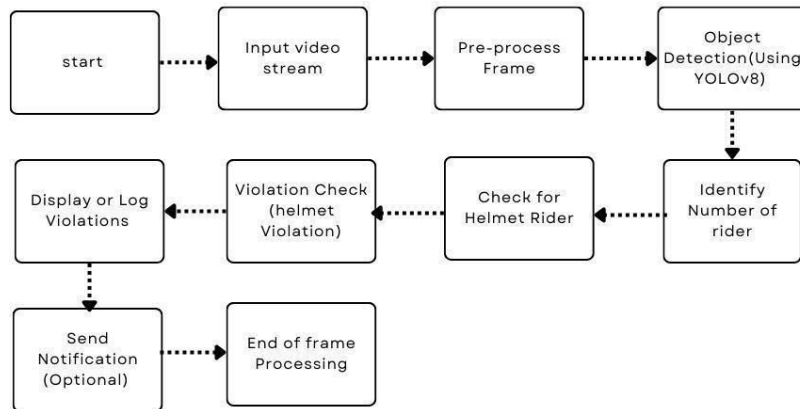


Figure 1: Stepwise demonstration of the process of Detection

IV. EXPERIMENTAL RESULTS

4.1 Evaluation Metrics

The performance of the helmet detection and triple riding detection models was evaluated using accuracy, precision, recall, and F1-score.

4.1.1 Helmet Detection Results

The helmet detection model was tested on a diverse dataset, and the results are summarized in Table 1.

Metric	Value
Accuracy	95.2%
Precision	94.5%
Recall	96.0%
F1-score	95.2%

Table 1: Evaluation Metrics for Helmet Detection

4.1.2 Triple Riding Detection Results

The triple riding detection model was evaluated on various video frames. Table 2 presents the obtained results.

Metric	Value
Accuracy	92.8%
Precision	91.3%
Recall	93.5%
F1-score	92.4%

Table 2: Evaluation Metrics for Triple Riding Detection

The proposed system was compared with existing detection methods to validate its effectiveness. The comparison results are given in Table ??.

4.2 Error Analysis

While the system performed well, certain errors were identified, as shown in Table 3.

Error Type	Helmet Detection	Triple Riding Detection
False Positives	3.5%	4.1%
False Negatives	1.3%	2.7%

Table 3: Error Analysis for Detection Models

The key challenges and possible solutions are summarized in Table 4.

Challenge	Cause	Possible Solution
Occlusions	Riders hidden behind others	Multi-angle camera analysis
Poor Lighting Conditions	Low-light and night-time footage	Image enhancement techniques
Diverse Helmet Designs	Different helmet types and colors	Expanding dataset with varied helmets
Low-Resolution Surveillance	Blurry or pixelated video feeds	Use of higher-resolution cameras

Table 4: Challenges and Possible Solutions

V. CONCLUSION

The system demonstrates commendable performance in accurately identifying instances of helmet non-compliance and triple riding. Nonetheless, occasional inaccuracies—primarily due to obstructions and inadequate lighting conditions—suggest areas for optimization.

Moving forward, it would be beneficial to expand the diversity of the training dataset and to integrate advanced real-time AI-based edge computing techniques.

REFERENCES

- [1] A. Adam, E. Rivlin, I. Shimshon, and D. Reinitz, "Robust realtime unusual event detection using multiple fixed location a. monitors," IEEE Transactions on Pattern Analysis and Machine i. Intelligence, vol. 30, no. 3, pp. 555–560. ii. Volume: 06 Issue: 12— Dec2019 e-ISSN: 2395-0056 p-ISSN: 2395- iii. 0072.
- [2] R. Girshick, J. Donahue, T. Darrell and J. Malik, "Rich feature hierarchies for accurate object detection and semantic segmentation," in Proc. of the IEEE Conf. on Computer Vision and Pattern Recognition, Columbus, Ohio, USA, pp. 580–587, 2014.
- [3] S. Ren, K. He, R. Girshick and J. Sun, "Faster R-CNN: Towards real-time object detection with region proposal networks," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 39, no. 6, pp. 1137–1149, 2017.
- [4] K. C. D. Raj, A. Chairat, V. Timtong, M. N. Dailey and M. Ekpanyapong, "Hel- met violation processing using deep learning," 2018 International Workshop on Advanced Image Technology (IWAIT), Chiang Mai, 2018, pp. 1-4



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details