IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 12, Issue 4, April 2024

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 | Monthly Peer Reviewed & Referred Journal |

|| Volume 12, Issue 4, April 2024 ||

| DOI: 10.15680/IJIRCCE.2024.1204047 |

ADVANCED TRAFFIC SURVEILLANCE SYSTEM : Augmenting Safety Measures And Ensuring Accountability On The Roads

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ABSTRACT: One of the problems in traffic regulations in India is riding motorcycle/mopeds without helmet, which increases accident sand deaths. In the existing system, the traffic police monitor the traffic violations through CCTV recordings, and in case if the rider without helmet is detected, then its vehicle number is recorded. But the constant monitoring is required to control the traffic rule violation which happens very frequently. To overcome these problems, we will require a system which would automatically handle traffic violations for non-helmet rider and thus would automatically extract the vehicles' license plate number. The various research has successfully done in this area using CNN, R-CNN, LBP, HoG, HaaR features etc., but the results are limited with respect to efficiency, accuracy and speed. To overcome the problems associated with it, we develop a Non-Helmet Rider detection system, which attempts to satisfy the automation of detecting the traffic violation of non-helmet person and extracting the vehicles' license plate number.

The main principle involved in this system is Object Detection using Deep Learning at three levels. The person, motorcycle/moped is detected at first level using YOLOv2, helmet at second level using YOLOv3, License plate at the last level using YOLOv2. Then the license plate registration number is extracted using OCR (Optical Character Recognition). Since, this work takes video as its input, the speed of execution is crucial.

KEYWORDS: YOLO, Helmet Detection, LP Detection and OCR

I. INTRODUCTION

As per the report by the world health organization, around50 million people are getting injured due to road accidents, and this burden is unevenly borne by motorcyclists, cyclists and pedestrians. The alarming fact is that, India ranks number one as far as road crash deaths are concerned because of rapid urbanization, avoiding helmets, seat belts and other safety measures while driving. When a two-wheeler meets with an accident, due to sudden deceleration, the rider is thrown away from the vehicle. In such times the helmet acts as life saviour. Helmet reduces the chances of the skull getting deaccelerated, hence sets the motion of the head to almost zero. Traffic rules are there to bring a sense of discipline, so that the risk of deaths and injuries can be minimized significantly. However, in reality, strict adherence to these laws is not followed. Manual surveillance of traffic using CCTV is an existing methodology. But number of iterations have to be performed to attain the objective and also it demands a lot of human resources. So, in cities with millions of populations with many vehicles running on the roads cannot afford this inadequate manual method of helmet

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detection. So here we propose a methodology for full helmet detection and license plate extraction using YOLOv3 and OCR.

The main aim of the system is to build a Non-Helmet Detection System in order to automate the traffic rules and detecting the violators by extracting the license plate number. The automated system, for detecting and penalize motorcycle riders without a helmet, will naturally motivate the two-wheeler riders to wear helmets. It will not only reduce the number of accidents but also reduce the requirement for manpower in monitoring the traffic violations.

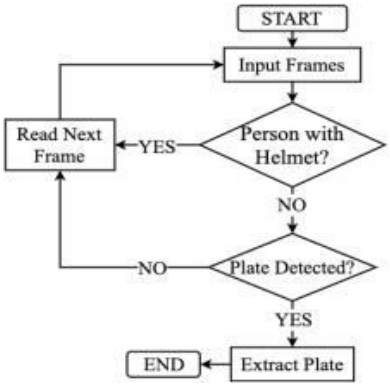
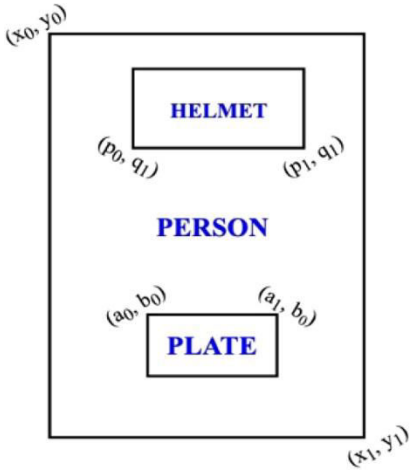


Fig 1: Graphical model of helmet detection and number plate detection

II. FEATURE EXTRACTION

The proposed non-helmet detection system leverages advanced computer vision techniques, specifically YOLOv3 for object detection and OCR for license plate extraction, to automate the enforcement of helmet laws and enhance road safety. By installing cameras at strategic locations on roads, the system captures images or video footage of passing vehicles, particularly focusing on two-wheeler riders. YOLOv3 processes these images in real-time, identifying instances where riders are not wearing helmets with high accuracy. Simultaneously, OCR technology extracts license plate numbers from the captured images, facilitating the identification of vehicles and their owners. Detected violations, such as riders without helmets, are flagged and recorded automatically, with authorities notified promptly. This automated enforcement mechanism enables appropriate actions to be taken, such as issuing fines or warnings to violators, reducing reliance on manual surveillance and enhancing compliance with traffic regulations. The system also monitors compliance over time, providing valuable data for analysis and informing enforcement strategies. Integration with existing traffic management systems ensures scalability and seamless operation, while privacy and security measures safeguard the handling of captured images and data. A user-friendly interface allows authorities to access violation data, generate reports, and track enforcement activities effectively, fostering a safer and more disciplined road environment.



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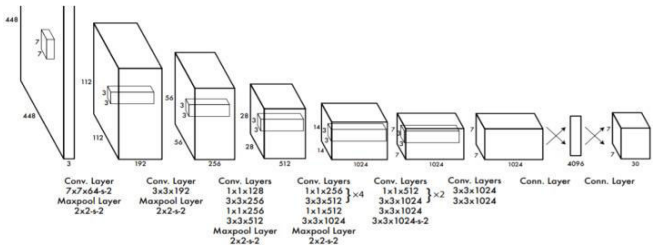

Fig 2: Working of Feature extraction from a image

III. CONTEXT ENCODING

The proposed non-helmet detection system is an innovative solution leveraging advanced technology, including YOLOv3 for object detection and OCR for license plate extraction, to automate enforcement of helmet laws and improve road safety. By strategically installing cameras along roadways, the system captures real-time images or video footage of passing vehicles, focusing on two-wheeler riders. YOLOv3 processes these images, accurately identifying instances where riders are not wearing helmets, while OCR extracts license plate numbers for vehicle identification. Detected violations are promptly flagged and recorded, enabling authorities to take appropriate actions, such as issuing fines or warnings, without extensive manual intervention. This streamlined enforcement process promotes compliance with traffic regulations, reduces the risk of accidents and fatalities, and offers valuable insights for refining enforcement strategies. Integration with existing traffic management systems ensures scalability and seamless operation, while prioritizing privacy and security to maintain public trust. Overall, the system represents a significant advancement in automated traffic enforcement, with the potential to create a safer road environment for all.

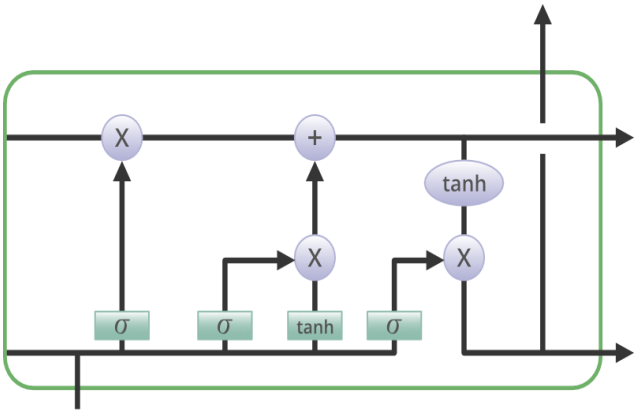

Fig 3: Graphical model of Context Encoding

IV. EXISTING SYSTEM

The existing systems for helmet detection have primarily utilized Support Vector Machines (SVM) coupled with techniques like Hough transform to classify helmets and human heads without helmets, as well as to detect the head of the motorcyclist. However, these approaches often rely solely on geometric features, resulting in limitations such as lower accuracy. For instance, some systems verify helmet presence solely based on geometric features, overlooking other potentially crucial factors. Additionally, while some systems compute edges on possible helmet regions for detection, they still struggle with accuracy issues. Overall, the main drawback of these existing systems is their relatively lower accuracy, which hampers their effectiveness in reliably detecting helmets and enforcing safety regulations.

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V. PROPOSED SYSTEM

The proposed system aims to elevate this framework into a more comprehensive Traffic Safety and Monitoring System. In the proposed system, enhancements are introduced, such as multi-object detection to identify pedestrians, vehicles, and road conditions, traffic flow analysis for congestion detection, automated violation detection, and integration with traffic management systems. It also incorporates license plate recognition, cloud-based processing, and a mobile application for authorities. Data analytics, privacy protection, and robust environmental adaptability further strengthen the system.

A user-friendly control panel and a maintenance plan ensure long-term reliability, culminating in a versatile and powerful solution for enhancing road 5safety and traffic management Implementing helmet and number plate detection using Python typically involves computer vision techniques and deep learning models. One popular approach is to use a pre-trained object detection model like YOLO (You Only Look Once)

VI. SYSTEM ARCHITECTURE

The proposed system architecture for the non-helmet detection solution using YOLOv3 and OCR comprises a camera infrastructure capturing real-time images or video footage of passing vehicles, particularly focusing on two-wheeler riders. These images are processed through the YOLOv3 object detection module to identify instances of riders without helmets, followed by OCR techniques to extract license plate numbers. Violations are flagged and recorded, and relevant authorities are notified. Data storage and management, along with a user interface for reporting and analysis, are integrated into the system, ensuring scalability, privacy, and security measures are in place. This architecture facilitates automated enforcement of helmet laws, contributing to improved road safety and traffic management.

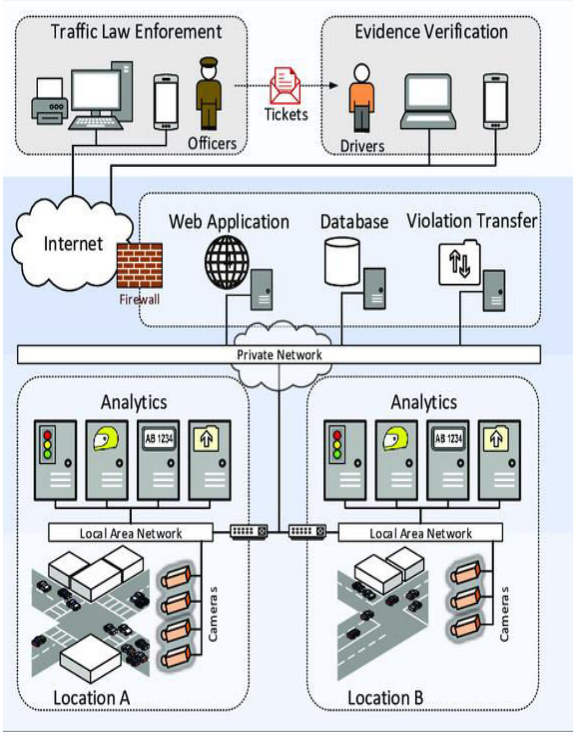

Fig 4: System Architecture of Algorithms

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VII. LITERATURE

Numerous studies have explored helmet detection systems for motorcyclist safety, such as Palanivel and Hiremath's review outlining various approaches in the International Journal of Innovative Research in Computer and Communication Engineering. Redmon and Farhadi's work on YOLOv3, published as an arXiv preprint, discusses advancements in object detection techniques. Additionally, Kumar et al. provide a comprehensive review of Optical Character Recognition (OCR) techniques in their paper, offering insights into the extraction of license plate numbers. Integrated systems, like Khodakovsky et al.'s study on object detection and OCR for license plate recognition presented at the 16th International IEEE Conference on Intelligent Transportation Systems, demonstrate the feasibility of combining these technologies for enhanced traffic enforcement. Furthermore, Uddin and Rokonuzzaman's research on automated traffic enforcement systems using computer vision techniques, as presented in the 3rd International Conference on Electrical Engineering and Information & Communication Technology, underscores the importance of incorporating advanced technologies for effective traffic management and safety measures.

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B. Identify the Headings

The proposed non-helmet detection system aims to leverage advanced technology to automate enforcement of helmet laws and enhance road safety. Utilizing YOLOv3 for real-time object detection and OCR for license plate extraction, the system seeks to identify instances of riders without helmets with high accuracy. By strategically placing cameras on roads, images or video footage of passing vehicles, particularly focusing on two-wheeler riders, are captured. These images are processed through YOLOv3 to detect helmet violations, while OCR techniques extract license plate numbers for vehicle identification. Violations are flagged, recorded, and appropriate enforcement actions are initiated, contributing to improved traffic management and safety. The integration of object detection and OCR technologies facilitates seamless enforcement, reducing reliance on manual surveillance and promoting compliance with traffic regulations. Overall, the proposed system represents a comprehensive approach to automated traffic enforcement, addressing key challenges in road safety and enhancing overall compliance with helmet laws.

C. Figures and Tables

a) Positioning Figures and Tables: Here we have used helmet 8k dataset.

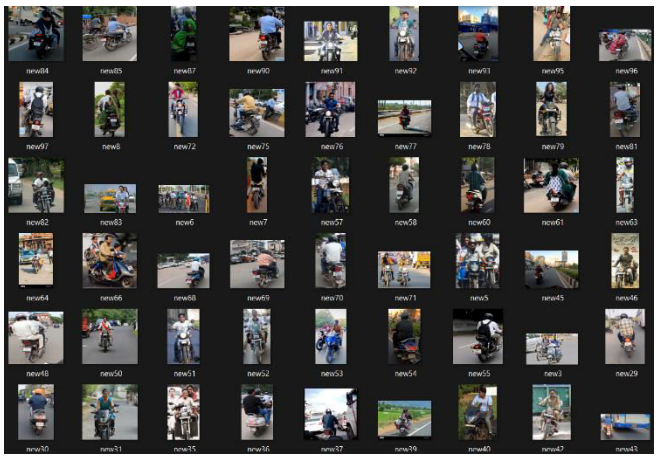

Fig 5: Helmet Dataset

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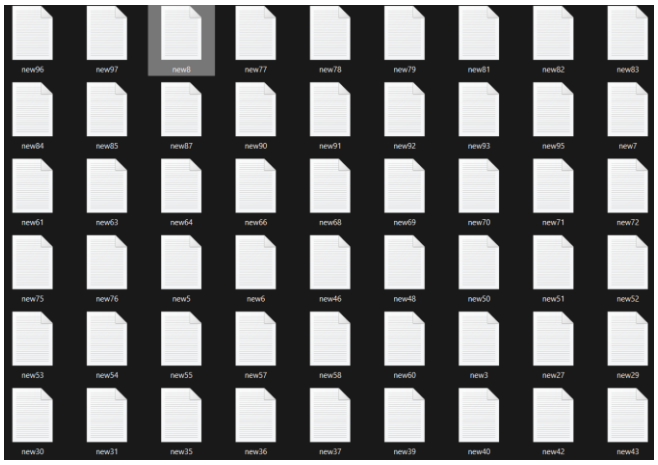

Fig 6: Descriptions of images in the dataset.

VIII. CONCLUSION

The proposed non-helmet detection system, utilizing YOLOv3 and OCR technologies, offers a promising solution to enhance road safety and enforce helmet laws effectively. By automating the detection of violations and integrating advanced computer vision techniques, the system streamlines enforcement processes and reduces reliance on manual surveillance. With its ability to accurately identify instances of non-compliance and extract license plate information, the system provides authorities with valuable data for targeted enforcement and analysis of compliance trends. By promoting greater adherence to helmet laws, the system has the potential to significantly reduce road accidents and fatalities, creating a safer environment for all road users. Overall, the proposed system represents a critical step forward in leveraging technology to address pressing challenges in traffic management and enhance public safety on the roads.

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INTERNATIONAL STANDARD SERIAL NUMBER INDIA

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