



“Automatic Helmet Detection and Number Plate Recognition”

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Abstract : The Automatic Helmet Detection and Number Plate Recognition system presented in this study addresses critical aspects of road safety and law enforcement. This innovative system leverages computer vision and deep learning techniques to automatically detect whether motorcyclists are wearing helmets and recognize the number plates of vehicles in real-time. The helmet detection component employs convolutional neural networks (CNNs) to analyze video or image streams from traffic surveillance cameras. It accurately identifies the presence or absence of helmets on riders' heads, contributing to the enforcement of helmet usage laws and enhancing road safety. Simultaneously, the number plate recognition module employs optical character recognition (OCR) and advanced image processing methods to extract alphanumeric characters from vehicle license plates. This information is crucial for tracking and identifying vehicles, managing traffic violations, and ensuring compliance with vehicle registration requirements. The integration of these two functionalities into a single system offers a comprehensive solution for enhancing road safety and law enforcement. The Automatic Helmet Detection and Number Plate Recognition system has the potential to reduce accidents, improve traffic management, and streamline the identification of violators. This technology can be applied across various domains, including traffic control, security, and public safety, contributing to safer and more efficient roadways.

Keywords: *Helmet Detection, Number Plate Detection, Motorcycle, convolutional neural networks (CNNs) Safety, Deep learning*

INTRODUCTION

In an era where road safety and law enforcement have become paramount concerns, the development of innovative technologies plays a pivotal role in ensuring the well-being of citizens and the efficient functioning of traffic systems. Among these technologies, Automatic Helmet Detection and Number Plate Recognition have emerged as indispensable tools for addressing these critical issues. Road accidents, particularly those involving motorcycles, pose a significant threat to public safety. While the use of helmets has proven to be one of the most effective measures in reducing the severity of head injuries in accidents, many riders fail to adhere to helmet usage laws. This lax compliance necessitates the need for a proactive solution. Simultaneously, the recognition of vehicle number plates is essential for identifying vehicles, managing traffic violations, and ensuring the legitimacy of vehicles on the road. Automatic Helmet Detection and Number Plate Recognition are two distinct yet interconnected components of a system designed to tackle these challenges. Through the fusion of computer vision, deep learning, and image processing technologies, this system has the capability to detect whether motorcyclists are wearing helmets and recognize the alphanumeric characters on vehicle license plates in real-time. The implications of such a system are far-reaching. It not only facilitates the enforcement of helmet usage laws and promotes road safety but also aids law enforcement agencies in efficiently identifying and tracking vehicles. Moreover, the technology provides a means to manage traffic violations effectively, ultimately enhancing the overall functioning of traffic systems. This

introduction serves as a prelude to an exploration of the methodologies, benefits, and potential applications of Automatic Helmet Detection and Number Plate Recognition, offering insights into how this innovative technology can play a vital role in making our roads safer and our communities more secure.

PROPOSED SYSTEM

- The helmet is the main safety equipment of motorcyclists. However, many drivers do not use it.
- The main goal of helmet is to protect the drivers head in case of an accident. In such a case, if the motorcyclist does not use a helmet, it can be fatal.
- We are dealing with a variety of motorcyclists with distinct colours of clothes, helmets, and angles of motorcyclists. to achieve this, we require a deep neural network that will help to determine the motorcyclist very accurately.
- We mainly aim to collect a database of all the motorcyclists who have violated the rules. One of the key problems we faced was determining whether the person is wearing a helmet or not and to differentiate between biker and pedestrian.
- To avoid these actions, there is need for a system that automatically detects the people who are not wearing a helmet and a system that detects number plates of the motorcycles and extracts the vehicle number which would help find the motorcyclist to be penalize for doing so, we used object detection deep learning Algorithm

OBJECTIVES

- To enhance safety and security.
- To monitor vehicle movement.
- To rapidly identify stolen vehicles and aid in their recovery, discouraging vehicle theft and supporting law enforcement efforts.
- The primary objective of a helmet is to protect the driver's head in case of an accident or fall from a bike. It should try to identify whether the motorcyclist is wearing a helmet or not in real-time.

LITURATURE SURVEY

J. Chiverton , “Helmet presence classification with motorcycle detection and tracking” IET, 2012 This paper J. Chiverton proposed system such that the past few years, many algorithms and models have been used for helmet detection, but this paper is used the background subtraction method to separate the background of the bikers and then isolate the head of the biker and identify the features of the helmet. It uses Referred following Techniques : 1.Helmet Detection. 2. Motorcycle detection and tracking. This system only detect helmet and number plate but does not sending alert to the motorcyclist.

Z. Chen , “Vehicle detection, tracking” in Procs. of the IEEE Int. This paper Z. Chen proposed system such as Propose to used a Multi-dimensional Gaussian Kernal Density Transform and a self-adaptive Gaussian mixture model for background subtraction. This paper presents an improved GMM algorithm that is less sensitive to sudden changes in the global illumination compared to the GMM presented in the paper. It employs a spatio-temporal Gaussian smoothing algorithm and a self-adaptive GMM for background modeling. Geometrical features to identify a helmet, it can detect any other object as a helmet.

C. Patel, “Automatic Number Plate Recognition System” This paper C. Patel proposed system evaluates the trichromatic imaging with a color-discrete characteristic approach can provide promising results for number plate detection. Some characteristics are 1. Number plate detection. 2. Recognizing the number plate characters Color is a noteworthy part of our visual experience. It can affect how we interpret things about the world, influence our appetite and mood, and even carry symbolic meaning for some people.

MOTIVATION

- Ensuring helmet usage improves road safety, reducing head injuries in accidents, while number plate detection enforces traffic regulations and security.
- Automation reduces the burden on law enforcement, making policing more efficient and cost-effective.
- Automated systems save money by eliminating the need for additional personnel and reducing corruption opportunities.

SYSTEM ARCHITECTURE

This is a helmet and number plate detection system in which we get an input images and videos from traffic surveillance system which is given as a input to convolutional neural networks and process accurate output whether the person is wearing helmet or not. In the next process if the person is not wearing helmet, the number plate detection will be done using convolutional neural networks and determines number plate characters of bike rider accurately and produces effective output.

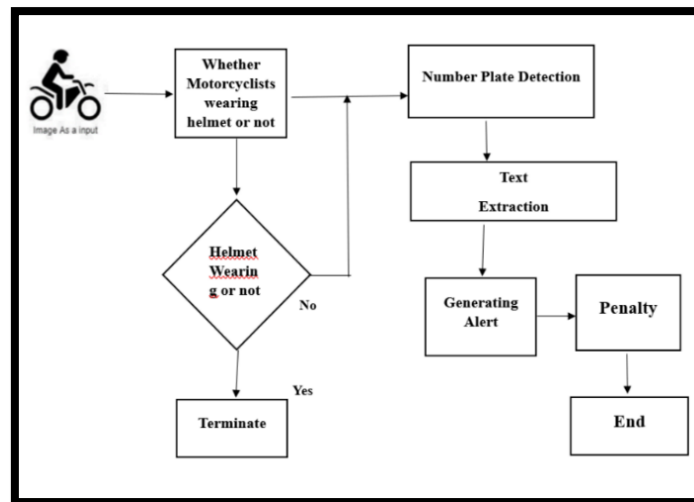


Fig 1: System Architecture Diagram

Modules

- **Image / Video Input:** Capture images or video streams from surveillance cameras, CCTV, or other sources.
- **Preprocessing:** image preprocessing to enhance quality and reduce noise and frame extraction from video for analysis
- **Feature Extraction:** Feature extraction is a part of the dimensionality reduction process, in which, an initial set of the raw data is divided and reduced to more manageable groups. So, when you want to process it will be easier.
- **Classification:** Classification is a supervised machine learning approach, in which the algorithm learns from the data input provided to it and then uses this learning to classify new
- **Helmet Detection:** utilizing deep learning model (eg: CNN) for real time helmet detection. Detecting the Presence or Absence of helmets on motorcycle riders.
- **Number Plate Recognition:** implementing Optical Character Recognition (OCR) for number plate recognition. Extracting alphanumeric characters from detected number plates. Handles Variations in Fonts, Sizes and lighting conditions.

Implementation of Module

1.Vehicle Registration: The registration module in our system plays a crucial role in managing and maintaining the database of motorcycle owners, their contact information, and associated vehicle details. The module is built using PyQt, a versatile Python library for creating graphical user interfaces. The PyQt GUI registration module offers a user-friendly interface that allows authorized personnel to input and manage the data related to motorcycle owners and their vehicles. It includes well-structured forms and intuitive controls for efficient data entry. The module provides fields for entering essential owner information, such as name, contact number, email address, and residential address. This information is critical for sending challan fines and notifications. The PyQt GUI-based registration module is a vital component of our system, ensuring the efficient management of owner and vehicle data. It enables accurate and timely challan fine notifications, enhances the overall functionality of the system, and plays a central role in ensuring road safety and regulation enforcement.

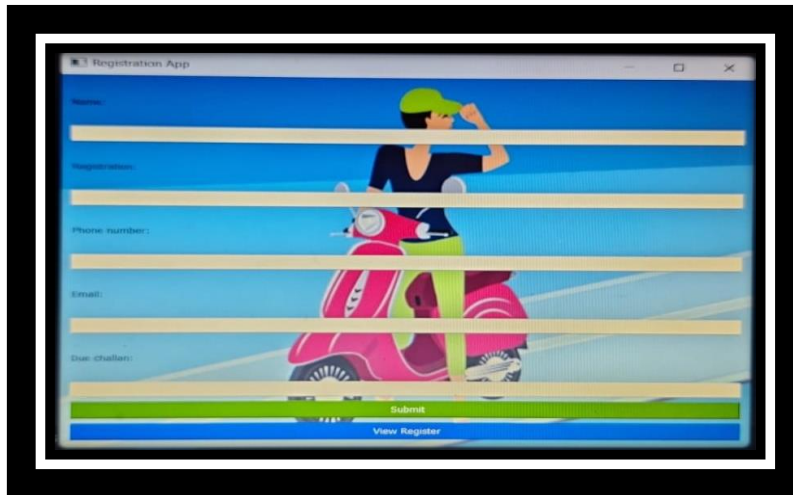


Fig 2: Vehicle Registration

2.Database: Create a database to store the details of motorcyclists. Each entry in the database should include the Name, Phone No, Vehicle Registration Number, Email, Challan

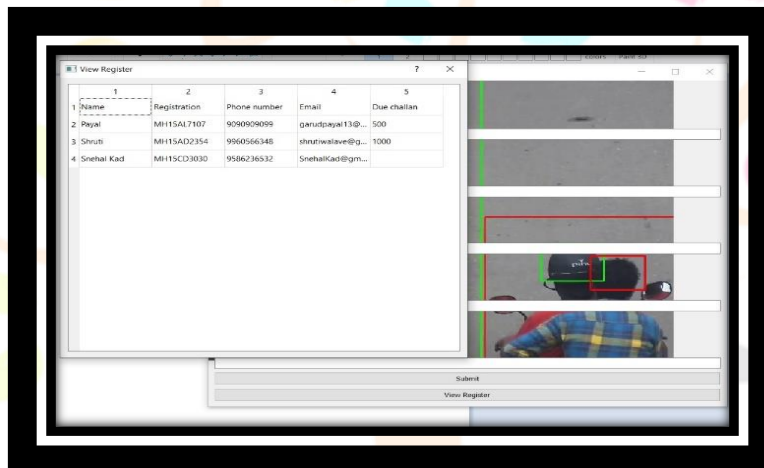


Fig 3: Database

3.Number plate & helmet Detection module: The detection module is the core component of our system, responsible for identifying individuals riding motorcycles without helmets and detecting their vehicle number plates. It acts as the primary decision-maker for triggering the issuance of challan fines. The detection module can be scaled to monitor larger areas and road networks. The use of YOLO for object detection ensures high accuracy and consistency in identifying violations. The detection module is the heart of our system, utilizing YOLO for real-time object detection, OCR for number plate recognition, and immediate action triggers to enforce helmet-wearing regulations and issue challan fines. Its efficiency and accuracy make it a critical component in promoting road safety and enforcing traffic regulations.

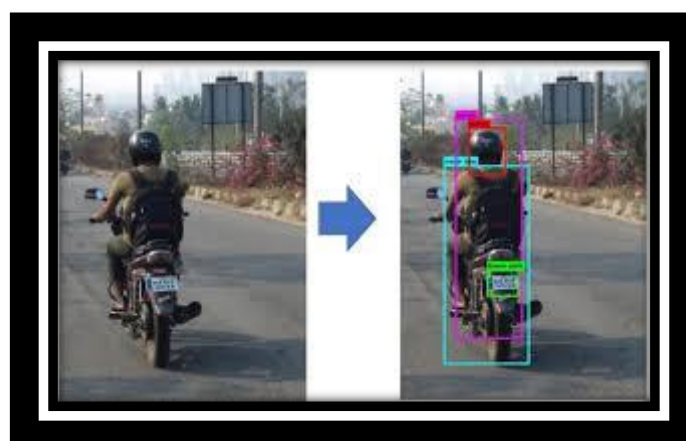


Fig 4: Number Plate Detection

4.Text extraction Module: The text extraction module is a crucial component of our system responsible for accurately capturing alphanumeric characters from the detected number plates using Optical Character Recognition (OCR) technology. Before performing OCR, the module identifies the region of interest within the image where the number plate is located. This process ensures that OCR is applied specifically to the area containing the license plate. The module may apply preprocessing techniques to enhance the quality of the image. These techniques could include image cleaning, resizing, and contrast adjustments to improve OCR accuracy. 19 Helmet and Number Plate Detection and Recognition Text extraction module is essential for accurately recognizing and extracting alphanumeric characters from license plates.

5.Alert module to send a copy of a fine by email:

The alert module is a vital part of our system, responsible for sending email notifications to the registered owners of motorcycles detected with riders not wearing helmets and for issuing challan fines. The alert module receives confirmation from the detection module that a violation has been identified. The module retrieves owner information from the system's database based on the detected vehicle's registration number. This information includes the owner's name, contact details, and email address. The alert module is tightly integrated with the system's database, allowing for seamless retrieval of owner information and updates on challan fines and notification status.

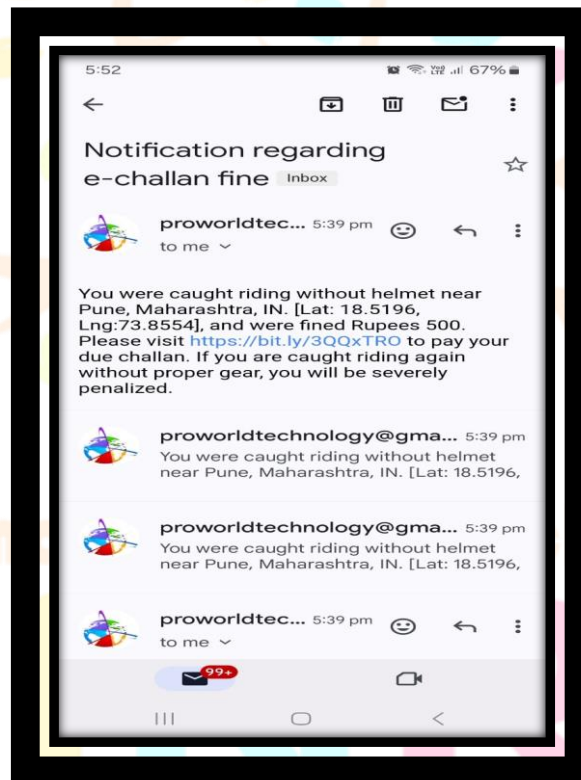


Fig 5: Email Notification

ADVANTAGES

- **Improved safety:** Helmet detection ensures that motorcyclists and scooter riders wear helmets, reducing the risk of head injuries in case of accidents. Properly worn helmets can save lives, and automatic detection ensures compliance with safety regulations.
- **Traffic management:** Number plate detection helps in monitoring and managing traffic by identifying and tracking vehicles more efficiently. It aids in enforcing traffic rules, such as identifying and penalizing vehicles with expired registrations, outstanding fines, or stolen plates.
- **Enhanced law enforcement:** These systems assist law enforcement agencies in identifying and tracking vehicles involved in criminal activities. They can quickly identify stolen or suspect vehicles by scanning their number plates. Increased automation: Reduces the need for manual monitoring and enforcement, saving time and resources. Allows law enforcement personnel to focus on more critical tasks.

- **Real-time data collection:** These systems can provide real-time data on the number of vehicles on the road, traffic flow, and safety compliance. This data can be used for traffic management, urban planning, and accident analysis.

FUNCTIONAL & NON-FUNCTIONAL REQUIREMENTS

Functional requirements:

- The system must be capable of detecting whether a motorcycle or scooter rider is wearing a helmet or not.
- The system should accurately capture and read the number plates of vehicles, including alphanumeric characters, symbols, and special characters.
- The system must process data in real-time, providing immediate feedback on helmet compliance and number plate recognition.
- The helmet detection accuracy should meet or exceed a predetermined threshold (e.g., 95% accuracy).
- The number plate recognition accuracy should also meet a defined standard (e.g., 98% accuracy).
- The system should be scalable to handle a high volume of traffic, covering multiple lanes and intersections.
- The system should be capable of simultaneously detecting and identifying multiple vehicles in the camera's field of view.
- Generate alerts and notifications for non-compliance with helmet regulations and for vehicles with problematic number plates.

Nonfunctional Requirements:

- The system should be able to handle a high volume of traffic without significant degradation in performance.
- The system should respond to violations and number plate recognition within a predefined time frame (e.g., less than 2 seconds).
- The system should have a high level of availability, with minimal downtime for maintenance or upgrades.
- The system should be reliable, with a low rate of false positives and false negatives in helmet detection and number plate recognition.
- The system should be scalable to accommodate an increase in the number of cameras and lanes without a significant reduction in performance.
- The user interface should be intuitive and user-friendly for both operators and administrators.

SYSTEM REQUIREMENTS

Software Used:

- Vs Code
- Python 3.10
- SQLite Database
- Language: Python
- Operating System: Windows 8 and above

Hardware Used:

- Processor - Processor core i3
- Speed - 1.1 GHZ
- RAM – 4GB
- Hard disk - 500 GB
- Keyboard - Standard Keyboard
- Mouse - Two or Three Button Mouse
- Monitor - LED Monitor

CONCLUSION

We have successfully implemented the Automatic helmet Detection and Number Plate Recognition project with the help of CNN, YOLO5 algorithm.

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