YOLOv3 Based Real-Time Detection of Helmet and Number plate

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ABSTRACT

The project is all about creating a smart system that can check whether a person riding a motorcycle is wearing a helmet or not. The main use of the project is about the road security of the rider. At the same time, it is also used to detect the number plate of the two-wheeler. The system uses a camera and computer vision technology to check whether the rider is wearing a helmet or not. The system captures the image and reads the number plate using special software. The system uses a Convolutional Neural Network (CNN) and Optical Character Recognition (OCR). The goal of this project is to improve road safety and help traffic police to catch rule-breakers more easily without needing to check the road all the time.

Through automatic recognition of helmets and number plates, the system diminishes the degree of human oversight needed, optimizing the efficacy of rule implementation and improving road safety. The system can be used on highways, traffic intersection, or installed into existing

CCTV infrastructures for twenty-four-hour observation and capture if helmet infringement. Yet motor riders do not obey laws, and therefore the chance of sever injury or death in event of an accident are more. It is impossible for traffic police to visually check all the riders for helmet use easily and quickly, particularly in congested areas. Thus, an automated system is required that can check for helmet usage and detect violators effectively.

KEYWORDS

Helmet detection, Number plate recognition, Road safety, Computer vision, Smart surveillance, Violators, rule breakers, visual check, optimization, security, Convolutional Neural Network (CNN), Optical Character recognition (OCR)

I.INTRODUCTION

Road safety is a concern in every county, particularly with the growing number of two -wheeler on the road. Most accidents occur due to the fact that rides do not use helmets, despite helmet use being mandatory as per law. Meanwhile, traffic police cannot check every vehicle manually. To address this, we can use advanced technologies such as computer vision and artificial intelligence.[1]

The project will help create a system that can automatically detect whether a two- wheeler rider is wearing a helmet or not, the system will also take the vehicle number plate. The project will help traffic authorities take action against the violators without physically being present everywhere. The system can be installed on CCTV cameras and can be used in public places like traffic lights or highways. This will help improve the safety on roads and help enforce traffic rules more efficiently.[2]

Fig:1 Helmeted and Non-Helmeted Riders

The Fig:1 talks about the helmeted and non-helmeted riders which is the basic phase of our system.

Road safety one of the most important issues in today's world, especially in developing countries with traffic

rules are often ignored. Among all Road user, two-wheeler Riders are at high risk because they are more exposed during accidents.[3] Wearing a helmet is a basic safety rule, but many people still right without one increasing the chance of serious injurious or even death. Although traffic rules require riders to wear helmet, it is hard for traffic police to monitor every road and catch violators manually.[4]

Traditionally, enforcement of helmet laws is manual by traffic police, who have to monitor riders, identify offenders, and impose fines. It is a time-consuming, manpower-intensive, and largely ineffective activity in busy or crowed roads.[5] Further, it is hard to implement uniformly on extensive networks of roads. To avoid these constraints, there is an increasing desire to use AI-in the guise of computer vision and AI to offer automated traffic monitoring and rule enforcement.[6]

The solution enjoys a number of benefits: It eliminates the necessity of human observation, runs constantly in real-time and can be implemented in numerous environments like traffic lights, highways, and checkpoints.[7] The captured data, e.g., the image of the rider, number plate, date and enforcement. Finally, the system is not only useful to the law enforcement authorities but also encourages public awareness and obedience to helmet legislations, making the road environment safer for all.[8]

II.LITERATURE REVIEW:

III.METHODOLOGY

Framework Type	Features	Disadvantages	Feature Scope	Author Name
CNN-based Helmet Detection	Used CNN to classify helmet and non-helmet using feature classification and extraction	This requires large dataset for training the system. And also slower on low-end systems.	This can be combined with easy models for faster interface (Internet, Wi-fi) [9]	Sharma 2020
YOLOv3 for Object Detection	It is a real time object detection with good speed and multiple class including helmet and number plates	With less accuracy than new versions (e.g., YOLOv5/YOLOv8)	Using advanced versions of YOLO and trained scenes for traffic.[10]	Redmon & Farhadi, 2018
Tesseract OCR for Number Plate Recognition	Extraction of text from number plats. Widely used and open-source systems with license.	Numbers with stylized text cannot be handles. Errors with blurred images	Using combination of image preprocessing and OCR models like CRNN will increase the scope.[11]	Smith R., 2007
Haar Cascade Classifier for Helmet Detection	Used for basic use cases. Simple implementation using pre-trained XML classifiers	Failed at detecting helmet styles also failed in complex scenes	Using deep-learning based detection may be helped. [12]	Paul 2019
SSD (single shot Detector) for Helmet Detection	Used on edge devices. Faster Than YOLOv3 for particular tasks	Very low accuracy than YOLOv3. Not useful for small object detection	Improving the Mobile Net with the help of SSD for mobile development. [13]	Liu 2016
Faster R-CNN	Suitable for detailed image analysis. High accuracy in object	Needs strong GPU. slow for real-time processing	Used for offline analysis of violation. [14]	Ren 2015
Hybrid Deep Learning + OCR System	Combination of helmet detection with plate recognition in a single line	Very complex to optimize and implement	Can be used for cloud systems for smart application. [15]	Reddy 2021
DeepSORT +YOLOv3 (Helmet + Tracking)	Tracking multiple objects and detect helmet violations over every time	Tracking the vehicle may fail with the traffic and also detecting	Using tracking models like Byte Track can be improved. [16]	Tanwar 2022

Introduction:

To develop a smart and efficient system for helmet violation detection and number plate recognition, a violation detection and number plate recognition, a technical step-by-step approach in necessary. It is based on cutting edge technologies such as computer vision. Machie learning, and optical character recognition. The intention is to make the observation of helmet wearing or not wearing by two-wheeler drivers autonomous with the gathering of the vehicle data. [17] The Helmet and Number Plate Detection System is made in a way that it is capable of automatically tracking riders of two-wheelers through the use of video or image inputs from camera. The system functions by integrating computer vision and artificial intelligence in detecting infraction such as helmetless riding. The process begins when a

camera is mounted in a position where vehicles cam readily be seem passing through-traffic intersection, highway, or city entry/exit point. The camera keeps recording or capturing images of vehicles passing on the road. [18]

These pictures are then forwarded to computer or processing unit where the detection system is located. The system's initial task is to identify whether the rider is wearing a helmet or not. This is accomplished through an object model, which is often deep learning based. YOLO (You Only Look Once) type models are employed widely since they are capable of detecting many objects in one frame in milliseconds and with great accuracy. The model is trained on a database of helmeted and non-helmeted rider images so that it can make the identification in real time.[19]

When the model identifies that the rider is not wearing a helmet, it initiates the subsequent action: the identification of the number plate of the vehicle. The system then scans the bottom half of the image to identify the number plate, it

crops the area and uses OCR (Optical Character Recognition) to read out the characters. OCR technology is able to take images of text (e.g., a number plate) and translate them into actual digital text. [20] Once the number is scanned, the system saves all the crucial information in a database. They are the image of the offense, The date and time of the offense, and the number plate text. This information can then be utilized to generate daily or weekly reports, or it can be forwarded to traffic authorities directly. In upgraded version of this system, it can also generate a challan (fine ticket) automatically or send a notification via SMS or email to the registered vehicle owner. [21]

The entire process operates automatically once the system is activated. It lessens the work burden of traffic police, applies road safety rules more rigidly, and allows for easier catching and punishment of violators. Implementation of artificial intelligence gives the system intelligence and allows it to manage large amounts of data in areas of congested traffic. [22]

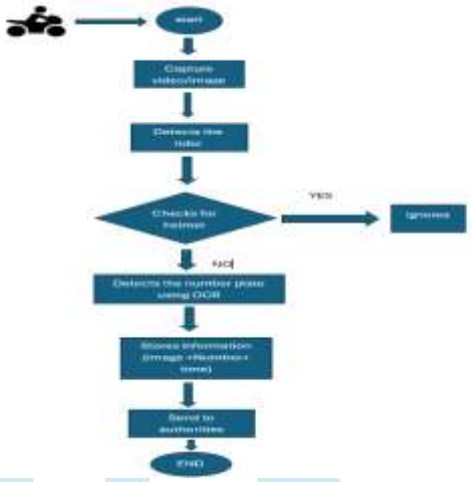

Fig:2 Flowchart for Helmet and Number plate detection

The Fig:2 flowchart illustrates the sequential working of an automated number plate and helmet detection system. It starts with a camera capturing video or image input from a traffic or road point. The identification of the rider follows in the second step by using computer vision techniques. [23]

After the rider is determined, the system performs a helmet check. If the rider is a helmeted motorcyclist, the system disregards the case and does nothing else. However, if the rider is helmetless, then the system proceeds to the next step-number plate detection. [24]

The Number plate is subsequently read and scanned through OCR (Optical Character Recognition) in order to obtain the vehicle number. The system stores the data that are obtained, including the accident image, Number plate, and timestamp. [25]

Finally, the data is passed on to the authorities (for example, traffic department) to take action in the form of fine or warning. The loop is now ready to process the next rider. [26]

IV.RESULTS AND DISCUSSION

When the helmetless rider was found, the system could go ahead to the second step-number plate detection. YOLOv3 was used for number plate localization, too, and Tesseract OCR for reading the text. OCR worked well for clen and plain number plates in the majority of cases. Performance did reduce to some extent for plates with quirky fonts, dirt, or motion blur.

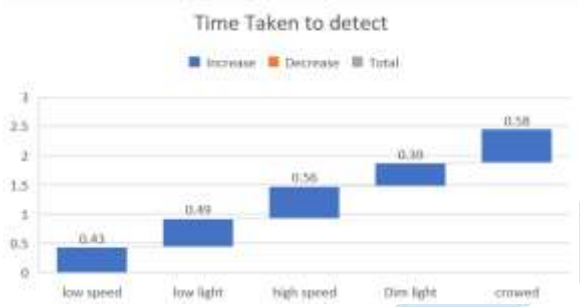

Fig:3 Detection time graph

The Fig:3 bar chart shows the average processing time (in seconds) that the system took to detect helmet and number plate offenses in various real time scenarios. X-axis talks about the various real-world test scenarios and Y-axis talks about time taken to recognize a rider and process the image.

The system operated on frames in close-to-real time and was capable of being synchronized with lice CCTV feed for constant observation. All the intrusion identified, date and time stamp, number plate text, and captured image were stored in a database reporting and evidence

Overall, the results verified that YOLOv3 is an extremely efficient and effective model for real-time helmet and number plate detection. Although the system performed optimally under controlled testing, precision can be enhanced further by incorporating more diversified images into the dataset and optimizing OCR preprocessing techniques. The project demonstrates a solid foundation for intelligent traffic monitoring systems that can reduce manual effort and help improve road safety

V.CONCLUSION

The project introduces a productive and smart approach towards monitoring traffic rule breaches, especially helmet detection and number plate recognition for two-wheeler riders. Using deep learning approaches like YOLOv3 for object detection and OCR for number plate detection, the system functions smoothly in real time and reduces human involvement in traffic checking.

This computerized system greatly improves road safety by detecting and documenting infractions like riding without helmets. It also facilitates the authorities in taking prompt and precise action using the captured photography evidence and vehicle numbers. Using this system for real-time monitoring, such as traffic lights and highways, will enhance enforcement of rules and rules and lower the rate of road accidents.

Overall, the initiative is a step towards more intelligent, AI-led traffic management and holds tremendous potential for future growth-like integration with e-challan systems, cloud storage, and smart city infrastructure.

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