Helmet Detection And Number Plate Using Deep Learning

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Abstract- *Individuals frequently disregard how important it is to wear helmets, which is tragic. A helmet reduces your risk of getting a serious brain injury and dying by deflecting most of the impact energy that would otherwise hit your head and brain during a tumble or collisions. In India, it is against the law to operate a motorbike or scooter without a helmet, which has increased fatalities as well as crashes. The existing system mostly relies on surveillance footage for keeping up with traffic violations, necessitating a close - up of the license plate by traffic police in the case that the motorcyclist lacks a helmet. Yet, this necessitates a substantial amount of personnel and time considering the high frequency of traffic violations and the rising everyday use of motorcycles. Imagine if there was an algorithm that monitored traffic infractions, such as driving a motorbike with no a helmet, and, if any were identified, generate the license plate of the vehicle that committed the violation. Helmet and license plate detection using a neural network is proposed in this paper. There will be two phases. Initially, we check to see if the riders are wearing helmets. If not, a second step is used to find their license plate. To identify unauthorized vehicles, we also look for license plates on passing vehicles.*

Keywords- Convolutional Neural Network, Helmet Detection, Machine Learning, Yolo

I. INTRODUCTION

The vast majority of people commute daily on bikes in impoverished nations. By definition, motorbikes are less crashworthy than closed vehicles

They are also less sturdy than four-wheel vehicles and less noticeable to other vehicles and pedestrians. Compared to drivers of enclosed cars, motorbike riders and passengers are more susceptible to weather and road conditions. The rider of a two-wheeler gets thrown from the vehicle if there were a mishap because of a quick braking. The velocity of the head stops when it strikes with an object, but the gesticulation of the brain is preserved by the mass of the brain until the object strikes the internal region of the head. This kind of brain damage may sporadically prove mortal. In these conditions, a helmet can save your life. Helmets reduce the chance that the head will deliberate down, which virtually eliminates head motion. After the accident's effect has been captivated by the helmet's cushion over time, the head finally comes to rest.

Moreover, the power of the hit is detached transversely to a broader area, guarding the skull from severe injuries. Most of all, the helmet acts as a machine-driven guard to protect the rider's head from anything they come into contact with. If a full helmet of decent features is worn, injuries can be reduced. The goal of traffic laws is to promote self-control so that the danger of mortalities and severe wounds can be significantly decreased. Unfortunately, in practice, these regulations are not adhered to strictly. It is necessary to provide.practical and efficient solutions to these problems.

Tomanually monitor traffic, current procedures include using Surveillance video. Yet in this instance, it takes a lot of labor to carry out the numerous iterations required to accomplish the objective.Thus, cities with millions of residents and several moving automobiles, this inadequate manual method of helmet identification cannot be used. Many studies in traffic analysis have been conducted in recent years, including those on vehicle recognition and categorization and helmet recognition.Computer vision technologies, such as contextual and forefront image detection to section the moving objects in a scene and image descriptors to extract features, were used to build intellectual traffic systems. To categorize the objects, computational intelligence technologies such as machine learning algorithms are also used. The realm of artificial intelligence known as machine learning (ML) involves a model that has undergone training utilizing input data, which it can then use to function independently. To make predictions or decisions, machine learning algorithms construct a mathematical representation using a set of example data known as "training data”. Hence, a Helmet detection model can be put into use by training with a certain dataset. Our helmet detection model makes it simple to identify riders without helmets. The rider's license plate can also be identified based on the classes that have been detected.

II. PROBLEM STATEMENT

In recent times, there has been a growing trend in utilizing both social networks and road networks as valuable sources of information for detecting various events, particularly concerning road traffic dynamics such as congestion, traffic jams, and accidents. Given this context, there is a pressing need to develop a comprehensive system aimed at effectively addressing the challenges associated with helmet detection and subsequent alerting or fine notification processes. Therefore, our project endeavors to tackle the issue of helmet detection and number plate extraction through the innovative integration of advanced technologies. By leveraging computer vision techniques and machine learning algorithms, we aim to develop a robust system capable of accurately identifying the presence or absence of helmets on riders, as well as extracting pertinent information from vehicle license plates. The primary objective of this initiative is to enhance road safety and streamline law enforcement efforts by providing real-time insights into helmet compliance among riders and ensuring the visibility of vehicle registration details. By tapping into data sources such as surveillance cameras positioned along roadways and intersections, our system will enable the seamless detection of noncompliant behavior, thereby facilitating prompt intervention and enforcement actions as necessary. Through the deployment of sophisticated algorithms trained on extensive datasets, we aim to achieve a high degree of accuracy and reliability in detecting helmets and extracting alphanumeric characters from license plates across diverse environmental conditions and scenarios. Additionally, our system will offer customizable settings and notification mechanisms, allowing for tailored responses to detected violations and facilitating effective monitoring and enforcement strategies. Overall, by addressing the problem of helmet detection and number plate extraction within the broader context of traffic management and law enforcement, our project seeks to contribute to the creation of safer and more efficient road networks, ultimately benefiting both motorists and the broader community.

III. LITERATURE REVIEW

In recent years, numerous studies have focused on enhancing road safety through automatic helmet detection and number plate recognition using computer vision and deep learning technologies. Various approaches have been explored to address the limitations of manual surveillance and traditional image processing techniques.

Lin et al. proposed a deep learning-based framework capable of detecting motorcycles, identifying riders, and assessing helmet usage with an accuracy of 86.6% per frame. This method emphasizes active detection and tracking of motorcycles and their riders, providing a comprehensive approach to helmet monitoring. Similarly, Sneha A. Ghonge utilized edge detection algorithms for motorbike tracking and proposed the integration of neural networks and Optical Character Recognition (OCR) for helmet absence identification and number plate extraction.

Prajwal M. J. leveraged YOLO (You Only Look Once) architecture to detect bikes, helmets, and license plates from video input, applying OCR to extract license numbers when helmet violations were detected. Another study by Lokesh Allamki used a YOLOv3-based custom object detection model, trained on over 11,000 images, achieving a mean average precision (mAP) of 75% and an OCR accuracy of 85%.

Wang et al. introduced a novel helmet detection framework tailored for aerial imagery from UAVs, integrating enhanced image segmentation, ESRGAN for image sharpening, and classification models to improve detection in complex scenarios.

These prior works highlight the progression from basic image segmentation to advanced real-time detection models like YOLOv3, YOLOv8, and Faster R-CNN. They also underscore the importance of dataset quality, the use of transfer learning, and the challenges posed by small or occluded targets. The current study builds on this body of research by adopting YOLOv8 for real-time detection and OCR-based number plate recognition, aiming to improve detection accuracy, adaptability, and scalability in varied urban environments.

IV. SYSTEM ARCHITECTURE

The proposed Helmet Detection and Number Plate Recognition system is designed as a real-time, automated framework leveraging deep learning and computer vision technologies. It begins with capturing video input from surveillance sources, which is then processed to extract individual frames. These frames are passed through a YOLOv8-based object detection module trained to identify specific objects including motorbikes, riders, helmets, and number plates. When a violation is detected—specifically, a rider without a helmet—the system triggers the Optical Character Recognition (OCR) module to extract the number plate information from the same frame.

To manage enforcement, the system integrates a database that maintains detailed records of vehicle owners, including their registration numbers and contact details. Upon identifying a violation, the system automatically matches the recognized license plate with the database and sends an email alert or fine notification to the vehicle owner. The modular architecture ensures scalability and real-time performance, while the use of modern deep learning models like YOLOv8 and Tesseract OCR ensures high accuracy in varied conditions such as different lighting, camera angles, and occlusions. This system significantly reduces the need for manual monitoring and promotes improved road safety compliance.

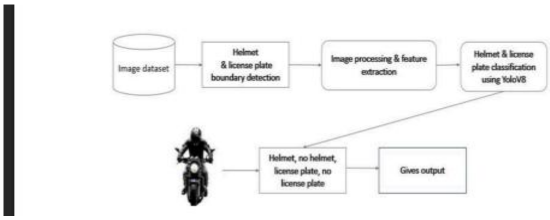

Figure 1 : System Architecture

V. RESULTS

The YOLO algorithm can be applied independently or as part of a bigger system.The prototype was trained on YOLOv8 for 10,000+ images on four classes for 40,000 iterations. The recognition of all the entities classes was obtained with high precision value and the mean average precision (mAP) got a constant max value of 85% hence the training was clogged at 40,000 iterations.

VI. DIAGRAMS AND VISUALS

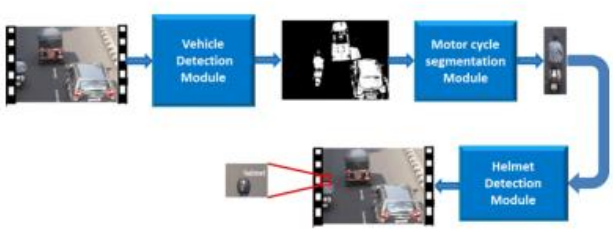

Figure 2 : Overview

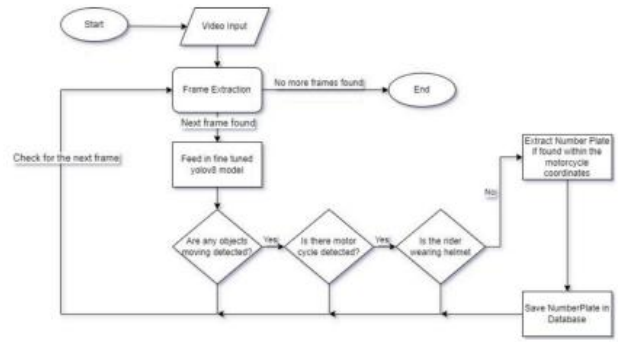

Figure 3 :Flow Diagram

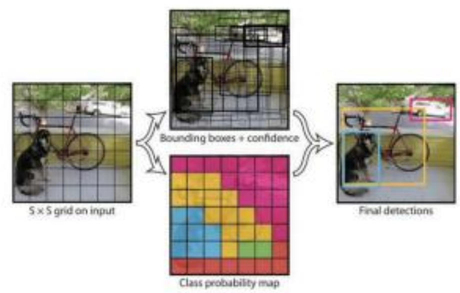

Figure 4 : Segmentation Pipeline

VII. CONCLUSION

In the proposed system, we designed a model that detects license plates, and helmets that identifies whether they are following rules or not. And also checks whether the drivers have license plates on their four-wheelers. This can be identified by our model using real-time footage. The algorithm and various computer vision techniques aid in the detection of helmets and license plates with high accuracy. For further enhancement, an official inputs a license number, and using the developed system, it can search, extract and identify the desired vehicle.

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