A Seminar Report

on

“ HELMET DETECTION WITH NUMBER PLATE RECOGNITION”

Submitted to the Savitribai Phule Pune University

in partial fulfillment of requirements for the award of degree

Third Year

in

Information Technology

by

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Talegaon. 2023 - 24

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2023 - 24

CERTIFICATE

This is to certify that the report entitled **" HELMET DETECTION WITH NUMBER PLATE RECOGNITION"** submitted by Mr. Saurabh Umesh PISAL (Seat No : T190558548), to the Savitribai Phule Pune University in partial fulfillment of the Third Year degree in Information Technokogy is a bonafide record of the seminar work carried out by him/her under our guidance and supervision. This report in any form has not been submitted to any other University or Institute for any purpose.

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DECLARATION

I Mr. Saurabh Umesh PISAL hereby declare that the seminar report **" HELMET DETECTION WITH NUMBER PLATE RECOGNITION" I**, submitted for partial fulfillment of the requirements for the award of degree of Third Year in Information Technology of the NMVP and PCET's Nutan Maharashtra Institute of Engineering Technology, Talegaon is a bonafide work done by me under supervision of Prof. Sonali Dongare.

This submission represents my ideas in my own words and where ideas or words of others have been included, I have adequately and accurately cited and referenced the original sources.

I also declare that I have adhered to ethics of academic honesty and integrity and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the Institute and/or the University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title of any other University.

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I would like to place on record my sincere gratitude to my seminar guide **Prof. Sonali Dongare**, Assistant Professor, Department of Information Technology, NMIET for the guidance and mentorship throughout the course.

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Contents :

1. Abstract :

There are very few automobiles in developing countries because motorcycles have always been the predominant mode of transport. Motorcycle crashes have been on the rise in the last few years. A number of people who are involved in traffic collisions include motorcyclists who do not wear reflective helmets, since they do not believe they provide sufficient protection. Once the traffic police spot those driving motorcycls on a whole-or mMotorcycles in junctions-without helmets, they also use video from CCTV to take control of the drivers of those vehicles and penalise those who are riding without one. However, it can only be achieved through human action and commitment. Secondly, the classifies moving vehicles as motorcycle or nonmotorcycle. for example, when referring to the head component, in the case of a motorcyclists, it is graded as either full face or non-full face. An excellent image analysis of the motorcycle number is then used to extract the characters that were missed by the identification software and/ Finally, the character count of the motorcycle is found, and from the motorcycle is examined using OCR software. It is an Object Detection Algorithm used to identify faces in an image or a real time video. The algorithm uses edge or line detection features proposed by Viola and Jones in their research paper “Rapid Object Detection using a Boosted Cascade of Simple Features . A Convolutional Neural Network is a Deep Learning algorithm which can take in an input image, assign importance to various aspects/objects in the image and be able to differentiate one from the other. CNNs are used for image classification and recognition because of its high accuracy. The CNN follows a hierarchical model which works on building a network, like a funnel, and finally gives out a fully-connected layer where all the neurons are connected to each other and the output is processed.

2. Introduction

In many countries, wearing helmets while riding motorcycles is mandatory by law to ensure the safety of the riders. Currently, the responsibility of monitoring helmet usage falls on the police force. However, due to the limitations of human senses and insufficient police force, this method has proven to be inefficient. CCTV surveillance-based methods are also used in major cities, but they require human assistance and are not automated. As the number of motorcycles on the road increases and concern for human safety grows, research in the domain of road transport has also increased. This paper proposes a system that automates the monitoring of motorcyclists by detecting those not wearing helmets and retrieving their license plate numbers in real time from CCTV camera videos at road junctions using machine learning. The problem of increasing road accidents in India has become a major concern, with a high number of deaths caused by head injuries due to a significant portion of the population not wearing helmets. To address this issue, an automated system is needed to detect individuals not wearing helmets and identify the license plates of the motorcycles to penalize the offenders.

The use of machine learning in transportation systems has become increasingly popular in recent years. Automated systems that detect helmet usage and license plates on motorcycles are just one example of how technology can improve road safety. In addition to improving enforcement, such systems can also provide valuable data for policymakers to make informed decisions about road safety regulations. However, there are some challenges in implementing such systems. For instance, the accuracy of license plate recognition algorithms can be affected by factors such as lighting conditions, weather, and the distance between the camera and the vehicle. In addition, the implementation of such systems requires significant investment in terms of infrastructure and manpower. Therefore, it is essential to carefully evaluate the feasibility of such systems and their potential impact on road safety. Despite these challenges, the use of machine learning and other advanced technologies has the potential to revolutionize road safety in developing countries. By improving enforcement and providing valuable data for policymakers, such systems can help reduce the number of deaths and injuries caused by motorcycle accidents. With continued research and development, these systems may become an integral part of transportation systems around the world, making roads safer for everyone.

3. Literature Review:

- **Romuere R.V.e Silva, Kelson R.T. Aires, Rodrigo de M. S. Veras "Detection of Helmet on MotorCyclists"**

In this paper, the process of classification and descriptors are used to detect the vehicles and then detect the persons with 2 wheelers and detect if they are wearing the helmet or not.

- **Lokesh Allamki, Manjunath Panchakshari, Ashish Sateesha, K S Pratheek "Helmet detection using machine learning and Automatic Number Plate recognition"**

This paper does the process of extracting the objects from the image using YOLO object detection and has 3 segments in the entire process :

1. Helmet detection
2. License plate Extraction
3. License plate recognition

- **Felix Wilhelm Sieberta, Hanhe Linb "Detecting motorcycle helmet use with deep learning"**

There are 3 divisions in this project in which the data is collected in the form of videos, preprocessed and used in detecting the riders of motorcycle with and without helmets.

1.Dataset creation and annotation
2.Helmet use detection algorithm
3.Results

- **M. Swapna, Tahniyath Wajeeh, Shaziya Jabeen "A Hybrid Approach for Helmet Detection for Riders Safety"**

In this model various previous methods related to automatic helmet detection has been taken into consideration and the new model has been given. This is a technique of automatic helmet detection , where the input is of either the video which has been recorded or it might be a video through a web camera.

- **C. Vishnu, Dinesh Singh, C. Krishna Mohan and Sobhan Babu "Detection of Motorcyclists without Helmet in Videos using Convolutional Neural Network"**

This model tells us that since the motorcycles are affordable, people use it for daily transportation. Due to this increased use the occurance of accidents are high . Major of the accidents include head injury, which is due to helmet violation by the motorcycle users. As many cities have surveillance system for safety purpose , we can use it for detecting non helmet riders which would be a cost effective approach. This approach uses a machine learning technique , CNN(Convolution Neural Network) for getting good images inspite of various problems like illumination, climate changes , etc.

4. Proposed Work

Detecting helmets and number plates in images or video footage is a computer vision task that can be accomplished using various approaches. Here is a possible methodology for a helmet and number plate detection project:

- **Collect and annotate a dataset:**

Collect a large dataset of images or video footage with a range of different scenarios where helmets and number plates are present. Annotate the images with bounding boxes around the helmets and number plates. To collect and annotate a dataset for helmet and number plate detection, you would need to follow these steps:

Define the scope of the dataset: Determine the purpose of the dataset and what kind of images and videos you want to include. For example, you might want to collect images and videos of motorcycles, bicycles, and cars.

Gather images and videos: Collect a large number of images and videos that represent the scope of the dataset. You can collect images and videos from publicly available sources, such as Google Images or YouTube, or by taking your own photos and videos.

- **Pre-processing:**

Pre-processing of images is an important step in any computer vision application, including helmet and number plate detection. Pre-process the images or video footage to improve the quality of the input data. This can involve resizing the images, removing noise, and adjusting lighting and color balance. Here are some of the pre-processing techniques that can be used in this area:

Image resizing: Resizing the images to a specific resolution can help reduce the computational cost of the detection algorithm. However, it is important to ensure that the images are not resized too much, as this can lead to loss of important details.

Image normalization: This involves adjusting the brightness and contrast of the images to improve the overall quality of the image. This can be useful in cases where the images are taken in different lighting conditions.

- **Choose a detection model:**

Choose a detection model that is suitable for your project requirements. There are many detection models available for helmet and number plate detection, but one popular and effective model is the You Only Look Once (YOLO) algorithm. We used pre-trained models such as YOLO. The YOLO algorithm is a real-time object detection system that uses a single neural network to predict the bounding boxes and class probabilities for multiple objects in an image. YOLO divides an image into a grid and predicts the probability of each object's center falling into each grid cell. This approach makes YOLO fast and accurate, and it is commonly used in various applications, including helmet and number plate detection.

- **Train the model:**

To train the model we collect a dataset of images that contain helmets and/or number plates. This dataset should be diverse and representative of the range of scenarios in which the model will be used. Fine-tune the pre-trained model on your specific dataset to achieve higher accuracy. Use techniques such as data augmentation and transfer learning to improve the model's performance.

- **Evaluate the model:**

Evaluating the performance of a model for helmet and number plate detection is a critical step in assessing its effectiveness. Evaluate the model's performance on a validation set to determine its accuracy, precision, and recall. Use metrics such as mean average precision (mAP) to evaluate the model's performance. Here are some common metrics used to analyze the performance of such models:

Intersection over Union (IoU): This metric measures the overlap between the predicted bounding box and the ground truth bounding box for each detected object.

Precision and Recall: Precision measures the proportion of true positive detections (i.e., correct detections) out of all detections made by the model. A high precision score illustrate that the model makes few false detections, while a high recall score indicates that the model detects most of the true objects.

- **Test the model:**

Test the model on a test set to see how well it performs on new data. To test the data, you need to follow these steps:

Obtain the dataset: Depending on the paper, the dataset used to train and evaluate the model may be publicly available or may need to be obtained from the authors. Ensure that you have access to the same dataset used in the paper.

Pre-process the data: Pre-processing steps such as resizing images, normalizing pixel values, and converting image formats may be required to ensure that the data is in the same format as used in the paper.

Load the trained model: If the paper provides the trained model, load it into memory. If not, the model may need to be trained using the same architecture and hyperparameters as described in the paper.

Run inference on the test set: Use the trained model to perform inference on the test set. This involves passing each image in the test set through the model and obtaining predictions for the presence and location of helmets and number plates.

Evaluate the model: Calculate evaluation metrics such as precision, recall, and F1 score to evaluate the performance of the model. Compare the model's performance with the results reported in the paper to ensure that it is consistent.

Visualize the results: To get a better understanding of how the model is performing, visualize the predicted bounding boxes for helmets and number plates on sample images in the test set.

Technology Used :

- **Software Requirement :**

a) Open CV
b) Tensorflow
c) Numpy
d) CNN (Convolutional Neural Network)
e) YOLO (You Only Look Once)

- **Hardware Requirement :**

a) Processors: Intel Core i3
b) Processor speed:1.0GHZ
c) RAM: 1GB or above

- **IMPLEMENTATION DETAILS :**

"Helmet detection and number plate recognition" is a combination of two distinct computer vision tasks. Helmet detection is a subset of object detection, and number plate recognition is a task related to optical character recognition (OCR). To implement this system, you will need to combine the two tasks into a unified solution. Here are the implementation details for each component.

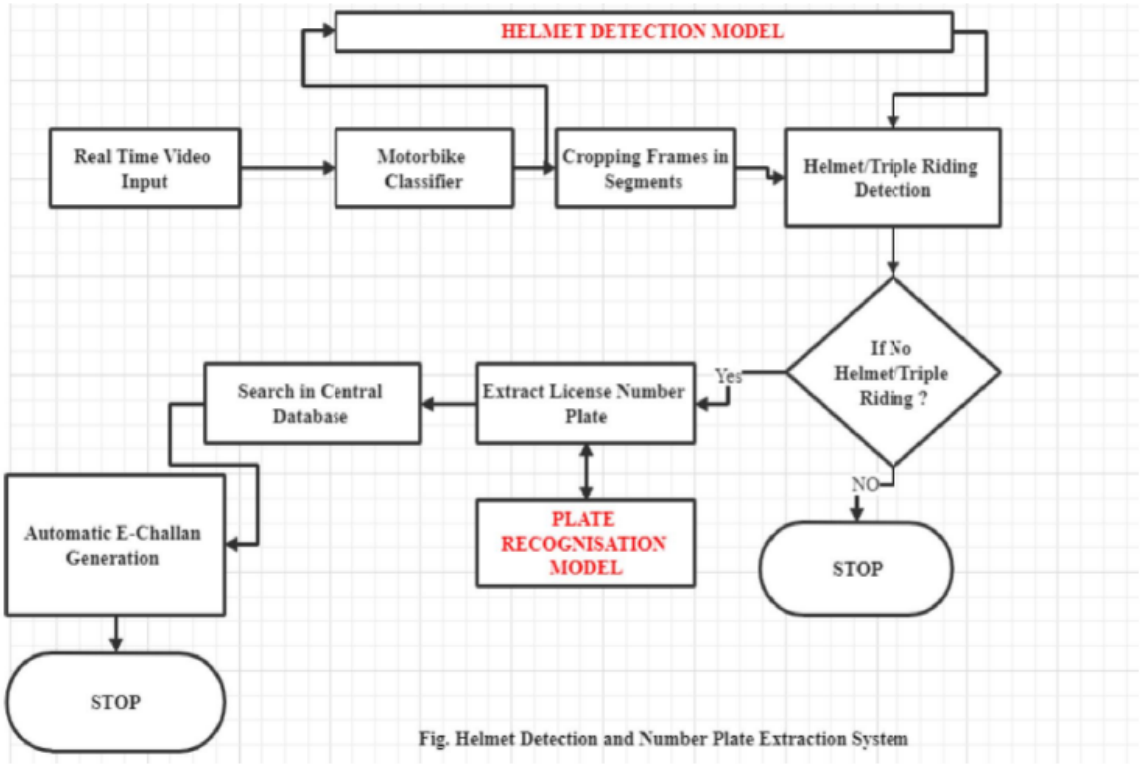


Fig. Helmet Detection and Number Plate Extraction System

- **Helmet Detection :**

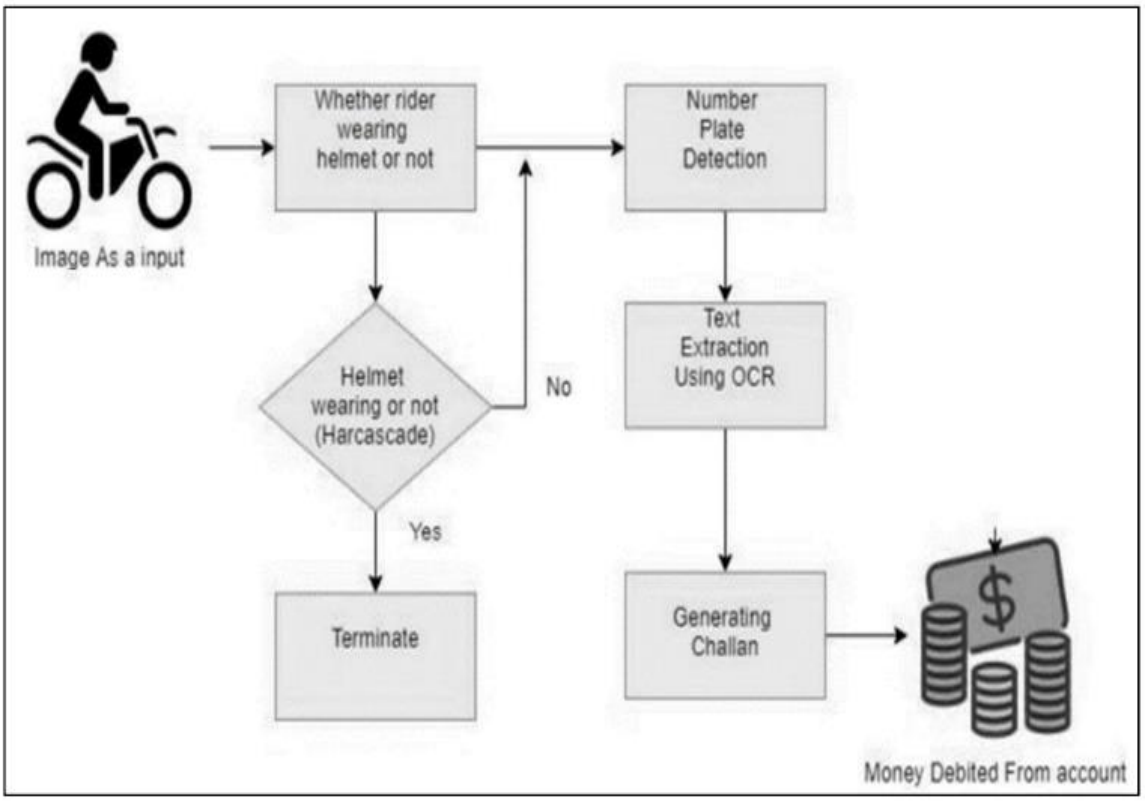
For the task of helmet detection and triple seat detection, we employed the YOLOv5 object detection algorithm. The video frames or images were fed into the YOLOv5 detector, which utilizes a deep neural network architecture to detect and locate helmets and triple seat violations. The YOLOv5 model was trained on a labeled dataset containing annotated images of helmets and triple seat violations. The algorithm outputs the bounding boxes and corresponding class labels for the detected objects, indicating whether a

helmet is present or not.

- **Plate Extraction :**

To extract the number plates from the detected vehicles, we utilized the Plate Recognizer API. The API takes the cropped vehicle images containing the detected number plates as input and performs optical character recognition (OCR) to extract the alphanumeric characters from the plates. The Plate Recognizer API utilizes pre-trained deep learning models specifically designed for license plate recognition. The extracted number plate information, such as the alphanumeric characters and any additional metadata, is returned by the API.

- **SYSTEM ARCHITECTURE :**



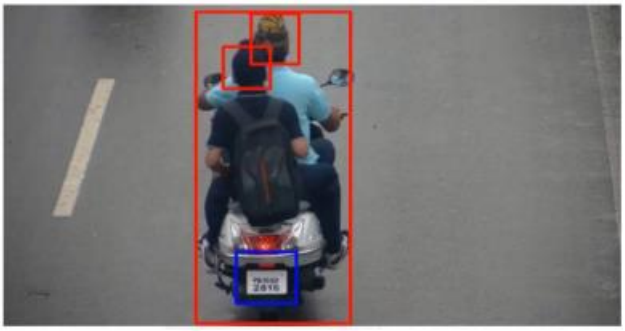
Here we have taken image of the bike racer as an input then it checks whether racer it wearing helmet or not. It checks the helmet wearing or not through the haar cascade algorithm if yes then it terminate the process , and if not then it check the number plate through the text recognition using OCR technique then after the text recognition and number plate detection it generate the chalan receipt and then it debited the money from the bike owner.

5. Results and Discussions :

This study proposes a helmet-wearing detection model based on YOLO. The approach involves integrating an attention mechanism into the YOLOv3 framework to enhance the model's feature representation and eliminate redundant features. This results in a more robust network that can better capture the relationships between different areas in the image. To simultaneously enhance network performance and reduce inference costs, we integrate the best training method. To evaluate the effectiveness of these suggested solutions, we constructed a dataset and performed various assessment tests on it.
Here are the some experimental results for "helmet detection and number plate recognition" model :

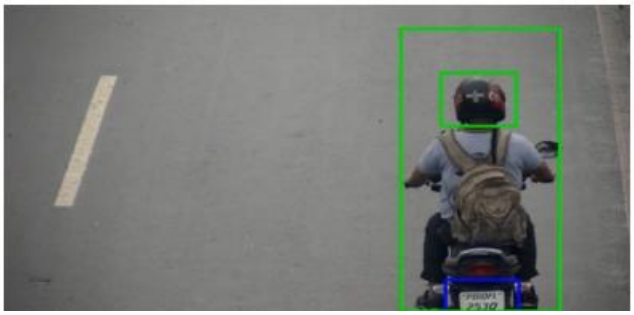
- **Input Screens :**

(a)



(b)

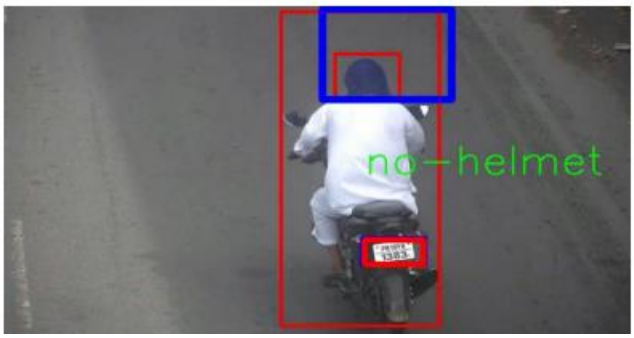
(c)



(d)

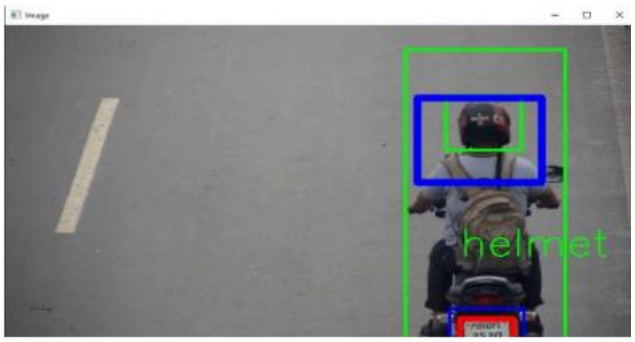
- **Output Screens :**

(A)



(B)

(C)



(D)

In Fig. (A) and (B), as we can see the rider on the two-wheeler is wearing a helmet which is being detected by the system, so a relevant message 'helmet' is being displayed thus confirming the presence of a helmet.
In Fig. (C) and (D), as we can see the rider on the two-wheeler is not wearing a helmet which is being detected by the system, so a relevant message 'no-helmet' is being displayed thus confirming the absence of a helmet.

(E)

(F)

In fig. (E) and (F), as we see the no. plates of the two-wheelers whose riders are detected not wearing a helmet are extracted and displayed as the output.

6. Conclusion and Future Scope :

• Conclusion :

In summary, this project has proposed a framework for detecting motorcyclists who are not wearing helmets from CCTV video and retrieving their vehicle license number plates automatically. Using Convolutional Neural Networks (CNNs) and transfer learning, the system achieves high accuracy in identifying helmetless riders. However, the framework goes beyond just detecting these riders, as it also recognizes and stores the license plate numbers of their motorcycles.

By storing the license plate numbers, the framework provides a means of identifying and penalizing riders who violate helmet laws. This comprehensive approach makes the system an effective tool for promoting road safety. The implementation of this framework can have a significant impact on road safety, especially since it can be integrated with existing CCTV networks. Furthermore, the use of transfer learning makes the system adaptable to different environments, making it a scalable solution that can be used in various locations. Overall, this project demonstrates the potential of using AI and machine learning to improve road safety. By providing a comprehensive solution for detecting helmetless riders and identifying their vehicles, this framework has the potential to reduce accidents and save lives.

• Future Scope :

1 Road safety: By detecting helmets and number plates, machine learning models can improve road safety by reducing the number of accidents caused by non-compliance with traffic rules. This can help in reducing injuries and fatalities on the roads.

2 Law enforcement: Police can use this technology to identify non-compliant vehicles and enforce traffic rules effectively. This can help in reducing traffic violations and improving law and order on the roads.

3 Automatic toll collection: In toll booths, number plate detection using

machine learning can help in automatic toll collection, eliminating the need for manual intervention and reducing traffic congestion. International Journal of Research Publication and Reviews, Vol 4, no 5, pp 2473-2484 May 2023 2483

4 Parking management: Machine learning-based number plate detection can be used to manage parking spaces in a more efficient manner. This can help in reducing parking congestion and improving traffic flow.

5 Traffic analysis: By analyzing the traffic flow using number plate detection, traffic engineers can make informed decisions about traffic management and infrastructure.

6 Improving the accuracy of the system: While the accuracy of the system is already high, there is always room for improvement. Researchers can explore new methods to enhance the system's accuracy, such as using more advanced deep learning algorithms, incorporating multiple sensors or cameras, or using additional image processing techniques. (Kulkarni, S, Sontakke, & V, 2021)

7 Extending the system's capabilities: The system can be extended to detect other objects of interest, such as pedestrians, vehicles, or traffic signs. This would make the system more versatile and useful for various applications, (Shanmugam, M, K, & Somasundaram, 2021)

8 Real-time implementation: While the current implementation can process images and videos in near real-time, it still has some processing latency. Future research can focus on developing more efficient algorithms that can perform object detection and recognition in real-time, with minimal delay. (Zhang, et al., 2020)

9 Scaling up the system: The current implementation can detect helmets and number plates in a single image or video. Future research can focus on scaling up the system to work with large-scale surveillance networks that cover entire cities or regions. (Ghazali, et al., 2021)

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