Helmet and License Plate Detection using Machine Learning

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Abstract - Over the years, the number of motorcycle accidents has been rising quickly in many nations. More than 37 million individuals in India ride two wheels. To ensure road safety, a mechanism for the automatic identification of helmet use must be developed. As a result, a unique object detection model that can recognise motorcycle riders is developed utilising a machine learning-based approach. When a rider without a helmet is spotted, the licence plate is retrieved, and an optical character recognition system is used to identify the licence plate number.Using a webcam or a CCTV as input, this application can be used in real-time.

***Key Words*: Automatic License Plate Recognition (ALPR), Deep Neural Network (DNN), Helmet Detection, Machine Learning, Mean Average Precision (mAP), Optical Character Recognition (OCR), You Only Look Once (YOLO).**

1. INTRODUCTION

Helmets are the primary piece of safety gear for motorcycle riders. The motorcycle rider is protected from accidents by the helmet. Although wearing a helmet is required in many nations, some motorcycle riders choose not to wear one or wear one inappropriately. Numerous studies in traffic analysis have been conducted in recent years, including those on vehicle detection and categorization and helmet detection. Computer vision technologies, such as background and foreground image detection to segment the moving objects in a scene and image descriptors to extract features, were used to develop intelligent traffic systems. To classify the items, computational intelligence technologies such as machine learning algorithms are also used.

Machine learning (ML) is the area of artificial intelligence where a trained model uses inputs from the training phase to operate autonomously. In order to generate predictions or choices, machine learning algorithms create a mathematical model using sample data, referred to as "training data," and are also utilised in object identification applications. Therefore, a Helmet detection model can be put into use by training with a certain dataset. This helmet detection model makes it simple to identify riders without helmets. The rider's licence plate is clipped out and saved as an image based on the recognised classes.An optical character recognition (OCR) model is given this image, recognises the text, and outputs the licence plate number as machine-encoded text. Additionally, a Webcam can be used to implement it. The goal of this study is to create a system that uses CCTV cameras to enforce helmet use. The created system tries to alter risky behaviours, hence lowering accident frequency and severity.

2. RELATED WORK

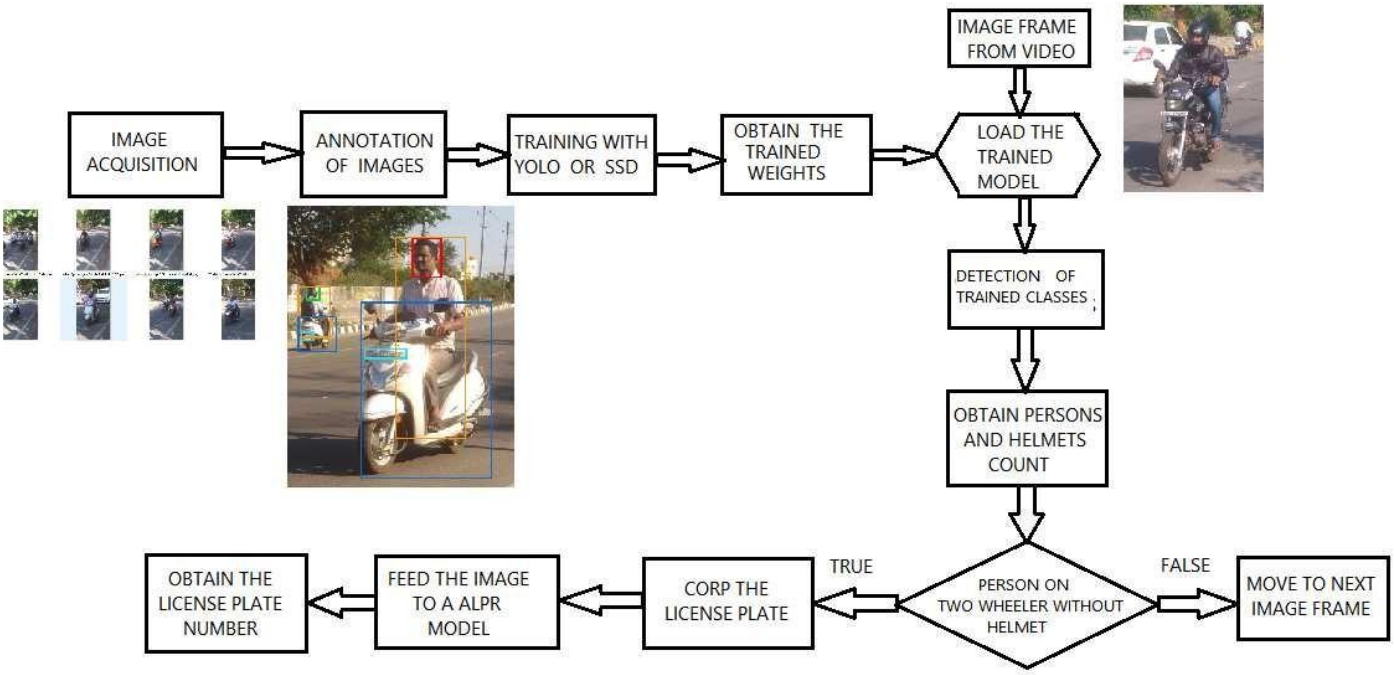
The issue of helmet detection has been addressed in a number of ways during the past few years. In, the authors employ a background subtraction technique to identify and distinguish between moving vehicles. Additionally, they classified human heads with helmets and without helmets using Support Vector Machines (SVM). In, Silva et al. suggested a hybrid descriptor model based on geometric shape and texture data to automatically identify motorcycle riders without helmets. They combined the Hough transform with SVM to find the motorcyclist's head. They also add a multi-layer perception model for the classification of distinct items to their work from [10].

A circular arc detection technique based on the Hough transform is used by Wen et al. They used it on the surveillance system to detect helmets. The flaw in this research is that they rely solely on geometric cues to determine whether a safety helmet is present in the set. Finding helmets requires more than just geometrical traits.suggests a computer vision system with the goal of partially detecting and segmenting motorcycles. Utilizing a helmet detecting device, the presence of a helmet confirms the presence of a motorcycle. The edges are computed on the potential helmet region in order to identify the existence of the helmet. It employs the Canny edge detector.

A system to detect moving objects using a k-NN classifier placed over a motorcycle rider's head to categorise a helmet was proposed by Waranusat et al. These models had a cap on the degree of precision that could be attained and were based on statistical data from photographs.

The accuracy of categorization has continued to increase with the development of neural networks and deep learning models. A convolutional neural network (CNN) based approach for object classification and detection was introduced by Alex et al. Despite using CNN, they have poor accuracy in detecting helmets due to restrictions on helmet colour and the presence of several riders on a single biker.

3. PROPOSED METHODOLOGY



Accuracy and speed are essential for real-time helmet detection. As a result, the You Only Look Once (YOLO) DNN model was selected. Modern, real-time object detecting technology is used by YOLO.

YOLOv3 is significantly faster and more accurate than the previous YOLO versions. In contrast to R-CNN systems, which require thousands of evaluations for a single image, it also makes predictions with a single network assessment. It is incredibly quick, outpacing R-CNN and Fast R-CNN by more than 1000 times and 100 times, respectively.

The art of finding examples of a particular class, such as animals, humans, and many more, in an image or video is known as object detection. Using pretrained object detection models, the Pre-Existing Object Detection API makes it simple to detect objects. However, these models identify a number of objects that are useless to us; as a result, a bespoke object detector is required to identify the required classes.

Five objects must be found in order to conduct helmet detection and number plate recognition and extraction. Helmet, No Helmet, Motorbike, Person (Sitting on the Bike), and License Plate are the objects.

It is necessary to develop a unique object detection model that can find these items. As a Dataset, a set of photos with the objects from the classes that need to be recognised are employed. The custom model is then trained using this dataset. Once trained, the model can be used to find these unique objects.

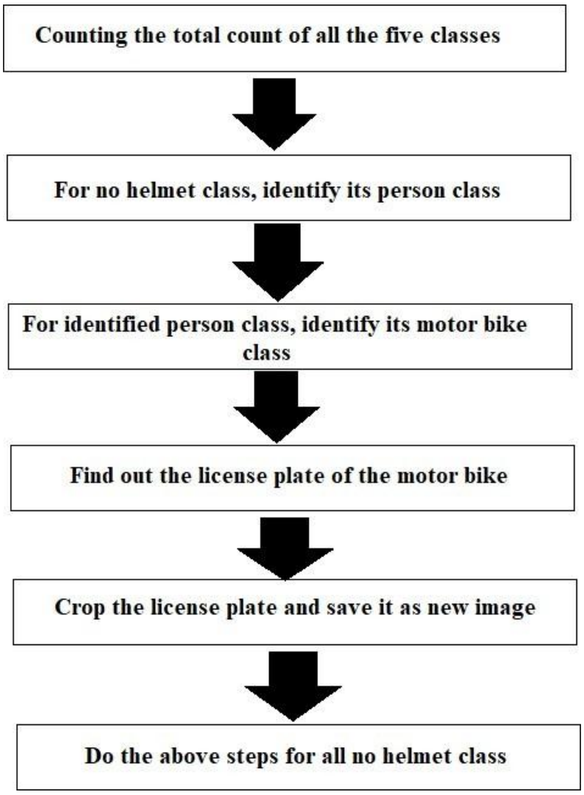
All of the collected photos are fed with their annotations during the training process. Using ground truth from the necessary classes, the model retrieves the features of each class from each image. We employ a deep learning classifier based on convolutional neural networks for extracting the characteristics and storing them in order to recognise those features in additional photos.

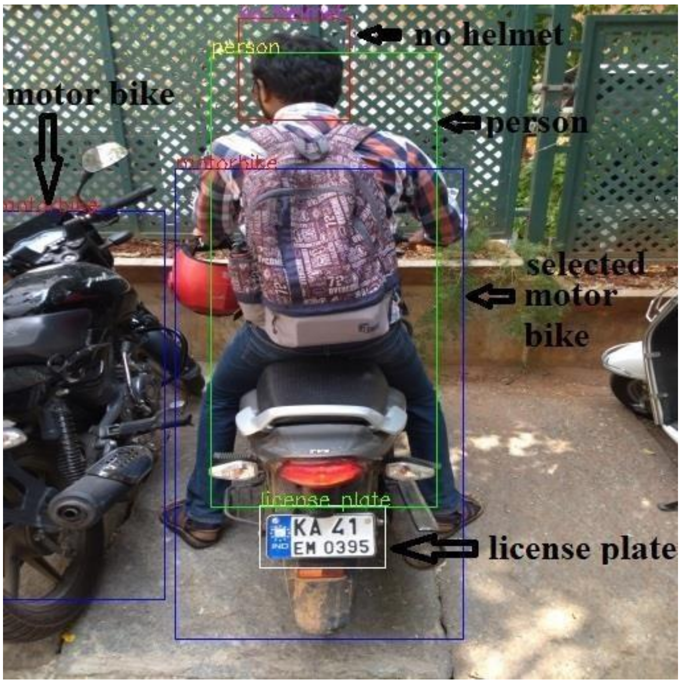
3.1 Helmet Detection

The YOLOv3 model receives the tagged photos as input to train for the specific classes. The model is loaded using the weights produced during training. After that, an image is provided as input. All five of the training classes are detected by the model. We learn about the guy riding the motorcycle from this. We can quickly determine the rider's other class details if they are not wearing a helmet. The licence plate can be extracted using this.

3.2 License Plate Extraction

The linked person class is identified once the helmetless rider has been located. This is accomplished by determining whether or not the no helmet class' coordinates fall inside the person class. Similar proceduresare used to identify the corresponding motorcycle and licence plate. The licence plate is cropped and saved as a new image after the coordinates are located.





3.3 License Plate Recognition

An optical character recognition (OCR) model is given the extracted licence plate. The OCR extracts the recognised strings from the machine-encoded text after identifying the text in the provided image. A list of anticipated licence plate numbers together with a confidence level are output by the OCR module. The confidence value conveys how confident the system is in correctly identifying the provided licence plate. Then, for later use, the licence plate identified with the greatest confidence value is saved in a text file.

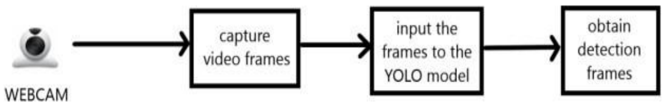
Plate #1

	Plate	Confidence
-	KA41EM0395	89.353058
-	KA41M0395	80.161301
-	KA416M0395	79.876579
-	KA41KM0395	79.874893
-	KA41BM0395	79.874687

4. REAL TIME IMPLEMENTATION

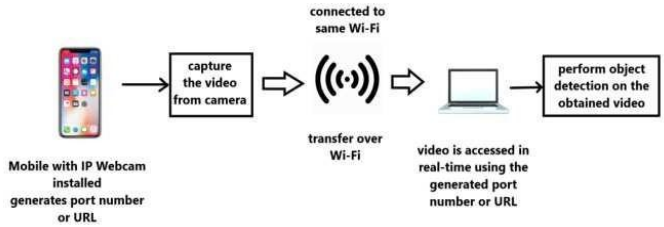
4.1 Using Webcam

The camera can be utilised as an input tool to get image frames for real-time object detection. Since we are utilising the YOLOv3-tiny model, the processing speed is up to 220 frames per second.



4.2 Using IP Webcam for Mobile

Instead of using the webcam, a mobile camera can be used as the input. As a mobile device can be carried and can viewthings from various perspectives, this can create a lot of opportunities. A further benefit is that this can all be done in real-time. This means that the footage can be obtained from a handheld device as well as from CCTV footage. Additionally, the close-up mobile video can provide a number plate that is sharper and easier to read so that the OCR can output an exact number.



5. RESULTS

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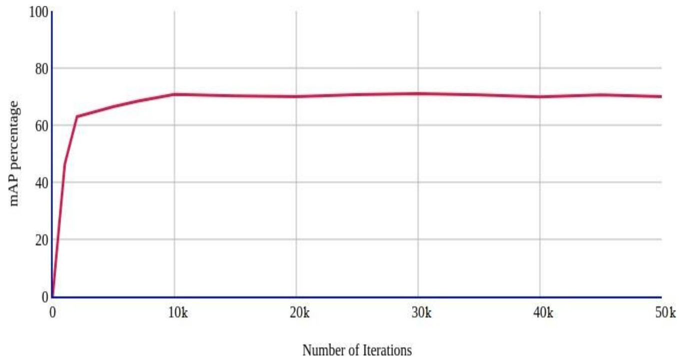
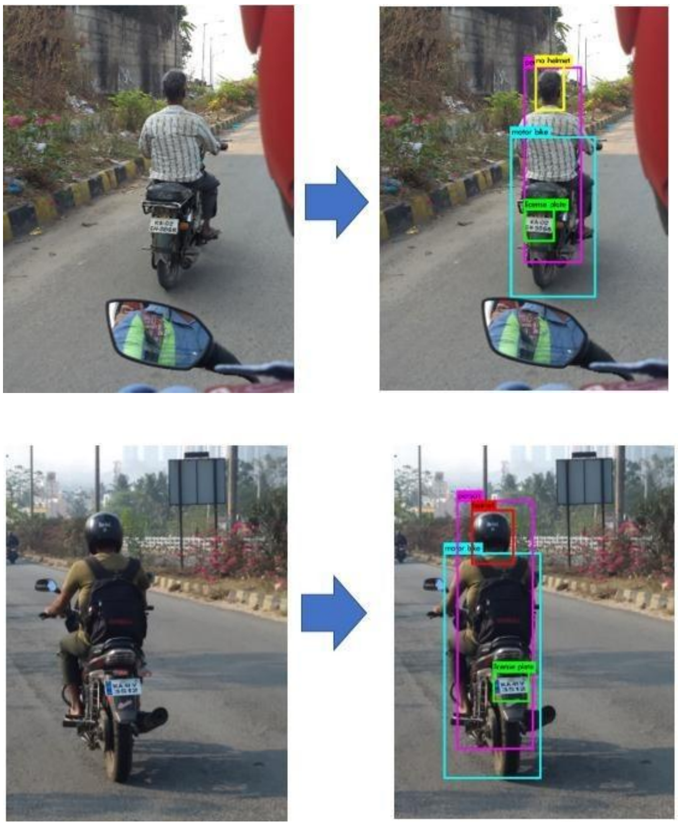
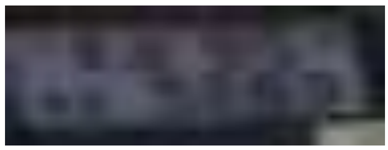


The graphic below displays a few samples of the input image and the item detector



From the output of the object detector, the code retrieves the licenceplate. The code used to retrieve licence plates only pulls information from motorbikes whose riders are not wearing helmets and discards the information from motorbikes whose riders are wearing helmets.

With an accuracy of upto 85%, the OCR model can find and identify any licence plates that are visible in an image. In the accompanying figure, a recognized licence plate is displayed as an example.



6. CONCLUSION

According to the data shown above, it is clear that YOLO object detection is ideally suited for real-time processing and was successful in accurately classifying and localizing all object classes. The suggested end-to-end model was successfully constructed and has all the necessary components to be automated and deployed for monitoring. A variety of strategies are used to extract the licence plates, some of which are created to handle the majority of situations while taking into account various scenarios like numerous riders operating without helmets. All of the software and libraries utilized in our project are open source, making them very adaptable and affordable. The initiative was primarily created to address the issue of ineffective traffic management. So, in conclusion, we can claim that if implemented by any traffic management departments, it will facilitate and speed up their work.

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