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AUTOMATIC HELMET AND LICENSE PLATE RECOGNITION USING YOLOV5 WITH INSTANT E-CHALLAN INTIMATOR

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Abstract
The main form of transportation in developing nations has always been motorcycles. The number of motorcycle accidents has increased in the last several years. Not donning a protective helmet is one of the main causes of fatalities in motorcycle accidents. Traffic police manually observing motorcyclists at intersections or using CCTV footage to penalize those who do not wear helmets is the most common way. However, it necessitates human involvement and work.This study suggests an automated method for identifying riders who do not wear helmets and obtaining their license plates from security camera footage. In order to obtain moving objects, the suggested approach first subtracts the background from the video. Next, moving items arecategorized as either non-motorcyclist or motorcyclist. The head section of a biker iscategorized as either helmet or non-helmet.Lastly, the motorcycle number plate of the indicated rider without a helmet is found, and the characters on it are extracted. The proposed system utilizes YOLOv5 fordetecting motorcyclists without helmets in traffic videos.

Keywords:
Motorcycle, Helmet, License plates, CCTV, YOLOv5.

1. INTRODUCTION

One of the most important safety equipmentfor motorcycle riders is a helmet.Regretfully, their use has not risen, especially in areas where helmet-free policies are strictly enforced. This technique aims to give an automated systemapproach to identify motorcycle riders whowear helmets and those who do not, along with the number plates that relate to each. According to the World Bank, 1 percent ofall road deaths worldwide usually occur in India, where there are 1% of cars. According to a December 2018 analysis bythe Mumbai Environmental Social Network, the percentage of road occupied by buses has slightly decreased from 6.2 percent to 2.2 percent, however the percentage of space occupied by private automobiles has increased over the past 20 years from 59 percent to 77 percent. The Government of India has proposed the Various Penalties under Motor Vehicles (Amendment) Bill - 2019 in an effort to encourage the use of helmets. A biker who violates section 194D will be fined Rs. 1000 and have their license revoked forthree months.

At the moment, traffic police manually keep an eye on motorcycle riders, helmet ornot. Manual verification is insufficient, time-consuming, and subject to human mistake. Furthermore, human labor is needed in large semi-urban and rural areas where CCTV surveillance-based approaches are not automated.

The exponential increase in motorcycle-related traffic accidents in recent years has highlighted the critical need for efficient enforcement and surveillance measures. Conventional approaches to oversight and implementation have been shown to be insufficient. Thus, utilizing cutting-edge computer vision methods like OCR andYOLOv5 appears to be a viable way to dealwith

With urgent problem. Our suggested method is a multi-step procedure. First, footage is taken via CCTV cameras that areplaced at key spots. Then, sophisticatedbackground removal methods are used to

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extract the important components from the frame, improving the precision of the analysis that follows. The identification of motorcycle riders and their lack of helmetsis the main focus of our investigation. By accurately locating and examining theregion of interest that corresponds to the motorcyclist's head in the video frame, thiscrucial duty is completed. When a riderwithout a helmet is identified, our system'soptical character recognition (OCR) component kicks in to extract and identify the license plate data. This data is essentialsupporting documentation for furtherenforcement proceedings. Our method provides a reliable and effective way toimprove road safety measures byintegrating OCR for text recognition and YOLOv5 for object detection in a seamless manner. This paper's practical ramifications for real-world applications—particularly inthe areas of law enforcement and traffic management—are what make it significant. By utilizing state-of-the-art technologies, we hope to support the creation of preventative measures that lessen the hazards connected to motorcycle riders' failure to wear helmets.

2. RELATED WORK

A solution to the problem of motorcycle detection in surveillance footage was put out by **Chiu et al[7].** This system divides the moving item into segments, and then uses a probability-based method to track motorcycles and heads. This approachhandles the occlusion issue, but it is not ableto handle minute deviations caused by noiseand lighting effects. Additionally, it detectsheads using Canny edge detection inside a specific search window size. To identify motorcycle riders, Chiverton et al. employed characteristics based on edge histograms**.**

P. Doungmala et al.[1] published two strategies for full and half helmet detectionin which has been the subject of numerous approach algorithms for many years. They detected whole helmets using the Haar feature extractor and partial helmets using the circular hough transform. Recall was accomplished in the experiments using images, with a score of 95.

Dhwani et al.[2] presented a method for identifying motorcycle riders who were notwearing helmets. Through thresholding, thesystem was able to identify moving cars. Using aspect ratio and area, they then divided the population into motorcyclists and non-motorcyclists. First, a zone of interest is identified in order to detect helmets.

To get beyond a few obstacles At the powersubstation, **J. Li et al. [3]** detected the presence of helmets with an accuracy of

80.7 percent. To find moving items, they applied the ViBe background subtraction technique. To identify helmets, they employed an SVM classifier and an Oriented Gradient Histogram after obtaining the region of interest.

K. C. D. Raj et al.[4] created a machine system in [9] that can both detect and recognize number plate characters andmotorcyclists riding without a helmet. They employed convolutional neural networks with Alexnet that were based on deep learning. They detected with good precision.

N. Boonsirisumpun et al.[5] suggested a strategy to use four different CNN models—GoogLeNet, VGG19, VGG16,and Mobilenet—in combination with a single shot multibox detector to recognize people riding bikes with or without helmetsin videos. Of these, Mobilenet performed the best.

Kai et al.[6] employed a Tensorflow modeland a deep learning technique to identify individuals at power substations. After that,they recognized helmets using color space transformation in HSV color space. Videoswere used for the experiments. The overalldetection accuracy of the system was 89.0 percent.

3. PROPOSED MODEL

3.1 Helmet and License Plate Recognition

3.1.1 Input Acquisition

The key input for the model is CCTV footage that records traffic activity on the roads. To improve clarity and eliminate noise, the film is gathered and pre- processed.

<u>3.1.1.1 Gathering CCTV Video</u>

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CCTV footage of traffic activity is continuously recorded by cameras placed strategically at major roads, crossroad and other high-traffic areas. To guarantee the models resilience and flexibility, footage isgathered during different hours of the day and in different weather conditions.

3.1.1.2 Camera Alignment andCalibration:

To standardize camera properties such as perspective, lens distortion and focal length, calibration methods are put into place. The uniformity of the object scale and spatial connections among various camera feeds is guaranteed by thealignment of camera viewpoints.

3.1.1.3 Optimization of Resolution andFrame Rate:

CCTV cameras are set up to record video atthe best frame rates and resolutions possiblein order to balance the need for data storagewith the quality of the images. Elaborating analysis is made possible by high- resolution video, and accurate object detection requires smooth motionrecording, which is ensured by sufficient frame rates.

3.1.1.4 Preprocessing Input:

To improve the quality of recorded video, preprocessing methods including denoising filters and contrast enhancement algorithmsare used. Reducing noise increases object clarity and boosts the efficiency of later computer vision algorithms.

3.1.2 Background Removal

The background reduction step is essential for separating out significant objects and improving the precision of tasks that followin terms of detection and recognition. In Order to differentiate between stationary background items and moving objects like cars, bikes and pedestrians background subtraction techniques like CNN in deep learning are used.

CNN (Convolution Neural Networks) One kind of deep learning algorithm thatworks especially well for tasks involvingpicture recognition and processing is theconvolutional neural network (CNN).Convolutional, pooling, and fullyconnected layers are some of the layers thatmake it up. The human brain's visual processing served as the inspiration for CNN architecture, which makes them idealfor identifying spatial connections and hierarchical patterns in images.

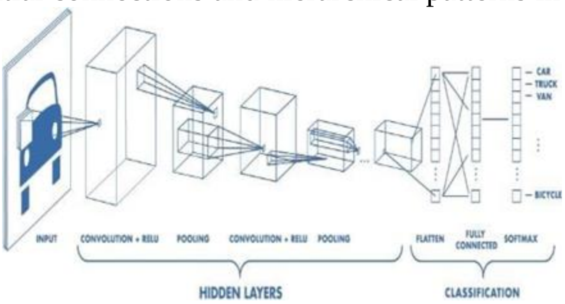

Fig-3.1.2.1 CNN

$$W_{out} = \frac{W - F + 2P}{S} + 1$$

3.1.3 Helmet Detection UsingYOLOv5

Motorcycle riders in the divided areas areidentified by their helmets using YOLOv5.When there is no helmet, the model detectsthis and stores it for further analysis.YOLOv5 can Identify multiple vehicles and detect whether driver is havingHelmet or not as shown in Figure 3.1.3.3. **YOLOv5**

YOLOv5 is a computer vision model that belongs to the You Only Look Once (YOLO) family. YOLOv5 is a popular object detection tool. There are four primary variants of YOLOv5, each offering progressively higher accuracy rates: small (s), medium (m), large (l), and extra large (x). Additionally, the training times for each variety vary.

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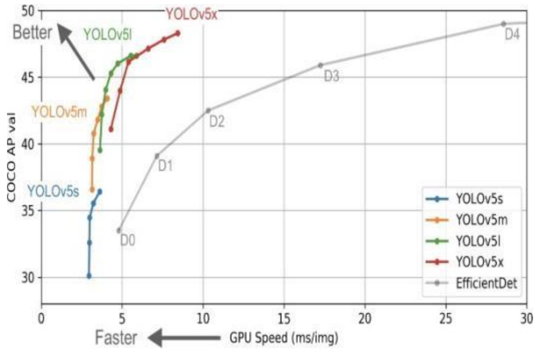

Fig:3.1.3.1 YOLOv5 Speed in Object detection.

Glenn Jocher's YOLOv3 PyTorch repository is a natural progression to the YOLOv5 repository. Developers frequentlyused the YOLOv3 PyTorch repository to port YOLOv3 Darknet weights to PyTorchbefore deploying them to production. Manypeople (including our Roboflow vision team) preferred the PyTorch branch's user-friendliness and would utilize it for deployment. To enable thousands of developers to train and implement their own unique object detectors that can detect any object in the world, Ultralytics started to make research advancements in additionto repository design modifications after completely duplicating the modelarchitecture and training process of YOLOv3.

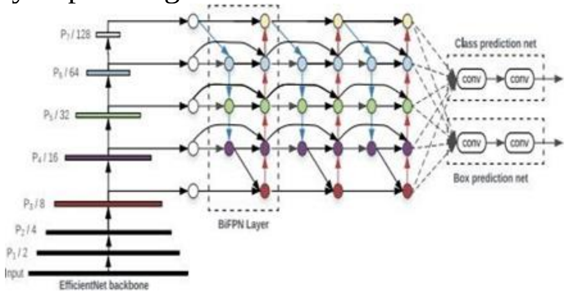

Fig-3.1.3.2 YOLOv5 Architecture.

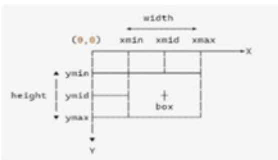

Fig-3.1.3.3 Bounding Box Calculationin YoloV5

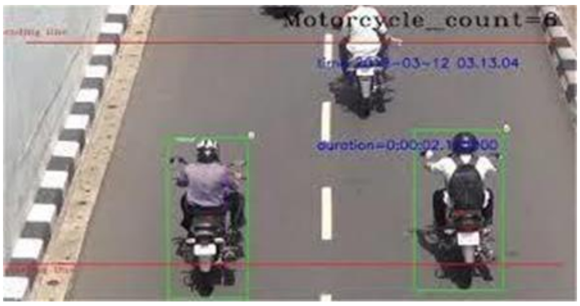

Fig-3.1.3.3 Helmet Detection Using Yolov5.

3.2 License Plate Extraction UsingOCR

To extract alphanumeric characters fromthe divided license plate sections, OCR techniques are used. For the purpose of identifying vehicles and recognizing license plates, extracted characters are processed.

OCR (Optical Character Recognition) Optical Character Recognition is referred toas OCR. It is the process that converts a text image into a computer-readable text format.For example, if you scan an invoice or a receipt, your computer will save the scan asan image file. You cannot use a text editor to

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edit, search for, or count the phrases in the image file. Using OCR, the image can be converted into a text file and its contentsrecorded as text.The text on vehicle registration plates will be automatically recognized by the Tesseract OCR, an optical character recognition engine. Python-tesseract Python-tesseract is an optical character recognition (OCR) tool for the Python programming language. It can thus identifyand "read" text that is embedded in photos.A wrapper for Google's Tesseract-OCR Engine is called Python-tesseract. Because it can read all image formats, includingjpeg, png, gif, bmp, tiff, and others, it is alsoutilized as a standalone script. Additionally,Python-tesseract will output the recognizedtext instead of writing it to a file if used as a script. It is capable of recognizing over 100 different languages.

Fig-3.2.1 License-PlateRecognition using Tesseract OCR

3.3 E-Challan Generation

An electronic e-challan is generated based on the owner information and the identifiedinfraction. The timestamp, location, and vehicle details of the infraction are all included in the e-challan, along with the associated penalty.

Notification to Owner of the Vehicle Through electronic communicationchannels, the vehicle owner is informed ofthe traffic infraction and the issue of the e-challan. Notifications can be sent via email, mobile application, or SMS, based on theuser's choices and the availability of contactinformation.

Instructions and Payment Options

The available payment alternatives and directions for paying the fine are included in the e-challan message. To offer the bike owner ease and flexibility, paymentmethods can include mobile wallets, onlinepayment portals, or dedicated payment centers.

Fig:3.3.1 E-challan

3.4 System Architecture

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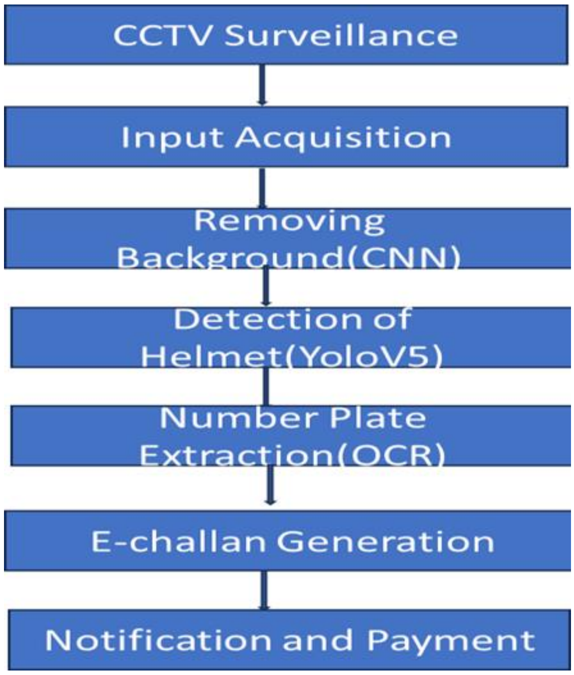

Fig:3.4.1 System Architecture

4. RESULTS AND DISCUSSIONS

Fig:4.1 Helmet Detection

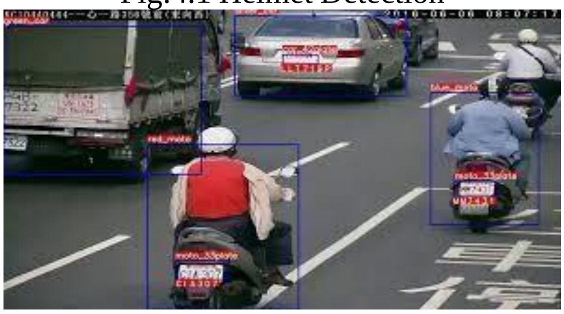

Fig:4.2 Detecting multiple Vehicles

Fig:4.3 License plate Detection

Fig:4.4 License number Extraction usingOCR

Fig:4.5 Automatic E-challan

5. CONCLUSION

The suggested method uses automaticlicense plate identification and detection ofmotorcycle riders without helmets to provide a comprehensive approach to improving road safety and traffic law enforcement. The system uses cutting-edgetechnology like OCR for license plate identification and YOLOv5 for helmet detection to speed up the process ofrecognizing traffic offenses and issuing e-challans. The technology increases efficiency, decreases the need for human involvement, and encourages compliancewith traffic laws by automating these functions. Convenience and transparency are further improved by the system's capacity to alert car owners of infractions and provide online payment alternatives. All things considered, the suggested strategy helps to promote safe driving conditions and efficient traffic control tactics. Road safety and adherence to traffic laws could be significantly improved with the further development and use of such systems.

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