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Detection of Helmetless Riders Using Faster R-CNN

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Abstract:- In India, more than 17 deaths and 55 road accidents happen each and every hour and mostly the two-wheelers add the account to an increase in road accidents belonging to the age group of 18-45 yrs and the causes regarding the same might be due to the helmet-less riding, triple riding and speeding. To overcome this issue we have come up with an idea to detect the riders without a helmet, those having a triple ride and to inform the cops when an accident occurs, this project mainly lends a helping hand to the cops. The cause of accidents by the two-wheelers is mainly because of not wearing helmets. Traffic control officers and doctors often say that the death could have been avoided if the rider was wearing a helmet. The riders wear helmets when they see a police vehicle or a motor vehicle checking ahead of them. The number of deaths or accidents caused by the shock of a sudden reaction when a helmetless rider sees a cop vehicle is remarkable. Another cause of accidents is taking more passengers than the manufacturing company of the two-wheeler. We propose a framework for real-time detection of traffic rule violators who ride bikes without using a helmet. This methodology initially identifies bicycle riders from surveillance video background subtraction and object detection. At that point it decides if the bicycle rider is using a head protector or not using Image Processing. In the event that the rider is riding helmetless, at that point the number plate of the bicycle is noted and the traffic safety rule violation report with the licence plate number and the picture is sent to the particular cop to make the move required.

Keywords:- *Image Processing Algorithms, Object Detection algorithms, YOLO Dataset.*

I. INTRODUCTION

In India, the number of accidents occurring each day is increasing rapidly. The two-wheelers account 25 percent of road crash deaths because of ignoring safety measures like wearing helmets while driving. More than two drivers are travelling in a two-wheeler is also a major reason. So here, we propose a framework for real-time detection of traffic rule violators who ride bikes without using a helmet. The road CCTV footage is used to detect whether a rider is wearing a helmet or not, using Deep Learning and Image Processing technology. The algorithm used here is faster R-CNN, because it increases the detection rate of motorcycles, compared to other deep networks such as CNN, fast R-CNN and YOLO. The violator's vehicle's registration number is recognized from the vehicle using open-ALPR and an alert is sent to the nearby police station.

Here we mainly categorized into four areas, they are

- Motorcycle Detection
- Head Detection
- Helmet Detection
- Number plate detection

II. BACKGROUND

Since bikes are reasonable and a day by day method of transport, there has been a quick increment in bike mishaps because of the way that the majority of the motorcyclists don't wear a helmet which makes it an ever-present risk each day to go by a bike. Over the most recent few years alone most of the deaths in accidents are due to damage in the head resulting in trauma to the skull or mind. In light of this, wearing a helmet is obligatory according to traffic rules, violation of which pulls in heavy fines. Inspite, an enormous number of motorcyclists don't comply with the standard. The police officer attempted to control this issue physically, however it is insufficient for the real circumstance. The requirement for security measures is an unquestionable requirement to decrease the number of deaths in road accidents, and use of helmets is a significant factor regarding safety.

A study that was conducted by the United Nations in 2015 estimated that the chances of surviving an accident rose by 42 percent on wearing a helmet. Even though helmets are for the safety of the riders, most of them avoid it due to reasons like "it spoils my hairstyle", "it feels uncomfortable"," good helmets are costly" or "it obstructs my peripheral vision". These reasons are not comparable to losing a life. The existing system for checking whether a rider is wearing a helmet or not is a checkpoint by police or other personnel to manually check each rider. In this system, there is an impossibility of riders evading checkpoints.

Thus the importance of automatic systems in traffic control has been increased in recent years. Presently, all major urban areas already deployed huge video reconnaissance systems to keep a vigil on a wide assortment of dangers. In this way utilizing such a already existing system will be a cost-efficient arrangement, however, these frameworks include an enormous number of people whose performance is not significant for long periods of time.Recent studies have shown that human surveillance proves ineffective, as the span of checking of

recordings expands, the blunders made by people likewise increases. We aim to improve the usage of a traffic stream framework, others are to lessen the expense of human work and abate the reasons for a mishap. The ideal solution is to develop an electronic detection system that can be automated to recognize this kind of problem without human cost.

III. RELATED WORKS

Based on the papers we did for research, a short analysis is done: In the paper done by Vishnu[7], a system for the automatic detection of the motorcyclists driving without helmets in the CCTV footage. Versatile background subtraction was utilised for the video edges to get the moving object.CNN was also used for identifying the motorbike rides in the moving object. They were able to identify 92.87 percent of the violator with a low false alarm rate of 0.5 percent on an average and with these lines showcased the proficiency of their proposed methodology.

Dharma Raj[9] also showed a related work of the developments of a system using image processing and deep convolutional neural networks(CNN) to identify the motorcyclists who violate the helmet law. Their system consisted of motorcycle detection, helmet v/s no helmet detection and motorcycle license plate recognition. CNN models were built for the classifier. The errors they faced were when the rider wore a hat it was identified as a helmet classifier. This issue could be resolved by increasing the training data with hats.

Baolin Bai's[8] paper, the system was developed with the Deformable Parts Model(DPM) which has a high detection accuracy in the image detection algorithm. The DPM is both efficient and accurate for object detection. The algorithm of MPCA and fast level locating was used for the training process. Even though high detection precision and detection speed were enhanced, the algorithm in the paper could only deal with the partial occlusion or damage with the vehicle occlusion problem and the effect of detection was not accurate under the occlusion of vehicle's condition or damage seriousness. False detections happened due to confusion among classes such as between car and bus and in other categories false detection was often due to the relatively strict bounding box criteria.

Nagarjuna's[10] paper had developed a car accident detection and communication system which would help to inform the relatives, nearest hospitals and police with the location of the accident. The system was able to send messages to the stored emergency numbers when the car collided or topped or tilted by more than 30 Degree. A drawback identified in this system was that the coordinates of the location were sent instead of the exact location which could be done by an application locating the map's location.

In Narong's[11] paper, a method using deep learning called Single Shot Multibox Detection was developed into the helmet detection problem. In this method, only a single CNN network to detect the bounding box area of motorcycle and rider and classify if the biker is wearing a helmet or not. The results of the experiment were good as the Deep Learning and CNN techniques were good algorithms which could be applied for the problem of image detection.

Yogameena's[12] paper of helmet wear analysis using deep learning had the framework which used the performance metric and means average precision on the CCTV footage. The framework consisted of foreground segmentation with the help ofGMM, motorcycle detection and detection of motorcyclists with or without helmet using faster RCNN

In Yuanlong Yu's[13] paper, they developed a study for a traffic accident detection method which includes a self-tuning iterative hard thresholding algorithm for learning sparse Spatio-temporal features and a weighted extreme learning Machine for detection. The drawback seen here was that false detection occurred when the collision happened in different depth.

In Rohit's[14] paper, a similar method of helmet detection was developed using deep learning, they used the Caffe Model for the detection and extraction which had an accuracy score of approximately 86 and another method used for image classification was the Inception V3 model which has an accuracy score of 74**.**

IV. PROPOSED METHODOLOGY

The system is divided into four modules:

A. Motorcycle Detection
B. Head Detection
C. Helmet Detection
D. Number Plate Detection

A. Motorcycle Detection

Bike and helmet recognition from a picture has been a precarious circumstance in the field of image processing. The difficulties confronted were the state of the bike in the picture, the acknowledgement of individuals riding on a cruiser or an empty vehicle with no rider, the spot of the traveler's head and the distinguishing proof of the helmet at the head area of the rider. Various steps of image processing were applied on the video images, before it detects the motorcyclist in the frame and also it's noticed that the properties derived using various algorithms using the information present in the image itself provide decrease the detection rate for motorcycle detection. Recently, deep learning algorithms such as CNN have taken on helmet wear analysis with it is comparably better than such hand-crafted features. As the faster R-CNN escalates the recognition rate of motorcycles, compared to other deep networks such as CNN, fast R-CNN and YOLO. We use faster R-CNN. This research and relative study for selecting an admissible algorithm, which provides more desirable accuracy in the existing world challenging conditions in

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difficult surveillance data and they are the key benefaction of the proposed work. We use the CCTV footage videos from the desired locations and we divide the video into different frames later we detect objects using open-CV source python code(based on faster R-CNN) and if the system detects the presence of a motorcycle, it first checks whether it has a rider or not. Based on this,the desired part from the frame and further checks are done.

B. Head Detection

From the above frames, we distinguished a cruizer (utilizing faster R-CNN). On the off chance if the model distinguishes the nearness of the bike, a limit box is made around it. This zone is then withdrawn from the current frame and passed to the image classifier for additional processing(image acquisition, image restoring, linear filtering,etc.) in the later stages. The image classifier will isolate the test image from the captured frame into one of the two goal classes. Faster R-CNN with VGG-16 a pre-trained model could distinguish humans or objects like person, horses and chair. In the view of camera position with its angle of depression, it produces human-head appearances. With the assistance of Gabor-Wavelets filter, conforms its sturdiness and stability against changes in the scale, orientation and dazzle are used for identifying highlights representing the facial segments. It steadily identifies the human head under various ecological conditions.

C. Helmet Detection

It is inferred from the related work, that the features and the CNN that exist now fail to control the real-world challenges for helmet wear analysis such as helmet detection of motorcyclists, so we use faster R-CNN. To find a robust and accurate model for helmet or no helmet classification, we begin our project from a simple model and increase the complexity of the model incrementally with input channels of RGB colour. The identification of people riding a motorcycle or it's just an empty vehicle with no riders, the location of the biker head and the detection of a helmet at the head location of the rider was examined. Various steps of image processing needed to apply on the video frames before it can identify the position of the motorcycle. In this module the detection model detects the presence of a motorbike and person with a helmet. The rider overlapping area at a specific point of time is detected and a set of coordinates and dynamically it depends on the position of the bounding boxes that is created around the motorbike and rider.The detected motorcycles were first manually classified into helmet and non-helmet classes for training the device.For training, we use the upper one-third of each motorcycle images as a region of interest extracting process,because this is the region most likely to contain the helmet or no-helmet informations. This new set of coordinates is used to crop the current frame.These cropped images from the frames that is motorbike person combination.This image is then passed onto the image classification model then classifies the cropped images into a helmet or no helmet classes and saves the image in directory else it is simply discarded.Another key contribution of the proposed system includes most of the real-world challenges of the head or helmet detection such as low resolution,blur,profile view,occlusion,bald head and persons with different helmet shape and size.The dataset collection and experimentation on these datasets are other major beneficiation of the proposed work.

D. Number Plate Detection

In continuation with the detection of motorcycles, the detection of motorcyclists with and without a helmet is performed similarly. We have experienced several different CNN models for character classification of motorcycle licence plates. We prepared the framework with various pictures of helmetless riders and we assembled the relating number plate. That is the motorcyclist with the protective cap isn't contemplated however the frame with the biker without head protector is put away in the registry. These pictures are moved to further processing. The entire system has been tested by expelling this module and the rest of the groupings, for example, bike detection and recognition of a motorcyclist with or without a helmet has been actualized. Hence, the region related (false positive) to the motorcycle, motorcyclist, head and helmet in background regions and foreground regions have been detected. As a result, it proves the significance of the initial foreground segmentation, motorcycle detection, detection of a motorcyclist with and without a helmet and Licence Plate recognition of the motorcyclists with and without helmets, delivers a framework for an automated helmet wear analysis system. The study of related work, dataset and experimentation on different types of challenging conditions are the key beneficiation of the proposed helmet wear analysis framework.

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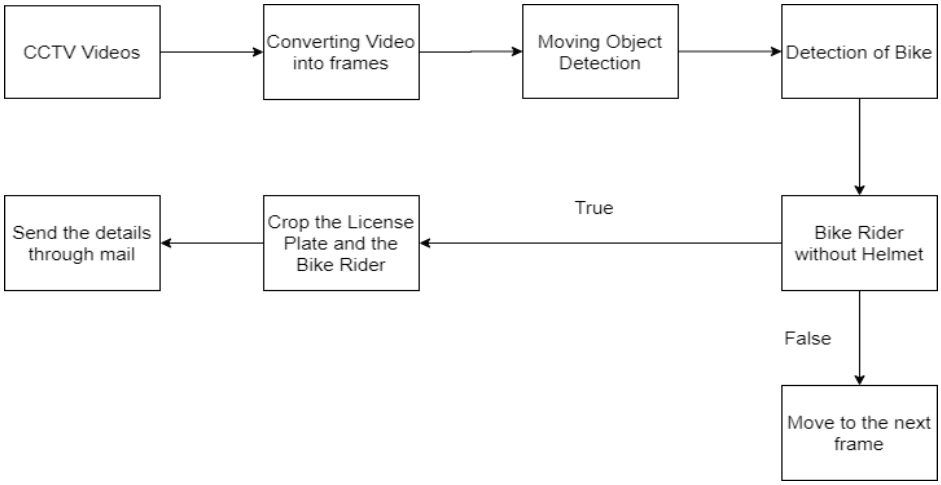

Fig 1:- The framework of the system

V. RESULT

The results obtained are shown as Figures below.

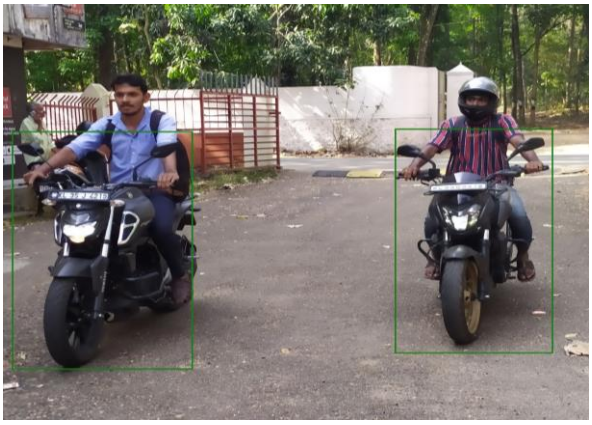

Fig 2:- Detection of Bike

Figure **2** shows the result of detection of the bike using our system. Bikes are highlighted with green colour boxes.

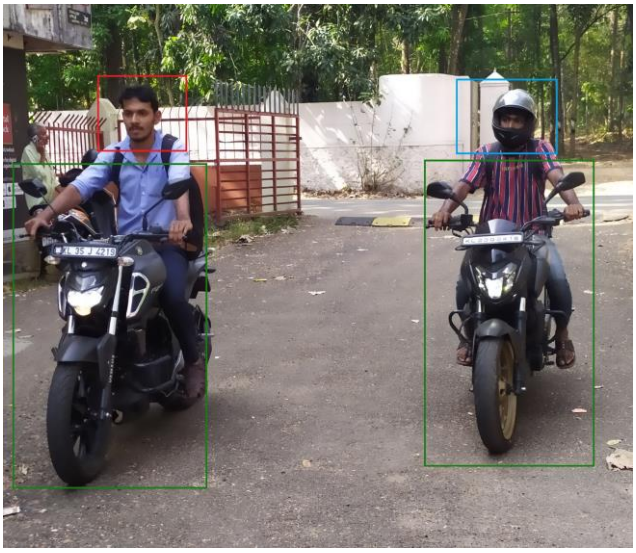

Fig 3:- Bike Rider without helmet detected

The main part of the system, that is the detection of helmetless riders are shown in Figure 3. Here the head with the helmet is highlighted with blue boxes and that of the head with no helmet is highlighted using red boxes.

Fig 4:- Cropped Number Plate

After detecting the helmetless riders, their vehicle number plate is cropped (Figure 4) and sent through the mail to the authorities along with the frame.

VI. CONCLUSION

This project aims to decrease the accidents caused due to not wearing the helmet. It also ensures whether the law is violated or not. It stores the image of the violated people along with a cropped number plate. It is then sent through the mail to authorities. The algorithm used here is the Faster RCNN which is faster and accurate when compared to the other one. The accuracy of the result of this project is 92%. It depends on the quality of the CCTV camera.

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