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Helmet Detection on Motorcyclists Using Deep Learning

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Abstract: The most popular vehicles in India are motorcycles and motorbikes. Particularly in India, traffic accidents are a leading cause of death worldwide. Although two-wheeled motorbikes are a logical option for a practical mode of transportation, they also greatly raise the incidence of fatalities and injuries in traffic accidents. Despite government regulations, many people still choose not to wear helmets when driving. A person may choose not to wear a helmet due to their own hasty or deliberate actions. In an effort to increase awareness in society, this project encourages the strict use of helmets and points individuals in the direction of safety. The program helps the traffic police find the violations while not slowing down traffic. When receiving a bill through SMS as they arrive at their homes, no one would ever attempt to break the law. The initiative revolves around the idea of transfer learning. YOLO is the object detection algorithm employed here (You Only Look Once). To try to identify people without helmets and send a snapshot of them to the closest police station, the project uses feature detection, which is the idea behind object detection. We intend to update the project so that it can recognize the license plate, even match the information of the person using the plate, and send an SMS bill to the offender.
Keywords: YOLO, motorcycle, and helmet detection.

I. INTRODUCTION

Over time, there has been a sharp rise in global population. As a result, the number of automobiles on the road has rapidly increased. As of 2018, there were roughly 1.3 billion people living in India. Many Indians are seen to favour two-wheelers for short-distance travel. Due to this, there are an astounding amount of two-wheelers on the road and over 21 million of them were sold in 2019 alone. Effectively manually enforcing traffic laws and regulations has grown to be quite challenging. Therefore, automating this procedure is essential if we are to effectively enforce road safety.

Helmets have shown to be incredibly effective in averting fatalities and serious injuries. Because of this, we decided to automate the process of looking for helmets and obtaining the vehicle's licence plate information. There isn't much in the way of road safety automation to make sure that traffic laws are being followed. Automated systems are capable of detecting violations like speeding and crossing a stop sign, and they are already in use on roadways. However, there is currently no automated system in place to identify and report violations of the helmet law. Many riders disregard safety precautions and assume they won't be caught if they choose to forgo wearing helmets.

The only way to punish the traffic rule violators in this area was to manually spot and catch them. Some riders even speed past the Traffic Police to avoid being caught and fined. It seemed necessary to automate this process as a result. There are many ways to automate this process, but one of the main ones is via employing object detection on video.

II. LITERATURE SURVEY

G. Sasikala and team [1] have discussed the Safeguarding of Motorcyclists Through Helmet Recognition. The author specially developed this project to improve the safety of the bikers.They proposed a mechanical setup. Advantages of this project are Helmet protects the head andface in case of accidents, and can study and understand the concept of RF transmitter and RF receiver circuit, the proposed system aims to reduce fatalities, and head and face injuries due to road accidents by enforcing helmet usage using RF communication, it also safeguards vehicle by replacing the conventional key with the keypad. The disadvantage of this modal is it shouldalways keep the receiver module and should be safely placed in a tool kit enclosure; it is difficult to recognize fast-moving motorcyclist helmets using this model.

Romuere Silva and team [2] have talked about using image descriptors and classifiers to detect helmets on motorcycle riders. This study describes a technique to identify motorcycle riders using public highways without a helmet. There are three steps in the system: Segmenting moving objects, classifying moving objects, and detecting helmets are the first two. Moving Objects Segmentation evaluates the image's objects of interest. Because the method only processes a small portion of the image, processing time is reduced. The next step is to categories the moving objects that were produced by the segmentation process. It is first important to extract visual features for pattern recognition tasks. The RoI determination is a crucial step towards solving our issue. It's employed to look for the helmet. The rider's head needs to be inside the RoI. The computational cost of the search region is reduced when RoI is used. All of the photographs in our database show the motorcycle rider's head inside the RoI. To locate regions resembling circles, CHT Calculates. It was utilized due to the motorcycle rider's head region's rounded shape. Because the geometry of the skull and the helmet is comparable, a technique that just considers geometric information, such as CHT, does not produce satisfactory results.

C.Vishnu [3] proposed a system that used adaptive background modeling and an improved adaptive Gaussian mixture model for the detection of moving objects from the video. CNN architecture was used to model the classifiers to detect motorcycles and helmets. The existing systems use different methods like SVM, CNN, and the Cascades for classification. For SVM's efficient working, they have used different feature extraction methods, but these feature extraction methods do not work well with low-resolution images. For SVM's efficient working, they have used different feature extraction methods, but these feature extraction methods do not work well with low-resolution images. Vishnu implemented a CNN approach that performed better than SVM classifiers and cascades. This motivated them to take the approach even further and implement a transfer learning approach to this problem.

Apoorva Saumya [4] has discussed "Detection of Bike Riders without Helmet andTriple Rides" using the YOLOv3 Model which is a consistent type of YOLO model. These days video Surveillance based systems have turned into a significant gear to remain a trackof any very crook or hostile to law movement in current human advancement. A promisingstrategy for accomplishing this mechanized recognition of motorbike helmet use is AI/ML.YOLOv3 has the advantages of detection speed and accuracy and meets the real-time requirements for ship detection. The challenges they faced during this methodology were Real-time Implementation, Occlusion, Direction of Motion, Temporal variations in Conditions, and Quality of Video Feed. YOLOv3 has the advantages of detection speed and accuracy and meets the real-time requirements for ship detection.

Dharma Raj KC [5] has discussed "Helmet Violation Processing" Using Deep Learning. They presented the development of a system using image processing and deep convolutional neural networks (CNNs) for finding motorcyclists who are violating helmet laws. The helmet violation process includes an Overview, Helmet/no-helmet classifier, and License plate character classifier. The main advantage of CNN compared to its predecessors is that it automatically detects the important features without any human supervision Drawback of CNN it does not encode the position and orientation of the object. Lack of ability tobe spatially invariant to the input data. Lots of training data are required.

Aditya Mandeep Vakani [6] has discussed "Automatic License Plate Recognition of Bikers with No Helmets" employs YOLO with pre-trained weights on the COCO dataset to first identify a motorcycle, then a person, and then a check to see if the two overlap to identify the person as being on the identified motorcycle. Furthermore, the upper one-fourth region is divided into helmet and non-helmet categories using a 5-layer CNN structure based on YOLO-LITE. A functional prototype of a system that can identify bikers who disobey the law by not wearing helmets and put their own safety in danger has been created. A system like this can actively contribute to a decrease in the number of people who disregard traffic laws. YOLO's advantages include speed and real-time processing. The system's limitation to operation in good illumination and clear weather is a downside.

Parasa Teja Sree [7] has discussed "Real Time Automatic Detection of Motorcyclists with and Without a Safety Helmet" which is a machine learning-based approach positioned to identify helmet usage among motorcyclists. Video frames attained from surveillance footage, the object detection-based algorithm is trained to spot motorcycles and their helmet. Through various tools and methods corresponding to Open CV and support vector classification, the desktop interface application is made possible tovisualize the live streaming traffic surveillance footage which uses Support Vector Machine(SVM) and CNN. This system has an accuracy of 87%. The advantage is Greater accuracy in generating image classification and recognition algorithms such as CNN will prove to be more beneficial. The only subsidiary due to the usage of CNN is the requirement for larger data processing units which increases the corresponding time taken for training the model.

Nitin Nagori [8] and his team realized that the detection and classification of images and video require features. And feature extraction manually is an invincible work and therefore used Convolutional Neural Network. CNN learns the whole image by extractingfeatures using feature maps and has proven to obtain better detection and classification. At the same time, this model needs a huge amount of data sets to train from the beginning. A smallamount of data may underfit the data based on a given type of learning.

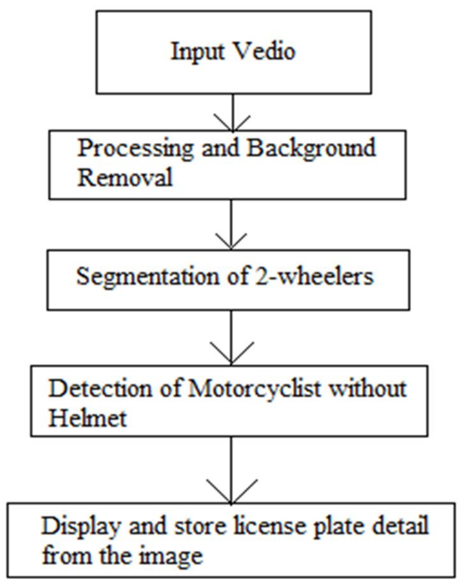
So, they used transfer learning on the CNN model, Yolov3-tiny darknet trained in advance on the COCO (Common Objects in Context) dataset. With these features, high precision is acquired. The major drawback was that this model needed a lot of datasets.
Dikshant Manocha and team [9] they carried out their project in four steps. Stage 1: This step entailed gathering data and classifying photos into positive (which includes those that need to be identified in real-time) and negative (which do not) (which are to be ignored in real-time). However, a lack of sample images restricts this step. Stage 2: Two situations must be educated into the machine. If the rider is wearing a helmet, nothing needs to be done. If not, the system must use the HAAR file to look for the registration number plate and send it to optical character recognition if it is discovered (OCR). Upon failure, a police officer on duty will receive an alert message with instructions on what to do. However, this limitation means that machine learning will take longer as the number of sample photos rises. However, system accuracy may suffer if the number of sample photos is lowered. Stage 3: At this point, the system has determined that the rider is not wearing a helmet. It has also identified the location of the license plate and called on OCR. By doing so, the real two-wheeler registration number for which a challan must be generated will be extracted. But this stage is constrained by inaccurate meteorological conditions. Stage 4: Web or mobile interfaces for paying fines were developed.

III. PROBLEM STATEMENT

Motorcycle riders often wear helmets for protection, yet many drivers lose their heads in collisions. If the motorcyclists are not wearing helmets when there is an accident, it may result in fatalities or serious injuries.
The traffic police are unable to verify that everyone is wearing a helmet because of the increased traffic and the number of connecting routes.

IV. METHODOLOGY

User Flow



A. Background Removal

The development of this work depends on the Background. Getting an image that can be utilised to spot moving things is the key goal. Vehicle potential exists in all moving objects.

B. Segmentation of two-wheelers

The goal of this stage is to distinguish between the two types of segmented objects, motorbikes and non-motorcycles.

C. Detection of Motorcyclists with a Helmet.

This stage is divided into three sub-stages, Determining RoI, Extraction of Attributes, and Image classification.

1) *Determining RoI:* It is a crucial phase in the system as proposed. By using this, you can narrow the search area, which means the result will process more quickly and be more precisely than if you were to use the entire image. The head region of the motorcyclists must be entirely contained within the RoI, as the system is interested in the detection of riders without helmets.
2) *Extraction of Attributes:* Models are composed of two main parts: The backbone layers serve as feature extractors, and the head layers compute the output predictions to further compensate for a small data set size, we will use the same backbone as a pre-trained COCO Model.

V. RESULTS

We train the helmet training data set using the YOLOv5 model. It is discovered that during the initial training phase, the model mapping rises quickly as the training time increases. On the variously colored helmets, YOLOv5 has an effective detecting impact. Once the rider is identified—helmeted or not—the number plate is identified as well, and the results are placed in a file directory from which we may later access the pictures.

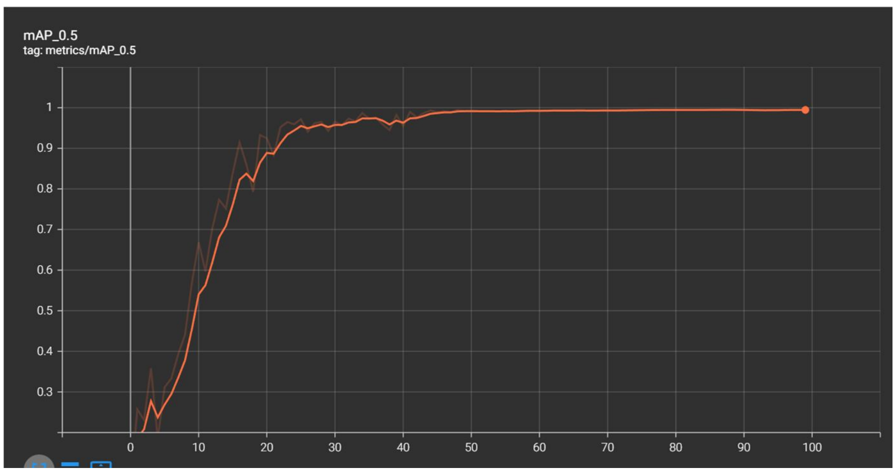


Figure 7.1- Mean average precision of up to 0.98 for about 25 test images is achieved.

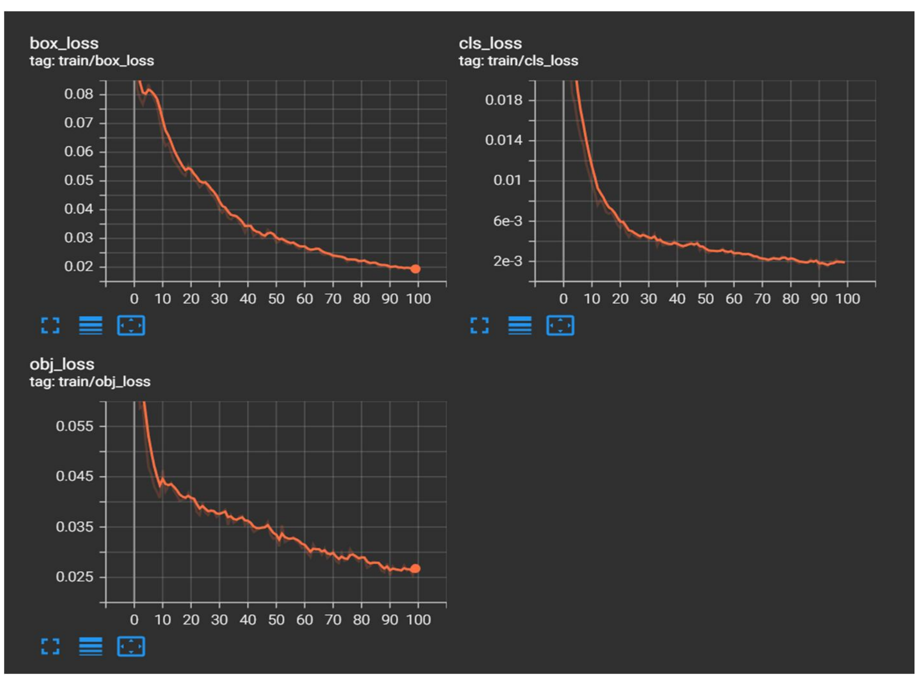


Figure 7.2 – The loses are minimum in box loss, classification loss and object loss.

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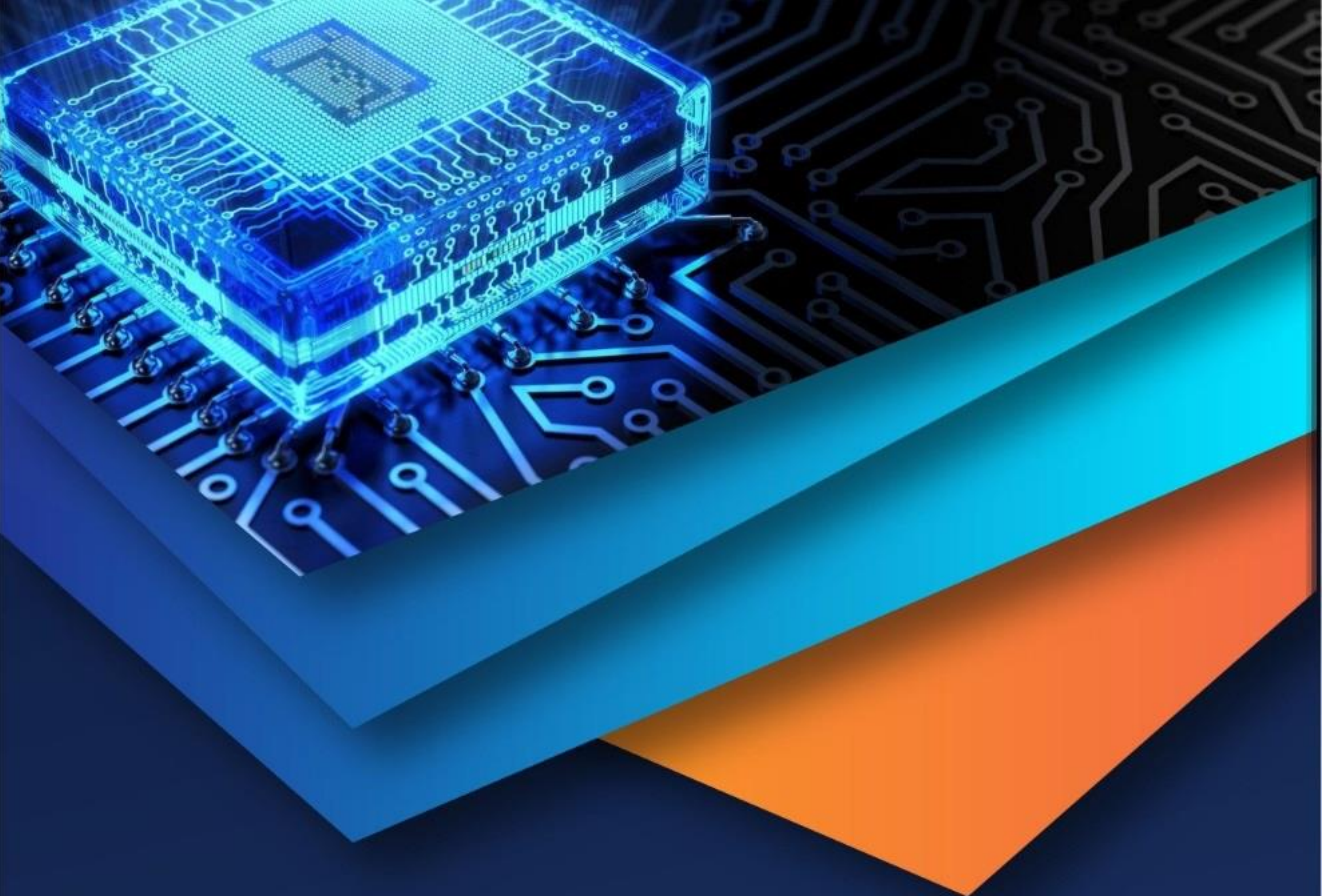

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