

Traffic Proctoring Using YOLOv5

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Abstract—Motorcycle accidents are a leading cause of fatalities in traffic accidents, particularly in developing countries. Non-use of helmets by riders or passengers is a major contributing factor to fatal injuries in these accidents. To address this issue, a deep learning-based approach for automatic helmet detection of motorcyclists is presented in this research paper. The approach involves two stages. An improved YOLOv5 detector is used in the first stage to identify motorcycles, their riders, in video surveillance footage. In the second stage, the detected motorcycles are further analyzed to determine whether the riders are wearing helmets. The bettered YOLOv5 sensor is enhanced with the emulsion of triplet attention and the use of soft- NMS rather of NMS to improve its delicacy. To validate the proposed method, a new and more comprehensive motorcycle helmet dataset. This dataset is larger than existing datasets and is derived from multiple traffic monitoring sources in Indian cities

Index Terms—Helmet detection system, YOLOv5, Background subtraction, Image processing.

I. INTRODUCTION

The World Health Organization (WHO) has produced a report on the worldwide road safety situation in 2022, which reveals that around 1.35 million individuals lose their lives in road traffic incidents yearly, with 28 Monitoring compliance with helmet use legislation is a challenge for law enforcement officers, as it is not practical to monitor every two-wheeler rider who flouts the law. Additionally, attempts to dodge the police might end in accidents, and the police may struggle to identify and trace fleeing two-wheeler riders. To enhance compliance with helmet use legislation and minimise the number of two-wheeler fatalities, it is vital to design effective tactics that incentivise riders to prioritise their safety. To prevent such situations, current video surveillance-based techniques are passive and require extensive human intervention, making them infeasible owing to human engagement, which diminishes efficiency over time. Thus, it is vital to automate this procedure for reliable and rigorous monitoring of these breaches. Additionally, numerous countries have established systems incorporating surveillance cameras. Hence, implementing the suggested infrastructure for identifying violators is cost-effective. The human monitoring is not especially successful, machine learning techniques can be utilised for video surveillance to detect two-wheeler riders without helmets. The primary purpose of this article is to automatically identify

two-wheeler riders without helmets using object detection and image processing techniques to distinguish between riders and helmets.

The primary contributions of this study are as follows: In this study, we present an automated helmet recognition of motorcyclists approach employing an upgraded YOLOv5 detector which combines the triplet attention. The approach consists of two stages 1) motorbike discovery 2) helmet discovery and may effectively improve the delicacy and recall of helmet discovery.

We provide a large-scale motorcycle helmet dataset which is gathered from traffic monitoring of several cities, encompassing diverse lighting, different views and varying congestion levels.

II. LITERATURE SURVEY

The initial phase in the helmet detection of motorcyclists is generally motorbike detection. In [3], the research state of motorbike identification based on classical approaches and deep learning is discussed in depth. Today, various approaches based on video or image have been presented for helmet detection. It may be classified into two categories: The first one is based on traditional methods, while the second is based on deep learning. From the available literature, it can be discovered that most of the present approaches are classical methods, and there are relatively few methods based on deep learning.

Helmet detection based on existing methods Conventional techniques [4-6] mainly employ similar principles as indicated in Figure 1. The first phase is moving object detection. Initially, the motion segmentation approach is utilised to extract moving objects from surveillance films. Typical motion segmentation approaches include optical flow, frame difference and background removal [7], [8]. Second, hand-designed feature descriptors, such as local binary pattern (LBP), histogram of oriented gradient (HOG), scale invariant feature transform (SIFT), are utilised to extract the characteristics of motorbikes and other vehicles. Lastly, bikes are identified using binary classifiers (such as support vector machine (SVM) and K-nearest neighbour (KNN)). Silva et al. [6] separated the difficulty of identifying helmet wearing by motorcyclists into two parts. The first stage comprises of the segment and

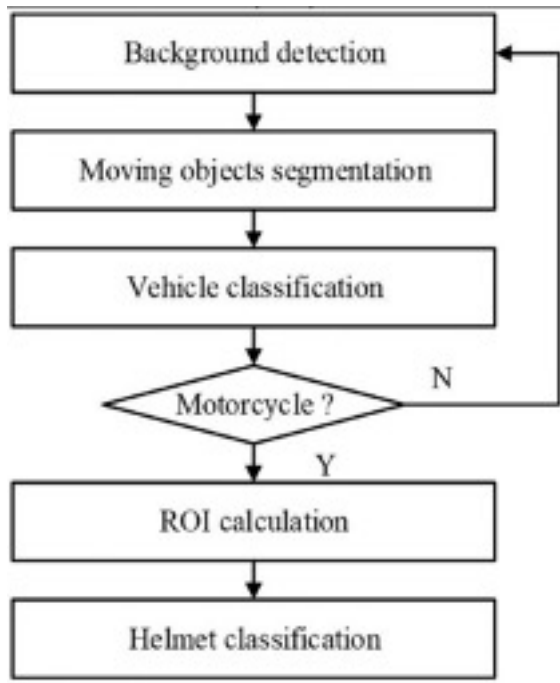


Fig. 1. Working of Existing Methods[23]

categorise the vehicle photos. This stage seeks to detect all the moving items in the scene. The second phase is helmet identification, which employs a hybrid descriptor to extract image characteristics and a support vector machine classifier to categorise an image in helmet and a non-helmet. Dahiya et al. [4] first spotted bike riders from surveillance footage using background removal and object segmentation. Next, it uses visual traits and a binary classifier to determine if the bike rider is wearing a helmet or not. Talaulikar et al. [5] also utilised a background removal approach to identify moving vehicles and principal component analysis (PCA) to the resulting features.

The disadvantages of this type of method are: 1. due to multi stage operation it becomes complicated to achieve real time speed. 2. It can be challenging to determine whether there is a person without a helmet when there are multiple riders on a motorcycle, especially when the person without a helmet is partially hidden by the person wearing a helmet. 3. The motion segmentation method will be significantly impacted by disturbances such as branch jitter, camera jitter, and traffic jams..

Helmet detection based on deep learning In later a long time, analysts have proposed a few strategies based on deep learning. In [9], the background subtraction strategy and the SMO classifier are utilized to identify cruisers from recordings. At that point, hand-crafted highlights and CNN are utilized to classify helmet and no head protector individually. At long last, it is confirmed that the exactness of CNN is higher than that of manual highlights. In [10], adaptive background subtraction is utilized to get the moving question on the video outline. At that point, CNN is utilized to classify motorcyclists in moving objects. At last, they proceed to utilize CNN to classify

the beat quarter region of bikes to encourage recognize that motorcyclists don't have protective caps. In [11], Gaussian blend demonstrate (GMM) is utilized to segment foreground objects, and after that name them. At that point, the framework employs a faster region-based CNN (quicker R-CNN) to distinguish bikes within the checked closer view objects to guarantee the presence of motorcyclists. Afterward, the speedier R-CNN was moreover utilized to identify motorcyclists with or without protective caps. In [9], [10] and [11], in spite of the fact that the head protector location embraces the profound learning strategy, the traditional foundation subtraction is still utilized to get the closer view target within the cruiser location arrange, which can be exceptionally destitute within the swarmed scene. In [12] and [13], it is proposed to utilize YOLOv3 [14] calculation to distinguish whether a motorcyclist is wearing a head protector, but the discovery of bikes isn't detailed. In [15] and [16], they first used the YOLOv3 calculation to identify the bike and individual within the picture, and after that calculated the covering range of the bounding box between the bike and the individual to determine the individual on the cruiser. At long last, they utilized the YOLOv3 algorithm to identify whether the motorcyclist wore a head protector. Be that as it may, within the view of traffic checking, motorcyclists and cruisers are exceedingly covering, so it is superfluous to identify motorcyclists independently. In [17], [18] and [19], they proposed to utilize SSD or YOLOv3 algorithm to distinguish the cruiser region, at that point extricate the upper portion of the picture, and utilize the classification calculation to distinguish the protective cap and non-helmet. Additionally, when there's more than one individual on the bike, the classification calculation will be invalid. In [20], [21] and [22], they respect the cruiser and the motorcyclist as a entirety, and after that specifically utilize the CNN show to distinguish whether the rider of the motorcycle is wearing a helmet. This one-step coarse-grained location strategy has exceptionally moo precision.

III. METHODOLOGY

In city traffic, there are many types of vehicles on the road such as two-wheelers, three-wheelers, four-wheelers, so traffic jams often occur. In such a complex context, it is difficult to accurately detect the motorcycle and judge whether the motorcycle rider is wearing a helmet. Although many motorcycle helmet detection methods have been proposed in several publications, these methods have many shortcomings, such as the accuracy and speed limit of traditional methods, and lack of data sets. High quality traffic police data. In this section, we propose a real-time accurate and automatic motorcycle rider helmet detection method based on deep learning, which consists of two steps, as shown in Figure 2. The first step is to detect motorcycle show. First, the image to be detected is taken from the CCTV camera, then the improved YOLOv5 algorithm, namely YOLOv5-MD, is used to detect the driving motorcycle in the image, of which there is at least one driver . The motorbike zone identified in the first step serves as input for the second level's helmet detection. , and

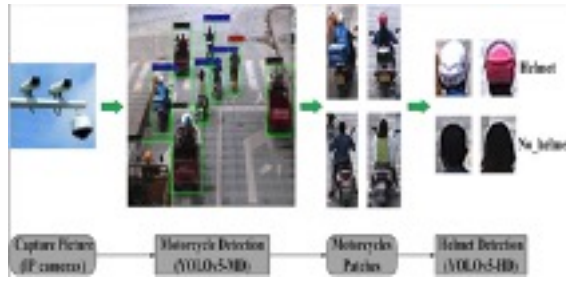


Fig. 2. Working of Algorithm[23]

then continue using the improved YOLOv5 algorithm, namely YOLOv5-HD, to detect if a cyclist is wearing a helmet. The network is created for each stage, YOLOv5-MD and YOLOv5-HD, to increase detection performance since the demands for motorcycle identification and helmet detection are quite different.

YOLOv5 network YOLO may be a classical one-stage object detection algorithm. It turns the detection issue into a relapse issue. Rather than extricating RoI, it specifically produces the bounding box facilitates and likelihood of each lesson by the relapse strategy. Compared with quicker R-CNN, it incredibly makes strides the discovery speed. The fifth iteration of YOLO, dubbed YOLOv5, was suggested by utralitytics in 2020 and beats all other modifications in terms of speed and accuracy. The YOLOv5 algorithm uses the parameters depthmultiple and widthmultiple to adjust the width and profundity of the spine organize, so as to urge four forms of the demonstrate, which are YOLOv5s, YOLOv5m, YOLOv5l, YOLOv5x. YOLOv5s is the best form with the littlest demonstrate parameters and the speediest location speed [23] According to affiliated exploration, current features and CNNs fail to handle real- world challenges for helmet use analysis, similar as motorcycle helmet recognition, therefore we use a hastily R- CNN. We begin with a introductory model and precipitously expand its complexity using RGB colour input channels to produce a stable and accurate model with or without helmet categorization. The location of the motorcyclist's head, the detection of a helmet at the motorcyclist's head position, the identification of persons riding motorcycles or an empty vehicle with no riders were all investigated. Several image processing processes must be done to the videotape sequence before it can identify the position of the motorbike. The discovery model in this module detects the presence of a motorbike.[24]

IV. MOTORCYCLE DETECTION

At show, YOLO series algorithms have been broadly utilized within the field of shrewdly transportation since of their tall exactness and high speed, such as permit plate acknowledgment [2]. The most recent form of YOLOv5 has way better execution than all past forms. Hence, we take YOLOv5 as the essential model of bike detection, and by adjusting the profundity and width of the backbone network, adjusting the yield of the arrange, joining triplet consideration, progressing

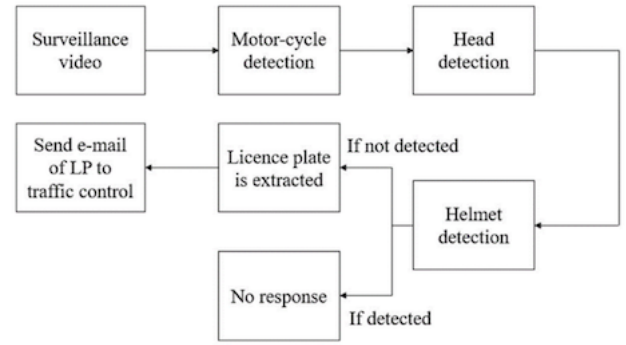


Fig. 3. Helmet detection[24]

NMS, utilizing K-means++ to recalculate the grapple estimate, we call the show utilized in this organize YOLOv5-MD.

The dataset for this stage was gotten from the traffic surveillance video. Within the activity scene, there are cars, motorcycles, bikes, tricycles and other sorts of vehicles. We discover that bikes, forward-looking tricycles and bikes are comparable in their riding state. In [12] and [13], they as it were consider one bike category, which can cause a lot of untrue location. In this manner, in arrange to diminish the untrue location rate, we identify three categories at this arrange, that's , motorcycle, bike and tricycle. At the same time, we found that the number of bike and tricycle pictures is generally little, so we utilize information upgrade strategies, such as flipping, deciphering, obscuring, etc., to grow a little number of categories.

The information of this arrange is from the initial image of activity observing, which contains a high resolution, conjointly has the taking after challenges:

- The size of motorcycles at diverse separations from the camera changes significantly.
- The pictures taken totally different scenes have distinctive seeing points, such as profile, front, back and so on.
- The brightening of pictures collected at diverse time interims is different.
- The challenges of diverse climate, such as rain and snow.
- The challenges of swarmed scenes, such as bikes blocking each other and other vehicles blocking each other

V. CONCLUSION

In this paper, we present a real-time end-to-end helmet detection of motorcyclists strategy based on YOLOv5 algorithm. This strategy can naturally distinguish the bike within the video or picture, and judge whether the rider on the bike is wearing a protective cap. Our strategy incorporates two stages of motorcycle discovery and protective cap discovery, and for each arrange, we prepare a demonstrate, which are YOLOv5-MD and YOLOv5-HD, to realize a real-time impact whereas guaranteeing tall precision.

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