International Journal of Innovative Research in Computer Science and Technology (IJIRCST)
ISSN(Online): 2347-5552, Volume-12, Issue-2, March 2024
https://doi.org/10.55524/ijircst.2024.12.2.16
Article ID IRP1437, Pages 91-95
www.ijircst.org

Helmet Detection and Number Plate Recognition Using YOLOv8 and Tensorflow Algorithm in Machine Learning

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Received 7 March 2024; Revised 20 March 2024; Accepted 29 March 2024

ABSTRACT- In many suburbs, urban areas and locals across the globe there is a disconcerting surge in motorcycle accidents has become increasingly evident. Even though a helmet is the most important safety gadget, people do not wear it. Yet helmets stand as indispensable guardians shielding riders from the ravages of head injuries, an all-too-common occurrence in the chaotic landscape of accidents. People even knowing the importance of helmet ignore wearing them, which prone to accidents causing head injuries and elevate the collective standard of road safety therefore it is incumbent upon both the governing bodies and individual riders alike to vigorously champion and enforce the unwavering and meticulous utilization of helmets as an inseparable facet of conscientious motorcycle navigation.

KEYWORDS- Helmet, Labeling, Machine Learning, Tensor Flow, YOLOv8

I. INTRODUCTION

Here we are developing an automated system that uses tensorflow, easyocr and YOLOv8 to detect motorcycles with and without helmet in real-time videos and images. If a motorcyclist is detected without a helmet, the system can generate an e-challan and send it to their registered address [2][3]. This technology could greatly assist traffic police in enforcing helmet-wearing laws and potentially reduce motorcycle accidents and fatalities.
Currently at some of the places traffic police monitor motorcyclists manually whether they are with or without helmet. Checking manually is time consuming and is inefficient as there are limitations of human errors. Also, in some of the areas like semi-urban, CCTV surveillance based methods are not automated and it requires human intervention.
The increase in the amount of accidents caused by bikers not wearing helmets, has led to an increase in the research field of road safety surveillance departments [4].

The approach used does automation of detecting motorcyclists wearing helmets or not. The system uses proposed Image Processing, using technologies such as Tensorflow, EasyOCR and YOLOv8.We have trained our dataset using library such as Ultralytics and OpenCV [1].And fined-tuned for helmet, no-helmet, number plate the dataset using the tool such as LabelImg.

This paper structuring Section II gives details on related work carried out, Section III gives the prior information of the proposed work. Section IV is an experiment performed and obtained results. Section V source conclusion.

II. RELATED WORK

According to the emerging technologies, there are different algorithms which are used for detection of objects. Historically, researchers globally have introduced various statistical methods to recognize helmet and number plate and extract characters. However these methods encounter various challenges while dealing with the diverse shapes and sizes of the fonts on number plate. This motivates the presentation of prior approaches for detecting Indian number plate followed by the introduction of a Machine Learning and Deep learning based methods for road identification.

Chiverton, John[11]. introduced a unique technique for detecting motorcyclists wearing helmets. Their system touted a thresholding process to detect moving vehicles and subsequently distinguished between motorcyclists and non-motorcyclists based on aspect ratio and area. Helmet detection was achieved by identifying the region of interest and employing a cascade classifier to identify the corresponding area.

Addressing certain challenges, Li et al.[12] achieved an 80.7 percent accuracy in detecting helmet presence at power substations. They utilized the ViBe background subtraction approach to identify mobile objects, followed by Histogram of Oriented Gradient analysis and SVM classification to detect helmets within the region of interest.

In another study, Waris et al[13]. developed a machine system capable of detecting motorcyclists without helmets and recognizing characters on number plates. They leveraged deep learning, specifically convolutional neural networks using the AlexNet architecture, to achieve high accuracy in detection tasks.

Furthermore, Gaytri, et al.[14] proposed a method to detect individual violating traffic rules by taking videos as input They employed four distinct CNN models - GoogLeNet, VGG19, VGG16, and Mobilenet - in combination with the Single Shot Multibox Detector. Among these models, Mobilenet demonstrated the highest accuracy of 85.19 percent. Initial steps involved determining the regions of interest for analysis.

In contrast, above all the models we have used YOLOv8, EasyOCR and Tensorflow which are the latest technologies. Instead of gray scale, we used LabelImg which provides labeling in (.txt) format for each corresponding image. The txt file contains the boundary box coordinates and its class in numerical form(eg.0,1,..)

III. PROPOSED WORK

The proposed system encompasses two pivotal components, each serving distinct yet complementary functions. Firstly, the system entails helmet detection, where its primary objective is to detect whether the rider is wearing a helmet.

This endeavor is facilitated by leveraging the LabelImg tool, which allows for the meticulous labeling of datasets into two distinct classes: helmets and those without helmets. Notably, the system exhibits a remarkable capability to discern subtle nuances, such as distinguishing between a helmet, cap, or scarf, and accurately categorizing them accordingly [5].
Moving onto the second part of the system, it revolves around number plate recognition. This phase of operation is initiated subsequent to the detection of a rider without a helmet.
Employing TensorFlow, the system adeptly identifies the Region of Interest (ROI), namely, the number plate. Leveraging the prowess of EasyOCR libraries, the system precisely extracts the alphanumeric characters from the license plate, storing them both in a designated folder and an Excel spreadsheet for keeping track of the output generated.

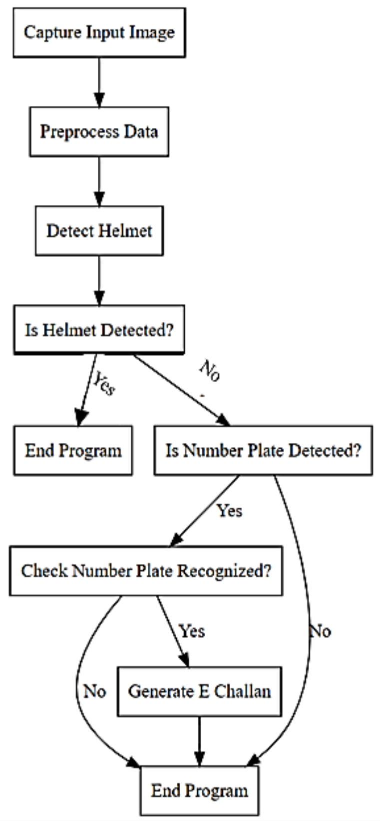

Figure 1: Block Diagram

Moreover, the system's modular design allows for scalability and flexibility, enabling future enhancements and adaptations to evolving safety standards and technological advancements. Through continuous refinement and optimization, the system serves as a formidable tool in promoting responsible motorcycle riding practices and upholding regulatory compliance on roadways.

Additionally the system's comprehensive approach extends beyond mere detection to include real-time monitoring and alerting mechanisms.

This multifaceted approach underscores the system's efficacy in promoting road safety by seamlessly integrating helmet detection and number plate recognition functionalities

IV. EXPERIMENT

A. Helmet Model

In the era of machine learning, algorithms relies on data as their primary source of learning, akin to how humans learn from experience [7]. In our specific application, we've undertaken a meticulous process of manually annotating images to train our model in detecting motorcyclists with or without a helmet. Each image is precisely labeled [6] to identify and delineate the presence of motorcyclists wearing a helmet, ensuring a comprehensive and diverse dataset for training purposes.

Table I: Helmet Classifier Prediction Labels

Helmet Classifier	Object	Prediction
	With Helmet	0
	Without Helmet	1

Above table I, show the prediction value of two classes that are With Helmet (0) and Without Helmet (1).
Upon completion of the annotation process, our system employs advanced object detection techniques to analyze each frame of visual data. This involves the precise placement of object detection boundary boxes over every discernible motorcyclist within the frame, allowing the algorithm to accurately identify and localize these objects in real-time.
Following are the confusion matrix, F1-curve, R-curve and so on:

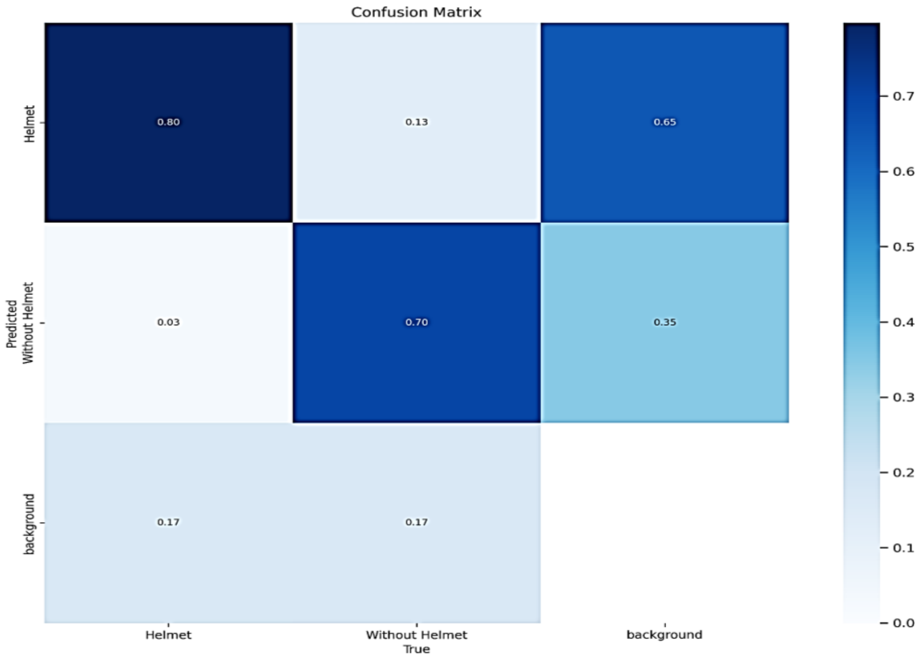

Figure 2: Confusion matrix

In the above figure 2, which is the confusion matrix, is used to represent the performance of a machine learning model used as a comparison between predicted values, (with a helmet, without a helmet,) and true values.

In figure 3, we observe that the f-1 score reveals the equilibrium between precision and recall at confidence levels but this balance decreases as the threshold nears 1 & 0. Furthermore figure 4, illustrates how recall reflects the percentage of detected cases with confidence levels indicating the models certainty in its predictions.

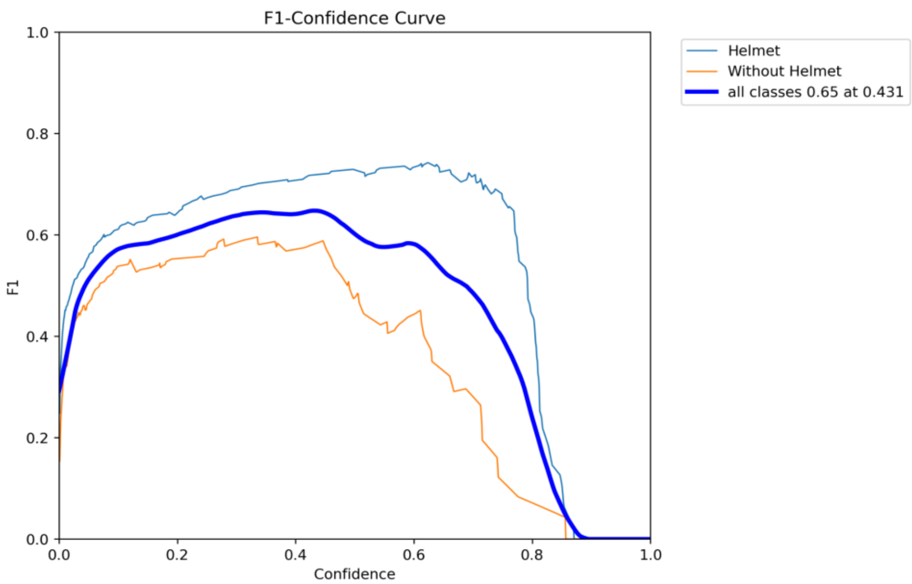

Figure 3: F1-score

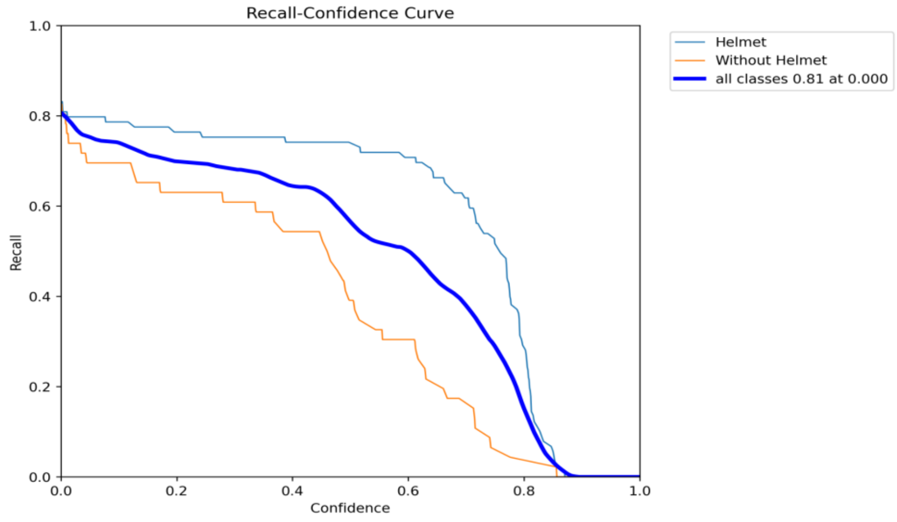

Figure 4: R-curve

B. Number Plate Model

The model is trained with a unique set of data which includes a variety of images of vehicles with visible license plates [8]. These images were collected from various places such as public databases like kaggle etc and actual situations. Every image is defined with bounding boxes indicating the ROI i.e. location of license plates [9].

The model structure consists of two main components that are a region-of-interest (ROI) extraction module and an optical character recognition (OCR) [1] module.

The XML file which contains the coordinates of the annotated license plate was used to extract the ROI from the input images. OpenCV was used to crop the region of interest from the images.And then EasyOCR library was used to extract the numbers from the number plate.

Figure 5: Input Image for license plate extraction

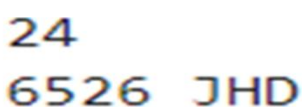

Figure 6: Crop output

Figure 7: Final extracted number plate

The process starts by taking any image as input (Figure 5), and from the input image we crop the ROI, i.e., the area of the number plate, as shown in Figure 6, then we apply OCR to extract the characters from the input image as shown in Figure 7.

V. CONCLUSION

In conclusion our method, for detecting motorcyclists with or without helmet using image labelImg tool and advanced object recognition techniques is a step forward in enhancing safety and efficiency across various fields. Through image annotations and precise object detection boundaries we have developed a dataset and trained our system to accurately spot motorcyclists with or without helmet. This approach not only boosts the precision and dependability of our system. Also ensures its adaptability in different environmental settings

Looking ahead we are committed to advancing our approach by exploring optimization strategies to enhance the performance and usefulness of our system further. Ultimately, we aim to contribute towards creating a more efficient future by harnessing machine learning and computer vision technologies to tackle societal issues.

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