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YOLO Based Advanced Smart Traffic Assistance Platform for Number Plate and Helmet Detection

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Abstract: ***Now a days road accidents are one of the major causes that are leading to human death. However the most common reason for motorcycle deaths is because many fail to confirm to the law of wearing helmet. Here is the software using YOLO V8 to recognize the motorbike drivers , who are not obeying helmet law in an automated way. The helmet and license plate detection system using YOLO V8 is a computer vision technology-based system that utilizes the You Only Look Once (YOLO) object detection algorithm to detect helmets and license plates in real-time. The system is designed to improve safety on roads and highways by detecting riders without helmets and vehicles without proper license plates. The system consists of motorcycle detection , helmet and no helmet detection as well as bike license plate recognition. The system is capable of processing image from a variety of sources, including traffic cameras and drones, and can detect the presence or absence of helmets and license plates in the image frames. It uses a deep learning model trained on a large dataset of annotated images to identify and classify objects. The output of the system includes a bounding box around each detected object and a label indicating whether it is a helmet or a license plate. The system can also be configured to generate alerts or notifications when violations are detected. Overall, this system provides a valuable tool for law.***

Keywords: Helmet, CNN, YOLO, OCR, Number plate.

I. INTRODUCTION

Motorbike accidents has become very common and most happening accidents in the country. This is mainly because many people do not wear the helmet.so, this is the best system to detect people not wearing helmet. A helmet and license plate detection project is a computer vision project that involves using algorithms to detect helmets and license plates in images or videos. The main objective of this project is to improve road safety by detecting whether a rider is wearing a helmet and whether the license plate of a vehicle is visible or not. The helmet detection system works by analyzing the image or video feed and identifying any instances of a helmet in the frame. The license plate detection system works by identifying the characters on the plate and comparing them to a database of valid license plate. The use of such systems can help reduce the number of accidents and fatalities on roads, especially in regions with high rates of non-compliance with helmet and license plate regulations.

YOLO V8 algorithm plays a key role to improve the accuracy for detecting helmet and license plate. The goal of this project is to detect the helmet and license plate easily. The System provides a high accuracy and efficiency to detect the people wearing helmet, not wearing helmet and also the license plate. The objective of this paper is to recognize helmet and license plate by using latest version of YOLO V8 algorithm. We can implement in the real time monitoring.

II. LITERATURE SURVEY

1) Romuere R.V.e Silva, Kelson R.T. Aires, Rodrigo de M. S. Veras "Detection of helmet on Motorcyclists"

In this paper, the process of classification and description are used to detect the vehicles and then detect the persons with 2 wheelers and detect if they are wearing the helmet or not. The processes used in this project are:

Vehicle segmentation and classification: Detection of the background- A reference of the road as background is considered so that the motion of the vehicle can be detected with respect to the stable object(road). Segmentation of moving objects- Using background subtraction, the moving objects(vehicles) are differentiated with the background which gives only an image of the vehicles and the background will be eliminated. Vehicle classification- The vehicles are classified as motorcycles or non-motorcycles and a feature vector is obtained for each generated image and passed on to random forest classifier to categorize vehicle as motorcycle or a non motorcycle. Detection of helmet: Determining RoI- This step is performed so that only the region of interest is chosen which reduces the processing time and increases processing time. Extracting the features- A sub-window is formed in the above generated RoI and the main part of the image (head in this case) is extracted and passed as input for the classifier to check if the biker has put on his helmet or not. This project/paper does mainly deal with helmet detection. For it to be used in surveillance system, it should be able to detect the number plate of the vehicle to impose fines on the rider which lacks in this project.

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2) *Allamki, Manjunath Panchakshari, Ashish Sateesha, K S Pratheek "Helmet detection using machine learning and automatic number plate recognition"*

This paper does the process of extracting the objects from the image using YOLO object detection and has 2 segments in the entire process. Helmet detection- Annotated images are given to YOLOv3 model for training and the actual input for detection is given after training the model. License plate Extraction- Once the person without helmet is detected then the class with respect to person and corresponding vehicle and its number plate is detected and the number plate is cropped. License plate recognition- The extracted number plate detected previously is passed on to OCR (Optical Character Recognition), the module outputs the string of numbers and alphabets with the accuracy percentage of the string recognized. This paper does not deal with the ability to detect the differences between motorcycle and a non motorcycle and this project cannot be implemented for input as video since the input given through OCR is images only.

3) *Felix Wilhelm Sieberta, Hanhe Linb "Detecting motorcycle helmet use with deep learning"*

There are 3 divisions in this paper in which the data is collected in the form of videos, preprocessed, and used in detecting the riders of motorcycle with and without helmet. Dataset creation and annotation- Random data in the form of videos is collected from Myanmar and is preprocessed to each video of 100 frames each and object detection is done through YOLO9000 algorithm with pre trained weights and the recognized vehicle with person is bounded using boxes. Helmet use detection algorithm- For object detection, the single stage approach of Retina Net is used to detect the helmets. ResNet50 as backbone initialized with pre-trained weights from ImageNet. The models were implemented using python keras library with tensor flow as backend. Results - The helmet use detection results of the algorithm on the test set, using the optimal model developed on the validation set (where it obtained 72.8% weighted MAP). The limitations for this project are that in many instances there will be 2 persons travelling in the motor-cycle and this model does not recognize is the pillion is wearing the helmet or not. This can detect only one person with a helmet or not and the accuracy is low for a CNN network

4) *M.Swapna, Tahniyah wjeeh, Shaziya Jabeen "A Hybrid Approach for Helmet Detection for riders Safety"*

In this model various previous methods related to automatic helmet detection are used and taken into consideration and the new model has been given. This is a technique of automatic helmet detection, where the inputs are of either the video or image or it might be video through a web camera. This method includes 4 different steps in it. Image procurement- This is the first step of any vision system, where cameras are used to capture images of riders on road. Preliminary processing technique – This step is mainly focused on elimination of background noise, enhancement of contrast and image binarization.

Vehicle classification – This step is mainly focused on vehicles classification based on two main parameters i.e., aspect ratio and size of the particular vehicle and then the vehicle are classified. Helmet detection – This step includes extraction of head part from the classified image and providing it to ROI where the matching of ROI and trained features happen to determine whether helmet is there or not. This model gives an idea of the number of people who violate the traffic rules. It is also cost effective as we use open-source technology like OpenCV, etc. for development purpose. Further this model can be used to detect people talking on phone while driving and to identify people driving at a high speed.

III.METHODOLOGY

The system architecture of a helmet and license plate detection system typically follows a client-server model, where the client is responsible for capturing and sending the images to the server, and the server is responsible for processing the images and detecting the presence of helmets and license plates. Here the only algorithm used for the detection and all the process is YOLOV8 algorithm. This helps in detecting the object, here in this the objects are helmet and license plate these two are detected using the YOLOV8 algorithm. This is the best algorithm for the detection of objects as it is the most recent version of YOLO.

The following is an overview of the system architecture:

1) *Client Component:* This component includes cameras or other image capture devices that are mounted on vehicles or at strategic locations such as checkpoints or toll booths. The cameras capture images of vehicles and their riders and send them to the server for processing.
2) *Server Component:* This component includes the following five sub-components which are involved in the process:
3) *Image Preprocessing Module:* This module preprocesses the images to improve their quality and reduce noise. It performs operations like filtering, contrast enhancement, and image resizing.

4) *Object Detection Module:* This module analyzes the preprocessed images to detect the presence of objects like helmets and license plates. It uses computer vision techniques such as Haar cascades, HOG descriptors, or deep learning models to perform object detection.
5) *Object Recognition Module:* This module recognizes the detected objects to determine whether they are helmets or license plates. It uses pattern recognition techniques or machine learning algorithms to perform object recognition.
6) *Database Module:* This module stores the detected objects along with the corresponding images and metadata in a database for later retrieval and analysis.
7) *Output Module:* This module generates the output of the detection process. It may display the location of the detected objects on the original image, generate a report or notification, or trigger some other action like sounding an alarm or sending an alert to law enforcement.



Fig. 1 Example of data labelling

The proposed system design can be explained with help use case diagram and class diagram of the system as shown in the figures below.

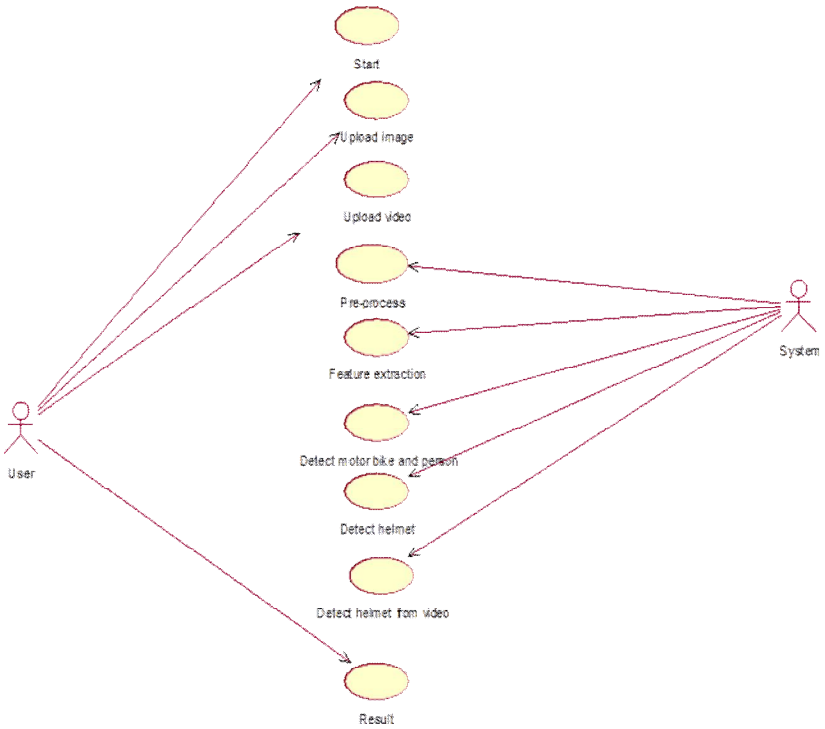


Fig. 2 Use Case Diagram of the system

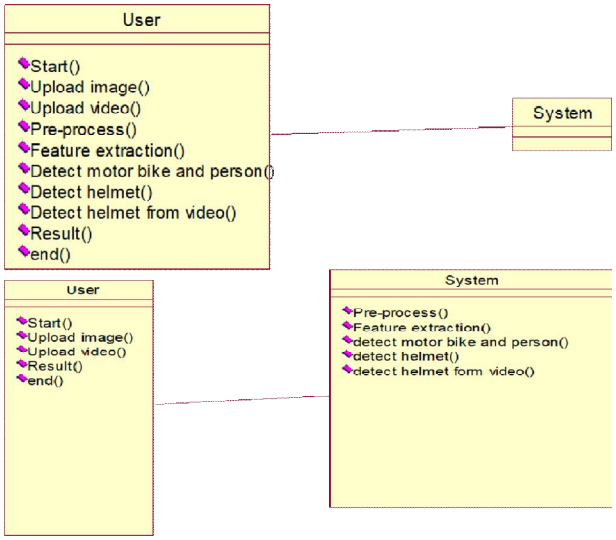
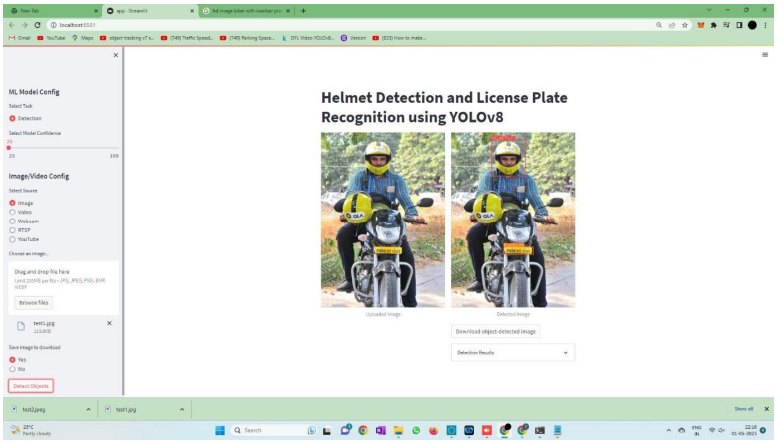


Fig. 3 Class Diagram of the system

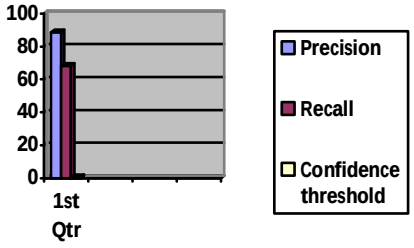
IV. TESTING & RESULTS

The screenshot of the proposed system is as shown in the figure. The front end for the system was designed using Streamlet package.



The system achieved the following parameters during the training pahse are as follows

Parameter	Value
Precision	88.63
Recall	68.3
Confidence threshold	0.85



The proposed model was tested by applying various types of 100 data samples. For this data the testing accuracy was found to be around 88 %

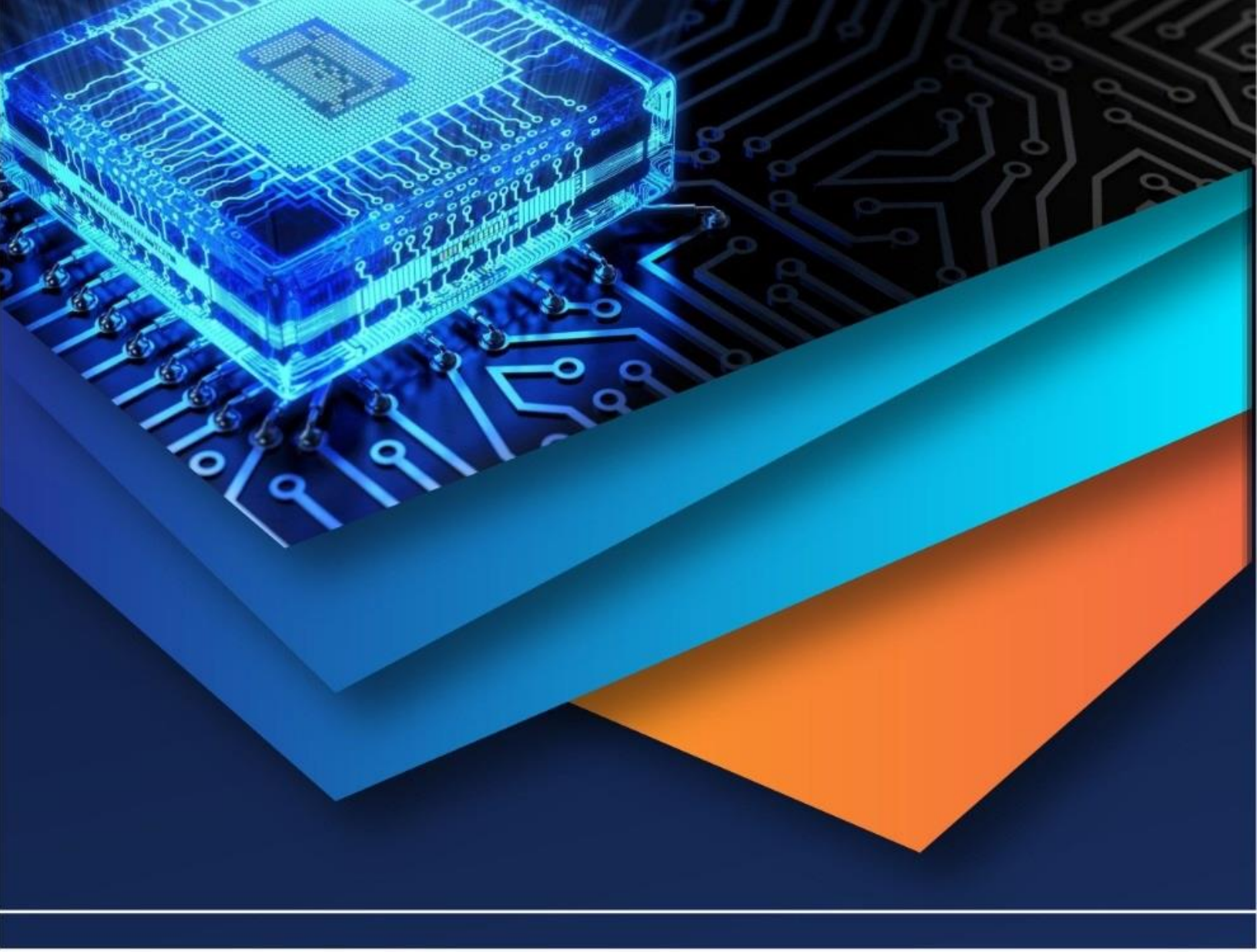
V. CONCLUSIONS

The YOLO V8 algorithm is an invaluable tool for quickly detecting helmet and license plate. The helmet detection and license plate recognition system are developed where a image file is taken as input. If the motorcycle rider in the image is not wearing helmet while riding the motorcycle, and then here we are uploading an image to identify the license plate number of that motorcycle is extracted from image and displayed. Object detection principle with YOLO V8 architecture is used for motorcycle, person, helmet, and license plate detection. YOLO V8 is used for license plate number extraction if the rider is not wearing a helmet. By using the YOLO V8 we detect the helmet and license plate with the accuracy of 88%, Not only the characters are extracted, but also the frame from which it is also extracted so that it can be used for other purposes.

After the continues trials and training of the system, we have succeeded to detect and predict the two major things such as helmet detection and license plate recognition with high accuracy of 88% by using CNN with YOLO V8 Algorithm. But there is a scope to acquire 100% of accuracy by using the upcoming and latest technologies developed with Deep Learning, Machine Learning, and Image Processing. We hope for the best and 100% of accuracy to detect helmet and license plate for saving lives.

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