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An Intelligence System for Helmet Detection and Number Plate Recognition

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ABSTRACT

In today's world, the two-wheelers are increasing use of easy transportation, the two-wheelers have prompted for the road accidents and injuries. The accidents and injuries are happening because the rider not wearing the helmet. Currently we can check the rider wearing helmet or not by Closed-circuit television (CCTV) footage video in the traffic junction, it requires human intervention to check the rider without helmet. The proposed project presents a machine structure to detect the two-wheeler rider with helmet or without helmet and extracting the number plate from the images. In the proposed system, the number plate of the particular vehicle can be retrieved with video footages to detect usage of helmet.

***Keywords*—YOLO, OCR, ANPR, Helmet detection, and Number plate recognition**

I.INTRODUCTION

The system provides the major safety measures for the riding a two-wheeler both for the rider and the pillion. The accidents of two-wheeler are increasing day by day, the major equipment for rider is helmet, but many riders not using helmet which causing the head injuries and death of rider. The main function of helmet is providing protection for head during the accident. The rider who not wearing helmet, which causing the deaths in road accidents in many places where the vehicle density is very high and the people are least bothered to take care about themselves by taking proper precautionary measures while riding two-wheeler. The government taking measures to avoid these problems by mandating the helmets for the rider as well as pillion, but people are careless not using helmets properly which causing a serious trouble not only for the people without helmets but also for others who is drive on the roads. So, keeping this in mind the public safety as an important measure, an intelligence system is developed for detecting rider with helmet and detecting and recognition of vehicle number plate. The automatic helmet detection plays vital roles where traffic police cannot be able detect the each and every two-wheeler rider presence of helmet and recognition of vehicle number plate without helmet.

This project is about helmet detection and vehicle number plate recognition and extraction uses the deep learning methodology. First, we have to categorize vehicles as two-wheelers or not on the road, using object detection algorithm like You Only Look Once Version 3 (YOLOv3). Then we have to identify the two-wheeler head part as person wearing the helmet or not wearing helmet. The recognition of wearing rider helmet or not wearing helmet on the head portion uses region of interest and bounding boxes, which is object detection tasks using convolution neural networks. If the rider of two-wheeler or the pillion who is not wearing the helmet then image of the rider with the two-wheeler is captured. The vehicle number plate of two-wheeler without helmet is recognized and characters from number plate will be extracted. The Optical Character Recognition is imaging technology used to identify number plates for their two-wheeler. The OCR uses tesseract tool for identification of vehicle number plate, the characters from number plate will be extracted and it's stored in folder. With increasing requirement of anti-terrorism and public security worldwide, the global law enforcement has been deploying vehicle plate recognition systems everywhere to fight against criminals. also, traffic management arrangements are set up on freeways to go over for vehicles going at speeds not permitted by law. This scheme is widespread, particularly in conditions of security and traffic facilities. In conclusion, the system will determine whether the motorcyclist is wearing a helmet or not. And depending up on the answer, it would extract the number plate soft hose motor cyclists who are not wearing helmets.

II.LITERATURE SURVEY

"License Plate Detection Using Convolution Neural Network–Back to the Basic with Design of Experiments", Yang Yang Lee, Zaini Abdul Halim, Mohd Nadhir Ab Wahab, This mentioned paper provides, the Automatic License Plate Recognition is an application which is hugely benefited from Convolution Neural Network (CNN) processing. The CNN has the mainstream processing of complex data. The YOLO is object detection algorithm in real time which accepts various CNN model designs for the feature extraction.

The good performing models such as YOLOv3 and Single-Shot detector (SSD) is a more general object detection algorithm and recognition tasks for effectively transferred the number plate detection application with effort in model tuning. This project focused on Design of experiment (DOE) for training the parameters in transferring YOLOv3 model design and optimizing the training specifically for number plate detection tasks. There is parameters interaction between DOE and YOLOv3 parameters these are used for seeking optimized train settings. The DOE results are effectively improving the YOLOv3 model to fit the vehicle number plate detecting task. [1]"Detection of Number Plate in Vehicles using Deep Learning based Image Labeler Model", Shashi Kant Gupta, Surabhi Saxena, Alex Khang, Bramah Hazela, Chandra Kumar Dixit,BhadrappaHaralayya, This mentioned paper provides, the deep learning playing very important role in today era. The deep learning is using for detecting the vehicle number plate. The deep learning model is trained with different numbers and alphabets by giving various number plates sample. The alphabets are taken from various perspectives and angles and consist of different colors in background. The training of model is essential because numerous vehicles in the globe with various fonts and backgrounds. The image labelers are used for model's segment methods. The image labeler which extracts features from the image. First image labeler separate numeric and alphabetic part from number plate. The deep learning model is trained separately with images of numbers and image of alphabets. The collection includes a bundle of pictures with different letters and numbers. The trained model images are compared with test images and recognizing the vehicle number plate.[2]"Detection of Helmetless Riders and Automatic Number Plate Recognition Using Machine Learning", Premmaran G, Dr. Sathishkumar P, This mentioned paper provides, they used one software that uses CNN for identifying the rider who do not wear protective helmet and CNN which is used for classification of image and recognition. The proposed system is dived into data collection, data preparation, model training, model testing and outcome evaluation. The accuracy, sensitivity, specificity and precision scores are calculated during the testing phase. First YOLO algorithm is used for detecting the targets or objects. The YOLOv3 calculation recognizes explicitly the things motion pictures, live feeds or photographs progressively. It separates the images for calculation. The boundary boxes consist of arraignment of classes with limit of boxes score. Each bounce box divides only one item for each border. The area in which region is used to fragment of picture is controlled. The picture with similar size is processed with pixels that characterize the ROI set to 1 and any remaining pixels set to 0. The ROI will create the sub image from the image. Next, the OCR is used for analyses a record of text and converts the characters into code that might be used for information handling. The OCR which is used fir separating different texts from one and another image. The segmentation of character used for separates each character from retrieved two-wheeler number plate. The texts are cropped from the image i.e., number plate characters from beginning to the finish of the image. The output is normalized into characters from the photos in database characters with comparison of characters which we identified from the images of vehicles.[3]"Helmet Detection and Number Plate Recognition Using Deep Learning", Prof. Pushkar Sathe, Aditi Rao, Aditya Singh, Ritika Nair, Abhilash Poojary, This mentioned paper provides, In the helmet detection model consists of YOLOv5 object detection for detecting moving vehicles, it uses transfer learning. Then will check the rider wearing helmet or not by using two methods, one being checking for overlapping between bounding boxes and second method is checking if a helmet exists in the specified range of coordinates above the motorcycle. The YOLOv5 consists of two main models, first model is of helmet and person class and second model is of number plate and motorcycle class using the transfer learning method. We collect the images from camera feed and takes frames from images and store them in folder. We use these images as input for our trained YOLOv5 model for helmet and motorcycle for object detection. This output is fed as input to trained YOLOv5 model of person and helmet. And through OCR technique we pass the cropped image of number plate to the OCR model. This model converts the text into a machine-readable format and saves it to the database. First it copies the images of number plate after it is detected and then performs image processing on the image and later it checks each character and recognizes the pattern and then it matches with its data and stores the characters in text format.[4]"Helmet Detection and Number Plate Recognition using Machine Learning", Gauri Marathe, Pradnya Gurav, Rushikesh Narwade, Vallabh Ghodke, Prof. S. M. Patil, This mentioned paper provides, the system which designed first it will classify moving objects as motorcycling or non-motorcycling. In the classified motor cyclist, the head portion is located and classified as helmet or non-helmet. Finally, the motorcyclist without helmet is identified and recognizing the vehicle number plate of motorcycle using the OCR algorithm. The implementation of this project uses the YOLOv3 algorithm for object detection. The YOLOv3 algorithm which first separate a frame into a grid. Some number of boundary boxes is predicted by each grid cell, the boundary boxes are around objects that score highly with the aforementioned predefined classes. The only one object is detected by boundary box. The YOLO algorithm, image is divided into an SxS grid. When the centre of target is falls into grid, the grid is responsible for detecting the target. The Optical Character Recognition (OCR) technology is the electronic or mechanical conversion of pictures of written, handwritten, or scanned text into machine readable and understanding text format. There are two methods for extracting the features in OCR, In the first method is a feature detection which defines a character by evaluating its lines and strokes. In second method the pattern recognition works by identifying the entire character. Once all the features are defined, the data is processed in neural network training model which detects the helmet and recognition of vehicle number plate.[5]"Helmet Detection on two-wheelers number plate recognition using image processing", Apurva Nehete, Tejasvi Nikam, Komal Ahire, Nikita Shinde, This mentioned paper provides, the programmed detection is used for finding number plate region. It consists of two stages the vehicle number plate is detected by a smart image processing algorithm and the rider with helmet is detected by picture handling calculation and library. The system is divided into subparts such as capturing image, rider helmet detection and vehicle number

plate detection. The images are collected through the web camera by the video, the video consists of huge data we can capture the images easily. In the video not able to get the information about characters of number plate properly because the loss of light or missing any other parameters, we loss the data. So, detecting the vehicle number plate the programmed detection methodology is used. The next step is the detecting helmet by the image collected by the web camera and the libraries. The computerized picture handling is the utilization of a computerized PC to deal with the advanced pictures through calculation the helmet is detected. The next step is recognition of vehicle number plate, in which the Indian tag discovery is using for locating area of vehicle number plate. The technology, Vehicle Number Plate Recognition (VNPR) is a picture handling innovation that utilizes efficient calculations to identify the vehicle number from the continuous pictures.[6]"Helmet Detection and Number Plate Recognition using Machine Learning", Ranveer Roy, Shivam Kumar, Paritosh Dumbhare, Mahesh Barde This mentioned paper provides, through Closed Circuit Television (CCTV) video the helmets are detecting in the traffic junction and taking control of rider of those vehicles and penalize those without wearing the helmet. Then classifying moving vehicles are motorcycle or non motorcycle. The identification of number plate through OCR software the rider who not wearing the helmet. In this project, first we have to detect the moving objects by applying adaptive background subtraction. These moving objects are classified into two classes such as motorcyclists and non-motorcyclists by through CNN classifier. The objects other than motorcyclists are on the road are discarded and predicted objects are passed for further process. Then implementing another CNN classifier determining and detecting the rider of motorcyclist wearing a helmet or not. The head part is located in upper part of image, these images what we getting head at upper part only and located image head portion is placed at top one part of four images. The identified head portion is given to the second CNN in which the trained to classify rider with helmet and rider without-helmets. The Haar Cascades is a machine learning technology which consists of trained functions, are used to identify positive and negative images. This algorithm uses feature extraction through which helmet is detected. If the motorcyclists who is not wearing the helmet, then check the vehicle number plate through OCR technique which is a text recognition technique. After the characters recognition and vehicle number plate detection is done and generate the Chelan receipt and the money is debited from the owner of motorcycle.[7]"A Survey on Helmet Detection and Number PlateRecognition for Safety and Surveillance System", Ajith R, Sharan S, Prajwal B H, L Shreyas, Navya Shree, This mentioned paper provides, the system provides the safety measures for two-wheeler riders and pillion. This project consists of different methodologies, first the objects are extracting from the image, then objects are detected through YOLO and it consists of 3 segments. The first step is helmet detection through YOLOv3 model in which giving the annotated images as input and training the model and the actual input for helmet detect ion is given after training the model. The person without helmet is detected and corresponding vehicle with rider is identified and vehicle number plate is extracted and saved. The extracted vehicle number plate is detected and sent to OCR, in which the module outputs is the string of numbers and alphabets with the accuracy the string is recognized.[8]

III. METHODOLOGY

In the YOLO technology, which detecting and recognizing different objects in image or video (in real-time). YOLO algorithm which is detector, which will detect object in multiple scales that uses extraction of features and heads, will be detected from multiple scales. The YOLO uses CNN network for detecting the object. The CNN which predicts different probabilities of class and bounding boxes at the same time. Detection of objects has applications in many fields of area such as computer vision, includes retrieval of image from video and video surveillance. It is broadly used in computer vision task such as detection of face, recognition of face, object co-segmentation of video.

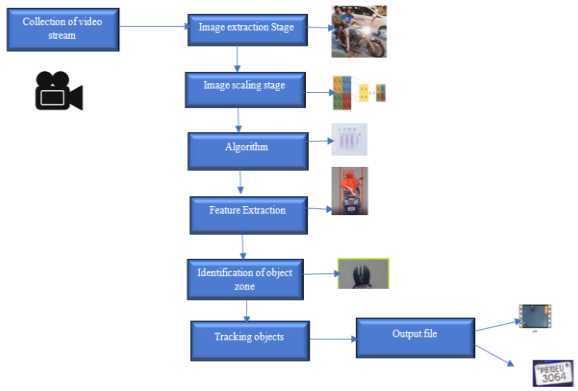

Fig.1. Architecture of YOLOv3 algorithm

The Fig.1 shows the architecture of YOLOv3 used for proposed work. This architecture consists of various blocks such as collection of video stream, image extraction and scaling stage, processing algorithm, feature extraction, object identification zone, tracking objects, log files and processed video as output. These blocks are discussed below.

1. Collection of video stream

Extracted video from the traffic is taken as the input to process it further to make the classification whether vehicle is two-wheeler or another vehicle. The video has to be stored in dedicated folder of the system.

2. Image extraction stage

The video will be read and the images are extracted. The vehicles are detected from extracted images.

3. Image scaling stage

Only single image is considered for scaling. The image is scaled down to SxS grid cells. The object detected has to be there at the center of the grid cells, for perfect recognition.

4. Algorithm

The object detected from the grid cell is further considered for classification of vehicles. The exact classification of vehicles is going to happen through CNN.

5. Feature extraction

In the feature extraction, bounding boxes are going to be created surrounding of the vehicles detected as per the requirement.

6. Identification object zone

In the identification of zone, bounding boxes are created surrounding of the head portion of the rider. The green color bounding box will be created around the rider who wears helmet. The red color box will be created around the rider who will not wear helmet.

7. Tracking objects
The number plates are extracted from the vehicles with no helmet riders.

8. Output file
The file extracted images of number plate and the video represents final expected outcome.

A.Convolutional Neural Network (CNN)
A Convolution Neural Network is network architecture for deep learning algorithm which is used for image classification and image recognition. The CNN is commonly used in Computer vision. We know that computer vision is artificial intelligence field which enables computer to understand and interpret the image or visual data.

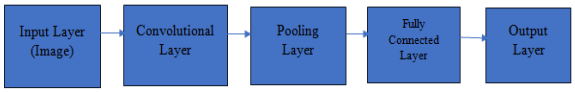

Fig 2: Simple Architecture of CNN

B.Optical Character Recognition (OCR)
The Optical Character Recognition is text detection algorithm. OCR is an electronic or mechanical conversion of image into text. Its free tool which converts image into text file, converts PDF into doc file and extracts the text from PDF lines.

1. PyTesseract OCR Tool
The PyTesseract is known as Python-tesseract which is an Optical Character Recognition tool which is used for python. This tesseract library is installed for extraction of characters from the vehicle number plate. This will read, identify and recognize the texts in the images and in the number plates. The tesseract uses the Convolution Neural Network for recognition of single character from the image.

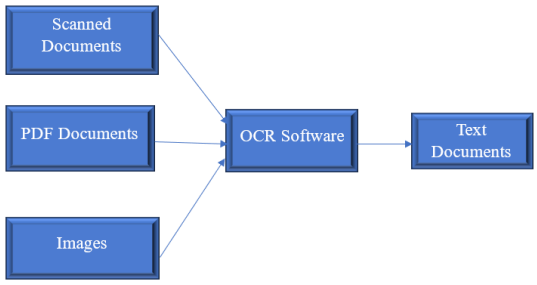

Fig 3: Architecture of OCR

The Fig.3 shows the architecture of OCR used for proposed work. The inputs for OCR software are scanned documents, PDF documents and images. The OCR software, first has image acquisition in which scanned image is converted into binary data and preprocessing happen. There are two types of text recognition that are pattern matching and feature extraction through which machine-readable text format we get it and saved it in text documents.

IV IMPLEMENTATION

1. Libraries and modules for python

A.cV2 (Computer Vision 2)
The cV2 is also known as OpenCV (Open-source computer vision), cV2 is python library allows us to perform real-time computer vision tasks and processing of image tasks. It provides features such as object detection, face recognition.

B.NumPy (Numerical Python)
NumPy is python library, this library works with arrays. In Python, there is data type called array. To implement the data type of array with python, NumPy is the essential library for analyzing and calculating data. It is specially used for numerical operations for arrays.

C.Random
The random is in-built python module, random module used to generate random numbers in python. The generated numbers not follow order randomly numbers will occur.

D.OS
The module OS in python provides functions for interact with the operating system. This OS module provides functions for creating and removing directory, fetching directory contents, identifying and changing directory.

E.PIL (Python Imaging Library)
Python Imaging Library (PIL) is a free and open-source additional library for the Python programming. This support for opening, manipulating, and saving many different images file formats. The PIL has capabilities of image processing to Python interpreter.

F.Time
Time is python module used for representing time in code such as objects, numbers and strings.

G.Imutils
An imutils is package, it consists of series of functions which are used for make basic image processing such as resizing, rotation, translation and displays images in matplotlib with OpenCV library in python 3 and python 2.7 version. Which is mainly used for convenience functions for image resizing and image processing?

H.TensorFlow
TensorFlow, an open-source software library for fast numerical computation which is created by google. This library is used for machine learning and artificial intelligence. It performs range of tasks but uses focus on training and interference of deep neural networks.

I.PyTesseract
The PyTesseract is known as Python-tesseract which is an Optical Character Recognition tool which is used for python. This tesseract library is installed for extraction of characters from the vehicle number plate. This will read, identify and recognize the texts in the images and in the number plates. The tesseract uses the Convolution Neural Network for recognition of single character from the image.

V WORKING OF PROJECT

A. Phase of development
1. Designing a module for functions to detect the helmet in the frame
2. Designing a module to detect the number plate and extract the vehicle number from frame.
3. Connecting all the modules together and testing the integrity and accuracy of the system.

B. Implementation
1. Taking video or camera as input.
2. Taking single frame from that input.
3. Checking if that frame contains a helmet.
4. If the helmet is present then going back to 2nd stage.
5. If helmet is not present then giving this frame to the function which detects number plate and extracts characters from it.
6. Repeating this procedure till the input is not empty/null.

C.Algorithm

step1: we have to capture the video from CCTV camera and stored it in particular folder, from which vehicle is detected.
step2: Install the libraries such as cV2, NumPy, Random, OS, PIL, time, imutils, tensor flow and pytesseract.
step3: Update the video path in the code to extract the video and execute it for further process.
step4: Run the module which classifies moving objects on the road and further it will be get loaded for next process.
step5: Execute the second module which detects rider wearing helmet or not.
step6: If the rider is wearing helmet, a blue color of bounding box will be created surrounding the head. And it will display "helmet" with green color of bounding box around the vehicle and head.
step7: If the rider not wearing the helmet, a blue color of bounding box will be created surrounding the head. And it will display "no-helmet" with red color of bounding box around vehicle as well as head.
step8: The rider who will not wear the helmet their vehicle number will be recognized and number plate will be extracted and stored in the folder.

D.Working of Yolo algorithm

YOLO algorithm works with below three techniques:

- Residual blocks
- Bounding box regression
- Intersection Over Union (IOU)

The YOLO algorithm takes single image from the video stream. First it separates image into a grid. Each grid cell is converted into boundary box. The grid cell predicts this number of boundaries box around particular object. The YOLO algorithm uses fully CNN algorithm uses neural networks for post processing output. The CNN takes an image an input and return tensor which gives coordinates and positions of predicted bounding boxes which contains objects. It uses probability that consists of probability for each of the bounding box contains object.

E.Detecting rider helmet

How we can implement helmet and vehicle number plate detection and extraction in Python using YOLOv3 and some other Computer Vision techniques. Our main motive behind helmet detection and number plate detection and recognition was to first detect if someone is wearing a helmet or not, if he is wearing it, no problem, but if not, detect his number plate and store it in one folder. Importing required libraries. Once importing is done Allow TensorFlow to use GPU. Read the network weights from yolo files. These "yolo.weights" is the file which we trained just to detect bikes and number plates. If we want to use GPU, set the backend and target to CUDA and Load the CNN model we trained to detect helmets.

Fig 4 (a): Detecting rider with helmet

Fig 4 (b): Detecting rider without helmet

The Fig 4 (a) shows that rider with helmet. Which uses yolo. Weights for detecting helmet, we trained this yolo.weights for bikes with helmet and without helmet. The Fig 4 (b) shows the rider without helmet.

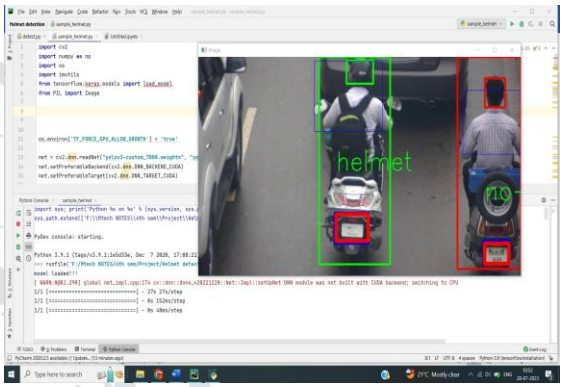

Fig 5: Identification of Helmets in single image

The Fig 5 shows that single image consists of rider and pillion wearing helmet or not. The rider wearing the helmet is represented with green color box. The pillion not wearing helmet is represented with red color box in the image.

F. Working of OCR algorithm

OCR algorithm works using the following four techniques:

- Acquisition of image
- Pre-processing of image
- Text Recognition
- Post-processing

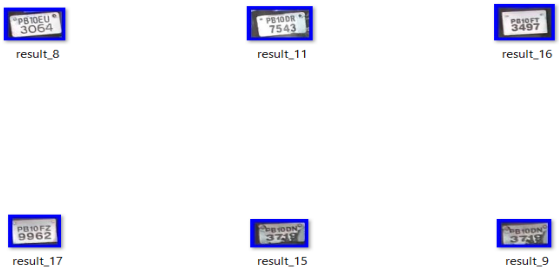

Fig 6 : Extraction of number plates

The Fig 6 shows that extraction of various number plates. The rider without helmet number plate is recognized and extracted the number plates and stored in folder.

VI.RESULTS

Results of helmet detection and number plate recognition

The final project output is discussed in this result chapter. Here we can see that how model is loaded in PyCharm tool and we can see the images of detected helmet and without helmet. Number plate of rider without helmet is identified and extracted the number plate.

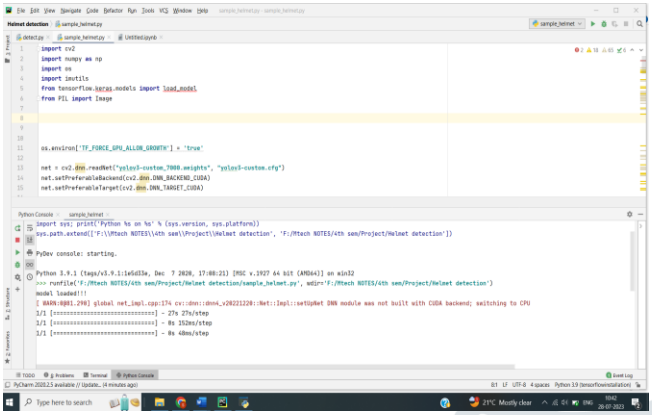

Fig 7 (a): Loading the Model

The Fig 7 (a) shows that loading of model in PyCharm tool. In the sample_helmet.py is python code which loaded, we can see the result as model loaded!!! In the left corner of the image. We can see that libraries are used for implementation such as cV2, imutils, NumPy and more.

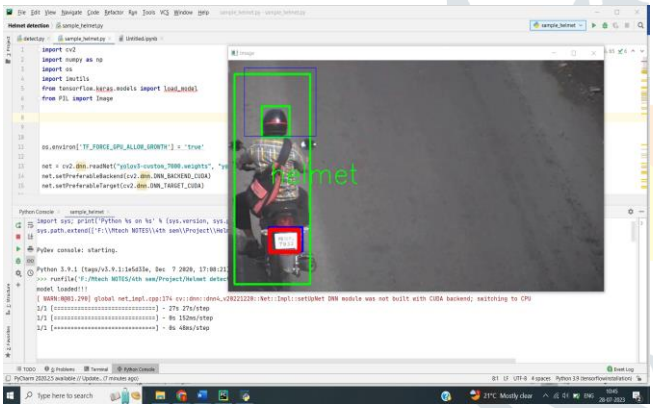

Fig 7 (b): Detection of rider with Helmet

The Fig 7 (b) shows that detection of the rider with helmet. In the image we can see that helmet is detected and its representing with green color box and head portion is located and identified with blue color portion. The entire moving vehicle is classified and representing with green color box with helmet.

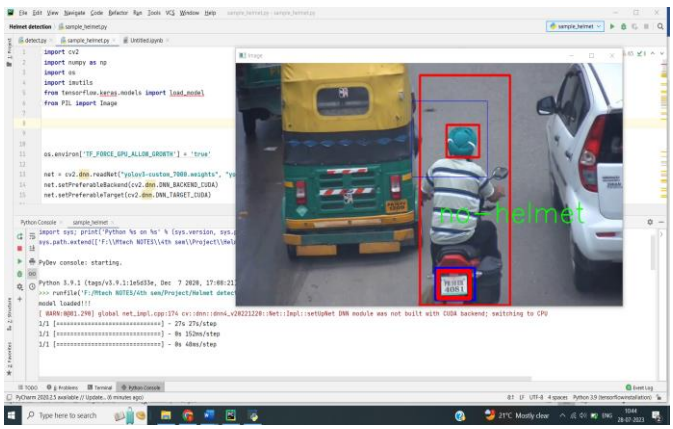

Fig 7 (c): Detection of rider without Helmet

The Fig 7 (c) shows that detection of the rider without helmet. In the image we can see that rider without helmet is detected and its representing with red color box and head portion is located and identified with blue color portion. The entire moving vehicle is classified and representing with red color box rider without helmet.And number plate is recognized and extracted which is represented with blue and red color box.

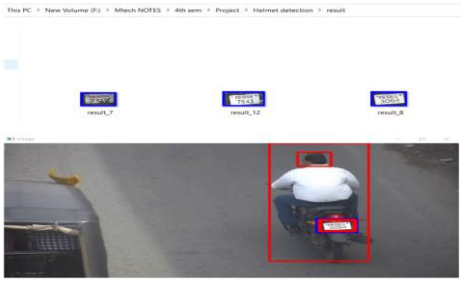

Fig 7 (d): Extraction of Number Plate 1 rider without helmet

The Fig 7(d) shows that the extraction number plate in result folder rider without helmet. The rider without helmet is identified in the head portion which represents the red color box. The number plate is extracted that rider in the folder. We can see that PB10EU 3064 number plate recognized and stored in folder.

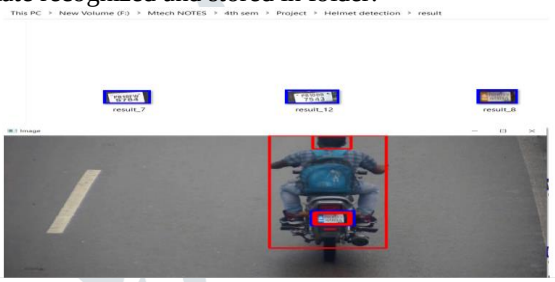

Fig 7 (e): Extraction of Number Plate 2 rider without helmet

The Fig 7(e) shows that the extraction number plate in result folder rider without helmet. The rider without helmet is identified in the head portion which represents the red color box. The number plate is extracted that rider in the folder. We can see that PB10FY4984 number plate recognized and stored in folder.

Fig 7 (f): Folder containing number plates

The Fig 7 (f) shows that folder containing number plates, represents the number plates captured from the video that are stored in separate folder. The folder which consists of number plates of rider who do not wear the helmet. The only rider without helmet number plates is recognized and extracted stored in folder.

CONCLUSION

In the project the proposed work is design with an aim to catch the traffic rule violators not wearing the helmet and reporting of the vehicle number plate of the violators. We are proposed to develop detecting helmet and vehicle number plate detection and recognition using YOLOv3 where a video file is taken as input.The proposed end-to-end model developed successfully and has all the capabilities to be automated and deployed for monitoring for extracting the number plates and helmet, some techniques are employed by considering different cases such as multiple riders without helmets and designed to handle most of

the cases. All the libraries and software used in our project are open source and hence is very flexible and cost efficient. The project was mainly built to solve the problem of non-efficient traffic management. Hence at the end of it we can say that if deployed by any traffic management departments, it would make their job easier and more efficient.

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