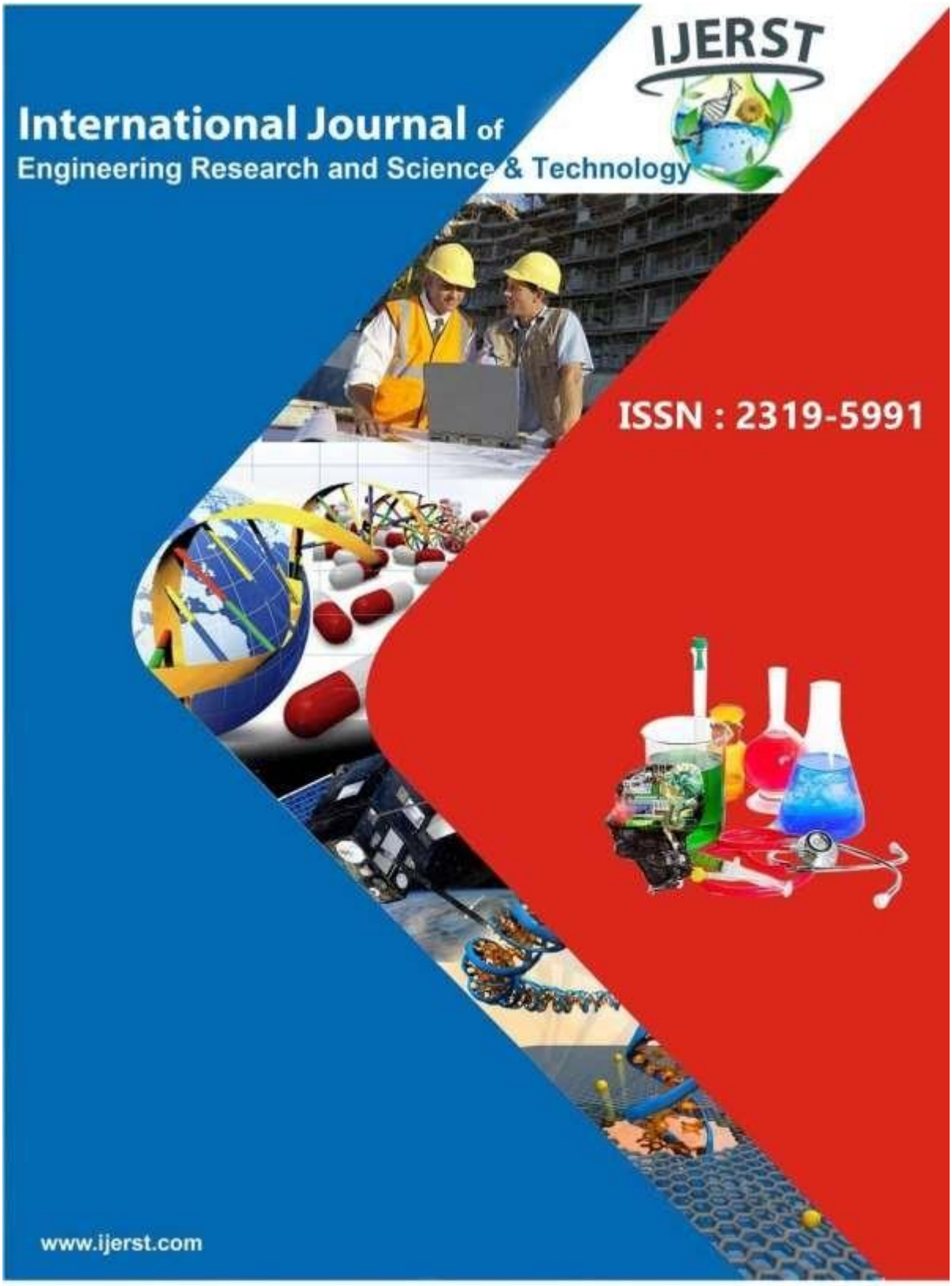

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Deep Learning based Discovery of Non-Helmet Riders and License Plate Number using Yolo v3 and OCR system

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Abstract:

In current situation, we come across various problems in traffic regulations in India which can be solved with different ideas. Riding motorcycle/mopeds without wearing helmet is a traffic violation which has resulted in increase in number of accidents and deaths in India. Existing system monitors the traffic violations primarily through CCTV recordings, where the traffic police have to look into the frame where the traffic violation is happening, zoom into the license plate in case rider is not wearing helmet. But this requires lot of manpower and time as the traffic violations frequently and the number of people using motorcycles is increasing day-by-day. What if there is a system, which would automatically look for traffic violation of not wearing helmet while riding motorcycle/moped and if so, would automatically extract the vehicles‟ license plate number. Recent research has successfully done this work based on CNN, R-CNN, LBP, HoG, Haar features. But these works are limited with respect to efficiency, accuracy or the speed with which object detection and classification is done. In this research work, a Non-Helmet Rider detection system is built which attempts to satisfy the automation of detecting the traffic violation of not wearing helmet and extracting the vehicles‟ license plate number. The main principle involved is Object Detection using Deep Learning at three levels. The objects detected are person, motorcycle/moped at first level using YOLOv2, helmet at second level using YOLOv3, License plate at the last level using YOLOv2. Then the license plate registration number is extracted using OCR (Optical Character Recognition). All these techniques are subjected to predefined conditions and constraints, especially the license plate number extraction part. Since, this work takes video as its input, the speed of execution is crucial. We have used above said methodologies to build a holistic system for both helmet detection and license plate number extraction.

I. Introduction

All over the world around 1.35 million lives are lost each year, 50 million people are getting injured due to road accidents, according to a report titled “The Global status report on road safety 2018” released by world health organization. It is very hard to imagine that this burden is unevenly borne by motorcyclists, cyclists and pedestrians. This report noted that a comprehensive action plan has to be set up in order to save lives. Worrying fact is that India ranks number one as far as road crash deaths are considered. Rapid urbanization, avoiding helmets, seat belts and other safety measures while driving are some of the reasons behind this trend according to analysis done by experts. In 2015

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India signed Brasilia Declaration on Road Safety, where India committed to reduce road crash deaths to 50 percent by 2020. Policy makers first have to acknowledge the problems that persist in India before halving road crash deaths. When a two-wheeler meets with an accident, due of sudden deceleration, the rider is thrown away from the vehicle. If head strikes any object, motion of the head becomes zero, but with its own mass brain continues to be in motion until the object hits inner part of the skull. Sometimes this type of head injury may be fatal in nature. From that point forward, cruisers have gotten more expansive with normal products, and there has been a quick expansion in motorcycle mishaps in view that most motorcyclists don't put on a head protector which makes it volatile consistently to experience a bike. Over the latest couple of years many people have passed on coincidentally because of head wounds. therefore, the carrying of a protecting cap (Helmet) is compulsory as indicated through transit policies, the infringement of which attracts in critical fines. Programmed Number Recognition (ANPR) is a framework that allows continuous acknowledgment of a automobile allow wide variety. As a computerized professional co-op, ANPR assists with similarly developing flip of activities, tweak the old utility and increment customer and representative usefulness. The primary job of ANPR, inside the utility, is to do away with the letters of the engine Vehicle permit number from the photograph. Brilliant vehicle management offers more administrations, a software where a purchaser can see car fixes utilizing just the tag variety removed from the transferred photo. by using utilizing ANPR to similarly develop execution,it could lessen the responsibility of numerous representatives and clients of auto administrations. Catchphrases – number plate, open ALPR, acknowledgment, picture making ready, smart servicevehicle. Mechanical investigations are firmly identified with PC insights, which center around PC created conjectures. Examining the utilization of science brings techniques, hypothetical and viable settings into the field of AI. Information mining is a field of study inside AI, and spotlights on the investigation of test information by unaided learning. In such times helmet acts as life savior. Helmet reduces the chances of skull getting decelerated, hence sets the motion of the head to almost zero. Cushion inside the helmet absorbs the impact of collision and as time passes head comes to a halt. It also spreads the impact to a larger area, thussafeguarding the head from severe injuries. In this project we are detecting whether two-wheeler rider wearing helmet o not, if he is not wearing helmet thenwe are extracting number plate of that two-wheeler. To extract number plate we have YOLO CNN model with some train and test images and if you want to add some other images then send those images to usso we can include those images in YOLO model with annotation to extract number plate of those new images.

II. Related Work

Programmed Number Recognition (ANPR) is a mindfulness program that distinguishes vehicle permit numbers after a fruitful identification in a gained picture [1] [2] [3]. Arising pictures assume a vital part in the calculation for the framework to work appropriately. By definition, a picture portrays a dream seen by the two eyes [4]. A number plate is a manner by which a vehicle can be found in an alternate manner [5]. This number can show up on thepicture utilized and the data returned is the vehicle's information. ANPR utilizes Optical Character Recognition (OCR) to acquire characters from sources like pictures from an observation camera or cameras [2]. To take a decent and exact photograph it is important to place the camera in the ideal spot. Each character is investigated fundamentally utilizing Optical Character Recognition (OCR). OCR can be characterized as the exchange of composed or printed information from any source, like composed or printed reports, photos, references to a content editing machine and the ideal source [8]. At the end of the day, it is the interaction by which texts from different sources are gotten, changed over and, at last, the outcome into a proper arrangement [5]. The OCR framework is utilized in many fields like business, industry, exploration, wellbeing and security, writing, and medication - to make gadgets for individuals with visual debilitations [8]. Generally, this program is accessible for applications, for example, plate number acknowledgment, identification acknowledgment at air terminals [4], scanner tag at the office [6], transcribed email [7] [8] [10]. In the ANPR framework, everything has a picture handling

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calculation or rule, just as a plate. There is a lot of trouble in handling the picture due to obscuring, absence of light, something that shrouds the perceivability of the tag, inaccurate point, diverse textual style or global inconsistency. Kunal Dahiya et al.[11] proposed an approach in which detection of bike riders are performed from surveillance videos using the methods of background subtraction and object segmentation. Then it uses histogram oforiented gradients (HOG), scale-invariant feature transform (SIFT), and local binary patterns (LBP) for classification. Practical safety helmet wearing detection method based on image processing and machine learning [12] used the ViBe background modelling algorithm to detect motion, followed by HOG and SVM and color feature recognition to detect safety helmets. Various existing methods proposed approaches that employ CNN algorithms, SVM classifier, OCR [13] to detect helmet law violators and their vehicle‟s license plate to send SMS
to these law offenders. Another existing method uses YOLOv2, YOLOv3[14] to detect helmet law offenders and to identify them by extracting their license plate number. This method takes

3. EXISTING MODEL

The Existing system monitors the traffic violations primarily through CCTV recordings, where the traffic police have to look into the frame where the traffic violation is happening, zoom into the license plate in case rider is not wearing helmet. But this requires lot of manpower and time as the traffic violations frequently and the number of people using motorcycles is increasing day-by-day. What if there isa system, which would automatically look for traffic violation of not wearing helmet while riding motorcycle/moped and if so, would automatically extract the vehicles‟ license plate
number. Recent research have successfully done this work based on CNN, R-CNN, LBP, HoG, HaaR features,etc. But these works are limited with respect to efficiency, accuracy or the speed with which object detection and classification is done. In this research work, a Non-Helmet Rider detection system is built which attempts to satisfy the automation of detecting the traffic violation of not wearing helmet and extracting the vehicles‟ license plate number. The main principle involved is Object Detection using Deep Learning at three levels.More importantly it acts as a mechanical barrier between head and object to which the rider came into contact. Injuries can be minimized if a good quality full helmet is used. Traffic rules are there to bring a sense of discipline, sothat the risk of deaths and injuries can be minimized significantly. However strict adherence to these laws is absent in reality. Hence efficient and feasible techniques have to be created to overcome these problems. Manual surveillance of traffic using CCTV is an existing methodology.

4. METHODOLOGY

In this research work, a Non-Helmet Rider detection system is built which attempts to satisfy the automation of detecting the traffic violation of not wearing helmet and extracting the vehicles‟ license plate number. The main principle involved is Object Detection using Deep Learning at three levels. The objects detected are person, motorcycle/moped at first level using YOLOv2, helmet at second level using YOLOv3, License plate at the last level using YOLOv2. Then the license plate registration number is extracted using OCR (Optical Character Recognition). All these techniques are subjected to predefined conditions and constraints, especially the license plate number extraction part. Since, this work takes video as its input, the speed of execution is crucial. We have used above said
methodologies to build a holistic system for both helmet detection and license plate number extraction.

4.1 Dataset

Proper and large dataset is required for all classification research during the training and the testing phase. uploading dataset called „dataset.txt‟ after uploading dataset

Upload dataset: - uploading „intrusion_dataset.txt‟ file, after uploading dataset will get below screen

4.2 The proposed model: -

The proposed a methodology for feature extraction using LBP based hybrid descriptor, HOG and Hough transform descriptors. Whereas Xinhua Jiang et al. incorporated grey level co-occurrence matrix along with LBP for feature extraction. YOLOv2 and COCO dataset can be employed to detect different types of objects and classify them accordingly The intended

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object are motorcycle, motorcyclists, pedestrians and workers. Helmet and tire color exhibits different characteristics, this can be exploited to detect motorbikes. proposed a method to identify two-wheeler accidents using a microcontroller and accelerometer. Most of the time pedestrians are the real victims for road accidents, their safety is essential. Jie Li et al. The proposed a method to classify pedestrians using SVM based on histogram of oriented gradient features (HOG). The last step involves helmet detection. Color based and circle Hough transform is used to detect helmet and HOG descriptors can also be used for helmet detection. Color feature recognition is another option. deployed color space transformation and color feature discrimination for detecting the helmet. GLCM statistical features and Back-Propagation artificial neural network is used to detect helmet more effectively. Helmet detection system involves following steps such as collection of dataset, moving object detection,

background subtraction, object classification using neural networks and extraction of license platenumber if the rider isn‟t wearing helmet. Waranusast et al. used KNN classifier for moving object extraction and classification. Here the head is classified as wearing helmet or not based on various features obtained from the segmented head region moving objects can be detected using adaptivebackground subtraction . ViBe background modelling algorithm can also be applied to detect motion objects
. Canny edge detection algorithm is used to get segmented moving objects.

4.3 Yolo : You Only Look Once (YOLO) is a real-time object recognition system that can identify multiple objects in a single frame. Up to 9000 classes and even unseen classes can be predicted. It is based on a single Convolutional Neural Network (CNN). The CNN divides an image into regions and then predicts the boundary boxes and probabilities for eachregion. During training and testing, YOLO views the whole picture so that it indirectly encodes contextual details about classes as well as their appearance. It applies a single neural network to an entire image and performs all detections at once. It recognizes objects more precisely and faster than other recognition systems.

4.3 Yolov4 : YOLOv4 is a real-time object detector that can detect multiple objects in an image, predict the classes of the detected objects, and to identify the location of the objects in the image without the loss of too much accuracy. It is faster and more accurate than YOLOv3, as it has the accuracy and FPS increased to 10% and 12% respectively when compared to that of the latter. Moreover, it can process videos in 65 FPS and is trained in COCO dataset by default. The architecture of YOLOv4 consists of 4 stages: input, backbone, neck and head. The input stage is to feed in the images. The backbone stage is to extract the features using a feature map. Among the feature extraction models (like ResNet, DenseNet etc.), CSPDarkNet53 has given more optimal results after experimentation. It is used to enhance the learning capability of CNN. The backbone stage also contains Bag of Freebies (BoF) to increase the cost of training leaving the cost of interference low, and Bag of Specials (BoS) which significantly improve accuracy. The neck stage contains the extra layers that go in between the backbone and the head. It is used to extract different feature maps at different stages of backbone. Spatial Pyramid Pooling (SPP) is added to increase the receptive field
and separate out the most significant context features. It is used as it produces a fixed length output size regardless of the input size given. The head stage contains YOLOv3 for sparse detection and is in charge of actually performing the object detection
.

4.4 Software Requirements Programming Language:
Python 3.6
Dataset: Plant Village
Dataset
Packages
: TensorFlow, NumPy, Pandas, Matplotlib, Scikit-learn

4.5 Hardware Requirements Operating System:
Windows 10 Processor: Intel Core i3-2348M
CPU Speed: 2.30 GHz
Memory: 2 GB (RAM)

4.6 DESIGN
Software design sits at the technical kernel of the software engineering process and is applied regardless of the development paradigm and area of application. Design is the first step in the development phase for any engineered product or system. The designer‟s goal is to produce a model or representation of an entity that will later be built. Beginning, once system requirement has been specified and analyzed, system design is the first of the three technical activities - design, code and test that is required to build and

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verify software. The importance can be stated with a single word "Quality". Design is the place where quality is fostered in software development. Design provides us with representations of software that can assess for quality. Design is the only way that we can accurately translate a customer‟s view into a finished software product or system. Software design serves as a foundation for all the software engineering steps that follow. Without a strong design we risk building an unstable system – one that will be difficult to test, one whose quality cannot be assessed until the last stage. During design, progressive refinement of data structure, program structure, and procedural details are developed reviewed and documented. System design can be viewed from either technical or project management perspective. From the technical point of view, design is comprised of four activities – architectural design, data structure design, interface design and procedural design.

4.7 Motorbike and Person Detection

The frame chosen is given as input to YOLOv2 object detection model, where the classes to be detected are Motorbike‟,
„Person‟. At the output, image with required class detection along with confidence of detection through bounding box and probability value is obtained as shown in the Fig. 1 (a) and Fig. 1 (b).

Fig. 1 (a): Frame with 'person' and 'motorcycle' classes detected (Case 1)

Fig. 2 (b): Frame with 'person' and 'motorcycle' classes detected (Case 2)

Fig. 3 (a): Extracted motorcycle and person images (Case 1)

With the help of functions given by Image AI library, only the detected objects are extracted as shown in Fig. 3 (a) and Fig. 3 (b) and stored as separate images and named with class name and image number in order. For example, it will be saved as motorcycle- 1, motorcycle-2, etc.… if extracted object is motorcycle or person-1, person-2, etc.… if extracted image is of person. The details of these extracted images which is stored in a dictionary which can be later used for further processing.

4.8 : HELMET DETECTION

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Fig. 4: Helmet detection

Once the person-motorcycle pair is obtained, the person images is given as input to helmet detection model. While testing the helmet detection model, some false detections were observed. So, the person image was cropped to get only top one-fourth portion of image, as shown in Fig. 4. This ensures that false detection cases are eliminated as well as avoid cases leading to wrong results when the rider is holding helmet in hand while riding or keeping it on motorcycle while riding instead of wearing. After applying cropped image to helmet detection model, output is as shown in Fig.4. The bounding box around helmet along with the detection probability is displayed as shown in Fig.4. As the rider wearing helmet in Case 1, no further processing is necessary. Since in Case 2, rider is not wearing helmet, no bounding box is created.

4.9. LICENCE PLATE DETECTION

If the helmet is found, there is no need for this step. However, if the helmet is not found, then the motorcycle image is given as input to license plate detection model. For training purpose, 832 images were collected as dataset which were images of bike, mopeds with their license plate. Then using labeling tool, the license plate in those images were annotated, i.e., a bounding box is created around license plate in those images so that the model could learn. The information regarding the bounding box isstored in .xml file with the name being same as image name. Then the annotated images are used to build the trained model for detecting license plates.

should this patient be operated on, and if so, what should be the extent of resection.

Fig. 6: License plate detection

Using the trained model, the bounding box is created across license plate in given input image. The corresponding information includes top-left, bottom right co-ordinates of bounding box, class name, confidence of detection in a .json file. Then to extract the license plate image only, the bounding-box co-ordinates stored in .json file are used and extracted images are stored. Sometimes, as shown in Fig. 6, for a single motorcycle image, more than one bounding box were detected. In that case, a threshold of 0.5 is set for confidence of detection. While reading details of bounding box in the .json file, the one with confidence greater than the threshold is chosen.

Fig. 7: License plate extraction and rotation

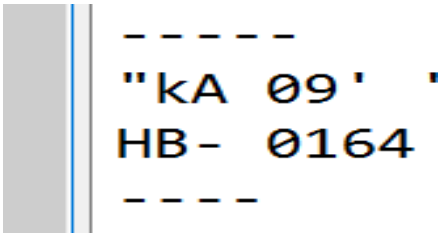

Fig. 8: Output after applying OCR

Before applying OCR directly to extracted license plate image, pre-processing as to be done to get output of better accuracy. Hence the image was rotated. Fig. 7 shows how the license plate image will be once it is extracted and rotated. Since the camera will be fixed position with respect to motorcycle, the angle to which the extracted license plate image has to be rotated, has to be found once

by trial and-error method and that value remains same for all the other cases. In this case, it was foundto be 6 degrees. The rotated image was rescaled so that OCR can detect the strings with good accuracy. The rescaled image size was determined by choosing a scaling ratio, i.e., ratio of size of rescaled image to the size of original image, width wise and height wise. Let w, h be the width and height of original image, w`, h` e the width and height of rescaled image. r be the ratio. Then the rescaled image size is obtained by:

w` = w * r ..... (1)

h` = h * r .....(2)

5. RESULT AND DISCUSSION

Table 1. Details of Threshold value with model

Sl. No	Detection model	Number Plate Detection	Threshold value
1	YOLO v2(Without Helmet)	Yes	0.5
2	YOLO v2(With Helmet)	No	0..87

Results obtained are discussed here for two cases. They are,
Case 1: When the motorcycle/moped rider is wearing helmet as shown in fig.5.
Case 2: When the motorcycle/moped rider is not wearing helmet and License plate is detected as shown in fig 6.

V.CONCLUSION

A Non-Helmet Rider Detection system is developed where a video file is taken as input. If the motorcycle rider in the video footage is not wearing helmet while riding the motorcycle, and then here we are uploading image to identify license plate number of that motorcycle is extracted from image and displayed. Object detection principle with YOLO architecture is used for motorcycle, person, helmet and license plate detection. OCR is used for license plate number extraction if rider is not wearing helmet. 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. All the objectives of the project is achieved satisfactorily.

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