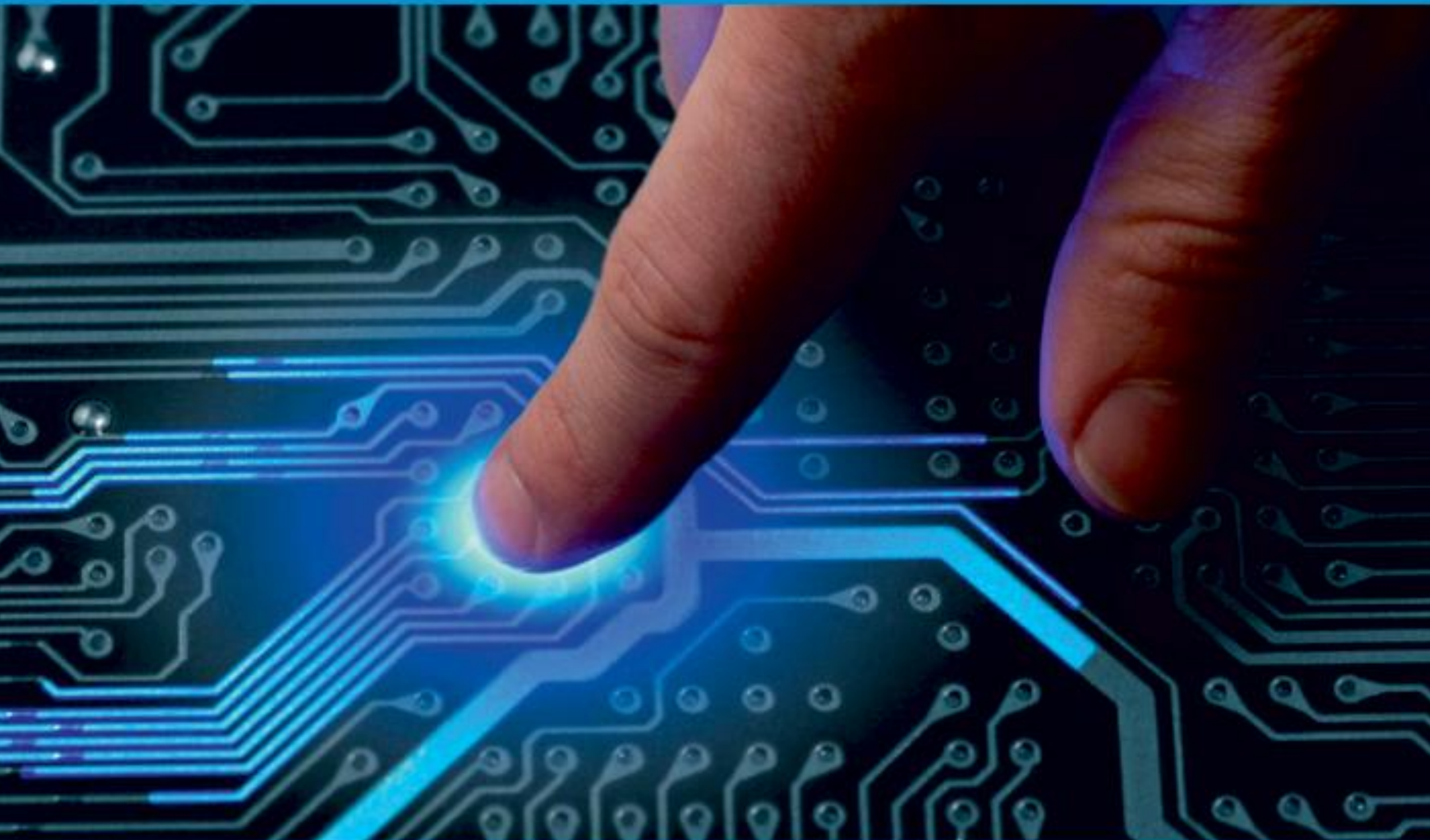
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 11, Issue 5, May 2023

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.379

9940 572 462 | 6381 907 438 | ijircce@gmail.com | www.ijircce.com

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 8.379 |

|| Volume 11, Issue 5, May 2023 ||

| DOI: 10.15680/IJIRCCE.2023.1105205 |

Smart E-Challan System (ECS) for Traffic Rules Violators

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ABSTRACT:Motorcycles have always been the primary mode of transportation in developing countries. Motorcycle accidents have increased in recent years. One of the main reasons for fatalities in accidents is that a motorcyclist does not wear a protective helmet . The most common way to ensure that motorcyclists wear a helmet is by traffic police to manually monitor motorcyclists at road junctions or through CCTV footage and to penalize those without a helmet. But it requires human intervention and effort. So this system Proposes an automated system for detecting motorcyclists who do not wear a helmet and retrieving their motorcycle number plates from CCTV video footage .First, the system classifies moving objects as motorcycling or non-motorcycling. In the case of a classified motorcyclist, the head portion is located and classified as a helmet or non-helmet. Finally, for the motorcyclist identified without a helmet, the number plate of the motorcycle is detected and the characters on it are extracted by using the OCR algorithm. E-challan will also be generated with offender details. A database will be generated with records to identify every offender accurately. The system implements pure machine learning in order to identify every type of helmet that it comes across with minimum computation cost.

KEYWORDS: YOLO V3,Tensorflow,OpenCV,Selenium Web Driver.

I. INTRODUCTION

The Smart eChallan System for Traffic Rule Violators is an advanced technological solution aimed at improving the efficiency and effectiveness of traffic violation enforcement. Traffic violations and road accidents are significant challenges faced by modern urban areas, necessitating the development of innovative systems to enhance road safety. Traditional traffic challan systems often suffer from manual errors, delays in issuing fines, and difficulties in tracking repeat offenders. To overcome these limitations, the Smart eChallan System leverages automation, real-time data processing, and integration with traffic monitoring technologies to streamline the process of issuing fines to traffic rule violators.

The system is designed to replace the traditional paper-based ticketing system with a digital and automated approach. By utilizing state-of-the-art technologies, such as Automatic License Plate Recognition (ALPR) and centralized databases, the system can efficiently capture and process violation details in real-time. This enables traffic police officers to promptly issue eChallans to violators, reducing delays and ensuring quicker enforcement of traffic rules. Furthermore, the system incorporates penalty calculation algorithms based on violation types and severity, ensuring fair and accurate fines.

Integration with existing traffic monitoring technologies, such as CCTV cameras and ALPR systems, further enhances the system's capabilities. By leveraging these technologies, the system can automatically detect and record traffic violations, eliminating the need for manual intervention and minimizing human errors. The seamless flow of data and communication between the various system components ensures efficient processing and storage of violation information, enabling comprehensive tracking of offenders and generating valuable insights for traffic management and decision-making.

Moreover, the Smart eChallan System includes a payment gateway subsystem that enables violators to conveniently pay fines online, enhancing user convenience and compliance. The system also generates digital receipts, ensuring transparency and accountability in the fine issuance process. By providing an integrated and automated approach to traffic violation enforcement, the Smart eChallan System aims to promote road safety, deter traffic rule violations, and contribute to improved traffic management in urban areas.

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II. RELATED WORK

In various fields, there is a necessity to detect the target object and track them effectively while handling occlusions and other included complexities. Many researchers (Almeida and Guting 2004, Hsiao-Ping Tsai 2011, Nicolas Papadakis and Aure lie Bugeau 2010) attempted for various approaches in object tracking. The nature of the techniques largely depends on the application domain. Some of the research works which made the evolution to proposed work in the field of object tracking are depicted as follows

Until very recently, most of the methods used for object detection and object classification used methods such as Haar, HOG, local binary patterns (LBP), the scale invariant feature transform (SIFT), or speeded up robust features (SURF) for feature extraction and then support vector machines (SVM), random forests, or AdaBoost for the classifier. Silva et al. [1] use methods such as histograms of oriented gradient (HOG), LBP, and the wavelet transform (WT) for feature extraction for classifying motorcyclists with helmets and without helmets. They use multiple combinations of the base features such as HOG+LBP+WT, obtaining seven possible feature sets. In [5], K. Dahiya et al. came up with helmet detection from surveillance videos where they used an SVM classifier for classifying between motorcyclist and non-motorcyclist and another SVM classifier for classifying between helmet and without helmet. For both classifiers, three widely used features - HOG, SIFT and LBP - were implemented and the performance of each was compared with that of other two features. They concluded that HOG descriptor helped in achieving the best performance.

In [6], C. Vishnu et al. proposed an approach using Convolutional Neural Networks (CNNs) for classification. In recent years, CNNs performing both automatic feature extraction and classification have outperformed previously dominant methods in many problems. Advances in graphical processing units (GPUs), along with the availability of more training data for neural networks to learn, have recently enabled unprecedented accuracy in the fields of machine vision, natural language processing, and speech recognition. Nowadays, all state-of-the-art methods for object classification, object detection, character classification, and object segmentation are based on CNNs. See for example the methods used in the ImageNet large scale visual recognition challenge [2].Li and Shen [3] use a deep convolutional neural network and long-short term memory (LSTM) for the license plate recognition and character extraction process. They use two methods for segmentation and recognition. [4] have shown the use of CNNs for text detection and recognition provides significant improvement over existing methods.

The YOLOv3 algorithm is capable of accurate object detection (traffic participants) with near real-time performance (~ 25 fps on HD images) in the variety of the driving conditions (bright and overcast sky, snow on the streets, and driving during the night).
YOLO v3 algorithm consists of fully CNN [7] and an algorithm for post-processing outputs from neural network. CNNs are special architecture of neural networks suitable for processing grid-like data topology. The distinctive feature of CNNs which bears importance in object detection is parameter sharing. Unlike feedforward neural networks, where each weight parameter is used once, in CNN architecture each member of the kernel is used at every position of the input, which means learning one set of parameters for every location instead a separate set of parameters.

III. PROPOSED SYSTEM

Algorithm USE:
YoloV5:
The Smart eChallan System for Traffic Rule Violators incorporates the YOLOv5 algorithm for object detection and recognition. YOLO (You Only Look Once) is a state-of-the-art real-time object detection algorithm that has gained.YOLOv5 builds upon the success of its predecessors by introducing improvements in terms of speed and performance. It uses a single neural network to simultaneously predict object bounding boxes and their corresponding class probabilities in a single forward pass. This approach enables real-time object detection with impressive accuracy.In the context of the Smart eChallan System, YOLOv5 plays a crucial role in automatically detecting and recognizing various traffic violations, such as speeding, red light violations, illegal parking, and more. The system integrates YOLOv5 with other components, such as CCTV cameras and ALPR systems, to capture violation details in real-tim significant popularity due to its accuracy and efficiency.

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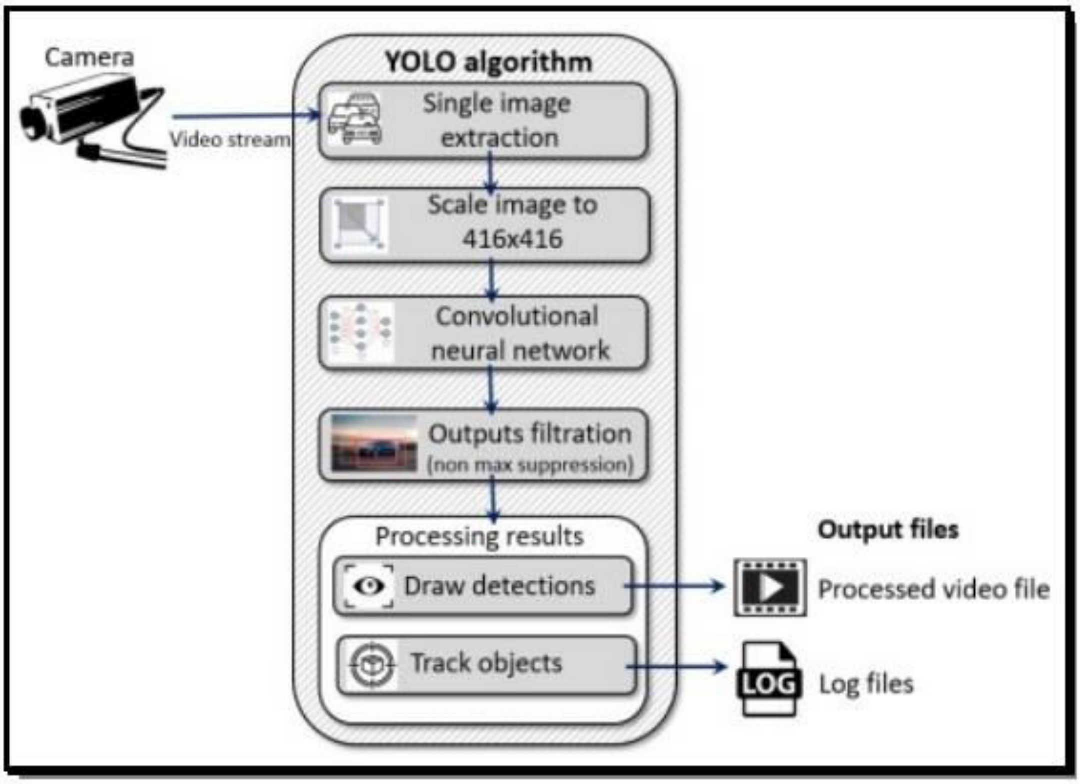

Fig1 : Yolov5 Architecture

This algorithm starts with extraction single image from video stream, in a next step extracted image is resized and that represent input to Yolo network. YOLO v5 neural network consist of 106 layers. Besides using convolutional layers, its architecture also contains residual layers, up sampling layers, and skip (shortcut) connections.
CNN takes an image as an input and returns tensor (see Fig 3) which represents:

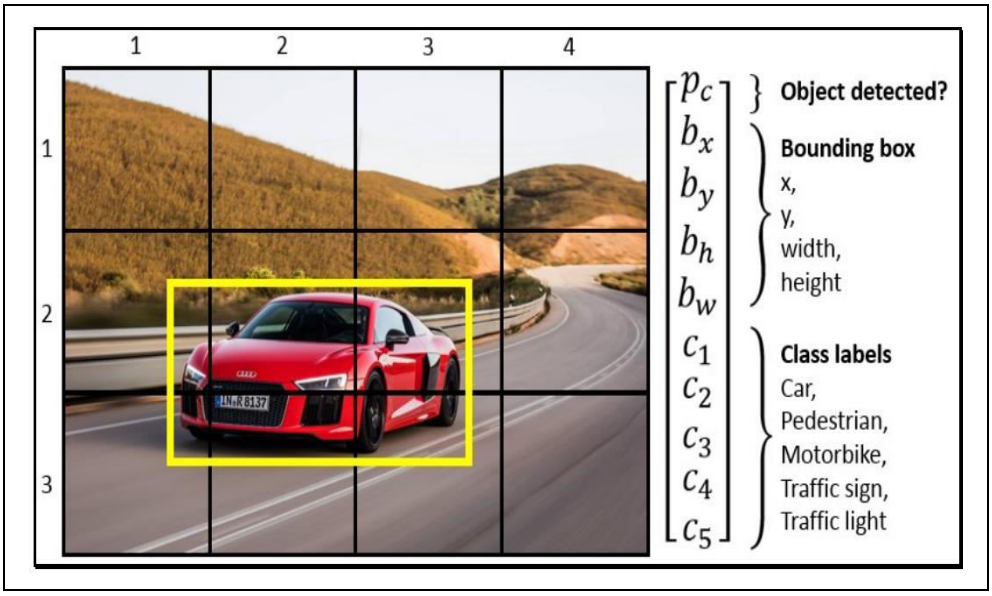

Fig. 2. Bounding box prediction.

- Coordinates and positions of predicted bounding boxes which should contain objects,

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- A probability that each bounding box contains object,
- Probabilities that each object inside its bounding box belongs to a specific class.

The detection is done on the three separate layers. Object detection done at 3 different scales addresses the issue of older YOLO neural network architectures, the detection of the small objects. Output tensors from those detection layers have the same widths and heights as their inputs, but depth is defined as: the number of bounding box properties such as width (bw), height (bh), x and y position of the box (bx, by) inside the image, 1 is the probability that box contains the detectable object (pc) and class probabilities for each of the classes (c1, c2, …, c5).

That sum is multiplied by 3, because each of the cells inside the grid can predict 3 bounding boxes. As the output from the network, we get 10 647 bounding box predictions.

This network has an ability to simultaneously detect multiple objects on the single input image. Features are learned during the network training process when the network analyses the whole input image and does the predictions. In that way, the network has knowledge about the whole scenery and objects environment, which helps the network to perform better and achieve higher precision results.

FLOWCHART OF PROPOSED SYSTEM

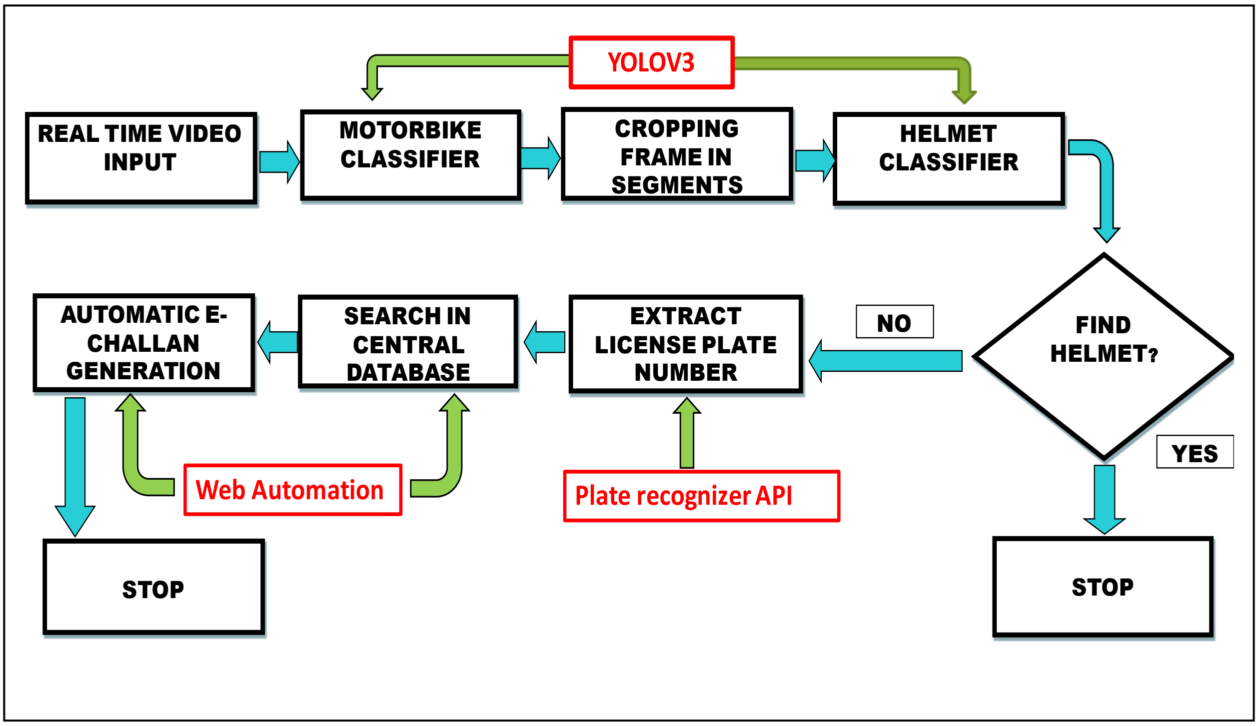

Fig. 3. Flowchart of Workflow

METHODOLOGY

One important element of deep learning and machine learning at large is dataset. A good dataset will contribute to a model with good precision and recall. In the realm of object detection in images or motion pictures.

- **For Motorcycle detection**: we used trained model with COCO Dataset with accuracy of 99%.
- **For Helmet Detection:** We created our own Yolov3 Model with our own dataset with 1000+ images of helmet and non-helmet riders.
- **For License plate:** We used API for extraction and web automation for getting details for E-Challan Generation.

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PROCEDURE FOR TRAINING A YOLO V5 HELMET MODEL:

Gathering images (Creating data set): To detect a bike rider with helmet or without helmet. We need bunch of images of bike-riders with helmet, bike-rider without helmet and bike license plate. In this project, we used 1000+ images.

Label Images:

Label the all images with the help of **LableImg tool**. In this project, **Helmet class** was created with the help ofLableImg tool. Create .xml file corresponding to each image with the above following categories of classes

Now that our dataset labels are in the required format, we need to create a train-test split. I chose to create a test set containing 10% of the images in the dataset. Configuring YOLO with your dataset. Now that we have created our train and test sets, we need to make some changes to train the YOLO model on the dataset.

Training:

Now that our dataset is ready to use, we can begin training. Before we start, compile the darknet repository with the `make` command. To compile with specific options, such as GPU, CUDNN and OPENCV. This will create a `darknet` executable.

Trained weights for model. You can set other parameters (learning rate, momentum, weight decay etc by editing the corresponding lines). Finally, model is ready to use.

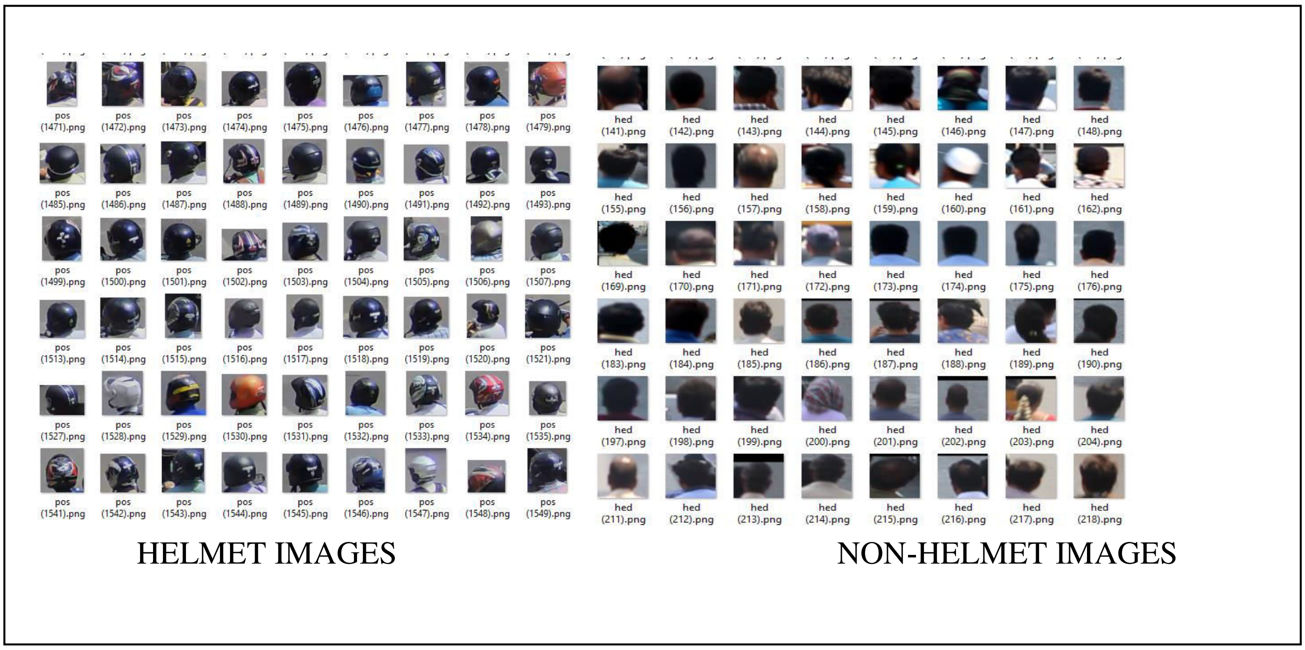

Fig 4: Helmet dataset

NUMBER PLATE DETECTION:

You can use our API to access our API endpoints, which can read license plates from images. Plate Recognizer provides accurate, fast, developer-friendly Automatic License Plate Recognition (ALPR) software that works in all environments.

The software can be used in many ways:

Recognize license plates from camera streams. The results are browsable, searchable, and can trigger alerts. The data repository can be in the cloud or stored entirely within your on-site network.

Recognize license plates from camera streams and send the results to your own application.

Integrate license plate recognition into your application directly in-code.

AUTOMATED E-CHALLAN GENERATION:

Further this Detected LP Numbers are injected to RTO Database for extracting the further details of the Violator. Now, we do Automation of web Browser, to get the details of offender from RTO Database.

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Selenium is an umbrella project for a range of tools and libraries that enable and support the automation of web browsers. Selenium supports automation of all the major browsers in the market using *WebDriver*.

WebDriver is an API and protocol that defines a language-neutral interface for controlling the behavior of web browsers. Web scraping is a technique which could help us transform HTML unstructured data into structed data in spreadsheet.

With Pillow Image Library, with extracted details saved in excel sheet an automatic E-challan is generated with details Including Date and time & further it can be sent through message, mail or post

IV. 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, then the license plate number of that motorcycle is extracted and displayed. Object detection principle with YOLO architecture is used for motorcycle, person, helmet, and license plate detection. Web api 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 are achieved satisfactorily.

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