REALTIME HELMET DETECTION AND NUMBER PLATE RECOGINITION USING MACHINE LEARNING

A PROJECT REPORT

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ABSTRACT

Current situation, we come across various problems in traffic regulations in India which can be solved with different ideas. Riding motorcycle 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. In Proposed we used yolov3 for object detection and (CNN) Convolutional neural network for detecting the number plate. Once fully trained, computer vision models can perform object recognition and detection and even track movement. As a result an automated system was created a variety of techniques, including Convolutional neural network (CNN) the you only look once (YOLOv) . In this study , yolov3 and CNN are used to compare motercycle helmet and licence plates detection. Our Application can be implemented in real-time using a Webcam or a CCTV as input.

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ABBREVIATION

S.NO	SYMBOL	ABBREVIATION
1	YOLO	You Only Look Once
2	CNN	Convolutional Neural Network

CHAPTER 1

INTRODUCTION

1.1. Introduction

Every country has seen an increase in motorcycle accidents over the years due to social and economic differences as well as regional variations in transportation circumstances. One common mode of transportation for those in the middle class is a motorbike. The primary piece of safety gear for motorcyclists is wearing a helmet, but not all drivers will follow. A bike accident is a major problem. Only 21.5% of the motorcycle riders had helmets on when the accident took place. The heavy weight of the helmet (77%), the sensation of heat (71.4%), neck pain (69.4%), the sensation of suffocation (67.7%), and the restriction of head and neck movements (59.6%) were the most frequently cited reasons for not using a helmet while riding a motorcycle. Overall, physical discomfort was the primary reason for this. Physical pain is generally regarded as the main drawback for motorbike riders from using helmets while riding.

Every motorbike rider is legally required to wear a helmet when driving a bike. However, some people on bikes used to ignore their safety, which resulted in them violating traffic rules by driving the bike without a helmet. The policeman tried to address this issue manually, but it was ineffective and proved to be quite challenging in practical circumstances. Therefore, automating this procedure is essential if we are to effectively enforce road safety. As a result, an automated system was created employing a variety of techniques, including Convolutional Neural Networks (CNN), the , the You Only Look Once (YOLO), etc.

1.2. Objective

The main aim of this thesis is to compare the machine learning algorithms that detect motorcycles' license plates and helmets. Here, the Convolutional Neural Networks (CNN) and YOLOv3 are trained with US License Plates and Helmet Detection datasets.

- The aim of this thesis includes the following objectives:
- Gather the proper datasets required for training and perform data pre-processing.
- Training the models using YOLOv3 and Convolutional Neural Networks (CNN) algorithms with training datasets.
- Testing the models using the test data set and recording the prediction results.

Calculating the accuracy of the algorithms and identifying the efficient algorithm that detects the helmets and license plates of motorcycles.

1.3. Overview

This thesis aims to compare two machine learning algorithms for motorcycle helmet and license plate detection and find an efficient algorithm among them. The datasets are prepossessed and trained using the training datasets. And the next step is to test the models and it is done using the test datasets. Based on the results accuracy is calculated and an efficient algorithm is identified.An efficient visual object detection algorithm with high detection rates is the Convolutional Neural Networks (CNN), which is based on machine learning. Numerous positive and negative example photos are provided as input to the classifier during training. You Only Look Once is a method of identifying objects in images and videos . It uses a

single neural network for recognizing objects. It uses Convolutional Neural Networks for detecting objects, the algorithm is popular because of its speed in the detection of objects in an image or video, accuracy for detecting the images is high, and the algorithm also has high learning ability to learn from the inputs and apply it to the detecting objects.

1.4. MODULES

1.4.1 Image Preprocessing

FIG 1.4.1

Image preprocessing is a crucial step before training the model. The datasets that are collected and downloaded in the previous step are now extracted and all the images in the dataset are brought into one format. If any unusual format is found then they are converted to the usual format. Here '.png' and '.jpg' format is taken for training the model. For the YOLOv3 '.txt' format is preferred. Here by using the LabelImg tool, the images are all labelled with height, width and centre of the

point of the images and the values are all stored in a '.txt' file for YOLOv3 as shown in figure 7. Now the datasets are categorized into two classes. First, categorize the Helmet Detection dataset into two classes i.e., a person with a helmet and a person without a helmet. Similarly, categorize the US License Plates dataset into a motorcycle with a license plate and a motorcycle without a license plate. Then the data is split into 80% as a training dataset and 20% as a testing dataset. For the training of the Classifier,we need a lot of positive and negative images. So, the images in the training dataset are separated into positive and negative images for the classifier.

1.4.2. Segmentation

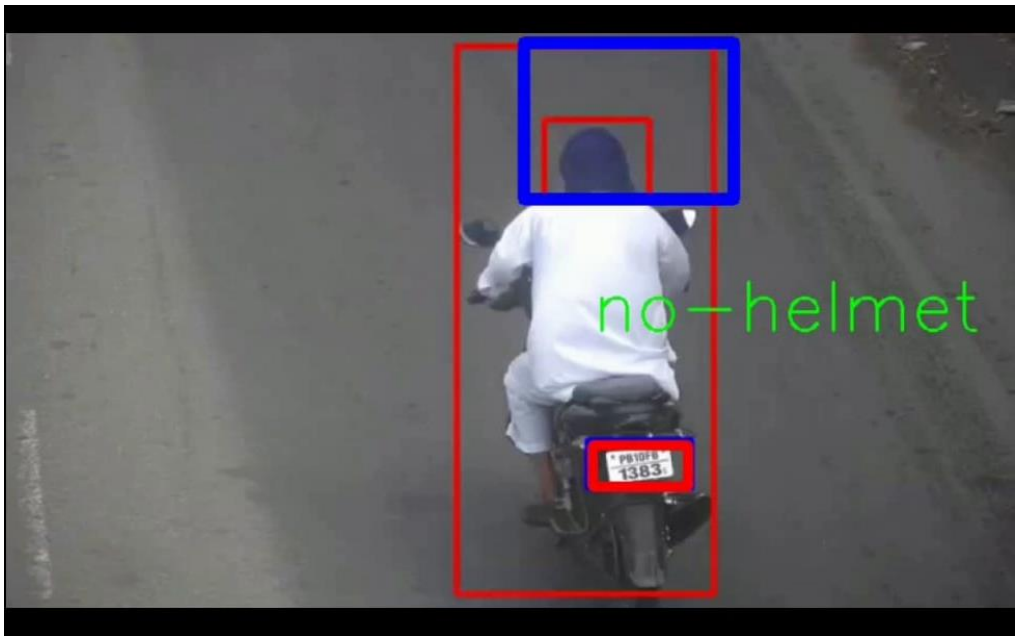


FIG 1.4.2

This way, an original image can be captured and stored. In other words, it should replace each pixel in an image with a black or a white pixel. It is a method of image segmentation. This method works on sorted data in order to smooth it.

The whole data is divided into segments of equal size and then various methods are performed to complete the task. Each segmented is handled separately. One can replace all data in a segment by its mean or boundary values can be used to complete the task.

Regression: Here data can be made smooth by fitting it to a regression function.The regression used may be linear or multiple . Our helmet detection using Yolov3 algorithm is used to detect the people who not wearing helmet .Then automatically extract the number plate.

The goal of preprocessing is to make raw data usable by computers. Preprocessing is especially vital for recognizing handwritten documents that are more sensitive to noise. Preprocessing allows obtaining a clean character image to yield better results of image recognition.

1.4.3. Extraction

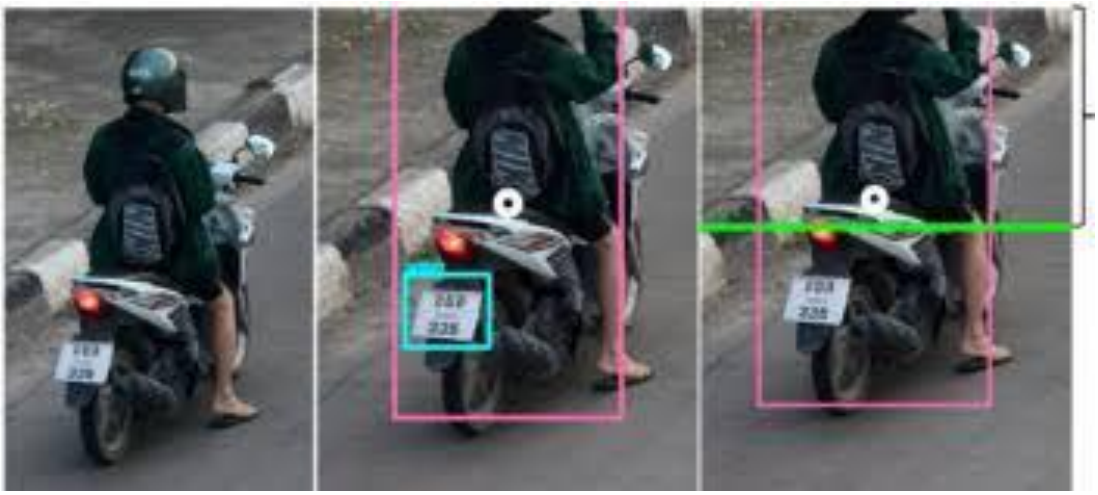


FIG 1.4.3

Once all the features are extracted, they can be fetched to a neural network (NN) to train it to recognize characters. The noise level on an image should be optimized and areas outside the text removed. A training dataset and the methods

applied to achieve the best output will depend on a problem . The identification of characters heavily depends on the context. The verification of the output requires a human-in-the-loop approach.

Who not wearing the helmet they captured and send message alert (No Helmet) to our telegram bot. Then , they punished or fined by police officer.

The process of segmentation is aimed at grouping characters into meaningful chunks. There can be predefined classes for characters. So, images can be scanned for patterns that match the classes. This step means splitting the input data into a set of features, that is, to find essential characteristics that make one or another pattern recognizable. As a result, each character gets classified in a particular class.

1.5 . Key Feature

Tag recognition is one of the procedures used for the proof recognizable purposes of the vehicle. The only goal of this task is to find the most advanced picture (acquired from the camera) approach to interpret the enrollment information. Usually, this procedure involves three stages. The tag restriction is the initial step, paying little consideration for the size and orientation of the tag. The following advance is character division and the last advance is character identification from the mark. Subsequently, during Template Matching, this venture reveals the essential thought of different calculations require to obtain character identification from the tag.The framework can likewise be utilized in profoundly populated territories and exceptionally confined zones to effortlessly distinguish traffic rule disregarded vehicles and proprietor's name, address and other data can be recovered utilizing this framework. This framework can be

computerized and it is utilized to perceive vehicles without approval, vehicles that damaged principles at populated zones like shopping centers, colleges, medical clinics and other vehicle parking areas. This can likewise be utilized on account of vehicle use in psychological oppressor activities, carrying, invalid number plates, taken autos and other criminal operations.

Due to this wearing cap is obligatory according to traffic rules, infringement of which draw in robust fines. Inspite, countless motorcyclists don't comply with the standard. By and by, every single significant city previously conveyed enormous video observation system to keep a vigil on a wide assortment of dangers. In this manner utilizing such previously existing framework will be a cost proficient arrangement, anyway these frameworks include an enormous number of people whose exhibition isn't maintainable for extensive stretches of time. Ongoing examinations have demonstrated that human reconnaissance demonstrates ineffectual, as the length of observing of recordings expands, the mistakes made by people likewise increments.

Two-wheeler is a prevalent method of transportation in pretty much every nation. Be that as it may, there is a high hazard included as a result of less assurance. To lessen the included hazard, it is exceptionally alluring for bicycle riders to utilize head protector.

Watching the helpfulness of head protector, Governments have made it a culpable offense to ride a bicycle without cap and have received manual systems to get the violators. In this model edges are separated from the recordings and changed over to grayscale picture, utilizing layout coordinating strategy (cross connection examination) bicycle riders are identified in the casing**.**

- The proposed approach is assessed on scanty traffic recordings as utilized inas well as on jam-packed traffic recordings gathered from the CCTV Surveillance Network of the Hyderabad City

- This highlight of the calculation referenced above aided in accomplishing quicker character acknowledgment of the tag. This character recognition procedure consists of steps such as preparation of the image, Defragmenting, Re dimensioning and Character constraint to be performed on the picture together in order to finish Model Matching.

- Use of versatile foundation displaying for the recognition of moving vehicles on occupied streets which handle the difficulties, for example, enlightenment impacts, climate change, and so forth. Instead of utilizing hand-made highlights, we have investigated the capacity of convolutional neural system to improve the order execution.

CHAPTER 2

LITERATURE SURVEY

[1] "Antitheft Vehicle & Helmet Monitoring"

Author Name : VINAY.K, PUNEETH.P , VASANTH.M , published 2022

In this study, we'll look at a variety of smart helmets and their methods and methodology. Jesudoos A et al.presented a technique in which sensors such as an infrared sensor, a vibration sensor, and a gas sensor are employed in conjunction with mems. By examining the breath of a person wearing the helmet, the gas sensor can determine how much alcohol he has drank. MEMS is in charge of the vehicle's bar control. A vibration sensor detects an accident. The load checker detects the vehicle's load. The PIC microcontroller is connected to the sensors. If a user has drunk alcohol, the gas sensor will detect it and display it on the LED display. If an accident happens, the vibration sensor will detect it and relay information to the controller through GPS.. If the rider engages in any reckless driving, the MEME sensor detects the quantity of the person's bank account. The IR sensor is used to determine whether or not the rider is wearing a helmet. a convolutional neural network to detect helmets, and adaptive background subtraction on video frames to obtain the moving objects. Later convolutional neural networks are used to identify the motorcyclists among moving objects. Again, CNN is applied to the upper one-fourth part of the motorcyclists to detect whether the rider is wearing a helmet or not. The performance of this model is done on the two data sets IITH_Helmet_1 which contains less traffic, model detects 98.63% with a low false alarm rate of less than 0.5% and data set 2 is IITH_Helmet2 which contains heavy traffic. The models are successfully detected

with 87.11% with a low false alarm rate of less than 0.5%.the model helmet detection using Single Shot Detector (SSD). The implementation is done in three stages, the first stage is the image gathering module in which the input datasets from the imaging system were obtained, photos are grouped in the cluster and the head portion is clipped and stored.

Advantages

- Accuratly detect the people who not wearing helmat.
- Our system reduce manpower and makes easier.

Disadvantage

- Initial investments are so high.
- Need more amount of manpower for existing system.

[2]. "A Review on Helmet Detection by using Image Processing and Convolutional Neural Networks"

Author Name: Prajwal M. J , Shashidhar R.

The main application of helmet detection is in traffic roads where accidents are more. Even though various measures are taken by government, it is not followed correctly by the motorcyclists, so several smart techniques should be employed. Construction industry and power substation suffer a lot of fatalities because of negligence in wearing safety helmets, hence there is a need of surveillance system that is capable of detecting helmets and preventing the deaths. A more sophisticated computer vision model that encompasses image processing, machine learning, Convolutional neural networks(CNN), classifiers such as support vector

machine (SVM), ViBe background modeling algorithm, a relevant data set containing helmets; caps; Histogram of Oriented Gradients(HOG) features and number of other techniques would solve the problem. Methods like COCO model, HOG descriptors, Hough transforms are used to detect objects. Optical character recognition(OCR), Haar like feature is used to detect number plates.

Advantages

- Reduce the concerns associatd with micromobility safety
- The system detects helmet wearing by scoter, motorcycle riders to decrese the probability of head injuries.

Disadvantages

- It is difficult to achieve real time speed due to multi stage operation.
- When a motor cycle has more than one rider especially when the person without a helmet is partially covered by the person with a helmet

[3]. "Detection of Non - helmet riders and extraction of licence plates numbers using yolov2 and OCR method "

Author Name: VINAYA SREE.P , SOWMIYA.A , Published 2022

Two-Wheelers are the main reason for the most number of road accidents. Though careless and rash driving is the main cause of these accidents, head injuries are also the foremost reason for the road accidents deaths. The solution for these problems is wearing helmet. 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, thus safeguarding the head from severe injuries. It acts as a mechanical barrier between head and object to which the rider came into contact. If a good quality helmet is used then injuries can be minimized. Traffic rules are there to bring a sense of discipline, so that 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. So here we proposed a methodology for helmet detection and extraction of license plate number using YOLOv2 and OCR.

Advantages

- Once the probable number plate area is located it is given to OCR.
- If OCR doesn't recognize the character from the image number plate.

Disadvantage

- It is difficult to judge whether there is a person.
- The non-uniformity of license plate number models for difficult state in another.

[4]. "Helmet Detection and Number Plate Recognition using Machine Learning"

Author Name: Gauri Marathe, Pradnya Gurav, Rushikesh Narwade , Published 2022

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. This system proposes an automated system for detecting motorcyclists who do not wear a helmet and a system for retrieving 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, the motorcyclist without a helmet is identified. Further we have developed a system which identifies the number plates and extracts the characters of the number plate using OCR algorithm

Advantages

- Real-time detection process for vehicle licenses plates
- Reliable performance and good accuracy for different number plate.

Disadvantages

- Automatic umber plate recognition system may not be entirely functional incase like, adverse weather condition.
- The non-uniformity of licence plate doesn't detecting properly.

[5]. "Automatic Detection of bikers without no helmet and number plate in DeepLearning"

Author Name: S. Kadam, R. Hirve, N. Kawle, and P. Shah Published 2022

In the article , the, Developed a model for, the automatic detection of bikers with no helmet, and number plate detection using the YOLOv2 CNN model. This research paper has two parts, first detecting the helmet and the riders who are not

wearing a helmet, and then the model predicts the number plate of the motorcycle. After identifying the number plates, the images are cropped and saved. The results obtained from the YOLOv2 by using mean average precision is 83.92% for helmet detection and 67.25% for number plate detection based on a convolutional neural network

Advantages

- Transmits real-time stamp of exit/ entry vehicle to the data base.
- Supports capture of license plate along with the vehicle image.

Disadvantages

- Investment costs are so high.
- Bad conditions and rainy seasons tie difficult to detect

[6]. "Implementation of licences plate detection for traffic control using deep learning"

Author : S. Shanmugam, P. Dhanasekaran, S. A. Lakshmanan, S. Balaganapathy, and A. Sharmila Published 2022

Implementation of license plate detection for traffic control is done using the deep learning algorithm. The authors developed the model in three stages the first stage is to detect the motorcycles from the video or image by using feature extraction methods such as Histogram of Oriented Gradients (HOG), and Scale-Invariant Feature Extraction (SIFT). The next stage is to detect the helmet when a person riding a motorcycle which is done using Convolutional Neural Networks (CNN) and Artificial Neural Networks (ANN). The last stage is to detect the license plate which is done by Optical Character Recognition (OCR). For the riders

who are not wearing helmets, the motorcycle number plates are detected and noted. The model classifies the objects and divides the object by aspect ratio. The Region of Interest (ROI) and feature extraction is used to find objects. A lot of positive and negative images are given to train the model. LBP Linear Binary Pattern is used for feature extraction. After the classifier is trained next step is to detect whether the rider is wearing a helmet or not.

Advantage

- There is the concern that storing information could lead to data leaks and theft, or misuse of their personal information.
- People also dislike the idea of their whereabouts being known at all times.

Disadvantages

- People also dislike the idea of their whereabouts being known at all times.
- The lack of manned surveillance, bad weather or any kind of hindrances and obstructions can make automatic number plate recognition systems ineffective. In such cases, the security measures may go kaput.

CHAPTER 3

SYSTEM ANALYSIS

3.1. Existing System

- The Existing system is using SVM algorithm,It is used for detecting people's wearing helmat or not.

- 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 , time and not properly accurate.For non helmet riders manual fine method is used this may take time and can’t fine many people’s.

Disadvantage

- Initial investments are so high.

- Need more amount of manpower for existing system.

- Camera costs are high and accuracy depands on open camera quality,range.

- Lack of weather condition to identify the vechile such as rainy time.

3.2. Proposed system

- The annotated images are given as input to YOLOv3 model to train for the custom classes. The weights generated after training are used to load the model.Once this is done, an video is given as input. From this we obtain the information regarding person riding motorbike.

- If the person is not wearing a helmet, then we can easily extract the other class information of the rider. This can be used to extract the license plate. Once the helmetless rider is detected, the associated person class is detected.

- This is done by finding whether the co-ordinates of the no helmet class lie inside the person class or not. Similarly, the same steps are followed to detect the associated motorbike and license plate. Once the coordinates of the License plate are found, it is cropped and saved as a new image.

Advantage

- Our system reduce manpower and makes easier.

- Accuratly detect the people who not wearing helmat.

- Accuracy 90% number plate and 92% helmet detectioning.

- In our project fine system is introduced direct image capture in realtime and message sent to our telegram**.**

CHAPTER 4

DESCRIPTION OF TECHNOLOGY & ALGORITHM

4.1. Machine Learning

Machine learning enacts the way humans act with the help of data and algorithms. “Machine learning, also known as ML, deals with the branch of computer science and artificial intelligence .” Using the statistical method, the predictions are made, by training the algorithms, which further uncover the insights in the mining project which deals with data. The obtained insights are helpful in the businesses' decision-making and also help expand the growth of the business, which directly increases the value of the business.The data scientist generally deals with all the work which includes insights, and insights help the business to grow economically and also technically. Machine learning is furtherconsidered as the subfield of deep learning. The machine learning algorithms are classified as Supervised Learning, Unsupervised Learning, and Reinforcement Learning.

Supervised Learning

Supervised learning has been tasked with access to Input values from defined external information and output values as specific class labels and the goal of the system is to assign new data to the appropriate classes. To predict the new classes, supervised learning uses the training labelled dataset $(x, y) \in X \times Y$, where x represents a data point and y is the corresponding true prediction for x. Supervised learning uses a set of variables to predict the output. The output variable acts as a supervisor that oversees the learning process of how future outcomes are predicted. Whereas Unsupervised learning is used to uncover and identify patterns and relationships in the data with no supervisor to check the validity of the output.

Classification tasks are supervised since they need ground truth information to build the model. It can detect the categorical output value once it has been trained, allowing the data to be divided into specified classes. The predictive model is known as a regression function when the output variable is continuous. For both, Supervised learning proved itself to be accurate and fast since it is already provided with the labelled training dataset.

Unsupervised Learning

Unsupervised learning is the process through which a computer learns without the assistance of a human. The algorithm is trained on a set of data that hasn't been labelled, classified, or categorized, and it's intended to operate on it without human intervention. Unsupervised learning seeks to restructure input data into new features or a group of comparable objects. Unsupervised learning seems to have no predetermined outcome. The system tries to find useful information from a large dataset. There are two different types of algorithms:

1. Clustering: Clustering, often referred cluster analysis, seems to be a machine-learning approach for categorizing unlabeled data into different groups. “A way of clustering data points into discrete clusters based on their similarity," is how it is defined. The objects with significant comparisons are grouped with those with little to no similarity [12]."

2. Association: A rule-based machine learning method for identifying interesting relationships between variables in huge databases is known as association rule learning [13]. Its goal is to use some interesting measures to detect strong rules found in databases. Association rules are used to figure out how or why particular objects are associated with a transaction involving many items.

Reinforcement Learning

The process of teaching ML models to make a set of judgments is known as reinforcement learning (RL). The agent gains the ability to do a task in an unpredictably complex environment. RL explains the ability to learn relationships between stimuli, actions, and the occurrences of pleasant or unpleasant events, known as rewards or punishments. The term "reinforcement" refers to the process of the reinforcer developing and reinforcing these associations, which includes both positive (positive reinforcers) and negative (negative reinforcers) reinforcers.

4.2. YOLOV3

- YOLO is an abbreviation for the term ‘You Only Look Once’. This is an algorithm that detects and recognizes various objects in a picture (in real-time). Object detection in YOLO is done as a regression problem and provides the class probabilities of the detected images.

- YOLO algorithm employs convolutional neural networks (CNN) to detect objects in real-time. As the name suggests, the algorithm requires only a single forward propagation through a neural network to detect objects.

- This means that prediction in the entire image is done in a single algorithm run. The CNN is used to predict various class probabilities and bounding boxes simultaneously.

- The YOLO algorithm consists of various variants. Some of the common ones include tiny YOLO and YOLOv3.

Important of YOLOV

YOLO algorithm is important because of the following reasons:

Speed: This algorithm improves the speed of detection because it can predict objects in real-time.

High accuracy: YOLO is a predictive technique that provides accurate results with minimal background errors.

Learning capabilities: The algorithm has excellent learning capabilities that enable it to learn the representations of objects and apply them in object detection.

YOLO algorithm works

YOLO algorithm works using the following three techniques:

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

Applications of YOLO

YOLO algorithm can be applied in the following fields:

Autonomous driving: YOLO algorithm can be used in autonomous cars to detect objects around cars such as vehicles, people, and parking signals. Object detection in autonomous cars is done to avoid collision since no human driver is controlling the car.

Wildlife: This algorithm is used to detect various types of animals in forests. This type of detection is used by wildlife rangers and journalists to identify animals in videos (both recorded and real-time) and images. Some of the animals that can be detected include giraffes, elephants, and bears.

Security: YOLO can also be used in security systems to enforce security in an area. Let's assume that people have been restricted from passing through a certain area for security reasons. If someone passes through the restricted area, the YOLO algorithm will detect him/her, which will require the security personnel to take further action.

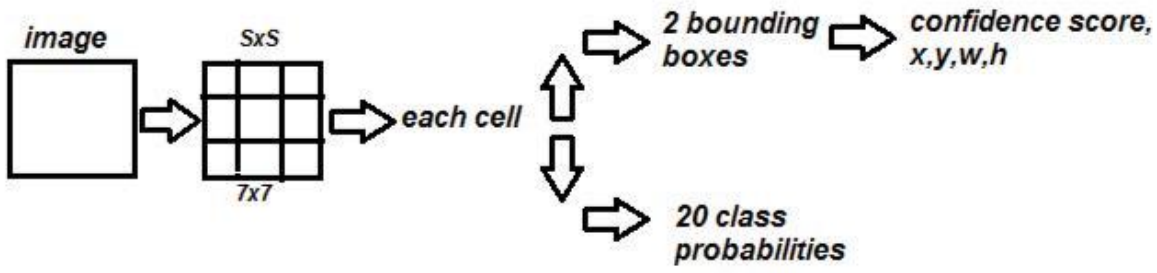


FIG 4.2

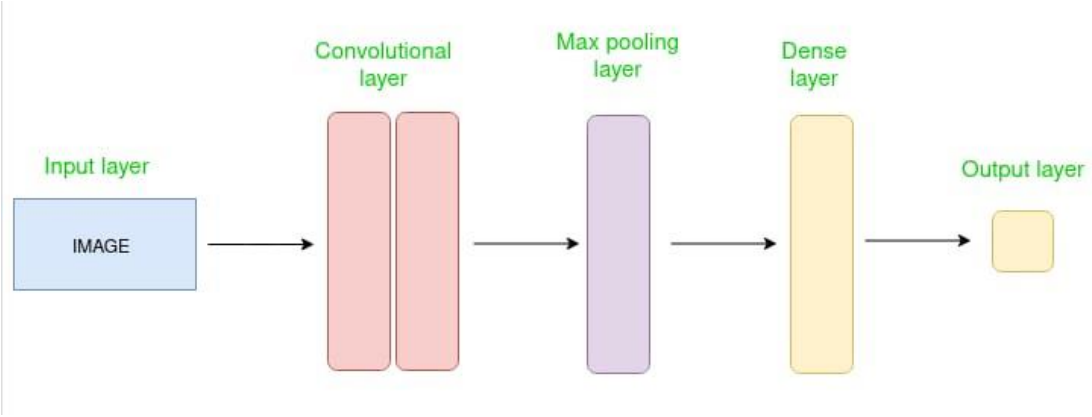
4.3. Convolutional Neural Network

Convolutional Neural Network (CNN)

- CNN is a kind of network architecture for deep learning algorithms and is specifically used for image recognition and tasks that involve the processing of pixel data. There are other types of neural networks in deep learning, but for identifying and recognizing objects, CNNs are the network architecture of choice.

- CNN is an efficient recognition algorithm which is widely used in pattern recognition and image processing. CNNs do not require human supervision for the task of identifying important features.

- They are very accurate at image recognition and classification. Weight sharing is another major advantage of CNNs. Convolutional neural networks also minimize computation in comparison with a regular neural network.



Purpose of CNN

- Convolutional neural network (CNN or ConvNet) is a network architecture for deep learning that learns directly from data.

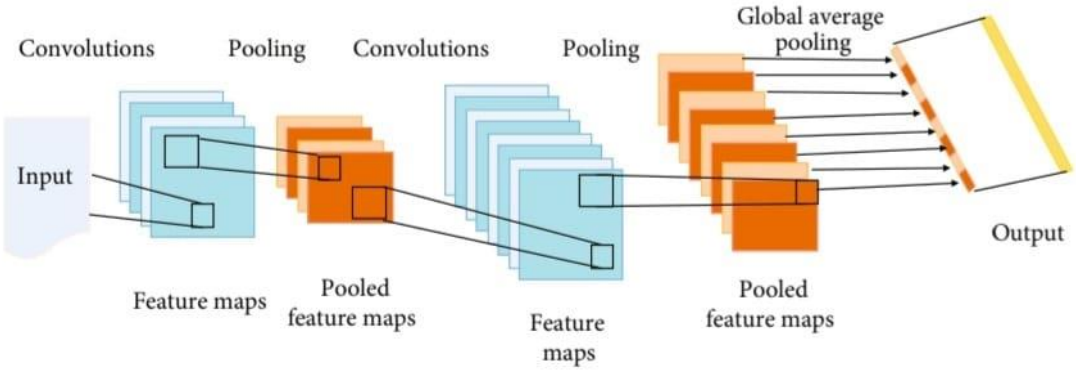
- CNNs are particularly useful for finding patterns in images to recognize objects, classes, and categories. They can also be quite effective for classifying audio, time-series, and signal data.

CNNs for Video Analytics

- To better understand how CNNs work, let's look at an example of CNNs used for video analytics, a process in which CNN-based computer vision models analyze captured video and extract actionable insights.
- Computer vision is a subfield of both deep and machine learning that combines cameras, edge- or cloud-based computing, software, deep learning, and CNNs to form neural networks that guide systems in their image processing and analysis. Once fully trained, computer vision models can perform object recognition and detection and even track movement. For this video analytics example, let's assume the input data is a set of millions of images of cars.
- Convolutional layers apply filters to the input data and learn feature detections. Typically, there are multiple convolutional layers connected via pooling layers.
- The early convolutional layers extract general or low-level features, such as lines and edges, while the later layers learn finer details or high-level features, such as car headlights or tires. Pooling layers decrease the size of the convolutional feature map to reduce the computational costs.
- Fully connected layers learn global patterns based on the high-level features output from the convolutional and pooling layers and generate the global patterns for cars. Once the input data is passed through the fully connected layer, the final layer activates the model, and the neural network issues its predictions.

How Do CNNs Work?

- Convolutional neural networks work by ingesting and processing large amounts of data in a grid format and then extracting important granular features for classification and detection.
- CNNs typically consist of three types of layers: a convolutional layer, a pooling layer, and a fully connected layer. Each layer serves a different purpose, performs a task on ingested data, and learns increasing amounts of complexity.



Application of CNN

- CNNs do not require human supervision for the task of identifying important features. They are very accurate at image recognition and classification.

- Weight sharing is another major advantage of CNNs. Convolutional neural networks also minimize computation in comparison with a regular neural network.

CHAPTER 5
BLOCK DIAGRAM

5.1. ARCHITECTURE

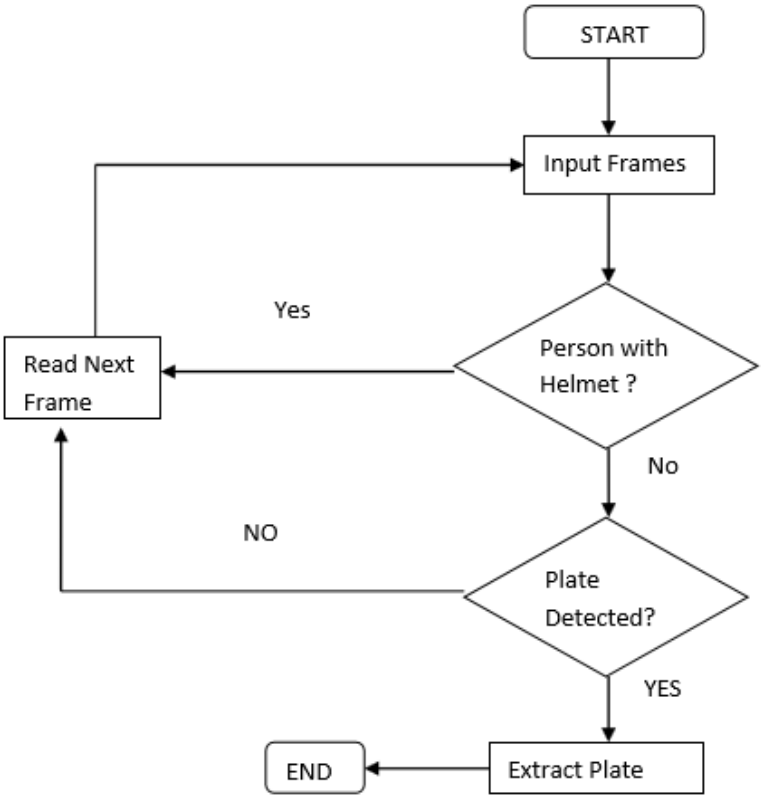


FIG 5.1

First our system get video as input then into the frames and descisioning the person wear helmet or not, then the person without helemet automatically recognize the number plate and make alert.

The input and output diagram in input the image acquisition equipments are video, scanner this is further processed and it is displayed in the computer monitor and which are stored in optical discs, video tape.

5.2. DATAFLOW DIAGRAM

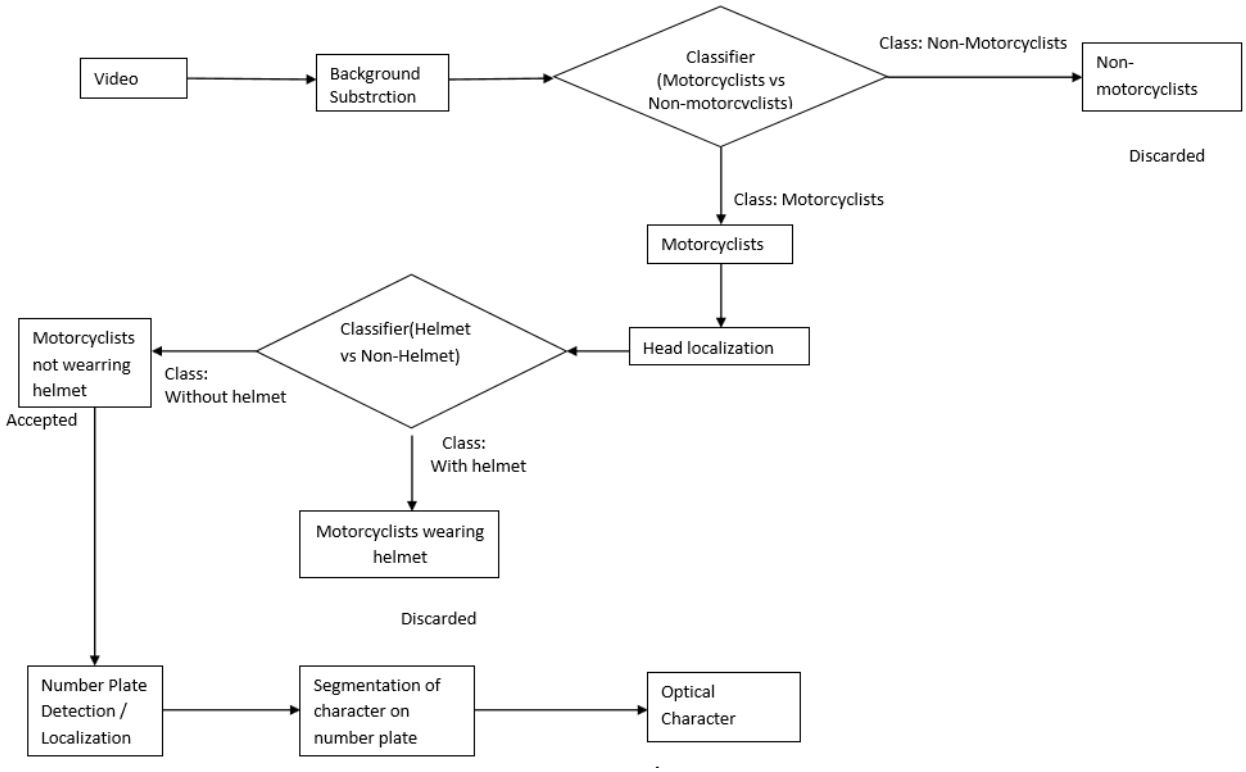


FIG 5.2

Structure design is an applicable model that characterizes the framework's structure and behavior. This includes the frame pieces and the relationship explaining how they work together to modify the overall structure.

epicts the basic system architecture which includes the input image as a video through camera and this image is processed and if any violations then helmet Automatic Tracking of Traffic Violations Using yolov Machine Learning all detected

CHAPTER 6
SYSTEM SPECIFICATION

6.1. HARDWARE SPECIFICATION

The below Hardware Specifications were used in both Server and Client machines when developing.

Processor	:	Intel(R) Core(TM) i3
Processor Speed	:	3.06 GHz
RAM	:	4 GB
Camera	:	1080p
Monitor	:	“17” inch

6.2. SOFTWARE SPECIFICATION

The below Hardware Specifications were used in both Server andClient machines when developing**.**

- Open CV
- Phython 3

Python language is being used worldwide as a wide extent of use headway and system improvement programming language. Colossal brands and web searcher are using python programming to make their task more straightforward. It is flexible, strong and far reaching**.**

6.3. FUNCTIONAL REQUIREMENT

- System should catch the number plate of the vehicle
- System should refresh the violation report to framework.
- System ought to naturally identify the number plate of vehicle
- System should naturally sending the update message to the proprietor of the vehicle of the infringement

NON FUNCTIONAL REQUIREMENT

Usability:

Easy Interface for catch of picture and Updated in the cloud

Dependability:

Capture the low light effectively , Violation Filing.

Execution:

Should not take unnecessary time in handling the caught picture and preparing it.

Supportability

Contain straightforward code with arrangements for future improvement.

CHAPTER 7

SYSTEM DESIGN

System configuration is the procedure for characterizing a framework's architecture, parts, components, interfaces, and information to fulfill the specified preconditions. Configuration of frameworks could be interpreted as using the theory of frameworks to advance objects. The study and techniques situated in Article develop into the most commonly used methods for the design of PC frameworks. In this way, the configuration of frameworks is the way to characterize and build frameworks to meet the client's defined needs. The UML has become the standard language in object situated investigation and structure.

7.1. System Architecture

Structure design is an applicable model that characterizes the framework's structure and behavior. This includes the frame pieces and the relationship explaining how they work together to modify the overall structure**.**

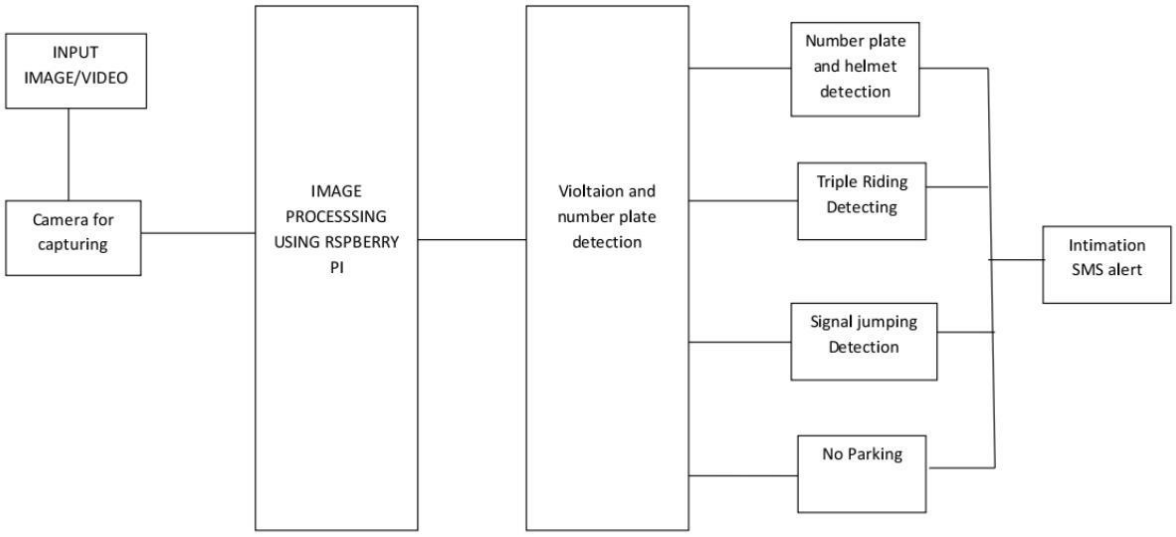


FIG 7.1

depicts the basic system architecture which includes the input image as a video through camera and this image is processed and if any violations then helmet, triple riding, signal , Automatic Tracking of Traffic Violations Using yolov and CNN, Machine Learning all detected.

7.2. Input and Output Design

The input and output diagram in input the image acquisition equipments are video, scanner this is further processed through it is displayed in the computer monitor and which are stored in optical discs, video tape and discs.

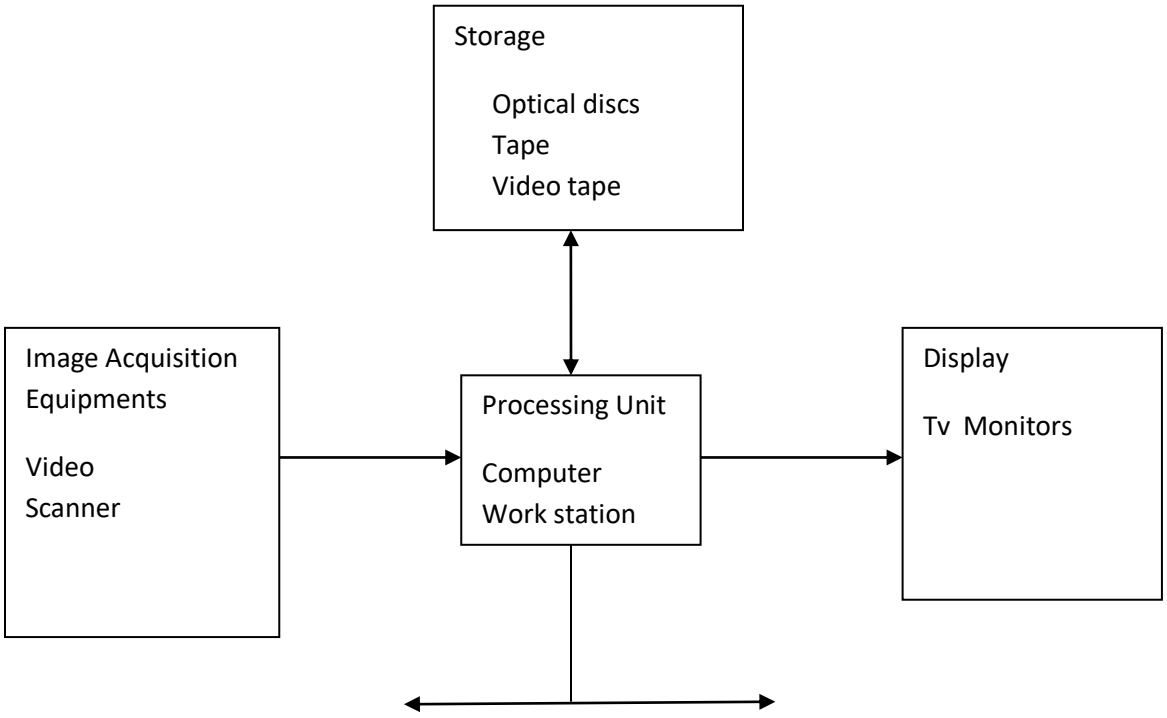


FIG 7.2

During the organized stage, the point of view on the application made during the raised level arrangement is isolated into modules and tasks. Justification design is cultivated for each program and a while later recorded as program points of interest. For each program, a unit test plan is made.

CHAPTER 8

SYSTEM TRAINING & TESTING

8.1. Training the Model

At first, the dataset which is split into train and test datasets in the previous stage is taken for training the algorithms.Training of the YOLOv3 algorithm is done using darknet, an open-source neural network training platform. The Darknet is set up using OpenCV, which is useful for viewing and detecting pictures without storing them. The data should be pre-processed for object detection before training; the data can be in any of these formats '.txt' or '.xml', however for YOLOv3 '.txt' format should be utilized. The dataset should be divided into two files they are train.txt and test.txt, these files contain the images of helmets and license plates of motorcycles for training the model and another for testing the model.Training of the Haar cascade classifier is done using the Trainer GUI toolHere, we have created a folder named for training the classifier. All the positive and negative images that are processed and split into a trained dataset and test dataset in the data preprocessing step are now used to train the classifier. A lot of positive images i.e., images of helmets and license plates of motorcycles are placed in the 'p' folder. Similarly, a lot of negative images of the helmets and license plates are placed in the 'n' folder. Now, open the Trainer GUI tool and browse the folder path in the Train tab. In the Common tab set the number of stages to 20. The Boost tabs are set accordingly. Now press the start button, which is located at the bottom, allowing us to start training the Classifier. After the training gets completed, a new folder named ' is created in the folder**.**

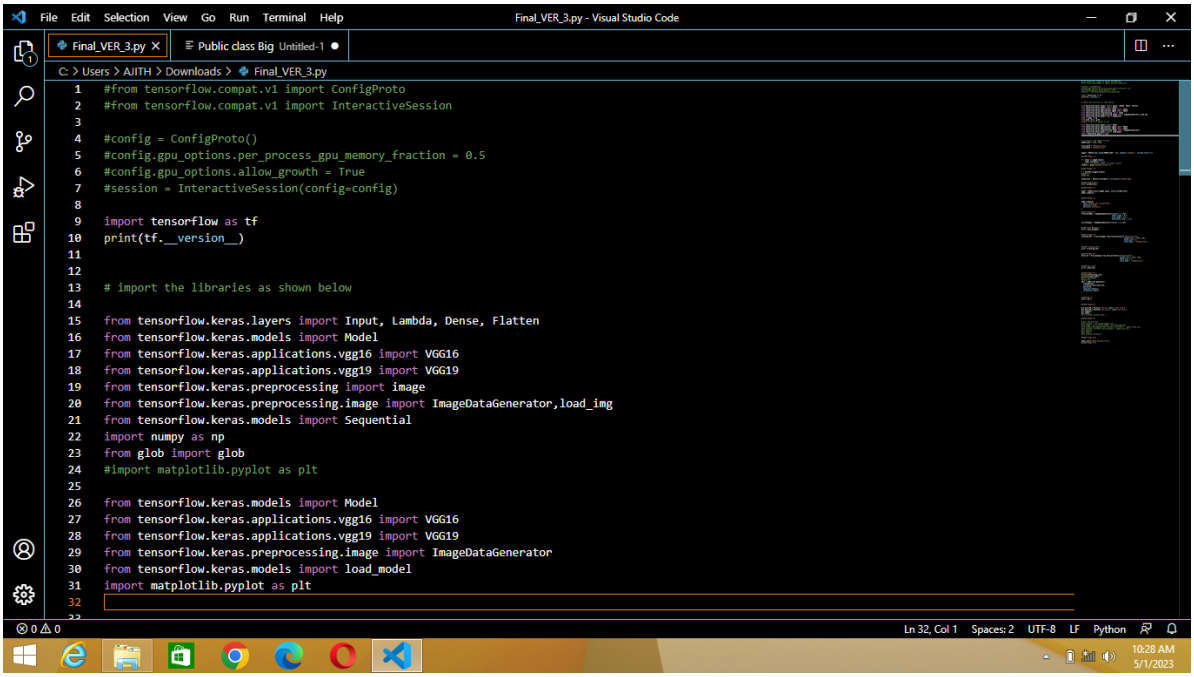


FIG 8.1.1

Helmet Positive and Negative Sample

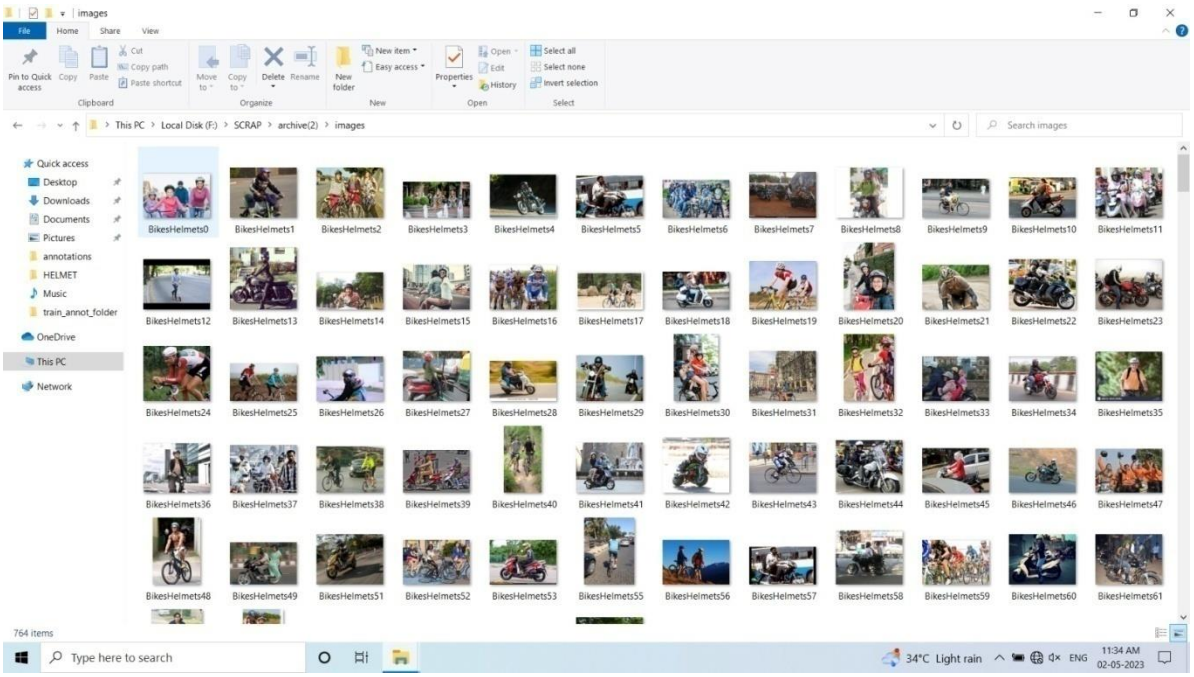


FIG 8.1.2

8.2. Testing the model

Testing

Testing is the method of testing a system or its components with the intention of deciding whether it meets the specified specifications or not. Testing involves running a program to detect any holes, bugs or incomplete specifications which contradict the actual requirements.

Testing Principle

A software engineer must grasp the fundamental theory that drives the software testing before implementing methods to design successful test cases. All the results will be traceable according to consumer needs.

Testing Methods

There are various methods which can be used for evaluating applications. They are

1. Black-Box Testing
2. White-Box Testing

1. Black-Box Testing

The research technique is called black-box testing without understanding the implementations of the inner workings. The tester does not know the architecture of the framework, and has no access to the source code. Typically, when running a black-search, a tester may interact with the device's user interface, presenting inputs and evaluating outputs without knowing how and where the inputs are being processed.

2. White-Box Testing

White-box testing is a thorough study of the internal logic and the structure of the code. White-testing is also called glass testing or open-testing. A tester needs to learn the internal workings of the code to do the white-box testing on an application. To assess which unit / chunk of code is behaving inadequately, the tester will look inside the source code.

Manual and Automated Testing

Manual Testing

This is a type of black-box testing, to be evaluated based on the software requirements. The application is reviewed by providing feedback, and it then discusses the results that need to conform to the functionality for which it was designed. Manual software testing is performed on a complete, integrated system to determine the system's compliance with its specified specifications. When testing a function program there are 5 steps involved.

- Determining the features to be exercised by the intended program.
- Production of test data according to application requirements.
- Quality based on the specifications of the test data and the program.
- Drawing up test scenarios and running test cases.
- Review of real and anticipated outcomes, based on the performed test cases.

Automated Testing

Testing an application from its automated attributes is based on this section. Automated testing includes testing software from non-functional specifications, but essential in nature such as performance, protection, user interface, etc. Testing can be performed at various SDLC rates.

Unit Testing

Unit testing is a software development process in which the smallest testable parts of an program, called units, are tested individually for proper functioning. Unit monitoring is often automated but can be performed manually, too. The aim of unit testing is to isolate each part of the system, and to demonstrate that the specifications and functionality of individual components are right. Thetables detail test cases and measurements.

Unit testing benefits

- Unit testing improves trust that code is changed / maintained.
- Development is faster.
- The cost of repairing a defect found during device testing is lower than that of higher-level found defeats
- Easy to debug.
- Codes are more reliable.

S1 #Test Case: -	UTC-1
Name of Test: -	Image Capture and Helmet Detection
Items being tested: -	Helmet Detection
Sample Input: -	Image
Expected output: -	Helmet should be detected
Actual output: -	Detection of helmet is done successfully
Remarks: -	Pass

FIG 8.2

CHAPTER 9

SYSTEM IMPLEMENTATION

Utilization is the affirmation of an application or execution of a course of action, thought, model, plan, specific, standard, estimation, or system. In that capacity, Use is a declaration of a computer, programming or other PC process through programming and programming action. There may be different executions for a given insurance or standard.

Data Collection

Smart Camera:

The sharp camera contains a twofold processor which enables the camera to work honorably with applications, for example, design coordinating, optical character affirmation and data organize code continuously. The whole plan conveys significant standards diminish scale pictures which are indispensable for the execution of the persistent eye following estimation. Exactly when the sagacious camera is related through FTP or Ethernet hard drive, the data would then have the option to be moved to various devices. In this venture we are utilizing web camera to illustrate.

Python OpenCV

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use

of machine perception in the commercial products.

OpenCV is a Python library that allows you to perform image processing and computer vision tasks. It provides a wide range of features, including object detection, face recognition, and tracking.

- Vision capabilities of OpenCV
- Real-time object detection. ...
- Image segmentation. ...
- Movement and gesture recognition. ...
- Face Recognition

Recognition or object detection in the image

```
# Import OpenCV module.

import cv2.

# Import pyplot from matplotlib as plt.

from matplotlib import pyplot as pltd.

# Opening the image from files.

imaging = cv2. imread("opencv-od. png")

# Altering properties of image with cv2.

imaging_gray = cv2. cvtColor(imaging, cv2
```

Features of OpenCV Library

- Read and write images.
- Capture and save videos.
- Image processing such as filtering and transformation.
- Feature detection.
- Video or image object detection such as human body parts, cars, signage, etc. Video analysis.

Tensorflow

Tensorflow is Google's Open Source Machine Learning Platform for programming data flow over a count of tasks. Hubs refer to numerical functions, while the edges of the diagram speak to the multi-dimensional points of information (tensors) within them.

Tensors are simply multidimensional clusters, an enlarge to information with a higher measurement of 2-dimensional tables. Tensorflow's numerous highlights make it suitable for profound learning. By burning through whenever, along these lines, how do we interpret how we can perform object detection using Tensorflow.

What is YOLO and for what reason is it Useful?

The R-CNN group of strategies we found in Part 1 fundamentally use districts to confine the articles inside the picture. The system doesn't take a gander

at the whole picture, just at the pieces of the pictures which have a higher possibility of containing an article.

The YOLO system (You Only Look Once) then again, manages object recognition in an alternate way. It takes the whole picture in a solitary case and predicts the bouncing box arranges and class probabilities for these containers. The greatest favorable position of utilizing YOLO is its eminent speed – it's fantastically quick and can process 45 casings for each second. YOLO additionally comprehends summed up object portrayal.

CHAPTER 10

RESULT AND DISCUSSION

The Convolutional Neural Networks (CNN) is also trained using the training datasets of Helmets and License plates, then the model is tested using the test datasets. The detection results of the Convolutional Neural Networks (CNN) model.Who not wearing the helmet they captured and send message alert (No Helmet) to our telegram bot. Then , they punished or fined by police office.

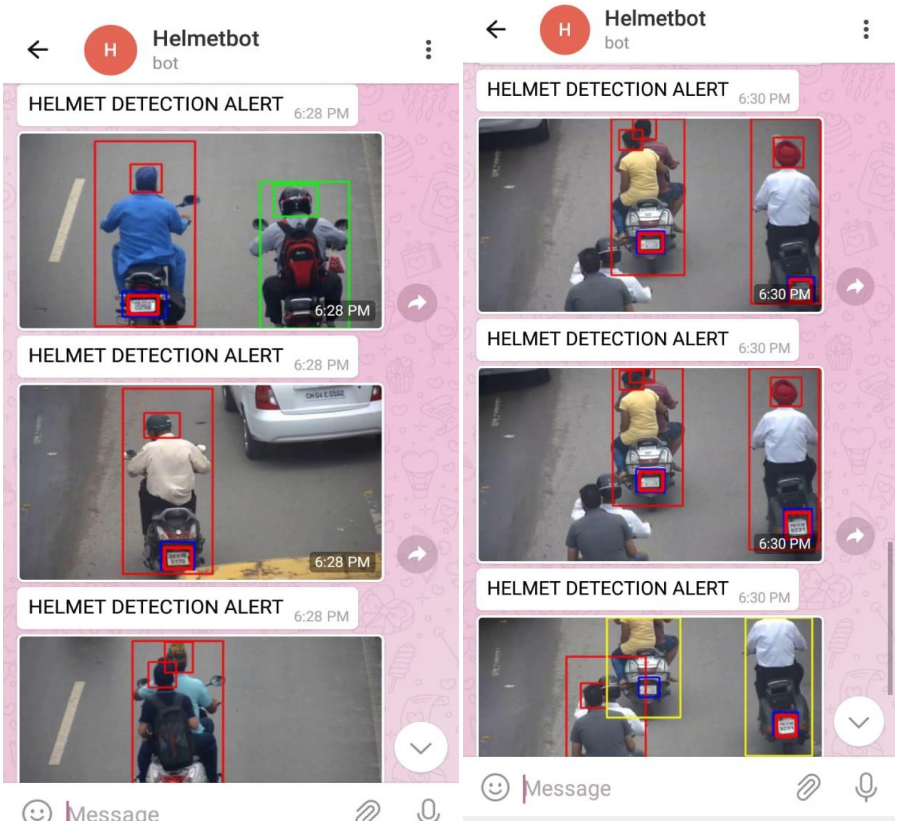


FIG 10.1

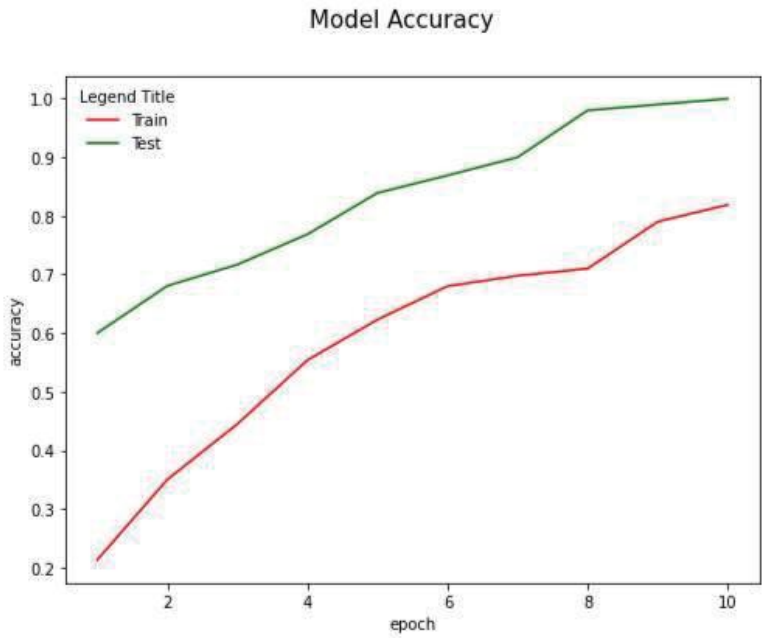
The detections of helmets from the images taken from the datasets using the trained Convolutional Neural Networks (CNN) model are represented in the confusion matrix along with their real values.

Here the accuracy of the helmet detection is calculated using the same formula,

$$\text{Accuracy} = \frac{T1+T2}{T1+T2+T3+T4}$$

$$\text{Accuracy} = \frac{83+85}{83+83+7+5}$$

$$\text{Accuracy} = 0.92$$



Accuracy obtained for helmet detection using the Yolov3 model is 92%

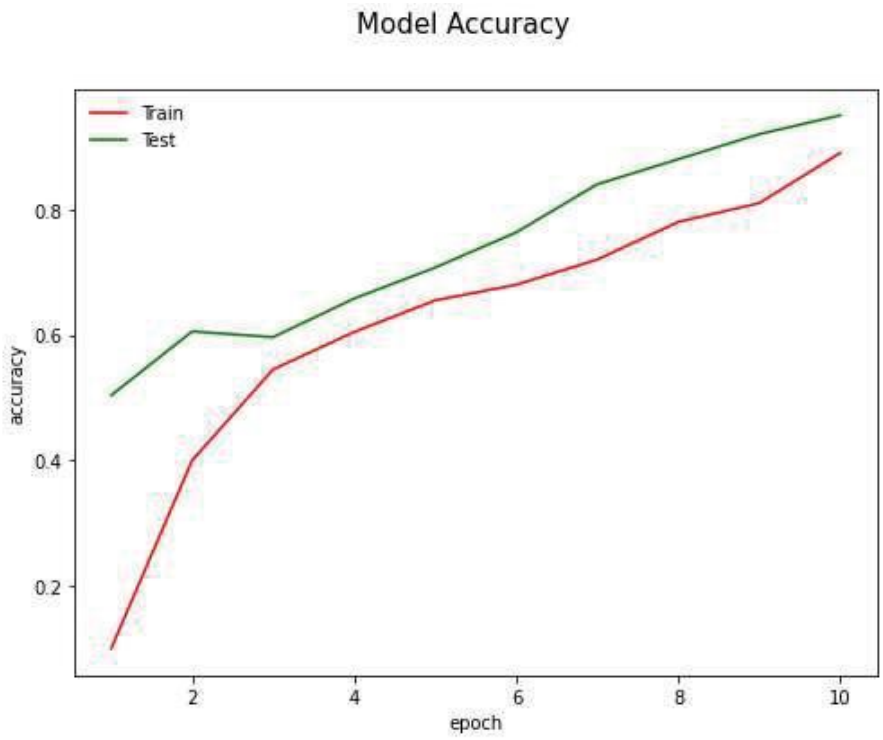
Similarly, the accuracy for the license plate using the Convolutional Neural Networks (CNN) is as follows:

$$\text{Accuracy} = \frac{T1+T2}{T1+T2+T3+T4}$$

$$\text{Accuracy} = \frac{60+45}{60+45+15+30}$$

$$\text{Accuracy} = 0.90$$

The accuracy obtained for License Plates detection using the Convolutional Neural Networks is 90%.



CHAPTER 11

CONCLUSION AND FUTURE SCOPE

11.1. Conclusion

In this thesis, we compared the helmet and license plate detection models using the algorithms YOLOv3 and Convolutional Neural Networks (CNN). The US License Plate and Helmet Detection datasets are used to train the models. Here to compare the two algorithms, a confusion matrix is used for better understanding. The confusion matrix represents the detection results of the models of helmets and license plates. In addition, using the confusion matrix table of the trained models the accuracy is also calculated. Although the algorithms are relatively similar, some variances reflect the accuracy and complexity of the trained models.

When compared to the YOLOv3, the CNN is more complicated. The methods take approximately the same amount of time; however, the The YOLOv3 train set is comparable and very simple. . Deep learning relies heavily on the trained set. If we train the model using a greater number of images then even Convolutional Neural Networks (CNN) may also achieve more accuracy.

11.2. Future Scope

Though the results obtained satisfied the research goal but the research can be expanded further. Till now we have detected whether the riders are wearing helmets or not, we can implement a similar system which stores the license plate details of the motorcycles. If riders do not wear the helmets and use the database details we can send an e-challan or warning message to the riders. And also, in our thesis we have limited to only one performance metric i.e., accuracy, we can expand this thesis further by including more performance metrics, which gives us a more efficient algorithm

CHAPTER 12

APPENDIX

12.1. SOURCE CODE

```
import cv2

import numpy as np

import random

import os

from PIL import Image

import time

import imutils

import telepot

from tensorflow.keras.models import load_model

token = '6199878006:AAFcjwAYiEGH5eAiA1x2dUpabggFiYTsTa8' # telegram token

receiver_id = 1838134505 # https://api.telegram.org/bot<TOKEN>/getUpdates

bot = telepot.Bot(token)

os.environ['TF_FORCE_GPU_ALLOW_GROWTH'] = 'true'

net = cv2.dnn.readNet("yolov3-custom_7000.weights", "yolov3-custom.cfg")

net.setPreferableBackend(cv2.dnn.DNN_BACKEND_CUDA)
```

```
net.setPreferableTarget(cv2.dnn.DNN_TARGET_CUDA)
model = load_model('helmet-nonhelmet_cnn.h5')
print('model loaded!!!')
#cap = cv2.VideoCapture(1)
cap = cv2.VideoCapture('video.mp4')
COLORS = [(0,255,0),(0,0,255)]
##fourcc = cv2.VideoWriter_fourcc(*"XVID")
##writer = cv2.VideoWriter('output.avi', fourcc, 5,(888,500))
###writer = cv2.VideoWriter('output.avi',(frame.shape[1], frame.shape[0]))
##writer.open()
def helmet_or_nohelmet(helmet_roi):
    try:
        helmet_roi = cv2.resize(helmet_roi, (224, 224))
        helmet_roi = np.array(helmet_roi,dtype='float32')
        helmet_roi = helmet_roi.reshape(1, 224, 224, 3)
        helmet_roi = helmet_roi/255.0
        return int(model.predict(helmet_roi)[0][0])
    except:
            pass
```

```
layer_names = net.getLayerNames()
#output_layers = [layer_names[i[0] - 1] for i in net.getUnconnectedOutLayers()]
output_layers = [layer_names[i - 1] for i in net.getUnconnectedOutLayers()]
ret = True
while ret:
    ret, img = cap.read()
    img = imutils.resize(img,height=500)
    # img = cv2.imread('test.png')
    height, width = img.shape[:2]
    blob = cv2.dnn.blobFromImage(img, 0.00392, (416, 416), (0, 0, 0), True, crop=False)
    net.setInput(blob)
    outs = net.forward(output_layers)
    confidences = []
    boxes = []
    classIds = []
    for out in outs:
        for detection in out:
            scores = detection[5:]
```

```
        class_id = np.argmax(scores)
        confidence = scores[class_id]
        if confidence > 0.3:
            center_x = int(detection[0] * width)
            center_y = int(detection[1] * height)
            w = int(detection[2] * width)
            h = int(detection[3] * height)
            x = int(center_x - w / 2)
            y = int(center_y - h / 2)
            boxes.append([x, y, w, h])
            confidences.append(float(confidence))
            classIds.append(class_id)
indexes = cv2.dnn.NMSBoxes(boxes, confidences, 0.5, 0.4)
for i in range(len(boxes)):
    if i in indexes:
        x,y,w,h = boxes[i]
        color = [int(c) for c in COLORS[classIds[i]]]
        # green --> bike
        # red --> number plate
```

```
        if classIds[i]==0: #bike
            helmet_roi = img[max(0,y):max(0,y)+max(0,h)//4,max(0,x):max(0,x)+max(0,w)]
        else: #number plate
            x_h = x-60
            y_h = y-350
            w_h = w+100
            h_h = h+100
            cv2.rectangle(img, (x, y), (x + w, y + h), color, 7)
            # h_r = img[max(0,(y-330)):max(0,(y-330 + h+100)) , max(0,(x-80)):max(0,(x-80 + w+130))]
            if y_h>0 and x_h>0:
                h_r = img[y_h:y_h+h_h , x_h:x_h +w_h]
                c = helmet_or_nohelmet(h_r)
                print('helmet or no-helmet')
                print(c)
##                 if c == 1:
##                     cv2.imwrite('test.jpg', img)
##                     bot.sendMessage(receiver_id, 'NO HELMET') # send a activation message to telegram receiver id
```

```
##                    bot.sendPhoto(receiver_id, photo=open('test.jpg', 'rb')) # send message to telegram

                cv2.putText(img,['helmet','no-helmet'][c],(x,y-100),cv2.FONT_HERSHEY_SIMPLEX,2,(0,255,0),2)

                 cv2.rectangle(img, (x_h, y_h), (x_h + w_h, y_h + h_h),(255,0,0), 10)

   #writer.write(img)

  cv2.imshow("Image", img)

   if cv2.waitKey(1) == 27:

      break

writer.release()

cap.release()

cv2.waitKey(0)

cv2.destroyAllWindows()
```

TRAINNING CODE

```
#from tensorflow.compat.v1 import ConfigProto
#from tensorflow.compat.v1 import InteractiveSession

#config = ConfigProto()
#config.gpu_options.per_process_gpu_memory_fraction = 0.5
#config.gpu_options.allow_growth = True
#session = InteractiveSession(config=config)

import tensorflow as tf
print(tf.__version__)



# import the libraries as shown below

from tensorflow.keras.layers import Input, Lambda, Dense, Flatten
from tensorflow.keras.models import Model
from tensorflow.keras.applications.vgg16 import VGG16
from tensorflow.keras.applications.vgg19 import VGG19
from tensorflow.keras.preprocessing import image
from tensorflow.keras.preprocessing.image import ImageDataGenerator,load_img
from tensorflow.keras.models import Sequential
import numpy as np
from glob import glob
#import matplotlib.pyplot as plt
```

```
from tensorflow.keras.models import Model
from tensorflow.keras.applications.vgg16 import VGG16
from tensorflow.keras.applications.vgg19 import VGG19
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.models import load_model
import matplotlib.pyplot as plt



# re-size all the images to this
IMAGE_SIZE = [224, 224]

train_path = 'Datasets/train'
valid_path = 'Datasets/test'



vgg16 = VGG16(input_shape=IMAGE_SIZE + [3], weights='imagenet',
include_top=False)

print("Stage 1")

for layer in vgg16.layers:
    layer.trainable = False
 # useful for getting number of output classes
folders = glob('Datasets/train/*')

print("Stage 2")
```

```
x = Flatten()(vgg16.output)
print("x")
print (x)

prediction = Dense(len(folders), activation='softmax')(x)

print("prediction")
print (prediction)

print("Stage 3")

model = Model(inputs=vgg16.input, outputs=prediction)
model.summary()



print("Stage 4")

model.compile(
  loss='categorical_crossentropy',
  optimizer='adam',
  metrics=['accuracy']
)

print("Stage 5")
train_datagen = ImageDataGenerator(rescale = 1./255,
                                   shear_range = 0.2,
```

```
                        zoom_range = 0.2,
                        horizontal_flip = True)

test_datagen = ImageDataGenerator(rescale = 1./255)


print("test_datagen")
print (test_datagen)


print("Stage 6")
training_set = train_datagen.flow_from_directory('Datasets/train',
                                        target_size = (224, 224),
                                        batch_size = 4,
                                        class_mode = 'categorical')


print("training_set")
print (training_set)


print("Stage 7")
test_set = test_datagen.flow_from_directory('Datasets/test',
                                    target_size = (224, 224),
                                    batch_size = 4,
                                    class_mode = 'categorical')
```

```
print("test_set")
print (test_set)


print("Stage 7")
print(len(training_set))
print(len(test_set))
#NN.fit_generator
#model.fit
FE_r = model.fit_generator(
  training_set,
  validation_data=test_set,
  epochs=20,
  steps_per_epoch=2,
  validation_steps=2
)


print("FE_r")
print (FE_r)


print("Stage 8")

plt.plot(FE_r.history['loss'], label='train loss')
plt.plot(FE_r.history['val_loss'], label='val loss')
```

```
plt.legend()
plt.show()
#plt.savefig('LossVal_loss')

print("Stage 9")

# plot the accuracy
#plt.plimage = cv2.imread(image_file)
#lab_image = cv2.cvtColor(image, cv2.COLOR_BGR2LAB)
#cv2_imshow(lab_image)ot(FE_r.history['accuracy'], label='train acc')
#plt.plot(FE_r.history['val_accuracy'], label='val acc')
#plt.legend()
#plt.show()
#plt.savefig('accuracy')

print("Stage 10")

model.save('model_TCE_new_1.h5')
print("Stage 11")
```

12.2. SCREENSHOTS

12.2.1. Helmet.py

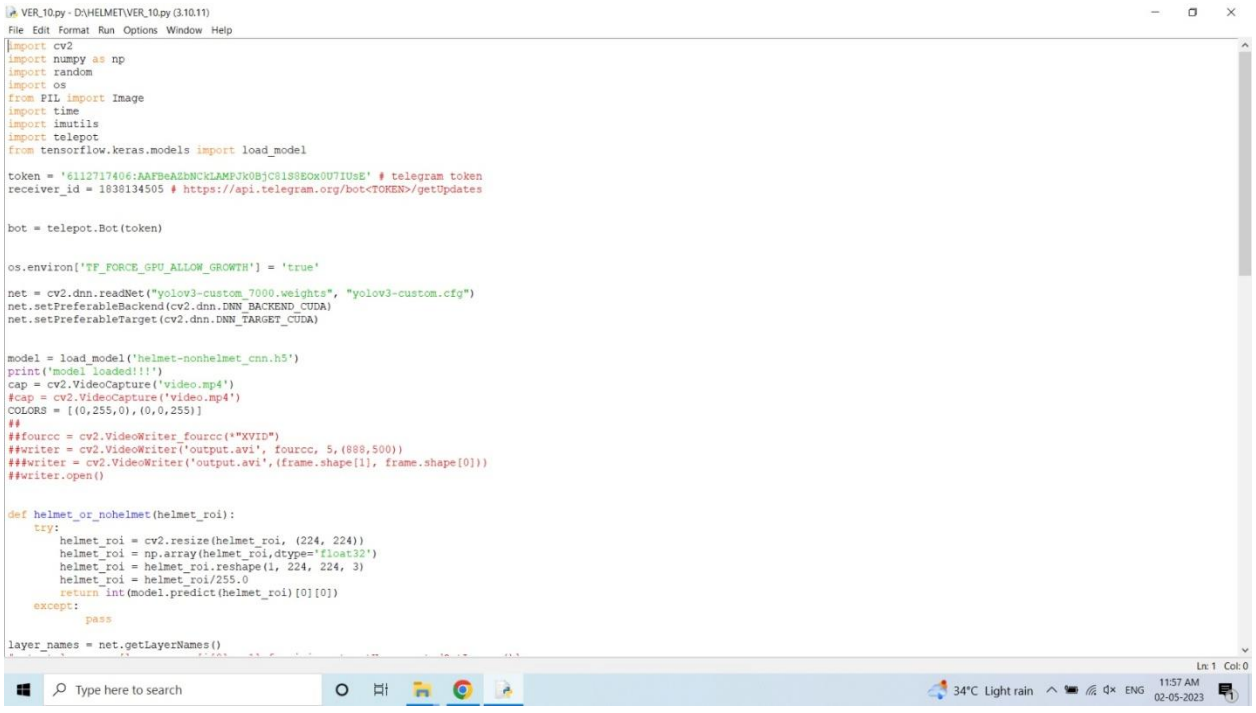


FIG 12.2.1

12.2.2. Input Load

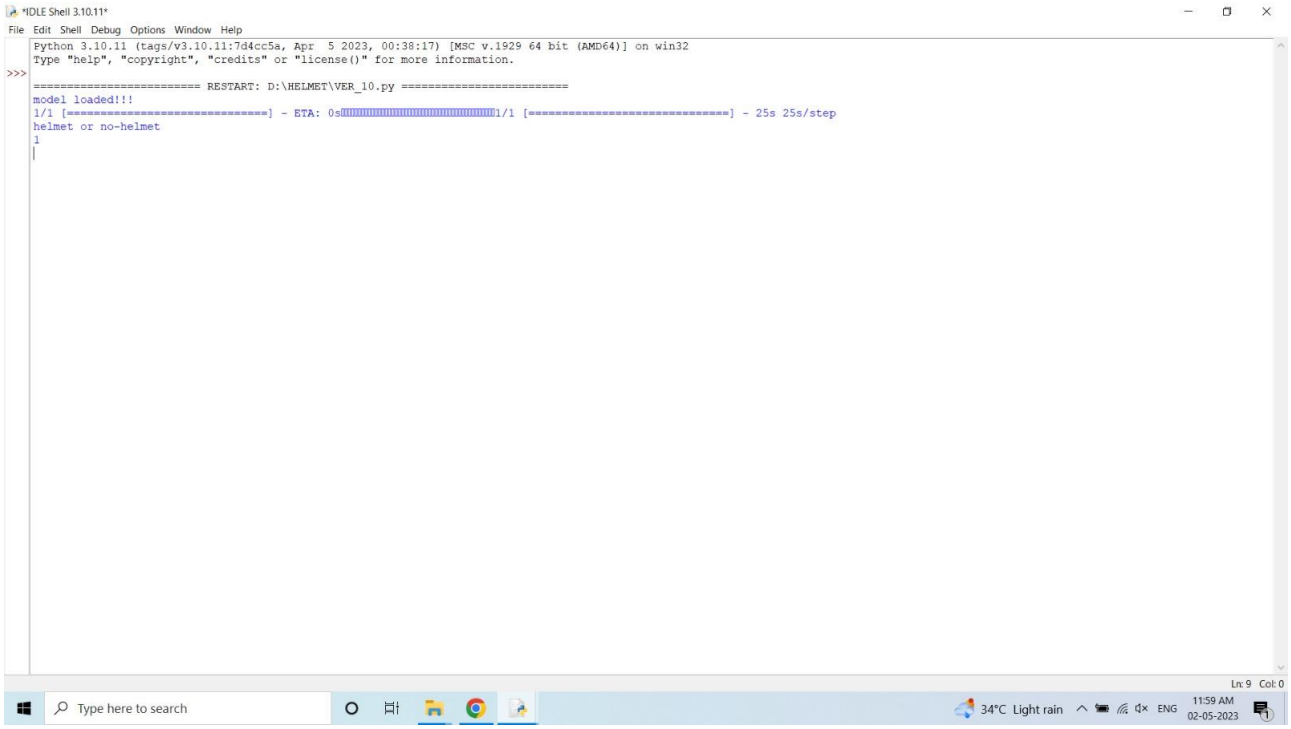


FIG 12.2.2

12.2.3. Segmenting Input

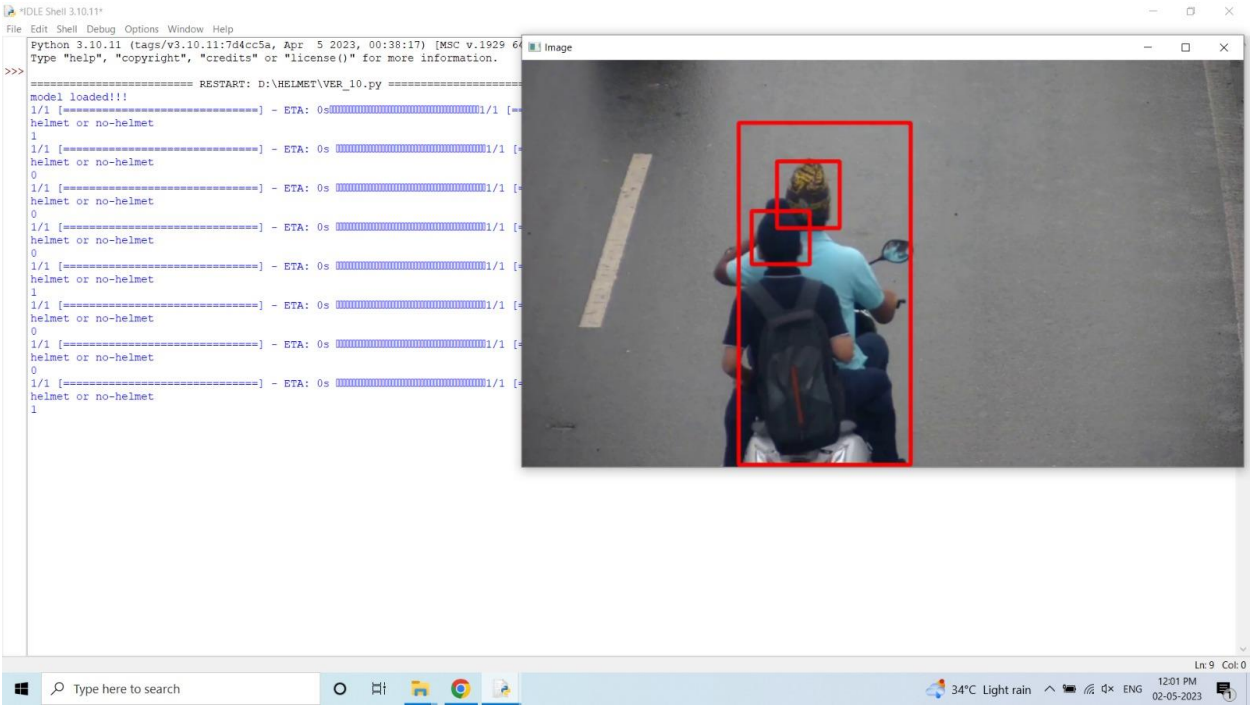


FIG 12.2.3

12.2.4. Extraction

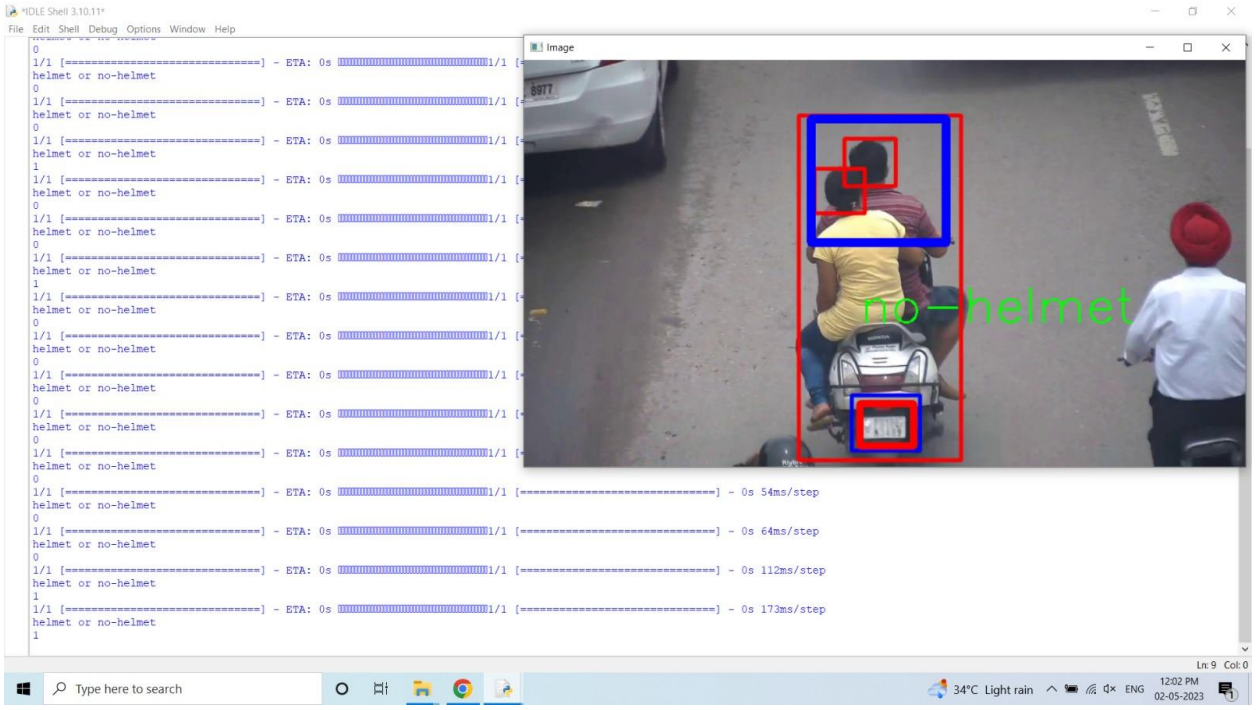


FIG 12.2.4

12.2.5. Creating new Bot

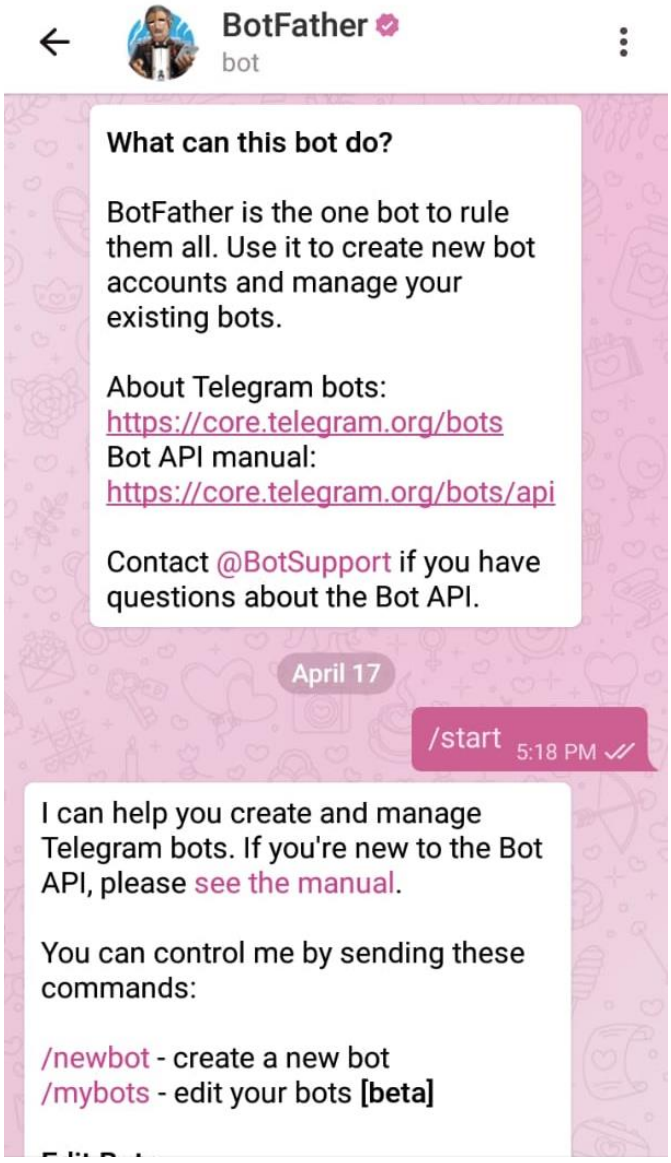


FIG 12.2.5

12.2.6. Alert bot Create

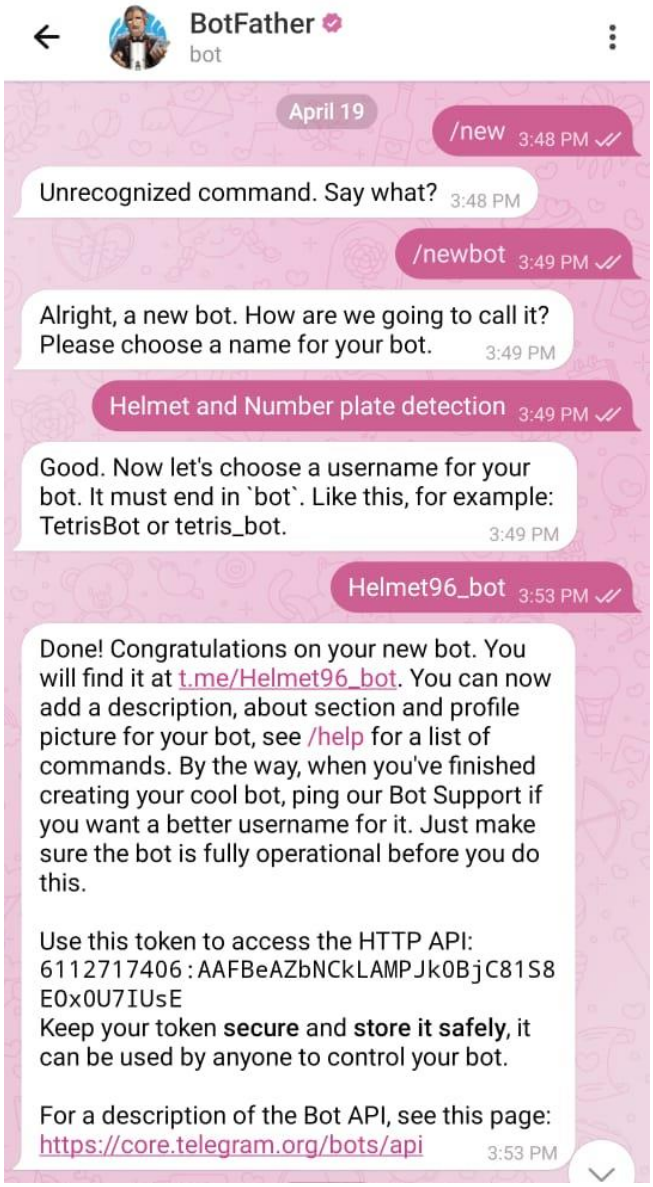


FIG 12.2.6

12.2.7. Alert Notification

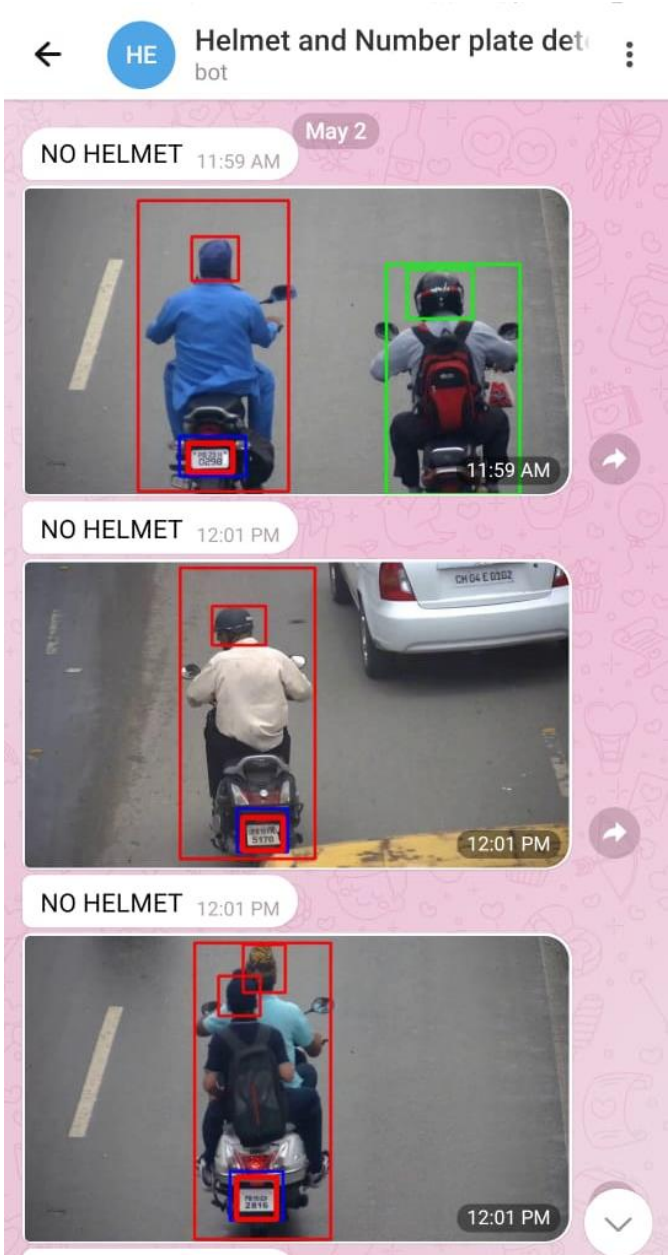


FIG 12.2.7

CHAPTER 14

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