Dissertation on

"Helmet Violation And Number Plate Detection System"

Submitted in partial fulfilment of the requirements for the award of degree of

Bachelor of Technology
in
Computer Science & Engineering

UE19CS390B – Capstone Project Phase - 2

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CERTIFICATE

This is to certify that the dissertation entitled

‘Helmet Violation And Number Plate Detection System’
is a bonafide work carried out by

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In partial fulfilment for the completion of sixth semester Capstone Project Phase - 2 (UE19CS390B) in the Program of Study -Bachelor of Technology in Computer Science and Engineering under rules and regulations of PES University, Bengaluru during the period June. 2022 – Nov. 2022. It is certified that all corrections / suggestions indicated for internal assessment have been incorporated in the report. The dissertation has been approved as it satisfies the 7th semester academic requirements in respect of project work.

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DECLARATION

We hereby declare that the Capstone Project Phase - 2 entitled **"Helmet Violation And Number Plate Detection System"** has been carried out by us under the guidance of Dr. Prajwala T.R, Associate Professor and submitted in partial fulfilment of the course requirements for the award of degree of **Bachelor of Technology** in **Computer Science and Engineering** of **PES University, Bengaluru** during the academic semester June - Nov 2022. The matter embodied in this report has not been submitted to any other university or institution for the award of any degree.

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ABSTRACT

Nowadays we can see that there are many road accidents happening and some of them also leading to death, most of them are motorcycle accidents. So we can reduce these accidents by wearing a helmet.

This project aims to automate a model that is able to find the two-wheeler vehicle riders who are not wearing the helmets in the traffic. Identifies motorbike helmet versus no helmet classification and also license plates recognition .Once motorbike is recognized determines whether the rider is having an helmet or the no helmet..If the rider is not having a helmet then the number plate of the motorbike is detected and also updates the details of the vehicle in the database and add fines.

The Machine learning algorithm used in this project is YOLO for identifying and detecting helmet.We will also extract the number plate of the vehicle by using OpenCV. For removing haziness and foggy images we use image enhancement techniques. So we use these different techniques to build better systems for the helmet detection and also extracting license/number plate numbers.

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CHAPTER-1

1. Introduction

In the current developing country like India where there is an increase in vehicles, most of the middle class economy range families prefer to ride a two-wheeler vehicle which is very reasonable for their financial status. While riding helmets most of the riders prefer not to wear helmets which increase the chances of death in times of accidents.

In the recent research that the government has conducted on the occurrence of road accidents the results/reports came out to be that most of the accidents are caused by the two wheelers and on further research it turned out to be that the deaths are caused because of the helmet's absence.

Even the current government has taken strict action regarding this helmet issue by assigning the traffic police the duty of capturing vehicles without helmets while riding a vehicle. But even in that case most of the time traffic police cannot capture all the vehicles that are not riding helmets. There is no accuracy or clarity in the images captured by the traffic policemen and a lot of images captured by the policemen were of no use.

So we intend to develop a model/project that focuses mainly on this incidents by penalising the riders or citizens who violates the traffic rules by analyzing the images directly from the cctv cameras so there will be zero error by the traffic policemen and images will be analyzed accordingly and get penalized based on their helmet presence and number plate is analyzed accordingly

CHAPTER-2

2. Problem Definition:

One of the leading causes of human death is traffic accidents. Among them, motorbike accidents are common and cause critical injuries. Over the past two decades, the number of vehicles has increased rapidly. As a result, it becomes very difficult to track every vehicle for traffic management and law enforcement purposes.

Our project aims for motorbike detection , helmet versus no helmet classification and the two-wheeler licence plate recognition. Once the motorbike has been detected it is further determined whether the motorcyclist is wearing a helmet or not using Machine Learning algorithms . If the motorcyclist is identified without the helmet, then the text in the license plate of the two-wheeler vehicle is detected using some text recognition algorithms.And the data of the vehicle is updated into the database.

CHAPTER-3

3. Literature Survey:

3.1 Detection of Non-Helmet Riders and Extraction of License Plate Number using Yolo v2 and OCR Method Prajwal M. J., Tejas K. B., Varshad V., Mahesh Madivalappa Murgod, Shashidhar R.

Summary:

In this study, a system for detection of non-helmeted riders is constructed which tries to fulfill automation of detecting rider's violation of no longer using a helmet & extracting the vehicles' registration code number.

One of the main principles is the object detection principle with YOLO architecture used to detect motorcycles, people, helmets and license plates.

OCR is used to extract license plates if the vehicle driver is not wearing a helmet.

Advantages:

The benefit of this is that they took video as input. This allowed for real time classification.

Limitations:

The issues with image clarity at night were not addressed and this particular work requires a high level of performance because it uses video input.

3.2 Automatic Detection .of Bike-riders without Helmet using Surveillance .Videos in Real-time.Kunal Dahiya, Dinesh Singh, C. Krishna Mohan Visual Learning and Intelligence Group (VIGIL), Department of Computer Science and Engineering, Indian Institute of Technology, Hyderabad, India

Summary:

This study describes a real-time method for spotting helmet-less bike riders in surveillance footage. The suggested method recognises bike riders from surveillance videos using background subtraction and object segmentation. The next step is to use a binary classifier and visual features to determine whether a biker is wearing a helmet. Depending on the tweet sentiment score label, someone may be depressed or not.

Advantages:

SVM is used as a classifier because of its robustness even when trained from a small number of feature vectors, It uses background subtraction and object segmentation to remove unnecessary objects and HOG descriptors are used which are efficient in object detection.

Limitations:

This approach locates the helmet in the full frame, which is computationally expensive, It often confuses other similar typed objects as helmets furthermore, It overlooks the reality that a helmet is only necessary for bike riders.

3.3 Vishnu, C.; Singh, Dinesh; Mohan, C. Krishna; Babu, Sobhan (2017). [IEEE 2017 International Joint Conference on Neural Networks (IJCNN) - Anchorage, AK, USA (2017.5.14-2017.5.19)] 2017 International Joint Conference on Neural Networks (IJCNN) - Detection of motorcyclists without helmet in videos using convolutional neural network. , (), 3036–3041. doi:10.1109/IJCNN.2017.7966233

Summary:

This paper completely focuses on extracting all the 2-wheelers without helmets using the Convolution Neural Networks (CNN). Background subtraction and Using gaussian mixture models(to separate images)

Advantages:

This model clearly separates the objects with good accuracy.It detects two wheelers without helmets.

Limitations:

It focuses solely on the classification of people wearing helmets and those not wearing them.

3.4 Khan, Fahad A; Nagori, Nitin; Naik, Ameya (2020). [IEEE 2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA) - Coimbatore, India (2020.7.15-2020.7.17)] 2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA) - Helmet and Number Plate detection of Motorcyclists using Deep Learning and Advanced Machine Vision Techniques. , (), 714–717. doi:10.1109/ICIRCA48905.2020.9183287

Summary:

The published framework presents a computerized structure to distinguish between motorcycle riders wearing helmets or not through images. The feature class extraction system is based on the extracted features. Trained in Common Objects in Context (COCO) and combined with computer vision. The Yolo layer is modified to detect three types of objects.specified layers and use a process of sliding window.

Advantages:

Increasing the dataset may help improve the accuracy and precision of item detection. The model can also be improved by using other frameworks, testing the findings against data to increase accuracy, and employing a blend of several techniques. This system uses Image, Processing & Deep learning & Computer Vision techniques.

Limitations:

Based on the type learning some data might underfit or overfit the data.

3.5 Su, Yen-Min; Peng, Hsing-Wei; Huang, Ko-Wei; Yang, Chu-Sing (2019). ***[IEEE 2019 International Conference on Technologies and Applications of Artificial Intelligence (TAAI) - Kaohsiung, Taiwan (2019.11.21-2019.11.23)] 2019 International Conference on Technologies and Applications of Artificial Intelligence (TAAI) - Image processing technology for text recognition. ,(), 1–5.*** **doi:10.1109/TAAI48200.2019.8959877**

Summary:

The system is based on image processing and OCR technology. Photos are taken from surroundings for testing. A study describes how image processing can improve the accuracy and efficiency of text extraction from images using optical character recognition. These two software programs are used in this study: character recognition and text detection.

Advantages:

Document archiving is a task that is performed by managers. A system for detecting improper words in dispute resolution was integrated to reduce the number of legal disputes

Limitations:

This task requires a lot of time to execute the program.

3.6 Wang, Wencheng; Wu, Xiaojin; Yuan, Xiaohui; Gao, Zairui (2020). ***An Experiment-Based Review of Low-Light Image Enhancement Methods. IEEE Access, 8(), 87884–87917.*** **doi:10.1109/ACCESS.2020.2992749**

Summary:

This study is used to improve visual effects of images which is beneficial for subsequent processing. In this case, low light image enhancement is used. In this study, retinex, frequency domain, image fusion, defogging model and machine learning methods were used.

Advantages:

Used in increasing contrast of the image. The Retinex method is effective in contrast to the image. Image fusion is simple and effective. Good preserving of image details.

Limitations:

Details can be lost while executing the algorithm. Color and pixels can get distorted because of high magnification. Complexity can be increased and it's prone to over enhancement.

CHAPTER-4

4. Project Requirement Specification

4.1. Project Scope

The current scenario of traffic police capturing the images of the bikes whose riders are not wearing helmets is a manual task and manual tasks are often not considered to be a feasible solution. So, what we intend to implement is we want to capture all the video data from the traffic signal surveillance cameras and analyse it later by detecting the two wheeler vehicles and later checking if the two wheeler rider is wearing a helmet or not and based on that we retrieve the license plate information of those vehicles and fine those riders accordingly.

4.2. User Classes and Characteristics

Motorcyclist

Designated Authority

Citizen

4.3. Operating Environment

OS - Windows 10+

Hardware - System with high RAM and a powerful processor

Software - Python 3, Keras, TensorFlow

4.4. Risks

Classifying images at night may be difficult due to poor clarity.

It is possible for some vehicles to have broken number plates.

it may detect other two wheelers where a helmet is not necessary for them.

4.5. Functional Requirements

Image inputs : Raw inputs captured are sent into preprocessing

Preprocessing : The images are refined and sent into the model 1.

Mode 1 : This model will check the refined images and confirm whether the rider has helmet or not

Model 2 : This model now gets the number plate image and the text is recognised using open cv model

Database : Now this date is passed from the model 2 to the database to store into the user or update the challan

4.6. Non-Functional Requirements

4.6.1. Performance Requirements

Accurate performance

Robust Model

Ability to work on all kinds of images

4.6.2. Safety Requirements

The data used for training the model is stored safely

The Database we use for updating the vehicle details is stored securely

Model must not leak data

4.6.3. Security Requirements

The videos used in our dataset need to be copyright free inorder for us to use the images freely to train our model

4.6.4. Other Requirements

Scalability:

The system must be able to scale for a larger dataset.

CHAPTER -5

5. System Design

5.1. Design Goals

The system that we are proposing will allow us to overcome the challenges that were faced by the existing system by changing the way vehicles will be detected as now everything will be automated.

Our proposed system is better than the old system as we are removing human error and reducing the probability of a motorcyclist who is not wearing a helmet not getting caught.

Features of the system:

Design Details

Reliability

The system which we are intending to build is more reliable than the current system.

Availability

We will ensure that the system is available as long as the cctv's are up and running.

Speed

The Response time or the time required for processing will be comparatively for some extent compared to the current systems prevailing in the market

Application Compatibility

The system will perform well irrespective of the operating system. It is compatible with most popular operating systems like windows,etc.

Legacy to modernization

The system will be open for any type of updations/modifications at all stages.

5.2. Constraints, Assumptions and Dependencies

Dependencies:

Our project entirely depends on the video input from the CCTV footage. Hence, presence of a camera at every possible location is a MANDATORY hardware dependency.As the project focuses on accessing the data from the cameras, the cameras should be up all the time without fail.

Assumptions made and constraints:

Our first assumption is that there is a camera installed at every traffic signal. The next assumption is that the user is in a well-lit environment.The other assumption is that camera is stable in order for us to be able to capture clear camera input.

Design and Architecture:

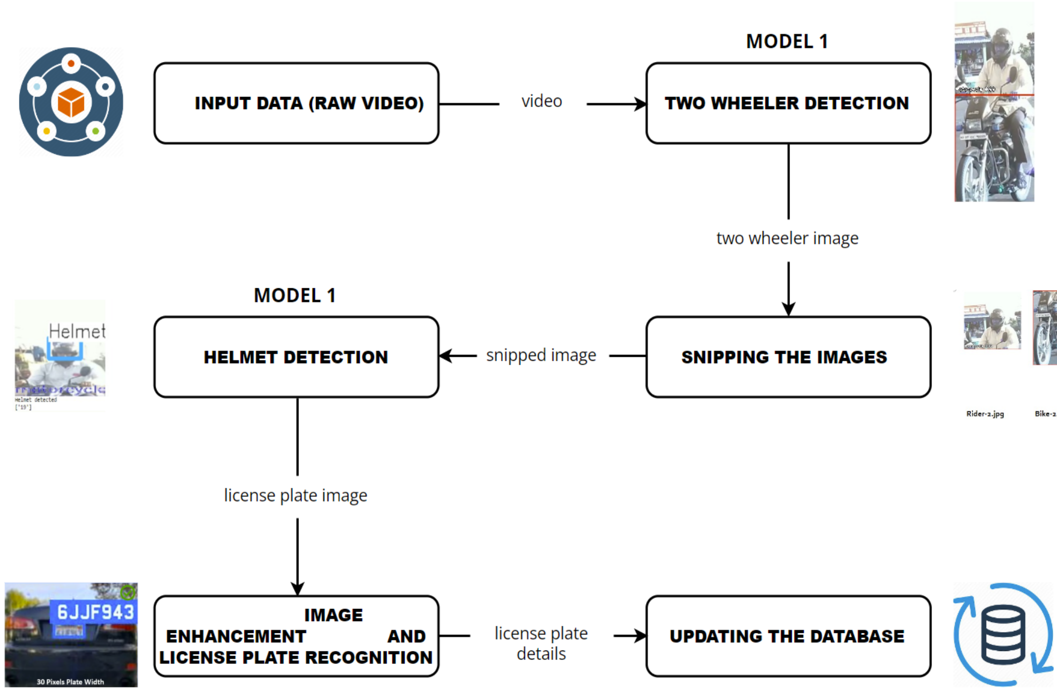

Fig 5.1: High Level Design [HLD]

In the very first stage the video is passed from the dataset that contains all the videos which are taken from the traffic signal surveillance and then this video is stripped into frames, In the next phase these frames are passed to the model for detection of two-wheelers in the frame. Later these images with two-wheelers are passed to the model where it detects the presence of a helmet for the rider in the head region of the image. Based on the output of the model if the motorcyclist has a helmet well and good but if the rider doesn't wear a helmet then the respective image will be passed to the next module where preprocessing of all the images occurs where all the foggy or hazy images get cleared using enhancement techniques and the number plate detection is done using text recognition methods.The output from this module will be updated to the database. If the user already exists in the database then it gets updated to the database of the existing id if not then it creates a new user entry.

5.3. Use Case Diagram

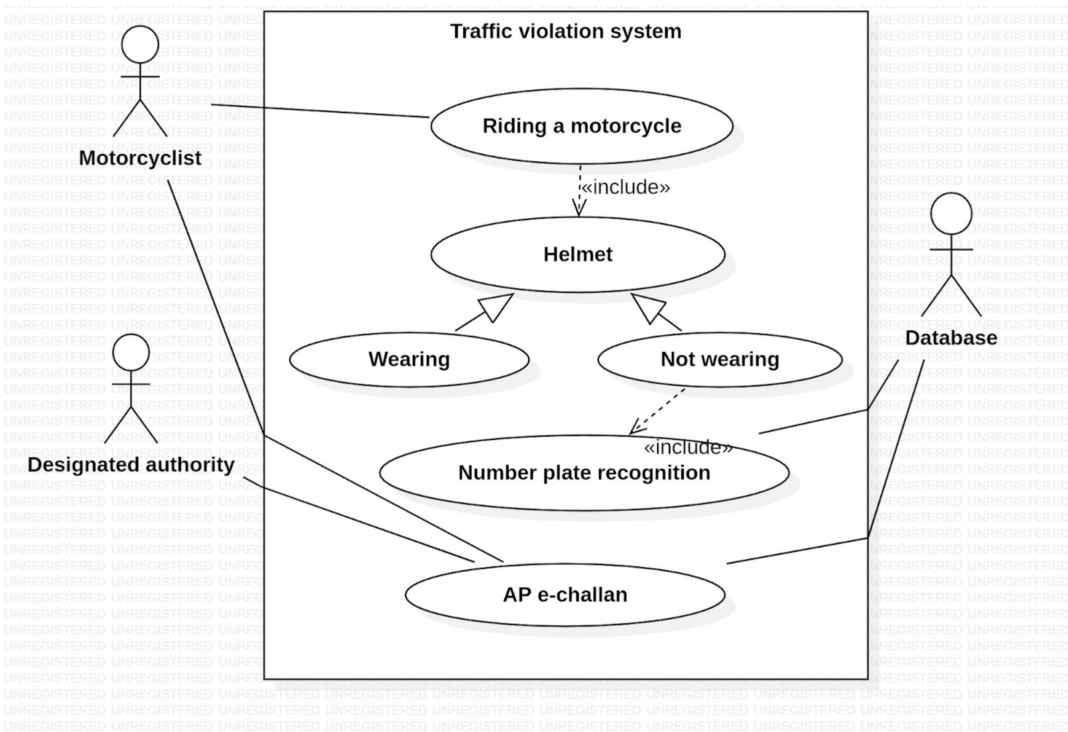

Fig 5.2: Use Case Diagram

Actors:

Motorcyclist

Designated Authority

Database (Handler)

5.4. Master Class Diagram

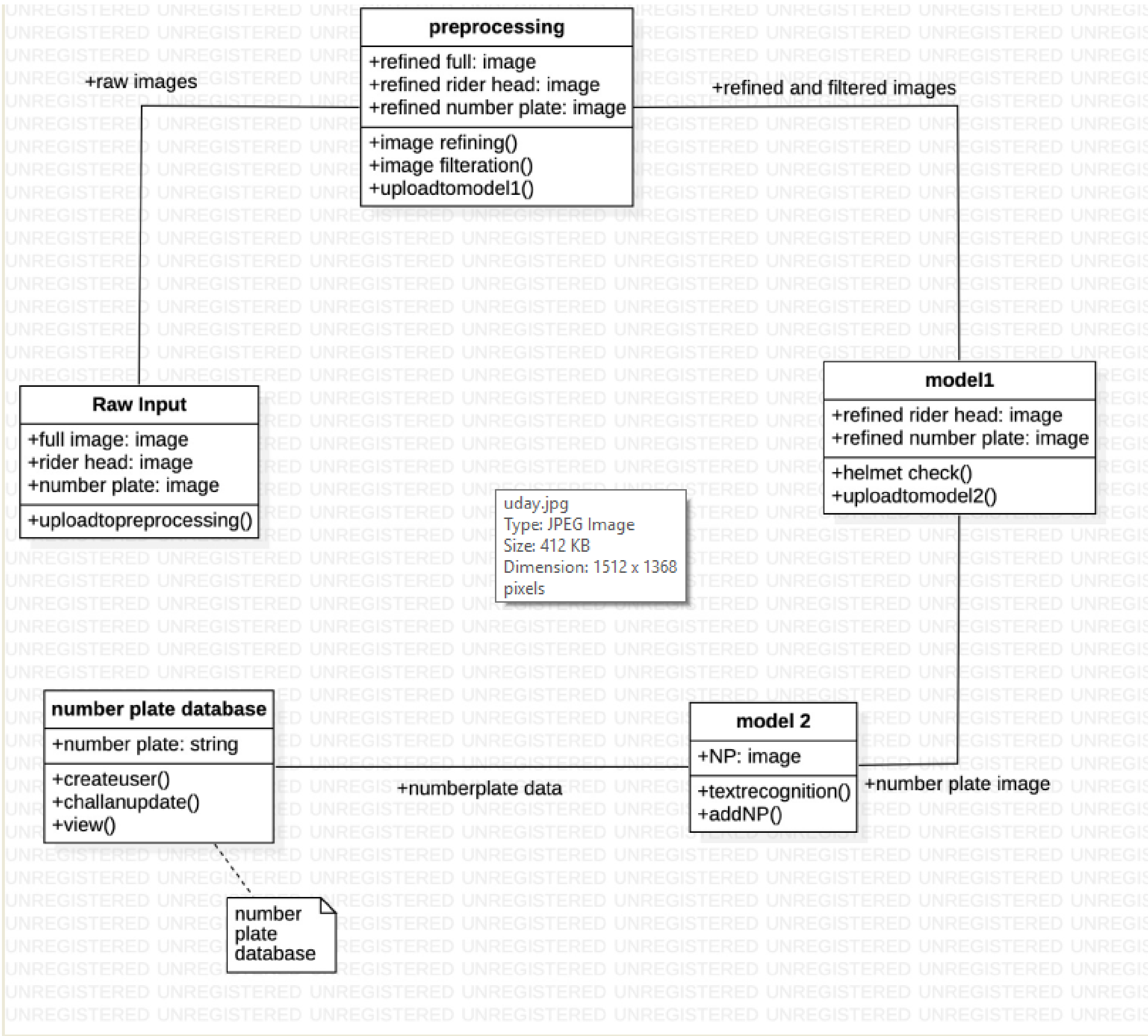

Fig 5.3: Master Class Diagram

5.5. Swimlane Diagram

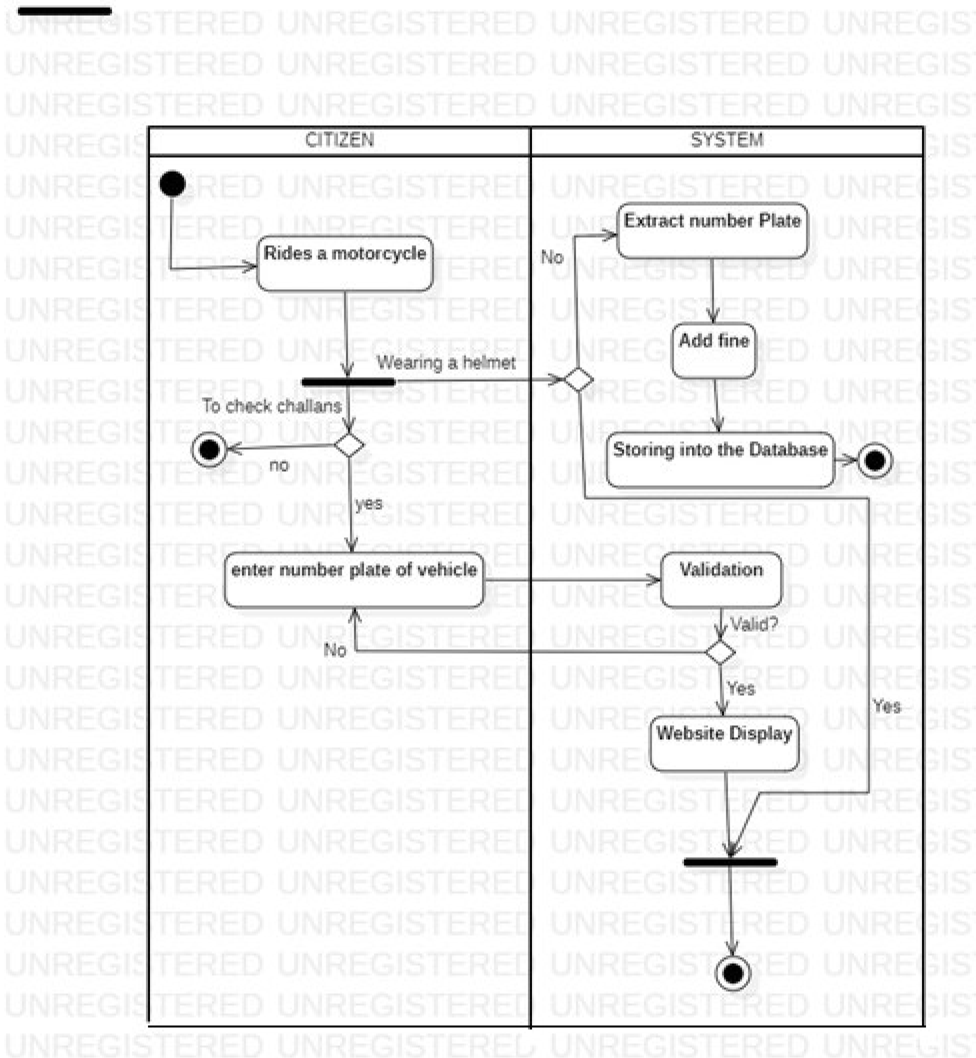

Fig 5.4: Swimlane Diagram

The swimlane has two phases or lanes which are citizens and the other phase or lane is the system. In the first lane a rider rides a motorcycle on a road, our model starts the process when the CCTV camera detects the two-wheeler. The live video is passed as an input to the system

If the rider or citizen is wearing a helmet well and good but if the rider is not wearing a helmet [This helmet detention phase is done by a complete different model which focuses completely on identifying whether a rider is wearing a helmet or not by cropping his upper body of the image and passing it to the model]

Riders who are not wearing helmet these are images are passed for the number plate extraction phase which an API takes care of it. Once a number plate is extracted, the user details are added or stored to the database for adding fines to the user with that number plate.

Citizen or rider or user can check his status or e-challan by logging into the system website. The system takes care of all the fines, handles all types of data handlings and shows the challan for the respective rider with their associated number plate if found by the model .

CHAPTER - 6

6 Proposed Methodology

6.1 YOLO Model Creation

6.1.1 Label Images:

Labelled all the images with the help of LableImg tool by drawing bounding boxes. In this project, Biker class and Helmet class were created with the help of LableImg tool. Annotations are saved as XML files in PASCAL VOC format, the format used by ImageNet. Besides, it also supports YOLO and CreateML formats.

The features you want your ML or DL system to recognise are defined by image annotation. These photos can be used to train your model using supervised learning techniques. When the AI model is implemented as a component of a computer vision application, you want it to be capable of performing picture recognition on unclassified images and then coming to a conclusion or taking the required action. This method is mostly used to locate items and boundaries before classifying them, for example, according to semantics or overall image comprehension. To acquire the desired outcome for each of these applications, a model must be trained, validated, and evaluated over an extended period of time.

Now that our dataset labels are in the required format, we created a train-test split. We chose to create a test set containing 10% of the images in the dataset.

For the object detection phase we use You Only Look Once YOLO v5 architecture. The YOLO v5 architecture is a single object detector, this architecture has three important parts or phases. Model backbone, Model head, Model neck. The basic purpose of Model Backbone is to extract significant features from an input image. To extract valuable, important features from an input image in YOLO v5, the CSP — Cross Stage Partial Networks are employed as the backbone.

The primary purpose of Model Neck is to produce feature pyramids. Pyramids of features enable models to scale objects successfully in general. The ability to recognise the same thing in various sizes and scales is helpful.Models that use feature pyramids perform well on unobserved data. Other models, such as FPN, BiFPN, PANet, etc., employ other feature pyramid methodologies.

6.1.2 Training:

As all the images are now labelled, we passed all these

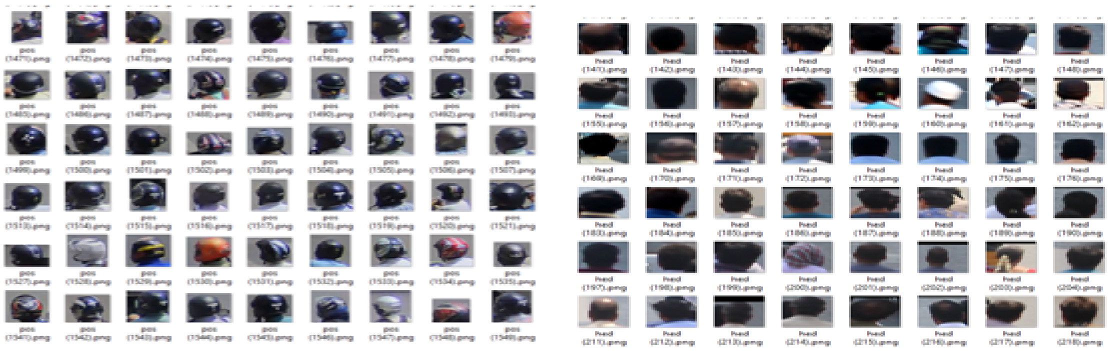

Fig 6.1: Helmet and Non Helmet images

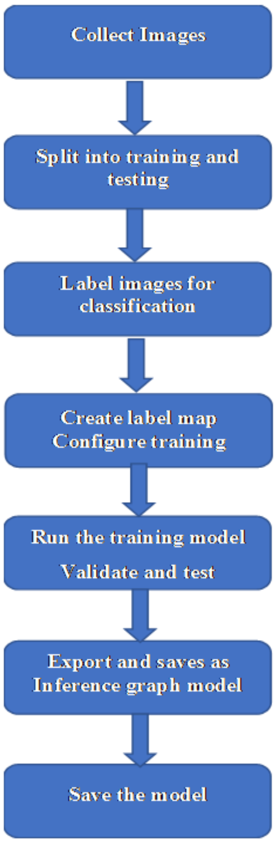

Fig 6.2: Flow chart of training and testing the model

Collecting images from the dataset splitting them into two parts one for the training and the other data part for the testing phase for the model. Drawing bounding boxes for the images by highlighting the biker position. Getting the coordinates of the images and passing these images to the model for the training phase. Once the model gets trained it's ready for our project.

The 1st model is trained for detecting the two-wheelers in the live streaming video that's passed as input to the model.Now the whole photo has been cropped into the two wheeler images if present and don't mind if the photos don't have any two-wheelers.

In the next stage these cropped images of the bounding boxes are passed to the 2nd model for detecting the helmet. Once the helmets are detected, respective images are omitted.

If the rider is found to be not wearing a helmet then pass this image to the number plate recognition process. Characters get recognized from the license plate recognizer.The recognition phase includes removing the blurred part of image, enhancing the low-light conditioned images and improving the clarity of the images and clearing out foggy or hazy images, these all phases are carried out by an API Automated License Plate Recognition(ALPR).

CHAPTER-7

7 Implementation and Pseudo Code

7.1 Two Wheeler Detection and cropping images

```
index=3
for item in output_array:      #getting the co-ordinates of detected bike frame for cropping of  only bike images...
  x1 = item['box_points'][0]
  y1 = item['box_points'][1]
  x2 = item['box_points'][2]
  y2 = item['box_points'][3]
  if(y2-y1 >  150 and y2>500 and (x2-x1)>150):
    new_frame  = returned_frame[max(int(y1-(y2-y1)*0.9),0):y2 , x1:x2 ]  #crops full image with bike & person
    helmet_image = returned_frame[max(int(y1/4-(y2/4-y1/4)*(0.8/4)),0):y1 , x1:x2] #crops only head part for helmet detection
    bike_image = returned_frame[y1:y2 , x1:x2] #crops only bike part for number plate detection
    count+=1
    cv2.imwrite("finalOutputs/bike/bike-"+str(count)+".jpg", bike_image) # saves the cropped images in given location...
    cv2.imwrite("finalOutputs/full/full-"+str(count)+".jpg", new_frame)
    cv2.imwrite("finalOutputs/rider/rider-"+str(count)+".jpg", helmet_image)
    plt.subplot(grid[0,index])
    plt.imshow(new_frame,interpolation="none")  # plotting the  cropped part of bikes  in output frame
    index+=1
    #plt.subplot(grid[0,index])
    plt.title("Analysis: " + str(frame_number))
    #plt.bar(labels,sizes,width = 0.2)
    print("------------END OF A FRAME --------------")
```

Fig 7.1: Snapshot of pseudo code for bike detection

Getting the coordinates of the two-wheeler.

Cropping the images accordingly into 3 parts.

Biker full image

persons helmet position

bikes number plate position

7.2 Helmet Detection Phase

```
 # Create a 4D blob from a frame.
       blob = cv.dnn.blobFromImage(frame, 1/255, (inpWidth, inpHeight), [0,0,0], 1, crop=False)
       #print(blob)
 # Sets the input to the network
       m=net.setInput(blob)
       #print(m)
 # Runs the forward pass to get output of the output layers
       outs = net.forward(output_layer)
       #print(outs)
 # Remove the bounding boxes with low confidence
       a=postprocess(frame, outs, confThreshold, nmsThreshold, classes)
       #print(frame)
       #print(classes)
       frame=cv.resize(frame, (250,250))
       cv2_imshow( frame)
       t, _ = net.getPerfProfile()
       #print(t)
       label = 'Inference time: %.2f ms' % (t * 1000.0 / cv.getTickFrequency())

       #print(label)
       cv.putText(frame, label, (0, 15), cv.FONT_HERSHEY_SIMPLEX, 0.5, (0, 0, 255))
       cv.waitKey(1)
       #print(a)
       if(a > 0):
           #print(s)
           print('Helmet detected')
       else:
           print('No helmet')
           nh.append(num)
res = [[int(i) for i in sub]for sub in nh]
helmetDefaulterList = list(itertools.chain(*res))

print(helmetDefaulterList)
```

Fig 7.2: Snapshot of pseudo code for helmet detection

Helmet detection based on the images passed from the initial phase where two wheelers cropped images are created.

Displaying the frame number of the image it came from and the status of the image whether the helmet was found or not.

Passing these frame numbers to the next phase which is number plate recognition.

7.3 Number Plate Extraction Phase

```
for defaulter in helmetDefaulterList:
    imge= IMAGE_PATH_DEF+str(defaulter)+".jpg"
    img = load_img(imge)
    plt.figure()
    plt.imshow(img)
    plt.show()

    with open(imge, 'rb') as fp:

        response = requests.post(
        'https://api.platerecognizer.com/v1/plate-reader/',
        files=dict(upload=fp),
        headers={'Authorization': 'Token 62ec273ccdea8d5935febe883e9cd877ff1e7153'})
    print("***************************")
    time.sleep(1)
    sett = dict(response.json())
    #time.sleep(1)
    if sett["results"]==[]:
        print(sett['results'])
        print("not detected")
        continue

    else:
        set1=sett['results'][0]['plate']
        list_num.append(set1)
        print(set1)
    print("****************************")
#list_num = list(set(list_num))
print(list_num)
```

Fig 7.3: Snapshot of pseudo code for number plate extraction

On passing the frame numbers from the helmet detection phase, these frame numbers are now taken and the respective lower part of the bike image is now considered.

Image enhancement is done for these frames and extraction of characters is done here.

CHAPTER-8

8 Results and Discussion

8.1 Two-wheeler Detection


```
480
Output for each object :  [{'name': 'motorcycle', 'percentage_probability': 98.62754940986633, 'box_points': [35, 0, 286, 269]}]
```

Fig 8.1: Snapshot of output for bike detection when bike is present

Result:

Initial stage is to split the video into frames and Detection of two wheeler from the whole frame by representing the probability of image and coordinates of the bikes.


```
510
Output for each object :  [{'name': 'motorcycle', 'percentage_probability': 98.24132919311523, 'box_points': [770, 617, 1319, 1016]}]
------------END OF A FRAME --------------
```

Fig 8.2: Snapshot of output for bike detection when bike is not present

Result:

When no more two-wheelers are present in the image it shifts to the next frame by printing an End of Frame message.

8.2 Multiple Two-wheeler Detection in single image

Fig 8.3: Snapshot of output for bike detection when multiple bikes are present

Detection of multiple two-wheeler vehicles in the frame, Adding coordinates to the two-wheelers in the image and once all the images are detected, shift to the next frame by displaying the statement End of frame.

8.3 Helmet Detection

Fig 8.4: Snapshot of output for helmet detection

Detected helmet by drawing the bounding box and a Helmet Detected message. Indicating cropped image number of full rider picture.

Fig 8.5: Snapshot of output for helmet not detection

Representing the status of the rider image whether there is helmet or not with a statement. Displaying the respective frame number of the cropped image.

8.4 License plate Detection

Fig 8.6: Snapshot of output for license plate extraction

Once the Helmet detection phase was done the images with no helmet frames were passed to the next phase which is License plate recognition. The detected vehicles number plates are analysed and extracted from the image.

CHAPTER-9

9 Conclusion and Future Work

9.1 Conclusion

Our study seeks to identify motorcycles, classify them according to whether they are wearing helmets or not, and read their licence plates. It is determined whether or not the biker is wearing a helmet after the motorbike has been located. If a rider is seen riding without a helmet, the motorcycle's licence plate will be seen..

A video file is used as the input for a system being built to detect non-helmeted riders. The motorcycle's licence plate number is retrieved and shown if the rider in the video clip is not wearing a helmet while operating the machine. For the purpose of detecting motorcycles, people, helmets, and licence plates, the YOLO architecture's object detection principle is employed.

Following this method will mostly ensure the identity of the user if he/she is wearing a helmet or not and fines can be charged and by doing so we might ensure that everyone will be wearing helmets.

9.2 Future Work

As a future work, We can add an interface where both the user and the police authority can access the fine information, The user can make the payment through the payment gateway and the police authority can check all the fine information on any vehicle.

References

[1] Zhou, F., Zhao, H., & Nie, Z. (2021). “Safety Helmet Detection Based on YOLOv5 ”. 2021 IEEE International Conference on Power Electronics, Computer Applications (ICPECA). doi:10.1109/icpeca51329.2021.936. March 2021.

[2] Khan, Fahad A, Nagori Nitin and Naik Ameya. “Helmet and Number Plate detection of Motorcyclists using Deep Learning and Advanced Machine Vision Techniques”. IEEE 2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA) - Coimbatore, India. July 2020.

[3] Wang Wencheng, Wu Xiaojin, Yuan Xiaohui and Gao Zairui. “An Experiment-Based Review of Low-Light Image Enhancement Methods". IEEE Access, 8(), 87884–87917. doi:10.1109/ACCESS.2020.2992749. March 2020.

[4] Prajwal M. J, Tejas K B, Varshad V, Mahesh Madivalappa Murgod and Shashidhar R. “Detection of Non-Helmet Riders and Extraction of License Plate Number using Yolo v2 and OCR Method”. International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-2, December 2019.

[5] Su Yen-Min, Peng Hsing-Wei, Huang Ko-Wei and Yang Chu-Sing. “Image processing technology for text recognition”. International Conference on Technologies and Applications of Artificial Intelligence (TAAI) - Kaohsiung, Taiwan. November 2019.

[6] Shreyas R Kumar, B. V. Pradeep, Adithya H. B, Padmaja B and Sunil M. P. “Dynamic traffic rule violation monitoring system using automatic number plate recognition with SMS feedback”. 2nd International Conference on Telecommunication and Networks August 2017.

[7] Vishnu C, Dinesh Singh C; Mohan Krishna and Babu Sobhan "Detection of motorcyclists without helmets in videos using convolutional neural networks". International Joint Conference on Neural Networks- Anchorage, AK, USA. May 2017.

[8] Kunal Dahiya, Dinesh Singh C and Krishna Mohan. "Automatic Detection of Bike-riders without Helmet using Surveillance Videos in Real-time". Visual Learning and Intelligence Group (VIGIL),Department of Computer Science and Engineering,Indian Institute of Technology, Hyderabad, India 2016.

Appendix A: Definitions, Acronyms and Abbreviations

YOLO-	You Only Look Once
CNN-	Convolutional Neural Network
R-CNN-	Region-based Convolutional Neural Network
VOC-	Visual Object Classes Challenge
SVM-	Support Vector Machine
ALPR-	Automated License Plate Recognition
CSP-	Cross Stage Partial

Annexure -I

Helmet Violation And Number Plate Detection System

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***Abstract*—In recent times, we can observe that there are numerous traffic incidents occurring, some of which result in fatalities; the majority of these accidents involve motorcycles. So, by using a helmet, we can lower these accidents.**

As result of this study, a model is being created for automatically identifying two-wheelers in traffic who are riding without helmets. identifies the classification of motorcycle helmet versus no helmet and furthermore reads license plate numbers. Once the motorcycle is identified in the frame of the live stream video, it can be determined whether the rider is wearing a helmet or not. If the rider is not wearing a helmet, the motorbike's licence plate is identified, which also updates the vehicle's information in the database and adds fines.

You Only Look Once (YOLO), a machine learning algorithm or model, was employed in this study to recognise and detect helmets. We will utilise an API Automated License Plate Recognition (ALPI) to obtain the vehicle's number plate. This API not only aids in the analysis of licence plate numbers but also improves image quality by improving quality of hazy and unclear photographs that are from morning weather or different climatic conditions. In order to create better systems for helmet detection and number plate extraction, we apply these several strategies.

Keywords- You Only Look Once (YOLO), Convolution Neural Network (CNN), Automated License Plate Recognition (ALPI), Cross Stage Partial (CSP), Support Vector Machine (SVM). Common Objects in Context (COCO).

I. INTRODUCTION

In a developing nation like India right now, where the number of motor vehicles is rising, the majority of middle class, lower income families prefer to travel by two-wheeler, which is extremely fair given their financial situation. The majority of bikers choose not to wear helmets when riding, increasing their risk of dying in accidents.

The government recently performed study on the occurrence of accidents, with a particular focus on road accidents, and the findings/reports indicated that most accidents are caused by two-wheelers when compared with the other modes of transport vehicles. Further investigation revealed that deaths are due to the absence of helmets.

Even the current government has taken strict action regarding this helmet issue by assigning the traffic police the duty of capturing vehicles without helmets while riding a vehicle. Although often traffic police aren't able to capture all vehicles without helmets, even in that case. There is no accuracy or clarity in the images captured by the traffic policemen and a lot of images captured by the policemen were of no use. Manually capturing images is a complete tedious task and can not ensure 100 percent coverage of the whole traffic.

So we intend to develop a model/project that focuses mainly on this incidents by penalizing the riders or citizens who violates the traffic rules by analyzing the images directly from the CCTV cameras so there will be zero error by the traffic policemen and images will be analyzed accordingly and get penalized based on their helmet presence and number plate is analyzed accordingly. This video is initially cut into frames and passed to the model and YOLO model analyses the images and classifies images into helmet vs non-helmet images.These images are passed to get the number plates and update accordingly to the database.

II. RELATED WORK

The most crucial stage of the project is object detection, and there are many methods for finding objects in an image. Every model has perks and drawbacks of its own. And the most accurate model according to the requirements of the project is the YOLO model and there are many versions in it.. Prajwal M.J et.al [1] has proposed that object detection is done using the YOLO model to detect the riders who are violating the traffic rule of wearing a helmet and extracting the number plates of those riders accordingly. For detecting the license plate they have used Optical Character Recognition (OCR) technique which reads the characters from an image.

This project performs by taking the video as an input instead of taking images or frames of the video. It process the live stream video directly without any cutting of frames.

The drawbacks of this are hey issues with the image clarity are not addressed and the project requires high level of computational capacity because it is processing the model with the help of video not images which requires more capacity, OCR technique is very expensive and occupies lot of space for the image produced.

Kunal Dahiya et.al [2] has done the object detection using the background subtraction and object segmentation which focuses on eliminating the unnecessary objects that are behind the rider or in the background and furthermore, detection of helmet is done using the binary classifier and visual features to determine whether a person is wearing a helmet or not. Depending on the score helmet status of the rider can be defined.

They have used Support Vector Machine (SVM) as a classifier because of its robustness even when trained from few number of feature vectors. And removing unnecessary objects done and HOG descriptors are used for the object detection (helmet detection) which is very much efficient.

This method identifies the helmet in a full frame which is computationally expensive as it has to compute the whole image and it often confuses with the other similar objects that look like helmet. Furthermore, it overlooks the reality that a helmet is only necessary for bike riders.

Vishnu C et.al [3] had focused completely on extracting all the two-wheeler riders that are not wearing helmets using the Convolution Neural Networks (CNN). The CNN concept done based on the two theories. Background subtraction and using Guassian mixture models (to separate the images). GMM has good accuracy in image segmentation and splits images accurately.

The model based on CNN clearly separates the objects with good accuracy whether the person is wearing a helmet or not. But most of its focus is mainly on the classification of people wearing helmets and people not wearing them.

Khan Fahad A et.al [4] his published framework depicts a computerized structure to distinguish between the motorcycle riders wearing helmets and the riders who are not wearing the helmets in the image.The feature class extraction system they did is based on the extracted features. These are trained in Common Objects in Context (COCO) and combined with the knowledge of computer vision. COCO file formatting is relatively simple, it contains annotations like object classes, bounding boxes and contains image metadata attributes like height, width, image source etc.

The YOLO layer is modified to detect the three types of objects, it uses a method of sliding window where the window slides to next objects after certain specified amount of time. Increasing the amount of data set may helps to improve the accuracy and precision of the object detection. The model accuracy can also be increased by using other frameworks, by testing the findings against the data, and employing a mixture of several techniques.

They used Image processing, Deep Learning and computer vision techniques for scanning the characters from the license plate. The data may be under-fit or over-fit based on the type of learning the model choose to use.

Chu-Sing et.al [5] done based on the data that they have acquired by capturing the images from the surroundings and split those images into testing and training parts. Their system is based on the image processing and Optical Character Recognition (OCR) technology, focused on how image processing can improve the accuracy and efficiency of the text or characters extraction from the images (number plates in this case) using the OCR technique. With the OCR handling huge databases and searching through those large databases with huge quantity of images is made easy. Character recognition and text recognition are the two software programs used in their study. Document archiving is a task that is performed by managers. It is very much time consuming.

Wencheng Wang et.al [6] his group study has resulted that to improve the visual effects of images which is beneficial for subsequent processing. In this case the images with low light or dullness in the images enhancement is done in order to increase the pre-processing stage of data set. In his study, Retinex (uses different filters in enhancing the low bright images) , frequency domain, image fusion (to get the exact images it combines two or more images that were captured in fraction of seconds delay), defogging and machine learning methods were used.

Their method used in increasing the contrast of the images, this is done by the retinex method for effective and clear image. Image fusion helps in preserving the details of the image. While using these techniques there is a chance of distortion of colours, complexity in images and clarity can be increased, chances of over enhancement of the images and details can be lost.

III. Proposed Methodology

A. Label Images

Labelling of all the images with the help of LableImg tool by drawing bounding boxes. In this project, Biker class and Helmet class were created with the help of LableImg tool. Annotations are saved as XML files in PASCAL VOC format, the format used by ImageNet. Besides, it also supports YOLO and CreateML formats.

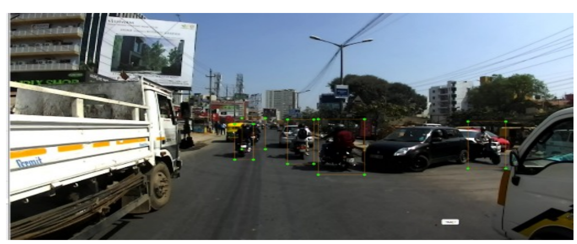

Fig. 1. Image containing bounding boxes for riders.

YOLO v5 architecture contains of 3 components head, neck, and backbone where head is same as that of YOLO v4 architecture, CSP-Darknet53 as a backbone, SPP and PANet as the model neck. The YOLO network employs residual and dense blocks to allow information to travel to the deepest levels and bypass the vanishing gradient issue. The issue of repeated

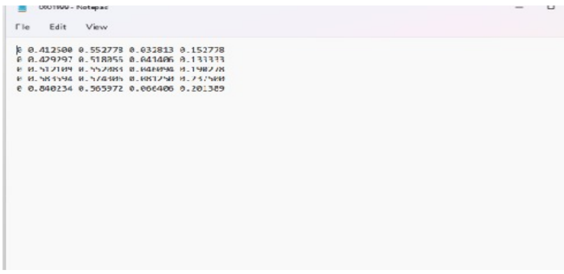

Fig. 2. Coordinates of bounding boxes.

gradients is one benefit of having dense and residual blocks, though. This issue is addressed by CSPNet by truncating the gradient flow.

These labels contains the four coordinates of the two-wheeler represented in a box format. If an image has multiple two-wheelers then there will multiple rows representing all the coordinates of the vehicles including rider.

The features you want your Machine Learning or DL system to recognise are defined by image annotation. These photos can be used to train your model using supervised learning techniques. When the AI model is implemented as a component of a computer vision application, you want it to be capable of performing picture recognition on unclassified images and then coming to a conclusion or taking the required action. This method is mostly used to locate items and boundaries before classifying them, for example, according to semantics or overall image comprehension. To acquire the desired outcome for each of these applications, a model must be trained, validated, and evaluated over an extended period of time.

Now that our data set labels are in the required format, we created a train-test split. We chose to create a test set containing 10% of the images in the data set and train set containing 90% of the images in the data set. So that we can train and validate our model clearly.

B. Training

As all the images are now labelled, we passed all these images shown in Fig.3

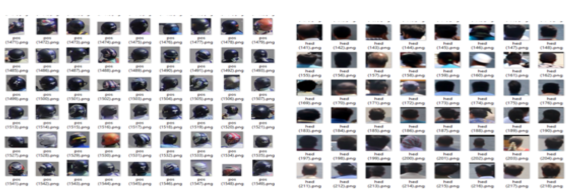

Fig. 3. Helmet and Non Helmet images.

Collecting images from the data set splitting them into two parts one for the training and the other data part for the testing phase for the model. Drawing bounding boxes for the images by highlighting the biker position. Getting the coordinates of the images and passing these images to the model for the training phase. Once the model gets trained it's ready for our project.

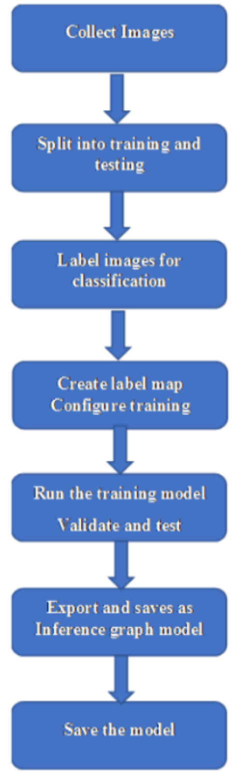

Fig. 4. Flow chart of training and testing of the model.

- The 1st model is trained for detecting the two-wheelers in the each frame of live streaming video that's passed as input to the model.
- Now the whole photo has been cropped into the two wheeler images if present and don't mind if the photos don't have any two-wheelers.
- In the next stage these cropped images of the bounding boxes are passed to the 2nd model for detecting the helmet to find whether rider is violating or not.
- Once the helmets are detected, respective images are omitted.
- If the rider is found to be not wearing a helmet then pass this image to the number plate recognition process.
- Alphanumeric characters gets recognized from the license plate recognizer.

Finally the list of vehicle registration numbers are stored into the excel sheet under the license plate no column.

IV. Results and Discussion

We have successfully trained our model in a way to identify the two-wheelers to an extent where it is capable of identifying various number of two-whelelers in a single image and passes to the next phases with frame numbers.

As the model outputs the vehicles status and the license plates of the two-wheelers. First output is the two-wheeler detection. There are 3 cases in this.

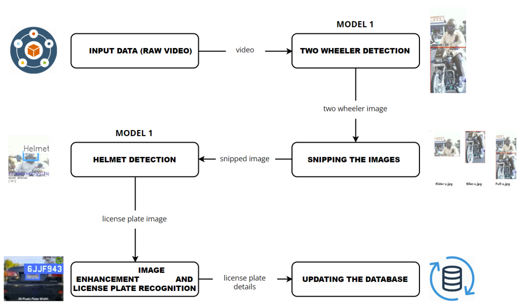

Fig. 5. Architecture diagram.

- If there are no two-wheeler in the frame passed to the model(fig 6).
- If there is a single two-wheeler in the frame(fig 6).

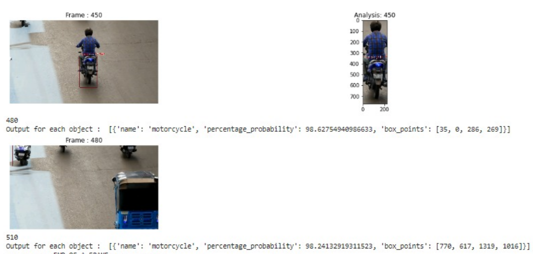

Fig. 6. Output for the single rider and no rider.

- If more than one two-wheeler is present in the frame, each two-wheeler is distinguished separately by snipping the image into a single bounding box for alll the two-wheelers..(fig 7).

Fig. 7. Output for multiple riders.

- Every two-wheeler is represented with a bounding box, every two-wheeler bounding box coordinates and probability of finding vehicle is represented(fig 8).

[{'name': 'motorcycle', 'percentage_probability': 98.62754940986633, 'box_points': [35, 0, 286, 269]}]

Fig. 8. probability and bounding box coordinates for every bike found

- The next phase's output is helmet detection, in which the model uses the rider's upper half of the image as input to determine whether or not the rider is wearing a helmet(fig 9).
- The last phase is the detection of license plate of the riders who are not wearing helmets(fig 10).

Fig. 9. Output for helmet detected and not detected

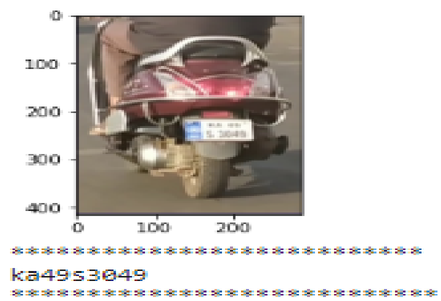

Fig. 10. Output for text extraction from license plate

Conclusion

Our study seeks to identify motorcycles, classify them according to whether they are wearing helmets or not, and read their licence plates. It is determined whether or not the biker is wearing a helmet after the motorbike has been located. If a rider is seen riding without a helmet, the motorcycle's licence plate will be seen..

A video file is used as the input for a system being built to detect non-helmeted riders. The motorcycle's licence plate number is retrieved and shown if the rider in the video clip is not wearing a helmet while operating the machine. For the purpose of detecting motorcycles, people, helmets, and licence plates, the YOLO architecture's object detection principle is employed.

Following this method will mostly ensure the identity of the user if he/she is wearing a helmet or not and fines can be charged and by doing so we might ensure that everyone will be wearing helmets.

As a future work, We can add an interface where both user and the police authority can access the fine information, The user can make the payment through the payment gateway and the police authority can check all the fine information on any vehicle.

References

[1] Zhou, F., Zhao, H., and Nie, Z. (2021). "Safety Helmet Detection Based on YOLOv5 ". 2021 IEEE International Conference on Power Electronics, Computer Applications (ICPECA). doi:10.1109/icpeca51329.2021.936. March 2021.

[2] Kunal Dahiya, Dinesh Singh C and Krishna Mohan. "Automatic Detection of Bike-riders without Helmet using Surveillance Videos in Real-time". Visual Learning and Intelligence Group (VIGIL),Department of Computer Science and Engineering,Indian Institute of Technology, Hyderabad, India 2016.

[3] Shreyas R Kumar, B. V. Pradeep, Adithya H. B, Padmaja B and Sunil M. P. "Dynamic traffic rule violation monitoring system using automatic number plate recognition with SMS feedback". 2nd International Conference on Telecommunication and Networks August 2017.

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[5] Prajwal M. J, Tejas K B, Varshad V, Mahesh Madivalappa Murgod and Shashidhar R. "Detection of Non-Helmet Riders and Extraction of License Plate Number using Yolo v2 and OCR Method". International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-9 Issue-2, December 2019.

[6] Su Yen-Min, Peng Hsing-Wei, Huang Ko-Wei and Yang Chu-Sing. "Image processing technology for text recognition". International Conference on Technologies and Applications of Artificial Intelligence (TAAI) - Kaohsiung, Taiwan. November 2019.

[7] Wang Wencheng, Wu Xiaojin, Yuan Xiaohui and Gao Zairui. "An Experiment-Based Review of Low-Light Image Enhancement Methods". IEEE Access, 8(), 87884–87917. doi:10.1109/ACCESS.2020.2992749. March 2020.

[8] Khan, Fahad A, Nagori Nitin and Naik Ameya. "Helmet and Number Plate detection of Motorcyclists using Deep Learning and Advanced Machine Vision Techniques". IEEE 2020 Second International Conference on Inventive Research in Computing Applications (ICIRCA) - Coimbatore, India. July 2020.

Annexure -II

<table>
<tr><td>Group No:103</td><td colspan="2">Title: Helmet Violation and Number Plate Detection System
Domain: ML and Image Processing</td></tr>
<tr><td colspan="3">Abstract: Nowadays we can see that there are many road accidents happening and some of them also leading to death, most of them are motorcycle accidents. So we can reduce these accidents by wearing a helmet.
This project aims to automate a model that is able to find the two-wheeler vehicle riders who are not wearing the helmets in the traffic. Identifies motorbike helmet versus no helmet classification and also license plate recognition. Once a motorbike is recognized it determines whether the rider is wearing a helmet or not. If the rider is not wearing a helmet then the number plate of the motorbike is detected and also updates the details of the vehicle in the database and adds fines.
The Machine learning algorithm used in this project is YOLO for identifying and detecting helmets. We will also extract the number plate of the vehicle by using OpenCV. For removing haziness and foggy images we use image enhancement techniques. So we use these different techniques to build better systems for the helmet detection and also extracting license/number plate numbers.</td></tr>
<tr><td>Team:

Supervisor:</td><td>Rongali Lalith Vardhan
PES2UG19CS337

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Yalipi Sushanth
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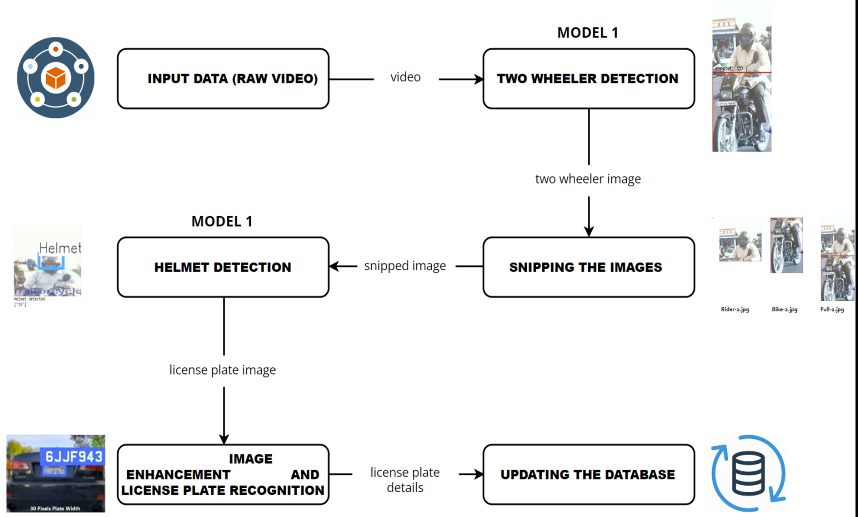
PES2UG19CS445

Dr. Prajwala T.R</td><td>Architecture/flow diagram

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