International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 07 | July 2022 www.irjet.net p-ISSN: 2395-0072

Deep Learning Based Vehicle Rules Violation Detection and Accident Assistance

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Abstract - *There's be high growth in population and most of the people prefer comfort. Nowadays a greater number of automobiles are being purchased in cities and also in growing rural areas. Due to more number vehicles results in heavy traffic, and controlling traffic is becoming more and more tough for the traffic police to handle. Other effect is a greater number of accidents occur which may lead to loss of several lives. In these situations, it creates necessity for develop a effective system that helps in detection of traffic violations and help in regulating the traffic rules and reduce inconvenience to the people. This proposed system can be put it in use in detecting violations such as Signal jumping, Triple riding, Helmet detection, No parking and can also detect the accidents that occur and the found traffic violators can be apprehended for breaking these rules, this framework is to assist traffic police who monitor the traffic manually in the IT cell.*

Key Words: **Violation Detection, YOLO ,Convolutional Neural Network, Accident Assistance, Image AI**.

1.INTRODUCTION

A Traffic violation detection framework must be realized in real time as the specialists track the streets all the time. Hence, traffic police will be at ease in actualizing safer roads precisely, but moreover effectively; as the traffic detection system identifies violation quicker than people. A better framework that is easy to use and work well in monitoring the traffic and taking actions against those violators and detecting accidents and providing assistance is established. This framework is to assist traffic police who monitor the traffic manually in the IT cell and also with the live camera monitoring present in those TMC's (Traffic Management Centre) it is easy to track the violation and if there's any accident found or detected it can be assisted right away without any delay. The monitoring framework can be scaled exterior the city to provincial & thruways without extra taking a toll. Since the video is being captured the total city will be covered rather than only signals and intersections. This moreover enables traffic police to capture traffic violation happening in little paths to thruways wherever the camera is present. These monitoring of violations and assistance to accidents can be efficiently be monitored and tracked in Traffic Management Centre /Traffic Operations Centre's. TMC have high-speed monitoring system, with 360-degree surveillance input and also the systems will have high GPU which is very much required for this framework to work effectively and efficiently. In Figure 1 we can observe the TMC [Traffic Management Center] where the majority of presented system will be put in use.

Figure 1: TMC [Traffic Management Center]

1.1 Literature Survey

The Framework that previously existed was only able to identify a single violation and also the captured images by the traffic police were not enough for proper identification of the violators. The captured images or the video by the traffic police were sent the IT cell where the footages were checked manually to identify the violator. Because of that many violators would be left out and would go unrecognized. As this is handled manually, it gets to be a tiring work for the group to continuously screen the screens and not let any violation go undetected through such tremendous traffic within the nation.

2. PROPOSED SYSTEM

The objective ofthe project isto computerize the traffic rul es violation location system and also this framework is to assist traffic police who monitor the traffic manually in the IT cell and make their job at ease. At TMC or Traffic IT Cell they screen live video streams of traffic and with the help of the proposed framework the violators will be detected easily and because of the system high-speed processor there won't be any delays. Once the violations are detected the framework checks for the number plate, once. that is

identified a SMS alert is sent to the violator. If any accidents are detected in the live streams, then a swift assistance can be delivered to that location with the help of TMC. Identifying and following the vehicle and their activities precisely is the most need of the framework. With the help of this, Police officers can be at ease and will be able to identify the violations that are in the traffic footage and also be able to get the details of the violator's vehicle from the image and the videos.

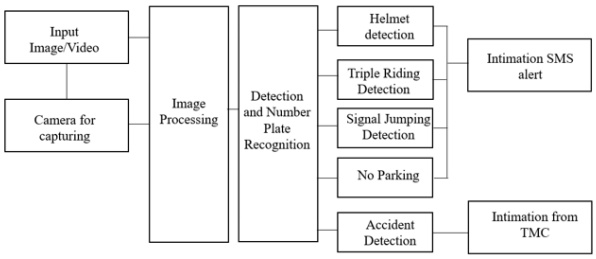


Figure 2: System Architecture

The figure 2 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 jumping and no parking are all detected.

2.1 Data Acquisition

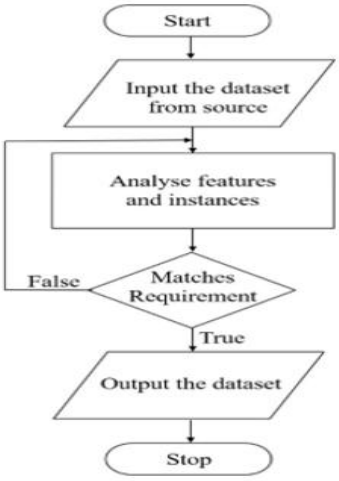


Figure 3: Data Acquisition

As shown in the Figure 3 the information set is collected from a source and a total analysis is carried out. The picture is chosen to be utilized for training/testing purposes as it were in the event that it matches our requirements and isn't repeated.

2.2 Pre-Processing the Data Set

The Figure 4 shows how the dataset is involved in converting the image from the RGB format to greyscale to ease processing, the use of an averaging filter to filter out the noise, global basic thresholding to remove the background and consider only the image and a high- pass filter to sharpen the image by amplifying the finer details. In initial step of pre-processing is converting the image data from RGB to Greyscale. It can be obtained by applying the below formula to the RGB image.

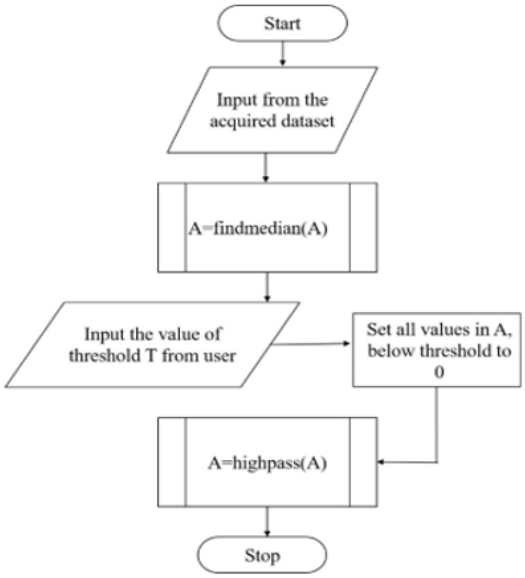


Figure 4: Pre-processing the Dataset

Noise Removal:

Noise removal algorithm is the method of removing or diminishing the noise from the picture. The noise expulsion calculations reduce or expel the visibility of noise by smoothing the complete picture clearing out regions close differentiate boundaries. Noise removal is the second step in image pre-processing. Here the grayscale picture which was gotten within the last step is given as input. Here we are making utilize Median Filter which could be a Noise Removal Technique.

2.3 Feature Extraction

We utilize a strategy called Histogram Orientation Gradient (HOG) to extract the highlights from the pre-processed picture gotten as input. In Figure 5 we can observe the feature extraction from the image. It includes different steps like finding Gx and Gy, which are gradients about every pixel within the x and y axes. After calculating Gx and Gy, magnitude and angle of each pixel is calculated using the formulae mentioned below.

Magnitude (μ) =√(G_x^2+G_y^2) Angle(θ)=|(tan-1)(G_y/G_x)|

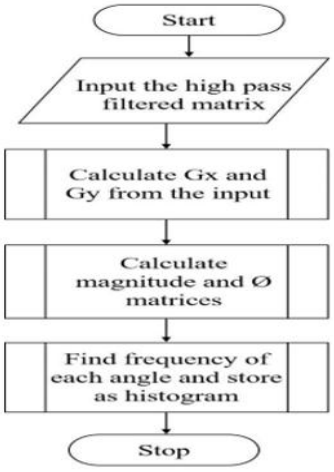


Figure 5: Feature Extraction

2.4 Classification using CNN:

When CNN is used for classification, we don't have to do feature extraction. Feature Extraction will also be carried out by CNN. We feed the pre-processed image directly to CNN classifier to obtain the type of required data that is present. As shown in the flowchart figure 6 classification of matrix is done in step-by-step manner.

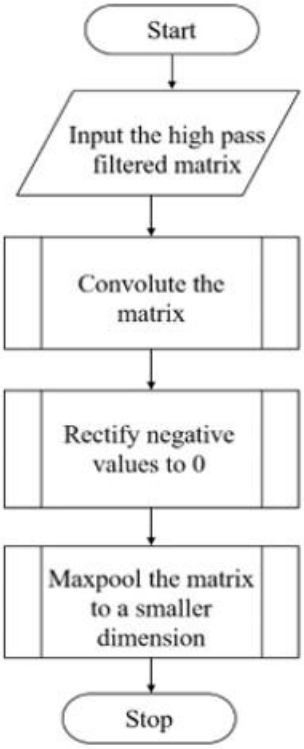


Figure 6: Classification using CNN

2.5 Violation Detection

a.) Yolo: YOLO also known as 'You Only Look Once' is based convolutional neural networks (CNN) to identify objects in real-time. This algorithm performs by putting in a single neural network on a full-sized image and then that image is divided in several sub parts and with the help of bounding boxes and the probabilities for each of those boxes are predicted. Any image that is inserted will be applied with grid lines then each grid box is check for the probability of the trained image. If an object center is appeared within a certain grid cell, then that cell will be responsible for detecting it. A bounding box is nothing but a outline that shows up an object in an image. As shown in the figure 7 a person is detected within a bounding box. It uses a single bounding box regression to predict the height, width, center, and class of objects. For Optimizing it uses the sum-squared error loss function which is a better way to optimize the images.

Figure 7: Yolo bounding box

b.) OCR: This algorithm is mainly used to pinpoint certain fragment or the figure in computerised image or in a video stream. In the presented framework as shown in the figure 8 OCR is used for Recognition of Characters on the License Plates. The algorithm is not only restricted for pointing out the words, it is also able to identify and read numbers and codes that are present in the input. Its applications are abundant across many industries for pointing out long string characters and letter along with serial numerical. In the figure we can observe the recognition of number plates.

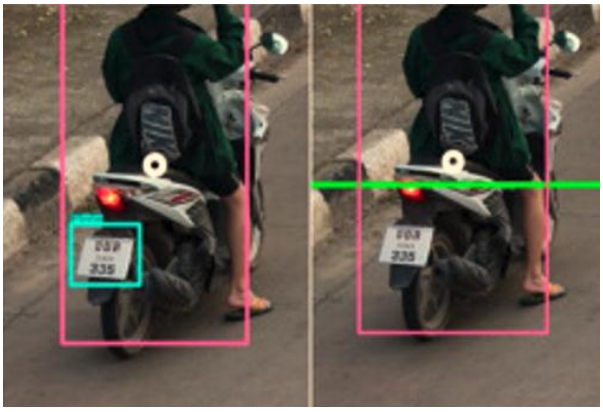


Figure 8: OCR for Number Plate Recognition

c.) Image AI: This is an open-source python library that is built on TensorFlow, it would help developers to build applications and systems that have self-contained Deep Learning and Computer Vision capabilities using simple and less line of code. Image AI gives an awfully strong still simpler to utilize set of classes and function modules. that would help in performing complex video object detections and also in tracking and video analysis. It supports many other deep learning algorithms such as YOLO V3 and Tiny Yolov3 etc., This library does require high speed GPU to run smoothly as it provides fast and accurate outputs. In the presented system this library is used for detecting the accidents that occur in video footages or in an image input.

3. RESULT & CONCLUSIONS

This presented system can be utilized for tracking violations and also in providing assistances for any occurring accidents. These tasks can be tracked in TMC/NOC's. Traffic violations can be detected efficiently with the algorithm proposed. The program runtime on a normal computer is slow whereas in GPU system or high processing speed capacity computers it will be quite fast. The framework provides an effective way to identify the vehicles that violates traffic rules and by tracking the accidents it gives a way to assist the accident scenes faster.

Figure 9:

When the figure 9 is uploaded, at first Motorcycle is detected, then its checks for other violations and identifies the violation as triple riding .below is the output.

```
best.pt --source triple1.jpeg
detect: weights=['best.pt'], source=triple1.jpeg
[640, 640], conf_thres=0.25, iou_thres=0.45, max
se, save_txt=False, save_conf=False, save_crop=F
, agnostic_nms=False, augment=False, visualize=F
/detect, name=exp, exist_ok=False, line_thicknes
f=False, half=False, dnn=False
YOLOv5 🚀 2022-4-7 torch 1.10.2+cu102 CPU

Fusing layers...
Motorcycle detected
checking for traffic violation
triple riding Detected
detecting licence plate
Speed: 1.5ms pre-process, 212.2ms inference, 1.8
 640, 640)
Results saved to runs/detect/exp67
```

Figure 10:

When the figure 10 is uploaded, at first Motorcycle is detected, then its checks for other violations and identifies the violation as triple riding and no helmet violation is detected as shown below.

```
[main 2022-04-27T03:32:33.730Z] ExtensionHostStart
[main 2022-04-27T03:32:42.412Z] Waiting for extens
[main 2022-04-27T03:32:42.911Z] Extension host wit


C:\Users\priyanka\Desktop\Phase 2 ppt\triple_ride\
detect: weights=['best.pt'], source=ride.mp4, data
max_det=1000, device=, view_img=False, save_txt=Fa
ostic_nms=False, augment=False, visualize=False, u
ness=3, hide_labels=False, hide_conf=False, half=F
YOLOv5  2022-4-25 torch 1.10.2+cpu CPU

Fusing layers...
Motorcycle detected
checking for traffic violation
no helmet
triple riding Detected
```

Figure 11:

When the figure 11 is uploaded, at first vehicles are detected, if it is detected then its checks for red color in image and if

identified it shows violation as signal jumping in the below output.

Figure 12:

The figure 12 is identified by the system as it checks the vehicles for violating no parking. Output is shown below.

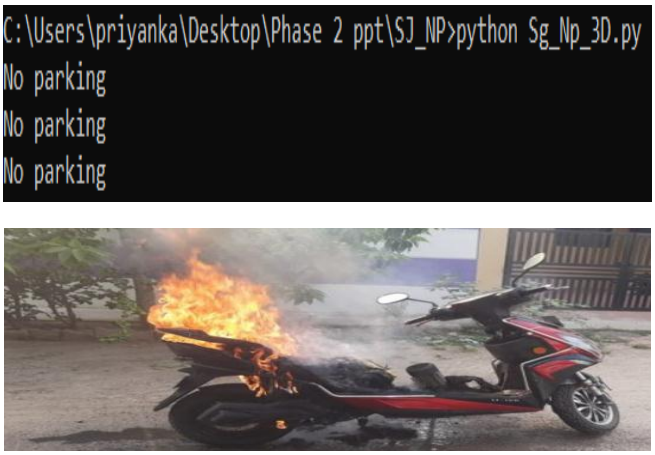
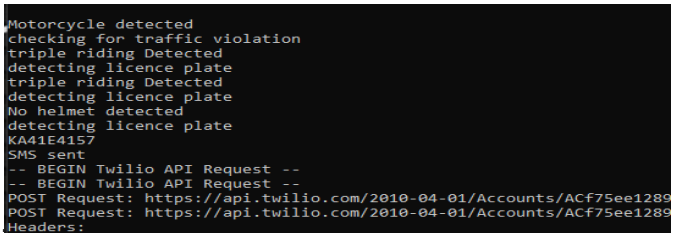


Figure 13:

In figure 13, accident is detected, we can observe the predictions and probabilities. The predictions are done for identifying fire in the scene, sparse traffic, dense traffic and accidents.

Figure 14:

In figure 14, the use of OCR algorithm can be observed. The number plate is detected with the help of openalpr API and the result is as shown. After detecting number plate SMS intimation is sent to the violator.



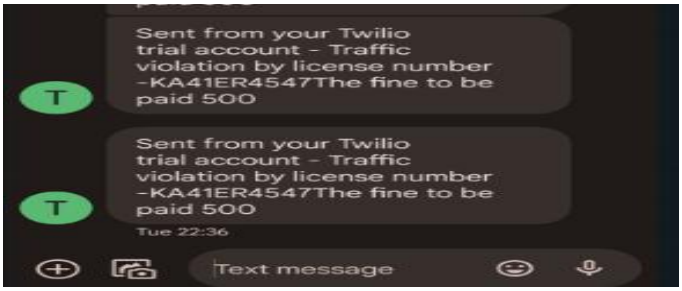


Figure 15:

In figure 15, we can observe SMS alert that is sent by the system after identifying the violator's number plate.

CONCLUSION

The presented system will be able to supplement the work of traffic police and assist them in pin-pointing the violations. And also, it makes their job easier to control the traffic and take any required measures against the violators. It creates consciousness within the people of the county to strictly follow the traffic rules. Detecting accidents in a live stream and also in the recorded videos helps the TMC to take actions faster and provide assistance in better way.

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