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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 automat- ically 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 utilize 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.

***Index Terms*— 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.
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 cannot 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

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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 processes 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 help 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 pro- cessing 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.

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

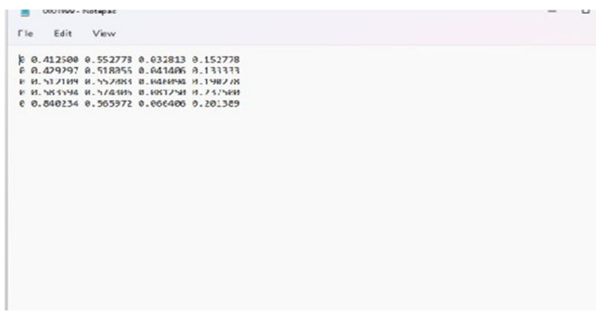

Figure. 2. Coordinates of bounding boxes

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.

Figure. 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.

- 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 get 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-wheelers 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.

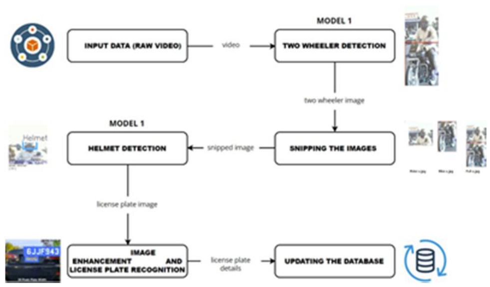

Figure. 4. Architecture diagram

Figure. 5. Output for the single rider and no rider

- If there are no two-wheeler in the frame passed to the model (fig 5).
- If there is a single two-wheeler in the frame (fig 5).
- 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 all the two- wheelers. (fig 6).

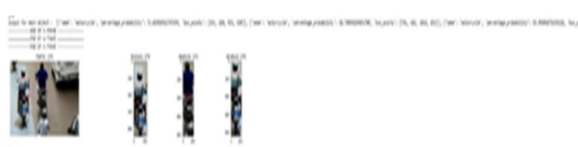

Figure. 6. Output for multiple riders

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

Figure. 7. probability and bounding box coordinates for every bike found

- Every two-wheeler is represented with a bounding box, every two-wheeler bounding box coordinates and probability of finding vehicle is represented (fig 7).
- 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 8).
- The last phase is the detection of license plate of the riders who are not wearing helmets (fig 9).

Fig. 8. Output for helmet detected and not detected

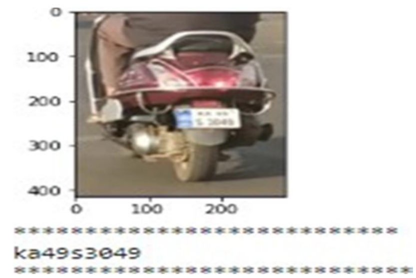

Fig. 9. Output for text extraction from license plate

V. Conclusions

Our study seeks to identify motorcycles, classify them according to whether they are wearing helmets or not, and read their license 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 license 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 license 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 license 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.

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