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Helmet Verify : AI Detection System for Safety Check

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Abstract: *In many nations, motorcycles are a common form of transportation. However, riding a motorcycle comes with a great risk when the correct safety equipment is not used. Therefore, wearing a helmet is highly recommended to promote safety while riding a bike. It is vital to build an autonomous helmet detection system that can identify the offenders on motorcycles in order to eliminate this manual dependency. Many riders choose not to wear helmets while riding two-wheelers or only do so when there are traffic police present. The goal of this study is to create a real-time autonomous system utilizing the YOLO deep learning method. A form of CNN called YOLO is suitable for real-time object detection.*

Keywords: CNN-Convolutional Neural Network, R-CNN-Region based CNN, YOLO-You Only Look Once, SVM-Support Vector Machine, IDE-Integrated Development Environment, CCTV-Closed Circuit Television

I. INTRODUCTION

In India majority of the vehicles owned are two-wheelers and people tend to ignore the safety gears while riding motorcycles. Consequently, most of the accidents caused in India are due to motorcycles, almost over 63% of accidents involve a motorcycle. These numbers seem more alarming as the reports suggest that every hour average of 67 accidents take place, where almost 20 people die in those 67 accidents. In order to reduce the fatality of these accidents, the government has mandated helmets while driving bikes. The manual strategies to catch violators have several drawbacks such as interrupting traffic flow, unpleasant weather conditions for police personnel, etc

Many strategies have been proposed in recent years to handle the challenge of object detection. Background subtraction was utilized by A. Adam et al. [7] to identify and differentiate between moving vehicles. They used SVM to categorize helmets in this instance. Waranusat et al. [4] classified helmets using a technique to detect moving objects based on a kNN classifier. The degree of precision that might be attained by these models, which were postulated based on statistical data from photographs, was constrained. With the evolution of neural networks and deep learning models there was further improvement in the accuracy of classification. A CNN-based technique for object recognition and classification was introduced by Alex et al. A. Hirota et al. [6] classified riders using a CNN. Even when they employ CNN, the precision of their helmet detection is limited to coloured helmets and the number of riders on a single motorcycle.

Also, role of ML and ESPs [13-72] are becoming important in recent applications, recognition and control.

We develop our model using a CNN extension known as YOLO due of its remarkable feature extraction capacity. This paper walks you through the process of implementing an autonomous helmet identification model that is trained with the DarkFlow framework and flags riders who are not wearing helmets.

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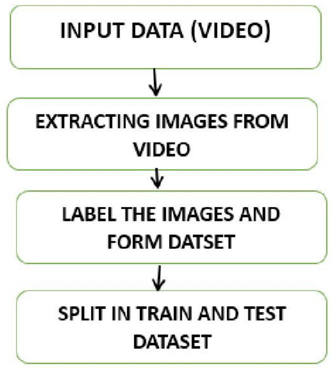
II. PROPOSED WORK

BLOCK DIAGRAM

Video Processing and Image Extraction



In this stage, we create our own dataset of images with riders with and without helmet on a bike. The input video is from CCTV footages around our campus and societies. Using a Python script, the images are extracted at specific frames of the video which have people riding bike. This script also labels images as per our requirement into two groups (People wearing helmets and people not wearing helmet). After that, we split these images into train and test dataset in 4:1 ratio.

Model Training

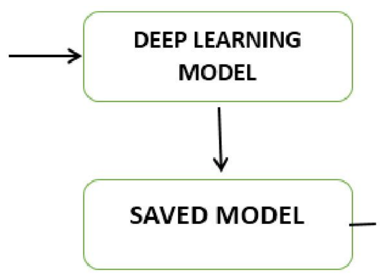


Fig.2 Model training Process

In this stage, a major concern was training a completely new model on our dataset, which would have costed us a lot of compute resources (heavy GPUs), to avoid this expensive affair we adopted the approach of "Transfer Learning" were a pre-trained model used to detect simple objects using YOLO algorithm was used as our base. On top of that, we used the custom-made dataset to train this model so as it would work in the situation we desire. The essence of Transfer Learning is to tweak the weights of the end layers to work as per our need.

Helmet Detection (using YOLO)

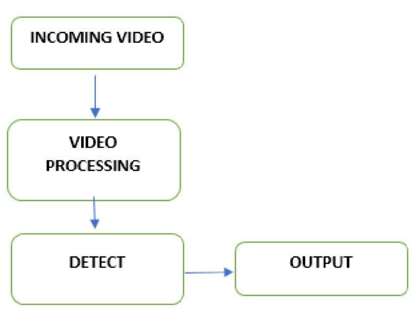


Fig.3 Process of Helmet Detection

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Here, the incoming video is imported into the model using the OpenCV library of Python. The video is split into frames which are passed on to the model for detection. These frames are fed to the model, which was trained on the custom-made dataset to detect people wearing helmets and red flag the violators. A key thing to note here is, the YOLO algorithm only propagates through many layers of the neural network only once for each image (frame) to detect the violators. This greatly increases the speed by which the model works.

III. RESULTS AND ANALYSIS

Fig. 4 Accurate prediction on pre-recorded video

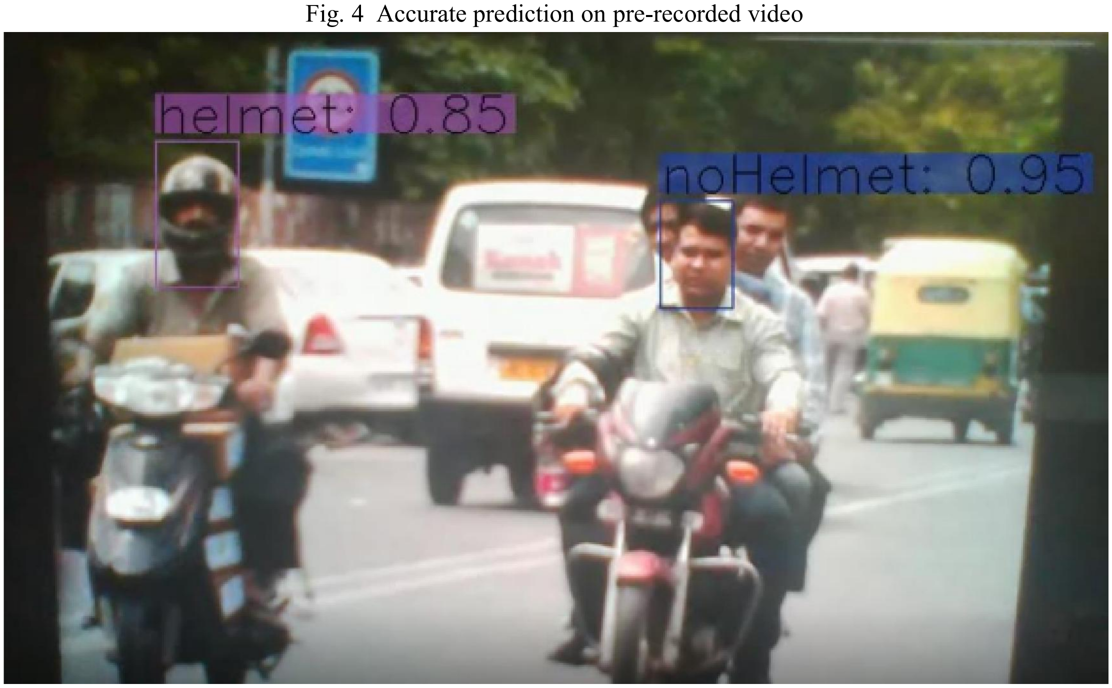

Fig. 5accurate prediction in a real time video input

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The proposed work successfully detects helmets on riders, Figure 5 shows us that our model ignores the pedestrians on road while detecting the rider wearing helmet which is desirable. Also, Figure 6 shows us that our model can easily discriminate among riders wearing and not wearing helmets in a single frame.

IV. PERFORMANCE EVALUATION

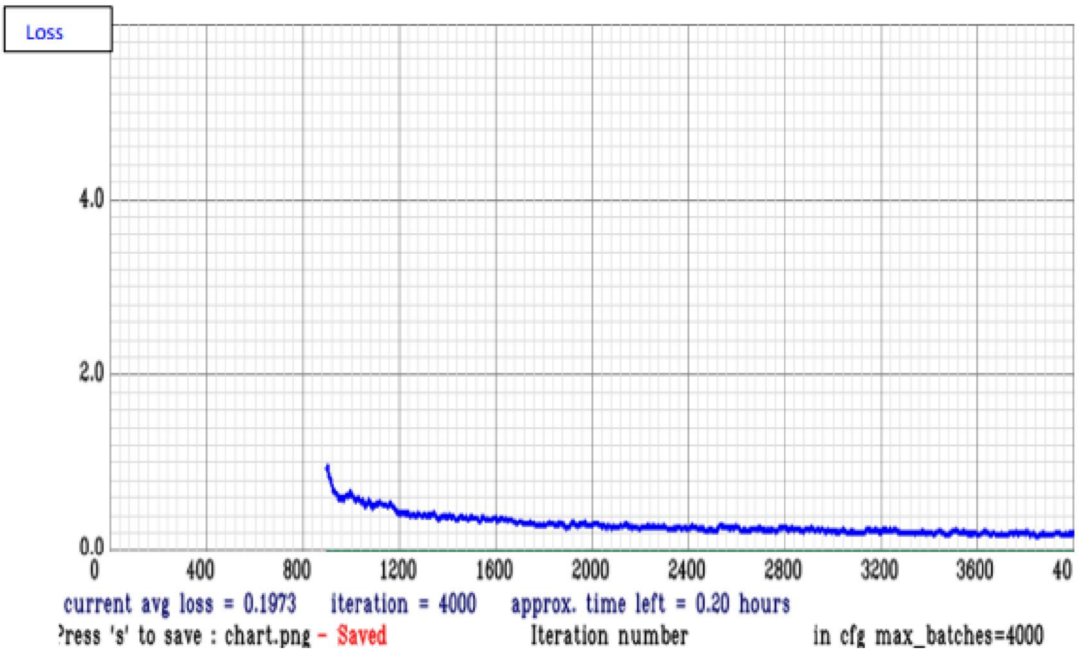

Fig. 6 Model Average Loss Vs Iteration

```
 calculation mAP (mean average precision)...
 Detection layer: 82 - type = 28
 Detection layer: 94 - type = 28
 Detection layer: 106 - type = 28
836
 detections_count = 1545, unique_truth_count = 1063
class_id = 0, name = helmet, ap = 98.31%        (TP = 619, FP = 22)
class_id = 1, name = noHelmet, ap = 94.03%      (TP = 405, FP = 27)

 for conf_thresh = 0.25, precision = 0.95, recall = 0.96, F1-score = 0.96
 for conf_thresh = 0.25, TP = 1024, FP = 49, FN = 39, average IoU = 73.52 %

 IoU threshold = 50 %, used Area-Under-Curve for each unique Recall
 mean average precision (mAP@0.50) = 0.961723, or 96.17 %
Total Detection Time: 533 Seconds
```

Fig. 7 mAP (Model Average Prediction) for Test Images

Figure 6 Shows us the model had a final average loss of 0.197 after training the model through 4000 iterations. Figure 7 Calculates the mAP of the model. mAP is a metric to find the accuracy of the model to detect a particular object. It compares the original bounding box value with the detected bounding box and returns a score, hence higher the mAP higher the accuracy. We can see from the Figure 8 that our model depicts accuracy of about 96% and an average detection time of 1.35 seconds, which is impressive for real time scenarios.

V. CONCLUSION

A reliable method to identify and flag motorcycle riders who are not wearing helmets is provided by the model described in this research. The ingenious approach to train the neural network using Transfer Learning technique along with the usage of open-source libraries in the code allows for the development of a cost-effective system to assist personnel to catch violators. YOLO algorithm used in our model shows us promising results, demonstrating its applicability in realworld situations. The outcome of this study can be utilized as the foundation for integrating this technology with fully autonomous systems, such as drones, to enable their operation in a wholly independent manner

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