Triple Riding Detection in Two Wheelers

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Abstract

India has an estimated amount of 3.7 crore motorcycles/mopeds and is thus home to the largest number of two-wheelers in the world. Due to this large number of motorcycles, a large amount of two-wheeler traffic accidents also happens. Triple riding on a two-wheeler is in violation of the provisions of the Motor Vehicles Act, 1988. Motorcycles/mopeds, which are meant to carry two persons, when used for triple riding can overload the vehicle due to accelerated wear and tear. Moreover, the increased load makes the vehicle harder to control and increases the braking distance thus making it dangerous. This project aims to address the problem of triple riding by creating an automated system which leverages deep learning convolutional neural networks.

Introduction

Triple riding is reported to be the second most common traffic violation immediately following helmetless driving. When triple riding, the two wheeler experiences an additional load due to the additional pillion which adversely affects the drivers control over the vehicle.In addition to this, the added weight increases the braking distance which can lead to mishaps.The two wheelers also experience accelerated wear and tear of the suspensions and engine when exposed to triple riding. The traditional systems have a great reliance on human intervention in order to be beneficial.Thus there is a need for an automated system which can detect the violation of the laws related to triple-riding.
Objective:- The main objective of this work is to create an automated system to detect triple riding violations by leveraging deep learning convolutional neural networks.This system aims to aid the law enforcement authorities by providing statistical information to them. Problem Statement:- Detection of triple riding on two wheelers in real-world data using deep learning.

MaskRCNN

Mask R-CNN is a deep learning model for image segmentation and object detection. Improvements over standard CNNs include a region aligning layer to preserve spatial information after pooling, and a small fully convolutional network (FCN) for generation of pixel masks of objects, which is done in parallel to class prediction and bounding box regression. This parallel branch is the main difference between Mask R CNN and Faster R CNN, which is the model on which it is based.

Proposed Approach

The proposed framework can be divided into the following 3 steps: 1) Detection of Two Wheelers and People We perform object detection using Mask R-CNN to detect two wheelers and people in the input video frame. This is achieved by running the Mask R-CNN object detection algorithm followed by segmentation in order to remove objects that are not of interest to the problem. Mask R-CNN outputs a dictionary containing coordinates for the bounding boxes, masks, and detection scores for the detected people and motorcycles.

2) Distance Factor Computation The goal of this step of the approach is to detect whether a given person is on the bike or not. This is achieved by calculating the distance factor (5).To detect if a person is 'on' the bike, we calculate the 'distance factor' for every person/bike pair in the image. The reasoning behind calculating the distance factor rather than raw distance was that the distance between the motorbike and people would vary drastically with distance from the camera as well as its angle. Distance factor on the other hand scales proportionally to these changes.

3)Triple Riding Detection With the distance factors for the motorbike-person pair obtained, the last step of the framework is the detection of triple riding. Experimentally a threshold was determined such that a distance factor falling below this threshold implies that the given person is on the given motorbike. Thus the counts of the number of people on every motorbike object is found and stored in a dictionary. If the count of people on a motorbike exceeds 2 the bike is flagged as a case of triple riding and is displayed in red in the output

Formulas

TP *: True Positve Cases*
TN *: True Negative Cases*
FP *: False Positive Cases*
FN *: False Negative Cases*
(x1,y1) *: Centroid of the Bike*
(x2,y2) *: Centroid of the Person*
BA *: Area of the Bike*

$$Precision = \frac{TP}{TP+FP} \times 100\% \quad (1)$$

$$Recall = \frac{TP}{TP+FN} \times 100\% \quad (2)$$

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} \times 100\% \quad (3)$$

$$False\ Alarm\ Rate = \frac{FP}{TN+FP} \times 100\% \quad (4)$$

$$Distance\ Factor = \frac{\sqrt{(x2-x1)^2+(y2-y1)^2}}{BA} \quad (5)$$

Figures

Figure 1:Some samples outputs

Dataset

1) MS COCO: The Microsoft Common Objects in context (MS COCO) dataset used to train the Mask R-CNN framework for object detection. 2) IIT-Hyderabad Dataset: The IIT-H dataset comprises traffic footage collected from the Hyderabad City CCTV Network. This dataset contains videos having different camera camera angles, varying illumination conditions, noise and an average frame rate of 25 frames per second (FPS). 3) Custom Images Dataset: We created our own Images dataset composed of images containing motorbikes with and without triple riding being present. The main objective of this dataset was to experimentally set the distance factor threshold.

Experimental Results

Metric	Score
Accuracy	94.01%
Precision	72.61%
Recall	74.30%
False Alarm Rate	3.61%

Table 1: Results

References

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Code Link

- https://github.com/sahil2k/triple-riding-detection