Grenze International Journal of Engineering and Technology, June Issue

Traffic Violation using Distance Estimation and CNN

Nakul R S[1], Neil[2], Shailesh Kumar Sharma[3] and Praveena T[4]
[1]1RV18CS097, [2]1RV18CS102, [3]1RV18CS149
[1-3]R V College of Engineering, Bengaluru, India
Email: nakulrs.cs18@rvce.edu.in, neilnagarajh.cs18@rvce.edu.in, shaileshkumars.cs18@rvce.edu.in
[4]Professor, CSE Dept, R V College of Engineering, Bengaluru, India
Email: praveenat@rvce.edu.in

***Abstract*—There has been an extensive need for an efficient model to approximate distances between objects on real time video surveillance. This paper presents a novel distance estimation to calculate distances from the stereo camera. The distance between contours of the vehicles is found using centroid formula and Euclid's estimation. The end product is a Machine Learning algorithm that provides an efficient solution to monitor traffic violations as well as swiftly catch the perpetrators on real time video.**

Index Terms— Stereo Camera, Traffic Violation, Euclid's algorithm, Cifar-10.

I. INTRODUCTION

The aim of the paper is to build and develop a project based on this ideology, but for practical uses not bound by National and International laws. This paper presents a well-trained and efficient model which will help estimate distance and traffic violations based on the sample dataset entered, this also includes highly efficient machine learning algorithms to implement the model and get a high accuracy.

II. LITERATURE STUDY

The state-of-the-art review mainly focuses on the current research works on object detection using machine learning. Distance detection can be considered as an object detection problem for classification and localization of vehicles in video imagery.

[1]. Pawarit et Narit. presented a comprehensive implementation of state-of-the-art model for distance estimation for stereo vision. It provides the base and proofs for various distance estimation techniques.

[2]. This paper relies on sound and the sensor that detects sound; hence interference is caused and provides a very accurate and state of the art distance estimation technique for robots.

[3]. This paper uses a very complex ML model which takes a lot of time to train and also uses the state-of-the-art technique for distance estimation using colours.

[4]. This paper uses methods that require to know the focal length between the distances of the camera and object as well as it also provides a very efficient model for removing the blur of the images.

[5]. This method has a low accuracy and also provides a method of pose estimation and facial estimation using distance estimation

[6]. This paper uses multi dataset and an efficient model for object specific extraction and the accuracies due to multi dataset are low.

Grenze ID: 01.GIJET.8.2.3

[7]. The Model used is slow due to the immense processing used and it uses a very effective model to give a very high accuracy.
[8]. Traffic violation alert and management uses an old method of detection which is slow and also provides a very efficient model to detect and store traffic violations.

III. Motivation

In India rapid urbanization and improved socio-economic status from the past few decades has resulted in high vehicular growth causing higher traffic incidents. There aren't enough solutions to this issue, hence we want to bring about a positive impact in our city where violators can be detected easily and
penalized for their violations. The idea was inspired from Military and Defence research projects which aim to track down enemy drones, identify hostile environments and identify criminals simply using satellite imagery.

IV. Problem Domain

- To be able to distinguish vehicles from non-vehicles in a given image.
- To be able to accurately predict the distance between two vehicles using distance estimation algorithms.
- To accurately predict the centroids of the vehicles in a given image to optimize distance estimation.
- To gather a dataset large enough with sufficient images in order to train the model.

V. Problem Definition

Traffic violation using Distance estimation and CNN. The objective of the project is to develop a well-trained and efficient and accurate model which will help us estimate distance and traffic violations based on the sample dataset entered.

VI. Statement

Traffic violation in an image is found using the process of detection of vehicles and then blurring of the background to find the distance between the two vehicles using Euclid's distance algorithm.

VII. Innovative Content

The architecture of the project consists of a distance estimation layer unilaterally dependent on the vehicle detection layer which in turn is dependent on a machine learning (object detection) layer. Starting with raw vehicle images as input, the project aims to design and implement code for the above specified roles to produce as output the segregation of vehicles that have violated the traffic rule constraint.

VIII. Representation

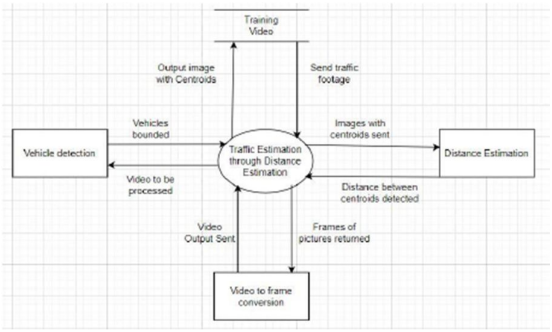

Fig 1: Representation of the project

IX. Solution Methodologies

Module 1 – Machine learning (Object Detection)

The first module uses Python to collaborate with Tensorflow and Keras API. We have designed an efficient architecture using both the packages to build a sophisticated convoluted neural network model using from the top up capable of detecting cars from static images. This model will be saved and used in the subsequent modules to come. Cifar-10 images are used to give a wide variety of objects to be detected. The end result of this model is to detect the objects into above classes on new images which we test on. The summary of the CNN architecture has a total of 289,443 parameters, with only 448 being non-trainable.

Module 2 / Module 3 – Mathematics and Video formatting

The rest of the project uses Python's OpenCv2 library and Yolov3 with some basic packages for distance estimation. Module 2 uses the above-mentioned packages to capture a video surveillance, process it and perform video enhancements. Module 2 focuses on using the machine learning model so created above to detect the different classes of images defined in real time video surveillance and segregated for the upcoming distance estimation module.

Between the transition from module 2 to 3, there lies an intermediate step to process the images for a better distance estimation. This step is again a machine enhancement model which reduces the background noise.

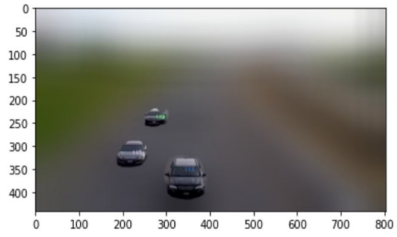

Fig 2: Blurred background of the test image

Once the contours are detected and images are processed, Module 3 uses Python's NumPy package also called as Numeric Python which provides complete mathematical functions to operate on. One such function, called the Euclidean distance is used here to find the distance between and two points. The Euclidean distance algorithm is used from all borders of the contours of the car with respect to the adjacent contours, thereby helping the officers in charge of traffic violation understand the commensurate distance of a violation.

X. Results and Sensitivity Analysis

A. Experimental Dataset

The project uses 2 different types of data-set. The first batch is used for a classification model. It is derived from pre-existing sources. The dataset consists of distinct images for cars, birds, flights, trucks and other objects. The idea is to use about three to four classes of the above mentioned in order to accurately perform a binary classification on the detection of vehicles and non-vehicles.

Fig 3: Few Cifar-10 classifier classes

The dataset above is pre-existing in the cifar domain and we can access it using TensorFlow as tf.keras.datasets.cifar10.load_data(). The pictures are blurred in order to increase the efficiency of the training model. The model obtained from the above dataset was able to classify the images on a 90 percent accuracy and store the weights for the modules to come.

The second type of dataset we are using is for the surveillance and the background noise reduction module. Once the trained classifier model is used on the real time video, we isolate the necessary images in order to augment the data and delineate the cars.

The dataset above is a class 2 dataset, meaning the classifier model has already acted upon it. The vehicles have been detected accurately and we can reduce the background noise and feed it into our distance estimation module.

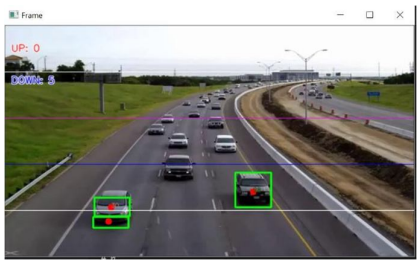

Fig 4: Secondary dataset

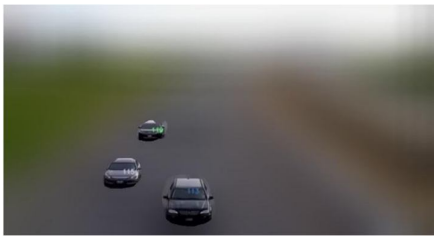

Fig 5: Augmented final data

B. Performance Analysis

Performance Analysis on the classifier model:

The machine learning model was tested on sample inputs (testing data) as well as in the real time surveillance video which is of the important hierarchy taking into note about our project. The model has a high accuracy of about 90 percent in classification alone.

C. Performance Analysis on noise reduction

The second pre-trained model for background noise reduction using transfer learning was to reduce noise even to the tiniest details, looking into all the aspects of the x,y,z dimensions of the graph.

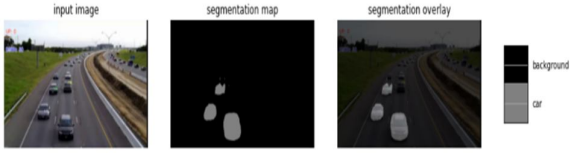

Fig 6: Augmentation model performance

D. Performance Analysis on distance estimation

Distance checking was performed on multiple varieties of images with less traffic to slightly denser traffic. The performance of the module is shown below. The distances were estimated extremely accurately using Euclidean distance, considering all the dimensions of the image.

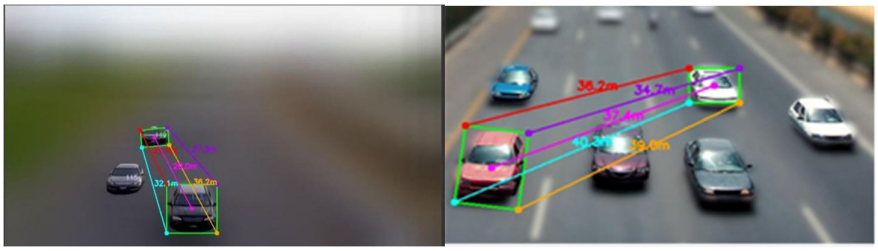

Fig 7,8: Distance estimation model performance

E. Unit Testing

Unit testing was performed on all the different models starting from classification to distance estimation. Below are the necessary accuracy details for the same.

TABLE I: EVALUATION METRICS

Model	Accuracy
Classifier	92%
Object detection	90%
Background - Blur	93%
Distance Estimation	68% (Resize Ratio)

XI. DATA MODEL

TABLE II: DATA MODEL

Type of Input	Process Involved	Output
Video recording from CCTV Cameras	Video to Image conversion	RGB Images
RGB Images	CNN	Vehicle Detection
Vehicles Detected	Euclidian's Algorithm	Distance between Vehicles

XII. COMPARISON OF RESULTS

TABLE III: RESULT COMPARISON

Paper	Effeciency in Classification	Effeciency in Distance Estimation
Traffic Violation using Distance Estimation and CNN	90%	68%
Object Distance Estimation with ML Algorithms for Stereo Vision	87%	85%(Stereo Visison Only)
MINIMUM DISTANCE ESTIMATION : A BIBLIOGRAPHY	NIL	Mathematical Based Only
Real-Time Distance Estimation and Filtering of Vehicle Headways for Smoothing of Traffic Waves	NIL	55%
Distance Estimation of Colored Objects in Image	98%	95%

XIII. JUSTIFICATION OF RESULTS

The paper presented has an overall efficiency of about 90% for object detection and 68% for distance estimation. Although these data cannot be traditionally compared with the related works as they simply rely on mathematical formula based approaches or object detection in static images. The paper presented works on dynamic real time video footage and hence an efficiency of 68% is unlike any other paper obtained.

XIV. CONCLUSION & FUTURE ENHANCEMENT

An object distance estimation with Machine learning algorithms using a stereo vision system for calculating distances from the stereo camera to the required object is proposed. Throughout this project, the potential of machine learning algorithms to resolve the stereo distance estimation problem even by using the straightforward model and a raw dataset from the feature extraction technique has been brought about.
In the near future the amount of traffic police required to stand at junctions can reduce vastly along with more accurate machine learning algorithms to detect the exact violation as well as keeping lanes and not switching at random times to cause accidents. This model could also be used in other projects such as social distancing detection to make sure people are practicing social distancing during the pandemic. The project also gained key notices from mask detection which acts as a clause of violation in our project.

REFERENCES

[1] Pawarit Akepitaktam, Narit Hnoohom, “Object Distance Estimation with Machine Learning Algorithms for Stereo Vision", Chiang Mai, Thailand, 30 Nov. 2019
[2] William C. P, “Minimum distance estimation : a bibliography”, Institute of Statistics, Texas, 2007.

[3] Rahul Bhadani, Matthew Bunting, Benjamin Seibold, “Real-Time Distance Estimation and Filtering of Vehicle Headways for Smoothing of Traffic Waves”, ACM/IEEE International Conference, 2019.
[4] Arif Rahman, Nuryono Satya Widodo, “Distance Estimation of Colored Objects in Image”, AIP Conference, 2016.
[5] Daniil A. Loktev, Alexey A. Loktev, “Estimation of Measurement of Distance to the Object by Analyzing the Blur of Its Image Series”, International Siberian Conference on Control and Communications (SIBCON), 2016.
[6] Xavier P . Burgos – Artizzu Matteao Ruggero Ronchi, Pietro Perona, “Distance Estimation of an Unknown Person from a Portrait”, LNCS, volume 8689.
[7] Jing Zhu, Yi Fang, “Learning Object-Specific Distance From a Monocular Image”, IEEE/CVF International Conference on Computer Vision, 2019.
[8] Gafencu Natanael; Cristian Zet; Cristian Foşalău, “Estimating the distance to an object based on image processing”, International Conference and Exposition on Electrical And Power Engineering (EPE), 2018.