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Vehicle Detection and Counting for Toll Plaza

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Abstract: *Many highway toll collection systems have already been developed and are widely used in India. Some of them contain manual toll collection, RF tags, barcodes and license plates recognition. All of these systems have drawbacks that lead to some errors in the corresponding system. At toll plaza, all lanes have a mixed lane system that is, both MTC and ETC. The delay and queue is mainly due to this two different charging methods vehicles pass through the same lane. In addition, with the help of collected data and visuals onsite investigation, some additional causes of traffic .Considering all these causes, this is the paper proposes solution to these problems. In this project we are using SSD_Mobilenet_V1 architecture. It uses the TenserFlow algorithm, which helps detect objects using images, videos, or CCTVs. It will contain study of areas such as Image processing, image enhancement. The proposed model can support government agencies to dynamically manage the toll plaza. It will help to tally all the cars at the end of the day to help avoid frauds which can conducted by the toll booth attendee.*

Keywords: MTC, ETC, Tensorflow, Image Processing, SSD_mobilenet.V1

I. INTRODUCTION

India is the country where we can observe most extensively National highway. The government plans to do this at various stages completion of the project under construction. Government signed a contract with a private company to build Roads, ports and other specific infrastructure usually a yearly period. The investment amount is collected for vehicles passing through this newly constructed highway. This calculated amount is called toll tax. In India, urban transportation with large scale and high speed development has entered a new century. Speedy Urbanization and the number of cars are forcing the city transportation to face new challenges and road safety .The problem will be noticeable. All toll plazas on the highway are manually operated and the operator collects cash from the driver and issues a receipt. This process can be slow, and tollhouses are often crowded on busy highways. However, tollhouses have many lanes to move traffic as fast as possible. Some lanes can be modified or paid in cash, but there are other lanes called Express Lane. This is for users with an electronic passport connected to a vehicle. There is special detector recognizes the vehicle's electronic ID card and deducts the amount directly from an account such as a bank account. B.

Sr. No	Paper Title	Mechanism	Advantages	Disadvantages
1	Vehicle Counting and Automated Toll Collection System using Image Processing	Automatic Visual Inspection and flaw Detection with SGLC Approach (spatial grey level cooccmce	Automated toll collection system is user friendly. It can reduce traffic congestion at toll plazas which leads to avoid fuel loss.	Three algorithms SVM, Random Forest, Extreme Learning machines (ELM) are compared for Intrusion Detection
2	"Detection and classification of vehicles for traffic video analytics"	Fast Get Vehicle accuracy	This system can automatically count the number of vehicles, classify the vehicles by type, estimate the speed of the moving vehicles and determine lane usage	using two different datasets of traffic videos
3	"Pattern recognition for detecting	Provides good result in handling attacks	Handles attacks in wireless sensor networks	Affected by illumination conditions ,factors, depends

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	distributed node exhaustion attacks in wireless sensor networks,"			on field view and resolution
4	The future of computer forensics: A needs analysis survey	The paper states that most of the crimes are electronic crimes and need to be checked	Authors surveyed for computer forensics and reported the type of crimes	Limitation to manual inspection are low speed, high cost, inability to perform real time inspection
5	"MIS: Malicious nodes identification scheme in network coding-based peer to-peer streaming	categories statistical ,spectral and model	Papers provide framework of a system to improve the QOS on network by providing hash	Hash computation has been provided. The computational overhead is
6.	Computer Vision Based Vehicle Detection for Toll Collection System Using Embedded Linux	Kalman filter is very powerful algorithm as it is robust and efficient enough so that it can be implemented on embedded platform	*No special tag for vehicle is needed. * License plates are not likely to be duplicated *No chance of interference between adjacent lanes	The processing algorithms are computation intensive. Low reliability because of the complexity involved in image processing.

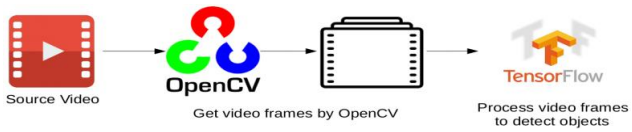
II. Proposed System

Vehicle detection and classification has been developed using OpenCV via image pixel manipulation and calculation. Vehicle classification and counting have been developed using Tensorflow Object Detection API.OpenCV (Open Source Computer Vision Library) is an open source computer vision and computer software library. OpenCVis designed to provide a common infrastructure for computer vision applications and to accelerate the use of machine sense in commercial products.

Source video is read frame by frame with OpenCV. Each frame is processed by the "SSD with Mobilenet" model developed on TensorFlow. This is a loop that continues working till reaching the end of the video. The main pipeline of the tracker is given at the above Figure.

Features of API -

1. Detect just the targeted objects
2. Detect all the objects
3. Count just the targeted objects
4. Count all the objects
5. Predict colour of the targeted objects
6. Predict colour of all the objects
7. Predict speed of the targeted objects
8. Predict speed of all the objects
9. Print out the detection-counting result in a .csv file as an analysis report
10. Save and store detected objects as new images under detected_object folder
11. Select, download and use state of the art models that are trained by Google Brain Team
12. Use your own trained models or a fine-tuned model to detect specific object



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The SSD paper: Single Shot MultiBoxhit a new high in performance and accuracy for object detection tasks, obtained over 74% mAP(Average Accuracy) at 59 fps on standard datasets like Pascal VOC and COCO. To understand SSD better, let's start by explaining where this architecture's name comes from

1. Single Shot: This means object locating and classification tasks are performed in a single pass over the network
2. MultiBox: This is the name of the bounding box regression technique developed by Szegedy et al. (we will cover it shortly)
3. Detector: Network is an object detector that also classifies detected objects.

2.1 MultiBox

The SSD bounding box regression technique was inspired by Szegedy's work on MultiBox, a method for fast categorical bounding box coordinate recommendations. Interestingly, in the work done on the MultiBox, an Inception-type convolutional network is used. The 1x1 transforms you see below reduce the size because the number of dimensions will decrease (but the "width"and "height" will remain the same).

The MultiBox loss function also incorporates two important components incorporated into the SSD:

- Reliability loss: This feature measures the reliability of the network for the objectivity of the computed bounding box. Categorical cross entropy is used to calculate this loss.
- Loss of location: This feature measures the distance between the predicted bounding boxes of

III. System Architecture

3.1 Detection

Object detection is an aspect of computer vision and imaging processing concerned with identifying instances of objects of a certain layers, such as vehicles or people, in electronic images and video. Common areas of interest in object detection include Pedestrian detection and face detection. Object detection can be applied to solve difficult problems in areas such as image retrieval and video surveillance. It is widely used in computer vision tasks including face detection, face recognition and object tracking. All object types have special properties that help in classificationsurname. For example, all faces are round. Object detection Algorithms use these special properties to identify objects in images and videos

3.2 Tracking

The purpose of tracking is to link the target objects sequentially image from video. This association can be very difficult complete when objects are moving rapidly relative to frame rate of the video. Things get more complicated when tracked objects change direction over time. In this scenario, video tracking systems often use motion modelling detailed information on how the target image can look like many possible orientations of the object. To track objects, an algorithm checks consecutive videos frame and return the movement of the target between frames. There are several algorithms used for object tracking, each with its merits and virtues.

3.3 Counting

Counting is the final step that includes determining the number of cars that have passed at a given time. Transport. The count can be recorded on the counting device or transmitted to a remote location over the Internet. A real-time system following request. This means detecting, tracking, counting and transmission must be done in a few milliseconds to a few seconds.

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IV. DATASET

In this work, 10 sample traffic video clips from the same location in two different times of the day (day and night) are used in the experiments. The video was recorded in Kuala Lumpur, Malaysia from 06 a.m. to 09 p.m. under clear-sky condition. Fig. 5 shows some examples of day and night images with different traffic volume and day-night illumination variations. Table I shows the video list recorded from a CCTV camera and time information used in the experiments. Only vehicles flow in one direction is considered for counting. These videos are then converted to frames and each frame becomes the input to object detection algorithm while, the output are bounding boxes with coordinate and object label. After that, three detector models are used for comparison to be selected as the best vehicle detector for the counting system. These model are chosen based on the popularity in both past studies and availability of pretrained models. Besides, they are widely used in industries for ease of implementation, especially on TensorFlow framework.

V. IMPLEMENTATION

5.1 Modules

- Data Collection
- Dataset
- Data Preparation
- Model Selection
- Analyze and Prediction
- Accuracy on test set
- Saving the Trained Model

VI. CONCLUSION

puneThis study explores as an aspect of building a robust vehicle detection and counting system management system capable of meeting toll challenges. It lays a good foundation to fix a critical component very important in developing a powerful solution: vehicle counting system.

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