A Synopsis on

Real Time Traffic Management Using Machine Learning

Submitted in partial fulfillment of the requirements
of the degree of

Bachelor of Engineering

in

Information Technology

by

Jyoti Tiwari (16104028)
Ankita Deshmukh (16104031)
Gayatri Godepure (17204002)

Dr. Uttam Kolekar
Prof. Kaushiki Upadhyay

Department of Branch Name
A.P. Shah Institute of Technology
G.B.Road,Kasarvadavli, Thane(W), Mumbai-400615
UNIVERSITY OF MUMBAI
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CERTIFICATE

This is to certify that the project Synopsis entitled ***"Real Time Traffic Management Using Machine Learning"*** Submitted by ***"Jyoti Tiwari (16104028),Ankita Deshmukh (16104031),Gayatri Godepure (17204002)"*** for the partial fulfillment of the requirement for award of a degree ***Bachelor of Engineering*** in ***Information Technology.***to the University of Mumbai,is a bonafide work carried out during academic year 2019-2020

Prof. Kaushiki Upadhyay
Co-Guide

Dr. Uttam Kolekar
Guide

Prof. Kiran Deshpande
Head Department of Information Technology

Dr. Uttam D.Kolekar
Principal

External Examiner(s)

1.

2.

Place:A.P.Shah Institute of Technology, Thane
Date:

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(Signature)

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(Jyoti Tiwari , 16104028)

_____

(Signature)

_____

(Ankita Deshmukh , 16104031)

_____

(Signature)

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(Gayatri Godepure , 17204002)

Date:

Abstract

The number of vehicles on the road is increasing day by day and the management of such huge traffic by traditional approach is not sufficient enough. In today's scenario the traditional approach works efficiently only if the count on the road is sparse, as the density of vehicles on a particular side of road increases or if the traffic is comparatively larger on one side than other side in such case the approach fails. Hence we aim to redesign the traffic signal, that is static switching to signal which can performs real-time signal monitoring and handling. So in this project the switching time of a signal will be decided on the basis of count of vehicles. Thereafter on the basis of count, switching time will be assigned to different led's which differs every time on the basis of density of traffic and this process will be repeated in a continuous loop. This practice can prove its most effectiveness in releasing the congested traffic at an efficient and faster rate.

Introduction

People in today's era prefer to use their own vehicles for commutation rather than public transport and this results in large number of private vehicles on road. This endless increasing amount of vehicles on road gives rise to many problems amongst them traffic congestion tops in every aspects. In such scenario one cannot restrict individual to limit the usage of their private vehicles but what we can do is at least manage traffic flow in a way that it doesn't alleviate congestion issues. The technological advance in various fields is growing rapidly, particularly

in the field of transport, namely Intelligent Transport System. Obtaining accurate real-time information of road traffic is a prerequisite of Intelligent Transportation Systems for traffic control and prediction. Many initiative has been taken to design a system that can perform real-time monitoring of traffic signals i.e. the traffic signal switching time will not be predefined one instead the switching time will be on the basis of the count of vehicles on each side of the road. This process of getting the count of vehicle on the road can be achieved using various object detection and tracking techniques. Our aim is to design and develop a miniature to

depict the current road situation along with monitoring and handling the traffic issues. Hence to proceed with this project we are using a pre-trained model YOLO to perform the task of object detection. The pretrained model YOLO uses OpenCV for ob-ject detection along with multiple foreground and background subtraction and removal of noise from the input image. The CCTV cameras that are being used for surveillance purpose can be made use to capturing the footage of the road, this image will be passed to the pretrained model as input image. To do so each side of the road will be divided into particular frames of same height and width for capturing the image. The count obtained from the image is the fed to the Raspberry board. As per the count obtained, switching time will be assigned for each side of road. The program will initially check if the count of vehicle in all frame is approximately same then the switching will remain at its predefined regular interval for all sides of signal, the real-time switching for the signal will be performed if the count of vehicles in all fames varies as threshold difference which be provided.

Objective

The main objectives are as follows:

1. To provide the sophisticated control and coordination on traffic.

2. Ability to recognize the current condition of traffic.

3. Improving safety on the road network.

4. Reducing congestion within and between cities.

5. To improve the traffic flow throughout the entire path by providing effective, real-time information to traffic controllers, thus enhancing system performance.

Literature Review

The papers reffered are mentioned below:

[1] Indrabayu , Rizki Yusliana Bakti , Intan Sari Areni , A. Ais Prayogi "Vehicle Detection and Tracking using Gaussian Mixture Model and Kalman Filter" , 2016 International Conference on Computational In telligence and Cybernetics Makassar , Indonesia , 22-24 November 2016

In literature[1], In this research of Vehicle Detection and Track-ing, Gaussian Mixture Model method was applied for vehicle de-tection and Kalman Filter method was applied for object tracking. The data used were vehicles video under two different conditions i.e. day and night condition. This research used (.mov) format vid-eo as input with frame rate of 25 fps and resolution of 640 x 480. Data was taken from top of a pedestrian bridge with static camera position. The detected foreground object is adapted with blob ar-ea. The object corresponding with blob area is detected as the ve-hicle object and marked by a bounding box. While the object de-tected as foreground but not corresponding with blob area will be ignored and is not marked by a bounding box. Validation of detec-tion system is conducted using Receiver Operating Characteristic analysis.

Fig 1.1 : Vehicle Detection & Tracking

[2] Li Xun , Nan Kaikai , Liu Yao , Zuo Tao "A Real-Time Traffic De tection Method Based on Improved Kalman Filter", 2018 3rd Interna tional Conference on Robotics and Automation Engineering (ICRAE) Guangzhou , China , 17-19 November 2018

In literature[2], Due to lack of current extraction methods for traffic basic data, a traffic information acquisition method based on improved Kalman filtering using traffic video was pre-sented in this paper. The Gaussian mixture model was improved for multi-vehicle moving targets detection. In order to further im-prove the detection efficiency, a heuristic improvement method was proposed. For the matching problem of multiple targets in the continuous video frame, com-bining the vehicle movement characteristic, the Kalman filter was used to estimate the vehicle position optimally, a real-time traffic detection method of matching the target chain was proposed. The proposed method can effectively improve the noise interference and foreground blurring in Multi-target vehicle detection, and can extract the vehicle moving target information from different traf-fic environments with high accuracy, different models and vehicle color. In the traffic detection process, mainly in the unit time through the vehicle as the test object, therefore, in the use of traf-fic video as the basic data, how two frames or adjacent video frames in the one by one corresponding to the vehicle, that is, no missing, no re-inspection, error detection and other issues, is the main content of this paper.

[3] Safoora Maqbool , Mehwish Khan , Jawaria -Tahir , Abdul Jalil , Ahmad Ali , Javed Ahmad Vehicle Detection, Tracking and Counting" 2018 IEEE 3rd International Conference on Signal and Image Pro cessing (ICSIP) Shenzhen , China , 13-15 July 2018

In literature[3], This paper presents a low-cost camera-based algorithm in order to control traffic flow on a road. Background subtraction is used to isolate vehicles from their background, Kalman filter is used to track the vehicles. This algorithm is implemented on both daytime and night time videos acquired from CCTV camera and IR camera. In this paper, we propose a computer vision-based vehicle detection, counting and tracking method that uses a Gaussian mixture model for background subtraction which yields a foreground mask. The foreground mask thus obtained is then processed using the morphological operators to eliminate noise. The BLOB analysis technique then helps in clearly discerning the vehicles from the background. In this paper uses Gaussian mixture model which has an advantage of detecting more minor details in foreground extraction because this method basically computes the PDF corresponding to every pixel in a frame which means that it is more flexible in terms of cluster covariance.

[4] R. Krishnamoorthy , Sethu Manickam "Automated Traffic Moni toring Using Image Vision" ,The 2nd International Conference on In ventive Communication and Computational Technologies (ICICCT 2018) Coimbatore , India , 20-21 April 2018

In literature[4], In this system automates the traffic signal lights with the assistance of multiple CCTV cameras connected over the Internet. Here the process comprises two primary phases: Vehicle Detection System and Traffic Scheduling Algorithm. Vehicle De-tection shall

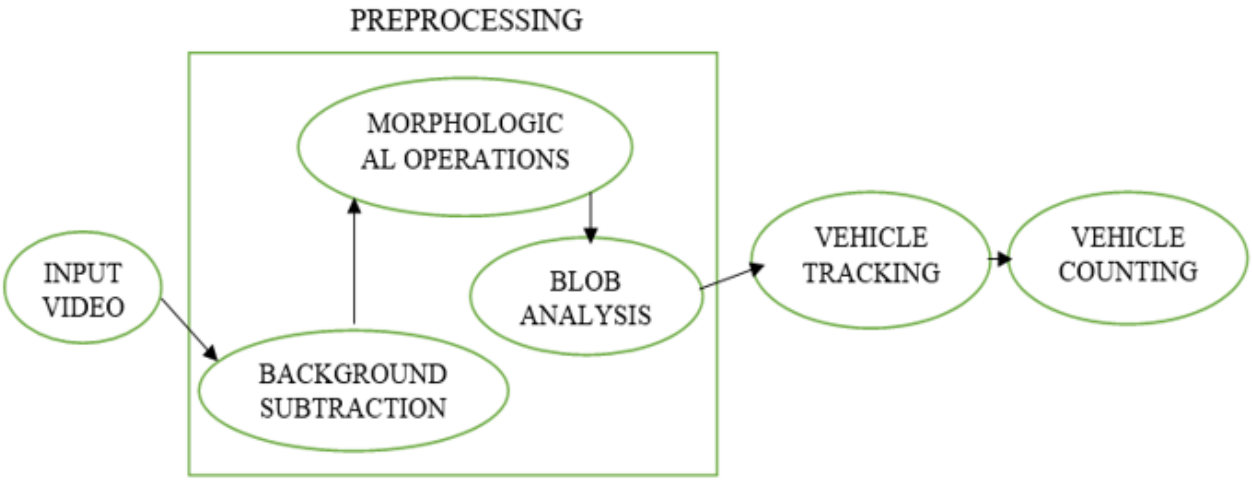


Fig 1.2

be carried out in Digital Image Processing (DIP) by applying a simple kernel-based Edge Detection in Spatial Domain followed by an algorithm to detect the perimeter of closed figures while simultaneously applying the concepts of Machine Learning to classify the vehicle type into the following categories of motorcycle, light motor vehicle, and heavy motor vehicle. The points taken into consideration are low com-plexity, greater efficiency, and faster process time without compromising on the accuracy of the results. The resources used are 2 MP CCTV cameras having a frame rate of 15 frames per second. In that respect, this system is found to be ex-tremely efficient.

[5] Jess Tyron G. Nodado , Hans Christian P. Morales , Ma Angelica P. Abugan , Jerick L. Olisea , Angelo C. Aralar , Pocholo James M. Loresco "Intelligent Traffic Light System Using Computer Vision with Android Monitoring and Control" , Proceedings of TENCON 2018 - 2018 IEEE Region 10 Conference Jeju, Korea(south) , 28-31 October 2018

In literature[5], The system worked with CCTV cameras positioned at every lane of the intersection for the acquisition of traffic images transmitted to the Raspberry Pi 3 mi-crocontroller for traffic density calculation using image processing. It utilized a traffic monitoring system and traffic lights operation control via a mobile android-based application. The model acquired traffic images from four lanes of the intersection then transmitted the data to the server. The microcontroller then collected the data gathered by the server and prepared the data for processing. The microcontroller then pro-cessed the captured images using image processing and sent the traffic density results to the mobile android-based application via Bluetooth. Then, a text was displayed on the mobile application indicating whether it is light, moderate or heavy traffic together with the system's vehicle count. An authorized user could view the mobile application and monitor real-time traffic situation of an intersection.

Problem Definition

With the highly rising traffic congestion all around the world, and it's management by traditional approach are not efficient for smooth commutation purpose hence there is a need to come up with a solution which can be globally accepted and would lead for the better management of traffic. In todays traditional approach the signal switches at its predefined regular interval, but the density of vehicles of the road at every signal doesn't remains the same as shown in fig 1.3, hence the static approach fails. Under such scenario, if the signal remains the same to switch at its regular interval then the side of road which is densely populated will always remain completely packed.

As mentioned in above systems designed till date are to getting vehicle count only, so that comparative study and analysis of traffic can be done. This model can work at its best at condition when traffic reaches to its peak, where the management by an individual becomes difficult. So our aim is to design a model, depicting the real-time traffic scenario and performing signal switching as per our criteria and conditions of threshold value.

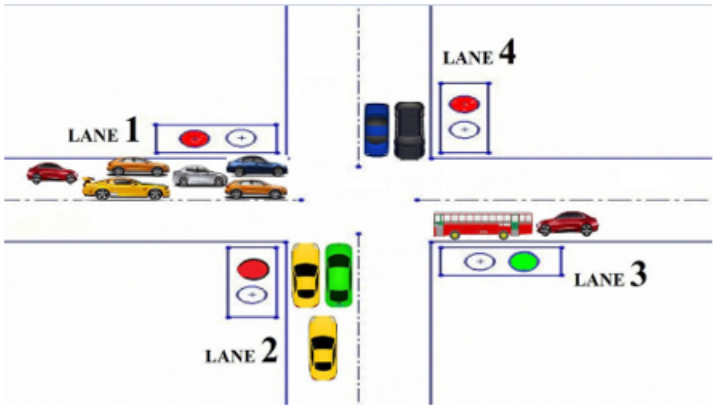


Fig 1.3

As shown in above diagram, the traffic at LANE 1 is densely populated with vehicles as compared to other three lanes. In normal signal switching method signal switching is done in clockwise manner which result in clogging of vehicles in a particular lane. To overcome the problem of assigning same switching timing for the signal even if the count of vehicles on the road is varying from lane to lane.

Proposed System

The model aims to provide a solution for current traffic issue by managing traffic signal on the basis of real time scenario. Here a pretrained model YOLO is used to perform the basic task of object detection, and correspondingly the count of the vehicles are stored in order to process further request of signal processing. Also the model is compatible with almost every type of camera, even the cheaper ones including the normal surveillance camera can be used to capture image at an initial level. Now the captured image will be passed to the model for vehicle detection purpose followed by vehicle counting process as shown in figure 1.4. This whole process of capturing image and detection will be repeated for all four sides of the road using one single camera i.e. pi camera, as pi camera is the most compatible camera for raspberry pi3 board. The camera will be fixed on a rotational motor (servo motor/stepper motor), so that it rotates 360 degree to capture image.

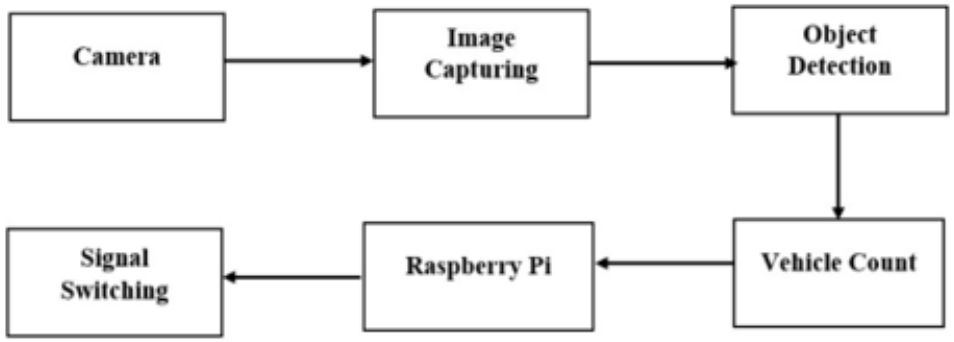


Fig 1.4 Block Diagram of the Proposed System

The captured image is then passed to a filter where the region is defined in terms of height and width, only vehicles present in that predefined region are detected and counted. This regions size remains constant for all image being captured. OpenCV is the library that plays important role in object detection, also as and when the object gets detected it forms a rectangular box around the object, so that one can even visually verify that the object detected as vehicle is actually a vehicle only.The count obtained from the image obtained from all for side of the road is now passed as input to the raspberry board. The raspberry computes the result by comparing all the count obtained from four different images.

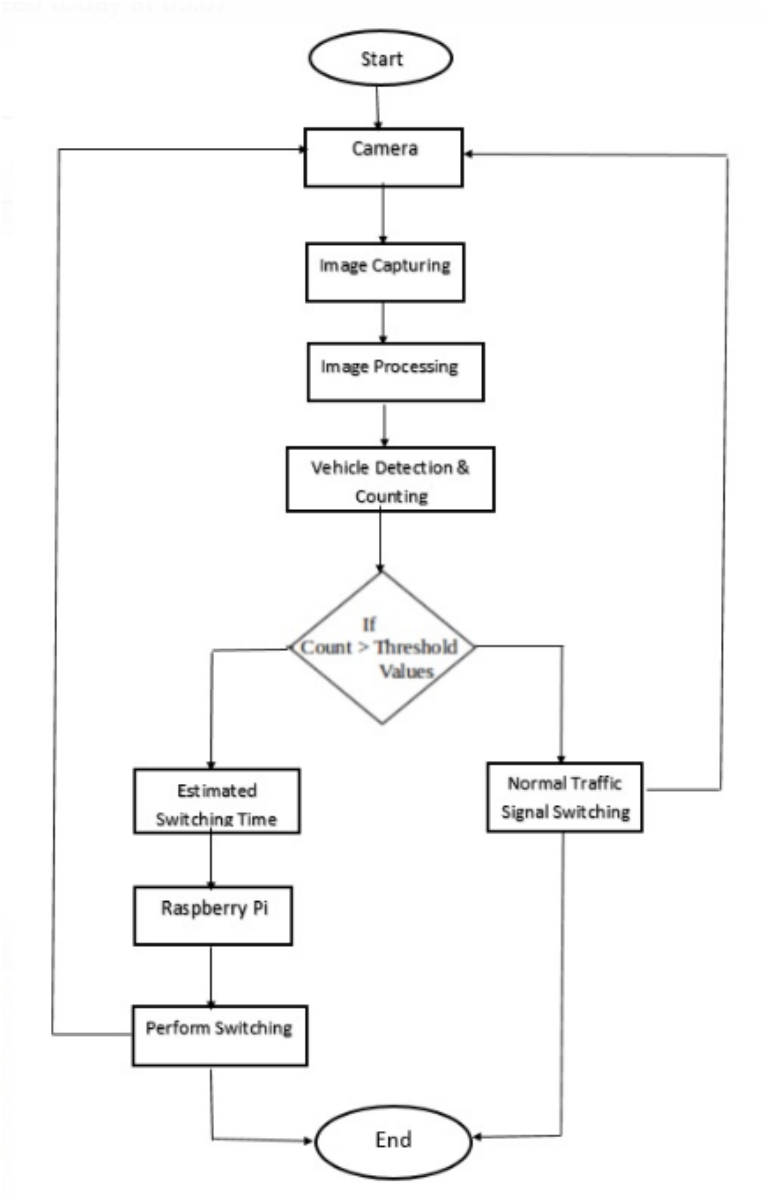
The model has some of its fixed threshold value fitted in to it, if the result form the four images is in limit of threshold then simple static switching will be practiced and every signal will be allotted with same switching time, as the traffic on all sides is either sparse or is densely populated by vehicles from all sides. Also in case if the computed result from either of signal crosses the threshold value than dynamic signal switching comes in to action. In dynamic switching the switching time will be assigned on the basis of how densely the road is jammed.

The model is designed keeping the point into consideration that the amount of traffic on all signal does not remains the same then how can threshold value remain the same, hence after few computational processes the model will learn by itself to set threshold value on the basis of how heaped signal is.

The figure shows how the camera capture and select image, how further process of detection and counting are taken forward to achieve the ultimate goal of performing real-time signal monitoring and according the signals are handled with the help of raspberry board.

Design and Implementation

A miniature model that depicts todays traffic scenario of various cities in urban as well as rural areas is constructed and considering the model as real time traffic situation, signal switching will be practiced on the model.



Initially with the help of camera image of all possible sides of the roads are captured. The task of image capturing will be performed by using a single camera placed at certain calculated height on the top of a steeper motor. Steeper motor is used to rotate the camera to 360 degree at a fixed rotational speed and capture the image, since the processing work will be done on raspberry board and interfacing of raspberry board with pi camera is very convenient, compatible and stable ,hence pi camera will be the best suited camera that can be used for image capturing purpose. The captured image is then passed to a yolo model which detects the object with its utmost accuracy when compared with other model. The detected objects are then bounded by colored rectangular boxes (different color for different vehicles) and are counted using an increment counted. The vehicles detection precision depends on the confidence and the threshold value provided by us.

The value stored in the increment counter is the actual count of number of vehicles present on the road, this value is then passed to the raspberry board. Similarly four different counter values are fed to the raspberry board. Here comes the computational role of raspberry, the board compares and computes the difference in count from all different side of road, it also check that the difference is not larger than threshold value, if so than every signal is assigned with different switching time so that the congested traffic get released along with the normal release, else the static switching at its predefined regular interval is done. While performing dynamic switching of signal computes the traffic density of all side of road and depending on density varying switching timing is assigned to the different leds of traffic light. Once time is allotted to the signal all the signal remains open for once, only after completing its one circle of open signal image is captured and fed to the board for the further processing.

For the implementation purpose we are successfully able to detect vehicle from an image of any extension (jpeg, jpg, jfif etc) passed to the model. Even we are able to collect the counter variable which depicts the density of traffic, and store them in a variable. This count is also fed to the Arduino board to check whether serial communication between the model and the board is established and we are able to receive replies from the board.

Summary

Real Time Traffic Signal Monitoring Handling system's aims to fix the problem of traffic which most of the cities in urban as well as rural areas are facing with the help of this project wherein the focus would be to minimize the vehicular congestion virtually without any installation of any kind of hardware. The setup only requires camera and raspberry pi board as its hardware requirement and the interfacing of hardware does not requires much wiring and interfacing thereby forming the setup as more portable. The model trained can be used for effective and efficient traffic flow without creating much chaos on the road. The model is prepared in such a way that it decide smart switching timing for the signal on all sides of the road so the no one has to wait for longer interval of time on the road and flow of traffic is smooth on the road.

References

[1] Indrabayu , Rizki Yusliana Bakti , Intan Sari Areni , A. Ais Prayogi “Vehicle Detection and Tracking using Gaussian Mixture Model and Kalman Filter” , 2016 International Conference on Computational In telligence and Cybernetics Makassar , Indonesia , 22-24 November 2016.

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[5] Jess Tyron G. Nodado , Hans Christian P. Morales , Ma Angelica P. Abugan , Jerick L. Olisea , Angelo C. Aralar , Pocholo James M. Loresco “Intelligent Traffic Light System Using Computer Vision with Android Monitoring and Control” , Proceedings of TENCON 2018 - 2018 IEEE Region 10 Conference Jeju, Korea(south) , 28-31 October 2018.

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1 Publication

Paper entitled **"Traffic Signal Handling and Monitoring"** is submitted at **"IEEE International Conference"**