GRID LOCK - "TRAFFIC DETECTION USING PYTHON AND OPENCV"

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Abstract: Traffic analysis has been a problem that city planners have been planning and developing for decades. There has been a number of ways developed to analyzed and streamline the traffic issue. At a particular period of time in a certain path, the count of vehicles is what is analyzed. The systems that are developed over the period are consisting of a number of sensors like a radar gun, microwave sensors, pressure tubes, magnetic loop, GPS based traffic analysis, etc. Over time the systems so developed have matured and are showing far better functionality than before. But the issue that exists with them is the high cost of the hardware resources, the lifetime of the sensors, limited information, reliability in various light and weather conditions, etc. The issue with them is that these systems require maintenance and periodic calibration. Therefore, this study has involved a computer vision based vehicle detection and counting system. The system involves a camera unit that gives us a view of the traffic in locality and then the system extracts every single frame of the video and then applies the Haar-cascade and number of graphical and mathematical modules on it which separates the vehicles from the background and then increases the count respectively.

Index Terms: **Vehicle detection, Vehicle recognition, Video surveillance, Video classification, Traffic Detection.**

I. INTRODUCTION

Cities have been expanding due to the massive population growth and migration, and so are increasing the requirements and the necessities of the millions of people living there. Bigger cities require larger and better roads and transportation facilities for its functioning, and thus the need for an efficient system for the management and the monitoring of the traffic. The traffic surveillance system has become a major part of the current existing cities and a need to have a better system have come to demand. There are various systems available in the market with their own perks and cons such as – magnetic loop, pressure tubes, radar gun, microwave sensors, etc. But these systems are mostly expensive and bulky and difficult to install. A better alternative to these is a video based traffic analysis system that has a large set of perks than cons.

Computer based systems are cheaper and better because of the increase in the storage capabilities, computational power. So in order to make it more automatic and computer based we have implemented various modules that introduces various new aspects and functionalities to the system. We use Haar-cascade classifier that takes wide place in the literature.

The main objective of the system is to introduce one that makes it easier to do multiple things using single and less cheap hardware such as a camera unit. On one hand, we are able to count the number of vehicles that are passing through a given path, detect the speed and lane that they are traveling on. The limits of other systems like the inability to work in the rainy season are handled by the vision-based system more properly. The perk of being less expensive than the other systems due to its cheaper hardware and less maintenance requirement have been in its favor for the first choice.

II. RELATED WORK

There have been various approaches to develop a system that can detect and classify the vehicles on the roads in motion and thus that could be used for traffic surveillance. The methods that were used and the logic involved along with the technology that was used to develop such systems is what we are going to discuss here.

Tursum, M and Amrulla G [1], were the people who proposed a video-based real-time vehicle detection and counting system. They used the optimized virtual loop method. A traffic surveillance camera was used to attain the video of the traffic and vehicles in motion, and the method was used to compute how many vehicles have passed. The counting system consisted of three steps by tracking vehicles movements within a tracking zone called the virtual loop.

Lei[2], was the one who developed another video based vehicle tracking system. In his system, the camera unit was purposely mounted at places which were high enough to capture a larger area. There were two main methods that were used in the system, 1. Adaptive background estimation and 2. Gaussian shadow elimination. Due to these two methods, the system was able to remove the background ghost effect and shadow that increased the efficiency of the system. But the drawback of the system was that due to camera placements at high altitude the system was not able to detect the type of the vehicle precisely.

Using a new method that involved the multiple virtual detection line and time spatial image, Mithun N.C., et al [3] proposed a similar vehicle tracking and detection system. KNN algorithm is used here to classify vehicles on the basis of the variations in their shaped and texture based features. Since this method also takes care of various illumination condition and have been proven to show better functioning and results.

Bas et al. [4] also proposed a method to count vehicles based on adaptive bounding box size to detect and track vehicles in accordance, with estimated distance from the camera. The region of interest (ROI) is identified by defining a boundary for each outbound and inbound in the image. Although the algorithm is improved to deal with some weather conditions, it is not able to detect the vehicles when they turn.

Intersections in city are the places where gridlock situation have higher tendency to take place. Habibu Rabiu [5] proposed a system in which he used background subtraction and kalam filter algorithm to detect and track vehicles and then classify them by the use of the linear discrimination analysis classifier.

III. PROPOSED METHODOLOGY

The system could be used for vehicle detection, lane detection, tracking of vehicles and its recognition. This system has three different paths:

1. Background Learning

2. Foreground Extraction

3. Vehicle Classification

Background subtraction is used to separate foreground image having vehicles from the background image.

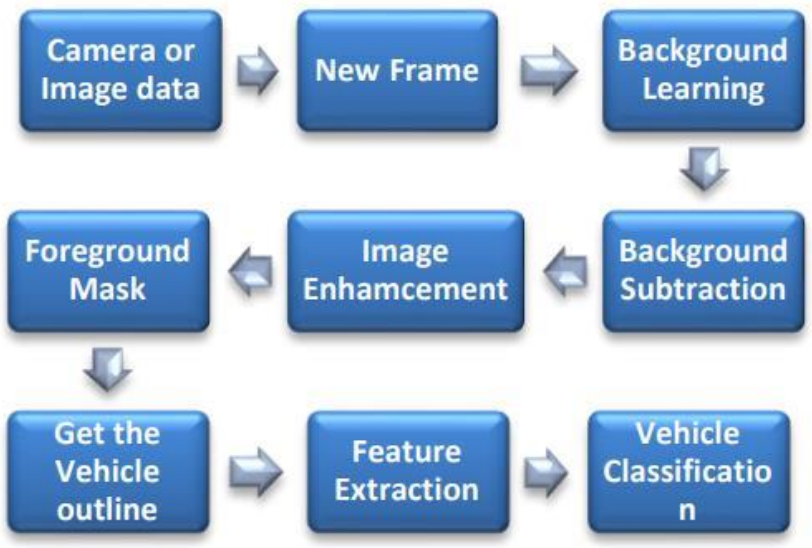

Figure 1: Block Diagram of Proposed Vehicle Detection Model

A. OBJECT DETECTION USING HAAR-CASCADE

The work we have done in order to detect vehicles using the haar-cascade classifier is depicted here. We have conducted the experiments in the NH24 highway near ABESIT College of Engineering. The location was easy for us to go and was one of the most highly used roads in Ghaziabad, India.

a) HARDWARE

The initial testing was done using a normal video camera of a smart phone that was used to capture the image and video of the traffic and the road for later use in the software. For testing the software, we set up camera module on the highway. We recorded 15 minutes long video of the traffic, multiple times so to get a input for the software.

b) SOFTWARE

We have tried and built various programs in order to develop this main software. Starting from detection of vehicles to tracking the vehicles on different lanes. We have used Python programming language for developing the software because python provides large set of standard libraries which helps in developing the software efficiently. OpenCV is one of the main library that we have used in our project along with other libraries.

IV. DETAILED METHODOLOGY

The first step in our project is to grab a data video on which we want to perform detection. After video selection, the system performs many tasks like detecting background, removing background, detecting vehicles, counting vehicles, etc.

A) OBJECT DETECTION

The first step in the process to count the vehicles is to detect them in the image. It might look very easy and also is easy for a human to detect the vehicles in the image but is not so for a computer to do so. Thus when we take the image as an array consisting of one value/one pixel, we are able to determine how the vehicles actually look like and thus define whether a vehicle exists in the image or not as we also have a clear image of the road with no vehicles on it. OpenCV is the tool that is used in order to check for the difference in the pixels of the existing stationary image of the road with no traffic. Firstly, it converts the RGB(Red, Green, Blue) image input to HSV(Hue, Saturation, Value) and then inspect each pixel.

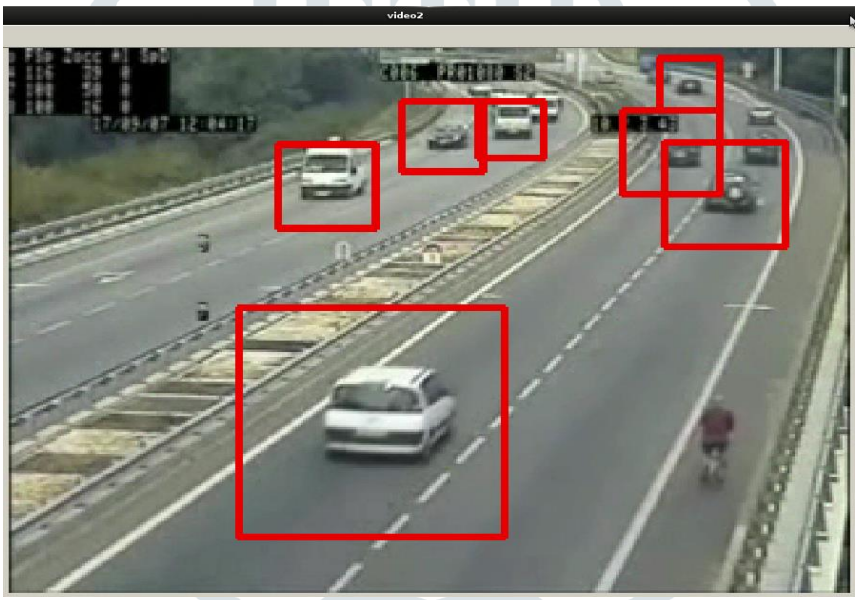

Figure 2: Vehicle Detection Using OpenCV and Haar-Cascade

We can use this information to determine the vehicle or no vehicle condition and so we can use this channel in our detection algorithm. It is very difficult to obtain an image with no traffic on it so we can use OpenCV to get an average out of the frames and create our background images.

On acquiring a background image we use OpenCV to detect when these values go above a certain value. We take this difference in the value of the pixels and we assume the difference as the presence of a vehicle and we increase the count. The pixels that have a different value than the one in the background image are represented as the bright spots in the image change representation and the object so are detected differently. The objects might be having some gap in the spots but they are filled up using the OpenCV library so that it does not cause any problem in the counting. Now the size of the spots are used to determine which vehicle is it and it is possible when we pass the spots through the vehicle counter algorithm.

B) BACKGROUND SUBTRACTION

The classifier that is used can produce false positive value and also false negative values. An additional layer was added to the algorithm in order to minimize the amount of false value before the classifier is applied in the image. This layer is having additional knowledge about the background as it contains only the things which are normally in it. This knowledge of the background gives an idea about what exists in the background on the input stream and where the vehicles are located. We have used mog background subtraction.

C) COUNTING VEHICLES

The vehicles counter is consisting of class objects, one called as a vehicle which is used to define each vehicle object, and the other vehicle counter which determines which vehicles are valid before counting them(or not). The object vehicle gives us information about each vehicle that is detected and is there in the images at a position, the frames it has appeared in, the direction in which it is going and whether we counted the vehicle yet, etc.

Vehicle counter is more complex and serves several purposes. To get an indication of what movements are true and which ones are false we use vehicle counter to determine the vector movement of the vehicles frame by frame. In order to get a more accurate result and no incorrect matching vehicles are detected, we use the vehicle counter to achieve the most accurate count of the vehicles.

V. CONCLUSION AND FUTURE WORK

The proposed work is implemented on python using OpenCV modules. A simple interface is developed to show the detection of images and vehicle count. Currently proposed system works with already captured videos but it can be modified to be used for live traffic videos by adding different hardware and microcontrollers.

The limitation of the system is that it does not work efficiently at detection of occlusion of the vehicles which decreases the accuracy of counting the vehicles. This problem could be solved by classifying the objects on the basis of color. Furthermore, the camera calibration techniques could be used because the camera angle also affects the system. The system could be improved for better accuracy using more sophisticated image classification techniques and artificial intelligence techniques.

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