

Vehicle Detention Using High Accuracy Edge Detection

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Abstract—Traffic violation and signal jumping have become a very common and there are no ways of tracking the culprits, at least not in the least expensive manner. The proposed model in this project has the main objective of detecting the velocity of the vehicle which has gone above the speed limit. In this paper we propose a model that will measure the velocity of desired vehicle and also detect the registered license plate number. Many researchers developed some systems with advanced technologies for traffic-violation detection in action and taking photography of incidents for records. In comparison with the traditional traffic violation detection technology, the video-based image processing method for traffic violation detection has many advantages, for example easy maintenance, high accuracy of detection, long life service, real-time detection and inexpensive

Keywords—image subtraction; deconvwnr;PSF; imread; randi; edge detection; image subtraction, rgb2gray.

I. INTRODUCTION

With increasing number of vehicles on roads, it is getting difficult to manually enforce laws and traffic rules for smooth traffic flow. Toll-booths are constructed on freeways and parking structures, where the car has to stop to pay the toll or parking fees. Also, Traffic Management systems are installed on freeways to check for vehicles moving at speeds not permitted by law. All these processes have a scope of improvement. In the center of all these systems lies a vehicle. In order to automate these processes and make them more effective, a system is required to easily identify a vehicle. The important question here is how to identify a particular vehicle? The obvious answer to this question is by using the vehicle's number plate. In this, we would introduce a system that detects all kinds of violations at a street intersection such as red light running, speed violation, stop line violation and lane violation by tracking individual vehicles. A digital camera is used for license plate reading. Traveling trajectory', approach lane, traffic signal and speed are used to decide whether the vehicle violates or not. The registration numbers and eight images of the violating vehicle are transmitted with an exclusive line to a central system at the metropolitan police agency. The license number is detected using edge detection technology, while velocity is detected based on change in car position from one to another frame.

II. TECHNIQUES INVOLVED

a) Image processing

Image processing refers to processing of a 2D picture by a computer. An image defined in the "real world" is considered to be a function of two real variables, for example, $a(x,y)$ with a as the amplitude (e.g. brightness) of the image at the real coordinate position (x,y) . Modern digital technology has made it possible to manipulate multi-dimensional signals with systems that range from simple digital circuits to advanced parallel computers. The goal of this manipulation can be divided into three categories:

- Image Processing (image in -> image out)
- Image Analysis (image in -> measurements out)
- Image Understanding (image in -> high-level description out)

b) Software Requirement

The idea behind the paper is complete automation of a system for monitoring the violations in traffic rules. The approach can be made cost effective, automatic and fast with the implementation of image processing techniques using MATLAB software. A continuous video that is monitoring the traffic on roads is interfaced to MATLAB software for implementing the image processing techniques in order to arrest the culprits. There are various functions in MATLAB software for

implementation of this technique. Each function is associated with commands, methods and properties for implementing various operations on the video that must be processed.

III. WORKING MODEL

The traffic at a desired location is continuously recorded and this video is further processed in order to trace out any of the traffic violations that are taking place. The video is interfaced to a PC and is processed using MATLAB software based on the image processing techniques. The sequence of steps that are involved in finding out the vehicles that are violating the traffic rules are:

1. Estimation of the speed of the vehicles in the video.
2. Tracing out the license plate of the vehicle that is against the traffic rules.

a) Estimation Of Vehicle Speed

Estimation of the speed of a vehicle is the prime steps in order to take steps to eliminate traffic violation. This is previously carried out using radar sources. The technique involved is the Doppler Effect. The previously adopted method is very much costly and demands a lot of manual effort for its implementation. Thus, an alternative method of speed estimation using image processing technique must be implemented. The image of the vehicle must be processed by different blocks in order to estimate the speed of a vehicle. The blocks involved in processing an image for velocity estimation are:

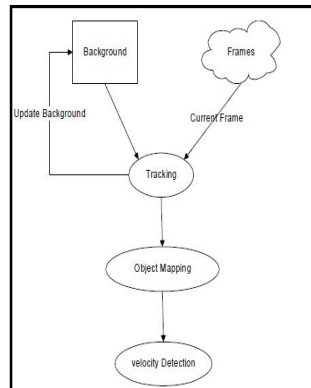


Figure.1 Flowchart of Velocity Estimation

The steps that are involved in estimating the vehicle's speed using image processing techniques are as per the flow chart that can be seen below.

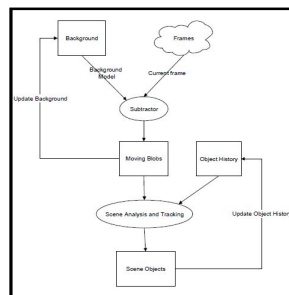


Figure.2 Flow Chart for Speed Estimation of a vehicle

The frames that are obtained out of the video recordings are used in order to obtain a background model. First step in background modeling is to categorize pixels of each frame into stationary and non-stationary. This is done by checking the intensity difference of each pixel with its corresponding pixels in temporal neighborhood images.

$$T = (| I(x,t) - I(x,t+1) | > 2\alpha) \wedge (| I(x,t-1) - I(x,t) | > 2\alpha) \quad (1)$$

Where $I(x,t)$ is the intensity value of pixel x in time t and α is the standard deviation of pixel x over samples. If T is false, the point is considered as a stationary pixel and could be involved in background model calculation. Background model will then be created via some intra-frame and inter-frame processes. It is a block that is used for the comparison of two frames by subtracting one frame from the adjacent frame. This is the main process for both background updating and identifying of the moving blobs that are located in the frames. In tracking module, each frame is subtracted from current background model. Based on the result of subtraction, the moving blobs are extracted. Regions that do not contain moving blobs are used to update the background model. The same information along with history of objects observed in previous frames is used as input to a processing module which determines current status of objects observed in the scene. Current object information is used to update object history for later use. This can be clearly viewed in the flow chart that is present on the left hand side. After car identification, its position is determined using Homograph matrix. Based on car position and change of this parameter with time, velocity of the car can be calculated automatically.

b) Tracing out the license plate

Necessary fine must be imposed on the vehicle that is violating the speed limit. This can be achieved by identifying the license number of the vehicle that is exceeding the speed limits. The sequences of steps that are involved in tracing out of license plate of the vehicle include:

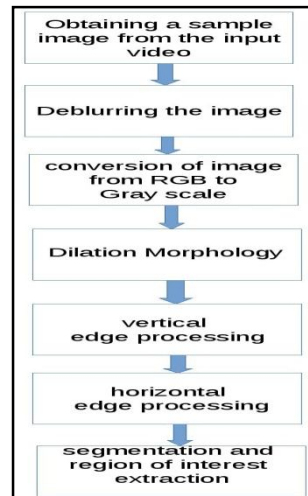


Figure.3 Flow Chart for extraction of Number Plate from a frame

c) Obtaining a sample image from the input video

This is done using the properties available in the function `mmreader`. The video is initially read into a MATLAB code using 'mmreader' function. Based on the format of the video, the number of pixels in each frame is automatically decided. The frames that are obtained from the video are stored into a directory that is created using a command 'mkdir' by using the 'read' method of the mmreader function. One frame is randomly picked from the available frames using 'randi' function and is further processed for obtaining the license plate of the vehicle. The blurred image that is obtained from the frames of the video must be de-blurred using the 'deconvwnr' function. This enhances better visibility of different parts of the picture. The de-blurring of a frame also includes noise removal from the frame.



a) Blurred Frame



b) De-blurred Frame

Figure.4 Images of a) Blurred Frame b) De-blurred Frame

From the process of de-blurring, noise can be removed from the frame and different parts of the frame can be visualized clearly. This conversion of a frame with true color into a gray scale image helps in the availability of various methods for further processing of the image in order to obtain the license plate of the vehicle from the entire image. This technique is used in order to remove noise that is convolved with the actual image. In this step of processing, if any pixel value in the image is decreased due to addition of noise, its value is set to maximum value based on the pixel values of the adjacent pixels. The dilation process is also used in order to join the broken edges of the image. This process makes edges of an image sharper. In turn, it helps in better detection of an image. In case of vertical edge processing, the image is processed column-wise. Each of the columns is traversed one after the other. A histogram is prepared based on this processing. The histogram is passed through a low pass filter to smoothen out unnecessary changes in the histogram values. The output of the low pass filter is given to a band pass filter. After this, a dynamic threshold is applied and all the values less than this are set to zero. This will remove the unnecessary columns from an image. The same process that is adopted in vertical edge processing is carried out on all rows of the image in order to process the edges of the image in horizontal direction. This step will remove the unnecessary rows from an image. This step involves dividing the image into different segments. Different parts of the image which have similar arrangement of pixel values are grouped into different segments. The segmentation is performed by observing the values of filtered histograms. A set of row and column numbers having highest probability of containing a number plate are prepared. These set of values are passed to the next step. Our region of interest is the license plate of the vehicle. The region containing a number plate will have maximum number of edges compared to any other part in an image. Applying this concept to all the extracted segments, the co-ordinates of the required region are extracted.

V. EXPERIMENTS

We tested the algorithm on several movies captured from USA roads. Some results are presented in this section. The below figure shows a car and the detected speed for it. After car identification, its position is determined using Homograph matrix. Based on car position and change of this parameter through time, velocity of the car is calculated.



Figure.5 Detected car coming with determining speed



Figure.6 Detected car after some while

Same car is identified in both of the above images which can be proved by the same value of ID that can be seen in both the images. The speed of the car is almost constant and it can be observed from above figures. Nearly same velocity results have been obtained in both images which is a proof for correctness of object positioning and velocity detection modules.

VI. CONCLUSION AND FUTURE WORKS

In this paper, a traffic surveillance system was developed based on the image processing techniques. The system's building blocks for both speed estimation and license plate detection were described. A combination of different functions and commands of the MATLAB software that are initially described was employed to form the proposed system. For background model generation and tracking, the W4 approach was used. Car velocity is computed considering the constant velocity assumption during short time periods. An experimental result for the velocity detection system on several real world scenes seems promising. One area of work which can improve the performance of the system is shadow detection and exclusion. When source of light is from behind, shadow will be in front of vehicles and may deteriorate the performance of object positioning algorithm. Enhancing silhouette generation by adding shadow removal process is our next step.

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