

# Extraction of Number Plate by Monitoring the Vehicle Speed using Image Processing

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**Abstract** - This paper proposes the idea of monitoring the speed of the vehicles such that they don't cross the limited speed inside the city making it easy for the flow of traffic. This of course avoids a lot of accidents. RF gun is used to detect the speed of the vehicle. The vehicle which cross the limited speed will be captured automatically with the help of signal that is transmitted to the camera from the microcontroller that is interfaced with the speed sensor. Then number plate is extracted from the entire image using image processing tool. Once the region of interest is detected the character are recognized and updated in the database. Then the information of the owner of the vehicle is passed to the nearest traffic control office and also the owner of the vehicle will get the message about the penalty details. Also, if the same person exceeds the limit again for the next time then the penalty will be doubled automatically. Thus, this system motivates to travel in optimal speed and also avoid malpractice on collecting the fine amount.

## I. INTRODUCTION

Most of the fatal accidents occur due to over speeding. It is a natural psyche of humans to excel. If given a chance man is sure to achieve infinity in speed. But when we are sharing the road with other users we will always remain behind some or other vehicle. Increase in speed multiplies the risk of accident and severity of injury during accident. Faster vehicles are more prone to accident than the slower one and the severity of accident will also be more in case of faster the severity of accident will also be more in case of faster vehicles. Higher the speed, greater the risk. At high speed the vehicle needs greater distance to stop i.e. braking distance. A slower vehicle comes to halt immediately while faster one takes long way to stop and also skids a long distance due to law of motion. A vehicle moving on high speed will have greater impact during the crash and hence will cause more injuries. The ability to judge the forthcoming events also gets reduced while driving at faster speed which causes error in judgment and finally a crash. So monitoring the speed of vehicles is important in case of more populated country like India and this paper propose such an idea.

## II. METHODOLOGY

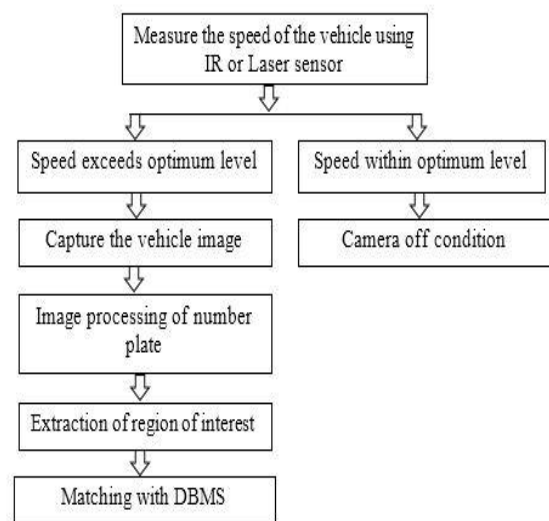


Figure1. Flow chart of overall system design

### A. Speed tracking using RF gun:

A radar speed gun (also radar gun and speed gun) is a device used to measure the speed of moving objects. It is used in law-enforcement to measure the speed of moving vehicles and is often used in professional spectator sport, for such things as the measurement of the speed of pitched baseballs, runners and tennis serves.

A radar speed gun is a Doppler radar unit that may be hand-held, vehicle-mounted or static. It measures the speed of the objects at which it is pointed by detecting a change in frequency of the returned radar signal caused by the Doppler Effect, whereby the frequency of the returned signal is increased in proportion to the object's speed of approach if the object is approaching, and lowered if the object is receding

Based on how much the frequency changes, a radar gun can calculate how quickly a car is moving toward it or away from it. If the radar gun is used inside a moving police car, its own movement must also be factored in. For example, if the police car is going 50 miles per hour and the gun detects that the target is moving away at 20 miles per hour, the target must be driving at 70 miles per hour. If the radar gun determines that the target is not moving toward or away from the police car, then the target is driving at exactly 50 miles per hour.

Doppler effect

Speed guns use Doppler radar to perform speed measurements. Radar speed guns, like other types of radar, consist of a radio transmitter and receiver. They send out a radio signal in a narrow beam, and then receive the same signal back after it bounces off the target object. Due to a phenomenon called the Doppler Effect, if the object is moving toward or away from the gun, the frequency of the reflected radio waves when they come back is different from the transmitted waves. From that difference, the radar speed gun can calculate the speed of the object from which the waves have been bounced. This speed is given by the following equation:

$$v = \frac{\Delta f c}{f 2}$$

where  $c$  is the speed of light,  $f$  is the emitted frequency of the radio waves and  $\Delta f$  is the difference in frequency between the radio waves that are emitted and those received back by the gun. This equation holds precisely only when object speeds are low compared to that of light, but in everyday situations, the velocity of an object is directly proportional to this difference in frequency.

By rearranging terms we can see that  $\Delta f$  is proportional to the velocity:

$$\Delta f = \frac{2fv}{c}$$

B. Speed comparison with the optimum level:

After detection of speed using the RF gun, the vehicle is compared with the optimum speed level using a microcontroller. If speed increases the optimum level, the image captured is done by the Radar gun and signal passes to camera and image is captured.

C. Capturing the image:

**Sensor Requirements**The image sensor is the prime input for a smart camera. An appropriate image quality is, therefore, essential for the performance of the entire system.

**Requirements of a Smart Camera**In general a smart camera is comprised of a sensor, a processing and a communication unit. In this section we briefly discuss the requirements for each of these units as well as some system wide requirements.

**Dynamic Range** Traffic surveillance applications enforce high demands on the image sensor. Typical traffic situations may contain a high dynamics, e.g., when high-intensity areas, such as the high-beam of a vehicle, appear concurrently with low-intensity areas such as the car's silhouette at night. Image sensors with high dynamic range and little blur are preferred for these applications. Additionally, high dynamic-range sensors ease the design of the camera control and the control of the lens aperture in changing light conditions

**Resolution and Frame Rate** Many available image sensors feature only small image formats such as CIF and QCIF. These formats are acceptable for cell phones. However, surveillance cameras require a larger resolution due the requirements of the image processing and the operators. Note that many currently available surveillance systems deliver images in PAL resolution (720x576 pixels). Most image processing algorithms for the smart camera are based on monochrome input, however, the operators prefer colour images for manual surveillance. The maximum frame rate (in fps) is another important parameter of the smart camera. It is determined by the image sensor and succeeding image processing stages. A frame rate of 15 fps is aimed for live video and fast response times of the image processing tasks.

**Digital Interface** In order to reduce the effect of temperature drift and aging as well as to avoid glue logic the image sensor has to deliver digital video output. Thus, the sensor has to include analog amplifiers and ADCs.

D. Number plate extraction using image processing

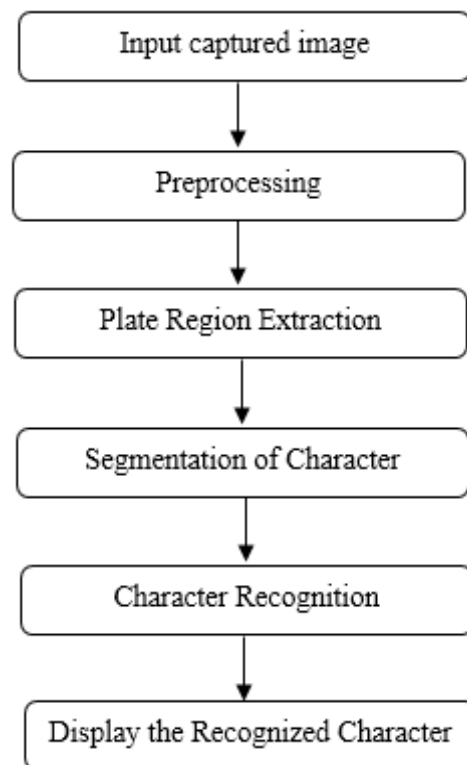


Figure2. License plate recognition using MATLAB

Convert a Coloured Image into Gray Image

The algorithm described here is independent of the type of colours in image and relies mainly on the gray level of an image for processing and extracting the required information. Colour components like Red, Green and Blue value are not used throughout this algorithm.

So, if the input image is a coloured image represented by 3-dimensional array in MATLAB, it is converted to a 2-dimensional gray image before further processing.

#### Dilate an Image

Dilation is a process of improvising given image by filling holes in an image, sharpen the edges of objects in an image, and join the broken lines and increase the brightness of an image. Using dilation, the noise with-in an image can also be removed. By making the edges sharper, the difference of gray value between neighbouring pixels at the edge of an object can be increased. This enhances the edge detection. In Number Plate Detection, the image of a car plate may not always contain the same brightness and shades. Therefore, the given image has to be converted from RGB to gray form. However, during this conversion, certain important parameters like difference in colour, lighter edges of object, etc. may get lost. The process of dilation will help to nullify such losses.

#### Horizontal and Vertical Edge Processing of an Image

Histogram is a graph representing the values of a variable quantity over a given range. In this Number Plate Detection algorithm, horizontal and vertical histogram were used which represents the column-wise and row-wise histogram respectively. These histograms represent the sum of differences of gray values between neighbouring pixels of an image, column-wise and row-wise. In the above step, first the horizontal histogram is calculated. To find a horizontal histogram, the algorithm traverses through each column of an image. In each column, the algorithm starts with the second pixel from the top. The difference between second and first pixel is calculated. If the difference exceeds certain threshold, it is added to total sum of differences. Then, algorithm will move downwards to calculate the difference between the third and second pixels. So on, it moves until the end of a column and calculate the total sum of differences between neighbouring pixels. At the end, an array containing the column-wise sum is created. The same process is carried out to find the vertical histogram. In this case, rows are processed instead of columns.

#### Passing Histograms through a Low Pass Digital Filter

To prevent loss of important information in upcoming steps, it is advisable to smooth out such drastic changes in values of histogram. For the same, the histogram is passed through a low-pass digital filter. While performing this step, each histogram value is averaged out considering the values on its right-hand side and left-hand side. This step is performed on both the horizontal histogram as well as the vertical histogram.

#### Filtering out Unwanted Regions in an Image

Once the histograms are passed through a low-pass digital filter, a filter is applied to remove unwanted areas from an image. In this case, the unwanted areas are the rows and columns with low histogram values. A low histogram value

indicates that the part of image contains very little variations among neighbouring pixels. Since a region with a license plate contains a plain background with alphanumeric characters in it, the difference in the neighbouring pixels, especially at the edges of characters and number plate, will be very high. This results in a high histogram value for such part of an image. Therefore, a region with probable license plate has a high horizontal and vertical histogram values. Areas with less value are thus not required anymore. Such areas are removed from an image by applying a dynamic threshold. In this algorithm, the dynamic threshold is equal to the average value of a histogram. Both horizontal and vertical histograms are passed through a filter with this dynamic threshold. The output of this process is histogram showing regions having high probability of containing a number plate.

#### Segmentation

The next step is to find all the regions in an image that has high probability of containing a license plate. Co-ordinates of all such probable regions are stored in an array.

#### E. Region of Interest Extraction

The output of segmentation process is all the regions that have maximum probability of containing a license plate. Out of these regions, the one with the maximum histogram value is considered as the most probable candidate for number plate. All these regions are processed row-wise and column-wise to find a common region having maximum horizontal and vertical histogram value. This is the region having highest probability of containing a license plate.

#### F. Image Segmentation and Extraction

From the output obtained from previous step we need to segment the image and each segmented character is matched with the trained templates to obtain the characters and then it is obtained as a set of number plate character in the text form.

#### G. DBMS

First of all our server is connected to the server in the traffic database. Now the license plate number is obtained as an output. The obtained output is queried from our server to the server in the traffic database. The server in the traffic database searches the query and gives us the result of the query in such a way that the name and address of the processed number plate is obtained as an output from the traffic server database. Now the penalty is sent to the owner of the vehicle for his disobedience of traffic rules.

#### H. Speed maintained at optimum level:

If the speed is not exceeding the optimum level the captured image is not captured and the camera will not get any signal to itself.

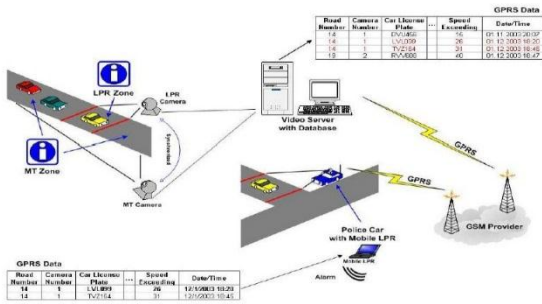


Figure 3. Overall System structure

III. RESULTS AND DISCUSSIONS

Original image:



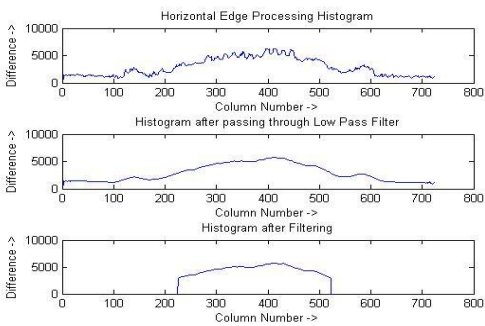
Gray Image



Dilated image:



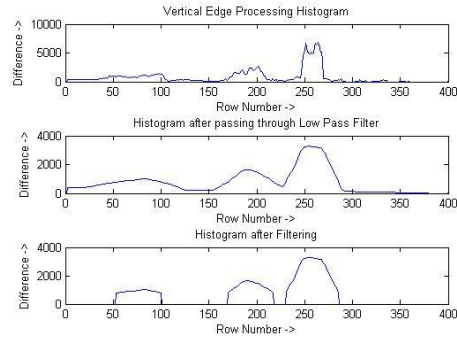
Horizontal Histogram



Horizontal Histogram Output Image



Vertical Histogram



Vertical Histogram Output Image



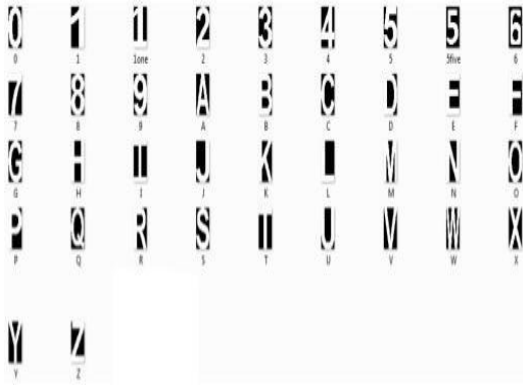
Cropped or Extracted Image



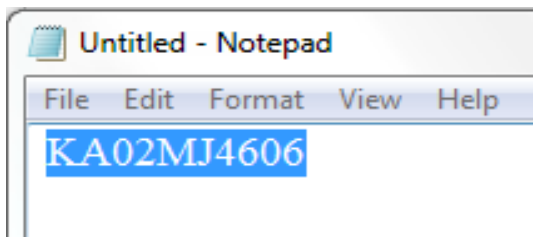
Segmented Image



Template Matching



Extracted number plate



Retrieve of information from the Database Inside Matlab

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Number plate: KA02MJ4606
Owner Name: S. Thomson
Address: 14/152, Niyas Road, Trichy
Mobile Number: 9500942628
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Informing Penalty Details to the owner



#### IV. CONCLUSIONS

This system provide a simple software to obtain the information of number plate using Image processing and automatic updating of Information using the traffic database management System. The automatic penalty and awareness message to the owner helps to avoid driving vehicle at over speed.

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