Real Time Traffic Control using Image Processing

Rahul Rane[1] Sayali Pathak[2] Aruta Oak[3] S. P. Khachane[4]
[1,2,3]Student [4]Professor
[1,2,3,4]Rajiv Gandhi Institute of Technology, Mumbai

Abstract— The Idea behind real time traffic control using image processing is due to increase in number of vehicles on road which causes traffic congestion. There are various successful techniques to overcome this problem such as inductive loop detectors, magnetic loop detectors and video based system. We propose a system based on measurement of vehicle density on road using Real Time Image Processing. To control the congestion in traffic signal intelligently by using density information in this paper we are presenting the algorithm with the help of which the congestion in traffic can easily retrieved. The image sequences from camera are analyzed using edge detection and counting methods. Subsequently the number of vehicles at intersection is evaluated due to which traffic can easily be managed moreover determined vehicle density can easily be compared with other direction of traffic in order to control traffic signals efficiently.[1]

***Key words*:** Traffic control, image processing, edge detection, background subtraction

I. INTRODUCTION

In recent years study shows that various traffic congestions caused due to increasing population of vehicles and traffic handling mechanism due to which traffic congestion has become a serious issue. The crucial reason behind increase in vehicle population is due to increase in human growth specifically in modern cities that subsequently rise vehicular travel because of which human routine life and sometime reason for life loss. For example, if there is a fire hazard in the middle of city where traffic is at its peak rate and due to the congestion in traffic the fire brigade might take long time comparatively. So it is very important to design an intelligent traffic control mechanism to avoid traffic jams and accidents.

The structure of roads and lanes in real world differs country to country due to which it will not be justified to manage the traffic in a common way. For example, one lane has less traffic and the other lane with huge traffic but the duration of green light for both lane is same. This will become waste of available resources and completely inefficient. By considering above example to manage traffic more efficiently the control mechanism should be design in such way that the lane with higher traffic concentration should be given more time for green signal and should be maintained according to the growth in traffic of all the lanes respectively.[3]

Current traffic control technique involves magnetic loop detector which buried in the road, infra-red and radar sensor on the side limits in traffic information and might require a separate system for traffic surveillance. Video based system offers many advantages compare to traditional techniques such as provides more traffic information combine both surveillances and traffic control techniques also it can be easily installed not to forget the limitation what it possess is wastage of memory due to continuous recording of traffic positioning. Another technique is inductive loop detector provides accost effective solution subject to higher failure rate when installed in poor road surface. Infra-red sensors are affected to a greater degree of by fog.[4]

This paper tries to evaluate the process and advantages of use of image processing for traffic control. Thus the use of this technology is extremely valuable for analysis and performance improvement of road traffic. A proposed system for detection of vehicle is based on techniques canny edge detection. However the use of this technology avoids using of unnecessary hardware and tools.

II. PROPOSED SYSTEM

A. *System Overview:*

We proposed various different steps to implement this project with less complexity as show in fig.1. A fixed rotating camera on tall structure to overlook the traffic scenario as shown in [1]. The image extracted from the camera is analyzed to detect vehicles and keep the number of count. Depending on the traffic time is set to each lane. For example if number of vehicles in three lane intersection is found to be 30,20,40 then the time allocated to each lane is in the ratio of 3:2:4. We should also have to take emergency situation into account that if such situation occurs on the intersection we have to monitor the time allocation accordingly.

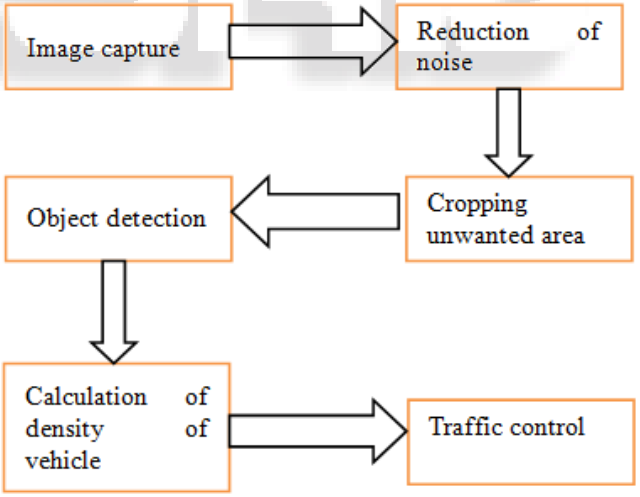

Fig. 1: System Overview

B. *Reduction of Noise:*

Starting with processing the live image using software called MATLAB the stationary image which is captured by camera mounted on the pole at traffic signal. The extraction of raw digital data is converted from RGB to gray scale in order to process the particular image further by taking the reference picture of road when there is not a single object present.

Fig no. 2(a) shows the image captured from the live camera of road with heavy traffic whereas fig 2(b) shows the image captured of blank road used as reference image.

Fig. 2(a):

Fig. 2(b):

C. Image Cropping:

Once we are done with noise reduction process our next step will be image cropping technique. The purpose of image cropping technique is to identify the interested region (road area) and to exclude the unnecessary background information. Since the background information will be stationary for every captured image we prefer to use fig. 2(b) as a reference frame by designing image cropping algorithm in MATLAB.[5] First a binary image having the same dimension is created as a reference image then the road area has been shaded white and leftover region as black .Finally the multiplication of reference image with the cropping black and white results in the final desired targeted area.

D. Object Detection:

The next step after cropping the image is nothing but object detection method in order to identify a count the vehicle which are present in the targeted frame. To perform object detection firstly the captured frame from real time image capturing process is extracted then by using the technique of noise reduction and image cropping we convert the real time image into the gray scale to determine the absolute difference of two image and the difference image only highlights the presence of vehicle on road. By taking in consideration the presence of vehicle in desired target area but due to the poor visibility (night view) the image captured will not be cleared. In order to improve the scenario the image gets converted into binary value based on the threshold value. With the help of this the presence of any object gets improved.[5] Now by using Canny edge detection algorithm we perform following function as shown in the fig. 3 and fig 4.:

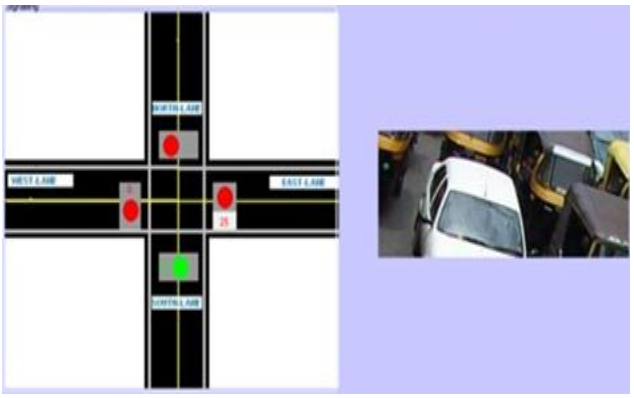

Fig. 3:

1) Smoothening: 5X5 Gaussian convolution mask of standard deviation (σ=1.4) this effect results to give blur image as well as to eliminate the noise of an image.
2) Gradient calculation: The next step is to find the edge strength by taking the gradient of image. Numerous kernel have been proposed for finding edges such as Prewitt kernel, Sobel kernel and many more.[5] Prewitt idea based on the calculation driven by.

$$\frac{\partial I}{\partial x} \simeq \frac{I(x+1,y)-I(x-1,y)}{2} \quad ,and \quad \frac{\partial I}{\partial y} \simeq \frac{I(x,y+1)-I(x,y-1)}{2}$$

3) Magnitude and phase: This step involves in finding the exact location of high intensity pixel by considering the difference of other intensity pixel value.[5] Suppose horizontal gradient is (dx) and vertical gradient (dy) thus the absolute gradient magnitude (|G|) is calculated by

$$|G| = \sqrt{dx^2 + dy^2}$$

The direction of the gradient (θ) is calculated by arctangent of the vertical gradient to the horizontal gradient:

θ= arctan(*dy* /*dx*)

Since arctangent value is very complex sometimes because it gives us floating point values so if the current pixel is $P_{x,y}$ and the va
lues of derivatives of the pixels are dx and dy direction of the gradient P is approximately one sector of the figure shown below.

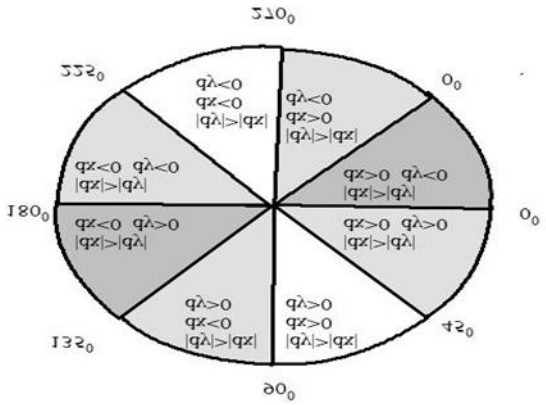

Fig.4

4) Non maximum suppression: Once the direction of gradient is known the value of fix pixel found in neighborhood under analysis are interpolated. The pixel that has low local maximum gradient and magnitude is eliminated. For example, if the

approximate direction of the gradient is between 0^0 and 45^0, the magnitude of the gradient at $P_{x,y}$ is compared with the magnitude of the gradient at adjacent points.

where $P_{x,y} = |dx_{x,y}| + |dy_{x,y}|$. The values of the gradient at the point P_a and P_b are defined as follows:

Pa =(Px+1,y−1 +Px+1,y)/2 where Px+1,y−1 = |dxx+1,y−1|+|dyx+1|,y−1 |Px+1,y = |dxx+1,y |+|dyx+1,y |

Pb =(Px−1,y+1 +Px,y+1)/2 ,where

Px−1,y+1 = | dxx−1,y+1 | + | dyx−1,y+1 | and Px,y+1 = | dxx,y+1 | + | dyx,y+1 |

The center pixel $P_{x,y}$is considered as an edge , if $p_{x\ y,} > p_a$ and $p_{x\ y,} > p_b$. If neither condition is not satisfied then the center pixel is eliminated.[5]

5) Thresholding: The output image may consist of broken edges contours which contributes to noise so by using thresholding with hysteresis we end up removing the noise from image.

E. Calculation of Density:

In order to calculate number of vehicles on desired targeted area the vehicle should mark first and then the numbers are counted by using edge detection algorithm. In order to consider a connected region as a vehicle it is possible that more than one region of vehicle is detected. This problem can be overcome by using EdgeTest library in edge detection algorithm. Where each detected vehicle is surrounded by bounding box and the top left region shows the number of vehicle detected.

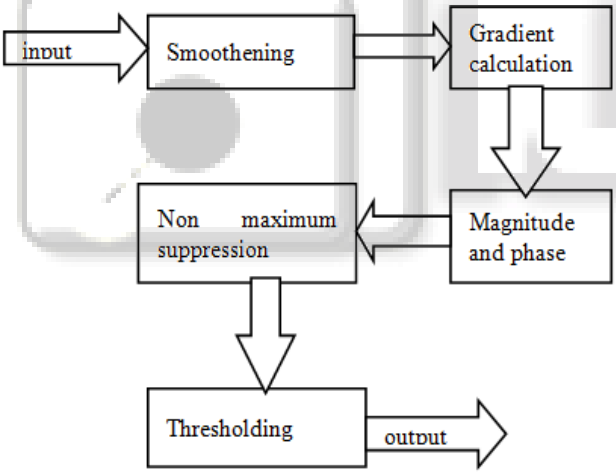

Fig. 5:

III. Conclusion and Future Work

Past researches have showed a promising result for including image processing in traffic light control. Earlier in automatic traffic control use of timer had a drawback that the time is being wasted by green light on the empty. This technique avoids this problem.

Upon comparison of various edge detection algorithms, it was inferred that Canny Edge Detector technique is the most efficient one. Analysis of various contour tracing and object counting methods revealed the Moore neighborhood technique to be more robust when compared to the others. It demonstrates that image processing is a far more efficient method of traffic control as compared to traditional techniques.

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