DYNAMIC TRAFFIC CONTROL SYSTEM USING EDGE DETECTION ALGORITHM

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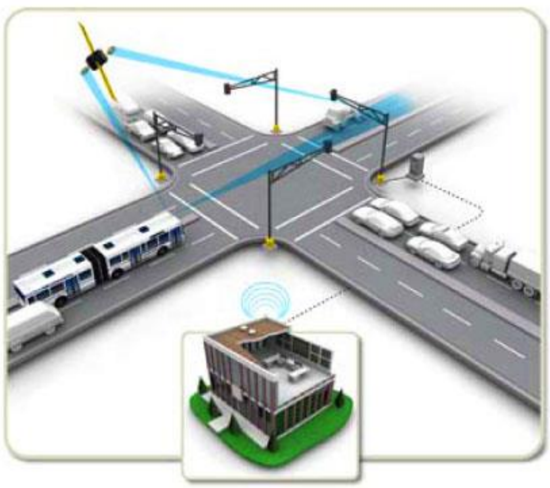
Abstract - As the traffic congestion increases on the transport network, due to slower speeds, longer trip times, and increased vehicular queuing, it's necessary to introduce smart way to reduce traffic. Already am edging closer to "smart city-smart travel". Today, a large number of smart phone applications and connected sat-naves will help get you to your destination in the quickest and easiest manner possible due to real-time data and communication from a host of sources. In present situation, traffic lights are used in each phase. The other way is to use electronic sensors and magnetic coils that detect the congestion frequency and monitor traffic, but found to be more expensive. Hence it proposes a traffic control system using image processing techniques like edge detection. The vehicles will be detected using images instead of sensors. The cameras are installed alongside of the road and it will capture image sequence for every 40 seconds. The digital image processing techniques will be applied to analyze and process the image and according to that the traffic signal lights will be controlled.

Index Terms – Vehicular queuing, Traffic light, Image Processing, edge detection

I. INTRODUCTION

Automatic traffic monitoring and surveillance are important for road usage and management. Traffic parameter estimation has been an active research area for the development of intelligent Transportation systems (ITS). For ITS applications traffic-information needs to be collected and distributed. Various sensors have been employed to estimate traffic parameters for updating traffic information. Magnetic loop detectors have been the most used technologies, but their installation and maintenance are inconvenient and might become incompatible with future ITS infrastructure. It is well recognized that vision-based camera system are more versatile for traffic parameter estimation. In addition to qualitative description of road congestion, image measurement can provide quantitative description of traffic status including speeds, vehicle counts, etc. Moreover, quantitative traffic parameters can give us complete traffic flow information, which fulfills the requirement of traffic management theory. Image tracking of moving vehicles can give us quantitative description of traffic flow.



II. BACKGROUND

In imaging science, image processing is processing of images using mathematical operations by using any form of signal processing for which the input is an image, a series of images, or a video, such as a photograph or video frame; the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two-dimensional signal and applying standard signal-processing techniques to it. Images are also processed as three-dimensional signals with the third-dimension being time or the z-axis.

Image processing usually refers to digital image processing, but optical and analog image processing also are possible. This article is about general techniques that apply to all of them. The acquisition of images (producing the input image in the first place) is referred to as imaging.

Closely related to image processing are computer graphics and computer vision. In computer graphics, images are manually made from physical models of objects, environments, and lighting, instead of being acquired (via imaging devices such as cameras) from natural scenes, as in most animated movies.

Computer vision, on the other hand, is often considered high-level image processing out of which a machine/computer/software intends to decipher the physical contents of an image or a sequence of images (e.g., videos or 3D full-body magnetic resonance scans). In modern sciences and technologies, images also gain much broader scopes due to the ever growing importance of scientific visualization (of often large-scale complex scientific/experimental data). Examples include microarray data in genetic research, or real-time multi-asset portfolio trading in finance.

III. METHODOLOGY

Following are the steps involved

- Image acquisition
- RGB to gray conversion
- Image enhancement
- Image matching using edge detection

Procedure

Phase1:

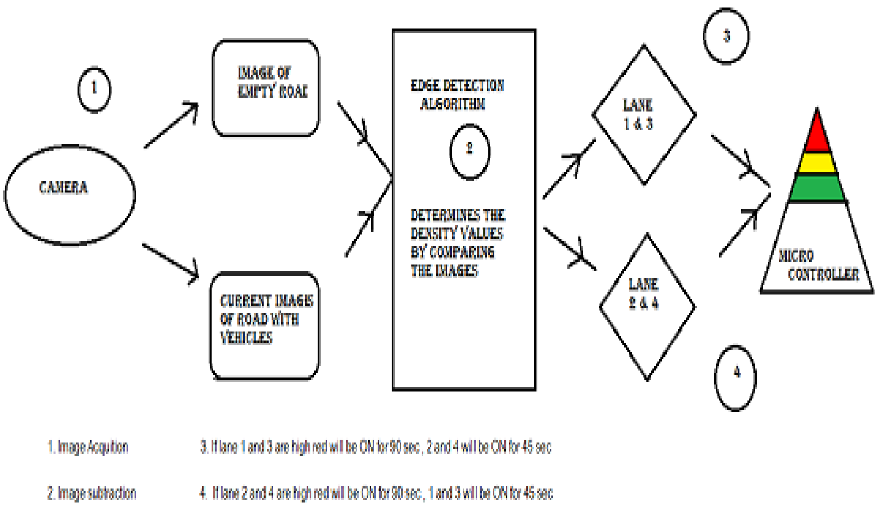
- Initially image acquisition is done with the help of web camera
- First image of the road is captured, when there is no traffic on the road
- This empty road's image is saved as reference image at a particular location specified in the program
- RGB to gray conversion is done on the reference image
- Now gamma correction is done on the reference gray image to achieve image enhancement
- Edge detection of this reference image is done thereafter with the help of Prewitt edge detection operator

Phase2:

- Images of the road are captured.
- RGB to gray conversion is done on the sequence of captured images
- Now gamma correction is done on each of the captured gray image to achieve image enhancement
- Edge detection of these real time images of the road is now done with the help of prewitt edge detector operator

Phase3:

- After edge detection procedure both reference and real time images are matched and traffic lights can be controlled based on percentage of matching.
- If the matching is between 0 to 10% - green light is on for 90 seconds.
- If the matching is between 10 to 50% - green light is on for 60 seconds. If the matching is between 50 to 70% - green light is on for 30 seconds.
- If the matching is between 70 to 90% - green light is on for 20 seconds. If the matching is between 90 to 100% - red light is on for 60 seconds.



IV. IMAGE ENHANCEMENT

The acquired image in RGB is first converted into gray. Now need to bring the image in contrast to background so that a proper threshold level may be selected while binary conversion is carried out. This is named as image enhancement techniques. The objective of enhancement is to process an image so that result is more suitable than the original image for the specific application. There are many techniques that may be used to play with the features in an image but may not be used in every case. Listed below are a few fundamental functions used frequently for image enhancement.

- Linear (negative and identity transformations)
- Logarithmic (log and inverse log transformations)
- Power law transformations(gamma correction)
- Piecewise linear transformation functions

The third method i.e., power law transformation has been used in this work. The power law transformations have the basic form

$$S = cr^{y}$$

where S is output gray level, r is input gray level, c and γ are positive constants. For various values of gamma applied on an acquired image we obtained the following graph shown in figure1.

From this figure it is evident that the power law curves with fractional values of y map a narrow range of dark input values into a wide range of output values with the opposite being true for higher values of input levels. It depicts the effect of increasing values of y >1. The images are shown with y =1,2,3,4,5 as may be seen, the figure with y =1 gives the best results in terms of making fine details identifiable. As is evident the fractional values of y cannot be used since these attempts show a reverse effect of brightening the image still further which we may find as undesirable for the present case.

V. EDGE DETECTION AND IMAGE MATCHING

Edge detection includes a variety of mathematical methods that aim at identifying points in a digital image at which the image brightness changes sharply or, more formally, has discontinuities. The points at which image brightness changes sharply are typically organized into a set of curved line segments termed edges. Among the key features of an image i.e. edges, lines, and points, In the present work edges are used which can be detected from the abrupt change in the gray level.

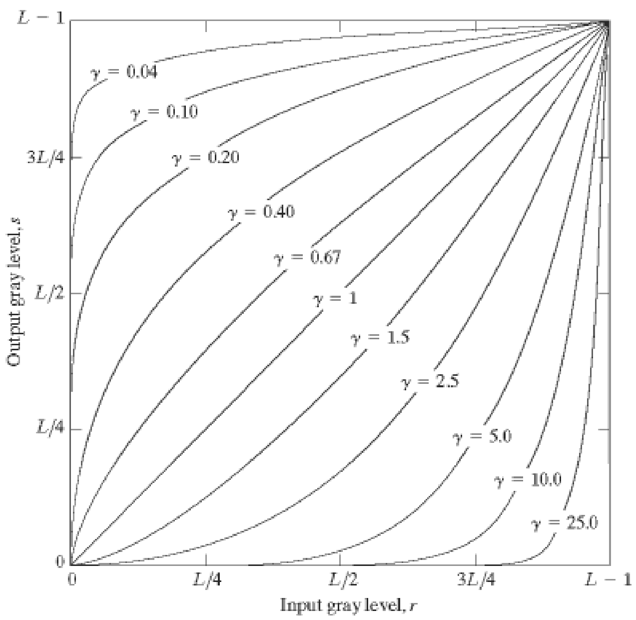


Fig 1: Gray graph

An edge essentially demarcates between two distinctly different regions, which means that an edge is the border between two different regions.

Here edge detection method for image matching is used:

- Edge detection methods locate the pixels in the image that correspond to the edges of the objects seen in the image.
- The result is a binary image with the detected edge pixels.

Common algorithms used are Sobel and Prewitt operators.

V.1. SOBEL

- The Sobel operator, sometimes called the Sobel–Feldman operator or Sobel filter, is used in image processing and computer vision, particularly within edge detection algorithms where it creates an image emphasising edges.
- Technically, it is a discrete differentiation operator, computing an approximation of the gradient of the image intensity function.

V.2. PERWITT

- The Prewitt operator is used in image processing, particularly within edge detection algorithms.
- It is a discrete differentiation operator, computing an approximation of the gradient of the image intensity function.
- At each point in the image, the result of the Prewitt operator is either the corresponding gradient vector or the norm of this vector.

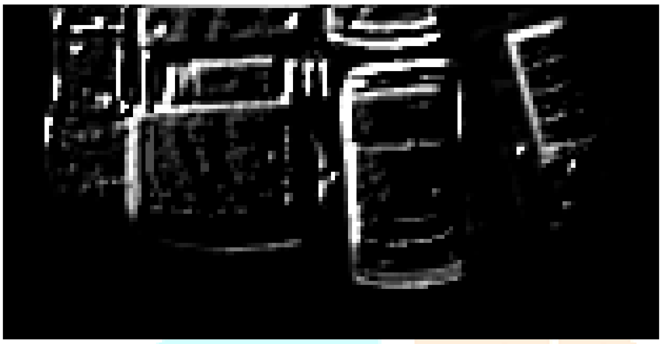


Fig 2: edge detected image (perwitt)

- First derivative is used to detect the presence of an edge at a point in an image.
- Sign of the second derivative is used to determine whether an edge pixel lies on the dark or light side of an edge.

The change in intensity level is measured by the gradient of the image. Since an image f (z, y) is a two dimensional function, its gradient is a vector

(1) The magnitude of the gradient is given by
G[f (x,y)] = √ Gx2 +Gy2

(2) The direction of the gradient is B(z, y) = tan-' (Gy/G)

(3) where the angle B is measured with respect to the X-axis. Gradient operators compute the change in gray level intensities and also the direction in which the change occurs. This is calculated by the difference in values of theneighboring pixels, i.e., the derivatives along the X-axis and Y-axis. In a two-dimensional image the gradientsare approximated by Gx= f(i+1,j)-f(i,j)

(4) Gy=f(I,j+1) -f(i,j)

(5) Gradient operators require two masks, one to obtain the X-direction gradient and the other to obtain the Ydirection gradient. These two gradients are combined to obtain a vector quantity whose magnitude represents the strength of the edge gradient at a point in the image and whose angle represents the gradient angle.

The edge detection operator we have used in the present work is Prewitt. Mathematically, the operator uses 3x3 kernels which are convolved with the original image to calculate approximations of the derivatives – one for horizontal changes, and one for vertical.

VI.PAPER EXPERIMENTAL RESULTS

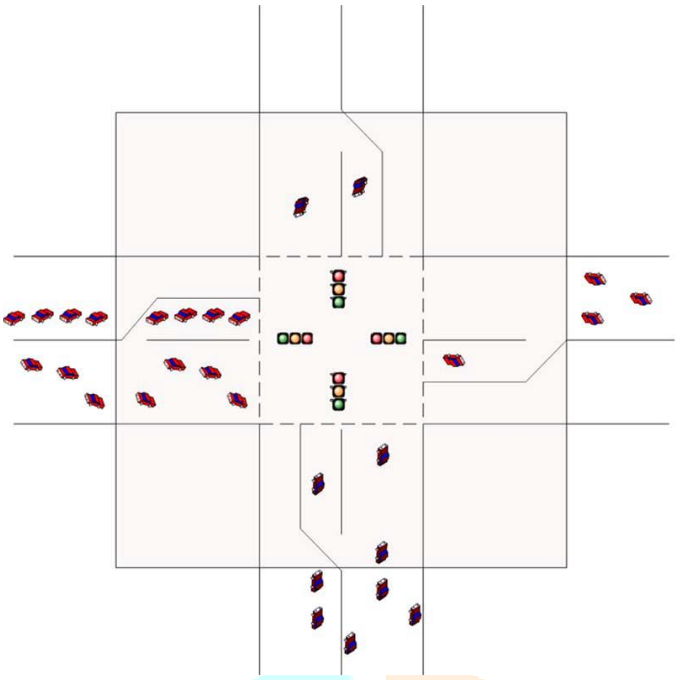
Experiments are carried out and depending upon the intensity of the traffic on the road we get the following results regarding on time durations of various traffic lights.

Result 1: Matching between 10 to 50% - green light on for 60 seconds

Result 2: Matching between 50 to 70% - green light on for 30 Seconds.

Result 3: Matching between 70 to 90% - green light on for 20 Seconds.

Result 4: Matching between 90 to 100% - red light on for 60 Seconds.



VII. CONCLUSIONS

The study showed that image processing is a better technique to control the state change of the traffic light. It shows that it can reduce the traffic congestion and avoids the time being wasted by a green light on an empty road. It is also more consistent in detecting vehicle presence because it uses actual traffic images. It visualizes the reality so it functions much better than those systems that rely on the detection of the vehicles' metal content. Overall, the system is good but it still needs improvement to achieve a hundred percent accuracy.

VIII. FUTURE ENHANCEMENT

In future this system can be used to inform people about the condition of traffic at different places. This technique allows the operator to gather the recorded data from a far end to his home computer without going there. Based on the technology studied it is possible to develop cost effective, weather resistant products that have the potential for more sophisticated applications, including vehicle speed measurement and length classification.No. of passing vehicle in the fixed time slot on the road decide the density range of traffics and on the basis of vehicle count microcontroller decide the traffic light delays for next recording interval. The recorded data can be downloaded to the computer through communication between microcontroller and the computer. The Administrator sitting on computer can command system (microcontroller) to download recorded data, update light delays, erase memory, etc. Thus administrator on a central station computer can access traffic conditions on any approachable traffic lights and nearby roads to reduce traffic congestions to an extent. In future this system can be used to inform people about different places traffic condition. This can be done through RADIO. Data transfer between the microcontroller and computer can also be done through telephone network, data call activated SIM This technique allows the operator to gather the recorded data from a far end to his home computer without going there. • Traffic lights can be increased to N number and traffic light control can be done for whole city by sitting on a single place.

• In ambulance system, the data of the patient in the ambulance can be sent to the Hospitals via GSM technology. Thus, it can provide early and fast treatment of the patient.

IX. REFERENCES

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