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Smart Traffic Signal

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***Abstract*- With the increase in population, traffic density on roads has increased to a level that makes navigating through cities extremely difficult. The apex of the problem is seen at traffic junctions, where the traffic light systems are hard coded and not adaptive to the real-time traffic conditions. The proposed system involves a closed loop control of traffic lights using a camera that acquires images of all four roads, followed by image processing to ascertain the real-time traffic congestion on the roads. The Canny Edge Detection technique is used in order to detect the edges of the vehicles in the images. The density of traffic on the road is determined by obtaining the Standard Variation value of the edge detected image. The traffic flow control algorithm has two aspects: the first being prioritization of roads, and the second, the duration of the traffic signal. The system has been developed using Laboratory Virtual Instrument Engineering Workbench (LabVIEW) which allows for effective real-time camera interfacing and image processing along with control of the traffic lights.**

***Keywords* - Real-time traffic light control, Image processing, LabVIEW, Standard Variation, Canny Edge Detection.**

I. Introduction

Traffic in cities today has reached an unprecedented level. In such a scenario, traffic jams at major junctions are commonplace. Traffic patterns are dynamic and constantly changing. It is often seen that the current system of fixed time sequenced signal lights cannot adapt to the changing traffic. Very often even though there is barely any traffic on the road, the green signal is given for an extended period of time. Besides leading to a waste of time, this increases the traffic congestion. There is a dire need for a smart system that can adjust the timings of these lights based on the traffic present on the road.

In the past, considerable work has been done on traffic control and monitoring systems. Traffic density control has been achieved using sensors like IR, Ultrasonic and loop detectors.

In the proposed model, priority is assigned to roads based on their traffic densities along with change in the delay time. The parameter used for sensing the traffic is Standard Variation. Systems developed in the past require a background image of a blank road. The proposed system requires no such reference image and performs image processing of the acquired images directly.

It has been observed that MATLAB is suitable for computation, but LABVIEW is preferable with respect to acquiring, processing and displaying signals.

Some systems on vehicle detection involve reading a video clip initially which is then segregated into a number of frames. Each frame is then considered as an independent image. The proposed system acquires real time images as opposed to video acquisition. This reduces the amount of processing to be done.

The proposed smart system will detect the density of the traffic on all four roads of the junction, and implement the following two aspects of control:

1. It will prioritize the four roads based on each of their traffic densities and run the sequence of traffic lights based on these priorities. The road with the maximum traffic will get the highest priority and so on. This will help avoid congestion on roads with heavy traffic.
2. It will adjust the timing of the signal lights on the roads based on the density of traffic. Thus a road with less traffic density will be given the green signal for a shorter period of time, while a road with more traffic will be given the green signal for longer.

II. Methodology

The methodology basically involves the following steps:

1. Image Acquisition
2. Image Processing
3. Implementation of Algorithm

These steps are illustrated in the Block Diagram shown below in Fig 1.

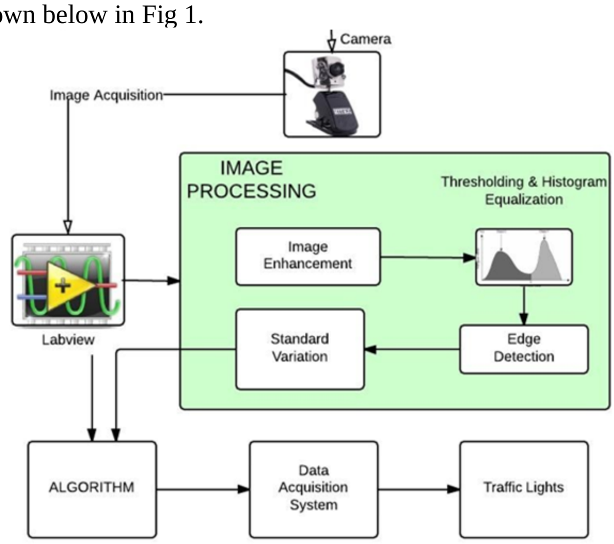

Figure 1: Block Diagram of Smart Traffic Monitoring and Control System

Image Acquisition and Processing

The camera is used to acquire images of the four roads. Following acquisition, image processing is performed.

The images are acquired continuously even as the current traffic light sequence is running. However the new sequence is implemented only after the completion of the ongoing sequence.

Image Acquisition

Images are obtained for each of the four roads with the help of a camera. The captured images are stored on the system in a file. This stored file is then opened after the completion of the ongoing traffic sequence in order to perform image processing and thereby control the traffic light timings.

Image Processing

Image processing includes the following steps:

- Image Enhancement
- Thresholding
- Histogram Equalization
- Edge detection

Image Enhancement

Image enhancement is the process of adjusting images so that the results are more suitable for display or further analysis.

The initial image is first converted to grayscale. The brightness of the image is then enhanced which is given a constant value of 50. This adds a constant value to all the pixels in the image, thus increasing the overall brightness of the image. This is done in order to reduce the noise in the image. The above has been inferred by testing the image with different constant values and observing the noise in the edge detected image.

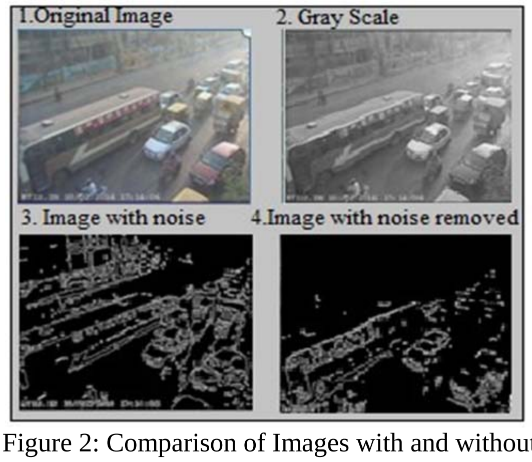

Figure 2: Comparison of Images with and without Enhancement

Thresholding

Thresholding refers to transforming grayscale images into black and white images (binary: white=1, black=0). The main purpose of thresholding is a radical reduction of information in order to simplify further processing.

Histogram Equalization

Histogram equalization essentially takes the histogram of an image and normalizes it, i.e. it redistributes the pixel values of an image to linearize the accumulated histogram.

Histogram Equalization is a general process used to enhance the contrast of images by transforming its intensity values. It is observed that better contrast facilitates edge detection in the image.

Figure 3: Image after Thresholding and Histogram Equalization

Edge Detection

Edges characterize boundaries and are therefore a problem of fundamental importance in image processing. Image Edge Detection significantly reduces the amount of data and filters out useless information, while preserving the important structural properties in an image. Edge detection refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensity which characterize boundaries of objects in a scene.

Standard Variation

In order to detect and compare the amount of traffic on the four roads, the Standard Variation values of the acquired images were compared. It was found that the output obtained in the form of Standard Variation is directly proportional to the traffic density on the road.

Standard Variation of the pixel values indicates the distribution of the values in relation to the average. The higher this value, the better the distribution of the pixel values.

Algorithm

After the standard variation values of the processed images are acquired, the traffic density information is organized according to priority and the roads are assigned corresponding values.

Prioritization

The road with most density is assigned a value of 4; the road with second most density is assigned a value of 3 and so on. Thus, the road with least priority is finally assigned a value of 1. The algorithm is implemented and the front panel is given below.

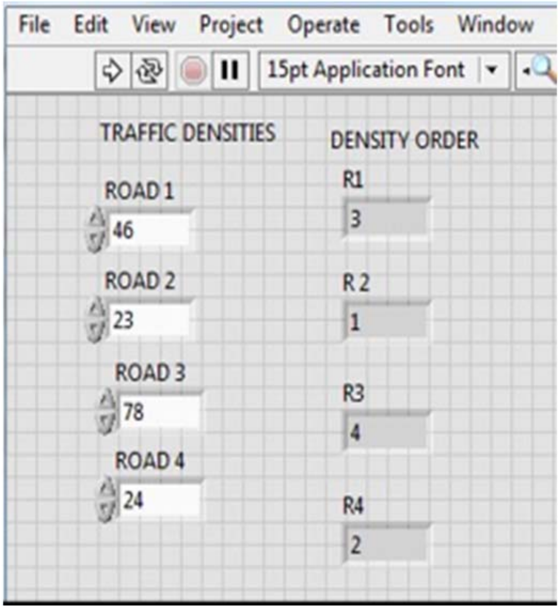

Figure 4: LabVIEW Front Panel for Prioritization

In this manner 24 (4 factorial) combinations of road densities ordered on basis of priority are possible. It is obvious that when the green signal is given to one road, the other three roads are given red signals.

DENSITY ORDER	SEQ 1	SEQ 2	SEQ 3	SEQ 4
1234	G4	G3	G2	G1
1243	G3	G4	G2	G1
1324	G4	G2	G3	G1
1342	G3	G2	G4	G1
1423	G2	G4	G3	G1
1432	G2	G3	G4	G1
2134	G4	G3	G1	G2
2143	G3	G4	G1	G2
2413	G2	G4	G1	G3
2431	G2	G3	G1	G4
2314	G4	G2	G1	G3
2341	G3	G2	G1	G4
3124	G4	G1	G3	G2
3142	G3	G1	G4	G2
3241	G3	G1	G2	G4
3214	G4	G1	G2	G3
3412	G2	G1	G4	G3
3421	G2	G1	G3	G4
4312	G1	G2	G4	G3
4321	G1	G2	G3	G4
4123	G1	G4	G3	G2
4132	G1	G3	G4	G2
4213	G1	G4	G2	G3
4231	G1	G3	G2	G4

Table 1: Traffic light sequences based on detected traffic density order

Timing

The second aspect of control lies in timing the lights based on which range the detected traffic density lies in. For instance, if the density lies in the range 21-40, the time delay will be 15 sec. This is illustrated in Table 2.

DENSITY	TIME
0-20	10 sec
21-40	15 sec
41-60	20 sec
61-80	25 sec
81-100	30 sec
101-120	40 sec

Table 2

This would be helpful in case one of the roads has a density of say 4 cars and the other road has 5 cars. Since the two roads have almost the same traffic density, the timing of the signals on both roads will be the same.

III. RESULTS AND FINDINGS

The acquired images can be seen in the LabVIEW Front Panel shown in Fig 5 along with the respective density values. It is seen that Road 1 is given the green light first, followed by Road 4, Road 2 and Road 3.

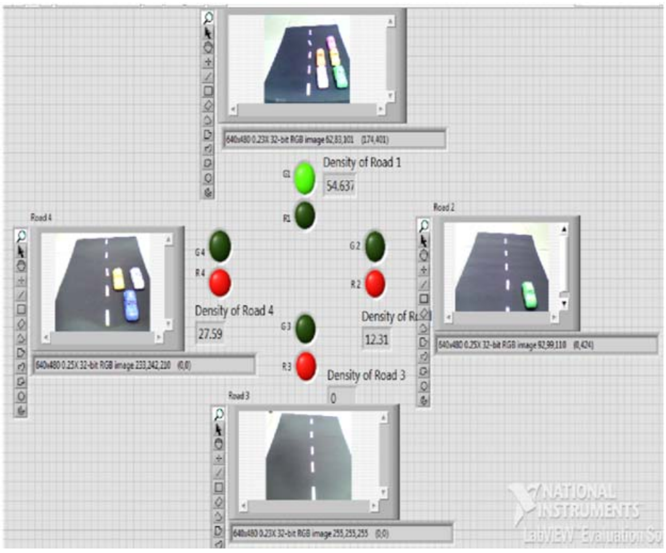

Figure 5: LabVIEW Front Panel: Traffic Control System

The light on Road 1 stays on for 20 seconds, Road 4 for 15 seconds, Road 2 and Road 3 for 10 seconds.

The developed system has been tested with real road images acquired from the internet.

IV. CONCLUSION

The developed system has been tested with real road images acquired from the internet and is seen to perform well. Instead of using surveillance videos and converting avi files to jpeg, the system directly acquires images using LabVIEW. This helps in reduction of processing. Further, a single camera has been used to monitor all four roads instead of using four different cameras for video acquisition.

NI LabVIEW enables convenient use of advanced algorithms for image processing. Further it facilitates real-time image acquisition. The Standard Variation values of the images are used to determine the overall traffic density on the junction. This can be used in future work by developing a multiple junction system with a server, to send other junctions information regarding junctions with high traffic density so as to avoid increase in traffic congestion.

The system suffers from the drawback that images acquired at night produce less consistent results compared to day time images. Future work can involve further image processing that would provide better results with night time images also.

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REFERENCES

[1] Vikramaditya Dangi, Amol Par1ab, Kshitij Pawar, S.S Rathod, 2012, “Image Processing Based Intelligent Traffic Controller”, Undergraduate Academic Research Journal (UARJ), ISSN : 2278 – 1129, Volume-1, Issue-1

[2] Jaywant Kamble, Pratik Kothawade, Abhijeet Kumbhar, May-2013, “Traffic Control System Using Image Processing”, International Journal of Emerging Trends in Electrical and Electronics (IJETEE – ISSN: 2320-9569) Vol. 3, Issue. 3

[3] Chandrasekhar. M, Saikrishna. C, Chakradhar. B, 2013 “Traffic Control Using Digital Image Processing”, International Journal of Advanced Electrical and Electronics Engineering, (IJAEEE), ISSN (Print): 2278-8948, Volume-2, Issue-5

[4] Ms. Pallavi Choudekar,.Sayanti Banerjee, 2011, “Real Time Traffic Light Control Using Image Processing”, Electronics Computer Technology (ICECT), 3rd International Conference.