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Traffic analysis and control using image processing

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Abstract. This paper shows the work on traffic analysis and control till date. It shows an approach to regulate traffic the use of image processing and MATLAB systems. This concept uses computational images that are to be compared with original images of the street taken in order to determine the traffic level percentage and set the timing for the traffic signal accordingly which are used to reduce the traffic stoppage on traffic lights. They concept proposes to solve real life scenarios in the streets, thus enriching the traffic lights by adding image receivers like HD cameras and image processors. The input is then imported into MATLAB to be used. as a method for calculating the traffic on roads. Their results would be computed in order to adjust the traffic light timings on a particular street, and also with respect to other similar proposals but with the added value of solving a real, big instance.

Keywords: Image processing, edge detection algorithm, Prewitt algorithm, traffic analysis, background subtraction.

1. Introduction

Recently the number of vehicles has increased throughout the world especially in big cities. It has become very difficult to manage the traffic congestion and high number of road accidents which is increasing day by day[1][2]. This situation is affecting our life in many ways such as health issues, pollution, and wasted fuel. There are many negative impacts of traffic congestion which includes but are not limited to wasting time of motorists, inability to forecast travel time, higher chance of collisions due to tight spacing and constant stopping. Therefore we need to develop a highly efficient method for traffic flow towards each direction such as cameras, induction loop detector, burying sensors in the road to detect traffic flow etc. But most of these techniques are expensive and hard to implement. Some other methods such as laser based system and ultrasonic detectors need big structures to be placed in the road which may in turn increase the traffic congestion[3]. Road traffic scenario in India is much different from other developed countries. Road conditions are getting worse day by day. Traffic is not stable. Our aim is to provide a intelligent traffic analysis and control system for the Indian scenario. The technique should work under all different road conditions, dense roads that are not structured and with vehicles of all types. This paper tries to analyse the use of image processing to adjust traffic light system in a junction.

2. Existing System

In this section we examine the different methods which are used to analyze and control traffic:

a) Magnetic loops



It is a technology that is been used for detection of vehicles and traffic control since the past few decades. It is more of a device that is buried inside each traffic lane and counts each vehicle that passes over them hence getting an idea of the total number of vehicles on the road. Magnetic loops are created with swirling wires continuously and burying it inside the lane whose end is then connected through a loop extension to a vehicle detector which in turn powers the loop causing a magnetic field in loop area. The magnetic flux changes whenever a metal object, such as a vehicle, moves over that loop. The change in flux is sensed by the detector. Troubleshooting problems require costly test equipment or diagnostic software. Drawback for this system is that these loops will only be useful in presence of continuous traffic

b) Microwave RADAR

Microwave radars use specially allocated radio frequency for detecting vehicles. There are two types of radio detectors.

First type uses Doppler principle to detect vehicles. According to the Doppler principle the difference in frequencies transmitted and received which is proportional to the speed of the vehicle. If the detector senses any shift in the received frequency it deduces that vehicle has passed. One major drawback with this system is that it cannot detect immobile vehicles.

The second type uses frequency-modulated continuous wave that varies the transmitted frequency continuously with time. This helps the system to detect the distance of the vehicles from the detectors which makes it possible to detect the immobile vehicles as well. Speed can be calculated by finding out the time taken to cover a particular distance in the known range of the detectors.

c) Laser Based Systems

Laser based systems can be used to for counting, classifying and measuring speed of vehicles. Laser based systems offer reliability and durability. Unlike systems based on magnetic loops the installation of these systems does not need any civil engineering work to be done on the floor of the road. Laser detectors, however, need to be installed on a overhead position. Thus, an overhead structure is needed for these systems. Also these systems assume structured traffic on the road which is not the case in India.

d) Infrared Detectors

Infrared detectors use an energy sensitive photon detector which is located on a optical focal plane to measure the infrared energy emitted by objects. When a vehicle crosses the detection region of the device, a change in energy is produces which is sensed by the photon detector. The drawback of this system is that it cannot determine the speed of the vehicle. Also if there is any change in weather conditions it may also lead degradation of these systems.

3. Proposed System

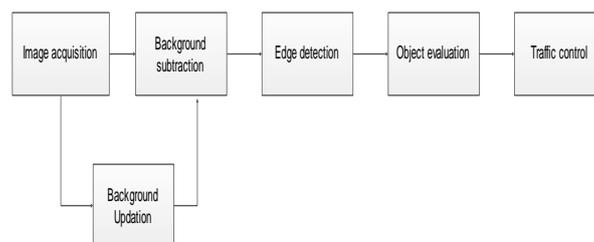


Fig 1: System overview

The main steps of our methods are given below:

1. Image capturing
2. Background subtraction

3. Edge detection
4. Counting the number of area covered
5. Controlling traffic lights

We plan to install cameras on top of traffic signals and capture real time road conditions. Images captured from the cameras are then processed using edge detection and background subtraction and then is compared with the reference image. The result is then used to update the traffic signal timings.

3.1. Image acquisition:

Phase 1:

At first background image collection is done with the help of the camera fixed in traffic junction. At first an image is captured with no traffic in the road and is set as the reference background image. Image enhancement such as RGB to grey scale conversion and gamma correction is done on the reference image. Then edge detection of this image is done using the method of Prewitt edge detection operator method.

Phase 2:

Every one minute a new image is captured to detect the current traffic scenario. Each image is then processed with image enhancement techniques such as rgb to grey scale conversion and gamma correction. And after image enhancement edge detection is done on the image using Prewitt edge detection operator method.

3.2. Background Subtraction:

Once the image has been obtained and image enhancement has been done on it the next step is to subtract the newly obtained image from the reference background image. This is done by pixel to pixel comparison of the newly obtained image and the background image. A pixel would be part of the foreground image, if its pixel value varies from its corresponding value in the background reference image. The edges then obtained on the basis of a threshold which is already defined.

3.3. Edge Detection:

An edge detection algorithm is used to find the edges of the image obtained by image subtraction. Edges are detected by the abrupt change in grey scale level. Some of the common techniques used for edge detection are Boolean edge detector, Sobel algorithm and Laplacian operators.



Fig 2: Different edge detection techniques

We have used Prewitt algorithm for edge detection which computes an approximate gradient of the image intensity function. A discrete differentiation operator is used in image processing particularly in edge detection called Prewitt operator. At each point during the image processing the Prewitt operator is calculated which is either the vector gradient or the normal of the vector.

3.4. Image matching:

After edge detection it is essential to match the two images. Edge based matching is the method in which two edge of the same image are pared together. Any edge or its representation on one image is analyzed and evaluated against all the edges on the other image. Edge detection of reference and the real time images has been done using Prewitt operator. Then these images are analyzed and accordingly the traffic light timings can be adjusted.

- Matching from 10 to 50% - green light on for 60 seconds
- Matching between 50 to 70% - green light on for 30 seconds
- Matching between 70 to 90% - green light on for 20 seconds
- Matching between 90 to 100% - red light on for 60 seconds

4. Comparison between conventional traffic light systems and our method:

Factors	Conventional method	Our method
Requirement of traffic police in peak hours:	Yes	No
Congestion of traffic	Possibility high	Less possibility
Variable traffic light timings	No	According to demand

Table 1: comparison between new and old method

5. Summary and Conclusion

Our method is designed to minimise the road traffic waiting at each junction for motorists. By using our method traffic signal timings will change according to the real time demands as changes in the road traffic are detected. This method enhances the effective control of road traffic and improves the efficiency of traffic flow especially in cities where the traffic congestion is very high.

This new method is capable of judging the rush of vehicles in a road junction and controlling the traffic lights according to the rush towards each direction. Our study illustrates that image processing is a better method to analyse and control road traffic signals. It is more consistent because it uses real time traffic images. According to our study this technique is easy for enhancing the effective control

of traffic and congestion in peak hours. Our system can replace the work of human in traffic control. It illustrates the real time scenario so it is much more efficient than other methods which use sensors and infra red light techniques.

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