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AUTOMATED SIGNAL SYSTEM

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Abstract— Now-a-days, with a huge increase in public and private transport as well as the ever increasing population, the traffic on the roads has significantly increased. This leads to a lot of wastage of precious man hours. The current situation for controlling a traffic light uses timer for each phase. In this paper we will talk about how this traffic can be controlled by using electronic sensors in order to detect vehicles and control the traffic signal. The other method discussed in this paper focuses on analysis of traffic density using image processing techniques. For this method, camera is being used to capture the video. The captured video will be converted into image frames, which will be used to analyze traffic density. We also aim to detect presence of emergency vehicles in traffic and give that lane priority to open. Hence, we will be analyzing traffic density on every signal using image processing and hardware systems i.e. IR sensors to change the waiting time frame of every lane.

Keywords— Image Processing, IR Sensors, Traffic Density.

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I. INTRODUCTION

In the recent years, with the ever increasing population, the numbers of vehicles on the roads are increasing and with that traffic congestion is becoming a significant problem. Due to these traffic jams, a lot of our valuable time is wasted which sometimes affect our day to day life as well and the cost of transportation also increases. If emergency vehicles get stuck due to such traffic congestions, life of a person can be at risk. A traffic controller uses a predetermined schedule for traffic convergence from each direction at a junction. Sometimes there is a possibility that on a junction one road is empty and the signal shows green while the other is highly congested and still the traffic light signals red to the road with the higher traffic density. Sometimes there can be gridlock conditions on a junction too. Hence we need an automated system to control the traffic light according to the lane density instead of the traditional time frame system. Our report is on density based traffic control with priority to emergency vehicles like ambulance and fire brigade. We focus on different techniques of density analysis and intelligent traffic system development. Majorly, the entire algorithm uses image processing or sensors for analyzing the traffic density. Same method is used for image acquisition in all the techniques. We make use of cameras to record the video of traffic condition on different lanes then images frames are taken from these videos. Image processing is nothing but analysis and manipulation of digital images. For calculation of traffic density using image processing further processing is done on the acquired image frames to determine the crowdedness. Additional processing is required for acquisition of emergency vehicles. The IR sensor works on the principle that whenever a vehicle passes between the IR transmitter and receiver the IR light is blocked and hence the resistance of the photodiode increases. And emergency vehicles are detected using the frequency of their sirens.

II. RELATED WORK

As we know there is lot of traffic congestion problem, it's necessary to solve it. Many different ways are used to solve this problem. Mainly this problem is solved using IR sensors and image processing. In this section we will write about few of these techniques. To solve this problem we had surveyed various paper and we found that this issue is majorly resolved by IR sensors and image processing techniques.

A. Using Infrared sensors to detect presence of vehicles:

In this system, we will use IR sensors to measure the traffic density. For each road there would be one IR sensor; these sensors will sense the traffic on that respective road. All the sensors are interfaced with the microcontroller. Using these sensors, controller can detect the traffic density and controls it. Microcontroller is the heart for this traffic system. IR sensors are connected to one port of the microcontroller and traffic lights are connected to other ports. If there is traffic on the road then sensor connected to that road gives output as logic 0, else logic 1. By receiving these IR sensor outputs, we have to write an algorithm to control the traffic system. If it is logic 0 of any of these sensors, then we have to turn signal on that particular lane green and give red signal to all other lanes. Here continuous monitor of the IR sensors for the traffic is required.

So, basically in this method, the IR detects the vehicle density and according to that the timer is adjusted.

B. Using Image Processing techniques to analyze traffic density:

Automatic traffic monitoring and surveillance are important for road usage and management. Traffic parameter estimation has been research area for the growth of intelligent Transportation systems (ITS). For ITS applications traffic- information needs to be collected and distributed. Different sensors have been assigned to estimate traffic parameters for updation of traffic information. Magnetic loop detectors have been used the most, but their installation and maintenance is difficult and might become incompatible with future ITS infrastructure. In addition to qualitative description of road congestion, image measurement can provide quantitative description of traffic status. Moreover, quantitative traffic parameters will help us get complete traffic flow information, which will be helpful for the requirement of traffic management theory. Image tracking of moving vehicles can give us quantitative description of traffic flow.

Table 1: System aims to achieve

In the present work the designed system aims to achieve the following:		
Signal the traffic light to go red if the road is empty	Distinguish the presence and absence of vehicles in road images	Signal the traffic light to go red if the maximum time for the green light has elapsed even if there are still vehicles present on the road

C. Detection of Vehicles:

To detect the vehicles on the road, obtain the current frame and the Background frame are converted to gray scale and the images are compared and subtracted to obtain presence of objects on the road . Morphological operations such as dilate & erode are carried out to remove the additional noise in the image and this image is further enhanced and it is converted to binary image. This image is then filtered using Gaussian filter and to obtain only the vehicles on the road. The next step is to count the number of vehicles present on the roads. To achieve these sets of connecting pixels are labeled which are the vehicles & they are marked with a bounding box.
RGB to Gray scale Conversion in order to achieve image enhancement is done. Median Method is selected to initialize the background which can resolve the shadow problem.

D. Detection of Ambulance:

To detect the ambulance on a lane, its siren is being detected. The red color & blue color of the siren is obtained using image segmentation based on color. Its respective centroids are found out and distance between each red & blue pair is calculated. If the distance between them is lesser than a given threshold distance, and if both the centroids lie on the same vehicle then the corresponding red & blue color is coming from the siren and the vehicle is an ambulance.
It can be also be detected using RFID tags.

F. Using RFID tags

RFID tags avoids problems that usually arise with Standard traffic control systems, especially those related to image processing and beam interruption techniques. This RFID technique deals with a multivehicle, multilane, multi road junction area. It provides an efficient time management scheme, in which a dynamic time schedule is worked out in real time for the

passage of each traffic column. The real time operation of the system emulates the judgment of a traffic policeman on duty. The number of vehicles in each column and the routing are proprieties, upon which the calculations and the judgments are based.

The proposed method provides an intelligent traffic control system to pass emergency vehicles smoothly. Here, each individual vehicle is equipped with special radio frequency identification (RFID) tag which is placed at a specific location which cannot be removed easily. This method makes use of RFID reader, max 232, and PIC16F877A system-on-chip to read the RFID tags attached to the vehicle.

If the RFID-tag-read belongs to the stolen vehicle, the location is tracked using GPS and then a message is sent using GSM to the police control room. In addition, when an ambulance is approaching the junction, it will communicate to the traffic controller in the junction to turn ON the green light until the ambulance passes and the red light for the other path should be turned red.

E. 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, and when there is 25,50 and 75% traffic
- These images of 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 Sobel 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 Sobel edge.
- Detection 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.

Table 2: After image matching, timing for green light to ON

Image Matching (in percentage)	Green Light ON Timing (in secs)
0 to 10	90
10 to 15	60
50 to 70	20
70 to 90	20
90 to 100	0 (Red Light is on for 60 secs)

Till now we have discussed about existing traffic control system and their drawback, to overcome from those drawbacks can build a flexible traffic light control system based on traffic density. For traffic density, edge detection techniques can be used. The edge detection is a technique in image processing used to identify an image object, image segmentation, image enhancement. Every edge detection techniques has its own pros and cons in various fields. In future rather than using existing edge detection techniques, we can use fuzzy logic and morphological based edge detection technique for regulating traffic light control system based on traffic density to save the time and to reduce operating cost.

III. CONCLUSION AND FUTURE WORK

Traffic density can be managed using IR sensors and Image Processing. Traffic in today's world is controlled by a microcontroller and a microprocessor which has a fixed algorithm and controls the traffic timers according to that. It is non-flexible and in best cases, a better algorithm is used which varies the traffic signal time throughout the day but does not control live traffic situations.

Secondly, when an emergency vehicle comes through, there are 2 ways in which it can be detected by using image processing or by using RFID tags which will allow it to pass through first making the other lanes' signal red.

Much such theoretical knowledge existsof how traffic density can be calculated and using that how the traffic can be managed efficiently using IR sensors or Image Processing, but none of them have been implemented yet as such. So, implementing it and finding the best way to manage traffic using the techniques discussed in above section can be very useful. So, the traffic density on each lane can be estimated and the traffic signal can be prioritized accordingly and also the emergency vehicles can be detected using the above methods.

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