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Image Processing Based Traffic Light Control

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Abstract— **We are very much aware of the fact that, the population of city and number of vehicles on the road are increasing day by day. With increasing urban population and hence the number of vehicles, need of controlling streets, highways and roads is major issue. The main reason behind today's traffic problem is the techniques that are used for traffic management. Today's traffic management system has no emphasis on live traffic scenario, which leads to inefficient traffic management systems. These traffic timers just show the preset time. This is like using open loop system. If we incorporate a closed loop system using camera, it is possible to predict the exact time on traffic light timers. If the traffic light timers are showing correct time to regulate the traffic, then the time wasted on unwanted green signals (green signal, when there is no traffic) will be saved. Timer for every lane is the simplest way to control traffic. And if those timers are predicting exact time then automatically the system will be more efficient. This paper represents the project that has been implemented by using the Matlab software and it aims to prevent heavy traffic congestion. This project does not actually measure the number of vehicles present on the road, but measures the area covered by vehicles on the road. Moreover, for implementing this project following steps must be considered: 1) image acquisition 2) RGB to grayscale transformation 3) image enhancement. At first, film of highway is captured by a camera has been installed in highway.**

A web camera is placed in a traffic lane that will capture images of the road on which we want to control traffic. Then these images are efficiently processed to know the traffic density. According to the processed data from matlab , the controller will send the command to the timer to show particular time on the signal to manage traffic.

***Index Terms*— Controller, Image acquisition, Image enhancement, RGB to grayscale transformation**

I. INTRODUCTION

Fast transportation systems and rapid transit systems are nerves of economic developments for any nation. Mismanagement and traffic congestion results in long waiting times, loss of fuel and money. It is therefore utmost necessary to have a fast, economical and efficient traffic control system for national development. The monitoring and control of city traffic is becoming a major problem in many countries. With the ever increasing number of vehicles on the road, the Traffic Monitoring Authority has to find new methods of overcoming such a problem. One way to improve traffic flow and safety of the current transportation system is to apply automation and intelligent control methods. As the number of road users constantly increases, and resources provided by current infrastructures are limited, intelligent control of traffic will become a very important issue in the future. Traffic congestion may result due to heavy traffic at a junction. To avoid congestion there are so many traffic management techniques available. But no technique is perfect by itself as the real time situations are generally continuously changing and the system has to adapt itself to change in the continuously changing circumstances. We have made an attempt to provide some traffic management strategy which is self-changing in nature, so as to fit in to continuously changing real time traffic scenarios. In this system time is assigned to traffic light of particular lane according to the traffic density on the road.

Limitations of Existing system

1. Heavy Traffic Jams

With increasing number of vehicles on road, heavy traffic congestion has substantially increased in major cities. This happened usually at the main junctions commonly in the morning, before office hour and in the evening, after office hours. The main effect of this matter is increased time wasting of the people on the road.

2. No traffic, but still need to wait

At certain junctions, sometimes even if there is no traffic, people have to wait. Because the traffic light remains red for the preset time period, the the road users should wait until the light turn to green. If they run the red

To avoid the above mentioned limitations, the paper implements feedback based traffic management system. The main emphasis is given to control traffic in minimum amount of time and building an efficient solution for traffic jams.

II. LITERATURE SERVEY

Pezhman Niksaz et. al.[1] propose a system that estimates the size of traffic in highways by using image processing has been proposed and as a result a message is shown to inform the number of cars in highway. This project has been implemented by using the Matlab software and it aims to prevent heavy traffic in highways. Moreover, for implementing this project following steps must be considered: 1) image acquisition 2) RGB to grayscale transformation 3) image enhancement and 4) morphological operations. At first, film of highway is captured by a camera has been installed in highway. Then, the film comes in the form of consecutive frames and each frame is compared with the first frame. After that, the number of cars in highways is specified. At the end, if the number of cars is more than a threshold, a message is shown to inform the traffic status. By this message we can predict the need to reduce the size of traffic carried. Experiments show that the algorithm will work properly

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In this particular research paper they have used video camera. Camera is shooting video and the video is then converted to sequence of images by taking snapshots. This is quite difficult as we are nothing to do with video coverage. So we avoided this method and decided to use a simple camera only.

Chandrasekhar. M, Saikrishna.C, Phaneendra Kumar[2] propose the implementation of image processing algorithm in real time traffic light control which will control the traffic light efficiently. A web camera is placed in each stage of traffic light that will capture the still images of the road where we want to control the traffic. Then those captured images are successively matched using image matching with a reference image which is an empty road image. The traffic is governed according to percentage of matching.

The key point of the paper is the technique which is used for image comparison. The authors have used image matching technique. SIFT algorithm is been used in this paper and this is very effective and pretty simple.

Vikramaditya Dangi, Amol Parab, Kshitij Pawar & S.S Rathod[3] propose the way to implement an intelligent traffic controller using real time image processing. The image sequences from a camera are analyzed using various edge detection and object counting methods to obtain the most efficient technique. Subsequently, the number of vehicles at the intersection is evaluated and traffic is efficiently managed. The paper also proposes to implement a real-time emergency vehicle detection system. In case an emergency vehicle is detected, the lane is given priority over all the others.

The key point of this paper is the technique which is used for edge detection. The authors have given the comparison of various edge detection techniques and conclude that canny edge detection is the best method for edge detection. Thus we are using canny edge detection.

Pallavi Choudekar et. al[4] they propose a system for controlling the traffic light by
image processing. The system will detect vehicles through images instead of using electronic sensors embedded in the pavement. A camera will be installed alongside the traffic light. It will capture image sequences. The image sequence will then be analyzed using digital image processing for vehicle detection, and according to traffic conditions on the road traffic light can be controlled.

In the present work the designed system aims to achieve the following.

Distinguish the presence and absence of vehicles in road images;

1. Signal the traffic light to go red if the road is empty;
2. 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.

Components of the current project

1. Hardware module
2. Software module
3. Interfacing

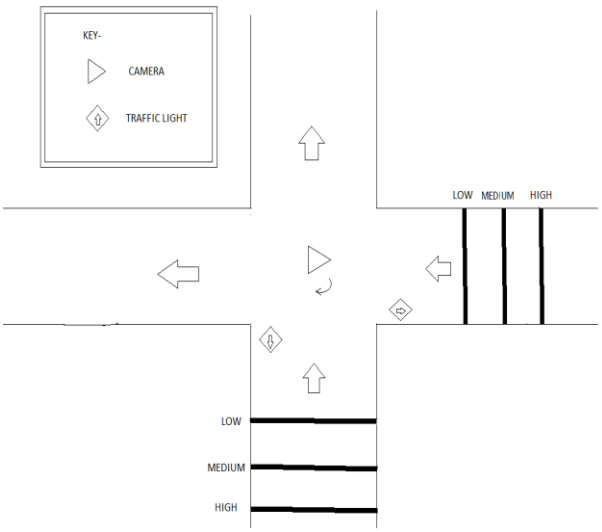
Key points- Intelligent Transportation System (ITS), Traffic light, Image Processing, edge detection

III. PROBLEM DEFINITION

Present Traffic Light Controllers are based on microcontrollers & microprocessors. These TLC have limitations because it uses the pre-defined hardware, which is functioning according to the program that does not have the flexibility of modification on real time basis.

Fig 3.1-General outlook of project

Due to the fixed time intervals of green, orange & red signals the waiting time is more and car uses more fuel. To make traffic



light controlling more efficient, we exploit the emergence of new technique called as “Image processing based traffic light controller”. This technique makes the use of Image processing. In this technique we would be drawing lines of green colour at an arbitrary distance. The reason for plotting only green coloured lines or strips is that we have to detect these strips through camera and there are very less number of vehicles that are painted in green. Camera would be placed at the signal which would be focusing on the lines drawn. If the specified lines get cut for a specific interval of time then green pixel area of the image reduces. Accordingly we can determine the traffic density at a particular signal .if all three lines are visible then it means that there is very low traffic on the road and thus the timer is adjusted to show less time say 20 seconds . Now if two lines are visible then number of vehicles on the road is increased as compared to initial situation and timer is now adjusted to show some more time say 25 seconds. If no strip is visible then it means that traffic is more and controllers have to increase traffic timer.

Thus optimization of traffic light switching increases road capacity and traffic flow, and can prevent traffic congestions. As shown in the diagram, there are three lines representing three traffic conditions viz. high, low and medium.

Hardware-
A webcam
Here, the images are captured by a USB web camera has been used.
PC- A PC is used as a central device for various image processing operations.
Interface-
The hardware interface is achieved through serial port of PC. Serial port driver are installed in PC.
Software-
A MATLAB software is used .the entire algorithm for image processing is implemented in MATLAB.

Introduction to image processing-

Image Acquisition-
Image acquisition in image processing is broadly defined as the action of retrieving an image from the source, usually a hardware-based source, so it can be passed through whatever processes need to occur afterward. The image that is acquired is completely unprocessed and is the result of whatever hardware was used to generate it. Image enhancement-it refers to accentuation, or sharpening, of image features such as boundaries, or contrast to make a graphic display more useful for display or analysis. This process does not increase the inherent information content in data. It includes Gray level and contrast manipulation, noise reduction, sharpening, filtering and magnification and so on.

RGB to greyscales conversion on image.
A greyscales image is an image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort also called black and white images. This conversion is required because grayscale images are easy to process as less image data is concerned. The intensity of a pixel is expressed within a given range between a minimum and maximum, inclusive.

IV. IMPLEMENTATION STEPS - (TIMING DETAILS)

Step1-
First the image is received through camera in RGB format .this is needed to be converted in grayscale. Thus it is processed in MATLAB in order to convert it into grayscale.

A) RGB to gray conversion-

Color image can be modeled as three band monochrome image data,where each band of the data corresponds to a different color. The actual information stored in the digital image data is brightness information in each spectral band. When the image is displayed, the corresponding brightness information is displayed on the screen by picture elements that emit light energy corresponding to that particular color.

B) Green colour subtraction-

The green colour subtraction is done for measuring pixel count.

C) Threshold-

The output image of non-maximum suppression stage may consist of broken edge contours, single edge points which contribute to noise. This can be eliminated by thresholding with *hysteresis*. Two thresholds are considered for hysteresis, one high threshold other low threshold. If any edge response is above a high threshold, those pixels constitute definite edge output of the detector for a particular scale. Individual weak responses usually correspond to noise, but if these points are connected to any of the pixels with high threshold, they are more likely to be actual edges in the image. Such connected pixels are treated as edge pixels if their response is above a low threshold. To get thin edges two thresholds (high threshold (TH) and low threshold (TL)) are used. If the gradient of the edge pixel is above the TH, it is considered as an edge pixel. If the gradient of the edge pixel is below TL then it is unconditionally set to zero. If the gradient is between these two, then it is set to zero unless there is a path
from this pixel to a pixel with a gradient above TH ; the path must be entirely through pixels with gradients of at least TL.
D) Black and white conversion-
The image required must be in the black and white form, so black and white conversion is made

Step2 –
Now the image is in black and white form, i.e. the green strip area is in white color and background is in black. So it is required to measure green area of the received Image. Green pixel area of this image is measured. If that area is say 10,000 pixels then each strip is having approximately 3300 pixels. By using this information, the set points are set in the code. It will help to specify three traffic conditions viz. low, medium and high. If pixel count is more than 6600 then traffic condition is low. If pixel count is more than 3300 then traffic condition is medium. If pixel count is closer to 10,000 then traffic is high.
Step3-
Thus according to pixel count a signature code is generated in MATLAB which is to be sent to controller to allocate timer. For ex. High traffic- 35 seconds
Medium traffic-30 seconds
Low traffic-25 seconds
No traffic- default (minimum)
Step4-
Microcontroller based hardware unit receives a code through serial port. Therefore, depending upon the signature code received, controller allocates the time on traffic timer.

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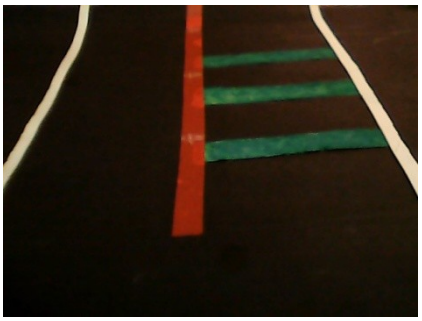
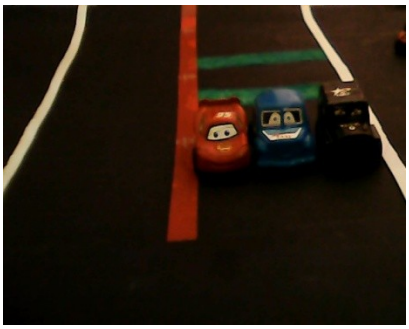
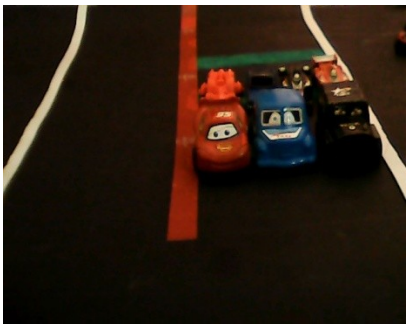
V.DEMO IMAGES-



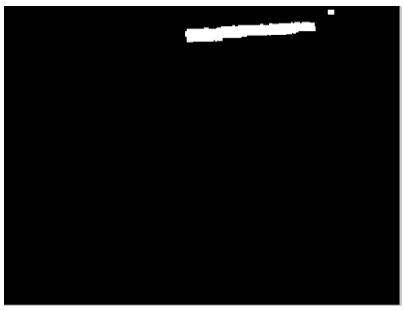




NO TRAFFIC
Pixel count>10000

HIGH TRAFFIC
Pixel count>0000

LOW TRAFFIC
Pixel count(7000-10000)



MEDIUM TRAFFIC
Pixel count(3500-7000)

ORIGINAL IMAGE

BLACK AND WHITE IMAGE

V) CONCLUSION-

The above paper presents the method of traffic light control through image processing. The earlier techniques had a drawback of time being wasted on green light on the empty road. Our implemented system avoids this problem. We have successfully implemented real time image processing based traffic light controller

This paper illustrates that image processing is the best way to control traffic when it comes to real time feedback. The key feature of this paper is that it removes the need of hardware sensors such as infrared sensors and RFID tags.

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