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Traffic Density Based Smart Signaling System Using Image Processing In MATLAB

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Abstract: *Today's traffic management system has no significance on live traffic scenario, which leads to amateurish traffic management systems. These traffic timers just show the pre-set time, this is like using open loop system. If we consolidate a closed loop system using camera, it is possible to predict the required time on traffic light timers according to the traffic density. If the traffic light timers are showing only required 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 each lane is the simplest way to control traffic and if those timers are predicting required time based on traffic density present in the lane then automatically the system will be more efficient. This proposed system measures the number of vehicles present in each lane using image processing in MATLAB software. It aims to control traffic based on current scenario of the traffic density present on the roads and also gives emergency alert to clear the lane in which emergency vehicle such as ambulance is detected irrespective of the traffic density.*

Keywords—*MATLAB, Closed loop system, Vehicle counting, Emergency, Vehicle detection.*

I. INTRODUCTION

Density and flow are the critical parameters for road traffic analysis. High performance road traffic management and control require real-time estimation of space and density as input for large spatial and temporal coverage of the roadway network. Vehicles crowding may result due to heavy traffic at a junction. To avoid this there are many traffic management techniques available but these old techniques are not perfect by themselves as the real time situations are continuously changing and the system has to modify itself to change in the continuously changing traffic scenarios. Thus we need a system to provide traffic management scheme which is self-changing in nature, so as to be prepared for continuously changing real time traffic scenarios.

The traffic lights that are used in today's traffic management system do not help much in detailing of when deciding when to change the lights for the various road users waiting in different lanes. How long the signal stays green in one lane and red in others is determined by simple preset timing that is calculated when the crossing is designed. Today's methods are robust and work well but the systems are very inefficient because they are unable to handle various situations that arise throughout the day. Unnecessary waiting time in the signal can be avoided by determining in which side the green signal should be ON for a long time during the traffic and to achieve this we need to find the density of the traffic present on the roads.

We found that Image processing is one of the best methods which we can use for adaptive signal controlling. Image processing provides measurement of Pattern i.e. measures various object in an image and Image Recognition i.e. Distinguish the objects in an image. Therefore this purpose of image processing can be used to identify the density of traffic present on the roads which gives the information of number of vehicles present in each lane.

In this proposed system, we place a camera such a way that it can capture the entire top view of the road on which we need to control traffic. We are using MATLAB to identify the number of vehicles present in each IN and OUT lane. MATLAB will send specific characters for each IN and OUT lane that depends on the number of vehicles which is fixed by MATLAB programmer. The specific characters will get send from PC to microcontroller by using USB to TTL in the binary form. Microcontroller will identify which characters is received and according to that it gives priority to that lane in which traffic density will be maximum. We are using 4 traffic signal set to clear the priority. In such a way that traffic priority will get cleared. After all four lanes are cleared according to the priority given to them by microcontroller camera will again get ready to click next image. Each IN lane is used to decide the priority and OUT lane is used to decide the duration. For how much duration LED needs to be ON that is decided by number of vehicles present in OUT lane. If the ambulance is detected then priority will be given to that lane, irrespective of the traffic density. The rest of the paper is organized as follows: Section II describes block diagram of proposed system. Section III explains techniques used in proposed system followed by output and conclusion in Section IV and V respectively.

II. BLOCK DIAGRAM OF PROPOSED SYSTEM

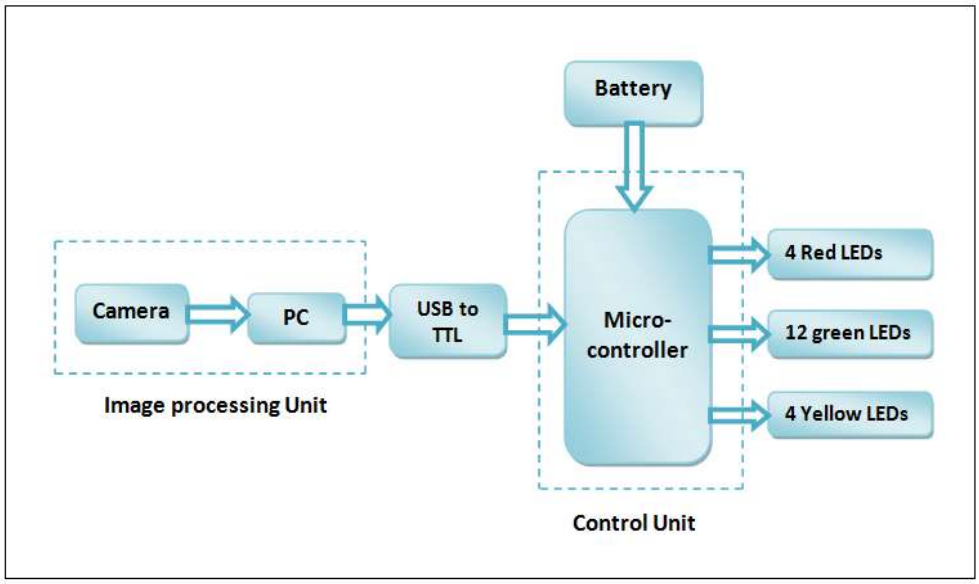

Fig.1. Block diagram of proposed system.

In fig. 1 camera is dynamically capturing entire top view of the four lanes and sending it to the PC. PC will process the received images using MATLAB software and gives the Information about the traffic density and emergency vehicle present in each lane in both IN and OUT direction. PC will send this information from processed image to the microcontroller using USB to TTL cable. USB to TTL is used for serial communication between PC and microcontroller. This will help to convert the information taken from PC to Binary format for the microcontroller. Microcontroller will control the Traffic signal lights i.e. LEDs used for four lanes to indicate signal according to the Binary information taken from PC. The preference and timer is given by the microcontroller. Four Red LEDs one for each lane is used to stop the vehicle flow and twelve green LEDs are used to surpass the traffic for given time

AT89S52 IC of 8051 microcontroller in fig. 2 according to fig.1 is used to control the traffic lights. When microcontroller receives the data of current scenario of traffic density present in each lane from PC then it will give priority and set timer accordingly.

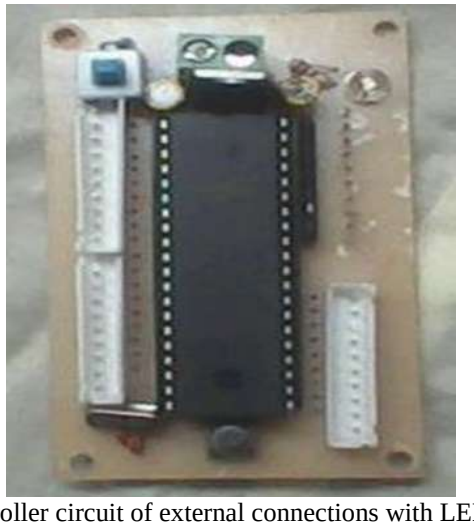

Fig.2. 8051 microcontroller circuit of external connections with LEDs, power supply etc.

Red, Yellow and Green LEDs are used to make traffic board in fig.3 according to fig.1. For each signal 4 LEDs are used. Yellow-4, Red-4, Left green- 4, Right green-4 and Centre green-4. All LEDs are connected with GPIO (General purpose Input Output) pins of AT89S52 in active low mode. Active low means when GPIO pin will get logic 0 then LED will glow.

Fig.3. Traffic signal board.

USB to TTL in fig. 4 according to fig.1 is connected with microcontroller's pins Rx and Tx i.e P3.0 and P3.1 GPIO pins respectively. USB to TTL Tx pin with Rx pin of AT89S52 and USB to TTL Rx pin with AT89S52.

Fig.4. USB to TTL converter.

III. TECHNIQUES USED IN PROPOSED SYSTEM

MATLAB is widely used in digital image and video processing as a computational tool. Digital image processing algorithms can be used to extract the size, scale or number of objects in a scene. Environment for data analysis, visualization and algorithm development is provided by the tools and algorithm used in functional techniques for processing digital images.

In our proposed system emergency vehicle detection is done using color thresholding algorithm in MATLAB [5], in which the RGB color thresholding is used to describe the color of siren of ambulance and also the specific region of number of pixels to describe the size of siren. Vehicle detection is done using Blob detection algorithm in MATLAB [3], in which size of blob is defined as general size of vehicle.

1.1 EMERGENCY VEHICLE DETECTION:

In this proposed system image captured by a camera will be a color image initially. Thus we will use color based thresholding in which thresholding is to be done based on color values in natural images [5] to detect an ambulance in an image. Where image will be compared with the predefined criteria of ambulance detection in which blue color intensity of siren with number of pixels used to define a region of siren set by the MATLAB programmer.

1.2 VEHICLE COUNTS IN RESPECTIVE LANE:

Once the process of emergency vehicle detection is completed, initially captured color image is then converted into grey scale image for lane detection, vehicle detection and its count. First, we build a background model to segment foreground objects [2], [4]. Then we apply blob detection [3], which returns the count of blobs present in that image. we have mentioned the different regions for different lanes in background model, so accordingly it returns the total count and depending on the regions we can decide the vehicle count in that particular lane. We put region of interest in each lane and gets the count for respective lane.

IV. VEHICLE DETECTION AND COUNT

Fig.5. Captured image of traffic model

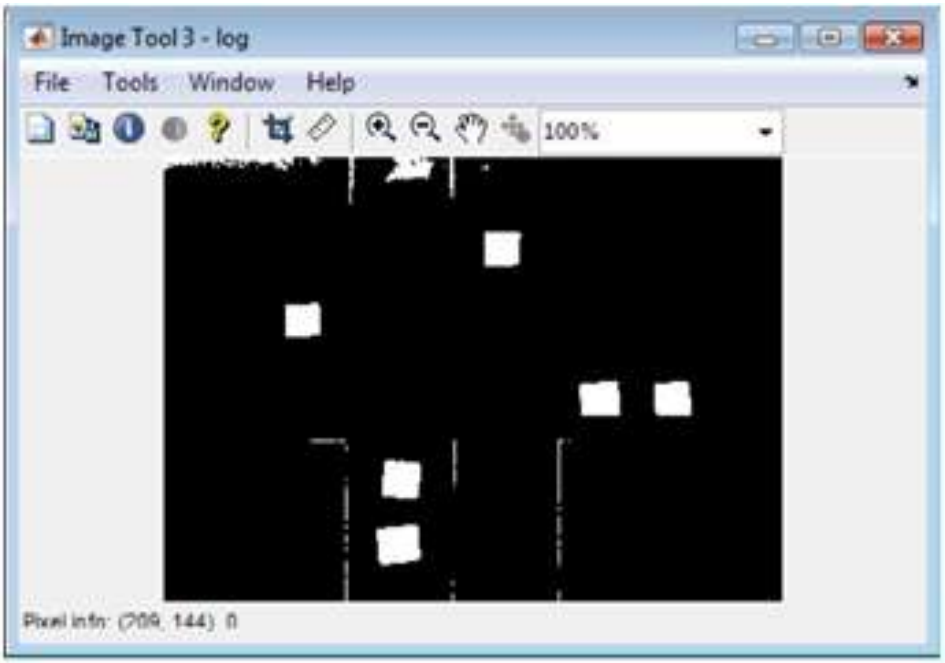

Fig.6. Blob detection

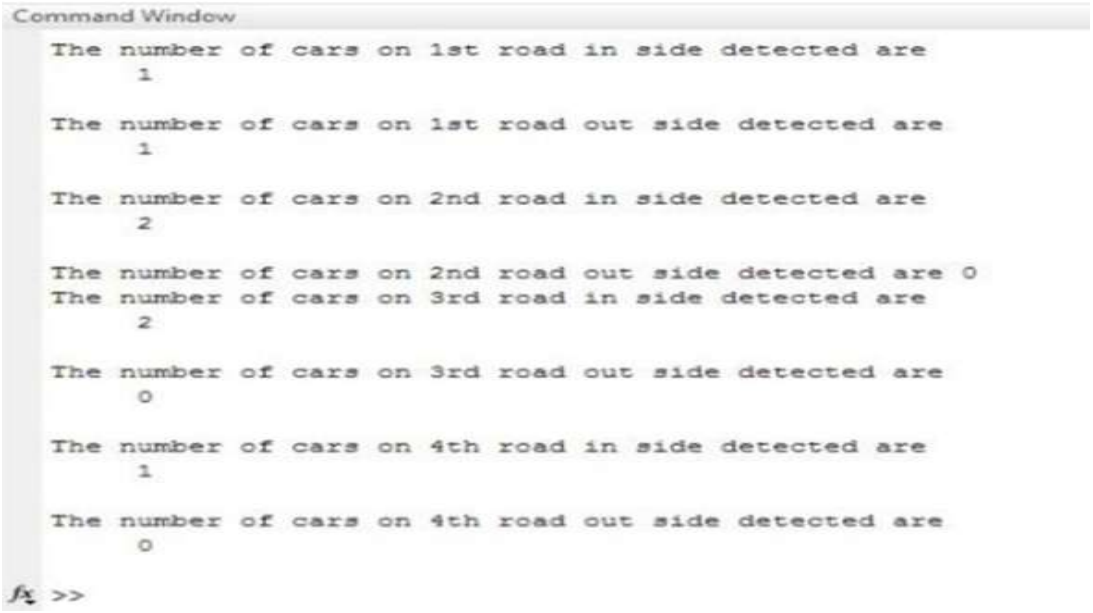

Fig.7. Output window

In fig. 7 output window of MATLAB code shows the number of vehicles detected in each IN and OUT lanes of respective roads.

ADVANTAGES

- The major advantage of this system is the adaptation of the cycle period to the entire region's traffic profile.
- It avoids the time being wasted by the green light on an empty road.
- Flexible as it adjusts the timing of traffic lights according to the actual road conditions.
- Ambulance detection and accordingly priorities are given to so that ambulance can reach hospital as soon as possible.

APPLICATONS

- This project can be used on all traffic signals.
- It can be used to count the no of vehicles on particular region for security purpose.
- Ambulance can be detected on any lane and that lane will get priority compared to other lanes.
- Smoke/fire can be detected using image processing and accordingly actions can be taken.

V. CONCLUSION

In this project, a method for controlling the traffic signal using Image Processing is presented. This is done by using the camera images captured from the lanes, each image is processed separately and the number of vehicles had been counted and according to that priority is given and green signal is operated based on timer. Due to the use of image processing over sensors this system has advantages such as low cost and easy setup with good accuracy and speed. Seeing that this method has been implemented using Image Processing and MATLAB software, therefore production cost is low while achieving high speed and accuracy.

FUTURE SCOPE

- The present system uses a single camera for monitoring traffic at an intersection; by using a separate camera for each road at an intersection will allow the system to use video processing which can improve the system efficiency further.
- The vehicle objects can also be categorized into various classes depending upon the geometrical shape of vehicle for blocking the passage of large vehicles e.g., trucks during day times.
- The emergency mode can be refined further by installing a GPS receiver in ambulance so that the base station will keep track of the ambulance location on a continuous basis and clear the road whenever will be required.

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