INTELLIGENT TRAFFIC LIGHT CONTROL USING IMAGE PROCESSING

[1]RAHISHET, [2]APARAJITA SAHOO, [3]APARNA INDORE, [4]VAIBHAVDESHMUKH, [5]PUSHPA U S

Department of Electronics and Telecommunications Engineering, Fr. C Rodrigues Institute of Technology, Vashi

Abstract- In India, with the growing number of vehicles, traffic congestion at junctions has become a serious issue. The density of vehicles is increasing day by day and there is an urgent need of adaptive traffic signals which can do real time monitoring of traffic density. This paper describes a system which uses image processing for regulating the traffic in an effective manner by taking images of traffic at a junction. A step by step approach of image acquisition, image processing and implementation of algorithm to change the traffic light duration as per the density of vehicles on different roads at a traffic signal is followed. The number of objects in a given image is counted and priority is given to the densest road.

Keywords- ARDUINO, MATLAB, Camera, Image Processing, Traffic Congestion, Traffic Monitoring, Priority

I. INTRODUCTION

Traffic lights play a very significant role in traffic control and regulation on a daily basis. The traffic lights that are used nowadays comprise of three lights: Red for stop, Yellow for wait and Green for go. Users are made to wait for the signal to change from red to yellow and then from yellow to green. The time that a commuter has to wait for is decided by the traffic signals. The traffic lights used nowadays are hardwired at the time of installation. They are pre-programmed to wait for a fixed duration of time after every change in signal. It is independent of the traffic on the roads and remains constant during its operation. Sometimes there is a situation where one particular road is very crowded as compared to others. A simple way of decongesting the road is by allocating more time for the vehicles on the densest road to pass as compared to other less dense roads. The system should be intelligent enough to decide the priority on a daily basis.

In this system, basically, the waiting time for the motorists on road with higher density is reduced. In doing so, the images for each lane are taken and processed simulataneously and a decision is passed as to which lane should be given how much amount of time and which should be the highest priority.

A camera is used to take pictures of the roads that connect in a traffic junction. The pictures taken are then processed to determine the density of vehicles on each road at that instant. A list of priority is assigned to each road in one cycle and the waiting time for that road is made to vary according to its density. A denser road is given more time to pass all its vehicles and reduce the traffic at the junction. This system is subjected to less hardware failure as it consists of a camera mounted on top of the signal which captures images and sends the images for image processing. Using MATLAB the density of the roads is determined and the microcontroller changes the duration of green light given for each road as per the output after image processing.

II. EXISTING TRAFFIC LIGHT SYSTEMS

The traffic lights used in India are basically pre-timed wherein the time of each lane to have a green signal is fixed. In a four lane traffic signal one lane is given a green signal at a time. Thus, the traffic light allows the vehicles of all lanes to pass in a sequence. So, the traffic can advance in either straight direction or turn by 90 degrees as shown in Fig.1.

So even if the traffic density in a particular lane is the least, it has to wait unnecessarily for a long time and when it gets the green signal it unnecessarily makes other lanes wait for even longer durations.

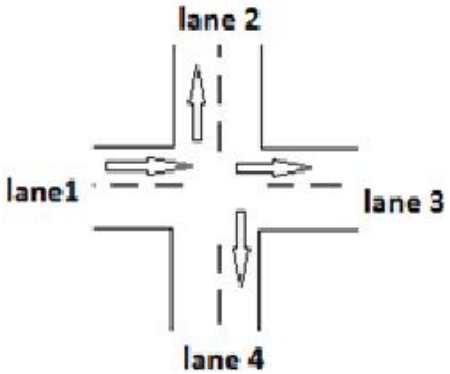

Fig.1 Lane diagram

III. METHODOLOGY

A. Image acquisition

The image is captured by a webcam. It is then transferred to the computer via a USB cable. The image acquisition and further processing is done by using MATLAB.

Fig.2 Image acquisition flow diagram

B. Image processing

The image is captured by using a webcam placed at the road junction. It has the capability of taking images of all the roads meeting at the junction. The webcam is mounted on the DC motor. The motor is responsible for capturing images from all directions in steps of fixed time interval. The speed of rotation of the camera is designed to be such that it is greater than the click-to-capture time of the camera. The acquired image is converted to grey scale image for further processing. The grey scale image is then converted to a binary image that contains only two colours, black and white. This image is known as the threshold image. The main purpose of thresholding the image is a radical reduction of information in order to simplify further processing. The thresholded image is then complemented for further image processing.

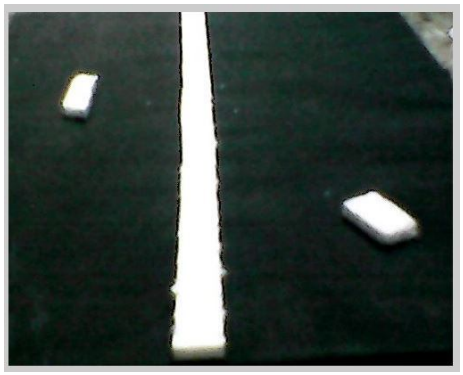

Fig.3 Original Image

1) Image cropping

The desired portion of the image is retained and the rest is cropped. Only the lane at which there is an incoming traffic at the junction is to be processed. Hence the image is cropped to select that section of the lane.

Fig.4Cropped Image

2) Image Enhancement

In this process the images are adjusted in such a way that the results are more suitable for further processing. In this, the obtained image is converted into a greyscale image.

3) Thresholding

Thresholding is transforming the greyscale image into black and white image (binary: white=1, black=0). The main purpose of thresholding is a radical reduction of information in order to simplify further processing. White colour is assigned to all the pixels that have luminosity greater than the threshold level and the others as black.

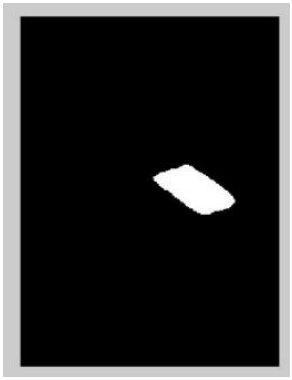

Fig.5 Threshold Image

4) Edge detection

Edge detection refers to the process of identifying and locating sharp discontinuities in an image. The discontinuities are abrupt changes in pixel intensities which characterize the boundaries of objects in an image.It filters out useless information, while keeping the important structural properties of an image. In this proposed system, canny edge detection technique is used. The boundaries of each image are found and the number of objects is calculated.

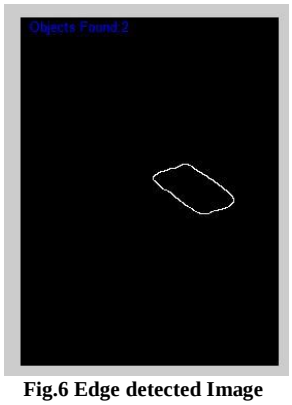

Fig.6 Edge detected Image

5) Object Counting

To count the objects present in the image, the close boundaries of the objects are identified. The exterior boundaries of the objects as well as the boundaries of holes inside these objects in the binary image are counted.

C. Changing the duration of traffic light

The duration of the traffic signal is monitored as follows:

1) The camera controlled by Arduino microcontroller rotates in clockwise direction and stops to take pictures of each lane. The clicked pictures are sent to MATLAB for image processing.
2) Then the camera rotates in anticlockwise direction and repeats the above step.
3) The images are processed in MATLAB and the priority of each lane is decided as per its traffic density.
4) The lane with the highest relative traffic density is given the highest priority and the lane with the lowest traffic density is given the least priority.
5) The lanes are arranged in the descending order of their priorities.
6) The duration of green signal of the lane with the highest priority is more as compared to others, so that the traffic in that lane can pass and reduce the congestion. The other lanes have their green signals as per their decreasing priorities.
7) After all the lanes have given their green signals, the traffic light completes its one cycle of traffic monitoring and congestion control.
8) This process repeats and the duration of green signal given to each lanes keeps adjusting itself after every rotation of the camera.

IV. PROTOTYPE DESIGN

The ARDUINO board is connected to the DC motor and the traffic lights. The DC motor is used for rotating the camera and controlling the timing of the image acquisition.

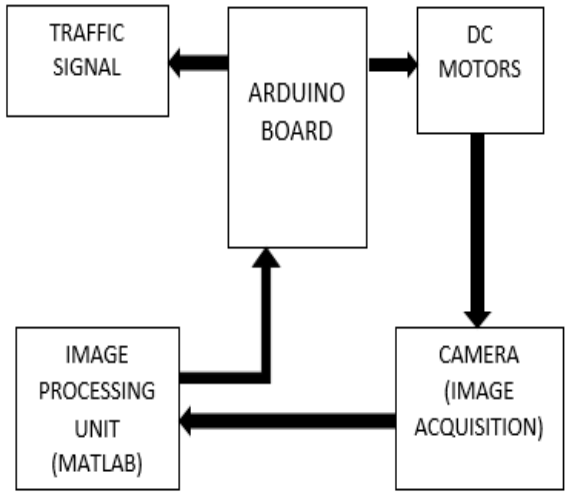

Fig.7 Prototype design connections

The camera is mounted over the DC motor and rotates according to the signals received from the ARDUINO board. The captured image is processed and the output is passed over to the ARDUINO board. It controls the duration of green signals of traffic lights.

V. COMMUNICATION BETWEEN ARDUINO AND MATLAB INTERFACE

The procedure for connecting the Arduino Microcontroller board to MATLAB via the USB port for serial communication is as follows:

The first step is to establish serial connection between the Arduino board and MATLAB via the USB port. The code for the Arduino board is written in the software Arduino and loaded on the board. In MATLAB the COM port is first configured. The configuration settings of serial port should match to that of Arduino. Then the data is sent serially from MATLAB to Arduino. This data is then processed by the Arduino board. After processing the output is given to the traffic light to change its duration as per the priority of the lanes.

CONCLUSION

This technique can be effective to combat the growing pressure of traffic on Indian roads. It uses image processing to estimate the density of vehicles on roads and regulates the traffic at fixed intervals of time. It is cost efficient and does not require the installation of complex machinery to monitor the traffic.Deploying this system will not only save the time consumed in waiting at traffic junctions, but will also conserve a lot of resources that are otherwise wasted.

REFERENCES

[1] Prashant Borkar, Amit R. Welekar, Sanjeevani Jenekar & S.P. Karmore, “Predictive Traffic Light Control System: Existing Systems and Proposed Plan for Next Intersection Prediction”.

[2] Raoul de Charette and Fawzi Nashashibi, “Traffic light recognition using Image processing Compared to Learning Processes”.

[3] Raoul de Charette, Fawzi Nashashibi, “Real Time Visual Traffic Lights Recognition Based on Spot Light Detection and Adaptive Traffic Lights Templates”.

[4] Mriganka Panjwani, Nikhil Tyagi, Ms. D. Shalini, Prof. K Venkata Lakshmi Narayana, “Smart Traffic Control Using Image Processing”.

[5] Ms Promila Sinhmar, Intelligent Traffic Light and Density Control Using IR Sensors and Microcontroller.

[6] Vismay Pandit, Jinesh Doshi, Dhruv Mehta, Ashay Mhatre and Abhilash Janardhan , “Smart Traffic Control System Using Image Processing”.

[7] Zixing Cai, Mingqin Gu, Yi Li, “Real-time Arrow Traffic Light Recognition System for Intelligent Vehicle”.

[8] George Siogkas, Evangelos Skodras and Evangelos Dermatas, “Traffic Lights Detection in Adverse Conditions using Color, Symmetry and Spatiotemporal Information”.

★★★