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Adaptive Traffic Control and Traffic Density Monitoring System using an Image Processing

Chhaya Aher[1], Shakil Shaikh [2]

P.G. Student, Dept. of E&TC Engineering, Pravara Rural Engineering College, Loni, Maharashtra, India[1]

Associate Professor, Dept. of E&TC Engineering, Pravara Rural Engineering College, Loni, Maharashtra, India [2]

ABSTRACT: Adaptive traffic control and traffic density monitoring system aims at automatically adjusting released time of vehicles as per density available to the roads at the intersection. The proposed system uses a web camera connected to computer placed at center place of intersection and stepper motor will rotate camera at 90 degree to each road for capturing vehicles images. Controls of the signal will be routed through the microcontroller. MATLAB® programming environment will be used for simulating actual road traffic and compute traffic released time for each road. Wirelessly traffic density information from traffic control unit will receive at traffic monitoring section and display real time graph of all four roads on computer with VB software. Depending on the number of vehicle my embedded system will generate signal effectively to control the flow of traffic on the road. Today's unpredicted growth of traffic has created serious problem in metro cities. Exiting automatic traffic control system with preset timing signal is inefficient for adaptation of varing traffic density at intersection and fail to allocate specific time to clear it.

KEYWORDS: Adaptive Traffic, Image processing, Zigbee, MATLAB Visual Basic (VB)

I. INTRODUCTION

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 or the Transport Ministry as the authority is known here in Malaysia has to find new ways or measures of overcoming such a problem. The measures taken are development of new roads and flyovers in the middle of the city; building of several ring such as the inner ring road, middle ring road and outer ring road; introduction of city trains such as the light rapid transit (LRT), and monorails; restricting of large vehicles in the city during peak hours; and also development of sophisticated traffic monitoring and control systems. But nowadays the existing traffic management becomes inefficient. Existing intelligent transportation systems (ITS) solutions detect vehicles in predefined positions. It is possible to obtain complete and integrated information (video-images and traffic volumes information). WSNs allow dynamic changes to network topology based on real needs and reports coming from sensors located along the road. When needed, the number of cameras which control a specific area may increase to produce more detailed information. Image processing is better technique to control traffic density in real time system .It shows that it can decrease traffic congestion and avoids time being wasted by green light on an empty roads .It is also more reliable in estimating vehicles presence because it uses actual traffic images etc. Count of vehicles which results in density estimation of the traffic at regular interval of time This is achieved through morphological operations dilation and opening .etc.

II. LITEARTURE SURVEY

The smart intersections equipped with sensors and communication infrastructure have been proposed. In this publication a novel multi sensor network to perceive the intersection environment is presented. Based on an intensive analysis of accident scenarios in Germany the system was designed to address 75 % of all severe and lethal accidents. 14 laser scanners, 10 cameras Sensor based traffic control by Michael Goldhammer et. al. [1] A vision-based vehicle detection method is presented in this paper. The proposed method is composed of two steps, i.e., hypothesis generation and hypothesis verification. An adaptive background modeling and updating method is proposed to detect foreground regions in video sequences by Qiong Cao et. al.[2]. We can calculate the density of the vehicle by using matlab tool by comparing the four side of the image which is given as a input. we can simulate the result of the four given input image but this cannot be used in real time applications as it is very slow by Pallavi Choudekar et. al.[3]. The discusses about some of the existing traffic light control system and their drawback and image processing technique i.e. edge detection

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techniques that helps in finding traffic density by Kavya P Walad et. al.[4].Various techniques have been presented for traffic control system. Inductive loops and infrared object sensors are most common detection systems to measure traffic flow on roads. Sensors based traffic control for controlling traffic By A. Albagul et. al. [*5*]. LAN and RFID based systems, though present a better solution are costly to deploy and maintain by Khalid A. S. et. al. [*6*]. A novel neural network and window-based image processing technique for road traffic applications. We use morphological edge detection techniques to detect vehicles. Once the vehicles have been detected, a back-propagation neural network is used for calculating various traffic parameters. This novel method has been implemented on a Pentium-based microcomputer system and the results are reported online in real-time. by M Y. Siyal et.al. [*7*].The inductive loops cannot communicate with each other, so they cannot share traffic data with each other. The wireless sensor network has these features: real-time, fault tolerance, scalability and coordination. Applying wireless sensor network into traffic area for traffic flow detection is easier to install, and provide real-time traffic flow for coordinate traffic control, also it can improve the classification rate byLiang Bao-juan et.al. [*8*]. The embedded software acquires traffic image from an on-system camera, detects and counts moving vehicles, estimates the traffic density and controls the traffic signals according to processed results by Payal Gupta et.al. [*9*].

III.HARDWARE DESIGN

It includes Adaptive traffic control system and traffic density monitoring and central monitoring system for traffic density .

A] hardware design of traffic sensing and adaptive traffic control unit

Image sensor: In this project a USB based web camera has been used .It is mounted on stepper motor and installed at the center of the intersection for sensing traffic on four roads i.e East , West, South and North.

Computer: A general purpose PC as a central unit for various image processing tasks has been used. Traffic images are simulated using MATLAB programming with computer. The interfacing between the hardware prototype and software module is done using parallel port of the personal computer.

Platform: consisting of a few toy vehicles and LEDs (prototype of the real world adaptive traffic control and traffic density monitoring system).

Microcontroller : ARM cortex M3 which provides the signal timing based on the traffic density. It is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption.

Stepper Motor: Unipolar 12v stepper motor is used for rotating camera in order to take images of roads at the intersection

Zigbee module : These are designed with low to medium transmit power and for high reliability wireless network. This modules operates within 2.4 to 2.4835GHz frequency band with IEEE 802.15.4 baseband.

Traffic signals: 12 Light Emitting Diodes (L.E.D.) are used for indication of traffic signal for four roads at the intersection.

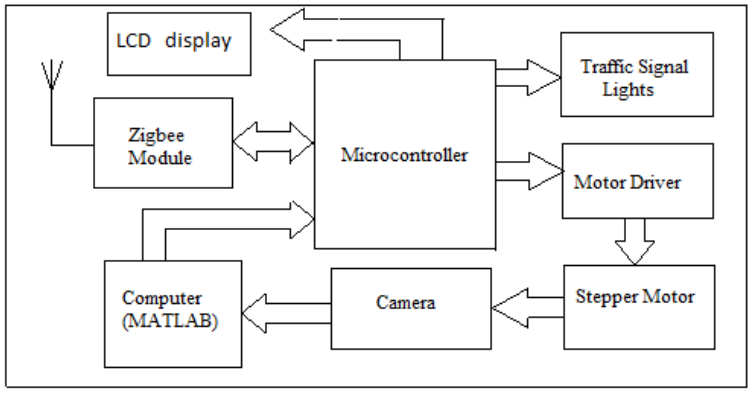

Fig.1 Adaptive traffic control system

B] hardware design of Central Traffic density monitoring system

Zigbee module : Zigbee is a low-cost, low power, wireless mesh network standard which operates in the industrial, scientific and medical (ISM) radio bands zigbee Module XBee-S2 is used in this work for the real time wireless

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transmission zigbee is based on an IEEE 802.15 standard. Data rate is 250 kbits/s and transmission distances range from 10 to 100 meters The transmitted signals from adaptive traffic control and traffic density unit are then received by zigbee Transceiver. TTL output from the receiver zigbee module is converted to RS232 using MAX232 level converter. The serial data are then plotted in Laptop using Graphical user Interface in MATLAB.

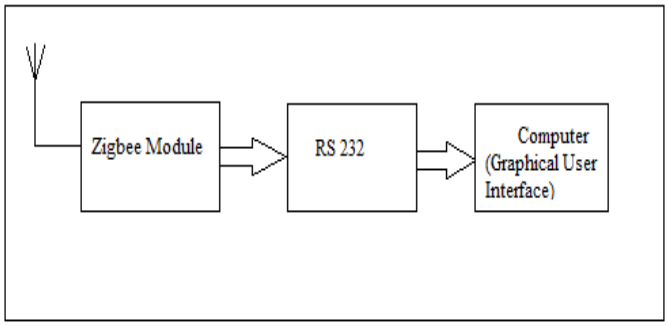

Fig.2. traffic density monitoring system

IV .SOFTWARE DESIGN

Morphological Image Processing : Morphological Image processing is mainly used to reduce the noise of an image. It uses two process dilation and opening to reduce the noise.
Image Processing Procedure: The steps followed in processing of a captured image includes experimentally found out results along with simplified consideration.
Fixing Queue Area: The predefined length L1 as queue length and road width gives maximum area of queue „T, is time required to clear the 100% queue area, and this will be maximum time setting for the control of signal at that intersection. This area of interest can be obtained by installation of camera at height and angle facing towards road. Hence L and T are experimentally found.
Region Of Interest (ROI): Area of queue is region of interest (ROI) and generating a cropped image of empty road or normal image scene with function imcrop (road, rect).
Conversion To Gray Scale: The Camera is used to Capture an image MATLAB function videoinput (‘winvideo,1, YUY2_640*480), convert all frames into gray scale image using MATLAB® functions rgb2gray(road) is used. Threshold value is applied to convert frame into binary MATLAB® function im2bw (road, threshold) is used .
Libelling and Counting : Similar element of same name is labelled .After the Morphological Image Processing it gives a contour of objects that represent the density and amount of traffic on the road . Blob analysis can be used to detect any kind of 2 dimensional shape of an image. The detection is based on local thresholding method with certain criteria. White portion of frame are counter as blob , the number of Blob NOB represents the traffic density on the road. Firstly background is fixed video clip is divided into number of frames an image processing is done

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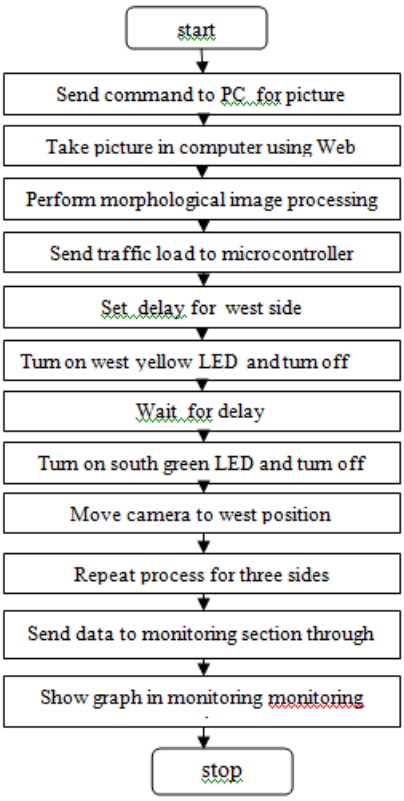

Fig.3 flowchart of project execution

Algorithm of this Work-

- Turn on west green LED
- Send command to PC for picture
- Take picture in PC using web camera
- Perform morphological operation on vehicles images
- Send traffic load to microcontroller.
- Set delay for west side
- Turn on yellow LED and turn off green LED of west side.
- Wait for delay
- Turn on green LED and turn off yellow LED of south side.
- Move camera to west position.
- Repeat process for three sides
- Send data to monitoring section through zigbee.
- Show graph on pc at monitoring section.

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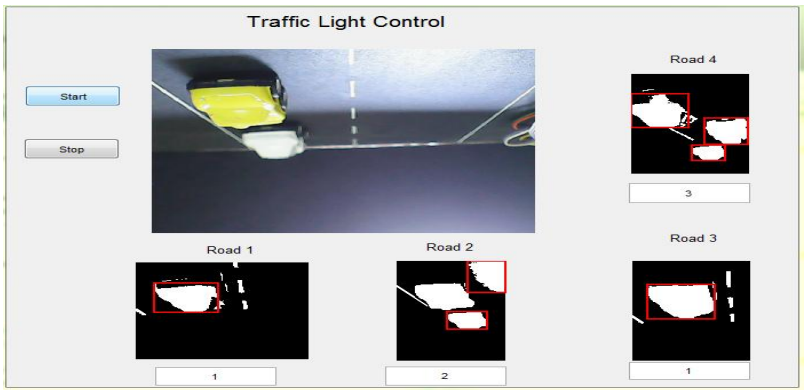

Fig. 4 snap of MATLAB GUI of traffic on roads

In fig.3, it shows real time graph using programming in Virtual Basic of traffic density vs. traffic time at monitoring section, as per traffic density available to roads. All traffic available at each side of road will be display on computer for analysing purpose at remote place.

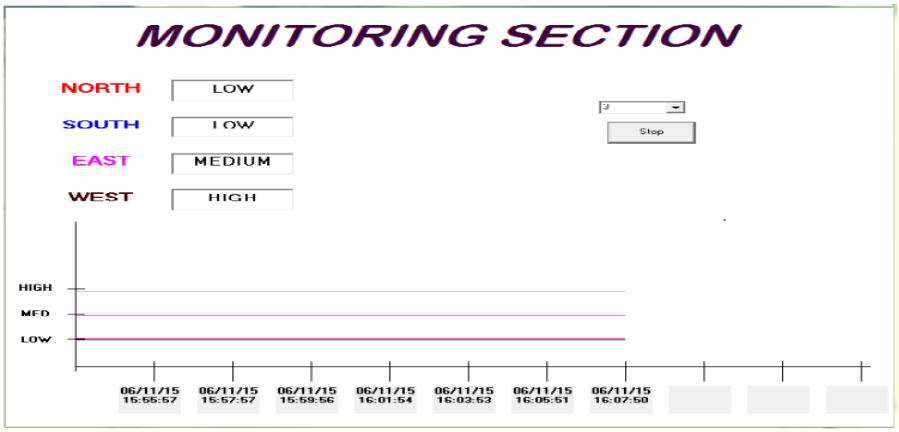

Fig. 5 snap of traffic time vs traffic density

VI. CONCLUSION

I have demonstrated my project on traffic density estimation and flow control based on image processing technique and I have successfully calculated the traffic and also implanted a signal system which shows the vehicle the direction on road. The accuracy in calculation of time due to single moving camera depends on registration position while facing road every time. I developed this project using software Virtual Basic, Matlab and in future I will generate a android based system to give traffic update to general for that they can avoid the traffic jam

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