VEHICLE DENSITY SENSOR SYSTEM TO MANAGE TRAFFIC

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Abstract

The aim of this study is to solve traffic congestion which is a severe problem in many modern cities all over the world. To solve this problem, we have a framework for a dynamic and automatic traffic light control system. Generally, each traffic light on an intersection is assigned a constant green signal time. It is possible to propose a dynamic time-based coordination schemes where the green signal time of the traffic lights is assigned based on the present conditions of the traffic. In this study, we adapt the approach to take data/input/image from object/ subject/vehicle and to process the input data by Computer and Microcontroller and finally display it on the traffic light signal to control the Closed Loop System.

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1. INTRODUCTION

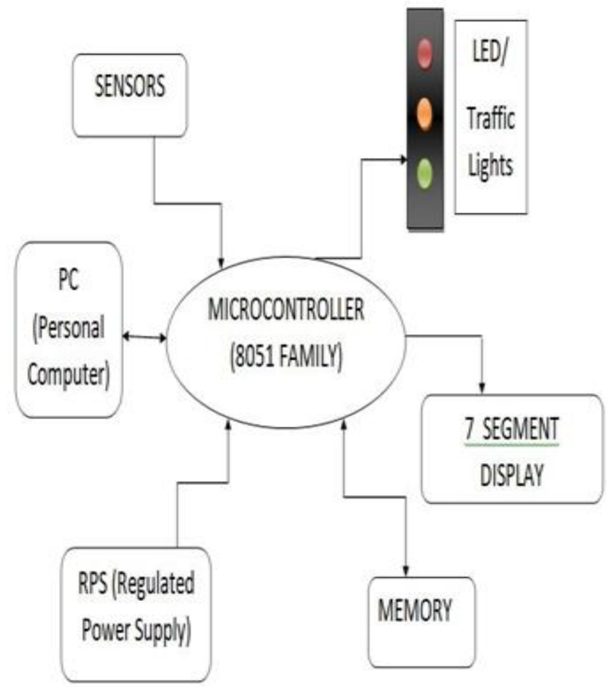
Traffic congestion leads to long and unpredictable commute times, environmental pollution and fuel waste. These negative effects are more acute in developing countries like India, where infrastructure growth is slow because of cost and bureaucratic issues. Frustration with the traffic lights results in an increase in accidents from cars moving when the traffic light, signals them to stop. Intelligent traffic management and better access to traffic information for commuters can help alleviate congestion issues to a certain extent.

The traffic lights ensure that vehicles from every direction get a chance to proceed through the intersection in an orderly fashion. Normally, we will have the traffic signal lights programmed for particular time intervals. But, in day-to-day life we observe that traffic on one side on a two-way road is predominantly more when compared to the other. In such a situation programming equal intervals of time for both types of traffics, attributes to congestion during hours of heavy traffic, making traffic delays.

But, here we propose a system that generates the traffic light signals based on the vehicle density, contrary to the old method of allotting the same time intervals to all roads irrespective of their traffic density. This type of traffic light signalling system is nowadays used in all the metropolitans.

In this method to monitor traffic, the density of traffic is measured by various sensors (sensors come in both manual and automatic measurement systems, those most commonly used are explained below), these sensors are placed on either sides of the road. The sensors output is given to a microcontroller then this data is fed to the computer to digitize the output. Thus, depending on density of traffic the timing of traffic lights are appropriately set.

2. BLOCK DIAGRAM



3. PROCESS AND COMPONENTS USED

3.1 Sensors

There is a wide range of sensor technologies available for vehicle detection. Some common and developing technologies are listed and one of the flexible types of sensors (IR sensor) used is explained in this paper.

Some of the commonly used sensors employed in the field of traffic monitoring systems include Infrared, Passive acoustic detector array, Piezoelectric, Photoelectric, Ultrasonic, Inductive loop detector, microwave/millimetre wave radar, magnetic detectors, etc.

3.1.1 Image Sensors

Video surveillance to monitor traffic states and detect incidents and hotspots is fairly common. It gives a comprehensive survey of the major computer vision techniques used in traffic applications. But the traditional setting for which vision algorithms exist can be seen in the lane based traffic. For usability in developing countries, algorithms are needed for scenarios involving chaotic traffic. Preliminary work on image processing algorithms for chaotic traffic sensing is done. The algorithms are offline, so the trade-off between computation and communication is not understood. Also the sensing accuracy itself has been tested on only few minutes of video clip. There are other works to use low quality images from CCTV for traffic sensing. But computational overhead, real-timeliness and accuracy of the designed algorithms haven't been evaluated. Thus though vision based traffic sensing for chaotic traffic seems feasible, there are several aspects that still need careful evaluation.

In comparison, we present an alternative traffic sensing system that works in chaotic non-lane based traffic. We have analysed the experimental results for the sensing accuracy on 16 hours of traffic in Mumbai. The algorithms are very low overhead and we have implemented them on low end embedded sensor platforms. Sensing and computation are done on the road. Only the traffic queue length values are communicated to the remote server, removing the communication overhead of video transfer.

3.1.2 Infrared Sensors

There are two types of infrared (IR) detectors; these are the active and passive type detectors. Active infrared sensors operate by transmitting energy from either a light emitting diode (LED) or a laser diode. A passive infrared system detects energy emitted by objects in the field of view and may use signal-processing algorithms to extract the desired information.

All objects emit some form of energy, which is in the form of heat or thermal radiation, this radiation most often falls in the infrared spectrum. This radiation cannot be seen by the naked eye, but can be detected by an infrared sensor that accepts and interprets it. In some infrared sensor like motion detectors, radiation enters the front and reaches the sensor itself at the centre of the device. This can be a system consisting of one or more individual sensors, each one being made from pyroelectric materials, these materials mat be natural or manmade. These are materials that generate an electrical voltage when heated or cooled.An experimental infrared optical system has been designed to detect and monitor vehicular road traffic.

The principle of an infrared vehicle sensor is: the thermopile element is used as a sensor which detects the temperature of the object situated within a sensing area. This element generates thermo-electromotive force which is dependent on the temperature [1].

The setup of sensor pair across road in our system uses 802.15.4 radios which have a spread propagation model, instead of ray propagation model of infrared. This makes our technique robust to noise and thus suitable for disorderly road conditions.

3.1.3 Video Sensors

An intelligent video sensor (IVS) combines image processing with video sensing and data communication. It can be realized as an embedded system and capture a stream of video, compute the data pertaining to high-level traffic parameters and transfer this video stream and the computed traffic parameters to a base station. Traffic parameters may include vehicle flow rate, average vehicle velocity as well as detection of obstacles and standstill. Video sensors usually include video image processors for processing the obtained images and videos. A video image processor (VIP) is a combination of hardware and software which extracts desired information from data provided by an imaging/video sensor. This imaging sensor can be a conventional TV camera or an infrared camera. A VIP can detect speed, count, occupancy, and presence. Because these sensors produce an image of several lanes, there is potential for a VIP to provide a wealth of traffic information such as vehicle classification and incident detection. The basic operation of a VIP can be described in the following manner: the operator selects several vehicle detection zones within the field of view (FOV) of the camera. Various image processing algorithms are then applied in real time to these zones in order to extract the required information, for example vehicle speed or occupancy.

Advantages of VIPs are that they are mounted above the road instead of in the road, the placement of vehicle detection zones can be made by the operator, the shape of the detection zones can be programmed for specific applications, and the system can be used to track vehicles.

The disadvantages that need to be overcome are: detection artefacts caused by shadows, reflections from the roadway and or varying weather conditions. The disadvantages can be overcome through design and installation of the hardware and design of the software algorithms.

3.2 Microcontroller

To overcome the problem of traffic congestion we design a system, which can control the traffic based on the density of vehicles at that particular time. Here a Micro-Controller and a Personal Computer in which all timing related details are fed to the PC and then the control signals are passed to a 89C51 based board which in-turn controls the various lights.

The microcontroller is connected to the PC through a serial communication cable. Through the cable the user sitting on the computer as traffic administrator can command the microcontroller system to send the recorded data for monitoring. For the basis of data of traffic at respective load, where sensor is situated, can update the timings of traffic lights delays with an updating command to microcontroller. Administrator can also send command to microcontroller to erase previous recorded data after analysis. Whenever any obstacle like vehicle passes between IR transmitter and IR sensor, microcontroller detects and increase number of vehicle count in a recording interval for particular traffic light.

On the basis vehicle count microcontroller decide the traffic light delays for next recording interval. Traffic light delays are classified as LOW, MEDIUM, HIGH range. Three ranges are predefined by varying vehicle count.

Sensor Ranges	
RANGE	COUNT
LOW	15
MEDIUM	25
HIGH	50

3.3 Regulated Power Supply

As per the power requirement of the hardware of the intelligent traffic light control and monitoring system, supply of +5V with respect to GND is developed. The complete circuitry is operated with TTL logic level of 0V to 5V. It comprise of 0V to 9V transformer to step down the 220V AC supply to 9V AC. Further a bridge rectifier converts the 9V into 9V√2 DC. It is further filtered through a 1000uF capacitor and then regulated using 7805 to get +5V. To isolate the output voltage of +5V from noise further filtering 220uF capacitor is used [2].

3.4 Personal Computer (PC) and Memory

The PC is interfaced with the microcontroller in order to provide all time traffic control to the administrator. This is done through serial port communication. To initiate the serial communication administrator has to configure the Communication port. Whenever administrator commands the microcontroller to send recorded data, the microcontroller sends all data, in terms of vehicle count recorded according to recording intervals, to computer. The microcontroller also sends the running configuration of parameters (Vehicle range values, delays, recording interval) on traffic light. The data can be saved on the computer as a excel file. The real time data for analysis is shown on computer [3].

Light Timings			
RANGE	RED	YELLOW	GREEN
LOW	30	5	30
MEDIUM	20	5	40
HIGH	12	5	50

3.5 LED/Traffic Lights

We designed a traffic signal controller system Personal Computer in which all timing related details are fed to the PC and then the control signals are passed to a 89C51 based board which light controls the various led LED traffic lights. According to the vehicle density information corresponding LED signal lights should glow to pass the traffic.

3.6 7 Segment Display

In traffic signals, seven segment displays are interfaced with the counter and controller, depending on the commands received; the counter displays the amount of waiting time. It is connected to pins of Port 1. Common Anode Connection which is suitable for this application. The microcontroller's timer is interfaced with seven segment display to display the delay of light [2].

3.7 System Process

The system tries to reduce possibilities of traffic jams, caused by automated traffic lights. The system is based on microcontroller. The system contains IR transmitters and IR receivers which are mounted on the either sides of roads. This IR system gets activated when any vehicle passes on road between IR transmitter and IR receiver. The microcontroller controls the IR system and counts number of vehicles passing on road at that particular time. The microcontroller also store vehicles count in its memory. Based on different densities of vehicles, the microcontroller decides the wait time and updates the traffic light delays. The IR system is situated at a certain distance from the traffic light. Thus based on the density of vehicles, microcontroller defines different ranges for traffic light time delays and updates them accordingly. The system records the vehicle density in its memory at predefined recording interval set by the user on real time basis. This recorded vehicle count data can be used in future to analyse traffic condition at respective traffic lights. For the analysis, the recorded data can be downloaded to the computer through communicating with the microcontroller. Administrator sitting at the computer can command system (microcontroller) to download recorded data, update light delays, erase memory, etc. By this process the administrator on a central station computer can access traffic conditions on any connected traffic light and nearby roads to reduce traffic congestions to an extent.

4. CONCLUSIONS

By using this system configuration we try to reduce the possibilities of traffic jams, caused by traffic lights. No. of passing vehicle in the fixed time slot on the road decide the density range of traffic and on the basis of vehicle count microcontroller decide the traffic light delays for next recording interval. Data transfer between the microcontroller and computer can also be done through telephone network or data call activated SIM. Thus, allowing immediate control of traffic lights at far off places. Traffic lights can be increased to N number and traffic light control can be done for whole city by sitting on a single place.

FUTURE SCOPE

In future this system can be used to inform people about the condition of traffic at different places. This technique allows the operator to gather the recorded data from a far end to his home computer without going there. Based on the technology studied it is possible to develop cost effective, weather resistant products that have the potential for more sophisticated applications, including vehicle speed measurement and length classification.

REFERENCES

[1] Promila Sinhmar "INTELLIGENT TRAFFIC LIGHT AND DENSITY CONTROL USING IR SENSORS AND MICROCONTROLLER" Rawal Institute of Engineering And Technology Zakopur, Faridabad- E-mail: promila.sinhmar@gmail.

[2] B. PRASHANTH KUMAR, B. KARTHIK " MICRO CONTROLLER BASED TRAFFIC LIGHT CONTROLLER", Department of Electrical & Electronics Engineering GOKARAJU RANGARAJU INSTITUTE OF ENGINEERING & TECHNOLOGY, 2011

[3] Rijurekhasen, Andrew Cross, adityavashistha, Venkata N. Padmanabhan, Edward Cutrell, and William Thies "Accurate Speed and Density Measurement for Road Traffic in India" IIT Bombay

[4] Dinesh Rotake "Intelligent Traffic Signal Control System Using Embedded System" 1. Department of Electronics Engineering, G. H. Raisoni College of Engineering, Nagpur Department of computer engineering, G. H. Raisoni College of Engineering, Nagpur

[5] Celilozkurt and fatihcamci "AUTOMATIC TRAFFIC DENSITY ESTIMATION AND VEHICLE CLASSIFICATION FOR TRAFFIC SURVEILLANCE SYSTEMS USING NEURAL NETWORKS" Computer Engineering Department, Fatih University Đstanbul, Turkey.