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Density Based Traffic Control System with Advanced Monitoring Techniques

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ABSTRACT

The aim of the project is to solve traffic congestion which is a severe problem in many modern cities all over the world. To solve the problem, we have designed a framework for an automatic and dynamic traffic light control system and developed a simulation model with codes in to help build the system on hardware. Generally, each traffic light on an intersection is assigned a constant green signal time. It is possible to propose dynamic time-based coordination schemes where the green signal time of the traffic lights is assigned based on the present conditions of traffic. This is achieved by using IR sensors across the road to monitor the length of vehicles blocking the road traffic. The signals from the IR receivers are fed to the microcontroller to follow the program with the time as desired. This is converted to DC using a Bridge rectifier. The microcontroller is also interfaced to an Omni vision camera and a memory card module for monitoring traffic violations.
Keywords: Omni vision, IR module

1. INTRODUCTION

Traffic Signal System or traffic monitoring is a vast domain where WSN(wireless sensor networks) can be applied to gather information about the traffic load on a particular road, incoming traffic flow, traffic load at particular period of time (peak hours) and in vehicle prioritization. Wireless Sensor Networks deployed along a road can be utilized to control the traffic load on roads and at traffic intersections. Sensors are deployed on either side of roads at intersection points and in emergency vehicles respectively. Consider a scenario of highly congested area where many vehicles such as personal transport, public transport and emergency vehicles (Ambulance, Fire brigade, VIP cars and other rescue vehicles) have to wait for long for the change of traffic signals at intersection points. Existing traffic light systems have timers that are set at regular intervals. This leads to the wastage of precious time especially in case of rescue vehicles for emergency conditions. In order to control this situation, we have proposed a system Smart Traffic Light Control System (STLC).STLC System controls the change of traffic lights at intersection points giving high priority to emergency vehicles. Sensors used in this system are IR sensor modules i.e. the transmitter and receiver are fabricated on a single chip thus eliminating the error of ---- Also to help authorities to work against law violations we have included the second part of our system as advanced monitoring techniques. The advanced monitoring system consists of an Omni vision camera and a memory card module. The camera clicks the picture of the number of the car when it is turned on by an IR sensor interfaced to it. This IR sensor indicated that the car is violating the law by passing the lane in spite of the signal not being green. As soon as the IR signal cut off by the rule breaking car the camera clicks the picture and sends it to the memory card module which can later be viewed by the concerned authorities and appropriate action can be taken against them.

2. BLOCK DIAGRAM

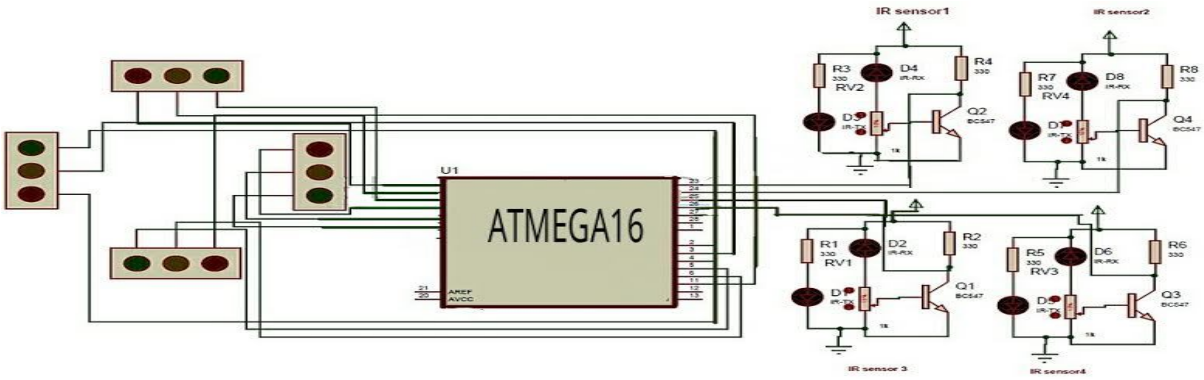

Figure 1 Circuit diagram [7]

This circuit consists of 12 IR sensors, atmega16 microcontroller, 4 traffic lights. IR transmitter looks like an LED.
The IR transmitter always emits IR rays from it. The operating voltage of this IR transmitter is 2 to 3v. These IR (infrared) rays are invisible to the human eye. But we can view these IR rays through camera. IR receiver receives IR rays that are transmitted by IR transmitter. Normally IR receiver has high resistance in order of mega ohms, when it is receiving IR rays the resistance is very low. The operating voltage of IR receiver is 2 to 3V. We have to place these IR pair in such a way that when we place an obstacle in front of this IR pair, IR receiver should be able to receive the IR rays. When we give the power, the transmitted IR rays hit the object and reflect back to the IR receiver. Instead of traffic lights, you can use LEDs (RED, GREEN, YELLOW). In normal traffic system, you have to glow the LEDs on time basis. If the traffic density is high on any particular path, then glows green LED of that particular path and glows the red LEDs for remaining paths. In normal traffic system, we allow the traffic for a certain low amount of time delay for each path when no sensor is blocked. As number of sensors getting blocked increase, we sense that traffic is piling in that particular lane and the delay of green LED for that particular lane is increased based on number of sensors blocked

3. COMPONENT DESCRIPTION

3.1 Microcontroller (ATMEGA 16) [3]

ATMEGA 16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is based on enhanced RISC (Reduced Instruction Set Computing) architecture with 131 powerful instructions. Most of the instructions execute in one machine cycle. Atmega16 can work on a maximum frequency of 16MHz.ATmega16 has 16 KB programmable flash memory, static RAM of 1 KB and EEPROM of 512 Bytes. The endurance cycle of flash memory and EEPROM is 10,000 and 100,000; respectively.ATmega16 is a 40 pin microcontroller. There are 32 I/O (input/output) lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD. ATmega16 has various in-built peripherals like USART, ADC, Analog Comparator, SPI, JTAG etc. Each I/O pin has an alternative task related to in-built peripherals.

3.2 IR Transmitter and Receiver [6]

An IR transmitter transmits IR waves i.e. waves having frequency in IR range. The wave propagation is line of sight. Therefore an IR receiver is placed exactly opposite the IR transmitter to receive the signal transmitted by transmitter. Thus an IR trans receiver pair is used to detect any obstacle between transmitter and receiver. When the voltage at the IR receiver is below the threshold level, an obstacle is said to be detected. When no obstacle is present, a known voltage will be detected at the receiver end.

3.3 LED

A light-emitting diode (LED) is a two-lead semiconductor light source that resembles a basic PN-junction diode, except that an LED also emits light. When an LED's anode lead has a voltage that is more positive than its cathode lead by approximately 0.6 to 2.2 Volts, current often flows and light is often emitted. On the other hand, when an LED's anode lead has a voltage that is less positive than its cathode lead by approximately 0.6 to 2.2 Volts, current often does not flow and light is often not emitted.

3.4 Camera Module OV 7670

The OV7670 camera is a low voltage CMOS image sensor that provides the full functionality of a single chip VGA camera and image processor in a small footprint package. It provides full frame, sub sampled or windowed 8 bit images. It is capable of operating at 30 frames per second (fps) .It uses proprietary sensor technology to improve image quality by reducing or eliminating common sources of image contamination such as fixed pattern noise, blooming, smearing to produce a clean fully stable image.

3.5 SD Card Module

SD Cards work only at 3.3V and both the power and I/O levels must be accommodated. The module used here uses FETs for level shifting and a 3.3V regulator for power when operating from 5.0V. A switch allows the module to be used with Arduinos / YourduinoRobo1 or Minis etc. running at 3.3V. This module also has a Micro SD socket on the back side, and can be used with 2Gb and 4Gb micro SD cards plugged in there. They worked OK with the SdFAT library. These cards are formatted FAT32 and SD/HC.

4. WORKING

The diagrammatic representation for the communication between the different end devices and coordinator has been depicted. In the absence of any traffic sensing part the system works as a normal system giving equal period of time to green signal in all the lanes. As soon as the traffic sensing part comes into the picture the role of the IR modules comes into play. Three IR sensors attached on each lane give an indication of traffic on that particular lane with the last IR signal being blocked(i.e. all three blocked) indicates and the first and the second(only one or two)IR signal being cut off

indicates low and medium traffic respectively. With each IR signal being cut our system adds a few seconds to the timer of the green signal and thus for maximum time the signal will be green in the lane of high density traffic and the signal will be green for minimum time in the lane of low traffic. The camera module gets activated as soon as the additional sensor on the lane gets cut off if the signal is not green. Thus this move will help the authorities in effective monitoring of traffic rules. The camera clicks the picture of the number plate and sends it to the memory card module where it is safely stored to be later viewed by the authorities and take appropriate action.

5. ADVANTAGES

5.1 Traffic signals can be controlled dynamically as per the peak and non-peak hour traffic.
5.2 Unnecessary stopping of vehicles for a longer duration is avoided when roads are relatively traffic free.
5.3 A particular route facing high traffic at particular time of the day is very well handled by this system.
5.4 If any of the IR sensors fail, the signal system can be switched to conventional fixed timing mode.

6. RESULT

SCENARIO	GREEN TIME FOR A PARTICULAR LANE
NO SENSOR BLOCKED	D secs
ONLY LOW DENSITY SENSOR BLOCKED	D+X secs
LOW AND MEDIUM DENSITY SENSOR BLOCKED	D+2X secs
ALL 3 SENSORS BLOCKED	D+3X secs

D- preassigned default time
X-delay time in seconds

7. CONCLUSION

In this paper we have proposed and implemented Smart Traffic Light Control and Congestion Avoidance System using microcontroller and IR sensors. This system can also be used to control the change of traffic lights at intersection points giving high priority to emergency vehicles. Furthermore this System can also provide smart traffic routing that chooses the shortest routes having the least congestions based upon IR received signals at various signals along a route.

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