International Journal of Electronics Engineering (ISSN: 0973-7383
Volume 11 • Issue 1 pp. 348-351 Jan 2019-June 2019 www.csjournals.com

Density based Traffic Signals Controlling Using ARDUINO and IR Sensors

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Abstract: Traffic congestion is a severe problem in most of the cities across the world and it has become a nightmare for the citizens. It is caused by delay in signal, inappropriate timing of traffic signaling etc. The delay of traffic light is hard coded and it does not depend on traffic. Therefore for optimizing traffic control, there is an increasing demand in systematic quick automatic system. This paper is designed to develop a density based dynamic traffic signal control. The signal timing changes automatically on sensing the traffic density at the junction. The microcontroller used in this project is ARDUINO. The system contains IR sensors (transmitter and receiver) which will be mounted on the either side of the road on poles. It gets activated and receives the signal as the vehicles passes close by it.
Keywords: IR (Infrared) sensor, Microcontroller Arduino.

I. INTRODUCTION

Traffic administration has the goal to constantly improve traffic system and regulation. As the number of vehicle users constantly increases and resources provided by current infrastructures are limited, intelligent control of traffic will become a point of focus in the future. Avoiding traffic jams is beneficial to both environment and economy. In our research we focus and optimization of traffic light controller in a city using IR sensor and developed using Arduino. An intelligent transportation system (ITS) estimates the traffic parameters and optimizes traffic signal to reduce vehicle delays and stop. Fixed control on traffic is basically not control according to the density, but in a manner of programming which is already fixed in the system. This paper proposes an intelligent system using Arduino for implementing it in the city.

II. BLOCK DIAGRAM

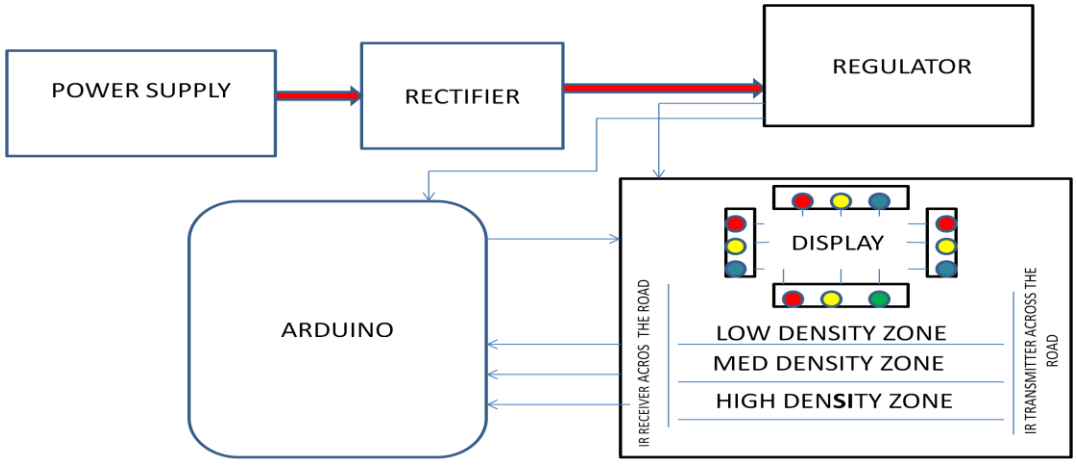

Fig1. Block Diagram of signal control system

III. BASIC HARDWARES OF THE SYSTEM

a) IR Sensor: - An IR (Infrared) sensor is an electronic device which can be used to sense certain parameters of its surroundings by either emitting or detecting radiations. It can also measure heat of an object and detect motion. It uses the infrared light to sense objects in front of them and map or guess their distance. This system consists of 4 IR sensors as a detector of 4 junctions. IR

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transmitter looks like an LED. This IR transmitter always emits IR rays from it. The operating voltage of this IR transmitter is 2 to 3v. These IR (infra-red) rays are invisible to the human eye. But we can see these IR radiations through camera. IR transmitter transmits IR rays that are received by IR receiver. Generally IR receiver has high resistance in the order of mega ohms but when it is receiving IR rays the resistance is very low. The operating voltage of IR receiver also 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 power is supplied, the transmitted IR rays hit the object and reflect back to the IR receiver.

Instead of traffic lights, we have used LEDs (RED, GREEN, YELLOW). In normal traffic system, you have to glow the LEDs on time basis. If the density of traffic is high on any particular lane, then glows green LED of that particular lane and glows the red LEDs for remaining lanes.

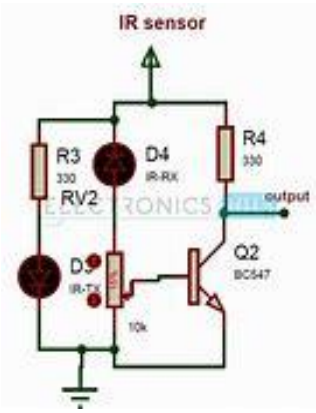
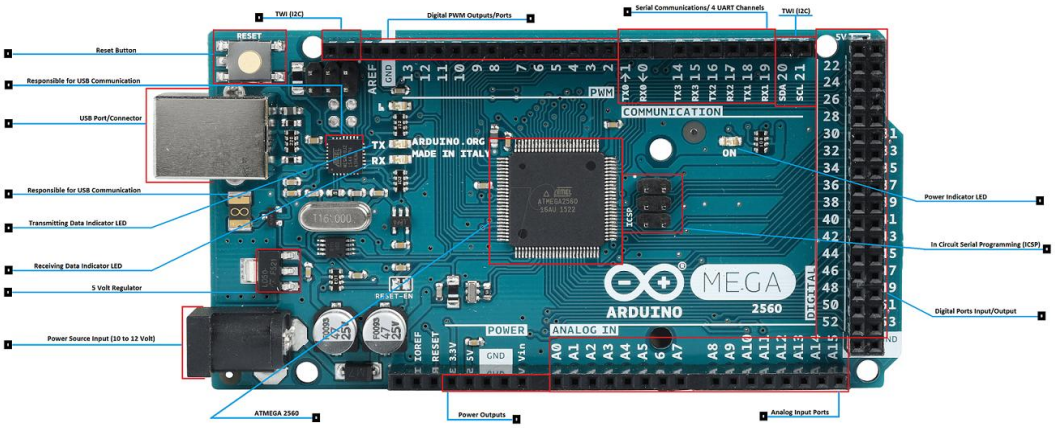


Fig.2.IR sensor equivalent circuit

Fig. 3. IR Sensor

b) Arduino Mega: -.

The main reason behind this is the additional features that are inbuilt with this board. First feature is the large I/O system design with inbuilt 16 analog transducers and 54 digital transducers that supports with USART and other communication modes.



Arduino MEGA Pinout
www.CircuitsToday.com

Fig 4 :Arduino

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Secondly, it has inbuilt RTC and other features like analog comparator, advanced timer, interrupt for controller wakeup mechanism to save more power and fast speed with 16 MHz crystal clock to get 16 MIBS. It has more than 5 pins for Vcc and Gnd to connect other devices to Arduino Mega.

Other features include JTAG support for programming, debugging and troubleshooting. With large FLASH memory and SRAM, this board can handle large system program with ease. It is also compatible with the different type of boards like high-level signal (5V) or low-level signal (3.3V) with I/O ref pin.

Brownout and watchdog help to make the system more reliable and robust. It supports ICSP as well as USB microcontroller programming with PC.

The Arduino Mega 2560 is a replacement of the old Arduino Mega, and so in general reference, it will be called without the '2560' extension. It is usually used for very complex projects.

c)LEDs

Three LEDs i.e. Red, yellow and green are used as a traffic light indicator which are connected in series with 1k resistor in the PCB board. All the LEDs are polarised and all its ground wire are connected together.

FiG5.1: Red LED

Fig5.2: Green LED

Fig5.3: Yellow LED

d) Power supply

As per the power requirement of the hardware of the density based traffic light control 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.

IV. IDEA AND METHODOLOGY

As we all know that traffic congestion is a major problem from a long time and traffic administration is also trying overcome this serious from a long time. So as a result one solution has been deducted which is controlling the traffic on time delay. The basic idea of this paper has been taken from the foresaid concept. According to that idea the traffic signal switches after a certain interval of time. The time interval is controlled by any microcontroller.

This was a very basic step towards the optimization of traffic on road but this was not up to the mark. So to control the traffic in more smarter and efficient way this project has been made by modifying the previous idea. The new idea is doing its job good as it has been seen that traffic jams are reduced and also the crucial time of the citizens are saved.

METHODOLOGY

- The system works on microcontroller(ARDUINO)
- Sensors are IR transmitters and IR receviers which are mounted on the sides of roads .
- The IR system gets activated when any vehicle cross on road between IR transmitter and IR recevier
- The microcontroller controls the IR system and gets activated when vechicles are passing in between the sensors

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V. RESULT

After knowing about the above said hardware and using appropriate programming for the microcontroller the following results have been obtained. The fig.3 shows when there is normal traffic at the junction the traffic light continues as time delay. The fig.4 shows that where there are more vehicle in any lane as compared to the other lane is given priority and the signal is green as soon as the lane is not cleared.

- If there are traffic at all the signals, then the system will work normally by controlling the signals one by one.
- If there is no traffic near a signal, then the system will skip this signal and will move on to the next one. For example, if there is no vehicle at signal 2, 3 and currently the system is allowing vehicles at signal 1 to pass. Then after signal 1, the system will move on to signal 4 skipping signal 2 and 3.
- If there is no traffic at all the 4 signals, system will stop at the current signal and will only move on the next signal if there will be traffic at any other signal.

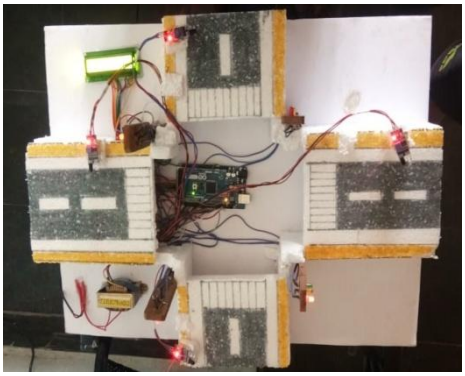

Fig3: Normal Operation

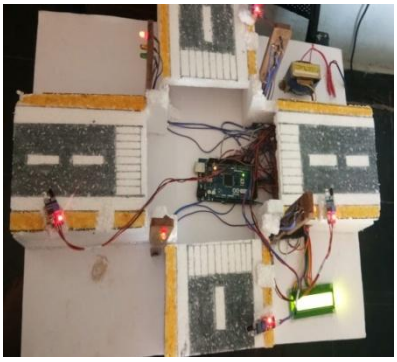

Fig4: Density Based Operation

VI. CONCLUSION

In this paper we have studied the optimization of traffic light controller in a city using Arduino and IR sensors. A traffic light system has been designed and developed with proper integration of both the hardware and the software. This interface is synchronized with the whole process of the traffic system. Automatically, this project could be programmed in any way to control the traffic light model and will be useful for planning proper road system.

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