DENSITY BASED TRAFFIC SIGNAL CONTROL 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 signalling etc. The delay of traffic light is hard coded and it does not depends on traffic. Therefore for optimising 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

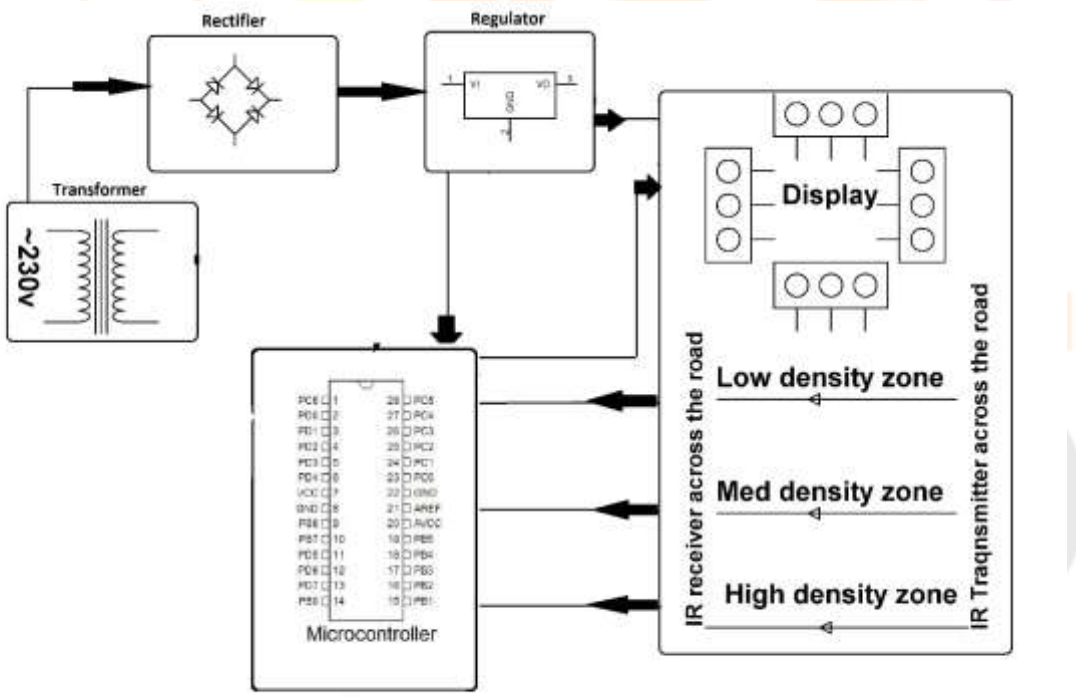


Fig1. Block Diagram of signal control system

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 consist of 4 IR sensors as a detector of 4 junctions.
IR 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.

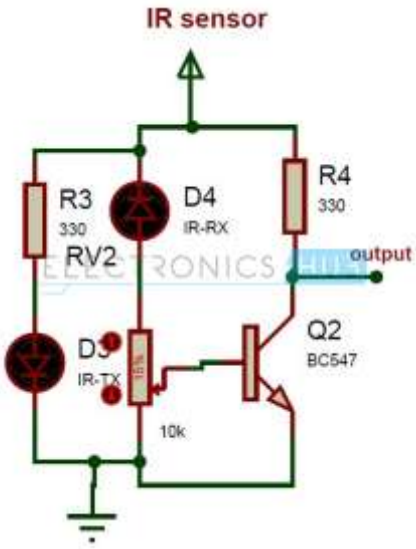


Fig.2.IR sensor equivalent circuit

Fig. 3. IR Sensor

b) **Arduino NANO**:- The Arduino Nano is a small, complete, and breadboard-friendly board based on the ATmega328 (Arduino Nano 3.x) or ATmega168 (Arduino Nano 2.x). It has more or less the same functionality of the Arduino Duemilanove, but in a different package. It lacks only a DC power jack, and works with a Mini-B USB cable instead of a standard one. The Arduino Nano can be powered via the Mini-B USB connection, 6-20V unregulated external power supply (pin 30), or 5V regulated external power supply (pin 27). The power source is automatically selected to the highest voltage source.

- ATMEGA 328:- The ATmega328 is a single-chip microcontroller created by Atmel in the megaAVR family.

Fig. 4. Arduino Nano

Fig. 5 Atmega328 Chip

PARAMETERS	VALUE
CPU Type	8-bit AVR
Performance	20 MIPS at 20 MHz
Flash memory	32 kB
SRAM	2 kB
EEPROM	1 kB
Maximum operating frequency	20 MHz
Maximum I/O pins	23

a) 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.

Fig.6. Red LED

Fig7. Green LED

Fig8. Yellow LED

b) 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

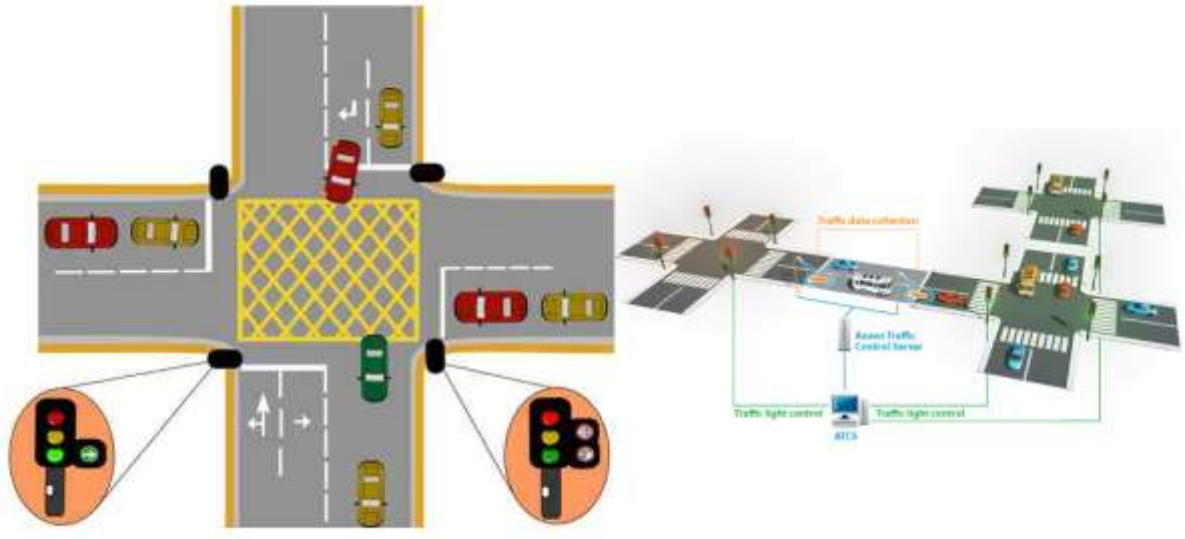
As we all know that traffic congestion is a major problem from a long time and traffic administration is also trying overcome this serious from a long time. So as a result one solution has been deducted which is controlling the traffic on time delay. The basic idea of this paper has been taken from the 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 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 gets activated when vehicles are passing in between the sensors.
- Based on different densities of vehicles, the microcontroller decides the glowing time of the traffic lights.

Fig9. Basic Layout of the traffic control system



Limitations of this Circuit:

- IR sensors sometimes may absorb normal light also. As a result, traffic system works in improper way.
- IR sensors work only for fewer distances.
- We have to arrange IR sensors in accurate manner otherwise they may not detect the traffic density.

V. RESULT

After knowing about the above said hardware and using appropriate programming for the microcontroller the following results have been obtained. The fig.1 shows when there is normal traffic at the junction the traffic light continues as time delay. The fig.2 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.

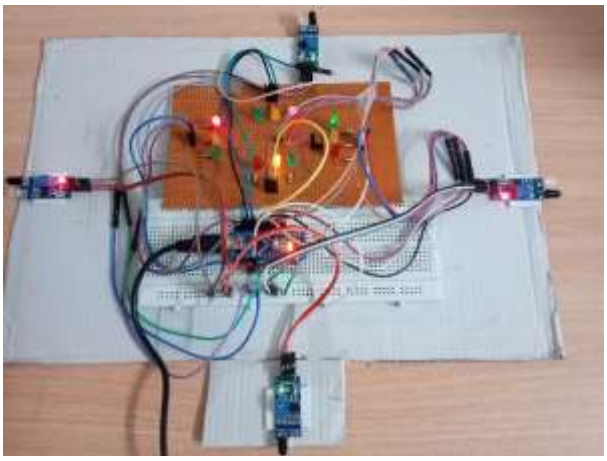


Fig8. Normal operation

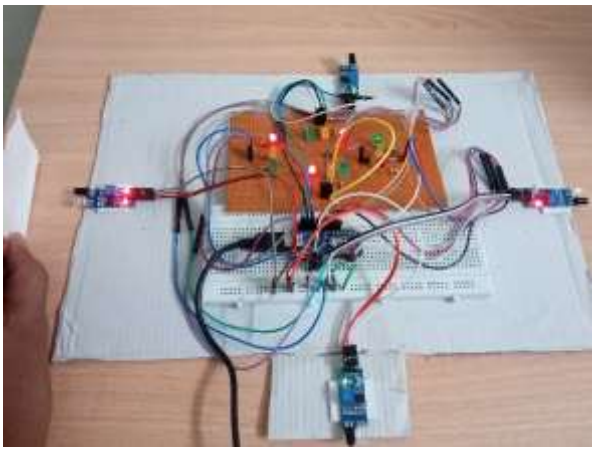


Fig9. After detecting vehicles

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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