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Smart Traffic Management System

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ABSTRACT: Traffic jams and obstruction is one of the major problem faced in the present day life traffic signal control only works on time delay basis irrespective of the vehicle density. With the quick expand in the vehicle usage causing more air pollution and noise pollution due to inefficient droppings in the traffic management. This advanced system includes a density based traffic control system which uses Arduino UNO, IR Sensors and LEDs for the constructive signal hold and vehicle density control at the road intersection. Smart traffic light control System using Arduino Mega design. These systems manage traffic flow at intersections, aiming for smooth vehicle movement. However, synchronizing multiple traffic lights at adjacent junctions is complex because of a number of variables. Conventional systems struggle with fluctuating traffic flows and lack consideration for emergencies, pedestrian crossings, and accidents. This often leads to congestion and traffic jams. The suggested method resolves these problems by integrating advanced control mechanisms to adjust traffic signals System dynamically, enhancing overall traffic management efficiency and safety.

KEYWORDS: Traffic Signal, Arduino Uno , IR Sensors , Bread Board , Jumper Wires

I. INTRODUCTION

In recent years, rapid urbanization and a surge in the number of vehicles have led to increased traffic congestion in urban cities. Traditional traffic light systems, which operate on a fixed-time basis, often fail to adapt to real-time traffic conditions, resulting in unnecessary delays, fuel consumption, and increased air pollution. This scenario necessitates the development of an intelligent traffic management system that can dynamically respond to varying traffic densities and ensure smoother vehicular flow. This project, titled "Smart Traffic Management System using Arduino and IR Sensors," aims to design and implement an efficient and cost-effective traffic control mechanism using embedded systems. The proposed system utilizes Infrared (IR) sensors to detect the presence and density of vehicles at intersection point. Traffic is increasing on the road day- by- day. As a result of which, two main issues arises. The troubles are no traffic, but still need to hold back massive traffic congestion. These problems occur due to slotted authority on traffic. This research will aim to control the traffic according to the density, but in manner of programming which is already fixed in the system

II. METHODOLOGY

Smart traffic management system working model is carried out for the actual representation of traffic management on a road intersection by using Arduino and IR

2.1 Material

2.1.1 Arduino Mega 2560:-

Arduino Mega 2560 is a microcontroller having 54 digital input/output pins, 4 UART's, and a 16MHz crystal oscillator. It is a versatile microcontroller and can be used for a variety of applications. External system connections are relatively easy as it provides USB connections. A computer can be readily paired with this microcontroller with the help of a USB cable. It controls the data sensed by the IR Sensors and then further carried out with the help of coding the microcontroller. The extra connectors are arranged at the end of the board.



Fig no.2.1.1 Arduino Mega 2560

2.1.2 IR Sensors :-

IR proximity sensor is an electronic instrument which comprises of an IR light emitting diode, an IR photodiode, an opamp (as comparator), couple of resistors (including a variable resistor) and capacitors whose basic operation is to detect the presence of any kind of object or obstacle in the vicinity of the sensor within the particular range. In this particular type of IR sensor module used in the project, IC LM 393 op-amp is used as comparator. When the IR receiver does not detect any of the signals from the IR LED, the potential at the inverting input of the comparator will be higher than that corresponding to the noninverting terminal. Hence the resulting output of the comparator becomes low. On the other hand, if the IR receiver detects some signals which are sent back after encountering an obstacle/object, the potential at the inverting terminal will be low than the non-inverting terminal. Hence the output of the comparator will be high

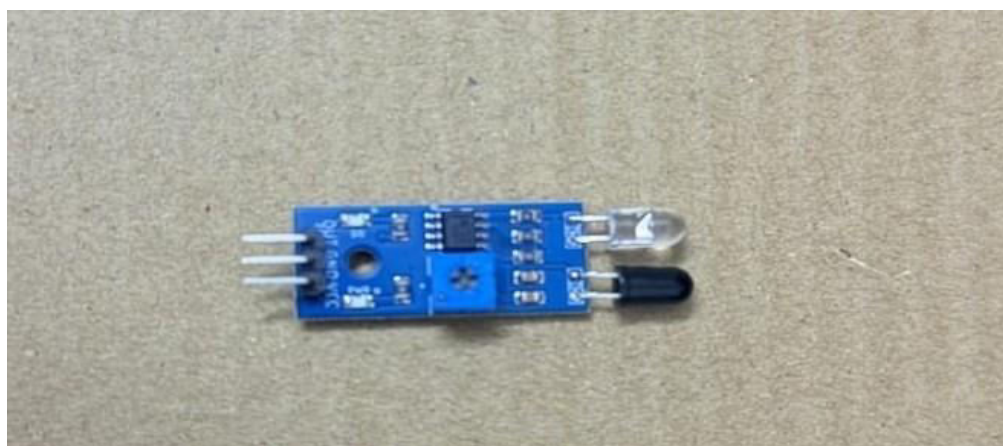


Fig. no. 2.1.2 IR Sensor

2.1.3 Traffic lights:-

LED is an active electronic device, comparable to a general purpose diode except for its ability to emit light with different wavelengths. When a suitable potential difference is applied across its terminals, electrons recombine with the holes within the device thereby releasing the energy in the form of photons. This phenomenon is known as the electroluminescence.

Following are the specific semiconductor combination employed for obtaining a LED emitting radiation of characteristic wavelength;

1. Gallium Arsenide – Infrared light
2. Gallium-Arsenide-Phosphorous – yellow/red light
3. Gallium-Phosphorous – green light



Fig. no.2.1.3 Traffic lights

2.1.4 Breadboard:-

The breadboard facilitates a temporary and easy connection for the IR Sensors to connect the Arduino Mega. Connecting the IR Sensor to the breadboard where the Vcc is connected to the negative connection on the breadboard and the ground connection of the IR Sensor is connected to the positive connection of the breadboard. All the traffic lights connection and IR Sensor connections interconnected by the Arduino where IR Sensors detect traffic density and the Arduino controls the traffic lights based on the code transmitted on the Arduino Mega. This setup allows for prototyping and testing before a permanent, more robust implementation is desired.

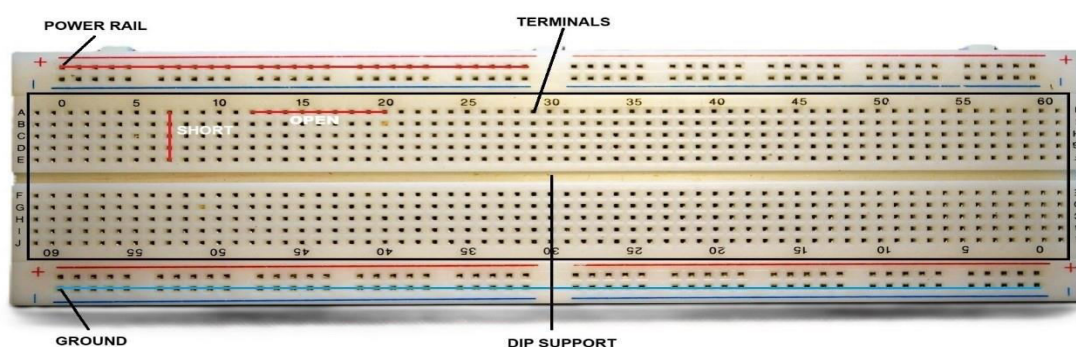


Fig. no. 2.1.4 Breadboard

2.1.5 Jumper wires:

Jumper wires are also known as jumper cables or breadboard wires are commonly used in smart traffic management system for making connections between the components on the breadboard or circuit board. They serve as temporary connections, allowing for quick and easy wiring through the circuit network connecting the IR Sensors and the Arduino to each other. These jumper wires are used for various electronic components like LEDs, sensors, and microcontrollers.



Fig.no.2.1.5 Jumper Wires

2.1.6 Proposed system:-

2.1.6.1 Infrared [IR] Sensor Working:-

Infrared technology has many wireless applications broadly in object sensing and remote controls. IR sensors as shown consist of a transmitter and a receiver. The transmitter transmits the light and the receiver keeps on receiving it. Whenever this connection gets interrupted, it initiates the counting process i.e., when the receiver does not receive the transmitted light anymore it is said that an object is present between transmitter and receiver. Using this approach, the traffic level and the signal timer are calculated further. In the proposed system, traffic level is calculated by using IR sensors.

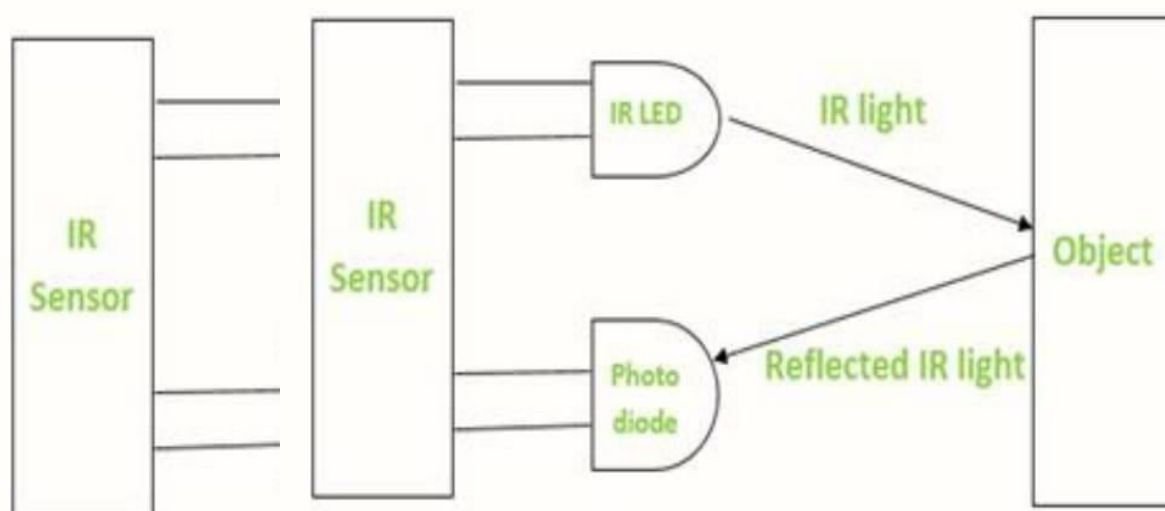


Fig. no. 2.1.6.1 Infrared [IR] Sensor working.

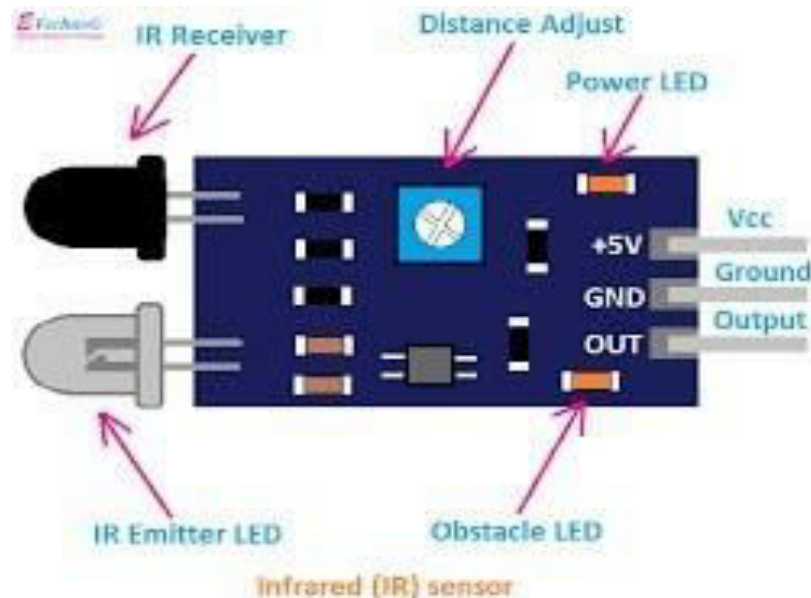


Fig.Infrared [IR] Sensor components

2.1.6.2 Mounting place of IR Sensor:-

The mounting of the first sensor is done at a particular distance from the traffic signal. The reason behind this is that the traffic signal has to turn GREEN irrespectively on/of whether there are vehicles in that particular lane or not to maintain the traffic flow. The timer of the signal is kept for a minimum time of 10 seconds. This is done only to prevent the breaking of flow at a particular signal.

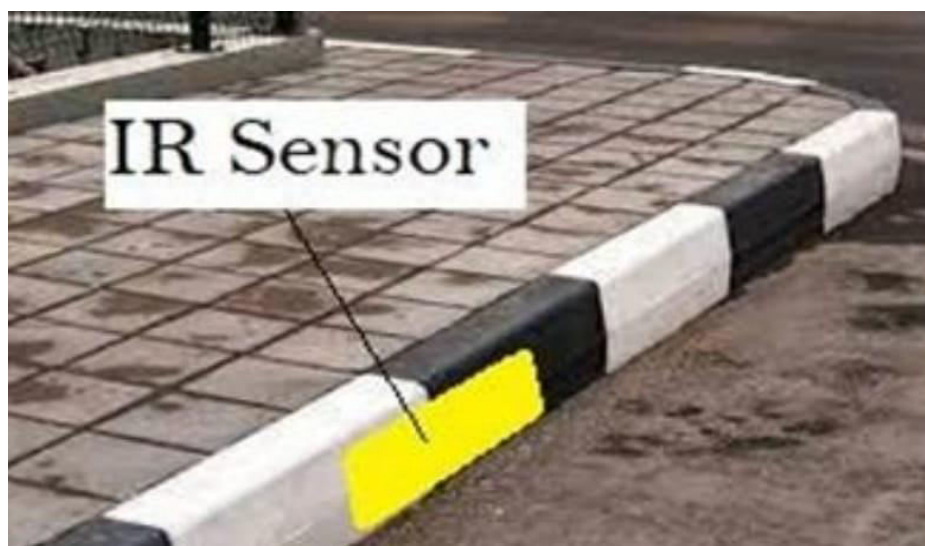


Fig. no. 2.1.6.2 Mounting place of IR Sensor

2.1.6.3 Circuit Diagram

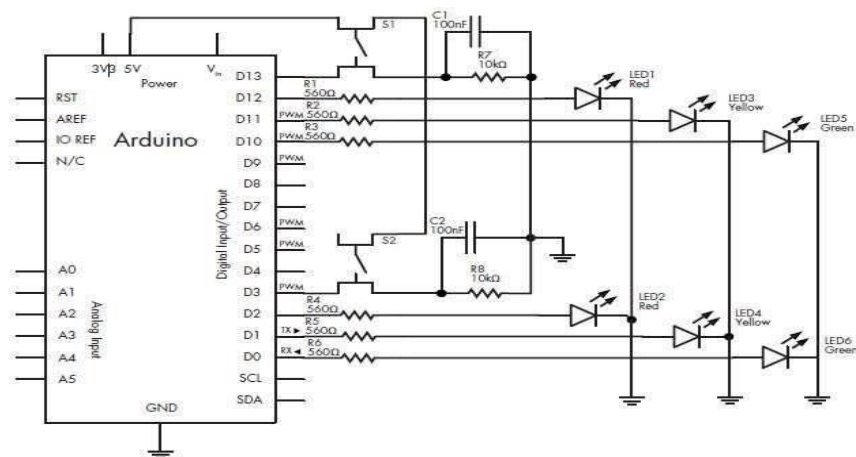
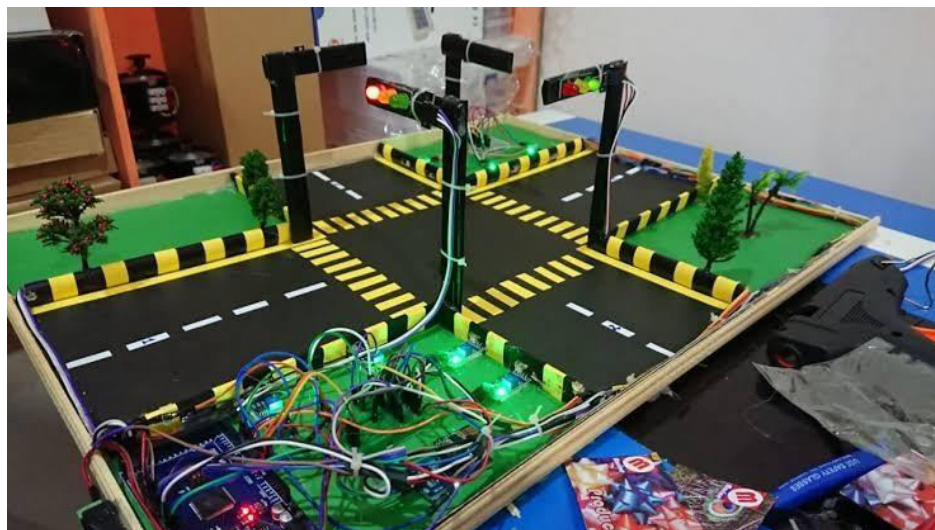


Fig. no. 3.3.6.3 Circuit Diagram

III. MODELING AND ANALYSIS



IV. RESULTS AND DISCUSSION

Traffic Light Control : The system of IR Sensors helps us to detect the traffic density on different intersection points of a densely populated area

Traffic Flow : The traffic signal timing is based on real time flow which helps us to reduce the delays and mprove the overall traffic flow

Reduced Timings : The system helps us to reduce traffic flow at intersections particularly

Improvement of safety: A well managed traffic flow can also improve the safety by reducing the accidents caused due to traffic

This smart traffic mangagement system can be useful into various civil engineering projects including road construction urban planning and transportation infrastructure development , contributing more efficient transportation process

V. CONCLUSION

A smart traffic management system utilizing Arduino and IR sensors offers a promising and cost-effective solution for improving traffic flow and efficiency in civil engineering projects. By leveraging these technologies, real-time traffic data can be collected and used to dynamically adjust traffic signals, leading to reduced congestion, optimized travel times, and enhanced overall road network performance. By dynamically adjusting traffic signals based on real-time conditions, the system can minimize waiting times, reduce fuel consumption, and enhance the overall efficiency of the road network. This smart traffic management system can be integrated into various civil engineering projects, including road construction, urban planning, and transportation infrastructure development, contributing to more efficient and sustainable transportation solutions.

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