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# Development of Traffic Light Control System Using Arduino Uno

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## Abstract

Everything is becoming smarter in the age of smart technology, and a smart transportation system is one area that will significantly impact how we live. This paper describes an Arduino Uno-based traffic light control system. The objective of this system is to offer advanced coordination and control to ensure that traffic flows as smoothly and safely as feasible. In this project, LED lights are used as indicators, and a microcontroller is used to automatically change the signal at a predetermined range with the daily technological breakthroughs. Instead of a timer, this traffic light management system will operate using a sensor, and Infrared (IR) sensors.

*Keywords: - Traffic light; Arduino Uno; infrared sensor; transportation system*



## 1. Introduction

Everything is becoming smarter in the age of smart technology, and a smart transportation system is one area that will significantly impact how we live (Hafizullah, Ahamed & Arefin, 2013). Thus, in this paper, a "Traffic Light System" is proposed, which involves applications of the control system. This project is a density-based traffic light control prototype, which compares the densities for both directions to determine which light should turn green. The traffic light control system exemplifies a control system. Here, the control system receives a series of input signals, and the output is one of the three lights that will be on for a while. The times of light on and light off can be established using traffic analysis at specific intersections. As an outcome, the input signal will control the output. The traffic light management system operates on a timer (Kham & Nwe, 2014).

The primary objective of this system is to offer advanced coordination and control to ensure traffic flows as efficiently and quickly as feasible. In this project, LED lights are used as indicators, and a microcontroller is used to automatically change the signal at a predetermined range, with the daily technological breakthroughs. Instead of using a timer, this traffic light management system will operate using a sensor. Infrared sensors are the kind that is utilized (Okpara et al., 2020).

Traffic lights, developed in 1912, are signalling devices that is conceived to control the traffic flows at road intersections, pedestrian crossings, rail trains, and other locations. Traffic lights consist of three universal coloured lights: the green light allows traffic to proceed in the indicated direction, the yellow light warns vehicles to

prepare for a short stop, and the red signal prohibits any traffic from proceeding (Isa et al., 2014).

Nowadays, many countries suffer from traffic congestion problems that affect cities' transportation systems and cause serious dilemmas. The rapid increase in automobiles and the constantly rising number of road users are not accompanied by promoted infrastructures with sufficient resources. Despite replacing traffic officers and flagmen with automatic traffic systems, the optimization of the heavy traffic jam is still a significant issue, especially with multiple junction nodes (Sinhmar, 2012). Partial solutions were offered by constructing new roads, implementing flyovers and bypass roads, creating rings, and performing road rehabilitation.

The IR sensors are employed in numerous traffic systems (Kham & Nwe, 2014; Isa et al., 2014; Sinhmar, 2012; Geetha, Viswanadha & Kavitha, 2014 and Kavya & Saranya, 2015). The IR transmitter and the IR receiver are mounted on either side of the road. When an automobile passes on the road between the IR sensors, the system is activated, and the car counter is incremented. The collected information about the traffic density of the different roads of a junction is analyzed to dynamically modify the delays of green lights at the lane with significant traffic volume. The whole system could be controlled by a PIC microcontroller (Hafizullah, Ahamed & Arefin, 2013; Okpara et al., 2020; Isa et al., 2014 and Sinhmar, 2012) or PLC (Dakhole & Moon, 2013; Jadhav, Madhuri & Ketan, 2014 and Ilyas & Zokarkar, 2016).

This research uses the Infrared Sensor(IR Sensor) as a motion sensor detector since it is more convenient for this project to be successful. It detects an object at the sensor, and the system will trigger a change in the traffic light when it is detected. If the IR Sensor detects a car, the traffic light will change from red to green as the other traffic light will change from green to yellow to red, and it will work vice-versa with the other IR Sensor and traffic light.

## 2. The Methodology of The Proposed Traffic Light System

The items that were used in this project are as follows:

*a) ATmega38 microcontroller*

The ATmega328 is the basis for a microcontroller board known as the Arduino Uno (datasheet). In addition to a 16 MHz ceramic resonator, it has a USB connector, a power jack, an ICSP header, six analogue inputs, and fourteen digital input/output pins, six of which can be used as PWM outputs, and a reset button. You only need to connect a USB cable, an AC-to-DC adapter, or a battery to operate; it comes with everything needed to support the microcontroller.

*b) IR infrared obstacle avoidance sensor*

IR Infrared Obstacle Avoidance Sensor powered at 3.3V or 5V DC input power. Green (Object Detection Indicators) and Red (LED Indicators) (Power Indicators) Range of obstacles: 2 cm to 10 cm. 35-degree detection angle output of just one bit. Size: 1.5 x 3.1 cm (L x W)

*c) LED traffic lights*

LED Traffic Lights Signal Module 5v RED, Yellow & Green.Size: 56 * 21 * 11mm Color: red, yellow, green LED: 8mm * 3 Brightness Normal brightness, Voltage: 5V. Input: Digital signal output, Interface is common cathode red, yellow, green control.

*d) Breadboard jumper wire cable*

Breadboard Jumper Wire Cable (2.54mm). The function of the jumper wire was to link two places in the circuit without soldering. The size of Pin/Hole is 2.54mm

*e) Arduino software (IDE)*

The Arduino Integrated Development Environment or Arduino Software (IDE) contains a text editor for writing code, a message area, a text console, a toolbar with buttons for standard functions, and a series of menus. It connects to the Arduino hardware to upload programs and communicate with them.

Since it is more practical for this project to be successful, as shown in Fig. 1, the sensor that is utilized is the Infrared (IR) sensor as a motion detection sensor. When an object is spotted at the sensor, the system will cause the traffic signal to change. If an IR sensor detects an automobile, one traffic light will change from red to green while the other changes from green to yellow to red. The other IR sensor and a traffic light will function oppositely.

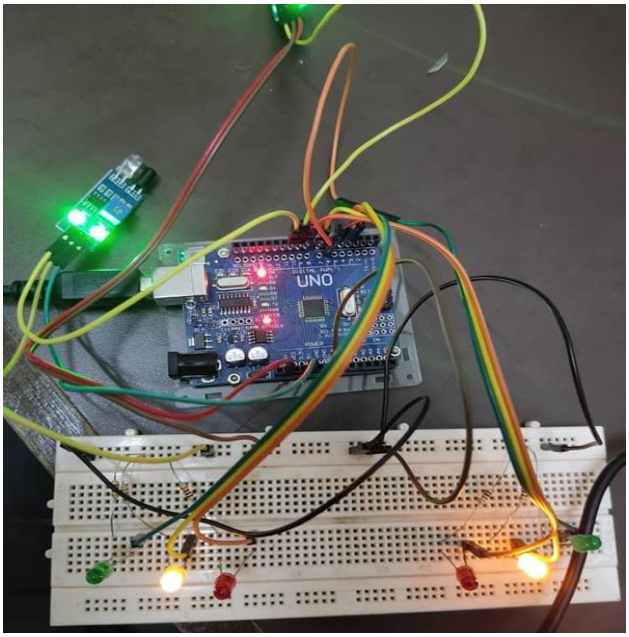



Fig. 1. The circuit of the proposed design

When our sensor picks up an object, the system alters the light signals. The other sensor will be able to detect an object on our second sensor as the lights change. This small project will provide the chance to research and demonstrate

how System Control Closed-Loop functions in real life. The benefit of an Arduino Uno traffic light is that it can detect an automobile and turn green when it does, as shown in Fig. 2. Traffic congestion may be lessened as a result. Additionally, it contributes to lowering traffic accidents and enhancing road safety for all users.


Fig. 2. The output pins from Arduino that have been used

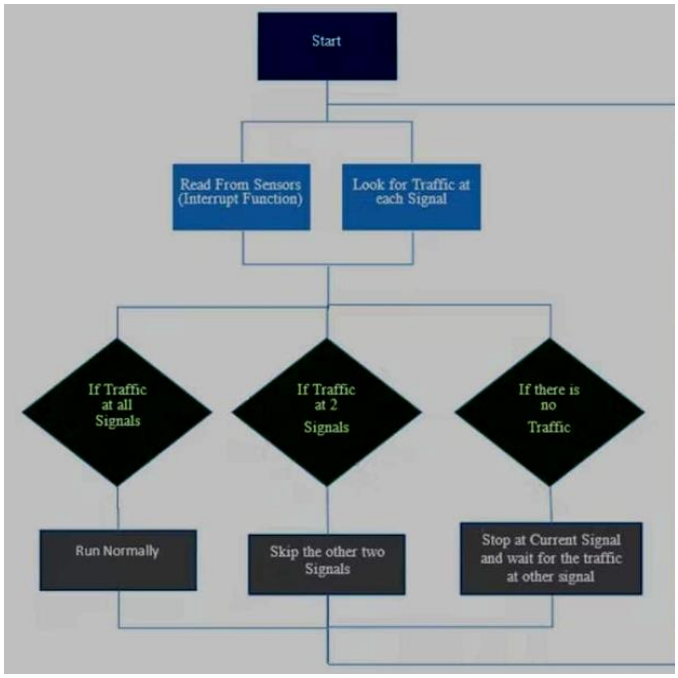



Fig. 3. The Flowchart of the proposed system

The Traffic Light Project's flowchart is shown in Fig. 3. To ensure that traffic flows as efficiently and quickly as possible, the primary goal of this traffic control system is to provide advanced control and synchronization. In this project, LED lights are used as indicators, and a microcontroller is used to change the signal at predetermined intervals automatically. However, in this project, an IR sensor is used to find any traffic, with the IR sensor identifying the presence of traffic, and LED lights are turned on and off automatically.

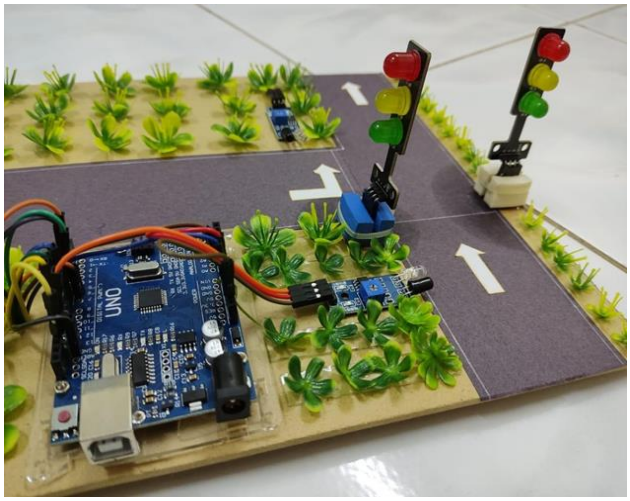
## 3. Result and Discussion

As shown in Fig. 4 (a) and (b), the board's green indication light turns on when the module notices a blockage in the path of the output signal while the output port continues to emit low-level signals continuously. When the potentiometer is turned counterclockwise, the detection distance is decreased. While turning the potentiometer clockwise increases the detection distance. The red indicator light is on the board level when the power is turned on. Since active Infrared (IR) sensors can only detect reflected light, the target detection range's reflectivity form is essential. The minimum and maximum detection ranges are for little things from a small area and a wide area from a grand. The summarization of the overall output is shown in Table 1.

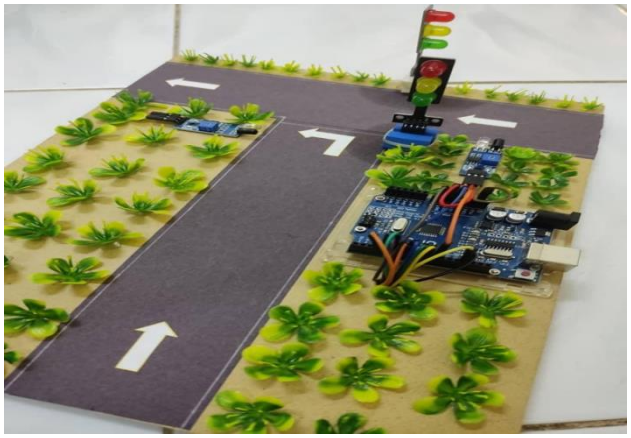
Table 1. The overall output results

| SENSOR | CAR DETECTED | LED OUTPUT |
|---|---|---|
| Sensor 1 | Yes | Green |
| Sensor 2 | No | Red |
| Sensor 1 | No | Red |
| Sensor 2 | Yes | Green |

The sensor module's three-pin interface, marked OUT, GND, and VCC OUT, is a digital output pin that should be connected to the microcontroller for any digital input. When an object is spotted, it will output logic LOW. GND is where the controller's ground or 0V is connected. Connect VCC to either +3.3V or +5V, which is the +ve supply. An IR sensor produces and detects infrared light to locate specific items or obstructions inside its field of view. In this instance, the IR sensor will identify the presence of moving traffic.




(a)



(b)

Fig. 4. The overall prototype (a) right view and (b) top view of the proposed system

## 4. Conclusion

Everything is becoming smarter in the age of smart technology, and a smart transportation system is one area where this will significantly impact how we live. This study describes an Arduino Uno-based traffic light control system. This system's primary goal is to provide advanced coordination and control to ensure traffic flows are as smooth as feasible. In this project, LED lights are used as indicators, and a microprocessor is used to change the signal at predetermined distances automatically. While technology advances daily, the control system can operate this traffic light using a sensor instead of a timer, and Infrared sensors are the kind that is utilized.

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