BioGecko

Vol 12 Issue 02 2023
ISSN NO: 2230-5807

Traffic Congestion Management Using Intelligent Techniques

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Abstract **-**Most cities around the globe suffer from severe traffic congestion, so it is necessary to switch from more manual or fixed-timed modes to an automated system with decision-making skills. Due to the present traffic light system's time-based nature, it may be ineffective if only one lane is open at once. We have developed a smart traffic control system framework to handle this problem. This is achieved by using PIR (Infrared proximity sensors). With the aid of the microcontroller, the green light's shining period is determined after the density has been determined using Arduino. Further gate opening and closing systems are installed at each lane to prevent junction crossings by people while the signal is red.

Index Terms: Traffic, Sensor, Arduino, microcontroller, sensors.

I. INTRODUCTION

In today's fast-paced world, traffic congestion is a severe issue for our daily activities. As many work hours are wasted in the signals, it lowers individual productivity and, thus, society's production. The primary causes of these tumultuous congested areas are many cars, the poor infrastructure, and the illogical arrangement of the signaling system. As long as engines run, many natural resources like gasoline and diesel are wasted without producing valid results, indirectly contributing to increased pollution. Because of this, modern schemes must be adopted by using a sensor-based automation approach in this field of the traffic signaling system to eliminate these difficulties or at least significantly minimize them. When engines are running, many natural resources like gasoline and diesel are wasted without ever being put to good use, which unintentionally leads to increased pollution.

Thus, innovative schemes must be adopted by using sensor-based automation techniques in this field of the traffic signaling system to eliminate these problems or at least minimize them to a considerable level.

Our primary research interests are around creating and improving a traffic light controller in a city using an IR sensor and an Arduino. An intelligent transportation system (ITS) analyses the traffic flow characteristics and modifies the signal timing to reduce vehicle delays and stops. Fixed traffic control fundamentally differs from traffic management based on density in that it is based on a programming style that has already been programmed into the system. This paper presents an Arduino-based intelligent system. Highlight the topic's importance in this section by generalizing.

II. LITERATURE

The current fixed signal timing system is ineffective in managing urban traffic congestion. When traffic density surpasses a specific threshold, a route requires a longer green signal duration to slow the flow of vehicles. The main problem with the current traffic light system is that the timing slots for transitions are predetermined by software, which causes unnecessary waiting time when no cars are on the opposite route [1].

Shruti K R and Vinoda K proposed a priority-based traffic controller employing a wireless sensor network in 2012. The author implements an adaptive traffic control system based on a wireless sensor network in this research (WSN). To manage the traffic signal in this system, time manipulation is used. Several intersections are controlled by

this method for traffic. With the use of a wireless sensor network, the author has significantly minimized traffic congestion brought on by traffic lights. To track traffic density in this system, they will keep the Road Side Unit (RSU) past the road and rely on its count (RSU). The Road Side Unit assesses traffic density on all roads and gives the road with the highest priority the maximum amount of green time, with the road with the lowest priority level coming after. [2].

Roadway traffic congestion will be tracked and measured in 2011 using Active RFID and GSM technology. The author uses a probing car to monitor and measure the roads' busyness in this study. They also provide a clear framework for analyzing traffic flow and congestion patterns. To estimate the typical path to cross two motorways, it places one active RFID tag, wireless router, and wireless coordinator at the roadside, roughly 200 meters apart. The active RFID tags affixed to the probe vehicle will send signals that these systems will use wireless devices to intercept. As the probe truck goes, it passes over roadside obstructions [3].

III. PROPOSED METHOD

We propose a system where the duration of each color signal (green, amber, amber, and red) is controlled by the amount of traffic present at that instant. PIR is used to do this (Proximity Infrared sensors). With the aid of the microcontroller, the green light's shining period is determined after the density has been determined (Arduino). The microcontroller will determine how long a flank will remain open or when to switch over the signal lights based on information from the sensors on the sides of the road (lanes) that detect the presence of vehicles.

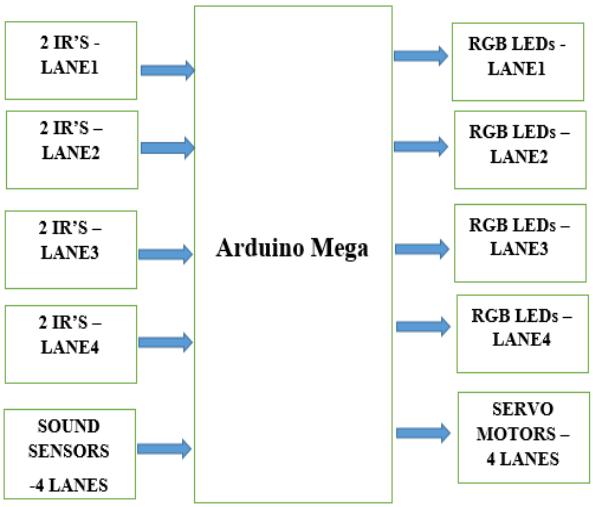


Fig.1. Block Diagram of proposed traffic control system.

A sound sensor is also installed to listen for the sirens of emergency vehicles and alter signals accordingly. Further gate opening and shutting systems have been installed at each junction to prevent people from crossing during RED signals. A sound sensor is established to recognize emergency vehicles' sirens and modify signals accordingly. A second gate opening and shutting system are installed at each lane to prevent junction crossings during RED signals.

IV. HARDWARE

A. Arduino MEGA board.

The Arduino firm produced the microcontroller included on the Arduino Uno board. The primary source of inspiration for this free and open-source microcontroller platform for electrical applications was the AVR Atmega328. Six analog input pins and 14 digital I/O ports are included in the Arduino Uno board's most recent iteration, which also has a USB connector.

Connecting the board to various electrical circuits is made possible via these ports. Six of the I/O ports, out of 14, may produce PWM output. This board has every component required to operate the controller, and a USB cable can connect it immediately to a computer.

The Arduino Mega is a microcontroller board based on the ATmega2560. It has 54 digital input/output pins (14 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

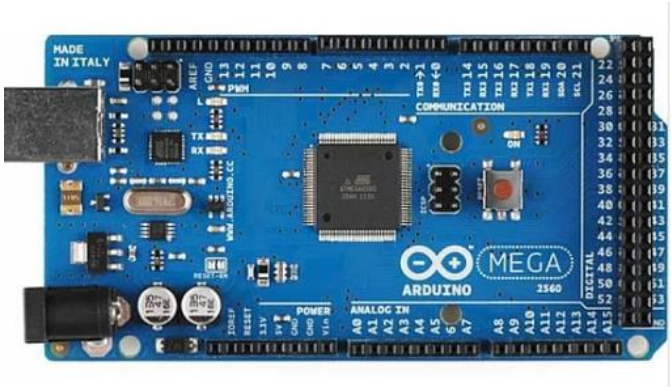


Fig.2. Arduino MEGA board.

B. IR Sensor

Fig.3. IR Sensor Module.

IR stands for infrared sensor. It is a passive device that monitors adjacent objects' infrared radiation. It is a technological device that emits in order to detect specific environmental stimuli. An IR sensor is able to identify an object's motion and heat. An IR transmitter and an IR receiver make up the IR sensor. An IR transmitter emits infrared light, which is reflected by another object. An IR receiver picks up this reflection to gauge the distance, which is then transferred to the Arduino through an analogue input.

C. **SOUND SENSOR**

Fig.5. MQ131 Sensor.

This module can determine when sound levels have risen above a chosen threshold. An LM393 op-amp receives sound detection data from a microphone. With a built-in potentiometer, the sound volume set point can be changed.

D. RGB LEDs

Fig.6. Node MCU

Since it is a semiconductor, it emits light when current flows through it. It operates on the electroluminescence concept. The employment of light-emitting diodes in the project above is for indication purposes.

E. Servo motor

Fig.7. SERVO MOTOR.

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors

to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor which runs through a servo mechanism.

F. Arduino IDE

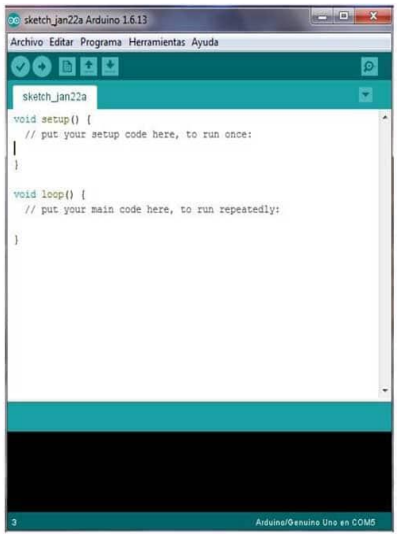
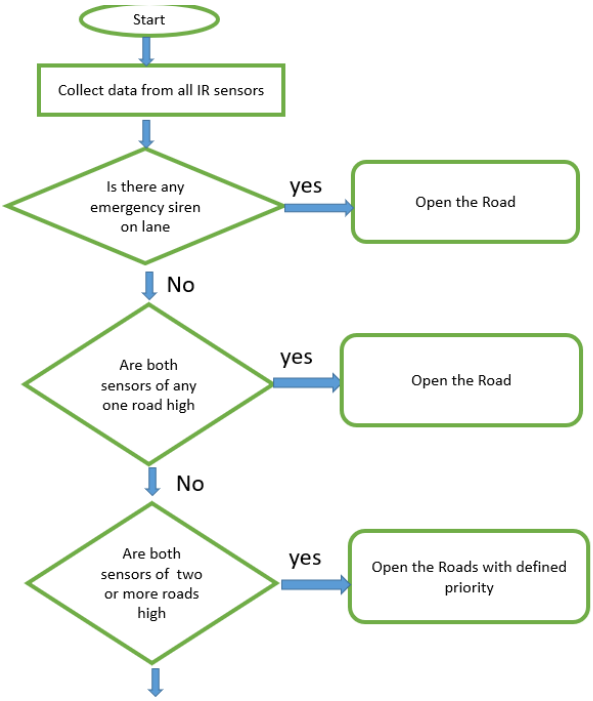


Fig.8. Arduino IDE.

In addition to a text editor for writing code, a message area, a text console, a toolbar with buttons for frequently used operations, and a number of menus, the Arduino Integrated Development Environment, sometimes known as the Arduino Software (IDE), is also available. In order to upload programmes and communicate with them, it connects to the Arduino hardware.

IV. FLOWCHART



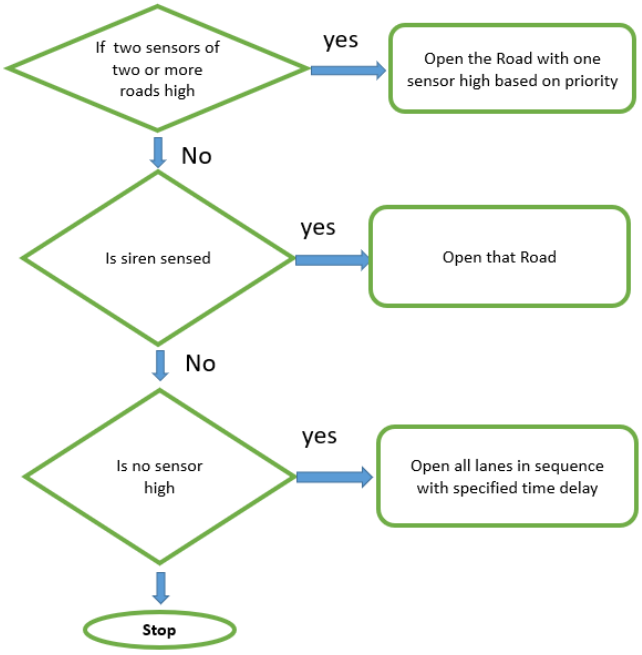


Fig.9. Flow chart.

V. RESULTS

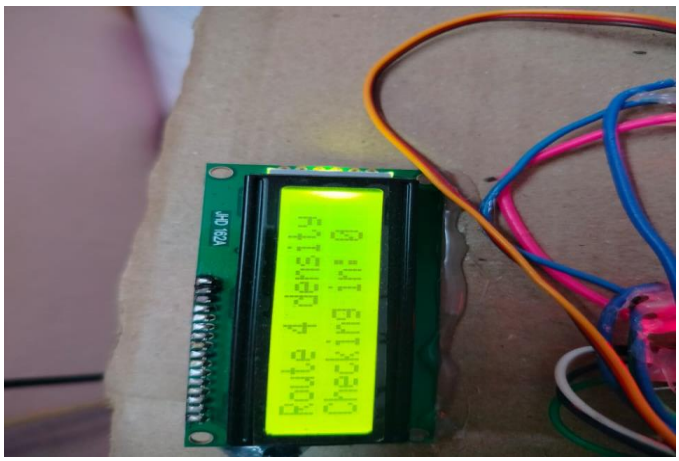


Fig.10.

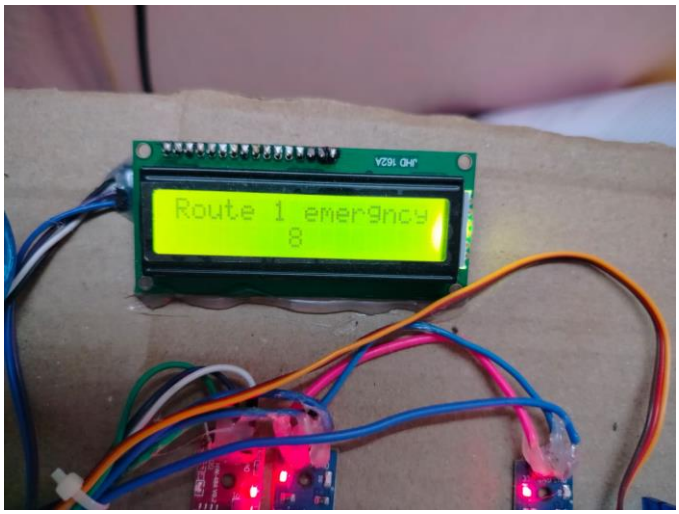
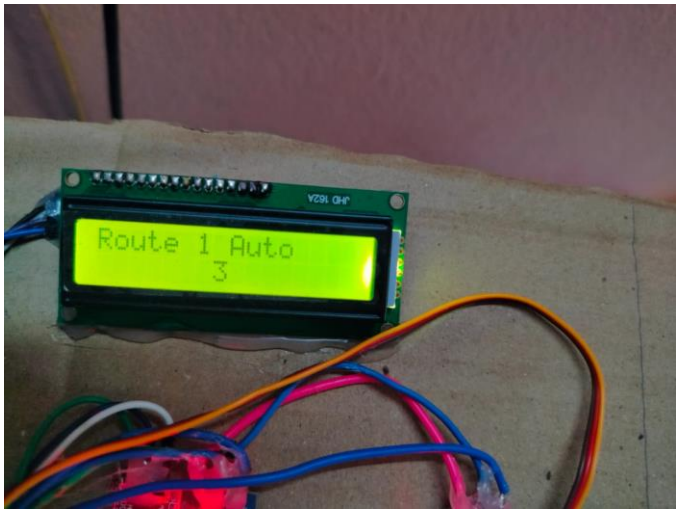


Fig.11.



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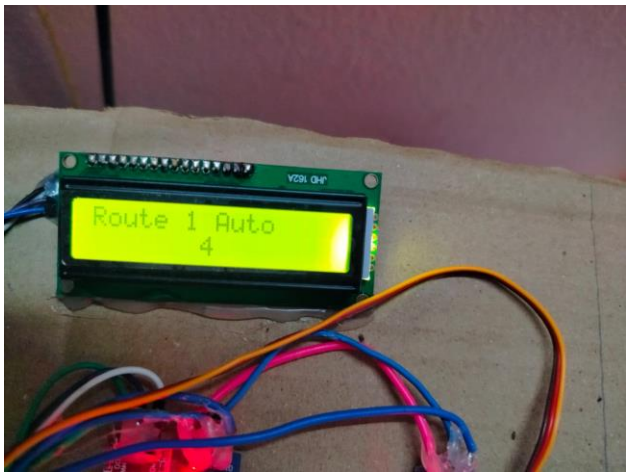

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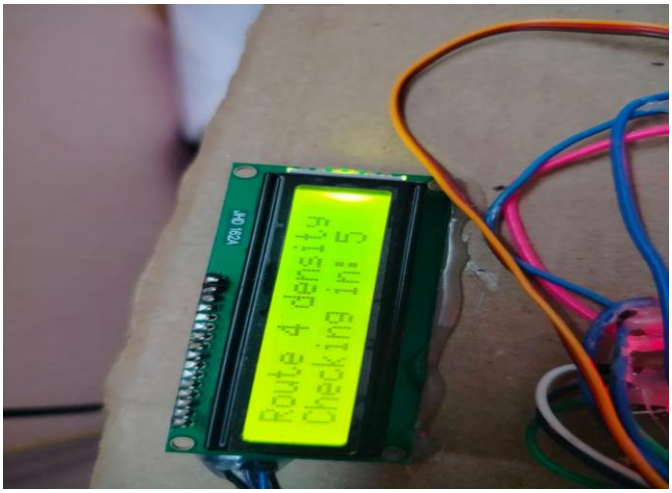

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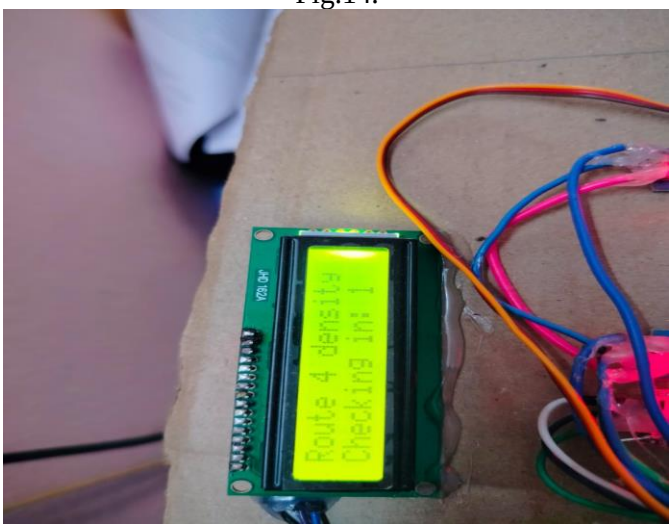


Fig.15.

A more effective and efficient traffic light control system can be produced by using an IR sensor and an Arduino. The intention is to make improvements to the traffic signal system to lessen traffic congestion and, in doing so, eliminate problems like fuel and energy waste, pollution, and time waste.

The traffic control system is managed by an Arduino UNO microcontroller. It is put in place at each stop sign on the intersection's route to keep time. To provide customizable traffic light timing periods dependent on traffic density at each traffic light, three LED lights—green, yellow, and red—are mounted at each traffic signal and labelled Traffic Light 1, Traffic Light 2, Traffic Light 3, and Traffic Light 4, accordingly. Each vehicle has a three-second timer.

The number of vehicles passing through the intersection is tallied, and delays are computed. If there are no vehicles on the road for one second, it will move to another intersection.

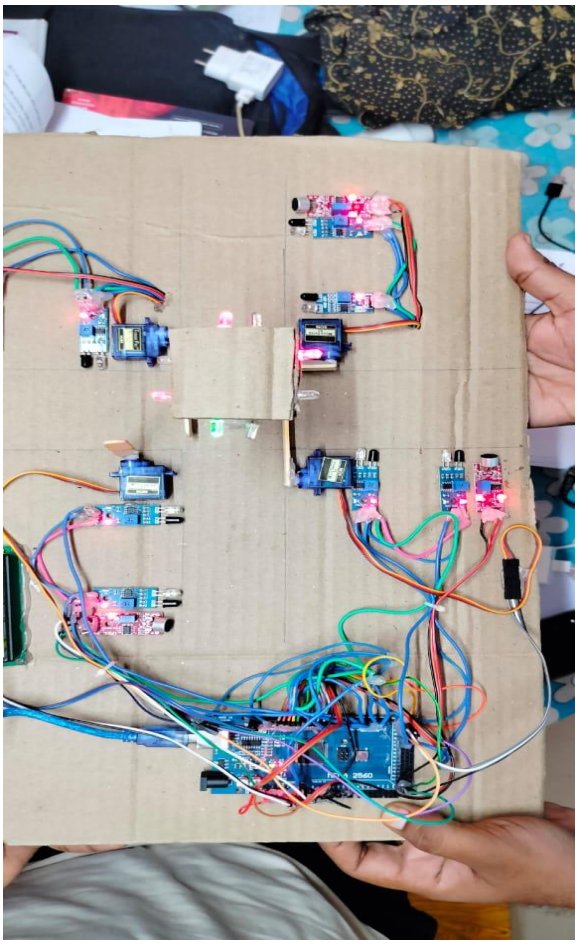


Fig.16

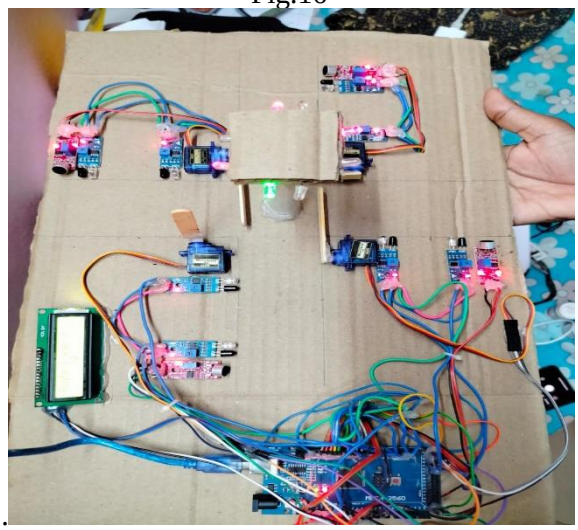


Fig.17.

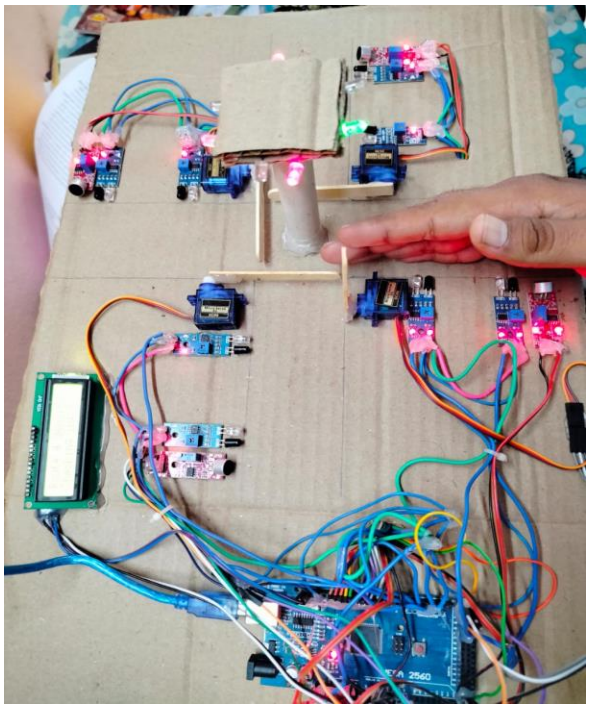
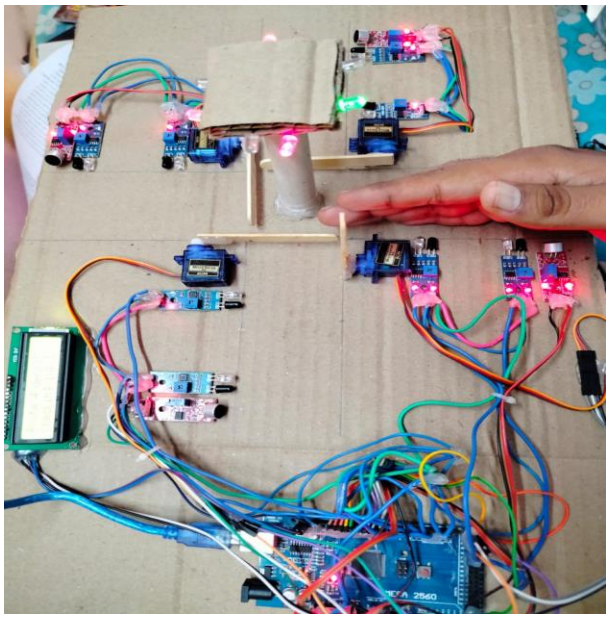


Fig.18.



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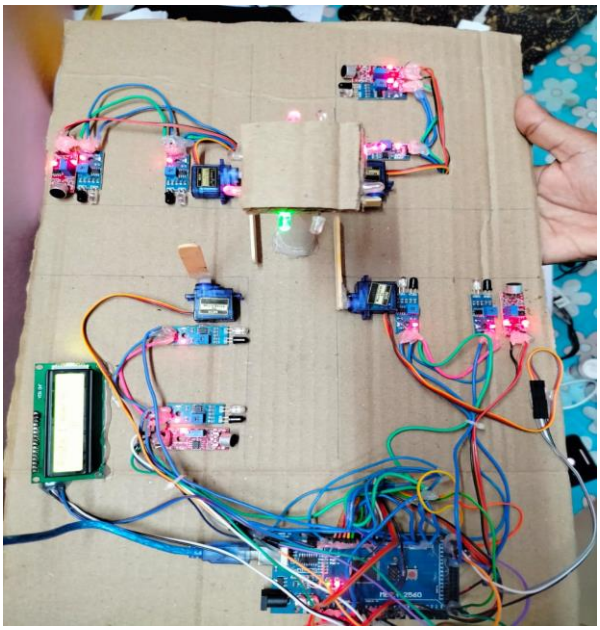

Fig.20.

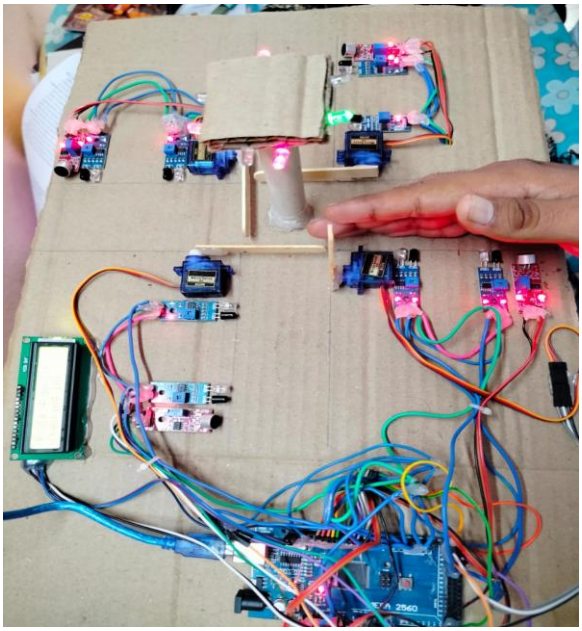

Fig.21.

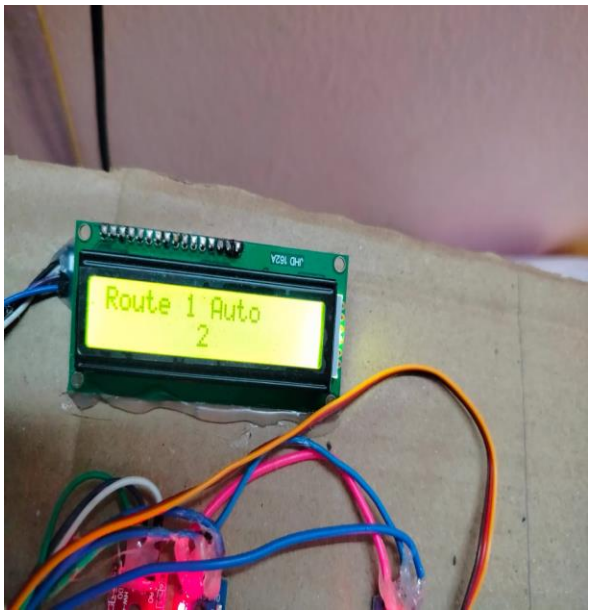

Fig.22.

The circuits, when implemented separately, works as per the desired output; however, while integrating all, output fluctuates and shows different response every time. This could be a problem of loose connections of the wires or internal wiring of the breadboard used. This project lists the results realized from the practical work and examines whether the practical implementation meets the ideas/solution approaches recommended in research. For this project, the primary communication is by using IR technology.

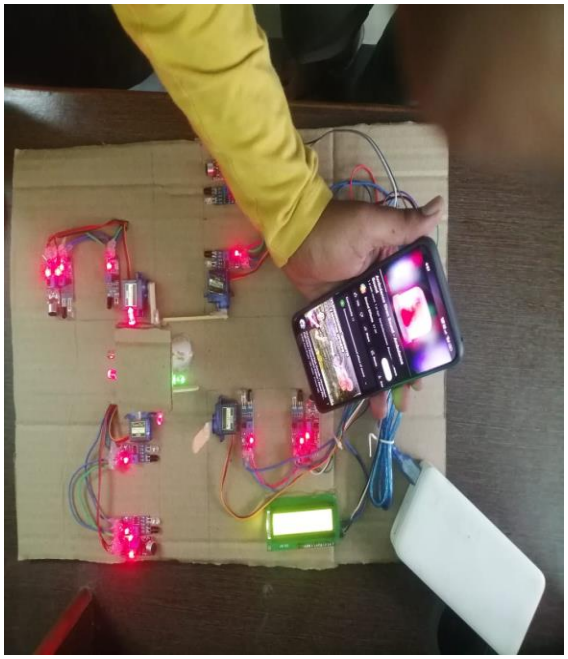

Fig.23.

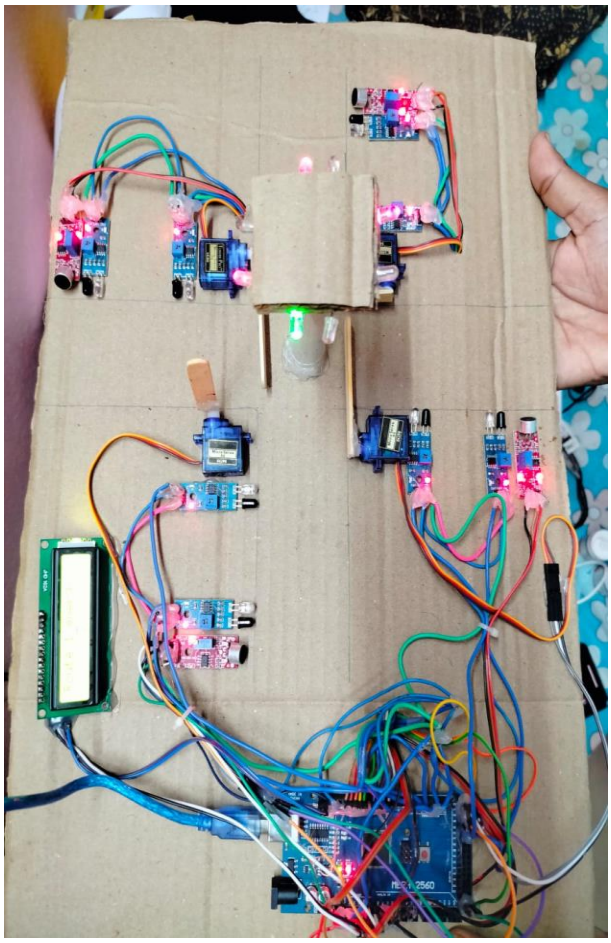

Fig.24.

VI. CONCLUSION.

Our country urgently needs an effective traffic management system due to the frequent traffic incidents. This initiative creates a cutting-edge technique to lessen traffic jams and unfavourable time delays. This technique may efficiently channel the maddening chaos of traffic in the real world by allocating periods depending on the merit of the carload in various lanes of multi-junction crossings. The prototype was put to excellent use in a little laboratory. Before placing this schema into practice on a larger scale, the following step is to gauge its effectiveness in a real-world setting. According to our predictions, this will result in a paradigm shift in how traffic management technologies are used in real-world situations.

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