ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ

"ಜ್ಞಾನ ಸಂಗಮ", ಬೆಳಗಾವಿ-590018, ಕರ್ನಾಟಕ, ಭಾರತ.

Visvesvaraya Technological University

"Jnana Sangama", Belagavi-590018, Karnataka, India.

A Societal Project (22MCAL38) Report on

"DENSITY BASED TRAFFIC CONTROL SYSTEM"

Submitted in partial fulfillment of the requirements of the 3th Semester in

MASTER OF COMPUTER APPLICATIONS

Submitted by

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March-2024

DECLARATION

I, RAJESH S, student of 3rd semester, **Dept. of CSE (MCA Programme), Postgraduate Studies, VTU Mysuru,** bearing USN:**4VZ22MC073** hereby declare that the Societal Project (22MCAL38) entitled **"DENSITY BASED TRAFFIC CONTROL SYSTEM"** has been carried out by me under the guidance of Dr. VIKAS S, Assistant professor, Dept. of CSE (MCA Programme), VTU, PG Studies, Mysuru-570029, submitted in partial fulfillment of the requirements for the 3rd Semester of **Master of Computer Applications** by the **Visvesvaraya Technological University, Belagavi** during the academic year 2023-2024. The report has not been submitted to any other University or Institute for the award of any other degree, diploma, or fellowship etc.

Place: Mysuru **RAJESH S**

Date: USN: 4VA22MC073

Signature

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Visvesvaraya Technological University

"Jnana Sangama", Belagavi-590018, Karnataka, India.

CERTIFICATE

*This is to certify that **Rajesh S** bearing **USN: 4VZ22MC073** has satisfactorily completed the **Societal Project (22MCAL38)*** entitled ***"DENSITY BASED TRAFFIC CONTROL SYSTEM"** in the academic year 2023-24 as prescribed by **VTU for III Semester of Master of Computer Applications**. This is certified that all the corrections/suggestions indicated during Internal Assessment have been incorporated in the report. The Project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the Master of Computer Applications degree.*

Signature of Guide	Signature of Program Coordinator
Dr. Dr.VIKAS S	**Dr. G F. Ali Ahammed**
Assistant Professor	Program Coordinator,
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It has been a great privilege for me to work under the guidance of, ***Dr.Vikas S****, Assistant Professor, Dept. of CSE (MCA Programme), VTU, PG Studie- Mysuru .I express my heartfelt gratitude to my guide* ***Dr.Vikas S****. Words are insufficient to appreciate my teacher for his whole hearted involvement, inspiration and constant support during the entire period of project work. I especially thank him for the exemplary guidance, monitoring, constant encouragement, understanding, care and empathy*

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Rajesh S

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Abstract

Traffic congestion is a severe problem in many major cities across the world and it has become a nightmare for the commuters in these cities. Traffic can be controlled in several main junctions by incorporating either automatic traffic light control or traffic police. But conventional traffic light system is based on fixed time concept allotted to each side of the junction which cannot be varied as per varying traffic density. At some times, priority of traffic light needs to be changed based on more number of vehicles waiting in same road, VIPs vehicles and Ambulance vehicles etc. We propose to design and develop a density based traffic signal system. The signal changes automatically on sensing the traffic density at the junction.

The prototype model was developed using IR sensors and Arduino. We use Arduino to write programming according to our requirements due to its simplicity and economy and IR sensors is used to measure the traffic density in a particular road.As a result, traffic light works in improper way. In future, it may be improved by using some suitable sensors. IR sensors are arranged on each road in accurate manner to detect traffic density properly; these sensors always sense the traffic on that particular road. All these sensors are interfaced to the arduino. Based on these sensors, controller detects the traffic and controls the traffic system. The controls of traffic light depend on number of vehicles available in the road.

Arduino Uno is used to control all the command from IR sensor and Object Sensor and execute them legitimately. Fundamentally it acts as the mind of the entire framework.

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Chapter-1

INTRODUCTION

1.1 Background

In modern life we have to face many problems one of which is traffic congestion becoming more serious day after day. It is said that the high volume of vehicles, the inadequate infrastructure and the irrational distribution of the development are main reasons for increasing traffic jam. The major cause leading to traffic congestion is the high number of vehicle which was caused by the population and the development of economy. Due to the massive growth in urbanization and traffic congestion, automatic based traffic light controller is needed to reduce the traffic delay and travel time especially in developing countries. Traffic problems will be also much more widely increasing as an expected result of the growing number of transportation means and current low-quality infrastructure of the roads This idea of controlling the traffic light efficiently in real time has attracted many researchers to work in this field with the goal of creating automatic tool that can estimate the traffic congestion and based on this Variable, the traffic signal can be varied.

In urban areas, traffic congestion has become a significant issue affecting daily life, economy, and the environment. Traditional traffic control systems often lack the adaptability needed to efficiently manage varying traffic densities. The Density-Based Traffic Control System aims to address this challenge by dynamically adjusting traffic signals based on real-time traffic density.

1.2 Objectives

The primary objective of this project is to design and implement a Density-Based Traffic Control System using Arduino Uno and IR sensors. Specific objectives include:

- Developing a system capable of monitoring traffic density in real-time.
- Implementing intelligent traffic signal control algorithms to optimize traffic flow.
- Creating a cost-effective solution applicable to various urban settings.
- Evaluating the effectiveness of the system in reducing traffic congestion and improving overall traffic management.

1.3 Purpose, Scope, and Applicability

1.3.1 Purpose

The purpose of this project is to alleviate traffic congestion in urban areas through the implementation of an innovative traffic control system. By dynamically adjusting traffic signals based on traffic density, the system aims to optimize traffic flow and improve overall transportation efficiency.

1.3.2 Scope

The scope of this project includes the design, development, and testing of a Density-Based Traffic Control System using Arduino Uno and IR sensors. The system will be capable of:

- Detecting vehicles using IR sensors.
- Calculating traffic density based on the number of vehicles detected.
- Adjusting traffic signals accordingly to optimize traffic flow.
- Providing real-time monitoring and control capabilities.

1.3.3 Applicability

This project is applicable to urban areas experiencing traffic congestion issues. It can be implemented in various settings, including intersections, highways, and urban road networks.

1.4 Achievements

Upon completion, this project aims to achieve:

- Development of a functional Density-Based Traffic Control System prototype.
- Validation of the system's effectiveness in reducing traffic congestion through simulation and real-world testing.
- Documentation of the system design, implementation process, and evaluation results.

Chapter-2

LITERATURE SURVEY

2.1 Present Traffic Signaling System

Under present scenario, traffic control is achieved by the use of a system of hand signs by traffic police personnel, traffic signals and markings. Each traffic control device is governed by standards of design and usage. Standard use of colors and shape aids in this identification and in deciding on the appropriate course of action. Under current circumstances, traffic lights are set on in the different directions with fixed time delay, following a particular cycle while switching from one signal to other creating unwanted and wasteful congestion on one lane while the other lanes remain vacant. The system we propose will provide the solution of this problem.

2.1.1 Problem Statement:

Statement [1]: It works on the time delay even if there is no vehicle on other sides. **Statement [2]:** During high traffic the green light is open for a less time, which a very less number of vehicles can pass at once.

2.1.2 Disadvantages of Classical Street Light:

The main disadvantages with conventional traffic light system is the time delay. In the conventional traffic system the signal pattern will complete its cycle and the vehicle have to wait even if there is no vehicle at the other junction To face the various problem mentioned above in the conventional traffic signaling system, we need a signaling system that is well equipped with recent inventions and technology. As it is well known to everyone that “ Time is a very precious thing “ , we need to save it and use it wisely. So if we can use automation in this particular case so that all the Traffic light system works according to to density to vehicle when it is really necessary. And if we can use controller circuits to implement a model so that all the traffic system work smartly and help us to save our precious time.

2.2 Operational Model

The model works on the principle of changing delay of Traffic signals based on the vehicle standing around an assigned section of the road. There are four sensors placed at four sides of a four-way road which sense the vehicle standing by the area covered by the sensors. Here we are using IR sensors replacing traffic control system to design a density based traffic signal system. IR sensor contains IR transmitter IR receiver (photodiode) in itself. These IR transmitter and IR receiver will be mounted on same sides of the road at a particular distance . As the vehicle come across these IR sensors, the IR sensor will detect the vehicle & will send the information to the microcontroller. The microcontroller will get the signal from the sensor, and provide the glowing time to LED according to the density of vehicles. The lane or road which has the higher density, then the LED will glow for higher time than average or vice versa. The traffic lights are initially running at a fixed delay of 6000 milliseconds.This entire embedded system is placed at that junction. Microcontroller is interfaced with LED's and IR sensors. The total number of IR sensors required are 4 and LED's are 12.

Chapter-3

DESIGN AND IMPLEMENTATION

3.1 Implementation of IR Sensor in Arduino UNO

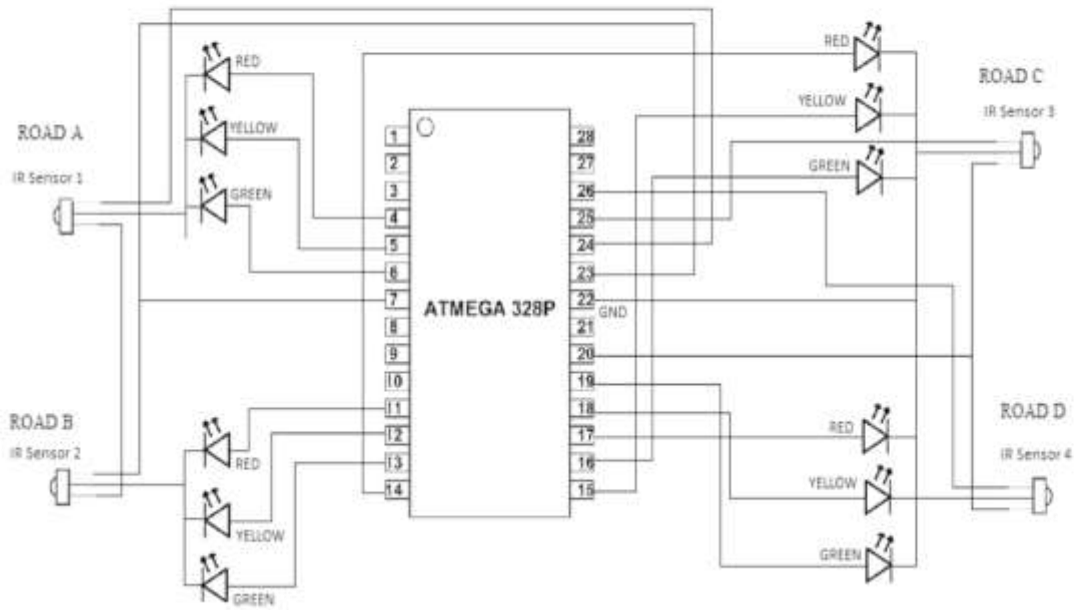


Fig 1: Circuit diagram of Traffic System operational model

3.2 Structure Analysis:

- We have used here 4 IR sensors (IR1, IR2, IR3, IR4) on each road in four way traffic signal. The sensor is placed on the divider of each road at the specific distance from the four way crossing. The sensors on each road sense the vehicle and sends the data to the microcontroller.
- The sensors are directly connected to the analog input pins of the Arduino uno (To Analog pin number A0, A1, A2, A3).The sensors get the supply voltage of 5v and ground. The output Leds are connected to the output digitals pins of Arduino uno(To Digital pin number 2, 3, 4, 5, 6, 7,8,9,10,11,12,13). •
- The Arduino uno board is supplied with 5v-12v power supply from a regulated dc source.

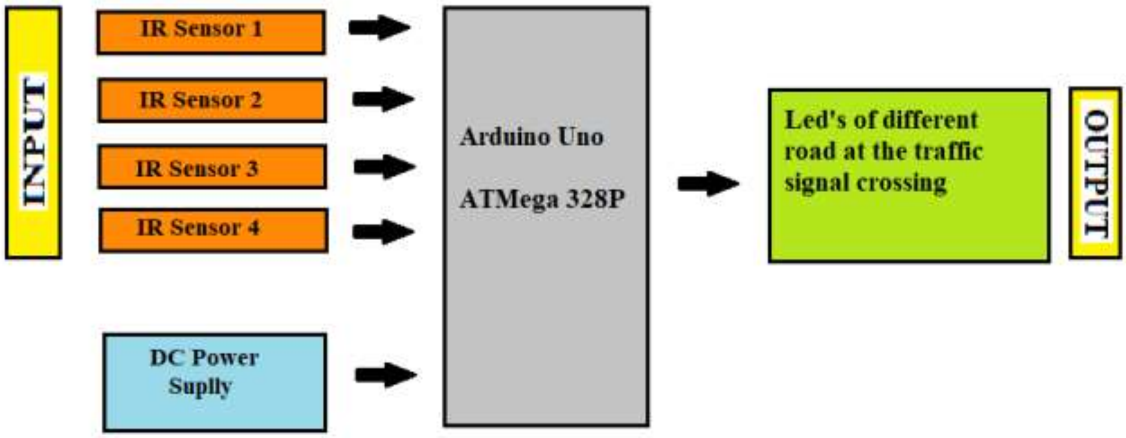


Fig 2: Circuit diagram of Density Based Traffic Control System .

3.3 Working Principle:

- Normally when there is less traffic or just say no traffic, the traffic signals will work with the time delay. As there is no traffic the IR sensor will send no data to the micro controller.
- When there is a high density of traffic, it become difficult to manage the vehicle. So to overcome this problem we use some modern techniques. Here we implement "Density Based Traffic Control System" .
- In the system mentioned above if the the traffic at the signal increases continuously , the signal will turn to green in priority wise. The road having the large number of vehicle will be given the green signal first and also duration of the green signal will larger than the standard delay.
- Once that road is cleared ,the Arduino will receive no data from the sensor on that road. After clearing this road, the green signal will move to road having less number of vehicle than this road.
- Like priority wise , the green signal will move to every road whenever the density of the vehicle is increased on some road of the traffic signal crossing.

3.4 POSSIBLE CONDITIONS :

The following conditions are given according to circuit diagram of Density Based Traffic Control System shown in above figure. Whenever the sensors of any road senses the vehicle density the green signal is open for longer time period (ie. 8 seconds) then the normal time period as assumed (ie. 4 seconds).

- When Sensor 1 senses density of vehicle ROAD 1 shows green signal and rest of roads shows red signal.
- When Sensor 2 senses density of vehicle ROAD 2 shows green signal and rest of roads shows red signal.
- When Sensor 3 senses density of vehicle ROAD 3 shows green signal and rest of roads shows red signal.
- When Sensor 4 senses density of vehicle ROAD 4 shows green signal and rest of roads shows red signal.
- When Sensor 1 and Sensor 2 senses density of vehicle, first ROAD 1 shows green signal, then ROAD 2 shows green signal and rest of roads shows red signal.
- When Sensor 1 and Sensor 3 senses density of vehicle, first ROAD 1 shows green signal, then ROAD 2 shows green signal and rest of roads shows red signal.
- When Sensor 1 and Sensor 4 senses density of vehicle, first ROAD 1 shows green signal, then ROAD 2 shows green signal and rest of roads shows red signal.
- When Sensor 2 and Sensor 3 senses density of vehicle, first ROAD 2 shows green signal, then ROAD 3 shows green signal and rest of roads shows red signal.
- When Sensor 2 and Sensor 4 senses density of vehicle, first ROAD 2 shows green signal, then ROAD 4 shows green signal and rest of roads shows red signal.
- When Sensor 3 and Sensor 4 senses density of vehicle, first ROAD 3 shows green signal, then ROAD 4 shows green signal and rest of roads shows red signal.
- When Sensor 1, Sensor 2 and Sensor 3 senses density of vehicle, first ROAD 1 shows green signal, then ROAD 2 shows green signal, then ROAD 3 shows green signal and rest of roads shows red signal.
- When Sensor 1, Sensor 2 and Sensor 4 senses density of vehicle, first ROAD 1 shows green signal, then ROAD 2 shows green signal, then ROAD 4 shows green signal and rest of roads shows red signal.

- When Sensor 1, Sensor 3 and Sensor 4 senses density of vehicle, first ROAD 1 shows green signal, then ROAD 3 shows green signal, then ROAD 4 shows green signal and rest of roads shows red signal.
- When Sensor 2, Sensor 3 and Sensor 4 senses density of vehicle, first ROAD 2 shows green signal, then ROAD 3 shows green signal, then ROAD 4 shows green signal and rest of roads shows red signal.
- When Sensor 1, Sensor 2, Sensor 3 and Sensor 4 senses density of vehicle, first ROAD 1 shows green signal, then ROAD 2 shows green signal, then ROAD 3 shows green signal and then ROAD 4 shows green signal.

CHAPTER- 4

DESCRIPTION OF COMPONENTS USED

4.1 Arduino Uno

- Arduino Uno is a microcontroller board based on the ATmega328P.
- It has 14 digital input/output pins (of which 6 can be used as PWM outputs),6 analog inputs, a 16MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.
- Connect it to a computer with a USB cable or power it with a AC to DC adapter or battery to get started.
- "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases.

4.1.1 Summary:

- Microcontroller ATmega328
- Operating Voltage 5V
- Input Voltage (recommended) 7-12V
- Input Voltage (limits) 6-20V
- Digital I/O Pins 14 (of which 6 provide PWM output)
- Analog Input Pins 6
- DC Current per I/O Pin 40 mA
- Flash Memory 32 KB (of which 0.5 KB used by bootloader)
- SRAM 2 KB
- EEPROM 1 KB
- Clock Speed 16 MHz
- Length 68.6 mm
- Width 53.4 mm
- Weight 25 g

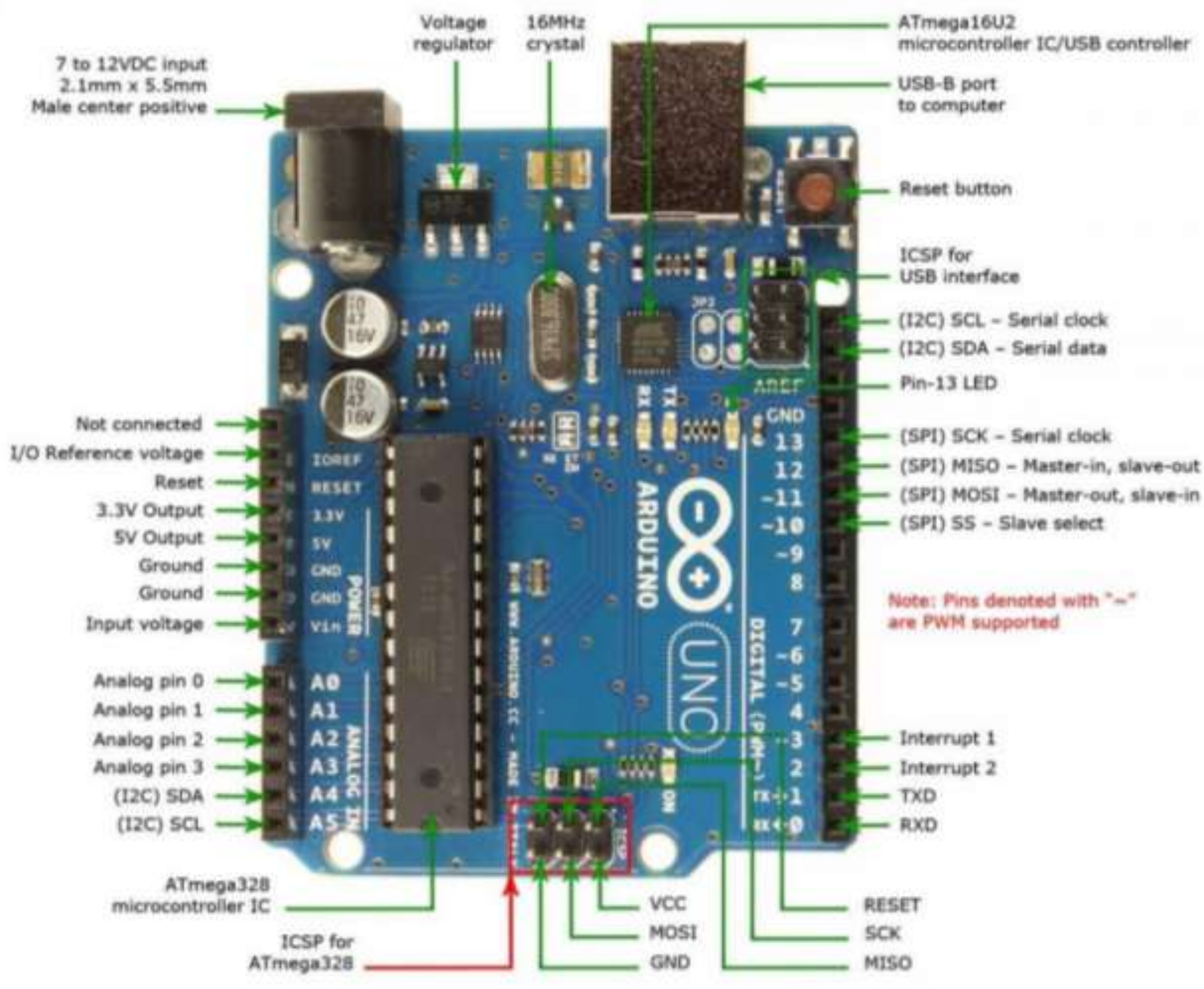


Fig 3: Picture of Arduino UNO

4.1.2 Physical Characteristics

The greatest length and width of the Uno PCB are 2.7 and 2.1 inches individually, with the USB connector and force jack augmenting past the previous measurement. Four screw gaps permit the board to be connected to a surface or case. Note that the separation between advanced pins 7 and 8 is 160 mil (0.16").

4.1.3 USB Overcurrent Protection

The Arduino Uno has a resettable poly-fuse that shields your PC's USB ports from shorts and overcurrent. Albeit most PCs give their own particular inner insurance, the fuse gives an additional layer of security. In the event that more than 500 mA is connected to the USB port, the circuit will consequently break the association until the short or over-burden is uprooted.

4.1.4 Memory

The ATmega328 has 35 KB (with 0.5 KB utilized for the boot loader) which includes

- 2KB for SRAM
- 1KB for EEPROM

4.1.5 Power

It can only works on 7-12 volts which can be possible via USB connection from the system. We can give supply to it by using a battery between Vin and GND. It also provides a IOREF pin to decide whether it should work on 5v or 3.3v.

4.1.6 Input and Output

- Serial: 0 (RX) pin to receive serial data.
- Serial: 1 (TX) pin to transmit serial data. •
- External Interrupts: Pin 2 and 3 are used to activate interrupt command.
- PWM: 8-bit PWM outputs are provided in ~3,~5,~6,~9,~10,~11 • LED: 13. The built-in-led shows whether Arduino is on or off.
- It has 6 analog input named A0,A1,A2,A3,A4,A5.
- Atmega328 has 28 pins in total.
- It has 3 Ports in total which are named as Port B, Port C and Port D.
- Port C is an analogue port and it has six pins, Port B and Port D are digital ports and have 7 pins each. So, in total ATmega328 has 14 digital pins.
- It also supports Serial Communications, we can perform serial communication via Pin # 2 (RX) and Pin # 3 (TX).
- It needs a crystal oscillator for generating the frequency. You can use crystal oscillator ranging from 4MHz to 40 MHz.
- UNO board uses 16MHz crystal oscillator.

4.2 IR Sensor:

An infrared Sensor is an electronic device that emits radiations in order to sense some aspects of the surrounding. An IR sensor can measure the heat of an object as well as detect the motion. Usually in the infrared spectrum, all the object radiate some form of thermal radiations. These type of radiations are invisible to our eyes that can be detected by an infrared sensor. The emitter is simply an IR LED and the detector is simply an IR photo diode which is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and these output voltage, change in proportion to the magnitude of the IR light received.

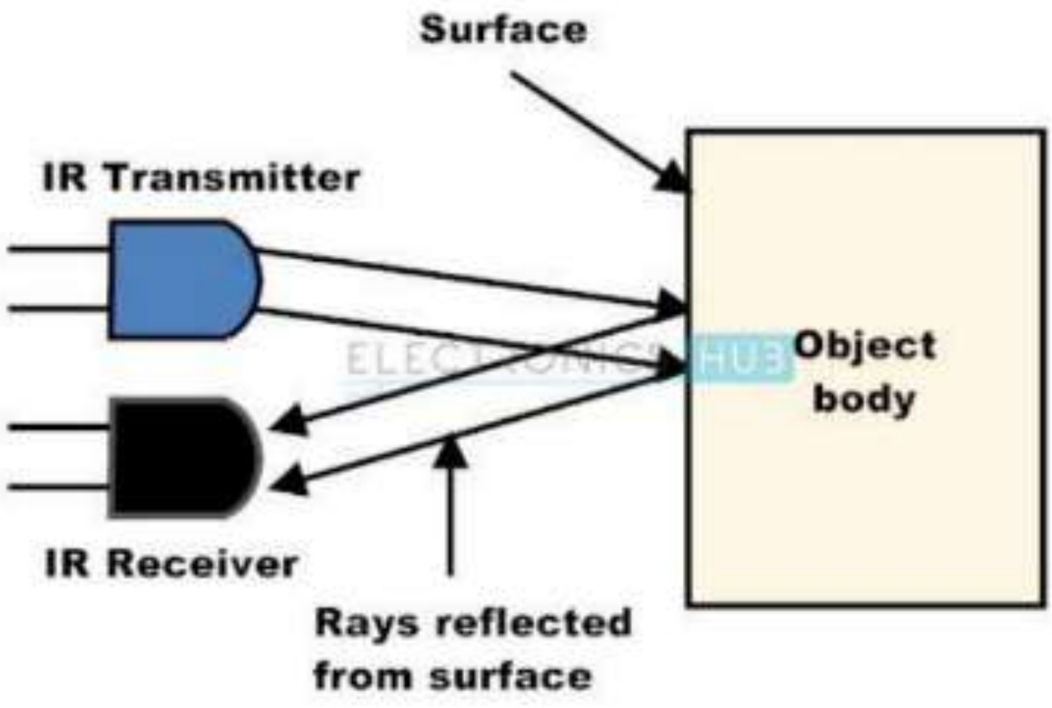


Fig 4: Working of IR sensor

Fig 5: IR sensor

Specifications for this item

Brand Name	Silicon TechnoLabs
Colour	Green
Height	4 centimeters
Item Weight	10.0 grams
Length	8 centimeters
Power Source Type	Dc
Voltage	5.00 volts
Width	8 centimeters

4.3 Led:

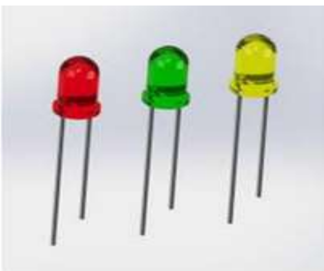


Fig 6: Led

A light-emitting diode (LED) is a Semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. This effect is called electroluminescence. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor. White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

4.4 Jumper wires:

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

Fig 7: Jumper wires

4.5 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 AC into 9V 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

Fig 8: battery

4.6 Voltage Regulator

A voltage regulator is used to regulate voltage level. lt generates fixed output voltage that remain constant for any changes in input voltage or load conditions.lt acts as abuffer for protection of electronic components from damage.lt uses a simple feed forward design and negative loops.

There are two types of Voltage regulators

1. Linear Voltage regualtors
2. Switching voltage regulators

Linear voltage regulators are easy to use and are compact and uses low power,low voltages. These are of two types Series and Shunt.Linear Regulator acts as voltage divider.ln ohmic region,it uses FET. The resistance of voltage regulator varies with load result in constant output voltage.We have use 1M7805 Voltage regulator.

CHAPTER- 5

IMPLEMENTATION

5.1 Code Snippet for Arduino UNO

5.1.1 Flow of Code

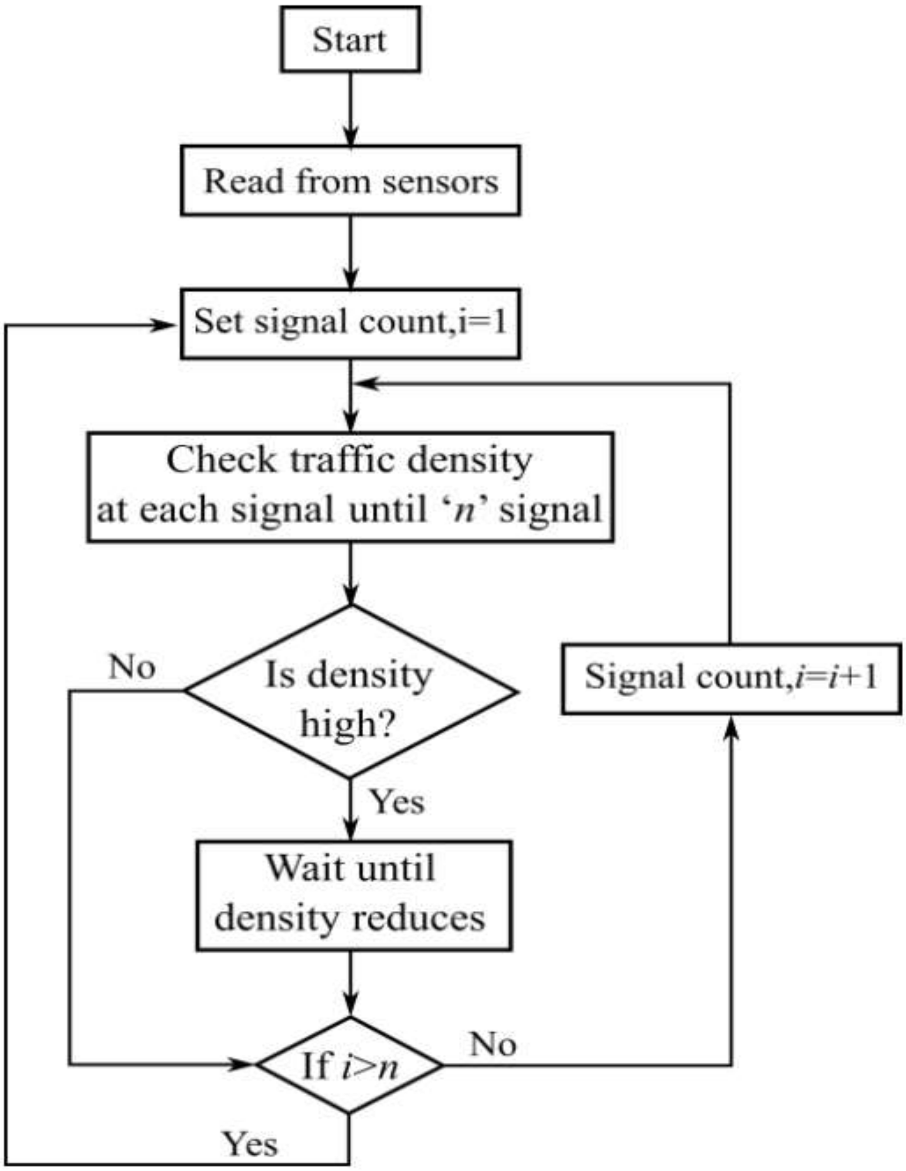


Fig9: Flow chart of density based traffic control

```
#define ledA1 2
#define ledA2 3
#define ledA3 4

#define ledB1 5
#define ledB2 6
#define ledB3 7

#define ledC1 8
#define ledC2 9
#define ledC3 10

#define ledD1 11
#define ledD2 12
#define ledD3 13

int a, b, c, d;

void setup() {

  Serial.begin(9600);

  pinMode(ledA1, OUTPUT);
  pinMode(ledA2, OUTPUT);
  pinMode(ledA3, OUTPUT);

  pinMode(ledB1, OUTPUT);
  pinMode(ledB2, OUTPUT);
```

```
  pinMode(ledB3, OUTPUT);

  pinMode(ledC1, OUTPUT);
  pinMode(ledC2, OUTPUT);
  pinMode(ledC3, OUTPUT);

  pinMode(ledD1, OUTPUT);
  pinMode(ledD2, OUTPUT);
  pinMode(ledD3, OUTPUT);
}

void loop() {

  readSensor();

  if (a == 1) {
    roadAopen();
  } else if (b == 1 && (a == 0)) {
    roadBopen();
    if ( a == 1) {
      roadAopen();
    }
  } else if (c == 1 && (b == 0 || a == 0)) {
    roadCopen();
    if (a == 1) {
      roadBopen();
    } else if (b == 1 && (a == 0)) {
      roadBopen();
    }
```

```
} else if (d == 1 && (b == 0 || a == 0 || c == 0)) {
  roadDopen();
  if (b == 1) {
    roadBopen();
  } else if (b == 1 && (a == 0 )) {
    roadBopen();
  }
}
////////////////////////////////////////////////////////////////////////////////////////////////////////////
else if ((a == 1) && (d == 1 || b == 1 || c == 1)) {
  roadAopen();
} else if ((b == 1) && (d == 1 || c == 1) && (a == 0)) {
  roadBopen();
} else if ((c == 1) && (d == 1) && (b == 0) && (a == 0)) {
  roadCopen();
} else if ((d == 1) && (a == 0) && (b == 0) && (c == 0)) {
  roadDopen();
}
////////////////////////////////////////////////////////////////////////////////////////////////////////////
else if ((a == 1) && (d == 0) && (b == 0) && (c == 0)) {
  roadAopen();
} else if ((b == 1) && (d == 0) && (a == 0 ) && (c == 0)) {
  roadBopen();
} else if((c == 1) && (d == 0) && (a == 0 ) && (b == 0)) {
  roadCopen();
}
else if ((d == 1) && (a == 0) && (b == 0) && (c == 0)) {
  roadDopen();
}
```

```
 ////////////////////////////////////////////////////////////////////////////////////////////////////////
 else if (c == 0 && a == 0 && d == 0 && b == 0) {
   roadAopen();
   if (c == 0 && a == 0 && d == 0 && b == 0) {
     roadBopen();
   }
   if (a == 0 && b == 0 && c == 0 && d == 0) {
     roadCopen();
   }
   if (a == 0 && b == 0 && c == 0 && d == 0) {
     roadDopen();
   }
 }
}

void readSensor() {
 a = analogRead(A0);
 b = analogRead(A1);
 c = analogRead(A2);
 d = analogRead(A3);

  if (a < 400) Serial.print("\n Road 1 = High density\n");
 else Serial.print("\n Road 1 = normal density \n");
 if (a < 400) a =1;
 else a =0;
  if (b < 400) Serial.print("Road 2 = High density\n");
 else Serial.print("Road 2 = normal density \n");
 if (b < 400) b = 1;
```

```
  else b = 0;
   if (c < 400) Serial.print("Road 3 = High density\n");
  else Serial.print("Road 3 = normal density \n");
  if (c < 400) c = 1;
  else c = 0;
   if (d < 400) Serial.print("Road 4 = High density\n");
  else Serial.print("Road 4 = normal density \n");
  if (d < 400) d = 1;
  else d = 0;

  Serial.print(a);
  Serial.print("\t");
  Serial.print(b);
  Serial.print("\t");
  Serial.print(c);
  Serial.print("\t");
  Serial.print(d);
  Serial.print("\t");
}

void roadAopen() {
  digitalWrite(ledA3, LOW);

  digitalWrite(ledA1, HIGH);
  digitalWrite(ledB3, HIGH);
  digitalWrite(ledC3, HIGH);
  digitalWrite(ledD3, HIGH);
  delay(10000);
  digitalWrite(ledA1, LOW);
```

```
  digitalWrite(ledA2, HIGH);
  delay(1000);
  digitalWrite(ledA2, LOW);
  readSensor();
}

void roadBopen() {
  digitalWrite(ledB3, LOW);

  digitalWrite(ledA3, HIGH);
  digitalWrite(ledB1, HIGH);
  digitalWrite(ledC3, HIGH);
  digitalWrite(ledD3, HIGH);
  delay(10000);
  digitalWrite(ledB1, LOW);
  digitalWrite(ledB2, HIGH);
  delay(1000);
  digitalWrite(ledB2, LOW);
  readSensor();
}

void roadCopen() {
  digitalWrite(ledC3, LOW);

  digitalWrite(ledA3, HIGH);
  digitalWrite(ledB3, HIGH);
  digitalWrite(ledC1, HIGH);
  digitalWrite(ledD3, HIGH);
  delay(10000);
```

```
  digitalWrite(ledC1, LOW);
  digitalWrite(ledC2, HIGH);
  delay(1000);
  digitalWrite(ledC2, LOW);
  readSensor();
}

void roadDopen() {
  digitalWrite(ledD3, LOW);

  digitalWrite(ledA3, HIGH);
  digitalWrite(ledB3, HIGH);
  digitalWrite(ledC3, HIGH);
  digitalWrite(ledD1, HIGH);
  delay(10000);
  digitalWrite(ledD1, LOW);
  digitalWrite(ledD2, HIGH);
  delay(1000);
  digitalWrite(ledD2, LOW);
  readSensor();
}
```

5.1.1 Serial Monitor Snippets

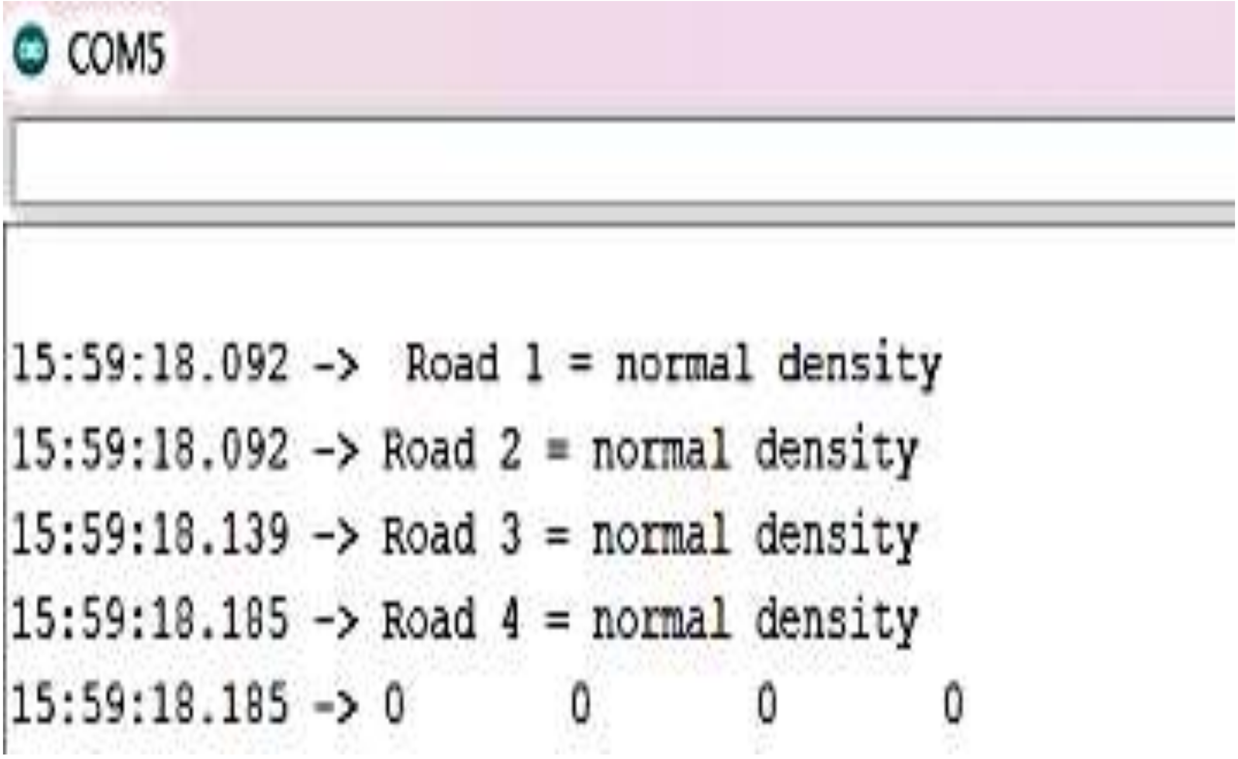


Fig 10: All Roads with normal density

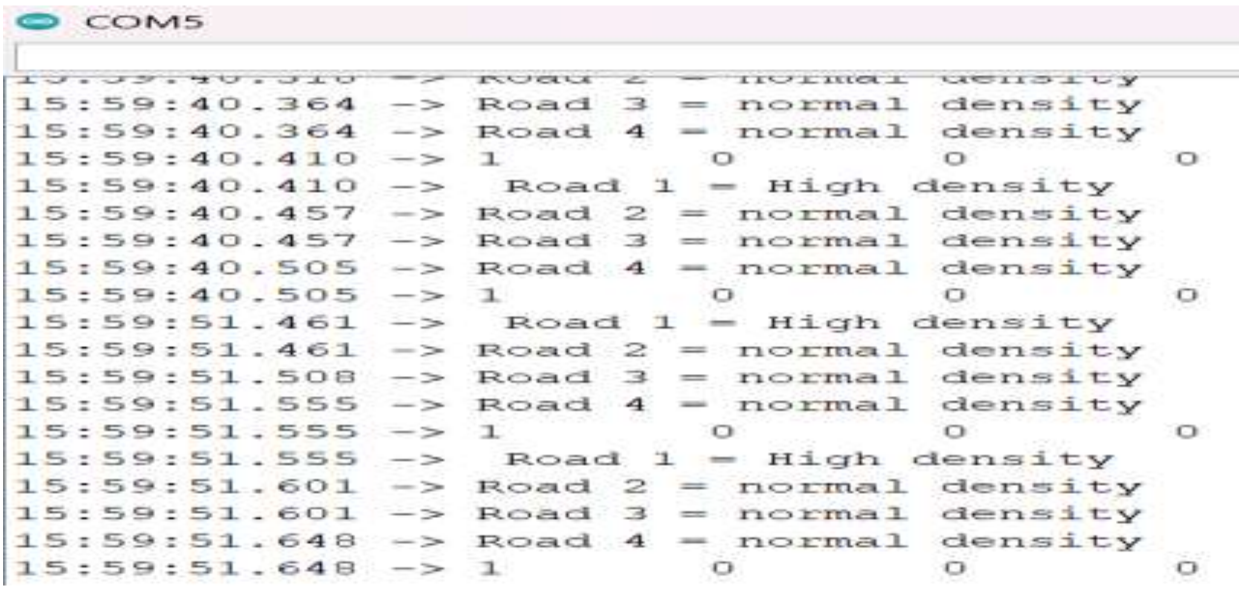
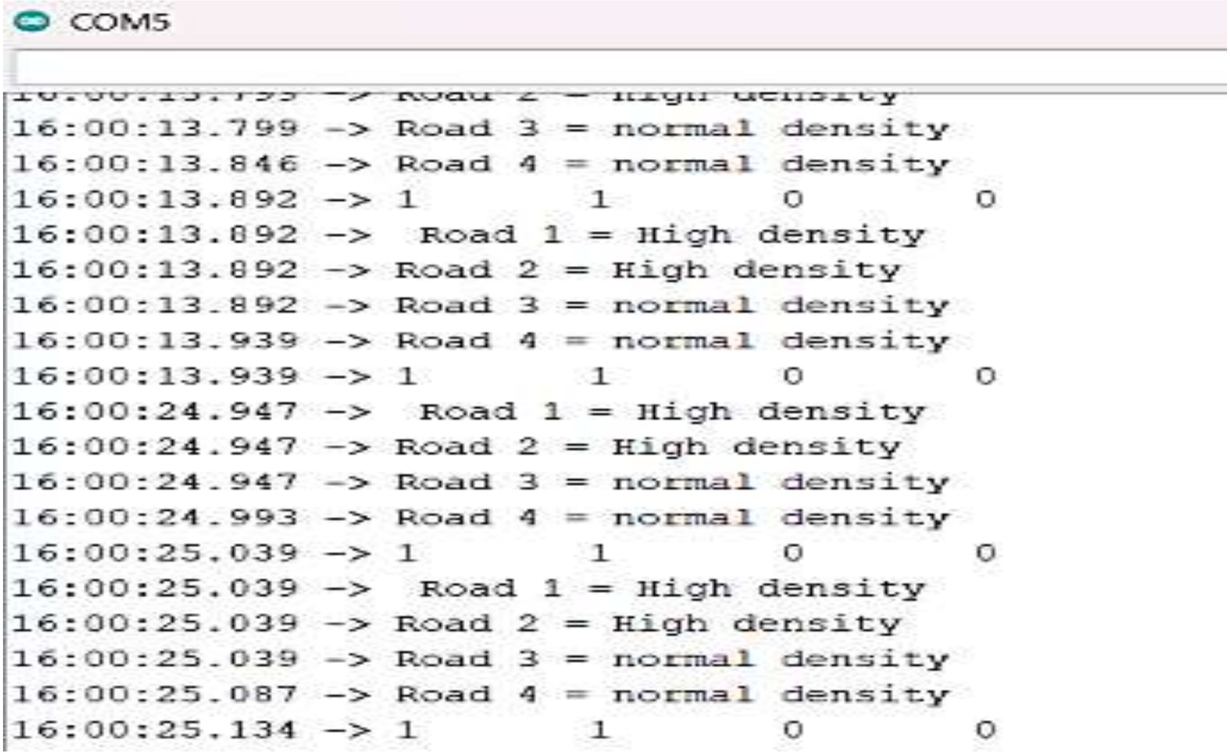
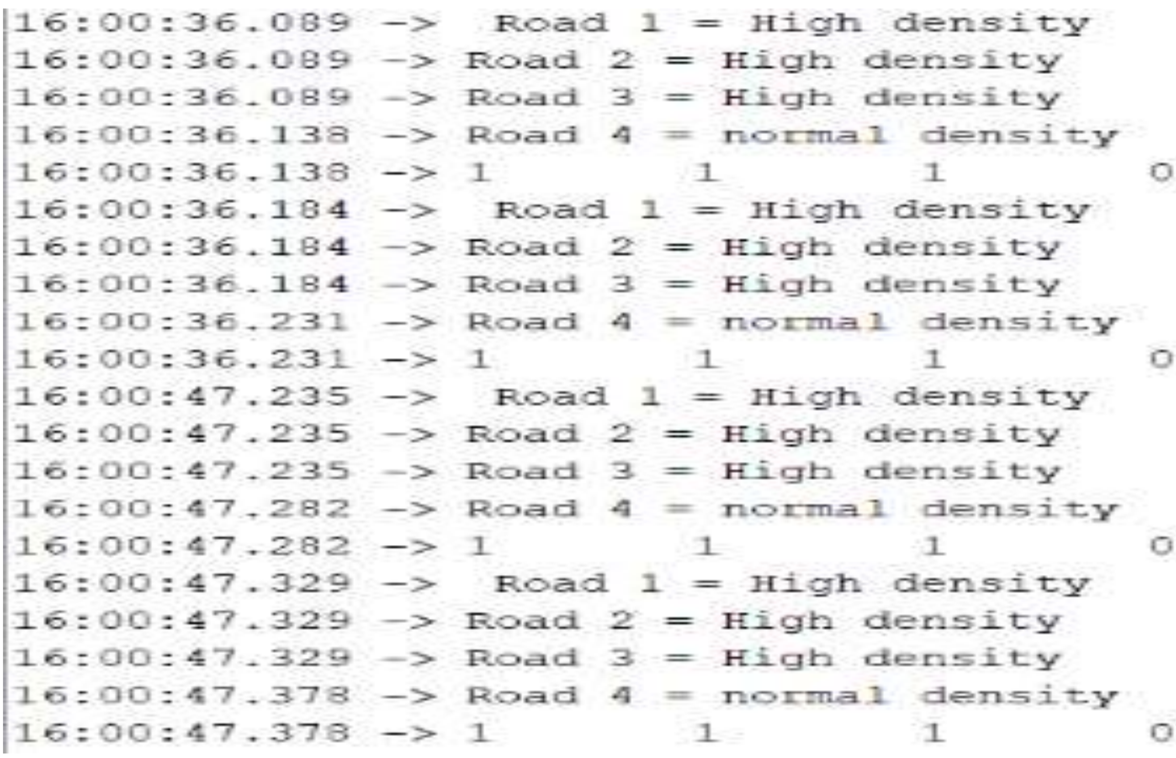


Fig 11: One Road with High Density



```
COM5
16:00:13.799 -> Road 3 = normal density
16:00:13.846 -> Road 4 = normal density
16:00:13.892 -> 1        1        0        0
16:00:13.892 ->  Road 1 = High density
16:00:13.892 -> Road 2 = High density
16:00:13.892 -> Road 3 = normal density
16:00:13.939 -> Road 4 = normal density
16:00:13.939 -> 1        1        0        0
16:00:24.947 ->  Road 1 = High density
16:00:24.947 -> Road 2 = High density
16:00:24.947 -> Road 3 = normal density
16:00:24.993 -> Road 4 = normal density
16:00:25.039 -> 1        1        0        0
16:00:25.039 ->  Road 1 = High density
16:00:25.039 -> Road 2 = High density
16:00:25.039 -> Road 3 = normal density
16:00:25.087 -> Road 4 = normal density
16:00:25.134 -> 1        1        0        0
```

Fig12: Two Roads with High Density



```
16:00:36.089 ->  Road 1 = High density
16:00:36.089 -> Road 2 = High density
16:00:36.089 -> Road 3 = High density
16:00:36.138 -> Road 4 = normal density
16:00:36.138 -> 1        1        1        0
16:00:36.184 ->  Road 1 = High density
16:00:36.184 -> Road 2 = High density
16:00:36.184 -> Road 3 = High density
16:00:36.231 -> Road 4 = normal density
16:00:36.231 -> 1        1        1        0
16:00:47.235 ->  Road 1 = High density
16:00:47.235 -> Road 2 = High density
16:00:47.235 -> Road 3 = High density
16:00:47.282 -> Road 4 = normal density
16:00:47.282 -> 1        1        1        0
16:00:47.329 ->  Road 1 = High density
16:00:47.329 -> Road 2 = High density
16:00:47.329 -> Road 3 = High density
16:00:47.378 -> Road 4 = normal density
16:00:47.378 -> 1        1        1        0
```

Fig13: Three Roads with High Density

```
16:00:58.379 ->  Road 1 = High density
16:00:58.379 -> Road 2 = High density
16:00:58.379 -> Road 3 = High density
16:00:58.426 -> Road 4 = High density
16:00:58.426 -> 1       1       1       1
16:00:58.473 ->  Road 1 = High density
16:00:58.473 -> Road 2 = High density
16:00:58.473 -> Road 3 = High density
16:00:58.519 -> Road 4 = High density
16:00:58.519 -> 1       1       1       1
```

Fig 14: All Roads with High Density

Chapter-6

ADVANTAGES AND DISADVANTAGES

6.1 Advantages :-

- Avoid wastage of time due to the traffic.
- Fully automatic.
- It provides the easy access in the traffic light.
- Low cost to design the circuit, maintenance of the circuit is good and easy convenience to handle.

Disadvantage:-

- 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.
- If sensing is done via image processing, the output would be more accurate but it becomes more complex .
- IR sensor may give inaccurate output, if dust particles are logged near to the transmitter receiver signal

6.2 Future scope:-

- IR receiver module extended with automatic turn off when no vehicles are running on any side of the road which helps in power consumption saving.
- The system can be replaced by image processing system which will give efficient results .

Chapter- 7

CONCLUSION

This project report gives the detail study of the "DENSITY BASED TRAFFIC CONTROL SYSTEM". The construction, working principle, implementation of the project is given throughout this report. Circuit meets expectations appropriately to switch traffic signals depending on the density of the vehicle. IR sensor senses the number of vehicle at the time of high traffic. The IR sensor senses the motion of the vehicle. The traffic lights have been effectively controlled by Arduino UNO. With orders from the controller, the traffic light of the specific road change from red-to-yellow, yellow-to-green and then again green-to-red.

Our project is a prototype of the original circuit and the IR Sensor can be used sense the vehicle. An IR sensor of high magnitude/range can be used to sense the vehicle at the distance.

The results of our project work supports our hypothesis that the Density Based Traffic Control System would save the time of the people when there is high traffic. The final conclusion drawn from our project work is that the circuit is very efficient and it can be used in four way traffic system in India.

APPENDIX

a) Cost Analysis of the project

Sl. No.	Name of the components	Quantity	Cost(Rs)
1	Arduino UNO	1	450
2	IR Sensor	4	145*4=580
3	LED	12	3*12=36
4	Battery connector	1	10
5	9v DC battery	1	50
6	Plywood	1	150
7	Jumper wires (Packets)	1	200
8	Connecting wires (8 Mtr)	1	80
9	Voltage regulator	1	20
10	Others		200
	TOTAL		**1776/-**

b) Software Use

- **Arduino IDE:**
- Latest stable version available at the time of development (e.g., Arduino IDE 1.8.13).

  Description: The Arduino IDE is essential for writing, compiling, and uploading code to the Arduino Uno microcontroller. This software allows developers to program the Arduino board using the C and C++ programming languages. It provides an intuitive interface for coding and uploading sketches (programs) to the Arduino Uno, facilitating the implementation of the traffic control algorithm and integration with IR sensors.

- **Microsoft Word or LaTeX:**

  Version: Latest version compatible with your operating system (e.g., Microsoft Word 2022) or a LaTeX distribution such as TeX Live or MiKTeX.

  Description: Microsoft Word or LaTeX is used for composing the project report, documenting the project's objectives, methodologies, results, analysis, and conclusions. Microsoft Word offers a user-friendly interface with extensive formatting options, making it suitable for users who prefer a graphical word processing environment. LaTeX, on the other hand, is a typesetting system used for producing high-quality documents with precise formatting. It's particularly popular in academic and technical fields for its support of mathematical equations, complex diagrams, and citations.

- **Graphics Software (Optional):**

  Examples: Adobe Photoshop, Adobe Illustrator, GIMP (GNU Image Manipulation Program), Inkscape.

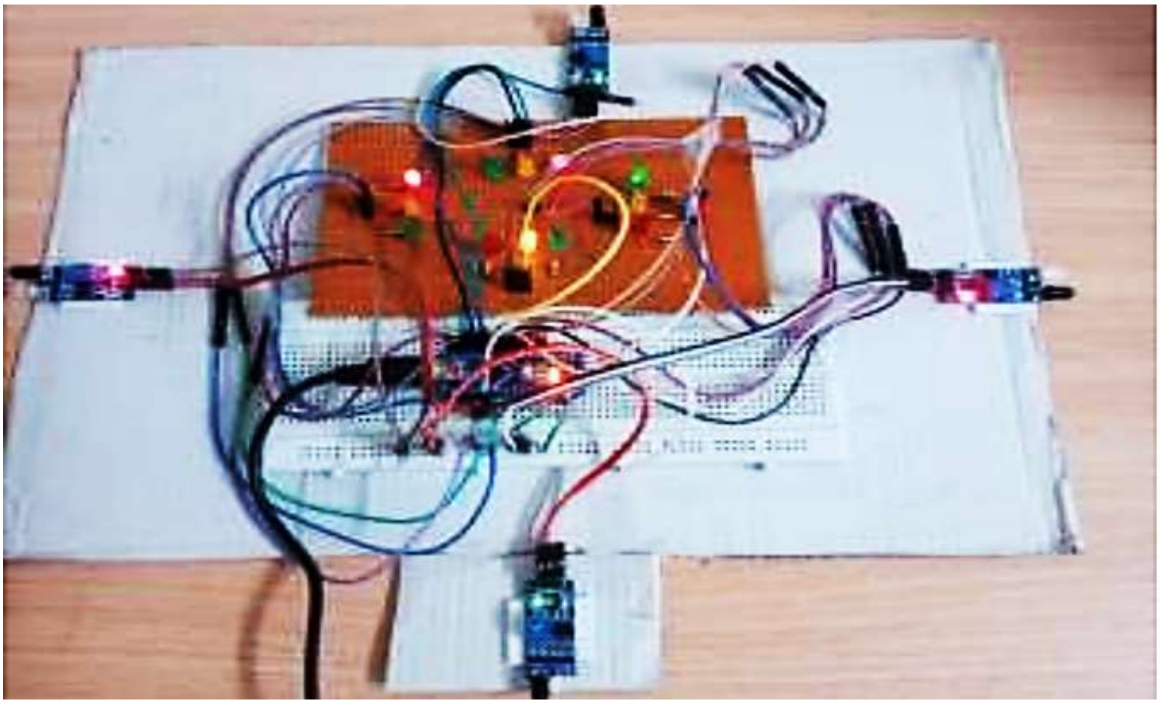
  Description: Graphics software may be utilized for creating diagrams, schematics, and visual representations of the traffic control system's architecture and components. These tools offer advanced features for designing and editing images, enabling the creation of professional-looking illustrations to enhance the clarity and visual appeal of the project report.

- **Simulation Software (Optional):**

  Example: Proteus, Tinkercad.

  Description: Simulation software allows developers to simulate the behavior of electronic circuits and microcontroller-based systems before deploying them in real hardware. This can be particularly useful for testing the functionality of the traffic control algorithm and sensor integration in a virtual environment, identifying and resolving potential issues or optimizations before physical implementation.

c) Photograph of the Project




VTU
ROAD-3
ROAD-2


VTU

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Journal papers:-

[1]. Yaser S.A.S. et al, “Arduino Mega Based Smart Traffic Control System,” Asian Journal of Advanced Research and Reports, 15(12), 43-52, 2021.

[2]. Jean-Paul Rodrigue, The Geography of Transport Systems, Routledge, 2020.

[3]. Olomo. R, Osemwegie. O, “Arduino Based Traffic Light System With Integrated LED Advertising Display”, Journal of Physics: Conference Series, Issue. 4, Vol. 1378, 2019.

Books:-

- Embedded System Design: A Unified Hardware / Software Introduction by Frank Vahid
- PIC Microcontroller and Embedded Systems: Using assembly and C for PIC 18 by Muhammad Ali Mazidi
- Principal of electronics

Websites:-

https://www.arduino.cc/

https://en.wikipedia.org/wiki/Arduino

https://www.electronicshub.org/ir-sensor/

http://www.circuitstoday.com/regulated-power-supply

https://en.wikipedia.org/wiki/Jump_wir