Project Report on

Smart Traffic System

Submission to The Robotics Club – SNIST as a part of Post Induction'23

Team No – 1

THE ROBOTICS CLUB

Integrating Knowledge...

THE ROBOTICS CLUB – SNIST

SREENIDHI INSTITUTE OF SCIENCE AND TECHNOLOGY

(AUTONOMOUS)

(Affiliated to JNTU University, Hyderabad)

Yamnampet, Ghatkesar, Hyderabad – 501301

2023

CERTIFICATE

This is the project work titled ‘Smart traffic system’ by ‘P. Phani Anirudh, Veluri Chandra sekhara Pradeep, S. Sathvik, B. Sai Anjanna Reddy, D. Bhavana’. This is a record of the project work carried out by them during the year 2023-24 as a part of POST INDUCTION under the guidance and supervision of

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DECLARATION

The project work reported in the present thesis titled "**Smart traffic system**" is a record of work done by Team-1 in **THE ROBOTICS CLUB** as a part of **POST INDUCTION – 2023.**

No part of the thesis is copied from books/journals/Internet and wherever the portion is taken, the same has been duly referred in the text. The report is based on the project work done entirely by Team-1 and not copied from any other source.

ACKNOWLEDGEMENT

This project report is the outcome of the efforts of many people who have driven our passion to explore into the implementation of **Smart traffic system**. We have received great guidance, encouragement and support from them and have learned a lot because of their willingness to share their knowledge and experience.

We thank our technical heads **Mr. G. Kovidh Addhish and Mr. Aarushraj Puduchery** for being with us till the end of the project completion.

We thank all members of the **Steering Body, Executive Body, Technical Advisory Board and Club's Incubation and Competence Committee** of **The Robotics Club** for helping us with crucial parts of the project. We are deeply indebted to **Mr. N V V S Narayana** – The President, **Ms. Mugala Shravani** – The Vice President, **Mr. N Abinav** – General Secretary and **Ms. Maliha** – SAB Chairman **THE ROBOTICS CLUB** respectively and also every other person who spared their valuable time without any hesitation whenever we wanted.

We also thank our faculty advisor **Dr. A. Purushotham**, Professor Mechanical Department, who encouraged us during this project by rendering his help when needed.

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ABSTRACT

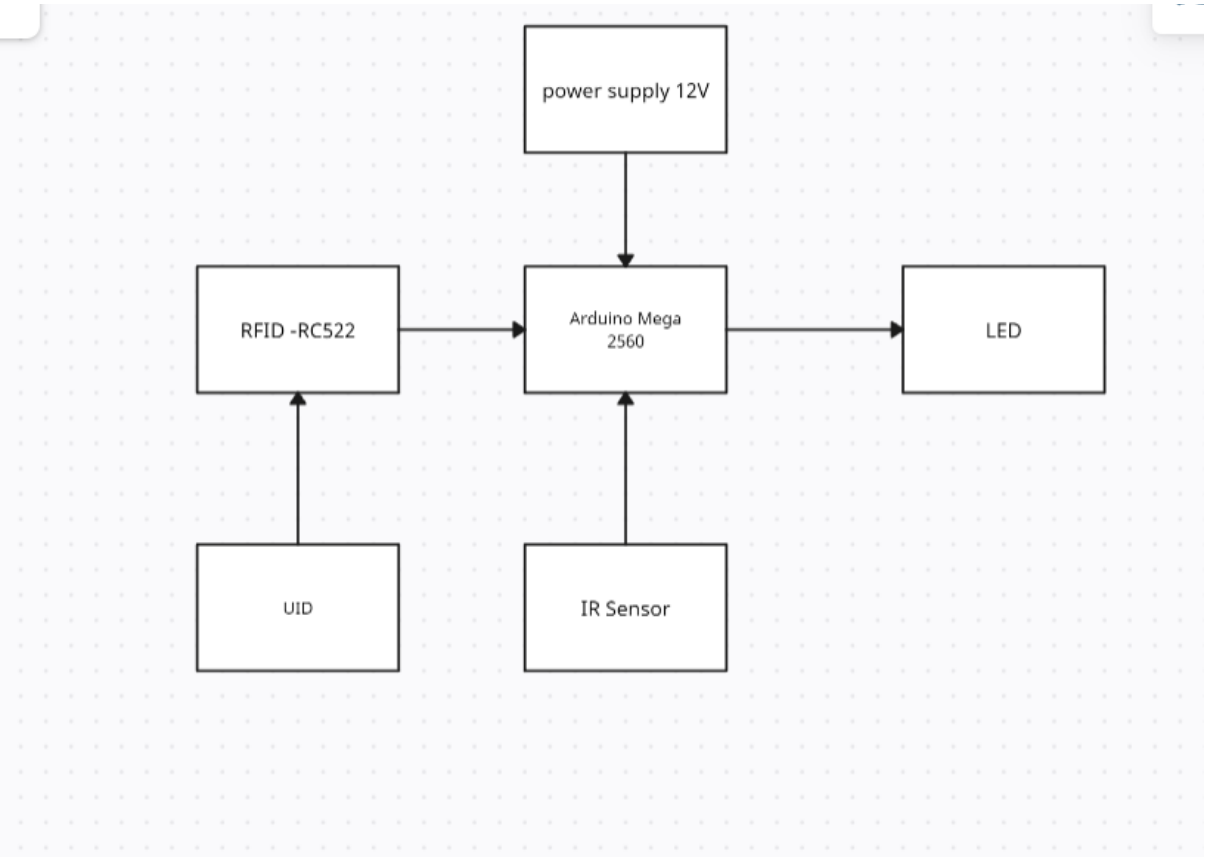
PROBLEM STATEMENT:

In cities one of the most prevalent issues encountered by individuals is the insufferable traffic congestion. Traffic congestion occurs when there is an imbalance, between the number of vehicles on the road and the capacity of the transportation system, including both infrastructure and management. This can result in delays and inefficiencies, for commuters. This situation can have an impact, on businesses, which in turn has an effect, on the economy. Students and Employees are also affected by the traffic jam and the effect of it on their lives play a major role on their productivity at work or school. Additional pollution, increased fuel consumption and delayed delivery of goods are some of the consequences of traffic congestion. In situations involving emergencies the waiting time caused by traffic jams can be particularly costly. There have been instances where ambulances have had to wait for the traffic to clear before reaching their destination.

TEAM'S APPROACH TO THE PROBLEM:

This paper proposes Smart Traffic System. Keeping the traffic in the scenario our team has brought this system that helps us to control the traffic efficiently which reduces in heavy traffic jams. There are IR sensors installed in each lane, which receive the count of number of vehicles in a particular lane. This ensures a flow of traffic. In case an emergency vehicle, such as an ambulance is approaching it is equipped with an RFID transmitter. The UIDs of these emergency vehicles must already be registered with the traffic control system. If there is a match, between the UID transmitted by the emergency vehicle and those registered in our system that specific lane will be given priority by turning its signal to green while others are set to red for an interval of time.

BLOCK DIAGRAM:



Smart Traffic System

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***Abstract*—In cities, one of the most prevalent issues encountered by individuals is insufferable traffic congestion. Traffic congestion occurs when there is an imbalance between the number of vehicles on the road and the capacity of the transportation system, including both infrastructure and management. This can result in delays and inefficiencies for commuters. This situation can have an impact on businesses, which in turn has an effect on the economy. Students and employees are also affected by the traffic jam and the effect of it on their lives plays a major role in their productivity at work or school. Additional pollution, increased fuel consumption and delayed delivery of goods are some of the consequences of traffic congestion. In situations involving emergency, the waiting time caused by traffic jams can be particularly costly. There have been instances where ambulances have had to wait for traffic to clear before reaching their destination.**

***Index Terms*—traffic congestion, smart city, RFID, Traffic management**

I. Introduction

One of the most prevalent problems faced by individuals in cities is the insufferable traffic congestion. When there is an imbalance between the number of vehicles on the road and the capacity of the transportation system, including both infrastructure and management, traffic congestion occurs. This can result in delays and inefficiencies for commuters. This situation can have an impact on businesses, which in turn has an effect on the economy. Students and Employees are also affected by the traffic jam and the effect of it on their lives plays a major role in their productivity at work or school. Additional pollution, increased fuel consumption and delayed delivery of goods are some of the consequences of traffic congestion. In situations involving emergency, the waiting time caused by traffic jams can be particularly costly. There have been instances where ambulances have had to wait for traffic to clear before reaching their destination.This paper proposes Smart Traffic System. Keeping the traffic in the scenario our team has brought this system that helps us to control the traffic efficiently which reduces in heavy traffic jams. There are IR sensors installed in each lane, which receive the count of number of vehicles in a particular lane. This ensures a flow of traffic. In case an emergency vehicle, such as an ambulance is approaching it is equipped with an RFID transmitter. The UIDs of these emergency vehicles must already be registered with the traffic control system. If there is a match, between the UID transmitted by the emergency vehicle and those registered in our system that specific lane will be given priority by turning its signal to green while others are set to red for an interval of time.

II. Literature Survey

There is a need for an upgrade to the conventional traffic system to alleviate severe traffic congestion, reduce transportation problems, reduce traffic volume, minimize overall travel time, optimize vehicle safety and efficiency, and expand health, economic, and environmental benefits. Several sectors exist. We propose a simple, low-cost, and real-time smart traffic light control system that aims to improve traffic management and overcome many defects. Using a microcontroller, the system controls various operations, monitors traffic density and volume, as well as controls the various operations The lighting transition slots are changed based on infrared sensors (lR) accordingly.

III. System Architecture

A. Existing System

An advanced traffic management system (TMS) is a context-aware solution that relies on real-time data from connected road infrastructure and predictive analytics to effectively coordinate traffic across city arteries.Such traffic management software, coupled with wireless urban connectivity, acts as a backbone for the implementation of an intelligent transportation management system.ITS traffic systems focus specifically on improving the throughput and safety of urban roads through adaptive controls and analytics.As a concept, intelligent traffic systems were designed to provide traffic managers with real-time and predictive insights about traffic flow speeds and traffic congestion/incidents. In practice, however, the success of such projects strongly depends on a city's ability to place a virtual management layer on top of physical traffic infrastructure.

B. Proposed System

A proposed system for smart traffic system aims to utilize sensors and algorithms to detect in which lane the traffic is more (or) an an ambulance is coming. The system would employ various sensors, such as IR sensors, RFID monitor the density i.e no.of vehicles and identify in which lane an

ambulance is coming. By analyzing the sensor data in real-time, the system can accurately detect the traffic / ambulance and trigger the traffic led and gives the green signal to the lane which has more density / in which lane the is coming. This way the traffic gets with in the time range and ambulance get to hospital fast and safe.

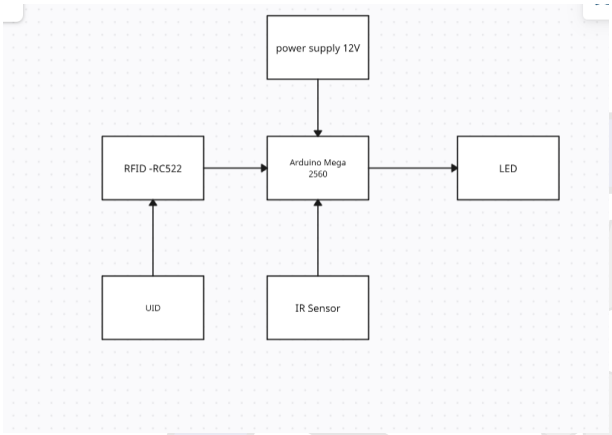

Fig. 1. Workflow

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IV. Architecture

A. Hardware

1) Arduino Mega 2560: The Arduino Mega 2560 is a microcontroller board based on the ATmega2560. It has 54 digital

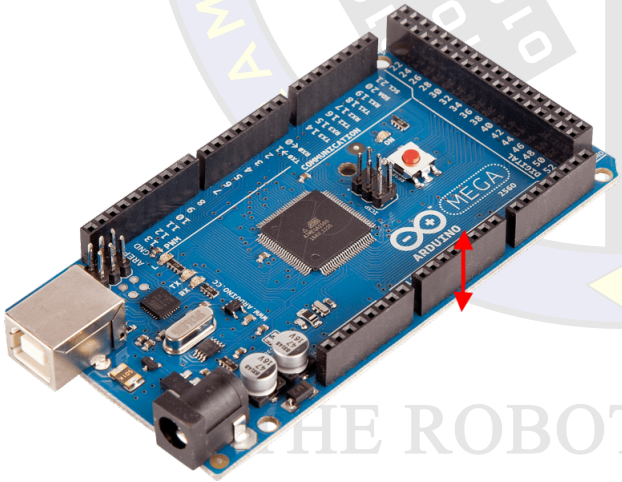

Fig. 2. Arduino Mega 2560

input/output pins, 16 analog inputs, 4 UARTs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. This board comes with resettable polyfuse that prevents the USB port of your computer from overheating in the presence of high current flowing through the board. The Arduino Mega 2560 board has communication facilities that allow it to be used with a computer, another Arduino board, and other microcontrollers. In robotics, its high processing capacity can handle extensive robotic applications. Its compatibility with the motor controller shield prompts the simultaneous control of multiple motors.

2) Infrared sensor: IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode. The wavelength ranges from 0.75 to 3m in the near-infrared region, 3 to 6m in the mid-infrared region, and more than 6m in the far IR region.

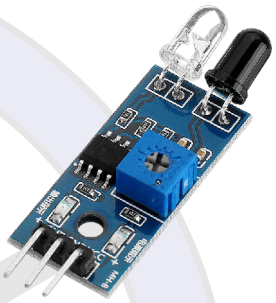

Fig. 3. Infrared sensor

IR sensor have a wide range of applications, from industrial automation processes to home security solutions; they can be used in both short-range sensing as well as long-distance operations.

3) RFID: Radio Frequency Identification (RFID) refers to a wireless system comprised of two components: tags and readers. The reader is a device that has one or more antennas that emit radio waves and receive signals back from the RFID tag. Tags, which use radio waves to communicate their identity and other information to nearby readers, can be passive or active. Their main applications are pet and livestock tracking, inventory control, access control in security situations, tap-and-go credit card payments, customer service and loss control.

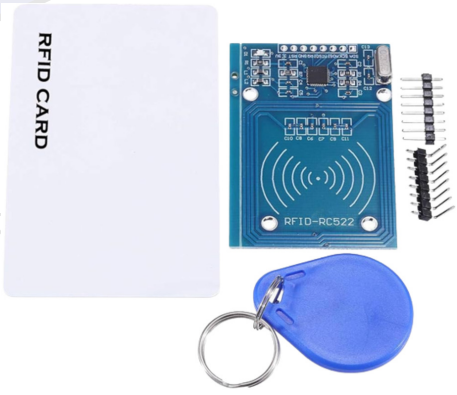

Fig. 4. RFID

4) Traffic LED: The visible light from an LED (light emitting diode) traffic light can be modulated and encoded

with information. Hence, it can be used for the broadcasting of audio messages or any traffic or road information. This LED has four pins namely Ground, pin for Red bulb, pin for Yellow bulb, pin for green bulb.

Fig. 5. Traffic LED

5) Rainbow wires: Rainbow Wire is extremely useful when you need to make a lot of connections without having to mess with wires or extend controls from one end to another for robots and other prototyping applications. Clean wiring harnesses make any project look more finished.

Fig. 6. Rainbow Wires

6) Vector board: Electrical circuit prototypes are made using vector boards, which can be soldered. In all boards, there is a provision for I/O connections.

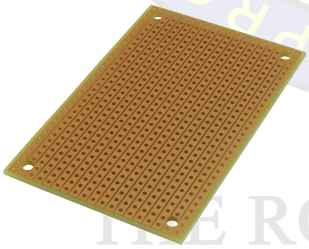

Fig. 7. Vector Board

Soldering components together can form the electrical connections for multiple circuits on this board.

B. Software

1) Arduino IDE: Open-source application software, Arduino Integrated Development Environment, was developed by Arduino.

Programming the Arduino is made possible by using a standard API known as the Arduino Programming Language,

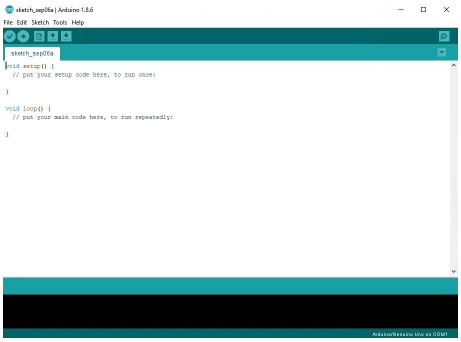

Fig. 8. Arduino IDE

which is used to program the microcontrollers in C/C++. Digital and analog input/output (I/O) pins are provided so that the boards may be connected to expansion boards.

2) Fusion 360: Fusion 360 has built-in capabilities to do 3D modelling, sheet metal, simulation and documentation. It can manage manufacturing processes such as machining,

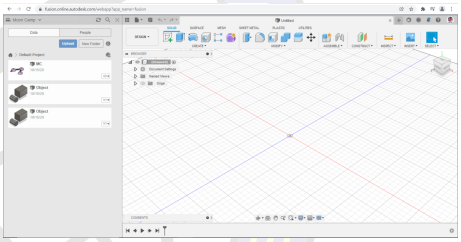

Fig. 9. Fusion 360

milling, turning and additive manufacturing. It also has electronic design automation (EDA) features, such as schema design, PCB design and component management. You can use it also for rendering, animation, generative design and a number of advanced simulation tasks (FEA).

3) Proteus Design Suite: The Proteus Plan Suite could be a restrictive computer program instrument suite utilized basically for electronic plan computerization. The program is utilized mainly by electronic plan engineers and professionals to make schematics and electronic prints for fabricating printed circuit sheets.

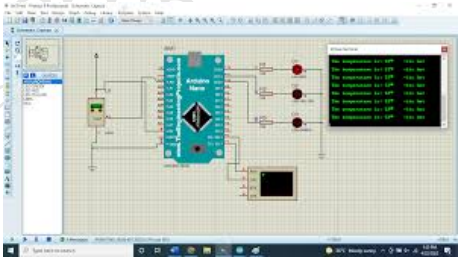

Fig. 10. Proteus

Proteus comes with a lot of features for designing your circuit board. These features make circuit board design much

easier for PCB designers. Also, the design tools offered by Proteus make it an ideal choice for board design.

V. Working Mechanism

The working mechanism of the product is mostly controlled by the micro controller Arduino Mega.

It begins after the IR sensors in each lane of the the 4 lane junction detects the density of the lane i.e no. of vehicles in the lane and send the results to the micro controller Arduino Mega.

The Arduino send the command to that traffic led and gives the green signal to the lane which has more density till certain period of time. This process repeats with rest 3 lanes as shown in Fig. 1.

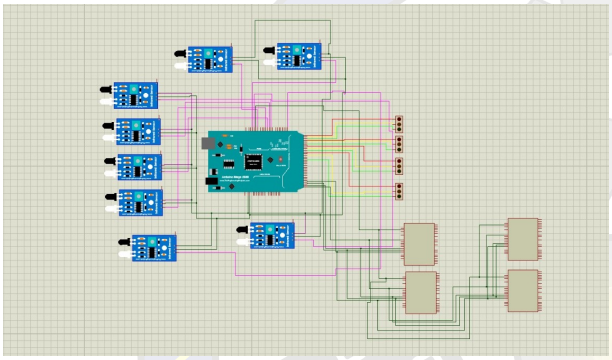

Fig. 11. Circuit diagram

Next RFID is used to sense ambulance. An UID tag is attached to the ambulance will get scanned with RFID which are placed to the roadside. the results will be directly sent to the the Arduino.

Arduino receives the signals and commands the traffic lead to clear the way for the ambulance which is i.e if the traffic led is showing green to other lane and the the ambulance is in the different lane the with in the time gap it should manage the and give green signal to the lane where the ambulance is passing so that the ambulance can reach its destination fast and safe.After this it again continues the first process.

All the connections 0f components of the product are shown in Fig.

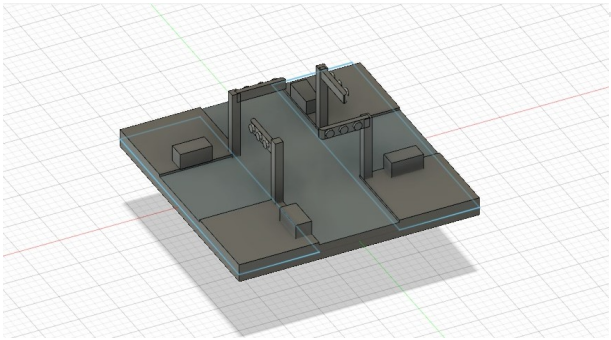

Fig. 12. CAD Design of Prototype

VI. Algorithm

A. ALGORITHM FOR PRODUCT FUNCTIONING

- To clear the traffic in a 4 lane junction .
- IR Sensor detects the density of 4 lanes .
- The lane which have more density gets detected and the result is sent to the Arduino Mega 2560.
- Arduino Mega gives commands to traffic led according to respective results.
- Result say the 4th lane has more density then the Arduino Mega instructs traffic led to give green signal to that lane for certain time period.
- RFID detects the ambulance which has UID on it.
- RFID send the the result to Arduino Mega.
- Arduino Mega gives commands to the traffic led to the green signal in which the lane where the ambulance is coming.

VII. Future Enhancements

The module module build by our team is an elementary prototype. It can be improved upon for higher degree of implementing esp 32 camera module for image processing, ultra sonic HC-SR04 and nrf 24l01 for higher range of scanning. Based on its functionality, the robot can be altered to detect and send the signal to give the way to ambulance. In case of special cases with help of image processing the traffic can controlled smoother. Enhance data analytic capabilities to provide comprehensive insights into traffic patterns, congestion hot spots, and potential improvements. The development of advanced visualization tools that will assist city planners and traffic management authorities in making informed decisions and implementing effective traffic management and infrastructure development strategies

VIII. Conclusion

The proposed technique is designed to be implemented and targeted directly for effective management of traffic so that emergency vehicles moving on the road can move smoothly without getting stuck in traffic jams until they reach their destination without requiring much human input. Further, the proposed system is efficient at identifying and detecting stolen cars, as well as controlling traffic congestion. Life is precious, so safety measures must be taken with great care in all aspects. In fact, ambulance services are included in this category as well. The intelligent ambulance system will permit flow control by implementing alternative methods for signal change to allow uninterrupted service of the control system. In terms of accuracy, RFID is quite comparable to a camera. Thus, the proposed paper also improves the performance of a traffic signal violation detection system. Traffic policeman's manual effort is reduced when automatic traffic light control supports the traffic density on the route.

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IX. SOURCE CODE

```
#include <Infrared.h>
#include <MFRC522.h>

int Gr_SignalTime = 10000;
int rfid_SignalTime = 10000;

char* rfid_id[]={"270021BEBE06","270021BCFE44"};
//Replace your RFID tags here

int trafficSignal1PinRed = 22;
int trafficSignal1PinOrg = 23;
int trafficSignal1PinGr = 24;
int trafficSignal2PinRed = 25;
int trafficSignal2PinOrg = 26;
int trafficSignal2PinGr = 27;
int trafficSignal3PinRed = 28;
int trafficSignal3PinOrg = 30;
int trafficSignal3PinGr = 31;
int trafficSignal4PinRed = 33;
int trafficSignal4PinOrg = 34;
int trafficSignal4PinGre = 37;

int lane1aIRSensorPin = 1;
// IR sensor pin for lane 1
int lane1bIRSensorPin = 2;
int lane2aIRSensorPin = 3;
// IR sensor pin for lane 2
int lane2bIRSensorPin = 4;
int lane3aIRSensorPin = 11;
// IR sensor pin for lane 3
int lane3bIRSensorPin = 8;
int lane4aIRSensorPin = 21;
// IR sensor pin for lane 4
int lane4bIRSensorPin = 10;

int RFIDResetPinL1 = 9;
// Reset pin for RFID RC522 module
int RFIDSSELPinL1 = ;
// Slave Select (SS) pin for RFID RC522 module
int RFIDResetPinL2 = ;
// Reset pin for RFID RC522 module
int RFIDSSELPinL2 = ;
// Slave Select (SS) pin for RFID RC522 module
int RFIDResetPinL3 = ;
// Reset pin for RFID RC522 module
int RFIDSSELPinL3 = ;
// Slave Select (SS) pin for RFID RC522 module
int RFIDResetPinL4 = ;
// Reset pin for RFID RC522 module
int RFIDSSELPinL4 = ;
// Slave Select (SS) pin for RFID RC522 module

void setup()
{
  Serial.Begin(9600);
  mfrc522.PCD_Init();
  mfrc522.PCD_DumpVersionToSerial();

  //IR sensors
  pinMode(lane1aIRSensorPin, INPUT);
  pinMode(lane1bIRSensorPin, INPUT);
  pinMode(lane2aIRSensorPin, INPUT);
  pinMode(lane2bIRSensorPin, INPUT);
  pinMode(lane3aIRSensorPin, INPUT);
  pinMode(lane3bIRSensorPin, INPUT);
  pinMode(lane4aIRSensorPin, INPUT);
  pinMode(lane4bIRSensorPin, INPUT);

  //RFID RC522 module
  RFID_init(RFIDResetPinL1, RFIDSSELPinL1);
  RFID_init(RFIDResetPinL2, RFIDSSELPinL2);
  RFID_init(RFIDResetPinL3, RFIDSSELPinL3);
  RFID_init(RFIDResetPinL4, RFIDSSELPinL4);

  // Initialize traffic signals (e.g., LEDs)
  pinMode(trafficSignal1PinRed, OUTPUT);
  pinMode(trafficSignal1PinOrg, OUTPUT);
  pinMode(trafficSignal1PinGr, OUTPUT);
  pinMode(trafficSignal2PinRed, OUTPUT);
  pinMode(trafficSignal2PinOrg, OUTPUT);
  pinMode(trafficSignal2PinGr, OUTPUT);
  pinMode(trafficSignal3PinRed, OUTPUT);
  pinMode(trafficSignal3PinOrg, OUTPUT);
  pinMode(trafficSignal3PinGr, OUTPUT);
  pinMode(trafficSignal4PinRed, OUTPUT);
  pinMode(trafficSignal4PinOrg, OUTPUT);
  pinMode(trafficSignal4PinGr, OUTPUT);
}
void loop() {

  // Detect vehicle density using IR sensors
  int densityLane1a = readIRSensor(lane1aIRSensorPin,
  lane1bIRSensorPin,1);

  int densityLane2a = readIRSensor(lane2aIRSensorPin,
  lane2bIRSensorPin,2);

  int densityLane3a = readIRSensor(lane3aIRSensorPin,
  lane3bIRSensorPin,3);

  int densityLane4a = readIRSensor(lane4aIRSensorPin,
  lane4bIRSensorPin,4);
  // Find the lane with the lowest density
  int minDensity = min(min(densityLane1,
  densityLane2),
  min(densityLane3, densityLane4));

  // Turn green signal for the lane
  with the lowest density
  if(RFID_checkDetection() == NULL) {

  if (minDensity == densityLane1)
  {
    setTrafficSignals(1);
  }
  else if (minDensity == densityLane2)
  {
    setTrafficSignals(2);
  }
```

```
  else if (minDensity == densityLane3)
  {
    setTrafficSignals(3);
  }
  else
  {
    setTrafficSignals(4);
  }
  }

  // Check for RFID detection
  else if(RFID_checkDetection()!=NULL) {
    String detectedUID = RFID_checkDetection();

  if (detectedUID != "") {
    // If RFID detected, turn the
    corresponding lane green for RFID_SIGNAL_TIME
    if (detectedUID == "Lane1_UID")
    {
      setTrafficSignals(1);
      delay(rfid_SignalTime);
    }
    else if (detectedUID == "Lane2_UID")
    {
      setTrafficSignals(2);
      delay(rfid_SignalTime);
    }
    else if (detectedUID == "Lane3_UID")
    {
      setTrafficSignals(3);
      delay(rfid_SignalTime);
    }
    else if (detectedUID == "Lane4_UID")
    {
      setTrafficSignals(4);
      delay(rfid_SignalTime);
    }
  }
  delay(Gr_SignalTime);
}
}
void setTrafficSignals(int lane) {
  switch (lane) {
    case 1:
      // Set lane 1 green and others red
      digitalWrite(trafficSignal1PinRed,LOW);
      digitalWrite(trafficSignal1PinGr,HIGH);
      digitalWrite(trafficSignal2PinRed,HIGH);
      digitalWrite(trafficSignal2PinGr,LOW);
      digitalWrite(trafficSignal3PinRed,HIGH);
      digitalWrite(trafficSignal3PinGr,LOW);
      digitalWrite(trafficSignal4PinRed,HIGH);
      digitalWrite(trafficSignal4PinGr,LOW);
      delay(10000);
      break;
    case 2:
      // Set lane 2 green and others red
      digitalWrite(trafficSignal1PinRed,HIGH);
      digitalWrite(trafficSignal1PinGr,LOW);
      digitalWrite(trafficSignal2PinRed,LOW);
      digitalWrite(trafficSignal2PinGr,HIGH);
      digitalWrite(trafficSignal3PinRed,HIGH);
      digitalWrite(trafficSignal3PinGr,LOW);
      digitalWrite(trafficSignal4PinRed,HIGH);
      digitalWrite(trafficSignal4PinGr,LOW);
      delay(10000);
      break;
    case 3:
      // Set lane 3 green and others red
      digitalWrite(trafficSignal1PinRed,HIGH);
      digitalWrite(trafficSignal1PinGr,LOW);
      digitalWrite(trafficSignal2PinRed,HIGH);
      digitalWrite(trafficSignal2PinGr,LOW);
      digitalWrite(trafficSignal3PinRed,LOW);
      digitalWrite(trafficSignal3PinGr,HIGH);
      digitalWrite(trafficSignal4PinRed,HIGH);
      digitalWrite(trafficSignal4PinGr,LOW);
      delay(10000);
      break;
    case 4:
      // Set lane 4 green and others red
      digitalWrite(trafficSignal1PinRed,HIGH);
      digitalWrite(trafficSignal1PinGr,LOW);
      digitalWrite(trafficSignal2PinRed,HIGH);
      digitalWrite(trafficSignal2PinGr,LOW);
      digitalWrite(trafficSignal3PinRed,HIGH);
      digitalWrite(trafficSignal3PinGr,LOW);
      digitalWrite(trafficSignal4PinRed,LOW);
      digitalWrite(trafficSignal4PinGr,HIGH);
      delay(10000);
      break;
    default:
      break;
  }
}
int readIRSensor(int pin1,int pin2,int a)
{
  if(digitalRead(pin1) && digitalRead(pin2))
  {
    setTrafficSignals(a);
    delay(Gr_SignalTime);
  }
}
String RFID_checkDetection()
{
  if ( ! mfrc522.PICC_IsNewCardPresent()) {
            return;
        }       // Select one of the cards
        if ( ! mfrc522.PICC_ReadCardSerial()) {
            return;
        }
  // Dump debug info about the card;
  PICC_HaltA() is automatically called

        mfrc522.PICC_DumpToSerial(&(mfrc522.uid));
}
```