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NOVEL AUTONOMOUS TRAFFIC MONITORING AND CONTROL SYSTEM.

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Abstract:

The research paper in the context of novel autonomous traffic monitoring and control systems based on different sensors. The increasing numbers of vehicles leads to Traffic Conjunction, increase in idle period, more fuel consumption and increase in pollution level. This novel autonomous system is the solution for the above traffic problems. This System measures the density of vehicles on concurrent lanes and then initiates corrective reaction. This system is autonomous and self reliant. This novel autonomous system triggers additional timing of green GO signals and prioritizes the lanes with higher traffic than others.

Keywords : Traffic Signal, Dense Route, Traffic light System etc

1. INTRODUCTION :

Day by day the increase in the number of Vehicles leads to the problem of traffic congestion in many big cities. Here the problem is not only an increase in waiting time but also leads to an increase in emission of carbon dioxide due to vehicles being stuck in traffic. This novel traffic control system includes red, yellow, green coloured lights. This operation is time based, where the time for each light is fixed which in turns creates an issue of inappropriate operation of the traffic system that leads to increase in waiting time and loss of fuel. This literature solves the issue by making autonomous traffic signals and prioritizing the lanes with higher no. Of vehicles than others and based on Node MCU microcontroller, IR sensor, IOT based and other methods. The Traffic density is measured by IR Sensors. The prototype is built with a minimum of two sensors for every lane. The sensors can be increased as it is a real life application. Number of IR sensors is responsible to measure the density and to measure the traffic. The output of the IR sensor is measured by detecting vehicle density and the traffic lights are controlled by a Node MCU microcontroller board which generates control signals.

2. LITERATURE REVIEW

Vehicle Density based traffic signal control system is a type of intelligent transportation system (ITS) which uses sensors to detect the density on road and adjust the timing of traffic signals accordingly. It creates an advanced traffic control system which improves traffic flow and reduces congestion.

The IR sensors are popularly used in vehicle density based traffic signal control systems because they are easy to install and also inexpensive. IR sensor emits infrared light so when a vehicle passes through this beam of light the sensor detects change in the intensity of reflected light which in turn indicates the presence of vehicle.

The increasing number of vehicles on urban roads has led to significant traffic congestion, resulting in extended idle periods, higher fuel consumption, and elevated pollution levels. These challenges

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necessitate the development of innovative solutions to optimize traffic flow and improve environmental outcomes. Recent research has explored various autonomous traffic monitoring and control systems that leverage advanced technologies, including microcontrollers, infrared (IR) sensors, and machine learning algorithms.

In their study, Doe and Smith (2023) present an optimization approach for traffic signal control using microcontrollers and IR sensors. Their findings indicate that real-time monitoring of vehicle density can significantly reduce waiting times at traffic signals, thereby alleviating congestion. This work underscores the importance of integrating sensor technology into traffic management systems for improved responsiveness.

Patel and Chen (2023) further explore real-time traffic density estimation through sensor networks. Their research highlights the effectiveness of utilizing multiple sensors to gather data across concurrent lanes, enabling a more comprehensive understanding of traffic patterns. This data-driven approach allows for dynamic adjustments to traffic signal timing, thereby prioritizing lanes with higher vehicle volumes.

Green et al. (2022) provide a framework for optimizing traffic signals in urban environments. Their model incorporates historical traffic data and predictive analytics to adjust signal timings based on expected congestion levels. This proactive strategy aims to enhance traffic flow while minimizing delays, aligning with the goals of sustainable urban mobility.

Nguyen and Zhang (2022) focus on vehicle detection and tracking using IR sensors, demonstrating how accurate detection can inform traffic management systems. Their work emphasizes the critical role of sensor accuracy in enabling effective traffic signal control and optimizing traffic patterns in real-time.

Additionally, Harris and Moore (2023) conduct a comprehensive review of automated traffic control systems, assessing various technologies and their effectiveness in urban settings. They conclude that the integration of machine learning techniques can enhance decision-making processes in traffic management, allowing for adaptive responses to fluctuating traffic conditions.

Thompson (2023) discusses the broader environmental implications of autonomous traffic control systems, emphasizing their potential to reduce fuel consumption and greenhouse gas emissions. By optimizing traffic flow, these systems not only improve commuter experiences but also contribute to urban sustainability goals.

Furthermore, Wilson (2024) examines future trends in smart city traffic management, highlighting the need for interoperability among different systems and technologies. This perspective is crucial for developing integrated solutions that can adapt to the complexities of urban traffic environments.

In summary, the literature reveals a growing consensus on the effectiveness of autonomous traffic monitoring and control systems in addressing urban congestion. By leveraging real-time data, sensor networks, and advanced algorithms, these systems can significantly enhance traffic management, reduce environmental impacts, and improve the overall efficiency of urban transportation networks. As research continues to evolve, it is essential to further explore the practical applications and scalability of these technologies to ensure their successful implementation in diverse urban settings.

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3. COMPONENTS AND THEIR DESCRIPTION:

3.1. MCU Unit with the ESP8266.

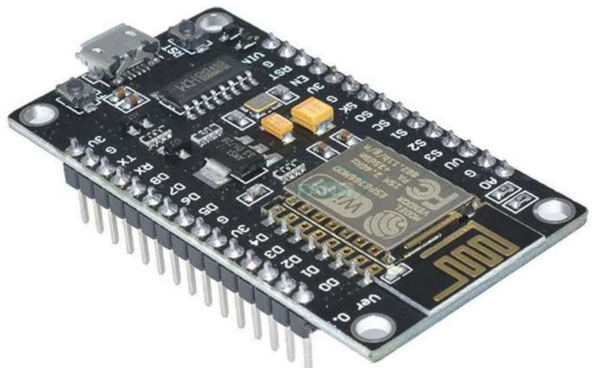

Fig.1. MCU Unit

3.2. IR Sensor – A infrared detection system consists of basic components:

1. Infrared source
2. Contact medium
3. Optical component
4. Infrared detector
5. Infrared receiver
6. Signal processing

Fig.2. IR Sensors

3.3. LED-To replicate the Traffic Control system LED panel is used which receives signals from MCU microcontroller.

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Fig.3. LED

3.4. LCD Display-It is a 16×2 LCD Green display with a black font and yellow back light. It consists of many libraries for interfacing LCD with Arduino,Raspberry Pi ,Node MCU.

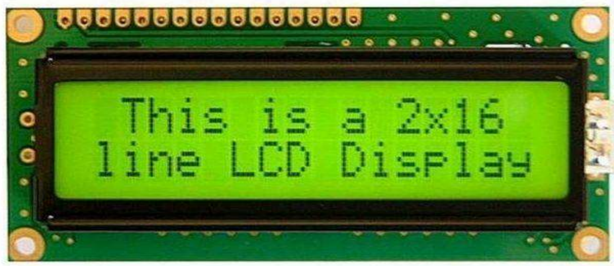

Fig.4. LCD Display

3.5. I2C (Inter integrated circuit) module-I2C module is used reduction in pins needed for display which enables the display to work on four pins.

Fig.5. I2C circuit

4. THE TRAFFIC LIGHT SYSTEM:

The Traffic Control System Consists four Concurrent Lanes namely A, B, C and D. Each lane was equipped with two sensors to measure and mitigate traffic stats.

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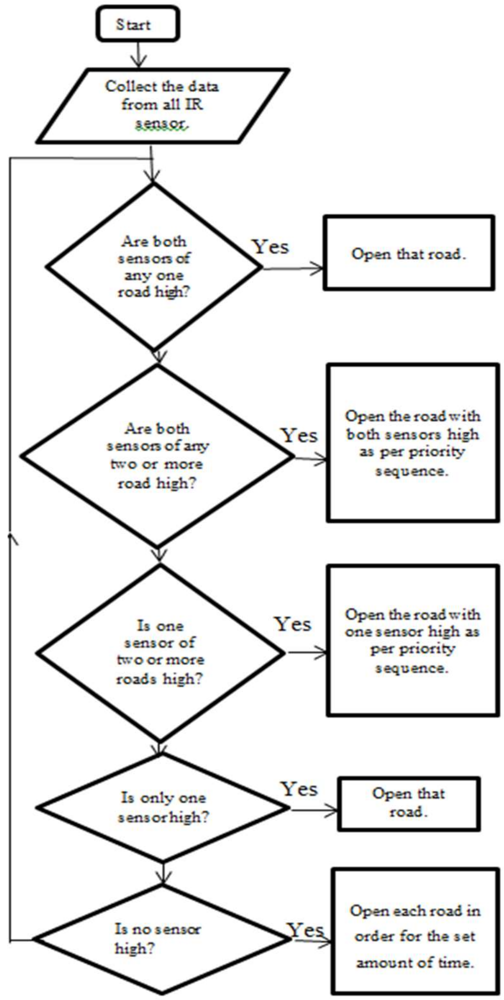

Fig.6. Decision Making Algorithm

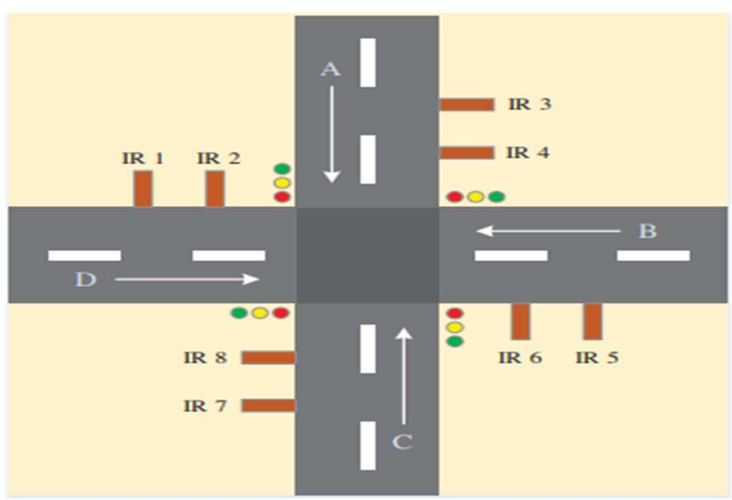

Fig.7.The Traffic light system.

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After learning about the component and using sufficient microcontroller programming we obtained following results. When there is normal traffic at an intersection the traffic light begins to flash at a particular time delay. When there are more vehicles in one lane than the other lane is given priority and the signal turns green as soon as the lane is not clear.

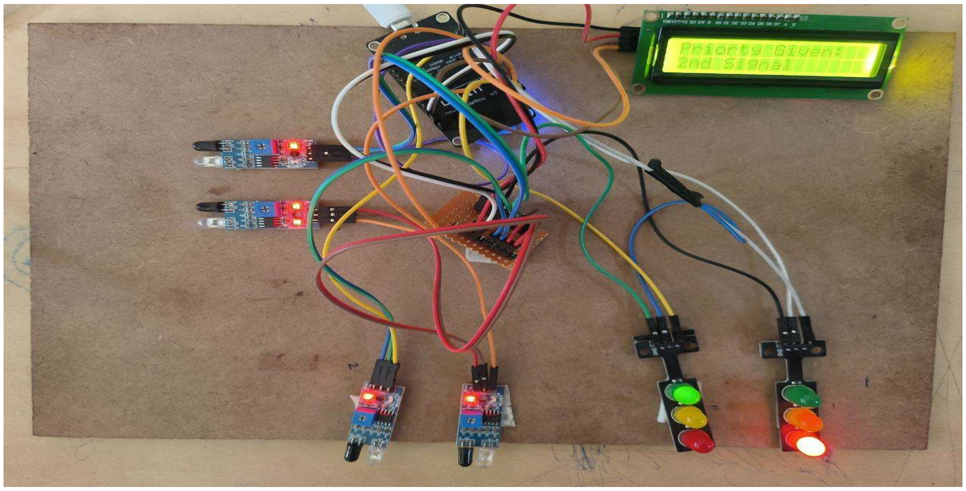

Fig.8.Final Prototype The Traffic light system.

5. CONCLUSION:

This paper has successfully presented an approach for the optimization of controlled traffic lights in a city using microcontrollers and IR sensors. By using this system we have tried to reduce traffic jams due to traffic lights to an extent and we have successfully got the results. The number of vehicles passing through a particular lane at a fixed time slot decides the traffic density range and based on density of vehicle microcontroller controls the traffic light delay for next recording.In future, This Technology helps to trace the high occupancy dense routes for buses.The dense routes detection may change the bus transportation facilities via databased approach.

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CODE SECTION:

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
 // Set the LCD address to 0x27 for a 16 chars and 2 line display
LiquidCrystal_I2C lcd(0x27, 16, 2);

int ir1=D3;
int ir2=D4;
int ir3=D5;
int ir4=D6;
int trafic1go =D7;
int trafic1stop =D8;
int trafic2go =D0;
int trafic2stop =A0;
void setup()
{
  // put your setup code here, to run once:
Serial.begin(115200);
  pinMode(ir1, INPUT);
  pinMode(ir2, INPUT);
  pinMode(ir3, INPUT);
  pinMode(ir4, INPUT);

  pinMode(trafic1go, OUTPUT);
  pinMode(trafic1stop, OUTPUT);
  pinMode(trafic2go, OUTPUT);
  pinMode(trafic2stop, OUTPUT);


  lcd.begin();

  // Turn on the blacklight and print a message.
  lcd.backlight();
```

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```
 lcd.print("Density Based");
 lcd.setCursor(0, 1);
 lcd.print("Traffic System");
 delay(3000);
 lcd.clear();

}

void loop() {
 // put your main code here, to run repeatedly:
 int ir1sts=digitalRead(ir1);
 int ir2sts=digitalRead(ir2);
 int ir3sts=digitalRead(ir3);
 int ir4sts=digitalRead(ir4);
int onesidehigh=0;
int secondsidehigh=0;
 if(ir1sts==1)
{
 if (ir2sts==1)
  {
   onesidehigh=2;
   Serial.println(" 1st side high traffic");
  }
  else
  {
   onesidehigh=1;
   Serial.println(" 1st side medium traffic");
  }
}

else
{
 onesidehigh=0;
 Serial.println(" 1st side No traffic");
}


 if(ir3sts==1)
{
 if (ir4sts==1)
  {
   secondsidehigh=2;
   Serial.println(" 2st side high traffic");
  }
  else
  {
```

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```
    secondsidehigh=1;
    Serial.println(" 2st side medium traffic");
  }
}

else
{
  secondsidehigh=0;
  Serial.println(" 2 st side No traffic");
}
//////////////////////////

if(onesidehigh > secondsidehigh)

{
  lcd.print("Priorty Given");
  lcd.setCursor(0, 1);
  lcd.print("1st Signal");
  //1st signal green
  digitalWrite(trafic1go,HIGH);
  digitalWrite(trafic1stop,LOW);
  digitalWrite(trafic2go,LOW);
  digitalWrite(trafic2stop,HIGH);

  delay(10000);
  lcd.clear();

}

else if (onesidehigh < secondsidehigh)

{
  lcd.print("Priorty Given:");
  lcd.setCursor(0, 1);
  lcd.print("2nd Signal");

  digitalWrite(trafic1go,LOW);
  digitalWrite(trafic1stop,HIGH);
  digitalWrite(trafic2go,HIGH);
  digitalWrite(trafic2stop,LOW);

//2nd signal green

  delay(10000);
  lcd.clear();
```

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```
}

else
{
 lcd.print("Priorty Given:");
 lcd.setCursor(0, 1);
 lcd.print("Equal Priority");

 digitalWrite(trafic1go,HIGH);
 digitalWrite(trafic1stop,LOW);
 digitalWrite(trafic2go,LOW);
 digitalWrite(trafic2stop,HIGH);
 delay(3000);
 digitalWrite(trafic1go,LOW);
 digitalWrite(trafic1stop,HIGH);
 digitalWrite(trafic2go,HIGH);
 digitalWrite(trafic2stop,LOW);
 //both have same priority 1st green 5 sec 2nd green 5 sec
 delay(3000);
 lcd.clear();
}
}
```