SHIV NADAR UNIVERSITY
CHENNAI

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SCHOOL OF ENGINEERING

PROJECT REPORT

SMART PARKING SYSTEM

PROJECT DONE BY:

- **PRANAV RP – 23011102063**
- **VISRRANTH S – 23011102083**
- **PRADITA G – 23011102062**
- **VISWAPRIYA S - 23011102084**

Introduction to Internet of Things and Laboratory

SHIV NADAR UNIVERSITY CHENNAI

ABSTRACT:

SMART PARKING SYSTEM:

A smart parking system is a solution devised to improve the parking efficiency and convenience of parking for the user in urban areas of parking like malls airports and other high traffic environment. The core objective of the project is to reduce time and effort that is required to search for a parking space, This project involves guiding the problem of time wasted searching for a parking space , This project consists of sensors like ultrasound sensor and RGB led sensor to monitor the availability of parking space in real time , this project aims to address these issues by leveraging technology to create more efficient and user friendly interface. The ultrasound sensor monitors the presence of car in the parking lot and the RGB led indicates the same. The parking fare is also calculated based on the time duration the car was parked in the slot providing a sleek and elegant approach to the calculation of the parking fare

INTRODUCTION:

OVERVEIW:

This project aims to provide implementing technologies and processes to monitor and manage parking spaces. The system will provide real-time information on parking availability and offer features like fare calculation based on the time duration the car was parked and allowing the user to quickly access the nearest available parking space, The data of whether the parking lot Is free or not is obtained with the help of ultrasonic sensors planted on the base of the slot such that It can sense the car's undercarriage which is within a few feet [1-2] for project purpose considered as [5cm] as soon as the undercarriage is detected within that range it is understood that the car Is parked and the time duration for which the car is parked is calculation with the help of clock time in the Arduino Uno board with an acceptable accuracy and an error of about 1%. This is sensed by the RGB led and hence glows red when the parking slot is occupied and green when it is empty, helping the user to understand which parking lot is empty, then the data is printed on a screen outside.

Key components: ultrasonic sensors, RGB led, LCD display, Arduino UNO board, Jumper wires

Data Analytics: Implement data analytics tool to analyze the parking patterns, peak usage time and other metrics. This information can help to improve the parking system.

Testing mechanism: a testing mechanism will be employed to check whether is each ultrasonic senor is working within specific period intervals to avoid any potential errors.

OBJECTIVE:

The objective of this project is to design and implement a smart parking system that improves the efficiency of parking on a college campus, reduces traffic congestion, and enhances the user experience for students, faculty, and visitors.

MOTIVATION:

The motivation behind a smart parking system project is driven by the need to address common issues associated with parking in urban environments and high-traffic areas.

And some primary reasons for implementing this project:

- **Alleviating the traffic congestion:** when we talk about urban highly populated areas a decent amount of traffic congestion is caused by the drivers searching for a parking space and some people parking their vehicles almost by the side of the road.
- **Improving user experience:** it makes it easier for the user to search for a proper parking space and makes it faster and efficient
- **Optimising the space utilisation:** helps use the available space better
- **Reducing environmental impact:** it helps reduce the emissions that the car emits, as according to a study on an average around 20 minutes is spent by the drivers to search for a proper parking space.

LITERATURE SUMMARY

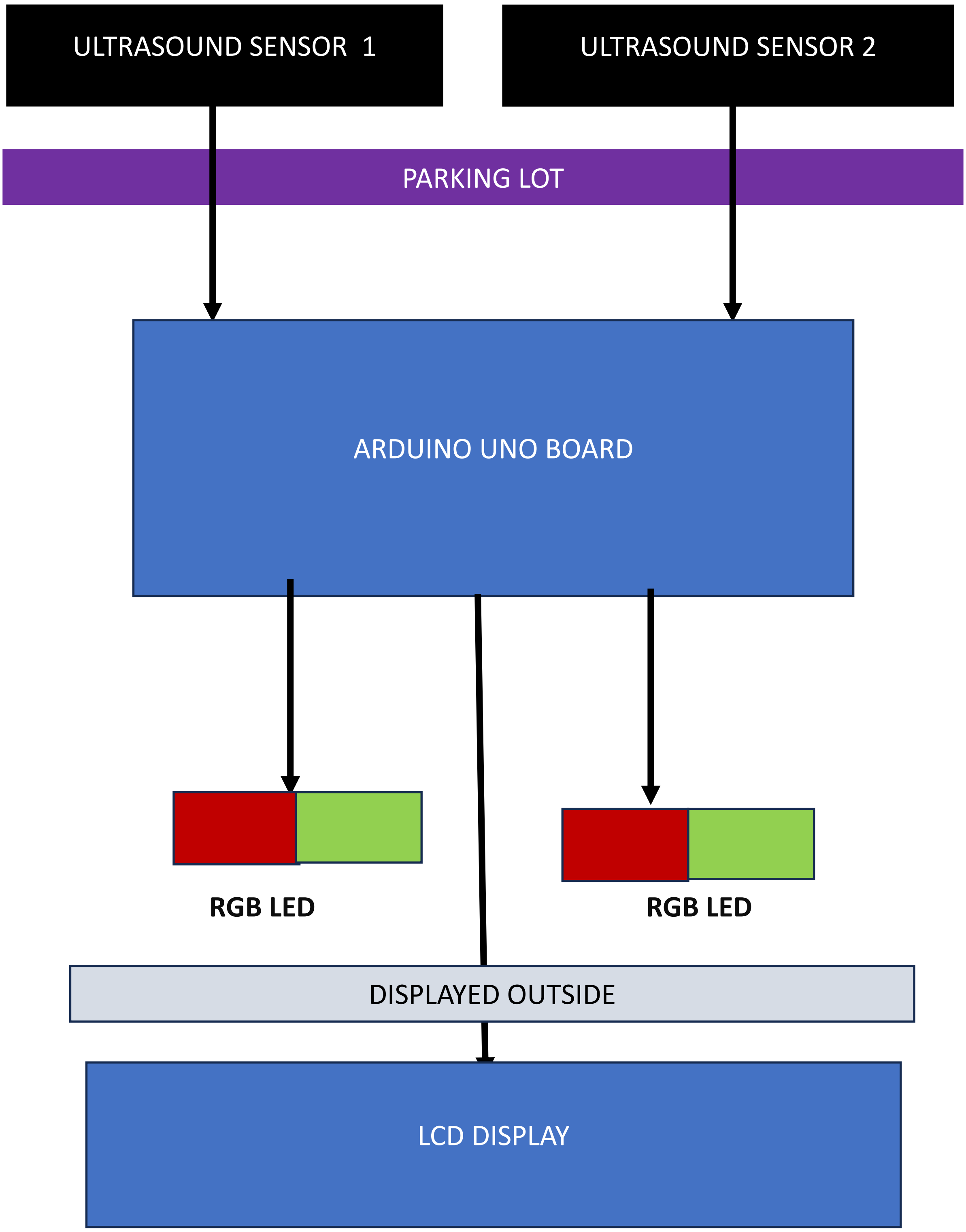
- The collection of papers on smart parking systems presents a comprehensive overview of how technology is addressing urban parking challenges. Here's a summary of the key points from these papers:

1. IoT-based Smart Parking System

- This system leverages Internet of Things (IoT) technology with Arduino components and mobile app. Onsite modules detect parking availability, providing real-time updates to users who can check and book slots via the mobile app. The solution aims to reduce fuel consumption and parking frustrations, improving urban sustainability
  2. Smart Car Parking System with Wireless Sensor Networks (WSNs)
- This approach employs wireless sensor networks for cost-effective and user-friendly parking solutions. It involves car detection with sensors and remote data communication. With an accuracy rate of 90%, this system uses ultrasonic sensors, Arduino modules, and XBee radios, demonstrating successful detection and communication, offering potential for future scalability and integration with mobile apps and GPS
  3. IoT-based Smart Parking System with Cloud Integration
- This system uses parking sensors, processing units, and cloud servers to enable real-time monitoring of parking availability via a mobile app. It emphasizes cloud integration, allowing for streamlined booking, parking, and occupancy confirmation. The implementation focuses on efficient data transmission and ease of use.
  4. Research Paper on Smart City Parking System
- This paper discusses an IoT-based system designed to address urban parking shortages. The proposed method utilizes RFID tags, infrared (IR) sensors, and an Android app for real-time parking updates. The system is cost-effective and convenient, with potential future enhancements including online payment integration.
  5. Camera-Based Smart Parking System Using Perspective Transformation
- This system addresses the lack of intelligent parking in smart cities, specifically at airports. It uses inverse perspective mapping for aerial view generation and a guidance system to help users locate parking spaces. In simulated tests at Macao International Airport, it achieved an impressive accuracy rate of 97.03%, demonstrating the economic potential for enhancing parking facilities.
  Together, these papers illustrate the diverse approaches to smart parking systems, highlighting the use of IoT, sensor technology, wireless networks, cloud integration, and camera-based systems to tackle urban parking challenges. Each solution aims to improve efficiency, reduce environmental impact, and enhance the user experience while offering scalability and potential for integration with other smart city infrastructure.

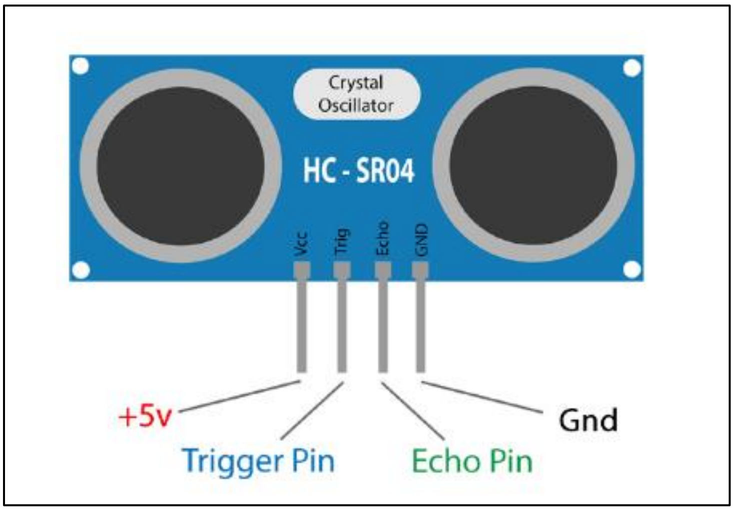
PROPOSED METHODOLOGY:

BLOCK DIAGRAM:

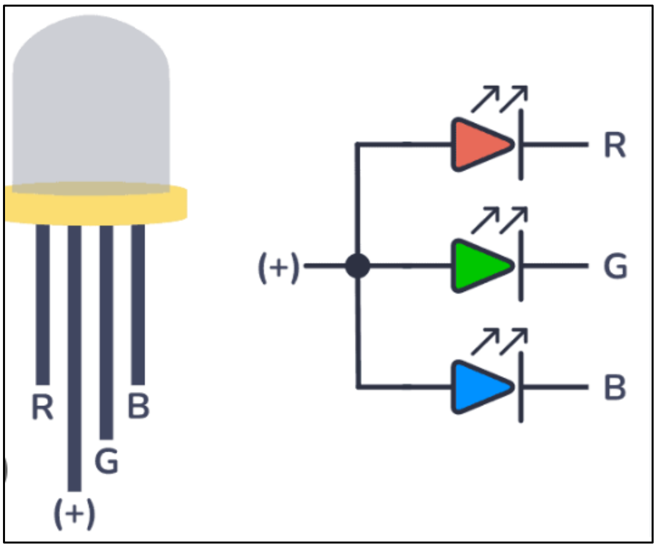


PIN DIAGRAM:

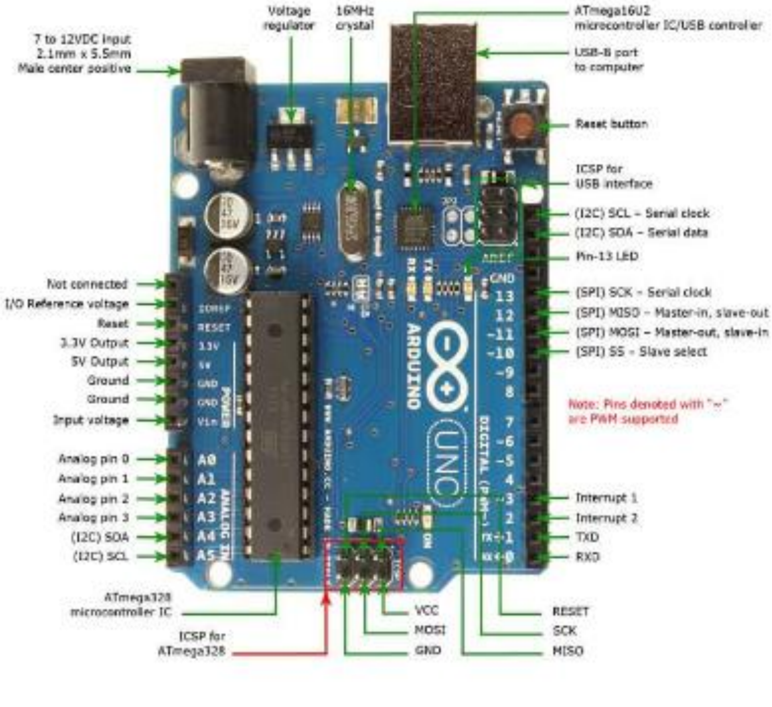
Pin diagram for ultrasonic sensor:



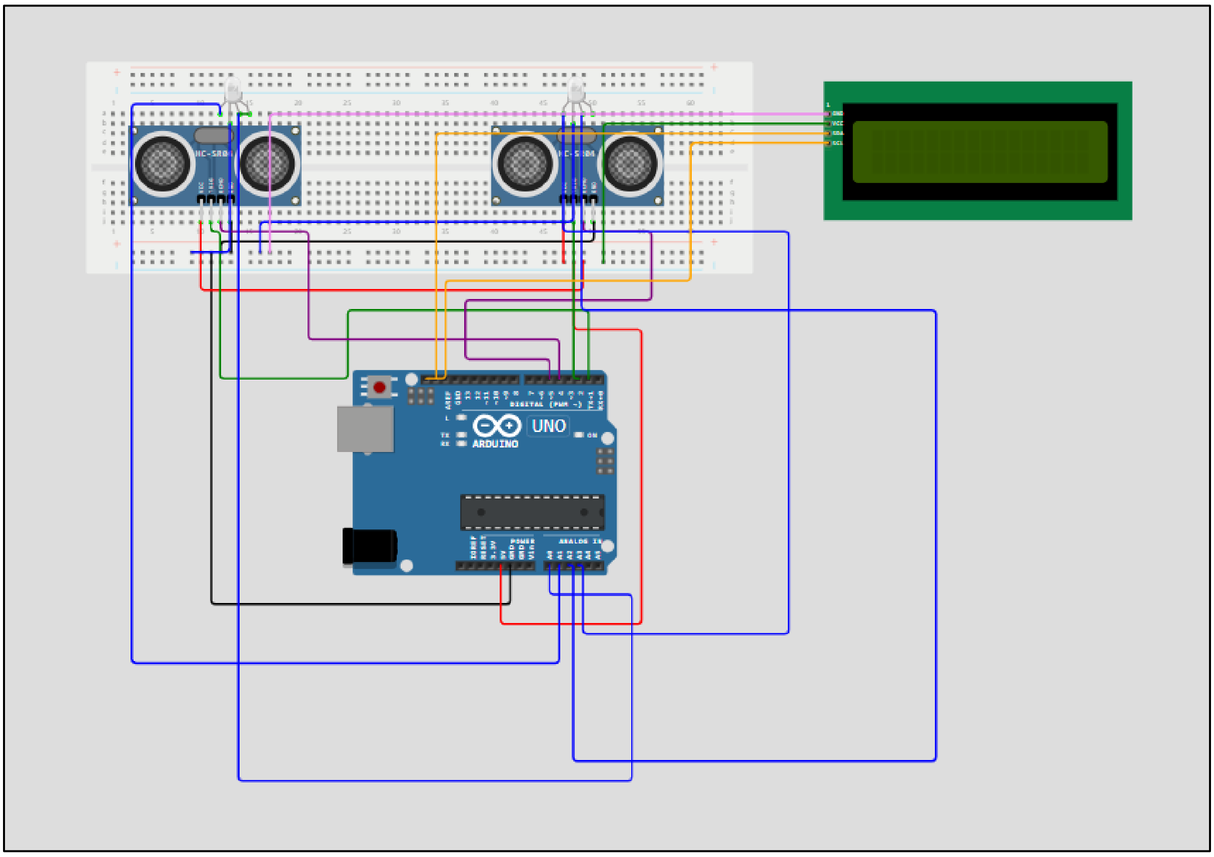
Pin diagram for RGB LED:



Pin diagram of Arduino uno board:



CIRCUIT DIAGRAM:



CONNECTIONS:

The connections according circuit diagram:

LED CONNECTIONS:

- The Led employed is an RGB led sensor
- The RGB has four pins red, blue and green and a common pin anode
- Three RGB sensors are used for the experiment
- The common pin is connected to the ground

The connections for RGB1 sensor

- The red pin of the RGB1 is connected to a Analog pin A1
- The green pin is connected to the A0

The connections for the RGB sensor

- The red pin of the sensor is connected to the pin A3
- The green pin is connected to A2

The connections for RGB3 sensor

- The red pin is connected to the pin A5
- The green pin connected to the pin A4

LCD CONNECTIONS:
- The VCC and GND are connected to the respective pins in Arduino Uno board
- THE SDA is connected to the SDA pin of the Arduino Uno board
- The SCL pin is connected to the SCL pin of the Arduino Uno board is connected to the A0

ULTRA SOUND SENSOR CONNECTIONS:
- There are three ultrasound sensors are used in this project

US1 sensor
- The ground pin of the US1 sensor is connected ground pin of the Arduino Uno board
- The VCC of the US1 sensor is connected to the 5 V pin
- The trig pin of the sensor is connected to the digital pin 1
- The echo pin of the sensor is connected to the digital pin 4

US2 sensor
- The ground and VCC pin are connected as usual
- The trig pin of US2 sensor is connected to the digital pin 2
- The echo pin is connected to the digital pin 5

US3 sensor:
- The ground and VCC pin are connected as usual
- The trig pin is connected to the digital pin 3
- The echo pin is connected to the digital pin 6

HARDWARE:

ULTRASOUND SENSOR:

Ultrasonic sensors use sound waves to detect objects and measure distances. They are often used in industrial, automotive, robotics, and other applications where distance measurement or object detection is required.

Technical specifications:

- **Operational principle:** emits ultrasonic waves it is typically between the range (40 to 400khz) and the measures time taken for the echo is what reaches the sensor after reaching the sensors receiver after touching the obstacle our case it is the car's undercarriage.
- **Operating current:** 15mA
- **Sensing range:** generally, the sensing range is between 2c – 4m
- **Accuracy:** Typically ranges from ±1 mm to ±10 mm, depending on the sensor type, distance, and environment
- **Resolution:** refers to the smallest distance increment detectable it is generally few millimeters 0.3cm

- **Sensor angle:** 15°
- **Response time:** 50ms – 200ms
- **Ultrasound frequency:** 120Mhz
- **Ambient temperature:** -25 c - +70c
- **Operating voltage**: 5V
- **Shock stress:** 30g, 80ms
- **Degree of protection:** IP 65

RGB LED:

The RGB led is provided with four pins three pins allotted for three colors red green and blue pins and the fourth pin is the common pin or the ground pin

It can be used for various purposes in this project it is used for indication of status of the parking lot

Technical specification

- **Color Channels**: RGB LEDs contain three separate LEDs (red, green, and blue) within one package, allowing for the creation of a wide range of colors by varying the intensity of each channel.
- **Control Method:** RGB LEDs can be controlled using analog or digital methods. Analog control varies the current through each channel, while digital control uses protocols like Pulse Width Modulation (PWM) to adjust brightness.
- **Common Configurations:**
- **Common Anode (CA):** The positive (anode) terminal is shared, and each LED has its own cathode.
- **Common Cathode (CC):** The negative (cathode) terminal is shared, and each LED has its own anode.
- **Forward Voltage:**
- For the red channel, typical forward voltages range from 1.8V to 2.2V.
- For the green and blue channels, typical forward voltages range from 2.8V to 3.3V.
- **Viewing Angle:** The angle at which the LED emits light, generally ranging from 30° to 120°. Wider angles provide broader coverage, while narrower angles are more focused.
- **Power Consumption:** Generally low, but depends on the total current draw and voltage**.**
- **Temperature Range:** The operating temperature range can vary but is typically between -40°C and 85°C.

LCD:

Technical specifications:

- **Size:** 85.0 x 29.5 x 13.5 mm
- **Maximum logic voltage:** 5.5 V
- **Led backlight voltage drop:** 4.2V
- **Led back light current:** 120m

o **Viewing Angle**: The angle at which the display can be viewed without significant distortion or color shift. IPS displays generally have the widest viewing angles.

o **Response Time**: The time it takes for a pixel to change from one color to another. It is typically measured in milliseconds (ms). Lower response times are preferable, especially for fast-moving images.

o **Refresh Rate**: The number of times the display refreshes per second, measured in Hertz (Hz). Common refresh rates are 60 Hz, 75 Hz, 120 Hz, and 144 Hz

ARDUINO UNO:

Technical specifications:

- **Microcontroller:** ATmega328P, an 8-bit AVR-based microcontroller.
- **Operating Voltage**: 5V, with a 3.3V output available for specific use cases.
- **Input Voltage (limits):** 6V to 20V. Exceeding these limits may cause damage.
- **Digital I/O Pins:** 14 digital input/output pins, numbered from 0 to 13. Six of these pins (3, 5, 6, 9, 10, 11) support PWM (Pulse Width Modulation).
- **Analog Input Pins**: 6 analog input pins, labeled A0 to A5, with a 10-bit resolution (values from 0 to 1023).

- **Flash Memory**: 32 KB (2 KB is used by the bootloader).
- **SRAM:** 2 KB, used for variable storage during runtime.
- **EEPROM:** 1 KB, used for non-volatile storage of data that persists after power cycles.
- **Clock Speed:** 16 MHz, driven by a quartz crystal.
- **USB:** USB connection for programming and serial communication with a computer.
- **I2C**: Analog pins A4 (SDA) and A5 (SCL) for I2C communication.
- **SPI:** Digital pins 10, 11, 12, and 13 for SPI communication.
- **Built in LED**: A built-in LED connected to digital pin 13 for testing and debugging.
- **USB Interface**: The board uses an ATmega16U2 microcontroller to handle USB-to-serial conversion, allowing the Arduino Uno to be recognized by a computer's USB port.
- **Operating Temperature**: 0°C and 85°C.

SOFTWARE:

Version of Arduino uno ide: **2.3.2**

METHODOLOGY OF THE PROJECT:

Here we have used Two ultrasound sensors 2 RGB led sensors and these are integrated to an Arduino uno board the ultrasound sensors are used to sense whether the car is parked in the slot or not. Using this information the RGB led flashes red or green light respectively it flashes red light when the car is parked and green when the parking slot is occupied and the time duration for which the car was parked is also noted when the senor is initiated and hence the fare is calculate accordingly

CODE:

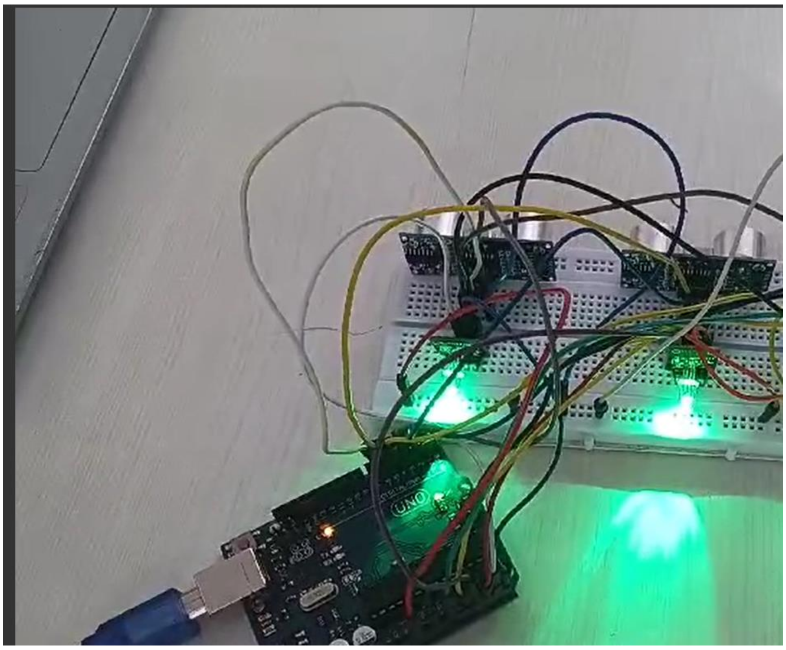
```
#include <NewPing.h>

// #include <LiquidCrystal_I2C.h>

// LiquidCrystal_I2C lcd(0x20,16,2);


int lst[6]={A0,A1,A2,A3,A4,A5};

int lot[3]={0,0,0},plot[3]={0,0,0};

int time[3]={0,0,0};

int trig,echo,fare;

float t;

unsigned int distance;



void setup()

{

  Serial.begin(9600);

  // lcd.init();

  // lcd.backlight();

}


void loop()

{

  for(int i=1;i<4;i++)

  {
```

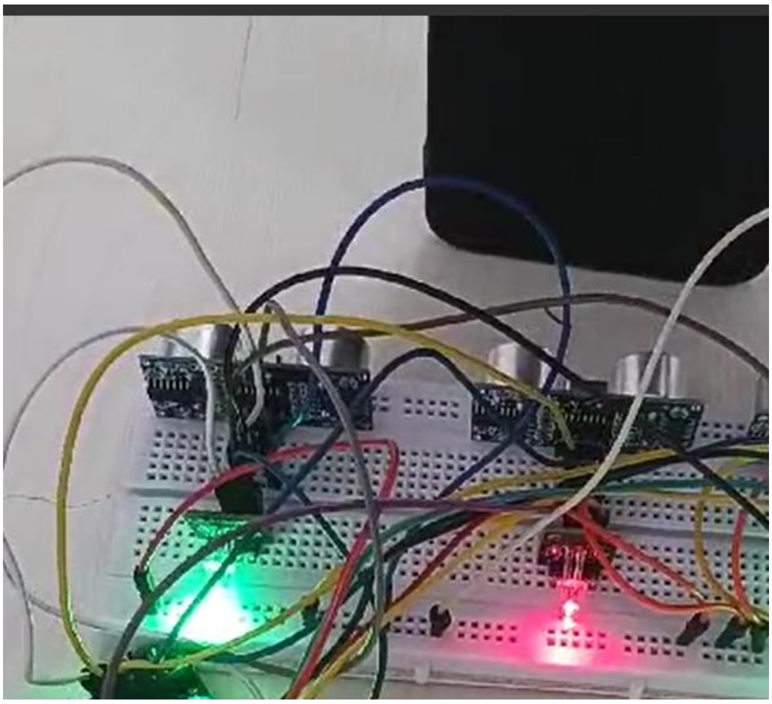
```
  trig=i;,jdhvkj
  echo=trig+3;
  NewPing sonar(trig,echo,200);
  distance=sonar.ping_cm();
  if(distance>0 && distance<5)
  {
   setcolour(i,0,255);
   lot[i-1]=1;
  }
  else
  {
   setcolour(i,255,0);
   lot[i-1]=0;
  }
 }


 if(plot!=lot)
 {
  for(int j=0;j<3;j++)
  {
   if(lot[j]>plot[j])
   {
    time[j]=millis();
   }
   if(lot[j]<plot[j])
   {
    Serial.print("Duration:");
    t=(millis()-time[j])/1000;
```

```
        Serial.print(t);
        Serial.println("sec");
        Serial.print("Fare: Rs");
        Serial.println(t*5);
        // printing(time[j]);
        time[j]=0;
      }
      plot[j]=lot[j];
    }
  }
}

void setcolour(int pin,int gv,int rv)
{
  analogWrite(lst[(pin*2)-2],gv);
  analogWrite(lst[(pin*2)-1],rv);
}

// void printing(int t)
// {
//   lcd.clear();
//   lcd.setCursor(0,0);
//   lcd.print("Duration:");
//   lcd.setCursor(0,9);
//   lcd.print(t);
//   lcd.setCursor(0,13);
//   lcd.print("sec");
//   lcd.setCursor(1,0);
//   lcd.print("Fare:");
```

```
//   lcd.setCursor(1,5);
//   fare=10*t;
//   lcd.print(fare);
// }
```

HARDWARE OUTPUT:





[here we have placed obstacle which is similar to a car body the ultrasound sensor will sense the obstacle]

SOFTWARE OUTPUT:

APPLICATIONS:

- we can apply the idea of smart parking system to areas like urban shopping sites and malls, places where heavy congestion is expected this provides a sense of relief from the congestion and efficient way to manage the overall parking space available
- dynamic pricing can be implemented where the user is charged according to the duration his car was parked in the particular parking slot
- the drivers are guided to the free parking spaces with the help of a digital display, without having to search for parking spaces
- parking space availability and detection this is one of its major applications
- with the help of smart parking system, we can also reduce the amount of emission that the car emits in the period of time spent for searching a proper parking space according to the census on an average about 20 minutes is spent by the drivers around the world searching for a proper parking space
- with the help of smart parking system, we can also analyze the data about the peak hours and the rest in order to improve the business strategy and also assess the effect of the emissions on the environment which will help us to employ certain restrictions and methods to reduce pollutions

INFERENCE FROM THE PROJECT:

- **Improved Parking Space Utilization**: By providing real-time information about available parking spots, smart parking systems can optimize space usage, reducing the need for additional parking infrastructure and making better use of existing space.
- **Decreased Traffic Congestion**: A smart parking system reduces the number of vehicles circling in search of parking, which in turn decreases overall traffic congestion and contributes to a smoother flow of vehicles in urban areas.
- **Environmental Benefits**: By reducing search time and traffic congestion, a smart parking system can lower carbon emissions and fuel consumption, contributing to environmental sustainability.
- **Increased Revenue for Parking Operators:** With dynamic pricing and automated payment systems, parking operators can increase revenue by optimizing pricing and reducing instances of unpaid parking or violations.
- **Data extraction**: The data collected from a smart parking system can be used to analyze parking trends, peak usage times, and user behavior. These insights can help in making data-driven decisions for parking lot design, urban planning, and traffic management.
- **Challenges and Areas for Improvement**: such as the need for more robust sensors, issues with data privacy, or the need for greater public awareness and adoption of the technology. Then we can also improve in the area's like implementing temperature sensors to check whether we have any animals in the parking slot and also implement CCTV or surveillance to make It more secure and also check the ultrasound sensors in regular interval of time to check for any errors.

CONCLUSION AND FUTURE WORKS:

in conclusion, smart parking systems offer significant benefits for urban environments, including reduced search times for parking. These systems contribute to environmental sustainability by lowering carbon emissions and fuel consumption, while also providing parking holders with increased revenue and better enforcement tools Furthermore, smart parking systems offer valuable data, enabling parking operators and urban designers to make informed decisions about parking lot design and traffic management. Integration with other smart city initiatives further enhances their utility, promoting a more cohesive urban infrastructure Despite the advantages, smart parking systems face challenges, such as sensor robustness, data privacy concerns, and the need for wider public adoption. Addressing these issues will be crucial to maximizing the benefits of smart parking systems and ensuring their success in creating more efficient and sustainable urban environments.

FUTURE WORKS:

We will work on improving this model and being able to develop it to real time implementations and also devise methods to overcome the disadvantages faced by the parking systems, we will also try to reduce the power consumption of the whole system by implementing technologies to reduce the consumption of power. And also incorporate other smart devices to make the system more efficient. Camera monitoring for better security purposes, And also number plate monitoring, Slot booking online, and also contactless payment.

REFERENCES:

- Anusha, Arshitha M S, Anushri, Geetanjali Bishtannavar and Ms. Megha D Hegde Department of Computer Science and Engineering Alva's Institute of Engineering and Technology, Moodbidri [review paper on smart parking system]
- By Dr.V. Kepuska, Humaid Alshams Florida Institute of Technology, Melbourne FL, USA [smart car parking system]
- Abhirup Khanna and Rishi Anand, University of Petroleum and Energy Studies (UPES), Dehradun, Uttarakhand [IOT based smart parking system]
- Ahteshamul huq osmani, Ashwini Gawade, Minal Nikam, Swati Wavare Under the guidance of prof.Kalpana Kadam Skn Sinhgad college of Engineering Department of Computer Engineering, Savitribai phule University Lonavala Maharashtra India [Research paper on Smart City Parking System]
- Bowie Liu, Hawking Lai, Stanley Kan and Calana Chan Faculty of Applied Sciences, Macao Polytechnic University Macao,China [Camera-Based Smart Parking System Using Perspective Transformation]