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Department.

Smart Parking System

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Introduction:

Finding a parking spot in busy cities can be tough. It wastes time and causes a lot of frustration for drivers. Traditional parking systems don't always help, as they're not very flexible. But now, there's a solution: Smart Parking Systems (SPS).

A Smart Parking System uses new technology to make parking easier and better. It uses things like sensors and computers to find empty parking spaces and help people know where they are. This report talks about a project to make one of these Smart Parking Systems. It explains what the project aims to do, how it works, and why it's important. By using smart technology, this project wants to make parking less stressful and more efficient for everyone.

Background:

Traditional parking systems, characterized by manual enforcement and static infrastructure, struggle to meet the dynamic needs of urban environments. They often result in inefficiencies, such as wasted time spent searching for parking spots, increased traffic congestion, and environmental pollution due to unnecessary vehicle emissions.

To address these pressing issues, Smart Parking Systems (SPS) have emerged as a transformative solution. SPS leverages advanced technologies to optimize the utilization of parking resources and improve the overall parking experience for motorists.

By deploying sensors and smart devices across parking facilities, SPS enable real-time monitoring of parking availability, allowing drivers to locate vacant spots efficiently. leading to enhanced operational efficiency and cost-effectiveness.

Sensors: There are a lot of sensors we can use in such a project, but we will talk about 3 important ones.

1-IR sensor: Infrared sensors are devices that detect and measure infrared radiation emitted by objects. All objects emit some form of thermal radiation, and IR sensors can detect this radiation without any physical contact. This characteristic makes IR sensors highly useful for a wide range of applications, from remote temperature sensing and motion detection to security systems and automated environmental control.

How IR sensors work: IR sensors typically operate by using a light system to detect the infrared energy (heat) emitted by objects in their vicinity. The most basic type of IR sensor includes an IR light source, such as an IR LED, and an IR detector, like a photodiode or phototransistor, that is sensitive to IR light at the same wavelength as that emitted by the LED.

When IR light hits an object, some of it is absorbed and some is reflected, depending on the properties of the object. The detector component of the sensor then measures the amount of IR light that returns, which can be correlated to certain properties of the object, such as distance, movement, or temperature.

Application in (SPS): In the context of smart parking systems, IR sensors are often used to detect the presence or absence of a vehicle in a parking space or used for Mechanized gate. They can be placed in parking spots to monitor the status of the space (occupied or vacant) and communicate this information to a central management system.

2-Ultrasonic sensor: Ultrasonic sensors use sound waves to detect objects and measure distances. These sensors emit ultrasonic waves, which are sound waves that are above the frequency of human hearing (typically above 20 kHz). When these waves hit an object, they bounce back to the sensor, which then calculates the distance to the object based on the time it takes for the echo to return.

How ultrasonic works: The core components of an ultrasonic sensor are the transmitter, which sends out the ultrasonic waves, and the receiver, which captures the echoed waves. These components are often combined into a single unit called a transducer. The sensor calculates the distance to an object using the speed of sound in air and the time interval between sending the wave and receiving the echo.

Applications in (SPS): Ultrasonic sensors are ideal for smart parking systems due to their accuracy in distance measurement. They can be installed in parking lots to detect whether spaces are occupied or vacant. Information collected by these sensors helps in directing drivers to available parking spots, significantly reducing the time spent searching for parking and improving overall traffic flow within parking areas.

3-LDR sensor: A Light Dependent Resistor, also known as a photoresistor, is a type of passive component that changes its resistance in response to changes in the ambient light intensity. These devices are made from high-resistance semiconductor materials that exhibit photoconductivity, a phenomenon where the material's electrical conductivity increases when light is absorbed.

How LDR works: A Light Dependent Resistor, also known as a photoresistor, is a type of passive component that changes its resistance in response to changes in the ambient light intensity. These devices are made from high-resistance semiconductor materials that exhibit photoconductivity, a phenomenon where the material's electrical conductivity increases when light is absorbed.

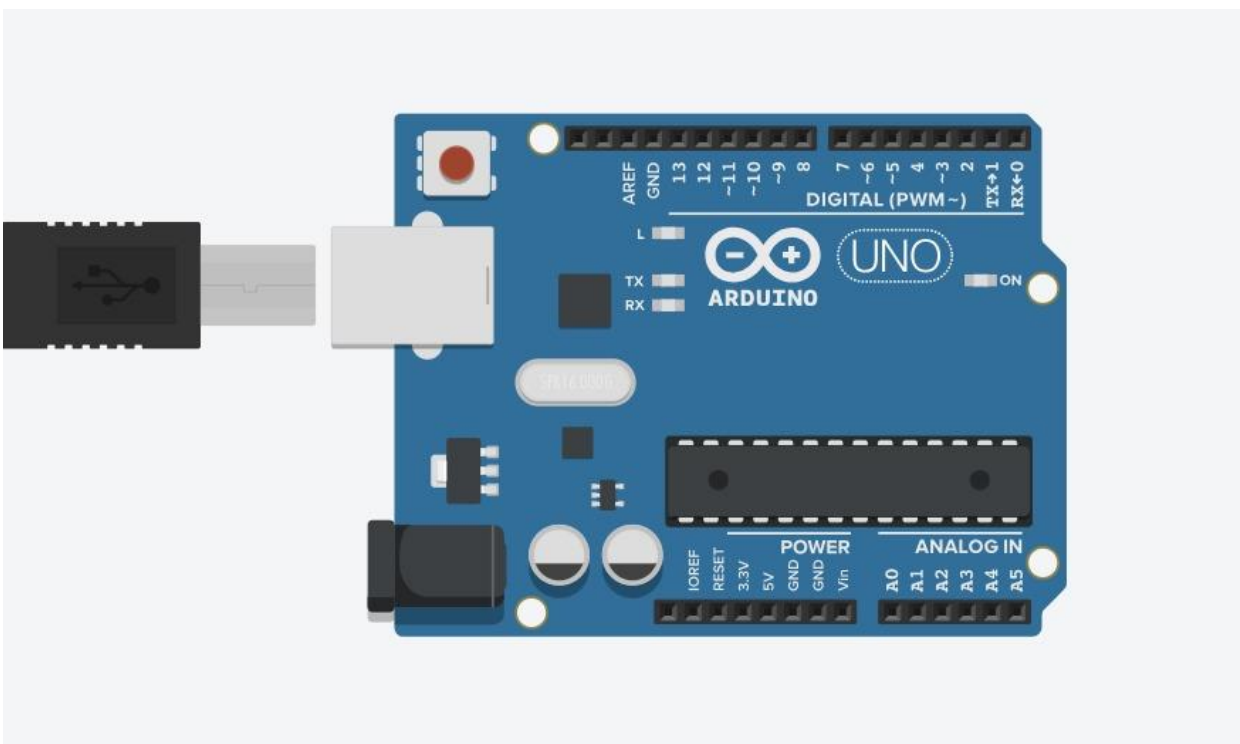
Applications in (SPS): it can be used in automatic lighting control system that turn on automatically at dusk and off at dawn.

Architecture:

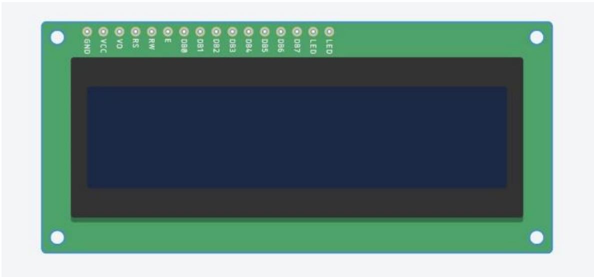
1) components:

Name	Quantity	Component
U1	1	Arduino Uno R3
U2	1	LCD 16 x 2
Rpot2	1	250 kΩ Potentiometer
R1	1	220 Ω Resistor
DIST1	1	Ultrasonic Distance Sensor (4-pin)
U3	1	IR sensor
SERVO1	1	Positional Micro Servo
R2	1	Photoresistor
R3 R4 R5	3	1 kΩ Resistor
D1 D2	2	White LED

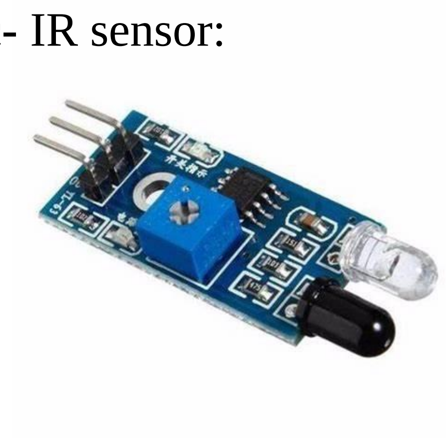
a- Arduino uno:



b- LCD 16x2:

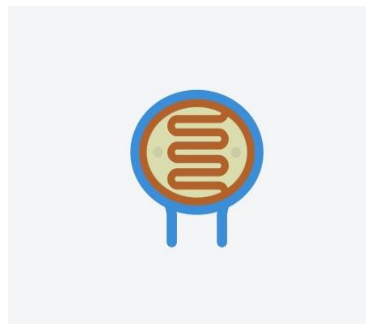


c- IR sensor:



d- Ultrasonic sensor:

e- LDR sensor:



f- servo motor:

g- potentiometer

h- resistors

I- LED

How It Works:

1- sensor deployment: Ultrasonic and IR sensors are installed to detect the presence or absence of vehicles to control the gate. These sensors continuously monitor the status of parking spots. LDR sensor is installed to control lighting system.

2- Data collection: the sensors collect the data (the presence or absence of vehicles and light.)

3- Data processing: Arduino microcontroller processes the data and makes action according to the written code.

4- User interface: display screen (LCD) is used so that the drivers can access the information about parking availability.

The Code:

1- initialization of variables

```
#include <Servo.h>
#include<LiquidCrystal.h>
#define trig 7
#define echo 6
Servo myservo;
int  rs=13 ,en=12, d4=11,d5=10,d6=9,d7=8;
LiquidCrystal lcd (rs,en,d4,d5,d6,d7);
int counter=4 ;
float dis =0,dur=0;
int SensorPin = 4;
int led1 =3 ;
int led2 =2 ;
int led_for_test =1;
```

2- Pins set up

```
void setup() {
  // put your setup code here, to run once:
lcd.begin(16,2);
Serial.begin(9600);
pinMode(trig,OUTPUT);
pinMode(echo,INPUT);
myservo.attach(5);
pinMode(SensorPin, INPUT); // for ir sensor
 myservo.write(0);
 pinMode(A0, INPUT); //  for  ldr  sensor
pinMode(led1,OUTPUT);  // for the led  1
pinMode(led2,OUTPUT);  // for the led  2
  lcd.print(" places: 4");
pinMode(A5,OUTPUT);
}
// //-------------------------------------------------------------
```

3- LCD set up

```
// //==================================================================
void l_c_d(int counter){
          // test passed but we need to  make it again  on the real  maket
      lcd.clear();
  lcd.setCursor(1, 0);
  if(counter>0){
  lcd.print(" places:");
    lcd.setCursor(0, 1);
   lcd.print(counter); }

   else{
    lcd.clear();
      lcd.print("Sorry no space ");
   }
}
```

4- Ultrasonic set up

```
float ultra_sonic(){       //  test passed
digitalWrite(trig,LOW);
delayMicroseconds(2);
digitalWrite(trig,HIGH);
delayMicroseconds(10);
digitalWrite(trig,HIGH);
dur=pulseIn(echo,HIGH);
dis=(dur*.0343)/2;
// Serial.print(dis);
// Serial.print("\n");
delay(100);
 return dis;
}
```

5- servomotor set up

```
//==============================================================================
//  best code for servo  motor to save it from burnning
void open_servomotor()         // still need to test
 {
for(int i=0 ;i<=90;i++){
  myservo.write(i);
  delay(15);
}
delay(500);

}
//=================================================================================
void close_servomotor()         // still need to test
 {

for(int i=90 ;i>0;i--){
  myservo.write(i);
  delay(15);
}
delay(500);

}

```

6- LDR

```
void controlling_light(){
if (analogRead(A0)<=300){
  // turn on the led
  digitalWrite(3,HIGH);
  digitalWrite(2,HIGH);


}
else{    //  turn of the led
  digitalWrite(3,0);
  digitalWrite(2,0);
}
```

7- running code

```
void loop() {

 controlling_light();

//============================================================
 digitalWrite(A5,0);
     delay(1000);  // just   for  indication
 //===========================================================
if(ultra_sonic()<=20&&counter>0) /////       modifiy this on the maket
{                    /// this part of code in  case of the car Entre the parking
open_servomotor();
    while(1){
    if(digitalRead(SensorPin)==0)
    {close_servomotor();
      counter--;
    l_c_d(counter);
    break;
    }

    }
}


// ================================================================
 else if (digitalRead(SensorPin)==0)                    /// this part of code in  case of the car leave  the parking
{
open_servomotor();
   // modifiy on the maket
 while(1){
    if(ultra_sonic()<=20){
      close_servomotor();
    counter++;
    l_c_d(counter);
    break;
    }

}
   }

  //  Serial.println(digitalRead(SensorPin));     just for testing
      // Serial.println(ultra_sonic());
     digitalWrite(A5,1);
      delay(1000);

```

Logic of the code:

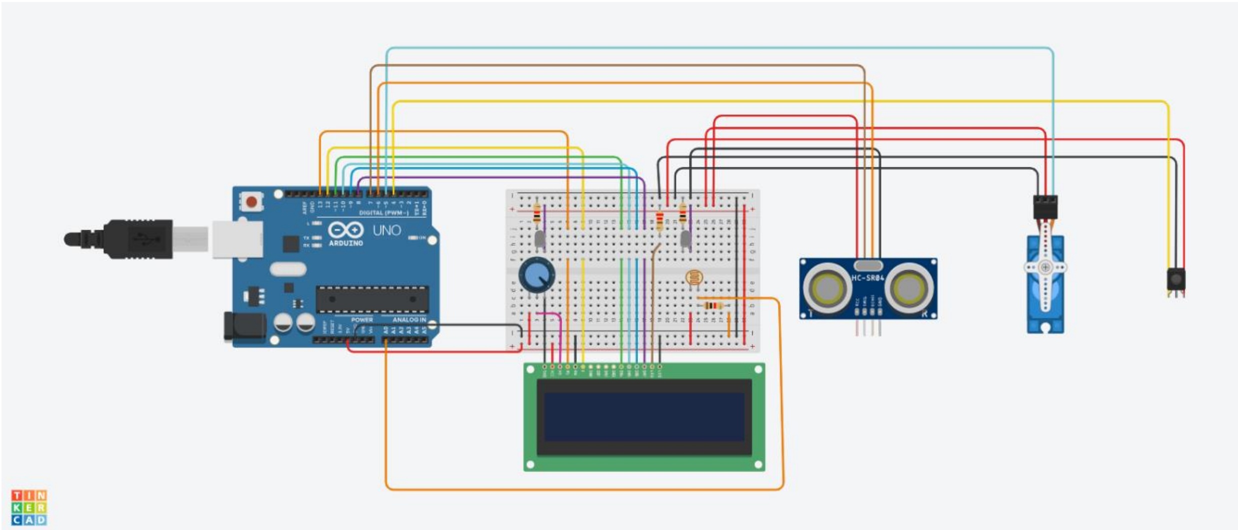
1- when the car enters the parking:

The Ultrasonic sensor detects the presence of a car, the servomotor opens the gate and remains open until the car enters the parking and comes across the IR sensor. The gate closes and the counter of the remaining free spaces decreases.

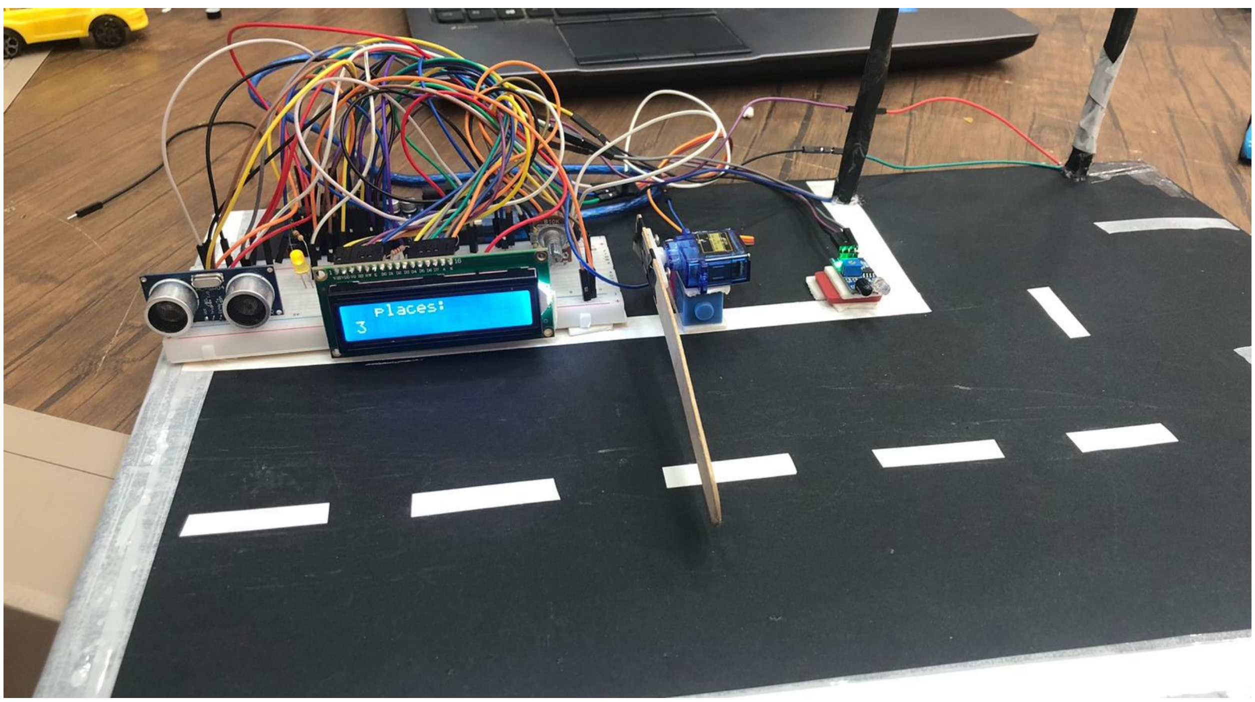
2-when the car gets out the parking:

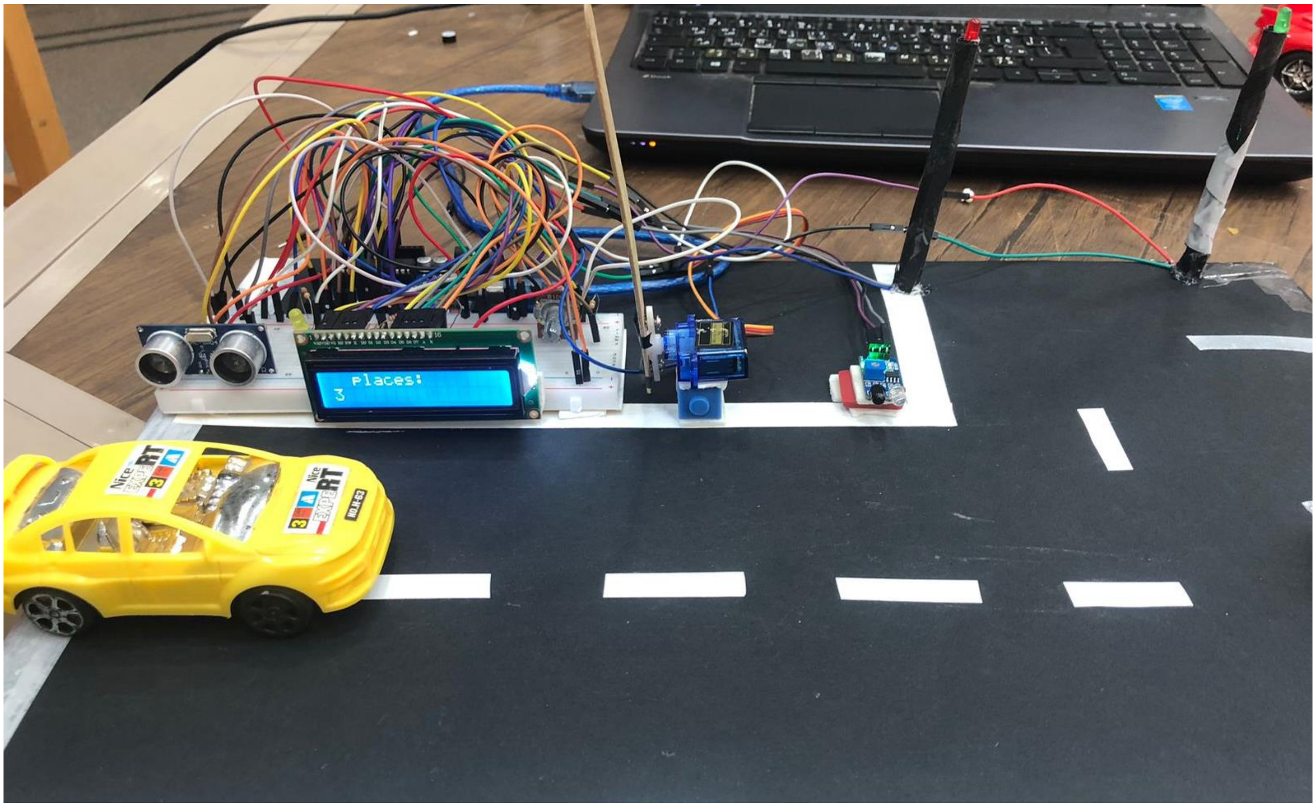
The IR sensor detects the presence of a car, the servomotor opens the gate and remains open until the car comes out of the parking lot and gets detected by the ultrasonic sensor. The gate closes and the counter of the remaining free spots increases.

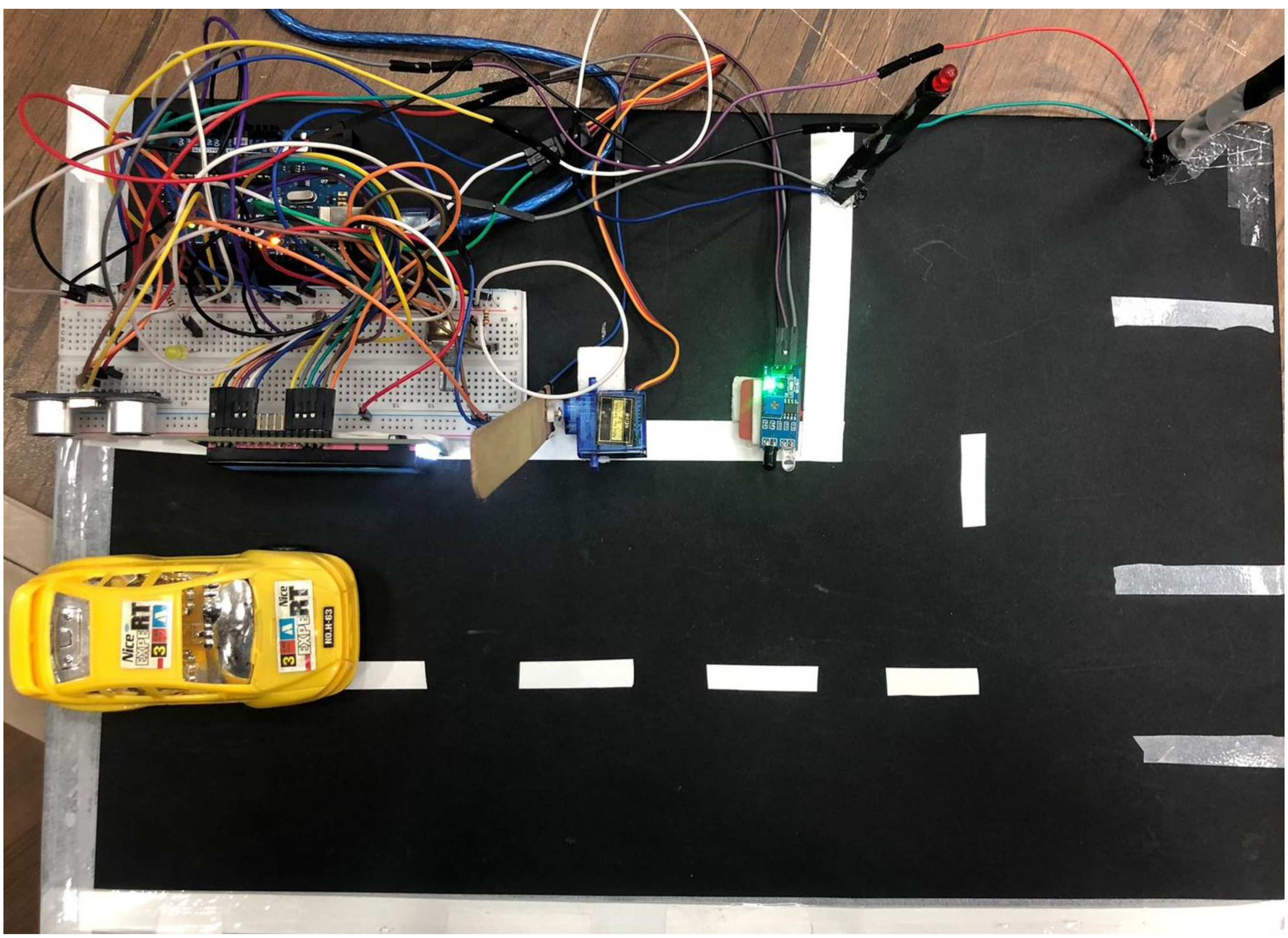
Simulation:



Execution:




places:
3



Results:

1- decrease in time spent searching for parking.

2- increase parking Efficiency.

3- reduction in traffic congestion.

4- economic benefits.

Overall, the application of a Smart Parking System is expected to enhance parking management significantly, offering tangible benefits in terms of efficiency, user satisfaction, economic impact, and environmental sustainability. These results contribute to a more efficient urban transport system and can be a pivotal component in the broader smart cities.

References:

1- “Art of Electronics” by Paul Horowitz and Winfield Hill

2- “Sensors and Actuators: Control System Instrumentation” by Clarence W. de Silva.

3- "Handbook of Modern Sensors: Physics, Designs, and Applications" by Jacob Fardeen.