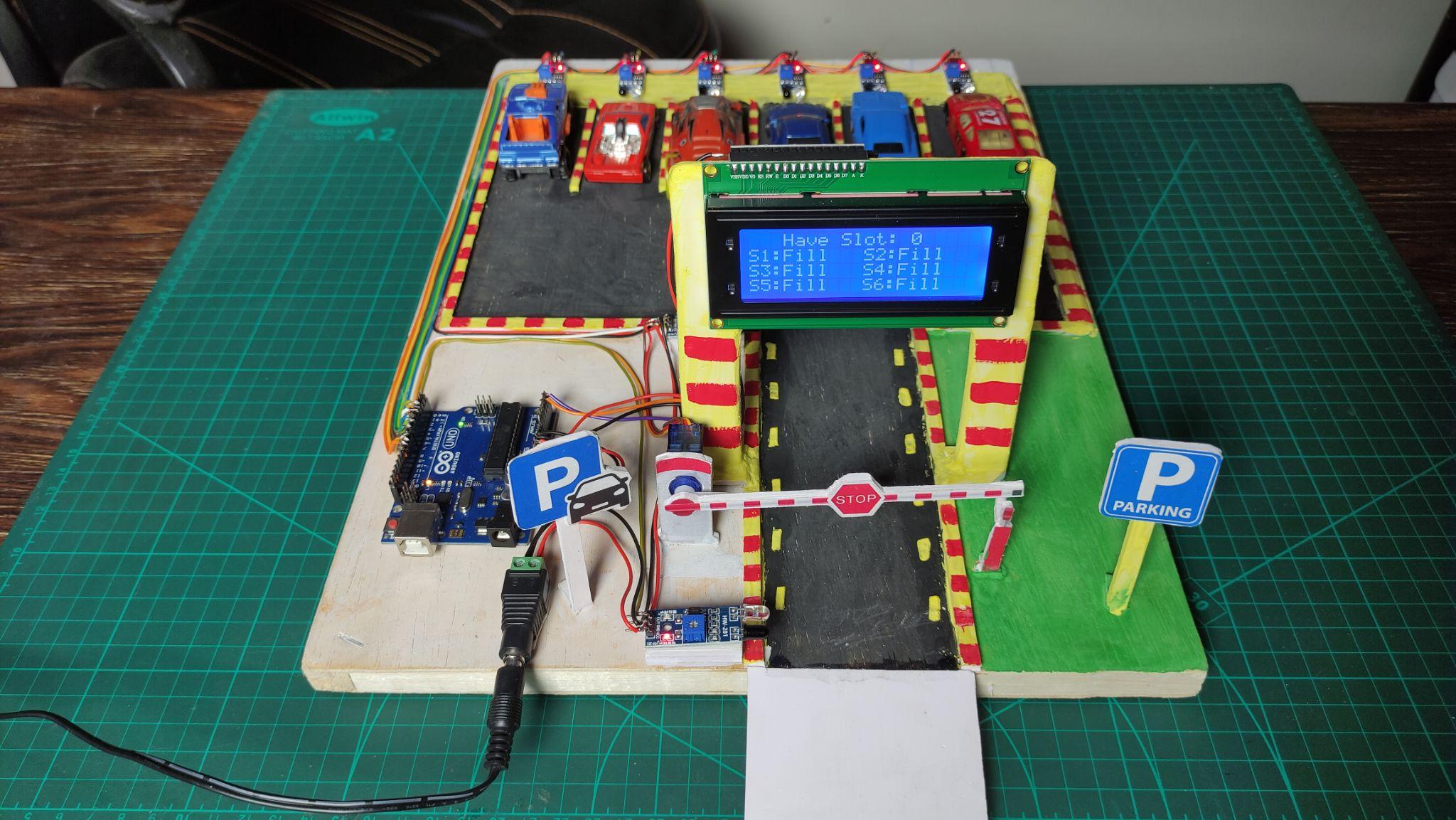
****

**Car Parking System**

**Project Report**

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**Subject: Technical Project – TPJ655**

**Program: Computer Engineering Technology (ECT)**

**Instructor: Benjamin Shefler**

**Date: April 8, 2022**

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**Executive Summary**

In response to parking concerns in a lot of areas, our team developed a car parking system. The main purpose of these project was to put in all the knowledge our team has received while studying the Computer Engineering Technology program at Seneca College. This project is also stand-in as a chance to advance our inner talents and to develop our abilities as a team.

This project contains everything our team has learned till now like networking, hardware, software, and programming. The Arduino UNO is the soul around which the whole idea of our project is revolving. It controls the IR sensors, the LED screen, and the motor. The LCD screen is used to display messages to the user. A script(.ino file) will be running on the Arduino UNO that will control and monitor the signals transmitted between Arduino UNO and other components. This system can be easily powered on at 12 V. Because of its inexpensive cost, low power consumption, and limited maintenance requirements, this system is ideal for average people, and organizations to maintain clear parking spaces.

**INTRODUCTION**

The challenges linked with automobile parking are rising day by day in light of the current situation. Staff is present in the nearby parking lot to monitor the area and car entry and exit.

In today's packed cities, finding parking is a major concern. There are too many cars on the road, yet there aren't enough parking spots. One of the most serious issues arises when we arrive at a parking lot and discover that there are no available parking spaces. It's an important time. Another major issue is that after entering a large parking space, we are perplexed as to where to place our automobiles. Perhaps we have all encountered these two issues that have squandered our valuable time. That is why we require effective parking management systems in all parking locations to provide quick and convenient parking. But have you ever considered what happens in the parking lot when people are replaced by machines? Using Arduino UNO, we will create an automatic automobile parking system project.

The IR sensors will be used to monitor vehicle movement, and a 16x2 LCD will be used to display the current parking status. There will be three parking spaces. The system automatically joysticks whether a parking space is available. If the slot in the automated automobile parking is empty, new cars are permitted to enter otherwise, the entry will be stopped by the servo barrier if the parking is full. On a 16x2 LCD, visitors may view the status of the availability of free parking spaces outside the parking garage. They can also view how many parking spaces are available on the LCD. As cars enter and exit the parking lot, the data gets updated.

**Functional Features of Product**

**Arduino UNO:** The Arduino Uno is a board with a microprocessor on it. It holds 14 digital I/O pins (six of which may be used as PWM outputs),6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power connector, and an ICSP header, and a reset button. It comes with everything we need to support the microcontroller; simply connect it to a computer through USB or power it is using an AC-to-DC converter or battery to get started. This processor will take code through various connections built on the board. And then it will update all the movement of the car's entry and exit and will be displayed on LCD.

**IR Sensors:** An infrared sensor is an electrical device that emits light in order to detect an item in its surroundings. An infrared sensor can detect motion as well as to measure the heat of an item. This will sense the car’s entry and exit which will turn the servo motor according to need.

**Micro Servo Motor:** When the IR sensor senses the movement of the car, code implemented in Arduino will make sure that the motor will move from 0 degrees to 180 degrees. A stick-like solid material will be attached to the motor which will function as a barrier between the entry and exit levels.

**Jumper wire:** It is an electrical wire, or a set of them in a cable, with a connector or pin at either end that is generally used to connect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering. To connect different input/output pins of Arduino to LCD, Motor, and the Sensors.

**Breadboard:** A breadboard, often known as a protoboard, is a building platform for electrical prototyping. In this project, we will use our Arduino microprocessor as it prevents short-circuit issues.

**LCD:** . For this project, we will use it for showing output purpose.

**USB-Cable:** It is the staple for connecting and powering electronic devices. We will be using this for uploading our code to Arduino and it will also power our circuit.

**Specifications of Product**

**Arduino UNO:**

* Operating voltage : 5V
* Digital I/O pins : 14
* Flash Memory : 32KB
* EEPROM : 1KB
* Length : 68.6mm
* Width : 53.4mm
* Weight : 25g

**LCD 16x2:**

* The operating voltage of this display ranges from 4.7V to 5.3V
* The display bezel is 72 x 25mm
* Number of columns – 16
* Number of rows – 2
* Number of LCD pins – 16
* Characters – 32

**IR Sensor:**

* Power: 3.3V ~ 5V
* Dimension: 39mm × 15.5mm (including the IR LED)
* Mounting holes size: 3mm
* Detection range: 2cm ~ 30cm (depending on the obstacle's color, farthest for white)
* Detection angle: 35°
* Recommended environment: indoor, to avoid the sunshine effect

**Servo Motor:**

* The operating Voltage is +5V typically
* Rotation : 0°-180°
* Weight of motor : 9 gm

**Functional Description:**

**Hardware:**

Firstly, IR sensors(x2), one of the sensors will sense the entry and the other sensor will sense the exit. As the car passes by, the servo motor will rotate from 0 degrees to 90 degrees so that the car can pass through it. Same thing will follow for the exit also. On the Arduino board, the LCD will be connected directly through jumper wires (male to male).Also the LEDs will be connected to the circuit to indicate if the parking is totally empty or has space to park the car inside. In nutshell, when a car arrives at the parking area's gate, the display continually displays the number of available spots. If there are any empty slots, the system uses the servo motor to open the entry gate. When a car enters the parking area and occupies a slot, the display indicates that one of the slots is filled till it reaches the limit. The GREEN LED will also be ON continuously to indicate that there is space left in the parking. If there are no available parking spaces, the system indicates that all slots are full and does not open the gate. And the same thing will be displayed on the LCD screen. And in this case the RED LED will turn ON and the GREEN LED will turn off indicating that there is no more space left in the parking area.

**Software:**

First off, in the code, our team has initialized the motor, LEDs, LCD screen, and sensors. Our team has also mentioned the pins attached to IR sensors, motors, and LCD. Then after the total space available is mentioned which must be displayed on the screen. Our team has decided to go with 3 spots to make it easy to demonstrate. Also, the welcome note is written in the code which will be displayed on the screen and after a delay of 2 seconds. Our team has selected the IR sensors as an input device. Considering the entry sensor as SENSOR 1 and exit sensor as SENSOR 2, when the car will pass through SENSOR 1, it will sense the car and then open the barrier. Also, it will automatically subtract the total space available, left slots will be displayed on the LCD screen. When the car will pass through the exit sensor first which means the car wants to exit the parking slot, SENSOR 2 will sense the car and it will open the barrier from the other side. Also, it will add value to the total space available.

**Product Design, Implementation, and Operation of the System**

**System block-diagram**

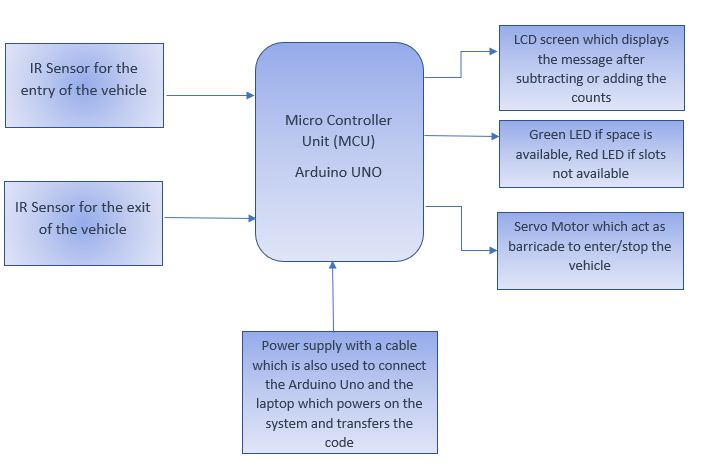
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Figure : Product design and structure

**Software Diagram**

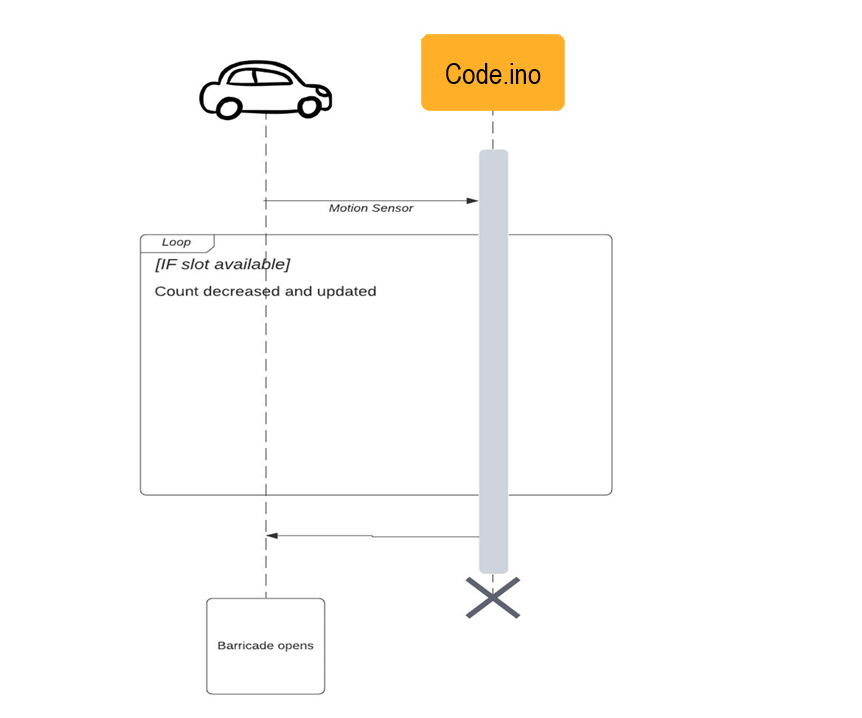
****

Figure : Software Diagram

**Theory of operation**

The major components of the project are the Arduino UNO, IR sensors, LEDs, motor, and LCD. As the control unit, the Arduino UNO is chosen for its hardware capabilities and the number of input/output signal pins it has. The Arduino UNO can support LCD. Also, it can withstand 9-12V signals. In this system, the Arduino UNO is connected to all the other components via its pins.

1) **Initialization**: The header files are included as Servo.h for the motor, Wire.h for the jumper wires, and LiquidCrystal\_I2C for the LCD screen. By adding this, it will initialize those parts.

**#include <Servo.h>**

**#include <Wire.h>**

**#include <LiquidCrystal\_I2C.h>**

2) **Defining sensors:** The sensors and the LEDs are assigned the pins of the Arduino UNO so that they work appropriately

**a. #define IR\_Sensor1 2**

**b. #define IR\_Sensor2 3**

**c. #define gatePin 5**

**d. #define redLed 6**

**e. #define greenLed 7**

3) **Occupancy:** The maximum slots are set as 3 and initially the slots occupied is set to 0.

**int maxSlots = 3;**

**int slotsOccupied = 0;**

4) **Defining input/output pins:** To set up all the equipment the following lines are used.

a**. void setup() {**

**b. Serial.begin(9600);**

**c. pinMode(IR\_Sensor1, INPUT);**

**d. pinMode(IR\_Sensor2, INPUT);**

**e. pinMode(redLed, OUTPUT);**

**f. pinMode(greenLed, OUTPUT);**

**g. digitalWrite(redLed, LOW);**

**h. digitalWrite(greenLed, LOW);**

**i. Gate.attach(gatePin); // Connect gate to its assigned pin**

**j. Gate.write(0); // Close the gate at the start**

**k. lcd.init(); // initialize the lcd**

**l. lcd.backlight();**

**m. // Print a message on the LCD display**

**n. lcd.setCursor(1, 0);**

**o. lcd.print("Initializing!");**

**p. lcd.setCursor(1, 1);**

**q. lcd.print("Parking System");**

**r. delay(3000);**

**s. lcd.clear();**

**t. }**



Figure : The "Initializing Parking System" message

5) **Increment/Decrement:** How our counting and displaying will work is \

**void loop() {**

**// Display the total slots in the parking on the 1st line of LCD display**

**lcd.setCursor(0, 0);**

**lcd.print("Total Slots: ");**

**lcd.setCursor(13, 0);**

**lcd.print(maxSlots);**

**// Display the slots remaining in the parking on the 2nd line of LCD display**

**lcd.setCursor(0, 1);**

**lcd.print(" Slots Left: ");**

**lcd.setCursor(13, 1);**

**lcd.print(maxSlots - slotsOccupied);**

****

Figure : Slots available and slots left message

**if (digitalRead(IR\_Sensor1) == LOW) { // If car is detected on the entry side**

**Serial.println("Car entering.");**

**if (slotsOccupied < maxSlots) { // If there are slots remaining**

**Gate.write(90); // Open the gate**

**delay(500);**

**while (digitalRead(IR\_Sensor2) != LOW) {**

**// Waiting for the car to enter**

**delay(500);**

**}**

**while (digitalRead(IR\_Sensor2) == LOW) {**

**// Waiting for the car to move away from the gate**

**delay(500);**

**}**

**slotsOccupied++; // Increment the number of slots currently occupied**

**Serial.println("Car entered.");**

**Gate.write(0); // Close the gate**

**}**

**else { // If no empty slots are available**

**// display No empty slots available message for 2 seconds**

**lcd.clear();**

**lcd.setCursor(0, 0);**

**lcd.print("No empty slots");**

**lcd.setCursor(0, 1);**

**lcd.print("available!");**

**delay(2000);**

**}**

**}**

****

Figure : "No empty slots available" message in the LCD screen

**if (digitalRead(IR\_Sensor2) == LOW) { // If car is detected on the exit side**

**Serial.println("Car exiting.");**

**Gate.write(90); // Open the gate**

**delay(500);**

**while (digitalRead(IR\_Sensor1) != LOW) {**

**// Waiting for the car to exit**

**delay(500);**

**}**

**while (digitalRead(IR\_Sensor1) == LOW) {**

**// Waiting for the car to move away from the gate**

**delay(500);**

**}**

**slotsOccupied--; // Decrement the number of slots currently occupied**

**Serial.println("Car exited.");**

**Gate.write(0); // Close the gate**

**}**

**if (slotsOccupied < maxSlots) { // If there are empty slots available, then turn ON the Green light and turn OFF red light**

**digitalWrite(redLed, LOW);**

**digitalWrite(greenLed, HIGH);**

**}**

**else { // If there are no empty slots available, then turn ON the red light and turn OFF green light**

**digitalWrite(redLed, HIGH);**

**digitalWrite(greenLed, LOW);**

**}**

**}**

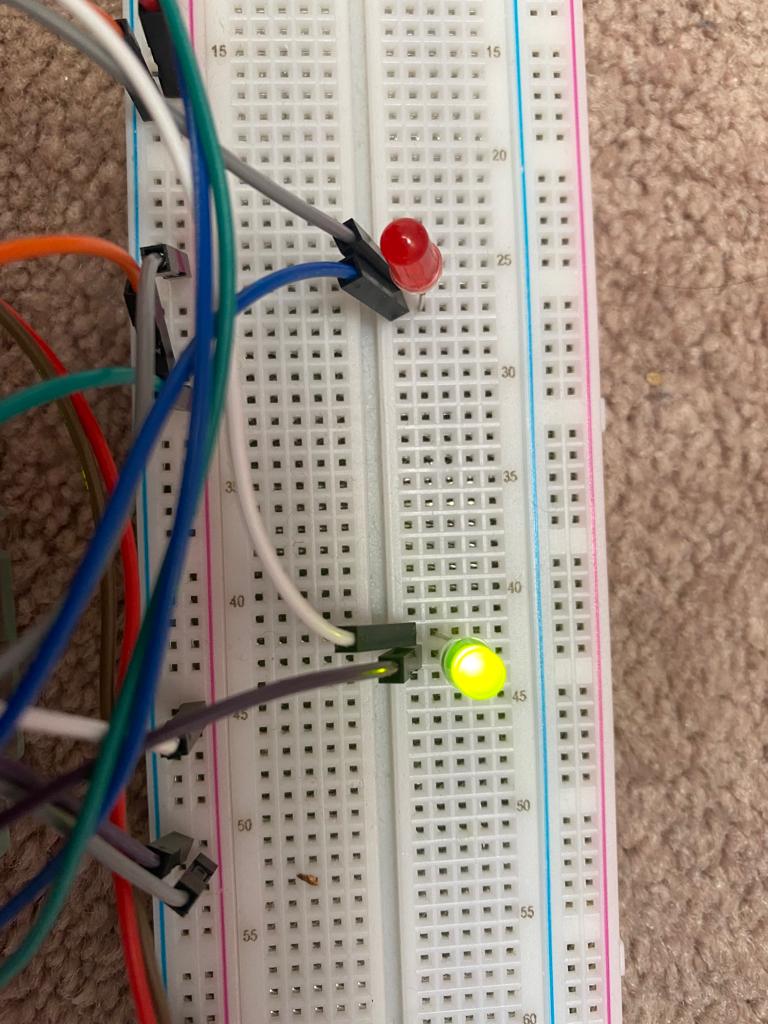


Figure : GREEN LED indicating space is left

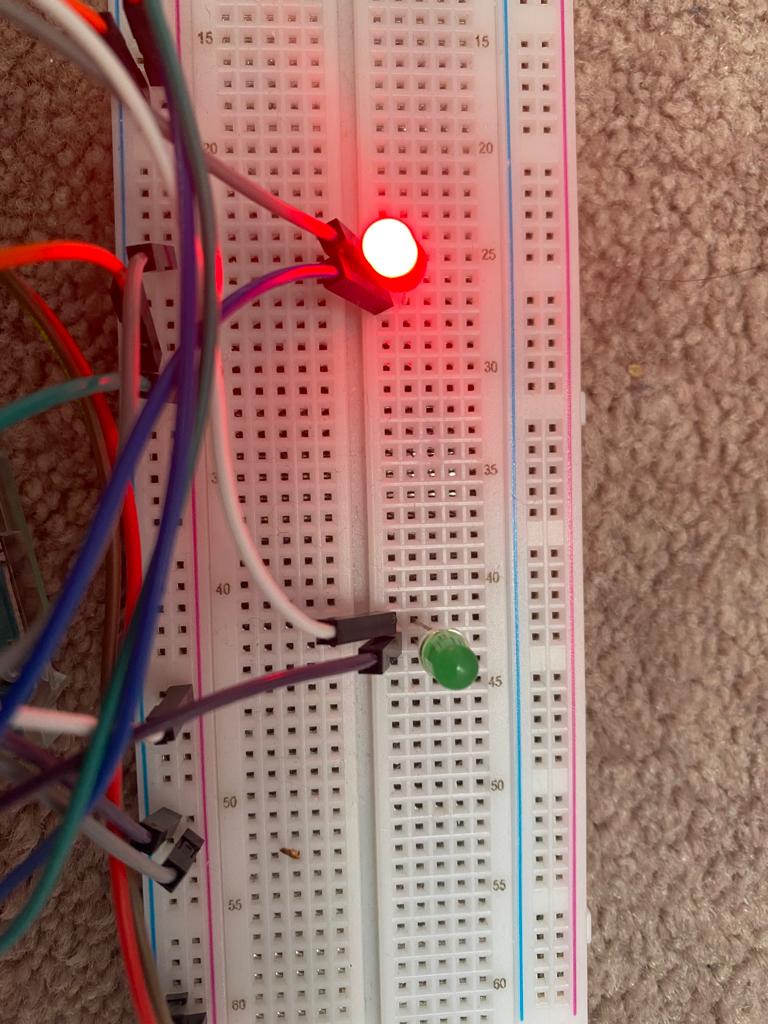


Figure : RED LED indicating space is full

**Maintenance Requirements**

The car parking system project does not require much maintenance. But several components are needed to be checked time to time.

1. Inspecting the parking system to examine if any sensor is unable to detect or not responding.
2. All aspects of safety and operation should be reviewed regularly so that you can get exact and perfect data which will eventually save time and cost.
3. As the sensors and barricade are very frequently used, we need to clean it frequently and should be sanitized more often.
4. It is also recommended not to upgrade Arduino UNO as it may cause disturbance in the project.
5. It is important to maintain the IR sensor in the summer as the life span of the IR sensor will be reduced. The temperature should be around 15 degree so that the sensor can work properly.

**Viability of the Product**

The car parking system project is a very viable because of the following reasons:

* It is very safe and easy to use.
* It is easy to connect to power supply.
* It is very cost efficient.
* It requires very less power.
* The setup is very compact in size.
* The maintenance is very limited.
* It is very flexible for very small areas.

**Difficulties faced**

Many hitches were laid in our path like:

* Arranging the components correctly so that the project work properly.
* Facing communication issues was the biggest difficulty our group faced.
* Making connections was also difficult as the whole project connections were little bit tricky.
* Writing the code was hard because our group was not very familiar with the Arduino UNO board and its system.
* Presenting the project online as it was very hard to explain anyone through the medium of computer.
* To figure out certain issues like the case of breakdown, no one will be able to move as the whole system would be down. So, it was important to solve this issue.

But overall, our team did very well, and the project was completed successfully. And we hopefully want our system to release it in the market on the small basis.

**Further Development**

For further development, Our system can be combined with payable parking either for daily, or for weekly, or monthly rates and live video cameras to keep an eye on a time limit. This system can also be enhanced in the future by adding a wide variety of applications, such as GSM-based internet booking, so clients can make their reservations at home or while in transit to shopping centers. Adding a distinctive sensor can further enhance this system's ability to distinguish the question and guide the driver or client in the quickest way. Automatic number plate recognition (ANPR) can be used for safety purposes. Also, the mechanical structure can be decreased, and try to make it eco-friendly. On the bigger level, a good business can be established by placing it in big areas so that more and more people get attracted and can pay and park with our system. We can also make the system more compact so that it can be flexible for any place.

**Conclusion**

Though this kind of parking system has shown widespread usage in many developed countries, many other backward countries do not have this kind of system. At minimal cost, this could be implemented, and the problem can be easily solved. This initiative aids automobile drivers in parking their vehicles with little time wasted by supplying precise information on the availability of parking spaces. Furthermore, the system offers a better parking system and convenience to the consumer. This system is limited maintenance and cost-effective, making it more attractive to common parking places. If we improve product functions, the system will become more powerful and perfect. Hopefully, it can be sold all over the world, not just in Canada.

This TPJ655 project has allowed us to put our professional talents to the test as well as show off our research abilities. This experience is indeed and will be beneficial in our future attempts. It also teaches us the teamwork and developed our communication skills .

**Appendix**

1. **Electrical Schematics**

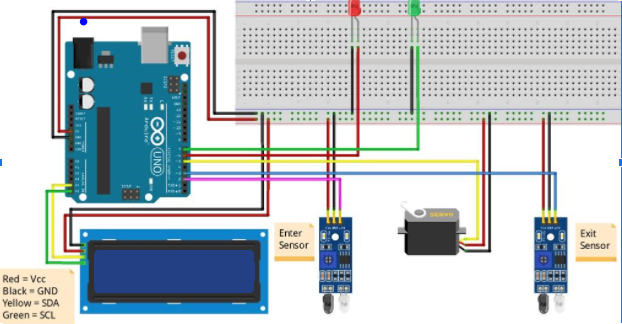
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Figure : Electrical Schematics

1. **Screenshot of the code:**

**Graphical user interface, text, application, email

Description automatically generated**

Figure : CODE.ino

Graphical user interface, application

Description automatically generated

Figure : CODE.ino

Graphical user interface, application

Description automatically generated

Figure : CODE.ino

Graphical user interface, application

Description automatically generated

Figure : CODE.ino

1. **Parts list**

|  |  |  |  |
| --- | --- | --- | --- |
| **Components** | **No. of Quantity** | **Unit Price (in CAD)** | **Total price (including tax)** |
|  |  |  |  |
| [**Arduino UNO**](https://www.amazon.ca/ARDUINO-A000066-Uno-DIP-1-5/dp/B008GRTSV6/ref=sr_1_8?crid=EGP7WAP3JG2M&keywords=arduino&qid=1643745383&sprefix=arduin%2Caps%2C297&sr=8-8) | **1** | **$ 27.99** | **$ 27.99** |
| [**IR Sensor**](https://www.amazon.ca/Gikfun-Infrared-Obstacle-Avoidance-EK1254x5C/dp/B07FFM7DYQ/ref=sr_1_1_sspa?keywords=arduino+ir+sensor&qid=1643745416&sprefix=arduino+ir+%2Caps%2C303&sr=8-1-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEyWTFQU0tWQVhVTk1FJmVuY3J5cHRlZElkPUEwNjc3NzYxM1BXOVRUSEVTTTdRUiZlbmNyeXB0ZWRBZElkPUEwNDA4NTkxMTA3OTcwS1ozREpaQiZ3aWRnZXROYW1lPXNwX2F0ZiZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU=) | **1\*** | **$ 11.98** | **$ 13.54** |
| [**180-degree Servo Motor**](https://www.amazon.ca/MMOBIEL-Airplane-Helicopter-Compatible-Raspberry/dp/B097RD8RB7/ref=sr_1_23_sspa?keywords=arduino+servo+motor&qid=1643745473&sprefix=arduino+ser%2Caps%2C438&sr=8-23-spons&psc=1&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEzUlNWTjdMUFE3SUs3JmVuY3J5cHRlZElkPUEwMjI3MzYyM1BQOFZLMTk5OFZQMSZlbmNyeXB0ZWRBZElkPUEwMzI2NjI5UTBNUThOOERERU84JndpZGdldE5hbWU9c3BfbXRmJmFjdGlvbj1jbGlja1JlZGlyZWN0JmRvTm90TG9nQ2xpY2s9dHJ1ZQ==) | **1** | **$ 14.39** | **$ 14.39** |
| [**16x02 LCD Display (With I2C module)**](https://www.amazon.ca/DSD-TECH-SH-D1602-Interface-Raspberry/dp/B07T8S3P1M/ref=sr_1_5?keywords=arduino+i2c+lcd&qid=1643745511&sprefix=arduino+i2c%2Caps%2C349&sr=8-5) | **1** | **$ 16.99** | **$ 19.20** |
| [**Breadboard**](https://www.amazon.ca/BusBoard-Prototype-Systems-BB830-Solderless/dp/B0040Z4QN8/ref=sr_1_3?crid=3RL39KBDRR18O&keywords=breadboard&qid=1643917233&s=industrial&sprefix=btreadb%2Cindustrial%2C119&sr=1-3) | **1** | **$ 9.60** | **$ 10.85** |
| [**Jumper Wires**](https://www.amazon.ca/gp/product/B01EV70C78/ref=ewc_pr_img_3?smid=A2WWHQ25ENKVJ1&psc=1) | **1** | **$ 16.99** | **$ 19.20** |
|  |  |  |  |
| **Total** |  |  | **$ 105.17** |

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[**https://bit.ly/3IQd0lJ**](https://bit.ly/3IQd0lJ)

[**https://bit.ly/3Ghsxcr**](https://bit.ly/3Ghsxcr)

[**https://bit.ly/3Gf4XNx**](https://bit.ly/3Gf4XNx)

[**https://www.geminiparkingsolutions.com/blog-post/advantages-of-parking-management-systems/**](https://www.geminiparkingsolutions.com/blog-post/advantages-of-parking-management-systems/)

1. **Contact Information**

|  |  |  |  |
| --- | --- | --- | --- |
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