A

Real Time/ Societal Research project Report

on

"Smart Parking System using Arduino"

Submitted in Partial fulfillment of the Academic Requirement for the Award of Degree of

BACHELOR OF TECHNOLOGY

in

ELECTRONICS AND COMMUNICATION ENGINEERING

Submitted by

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Under the esteemed guidance of

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CMR INSTITUTE OF TECHNOLOGY

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CERTIFICATE

This is to certify that a Real Time/ Societal Research Project entitled with ***"Smart Parking System using Arduino"*** is being submitted by:

R. TEENA SREE **22R01A0454**

to JNTUH, Hyderabad, in partial fulfillment of the requirement for award of the degree of B. Tech in Electronics &Communication Engineering and is a record of a bonafide work carried out under our guidance and supervision. The results in this project have been verified and are found to be satisfactory. The results embodied in this work have not been submitted to have any other University forward of another degree or diploma.

Project Supervisor **HOD, ECE**

(Mr. D. Rahul) **(Dr. K. Niranjan Reddy)**

EXTERNAL EXAMINER

ACKNOWLEDGEMENT

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We will be failing in duty if we do not acknowledge with grateful thanks to the authors of their references and other literatures referred in this Project.

We express our thanks to all staff members and friends for all the help and coordination extended in bringing out this Project successfully in time.

Finally, we are very much thankful to our parents and relatives who guided directly or indirectly for every step towards success.

R. TEENA SREE **22R01A0454**

DECLARATION

We **R. TEENA SREE (22R01A0454), R. KARTHIK REDDY (22R01A0457), N. REVATHI (22R01A0444), U. HARSHITH (22R01A0462)** of the Project entitled as ***"SMART PARKING SYSTEM USING ARDUINO"*** hereby declared that the matter embodied in this Real Time/ Societal Research project is the genuine work done by us only and has not been submitted either to the university or to any university/institute for the fulfillment of the requirement of any course of study.

R. TEENA SREE **22R01A0454**

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ABSTRACT

This project is to set up a smart parking system. According to primary investigation, nowadays maximum people want a smart parking system for hassle free parking with digital assistant. The IR Detection Sensor is utilized with Arduino to indicate the empty slot. By measuring the distance drivers can find the empty slot in parking to park the car and help the driver to find the slot easily and reduce the searching time. As the parking place is found to be empty it is detected. We achieved this by programming the sensors and Arduino. This sensor and Arduino Microcontroller based technological solution can prevent inadequate parking, take payment digitally and save time and manpower. This can be a sustainable solution at a cheaper cost. The discussed systems will be able to reduce the problems which are arising due to the unavailability of a reliable, efficient and modern parking system, while the economic analysis technique will help in analyzing the projects' feasibility.

The smart car parking project aims to provide confusion free and easy parking. This project helps the drivers of cars to park their vehicles with minimum waste of time with accurate information of the availability of the space to park. It includes an Arduino Uno as the microcontroller unit to which the servo motors, LCD display is interfaced. The LCD displays the availability of the space, the IR sensors keep the check of the number of cars entering and exiting the parking space. The IR sensors detect the availability of the parking space.

FIGURE NAMES

LIST OF ABBREVATIONS

1	LCD	Liquid crystal display
2	MCU	Mirco Controller Unit
3	I/O	Input/output
4	USB	Universal Serial Bus
5	IR	Infrared Sensor
6	IDE	Integrated Development Environment
7	GND	Ground
8	PWM	Pulse width modulation
9	IC	Integrated circuit
10	PC	Personal Computer
11	LED	Light-emitting Diode
12	TV	Television
13	VCC	Voltage Common Collector
14	VEE	Voltage Emitter Emitter
15	5VDC	5 volts of direct current
16	PIR	Passive Infrared Sensor

INTRODUCTION

1.1 Background of study and motivation:

Parking is a major problem in our country. Drivers in our country cannot properly park their vehicle in the parking slot because of improper parking systems. Sometimes when they do not find any parking space, they park their vehicle in the roadside and as a result roads become so narrow and occurs traffic jam.[1] Also, sometimes it seems that people start fighting for parking slot in the parking lot. Because from outside people cannot understand whether there is any parking space available or not. It also wastes a lot of time. Till now no smart technology has existed to solve this problem. This project will change and standardize the parking system for a parking lot. [3]

An automated car parking system is a process through which car parking can be done more efficiently and easily than the manual method. The system will provide the user with better services. The system counts the number of cars in the garage and checks if there's any vacancy. There's an entry and exit path. When the vehicle enters, the display shows the number of cars inside. When any vehicle leaves, the count decreases and is shown on display.[2] If the garage is full. The display will show a message regarding that. This whole process includes the use of Arduino, Display and sensor. The sensor detects whether the vehicle is entering or leaving. The report then showed on display. [5]

1.2 Project Objectives:

The objectives to be achieved are:

- Providing safe and secure parking spots within a limited space.
- Developing a sophisticated automated parking system that lowers workforce, and traffic congestion and saves time.
- Automatically keeping count and monitoring total entered and exited vehicle and calculate free available slots.
- To optimize the use of parking space by reducing the time spent searching for a vacant spot.
- To automate the parking process, making it more convenient for drivers.

Methodology and Modelling

2.1 Introduction:

The rapid advancement of technology has significantly influenced various aspects of urban infrastructure, leading to the development of smart systems designed to enhance efficiency and convenience. Among these innovations, smart car parking systems have emerged as a crucial solution to address the challenges associated with urban parking, such as space management and congestion. This project focuses on the design and implementation of a smart car parking system utilizing an Arduino Uno microcontroller, an IR sensor for vehicle detection, and a servo motor for barrier control.

The primary goal of this project is to create an automated parking management system that can detect the presence of a car in a parking spot and accordingly manage a barrier to allow or restrict entry. By leveraging affordable and readily available components, this system aims to provide a cost-effective solution that can be easily implemented in various parking environments.

In the following sections, we will outline the methodology and modelling of the smart car parking system. This includes the selection and configuration of components, the design of the circuit, and the development of the control algorithm. Through this comprehensive approach, we aim to demonstrate the practical application of Arduino-based systems in solving real-world problems and enhancing the functionality of urban infrastructure.

A Smart Car Parking system using Arduino is a technology-driven solution designed to streamline the parking process. It utilizes the Arduino microcontroller as the brain of the system, which is programmed to control and manage parking spaces efficiently.

The system typically includes sensors to detect the presence or absence of cars in parking slots, display panel for showing availability, and a network connection to relay information to a central management system or app. This setup allows drivers to quickly identify open parking spots, reducing time and fuel spent searching.

The Arduino's programmability enables customization of the system to fit specific needs, such as integrating payment systems or access controls.

2.2 Circuit Diagram of the proposed project

The circuit shown in Fig. 1 an Arduino microcontroller (MCU) requires only 5V. As Arduino Uno has an inbuilt 5V voltage regulator, a common 5V supply can be used for the whole system.

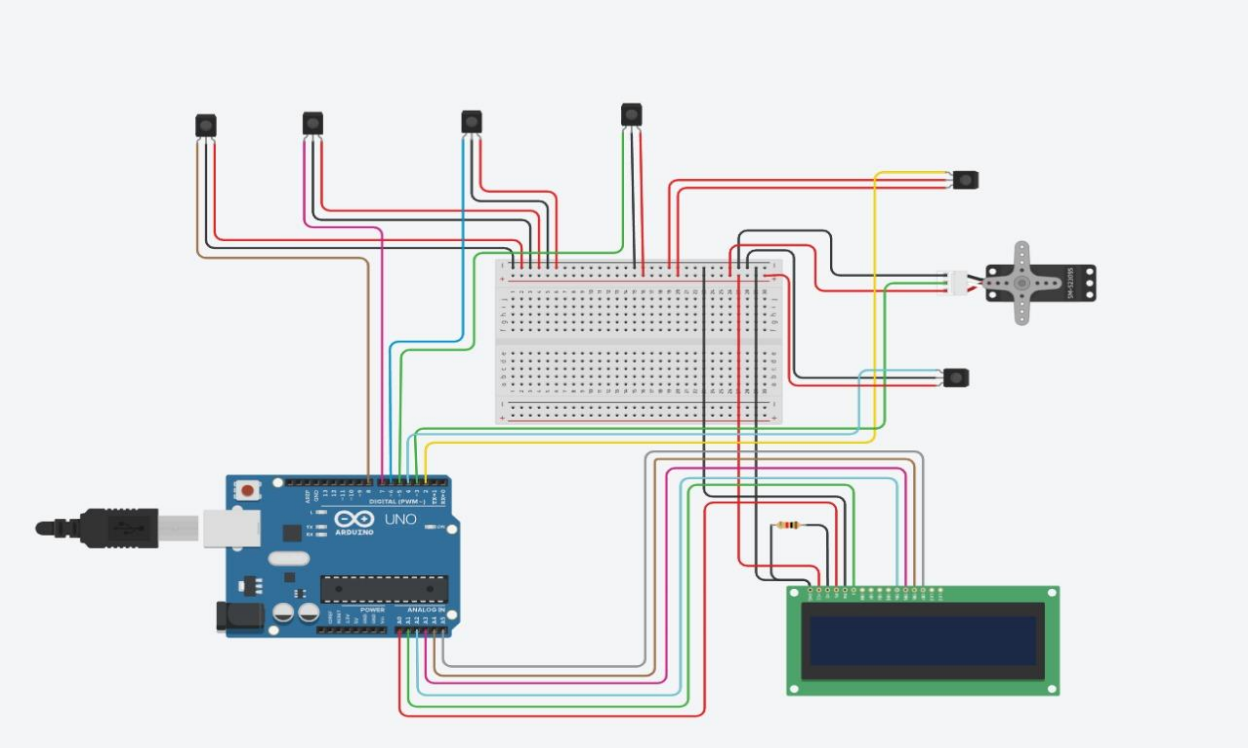

Figure-2.1: Circuit diagram of car parking system

The circuit shown in Fig. 1 an Arduino microcontroller (MCU) requires only 5V. As Arduino Uno has an inbuilt 5V voltage regulator, a common 5V supply can be used for the whole system.

The brain of the circuit is Arduino Uno MCU board (BOARD1). It is based on Arduino UNO R3 V1.0 and has 14 digital input/output (I/O) pins, six analogue inputs, servo motor, a USB connection, IR sensor. It can be programmed using Arduino IDE software IR sensor are connected to Arduino digital pins 2 and 3 and servo motor are connected to Arduino pins 13, which are used for serial communication.

The LCD display (LCD) is used to display messages during action. Here, a 16×2 display is used; each character is made of 5×7 dot-matrix. Pins 3, 4, 5 and 6 of the LCD are the control lines connected to preset (PR1) output, pin 12 (Arduino), GND and pin 11 (Arduino). Pins 11, 12, 13 and 14 are data pins of the LCD that are connected to pins 7, 6, 5 and 4 of Arduino, respectively.

2.3 Construction and working principle:

2.3.1 Process of work

The construction and working of the project are divided into two parts: -

Entry Part:

The project is a sensor based automatic system. The Entry Part of the project consists of Arduino UNO microcontroller to which a servo motor, IR sensor, LCD are interfaced. The servo motor acts as a gate at the entrance, and it opens and closes when the IR sensor detects the presence of car. The input IR sensors read presence of any car and sends to the controller Arduino UNO board. While the entry IR sensor detects cars, it opens the door in condition of having available slot. After entering the car, the gate gets closed with the help of servo motor. The motor gets instructions from the board. The LCD displays the parking slots which are empty for car drivers. While A car gets into a slot, the corresponding slot status in the LCD display shows "Total Slots". At the time of exiting a slot, the status of the slot changed to "Slots Occupied". When all the slots are booked, the system doesn't allow the fifth car to enter, and shows "Sorry parking full". The IR sensors detect the presence and absence of cars in each parking slot.

Exit Part

The Exit Part of the project consists of Arduino Uno to which a servo motors, IR sensor and the object counter are interfaced. The servo motor acts as a gate at the entrance, and it opens and closes when the IR sensor detects presence of car. When a car exits from a slot, the exit IR sensor detects the car and opens the gate with the servo motor. Then the total available free slot count increase by 1 in the screen.

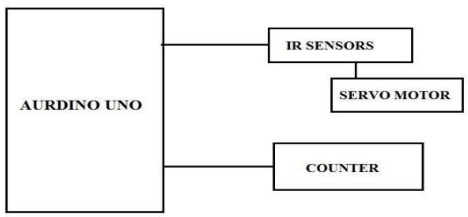

Figure-2.2: Exit part of car parking system

2.4 Hardware Design

Hardware equipment that we need to build the project are given below:

- Arduino UNO
- LCD Screen
- Bread Board
- Power Supply
- Connecting Wires.

2.5 Description of the important component:

First, we use Proteus software to complete the simulation. in this simulation, we've used some important components to build the whole parking system, which are Arduino UNO R3 V1.0, 16x2 Alphanumeric LCD Display Module, MOTOR-PWMSERVO, IR sensor with module.

2.5.1 Arduino Board:

Arduino is a project made by the largest technical community of engineers, developers and hobbyists whose goal is to develop ideas and interactive control projects around the world, based on different types of electronic panels but programmed in a language Single programming and free.

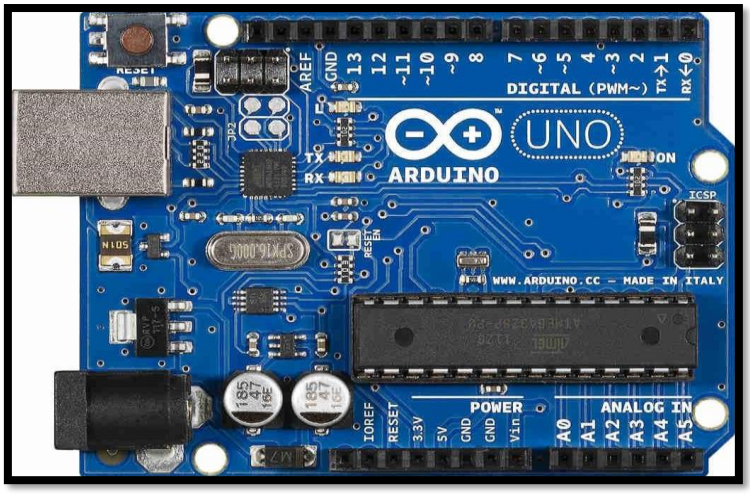

Figure 2.3: Arduino UNO Board.

Sure, Arduino is not the only electronic controller in the market, but there are many micro-controllers available in the market such as Parallax, Basic Stamp and the most powerful competitor, Raspberry Pi, all with powerful capabilities and the ability to work. Full projects, of course depending on the needs of your project, but what distinguishes the following Arduino Open-source platform Open-Source Hardware and Software.[23]

Arduino is made primarily of ATMEGA8 and ATMEGA168 controllers, and all its designs are licensed under the Creative Commons license. This is the most important feature for electronic circuit designers because it makes it easier for them to design anything they want. The software is written in C ++, and is available to everyone to download and programmers can modify it according to their needs.

It is the most widely used and widely used one of the many Arduinos. It is the first choice for beginners. It is easy to learn. It operates with an ATmega328 controller. This type has 14 digital ports (I / O), 6 of which can be used as ports to control the " PWM Outputs ", the most important feature of this type is that the control chip" ATmega328 "is not fixed in the board but installed on the holder of the integrated circuit" IC ". This feature makes it the best option for beginners so that if burned the slide while working on your project by mistake, you can Restore your work on the board as soon as you change the slide The ATmega328 controller is similar to the same model.

The first-ever type of Arduino's motherboard is the ATmega32u4 controller, which has a unique feature that contains a built-in USB connection, eliminating the need to use a secondary processor. The feature allows the panel as soon as it is connected to your device to appear as a keyboard and mouse, which makes it ideally suited to build various applications that enable you to control your PC. [23]

Advantages of Arduino:

- **Simplicity**

  Arduino's paintings are designed to suit the needs of all engineers, designers, professors, students, and interactive electronics enthusiasts around the world.

- **The price**

The Arduino Plate is less expensive than any competitor of the same type. The most expensive painting is not more than 600.

- **Self-Assembly**

Easy to deal with and easy to connect circuits, as we mentioned in our first article

that it was an easy solution to the problem of microcontrollers and complex connections.

- **Multi-platform**

The Arduino program can work with all the different operating systems of Windows, Mac and Linux, while most other boards running on Windows only

2.5.2 16x2 Alphanumeric Display

16x2 Alphanumeric Display means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in a 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

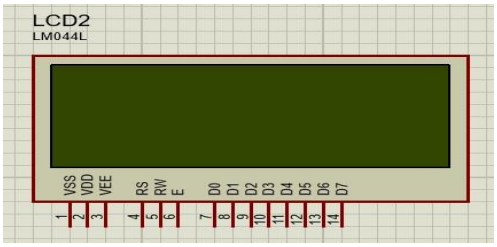

Figure 2.4: 16x2 Alphanumeric Display

The term LCD , It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations etc.

- **LCD 16×2 Pin Diagram**

- Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.
- Pin2 (VCC/Source Pin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.
- Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.
- Pin4 (Register Select/Control Pin): This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).

- Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).
- Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.
- Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8-pins are connected to microcontroller unit like 0 to 7.
- Pin15 (+ve pin of the LED): This pin is connected to +5V.
- Pin 16 (-ve pin of the LED): This pin is connected to GND.

- **Features of LCD 16x2**

  The features of this LCD mainly include the following.

- The operating voltage of this LCD is 4.7V-5.3V.
- It includes two rows where each row can produce 16 characters.
- The utilization of current is 1mA with no backlight.
- Every character can be built with a 5×8-pixel box.
- The alphanumeric LCDs alphabets & numbers.
- Is display can work on two modes like 4-bit & 8-bit.
- These are obtainable in Blue & Green Backlight.
- It displays a few custom generated characters. [24]

2.5.3 SERVO MOTOR:

A servo motor is a rotary actuator that enables precise control over angular position, velocity, and acceleration. It comprises a motor, gearbox, control circuitry, and a feedback mechanism. Unlike conventional motors that simply rotate continuously when powered, a servo motor can rotate to a specific angle based on the input it receives from a controller. This precise control capability makes servo motors indispensable in various fields, including robotics, industrial automation, aerospace, and automotive systems.

Figure 2.5: SERVO MOTOR

The servo engine is a motor that comes with a Gear gearbox and a Shaft transmission that gives motion greater torque and greater precision. This engine can rotate 180 degrees and in some types 360 degrees. The servomotor is internally made up of a "mostly microcontroller" control circuit. When the engine gives pulses at a certain time constant, the engine rotates to the angle according to that time constant. In the Arduino, programming environment there is a library called Servo Library installed in the program. This library gives us the ability to control most of the 180-degree Cervo drives. At the end of this post, you will have the ability to use the library's commands through practical examples.[25]

It consists of three parts:

- Controlled device
- Output sensor
- Feedback system

It is a closed-loop system where it uses a positive feedback system to control motion and the final position of the shaft. Here the device is controlled by a feedback signal generated by comparing output signal and reference input signal.

Here reference input signal is compared to the reference output signal and the third signal is produced by the feedback system. And this third signal acts as an input signal to control the device. This signal is present if the feedback signal is generated or there is a difference between the reference input signal and reference output signal. So, the main task of servo mechanism is to maintain the output of a system at the desired value at presence of noises.[25]

- **2.5.4 IR Sensor:**

An infrared (IR) sensor is a type of electrical gadget that detects and measures infrared radiation in its surroundings. In the year 1800, an astronomer named William Herchel made an unintentional discovery of infrared radiation. He found that the temperature just beyond the red light was the highest when measuring the temperature of each hue of light (separated by a prism). Because the wavelength of IR is longer than that of visible light, it is invisible to the human eye (though it is still on the same electromagnetic spectrum). Infrared radiation is emitted by everything that emits heat (anything with a temperature over roughly five degrees Kelvin).[27]

Figure 2.6: Obstacle Infrared Sensor module MOD56

The IR sensor module includes five essential parts like IR Tx, Rx, and Operational amplifier. The pin configuration of the IR sensor module is discussed below.

- VCC Pin is power supply input
- GND Pin is power supply ground
- OUT is an active-high o/p

The main specifications and features of the IR sensor module include the following.

- The operating voltage is 5VDC
- I/O pins – 3.3V & 5V
- Mounting hole
- The range is up to 20 centimeters
- The supply current is 20mA
- The range of sensing is adjustable
- Fixed ambient light sensor

- **Types of IR Sensor**

The classification of IR sensors can be done based on the application which includes the following.

- Active Infrared Sensors
- Passive Infrared Sensors

- **Active IR Sensor**

This type of sensor includes both the emitter & the receiver which are also known as transmitter & receiver. In most situations, a laser diode or LED is used as a source. For non-imaging infrared sensors, LED is used whereas laser diode is used for imaging infrared sensors.

The working of an infrared sensor can be done through radiating energy, detected and received through the detector. Further, it is processed through a signal processor to fetch the required data. The best examples of active infrared sensors are reflectance & break beam sensors.[27]

- **Passive Infrared Sensor**

Passive Infrared Sensor (PIR) includes detectors only and this kind of sensor uses targets like infrared transmitters or sources. Here, the object will radiate energy & detect it through infrared receivers. After that, a signal processor is used to understand the signal to obtain the required data. The best examples of PIR sensors are bolometer, Pyro-Electric Detector, Thermocouple-Thermopile, etc. PIR sensors are available in two types like thermal IR sensor and quantum IR sensor.[27]

2.5.5 Other Components:

The project uses some other electronic components like:

- Board:

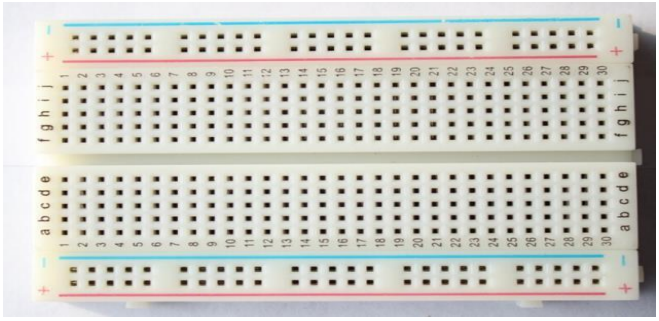

Figure -2.7.1: Bread Board.

- Connecting wires:

Figure -2.7.2: Connecting Wires.

2.6 Flow Chart

The flow chart includes how the system works. The program flow chart is given below:

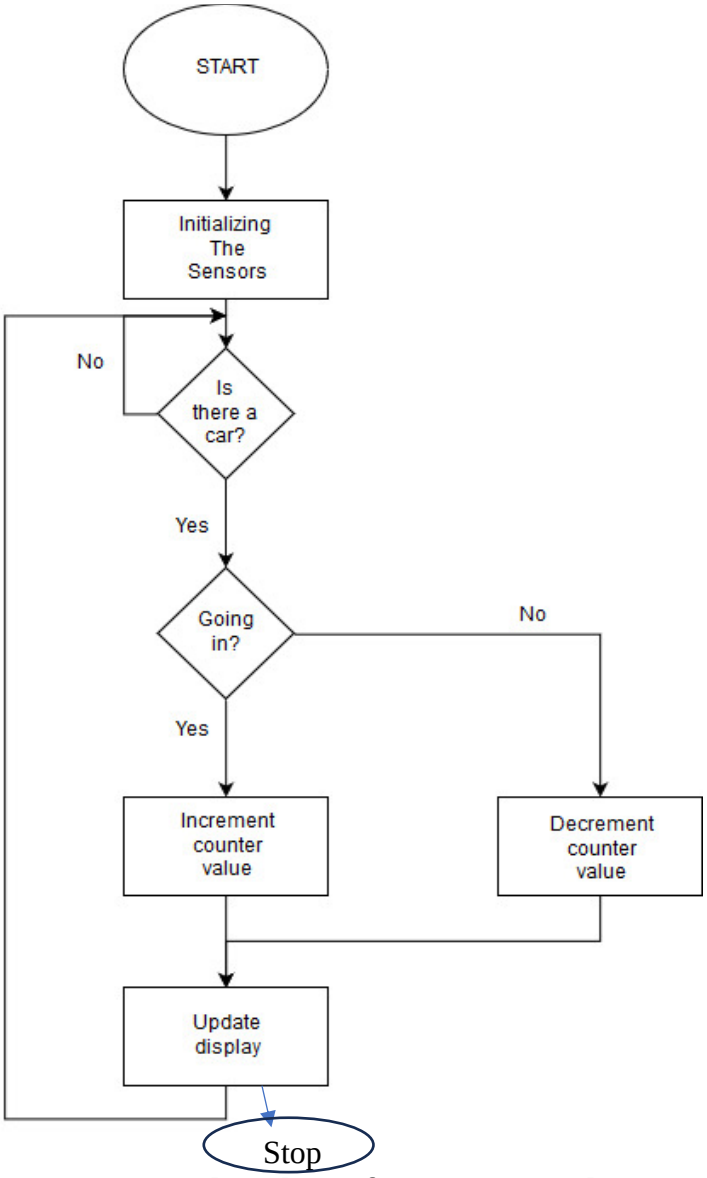

Figure 2.8: Flow chart of Smart Car Parking System

2.7 Implementation:

To implement the Smart Parking System, we have used Proteus professional 8.12 simulating software and Arduino IDE. Figure 9 shows the simulation implementation of the project.

Firstly, A new project created without any firmware in proteus. After creating the blank new project, there will be a schematic diagram window. In this schematic window, the simulation circuit is constructed. All of the devices used here, were found under pick device option. Arduino UNO R3 V1.0 was chosen as microcontroller board for Smart Parking System. This system works on the basis of some major components such as Arduino UNO R3, IR-SENSOR, MOTOR-PWMSERVO, LM044L 16x2 Alphanumeric Display had used in this project.

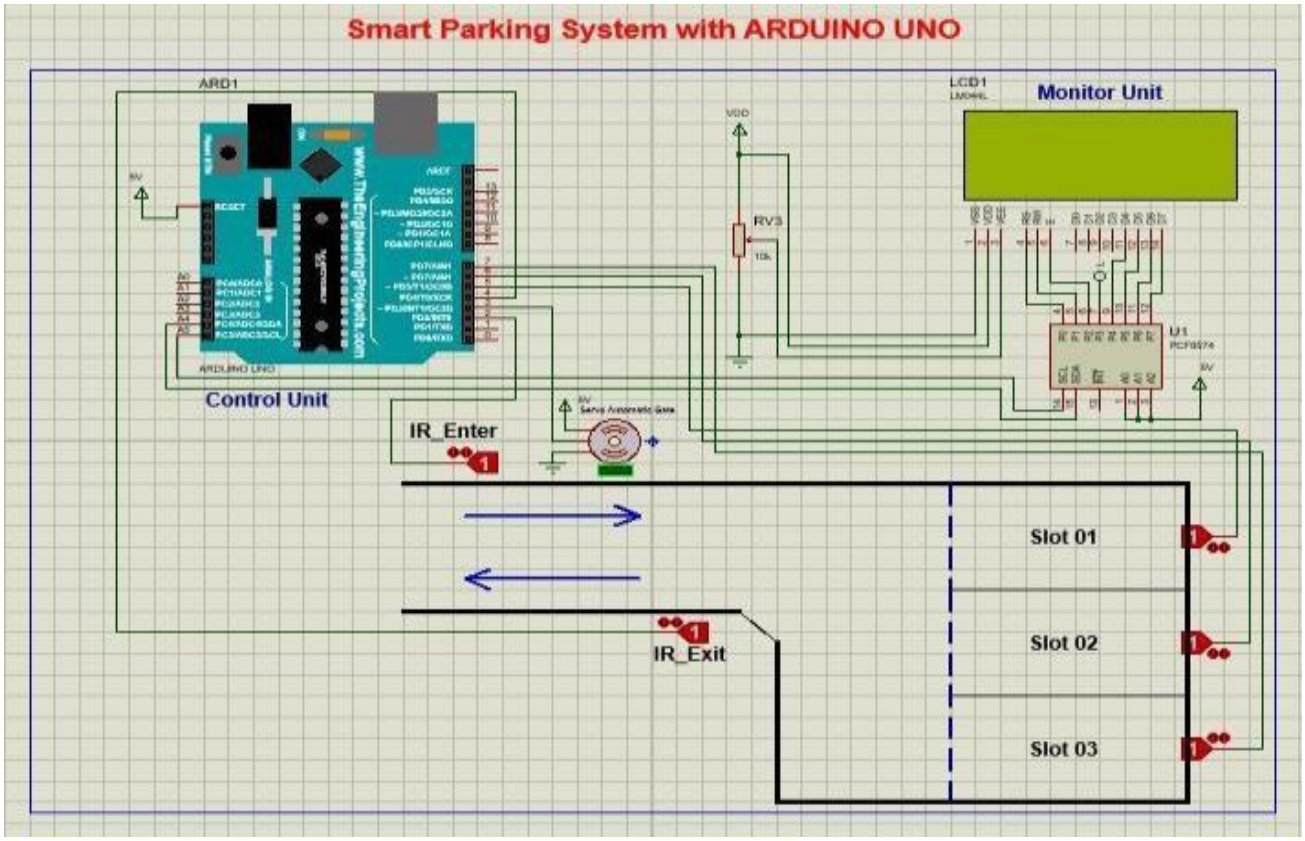

Figure-2.9: The Schematic View of Smart Parking System using Arduino UNO

The display was connected to the board through the expander. So basically, we have used the LM044L 16x2 Alphanumeric Display to print the slot list, each slot payment status of the parking lot. For the connection of the Display, we used Remote 8-bit I/O expander to reduce

the connection with the Arduino pin. As it is a simulation-based project, IR sensor use was not too easy. The logic states are used to show the functionalities of the IR sensors. Every logic state connected to individual digital I/O pin of the Arduino UNO. The servo motor was also connected with a digital pin for getting instruction and it get external power to run.

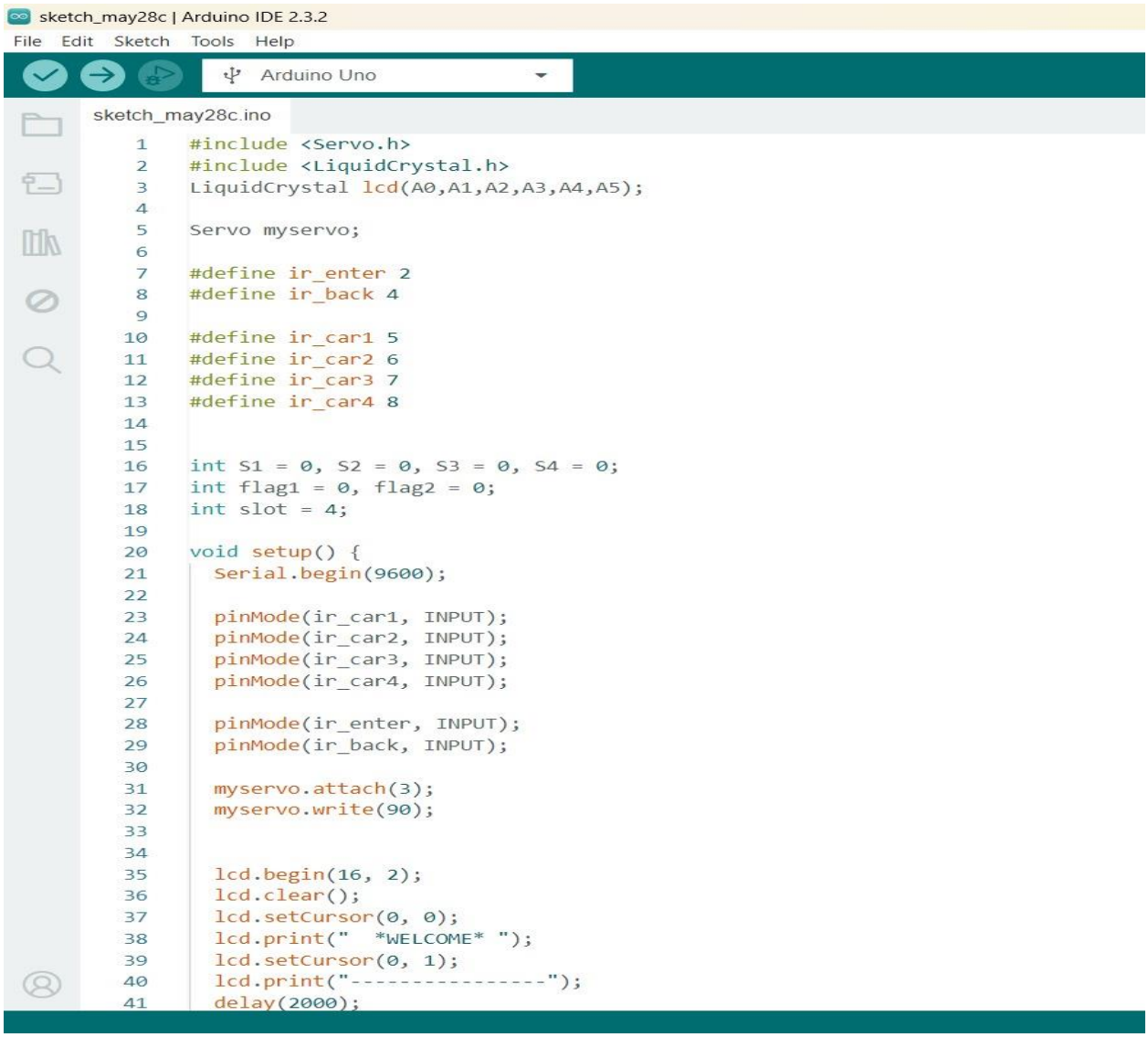

Figure 2.9.1: The code window on Arduino IDE

Two IR sensors are set at the gate of the parking spot to detect entry and exit of car. Each slot also has an IR sensor to identify slot is empty or not. The servo motor rotates 180 degrees to open the gate and 90 degrees to close the gate. After setting up the components as figure 9, we went to Arduino IDE and installed all the necessary libraries to run the project successfully. Then the codes/commands were written and uploaded to the Arduino Board. After uploading finely, the code worked without any errors.

2.8 Test/Experimental setup:

While doing the setup, the project was evaluated to determine if every functionality is accomplished or not. The code was edited as proposed requirements.

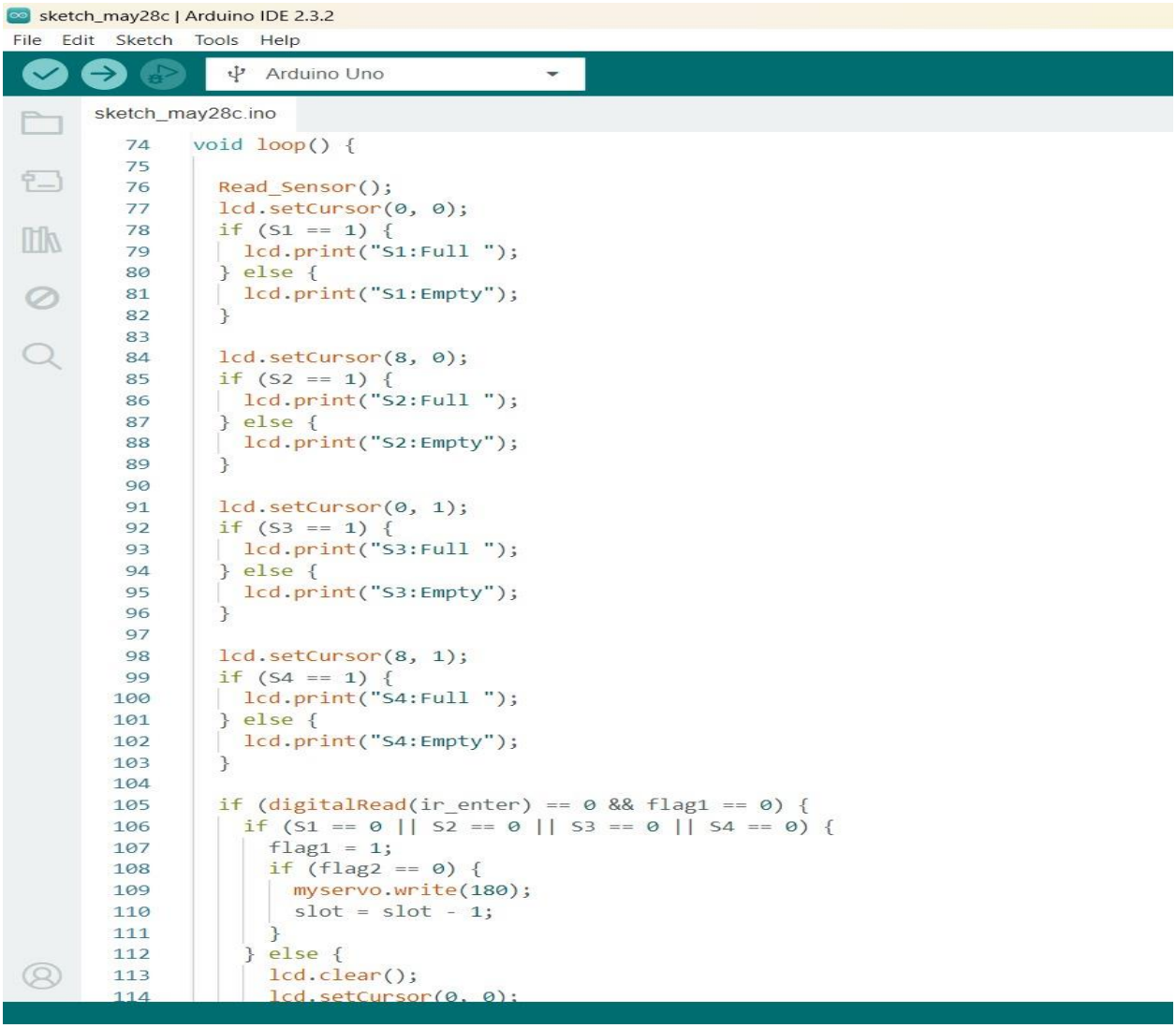

Figure-2.9.2: File in Arduino IDE

After running the instruction code finely, there will be a file found under IDE's compiler console and this file location should be copied. In proteus, double click on the Arduino board and in the program file section, paste the link without any change. Click ok and run the simulation. The system will run expectedly. All the output was observed while running the simulation as follows.

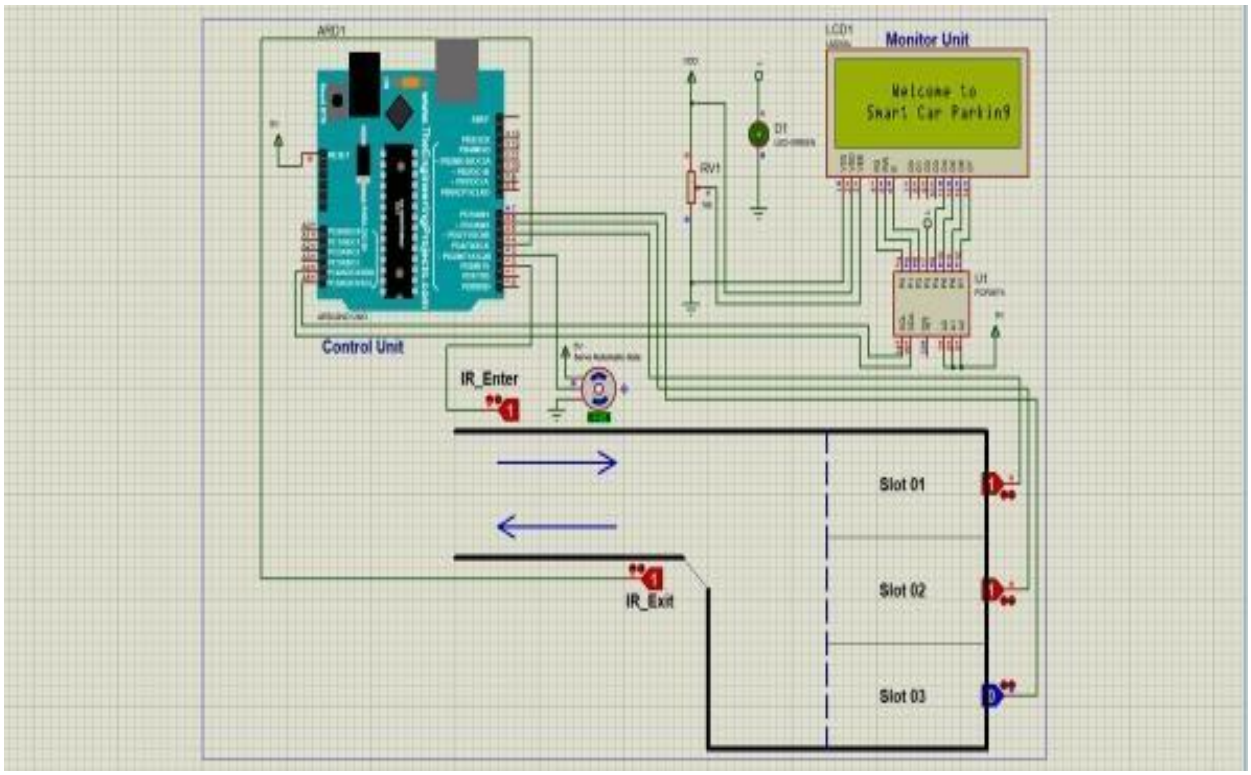

Figure-2.9.3: After Simulation Run Successfully

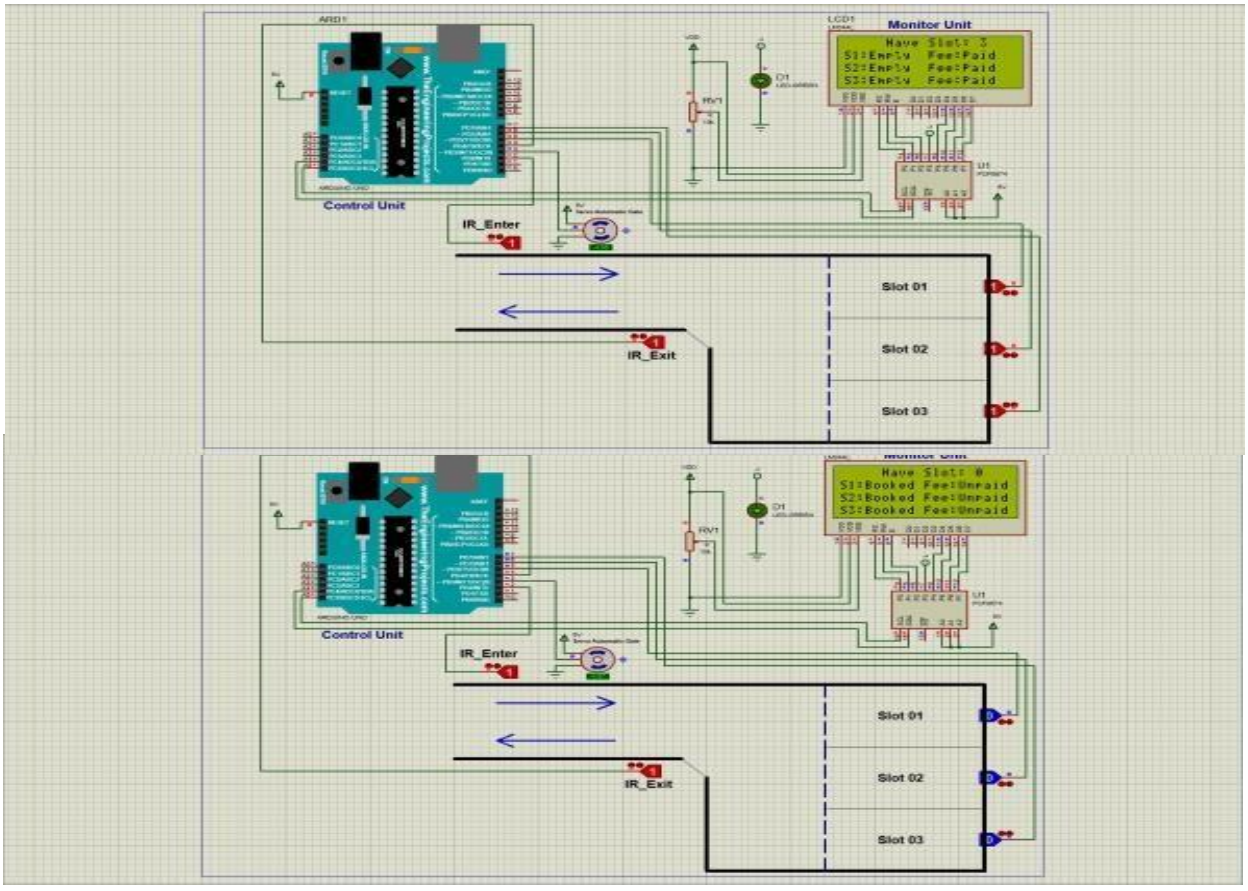

Figure-2.9.4: Running Simulation

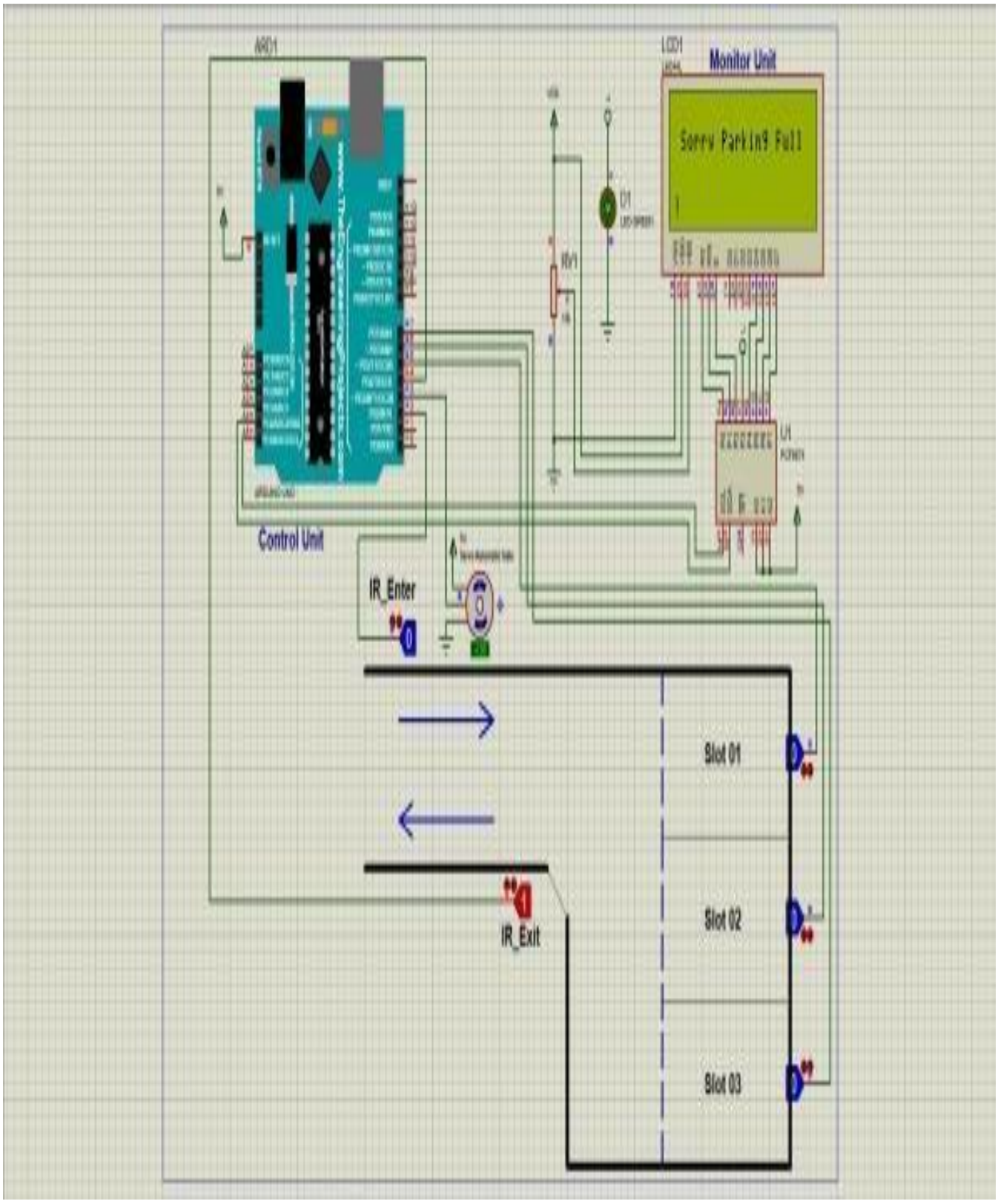

Figure-2.9.5: Running Simulation

2.9 Problem Statement:

- **Parking Lot Problems**

Difficulty in Finding Vacant Spaces Quickly finding a vacant space in a multilevel parking lot is difficult if not impossible, especially on weekends or public holidays. Finding spaces during weekends or public holidays can take more than 10 minutes for about 66% of visitors. Stadiums or shopping malls are crowded at peak periods, and difficulty in finding vacant slots at these places is a major problem for customers. Insufficient car park spaces \ lead to traffic congestion and driver frustration.

- **Improper Parking**

If a car is parked in such a way that it occupies two parking slots rather than one, this is called improper parking. Improper parking can happen when a driver is not careful about another driver's rights. This is tackled by the development of automated smart car parking system.

RESULTS

- It guarantees snappy and computerized parking and simple recovery of vehicles.
- Up to 3 cars can be effectively and securely parked in the outlined model.
- The surface space required is identical to the parking spot of two cars as it were.
- Most reasonable for parking in workplaces, shopping centers and comparable spots.
- Low support levels are required by the framework.
- Sensors utilized have high affectability and are anything but difficult to deal with.
- Minimal effort framework, giving most extreme computerization.
- It doesn't require observable pathway operation.
- Cordial reorientation of cars for driving in and out.
- Security of vehicle.

3.1 Hardware Connections:

- Connect the Vcc stick to the positive rail on your breadboard.
- Connect the Gnd stick to the negative rail on your breadboard.

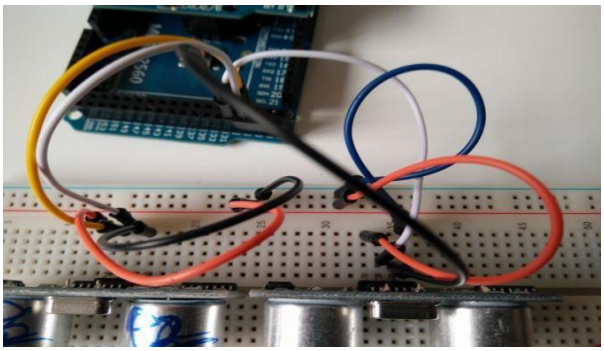

Figure 3.1: Working model of Smart Car Parking System

- Connect the Trig stick to any advanced stick on the Arduino.
- Connect the Echo stick to any computerized stick on the Arduino.
- Finally, interface the positive rail of the breadboard to 5V stick on the Arduino and the negative rail of the breadboard to the Gnd stick on the Arduino.

3.2 CODE:

```
#include <Servo.h>
#include <Wire.h>
#include <LiquidCrystal.h>
LiquidCrystal lcd(A0,A1,A2,A3,A4,A5);
Servo myservo;
#define ir_enter 2
#define ir_back 4

#define ir_car1 5
#define ir_car2 6
#define ir_car3 7
#define ir_car4 8


int S1 = 0, S2 = 0, S3 = 0, S4 = 0;
int flag1 = 0, flag2 = 0;
int slot = 4;

void setup() {
  Serial.begin(9600);

  pinMode(ir_car1, INPUT);
  pinMode(ir_car2, INPUT);
  pinMode(ir_car3, INPUT);
  pinMode(ir_car4, INPUT);

  pinMode(ir_enter, INPUT);
  pinMode (ir_back, INPUT);

  myservo.attach(3);
  myservo.write(90);

  lcd.begin(16, 2);
  lcd.clear();
  lcd.setCursor(0, 0);
  lcd.print(“ WELCOME ");
  lcd.setCursor(0, 1);
  lcd.print("----------------");
  delay(2000);
  lcd. clear();
  lcd.setCursor(0, 0);
  lcd.print("TITLE :   Car");
  lcd.setCursor(0, 1);
  lcd.print(" Parking System ");
  delay(3000);
  lcd. clear();
  lcd.setCursor(0, 0);
  lcd.print("Total Slots = ");
```

```
 lcd.setCursor(0, 1);
 lcd.print("   4 ");
 delay(3000);
 lcd.clear();

 Read_Sensor();
 int total = S1 + S2 + S3 + S4;
 int available = slot - total;
 lcd.clear();
 lcd.setCursor(0, 0);
 lcd.print("Slots Occupied = ");
 lcd.setCursor(0, 1);
 lcd.print(        total );
 delay(3000);
 lcd.clear();
 lcd.setCursor(0, 0);
 lcd.print("Available Slots=  ");
 lcd.setCursor(0, 1);
 lcd.print(   available );
 delay(3000);
}
void loop() {

 Read_Sensor();
 lcd.setCursor(0, 0);
 if (S1 == 1) {
   lcd.print("S1:Full ");
 } else {
   lcd.print("S1:Empty");
 }

 lcd.setCursor(8, 0);
 if (S2 == 1) {
   lcd.print("S2:Full ");
 } else {
   lcd.print("S2:Empty");
 }
 lcd.setCursor(0, 1);
 if (S3 == 1) {
   lcd.print("S3:Full ");
 } else {
   lcd.print("S3:Empty");
 }
 lcd.setCursor(8, 1);
 if (S4 == 1) {
   lcd.print("S4:Full ");
 } else {
   lcd.print("S4:Empty");
 }
```

```
  if (digitalRead(ir_enter) == 0 && flag1 == 0) {
    if (S1 == 0 || S2 == 0 || S3 == 0 || S4 == 0) {
      flag1 = 1;
      if (flag2 == 0) {
        myservo.write(180);
        slot = slot - 1;
      }
    } else {
      lcd.clear();
      lcd.setCursor(0, 0);
      lcd.print(" Sorry Parking ");
      lcd.setCursor(0, 1);
      lcd.print(" Full !!");
      delay(1500);
    }
  }

  if (digitalRead(ir_back) == 0 && flag2 == 0) {
    flag2 = 1;
    if (flag1 == 0) {
      myservo.write(180);
      slot = slot + 1;
    }
  }

  if (flag1 == 1 && flag2 == 1) {
    delay(1000);
    myservo.write(90);
    flag1 = 0, flag2 = 0;
  }

  delay(1);
}

void Read_Sensor() {
  S1 = 0, S2 = 0, S3 = 0, S4 = 0;

  if (digitalRead(ir_car1) == 0) {
    S1 = 1;
  }
  if (digitalRead(ir_car2) == 0) {
    S2 = 1;
  }
  if (digitalRead(ir_car3) == 0) {
    S3 = 1;
  }
  if (digitalRead(ir_car4) == 0) {
    S4 = 1;
  }
}
```

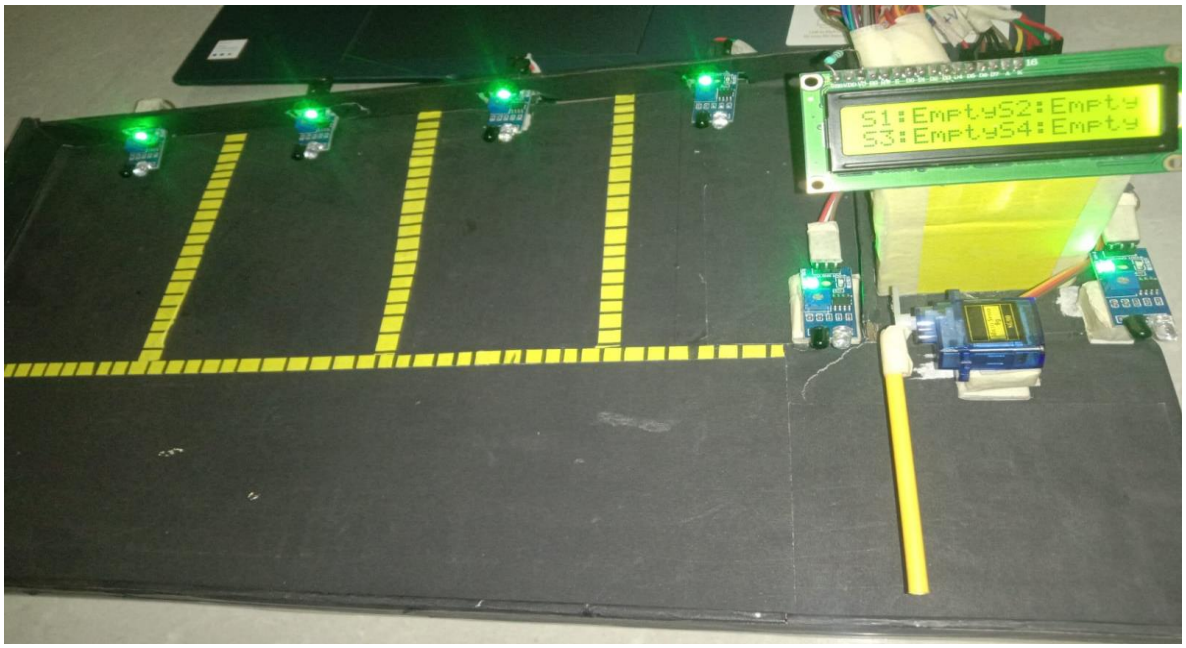

Figure-: Actual Working Model

3.3 Advantage of smart car parking system

The Advantages of smart parking system are:

- Reduced traffic.
- Reduced pollution.
- Enhanced User Experience.
- Integrated Payments.
- Increased Safety.
- Real-Time Data and Trend Insight.
- Decreased Management Costs.
- Increased Service and Brand Image.
- Security from theft and car damage.
- Simple structure, simple operation.

3.4 Disadvantage of smart car parking system

- It achieves wireless technology with limited options of connecting to device only.
- It does not know who the driver in the car is, checks only the key placed.
- Node-to-node implementation requires more time.

CONCLUSIONS AND FUTURE WORK

4.1 Conclusion

Our project detects empty slots and helps the drivers to find parking space in unfamiliar cities. The average waiting time of users for parking their vehicles is effectively reduced in this system. The optimal solution is provided by the proposed system, where most of the vehicles find a free parking space successfully.[22] Our preliminary test results show that the performance of the Arduino UNO based system can effectively satisfy the needs and requirements of existing car parking hassles thereby minimizing the time consumed to find vacant parking lot and real time information rendering. This smart parking system provides better performance, low cost and efficient large scale parking system. It also eliminates unnecessary travelling of vehicles across the filled parking slots in a city. Smart Parking solutions are designed to provide drivers with the ultimate solution on their journey from beginning to end without searching for parking, cost, travel time etc. This advantage comes by paying marginal fees to the smart parking service providers. To change a culture which has existed for several centuries is a humongous task. Parking has always been a now affair with direct cash exchange. The inclusion of technology in this method is a change in culture which will take time to establish. Smart Parking is one of the most adopted and fastest growing smart city solutions across the world. Airports, universities, shopping centers and city garages are just a few entities that have begun to realize the significant benefits of automated parking technology.[28]

In this study, the various types of smart parking system and has been presented. From the various examples of the implementation of the smart parking system being presented, its efficiency in alleviating the traffic problem that arises especially in the city area where traffic congestion and the insufficient parking spaces are undeniable. It does so by directing patrons and optimizing the use of parking spaces. With the study on all the sensor technologies used in detecting vehicles, which are one of the most crucial parts of the smart parking system, the pros and cons of each sensor technologies can be analyzed.[16] Although, there are certain disadvantages in the implementation of visual based system in vehicle detection as described earlier, the advantages far outweigh its disadvantages.

4.2 Future Work

In some of the parking areas are lacking such facilities and hence fail all the security norms necessary to park a vehicle. Looking at such a huge concern, it is highly required that each and every parking area should be well equipped with high tech parking control systems, that nevertheless lasts the best. These innovative parking control systems not only make a bright choice but also allow you to pay the right price without getting any worry.[12] Parking control system has been generated in such a way that it is filled with many secure devices such as barricades, swing gates, slide gates, parking control gates, toll gates, time and attendance machine, car counting system etc. These features are hereby very necessary nowadays to secure your car and to evaluate the fee structure for every vehicle's entry and exit. Nowadays parking is very important and hence it is necessary for every vehicle owner to park his or her car in a secure designated parking slot available. To escalate this system various parking owners have integrated themselves with sophisticated parking control systems, which are high tech and offers full-fledged parking services.[6]

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