Design & Implementation of Microcontroller based Automatic car parking system



SONARGAON UNIVERSITY (SU)

Supervised By

Rudaina Tasnuva

Lecturer

Department of EEE

Sonargaon University (SU)

Submitted By

Md. Bodrul Alam	EEE2001019061
Anis Mollah	EEE2001019120
Md. Shagor Mahmud	EEE2001019137
Md. Hafijur rahaman	EEE2001019161
Mahi Uddin palas	EEE2001019073

Department of Electrical & Electronic Engineering (EEE)

Sonargaon University (SU)

147/I, Panthapath,

Dhaka-1215, Bangladesh

Date of Submission: 15/09/2023

Declaration

It is declared hereby that this thesis paper or any part of it has not been submitted to anywhere else for the award of any degree.

.....	….....
Md. Bodrul Alam	**Anis Mollah**
.....	….....
Md. Shagor Mahmud	**Md. Hafijur rahaman**
.....	
Mahi Uddin palas	

Under Supervision of

.....

Rudaina Tasnuva

Lecturer

Department of EEE

Sonargaon University (SU)

Certification

This is to certify that this project entitled "**Design & Implementation of Microcontroller based Automatic car parking system**" is done by the following students under my direct supervision. This project work has been carried out by them in the laboratories of the Department of Electrical and Electronic Engineering under the Faculty of Engineering, Sonargaon University (SU) in partial fulfillment of the requirements for the degree of Bachelor of Science in Electrical and Electronic Engineering.

Supervisor

……

Rudaina Tasnuva

Lecturer

Department of Electrical and Electronic Engineer (EEE)

Sonargaon University (SU)

ACKNOWLEDGEMENT

The report titled as on **Design & Implementation of Microcontroller based Automatic car parking system**" has been prepared to fulfill the requirement of our practicum program. In the process of doing and preparing our practicum report, we would like to pay our gratitude to some persons for their enormous help and vast co-operation.

At first, we would like to show our gratitude to the University authority to permit us to do our practicum. Specially, we would like to thank to our honorable teacher **Rudaina Tasnuva,** Lecturer, Department of Electrical & Electronics Engineering, SU– Sonargaon University, Dhaka, for his valuable and patient advice, sympathetic assistance, co-operation, contribution of new idea. Deep theoretical and hardware knowledge & keen interest of our supervisor in this field influenced us to carry out this project. His endless patience, scholarly guidance, continual encouragement, constant and energetic supervision, constructive criticism, valuable advice, reading many inferior draft and correcting them at all stage have made it possible to complete this project.

ABSTRACT

Many problems occur for the car parking system in big theatres, Malls, Auditorium areas, Sensational tourist places of car traffic and need some advanced solution for that. Smart car parking system obtains information about available parking spaces it saves the time and efforts and also fuel wastage it could help bring order out of the chaos that exist at present in the car parking issue.

TABLE OF CONTENTS

Topics	Page No
ACKNOWLEDGEMENT	4
ABSTRACT	5
CHAPTER NAME	6
LIST OF FIGURES	7
TABLES	11

CHAPTER I: INTRODUCTION

TOPICS		Page No.
	Introduction	13
	Background Study	13
	Objectives	17
	Project Organization	17

CHAPTER II: THEORY OF THE PROJECT

	Introduction	18
	Theory	18
	Arduino Uno	18
	LCD Display 20x4	26
	12v DC Power Supply	29

CHAPTER III: DESIGN AND FABRICATION

	Introduction	26
	Block Diagram of the Project	26
	Circuit Diagram & Description	27
	Overview of smart car parking	28
	Working Principle	27
	Image of Project	28

	Used Materials	26
	Conclusion	**29**
	References	
	Appendix	30-35

LIST OF FIGURES

FIGURE NO.	FIGURE NAME	PAGE NO
	Arduino UNO Pin Diagram	14
	I2C display module	18
	LCD Display 20x4	19
	LCD Pin Out of LCD	19
	Power Supply	25
	Connecting Wire	24
	Block Diagram of the Project	26
	Circuit Diagram of the Project-1	27
	Circuit Diagram of the Project-2	28

CHAPTER I
INTRODUCTION

1.1 Introduction

A car parking system is a mechanical device that multiplies parking capacity inside a parking lot. Parkingsystems are generally powered by electric motors or hydraulic pumps that move vehicles into a storageposition. Car parking systems may be traditional or automated. Automatic multi-storey automated car parksystems are less expensive per parking slot, since they tend to require less building volume and less groundarea than a conventional facility with the same capacity. In the long term, automated car parking systems arelikely to be more cost effective than traditional parking garages. Car parking systems reduce exhaust gas carsneed not drive around in search of street parking spaces.

1.3 Objectives

Smart car parking project aims at providing a confusion free and easy parking. This project helps the drivers of the cars to park their vehicles with minimum wastage 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 IR sensors are interfaced. The LCD displays the availability of the space, the ultrasonic sensors keeps the check of the number of cars entering and exiting the parking space. The IR sensors detect the availability of the parking space.

CHAPTER II
THEORY OF THE PROJECT

Introduction

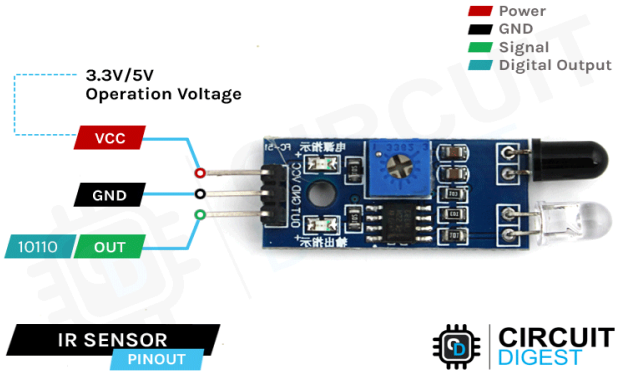
This chapter includes the total over view of the device. In this chapter we have followed-up the theory of Arduino Uno,LCD Display ,IR Sensor,Servo Motor,Breadboard, and other components. Here we can know that the total system overview of the projects. And we will also know that how the equipment are working with each other.

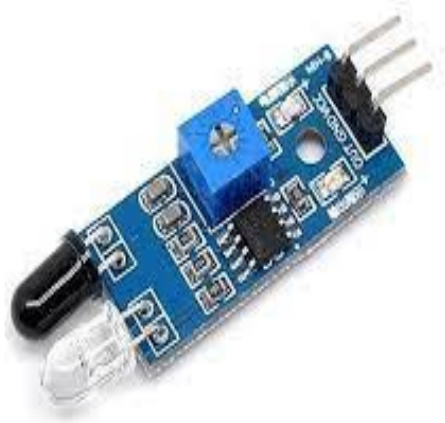
Theory

The servo motors, LCD display, and IR sensor are all connected to an Arduino Uno microcontroller unit. The LCD shows how much space is available, and the IR sensors keep track of how many automobiles enter and exit the parking place. The IR sensors identify whether or not a parking place is available.

IR SENSOR

An infrared sensor is an electronic device, which emits inorder to sense some aspects of the surroundings. An IR sensorcan measure the heat of an object as well as detects themotion. Usually in the infrared spectrum, all the objects
radiate some form of thermal radiations. These types ofradiations are invisible to our eyes, which can be detected byan infrared sensor. Its operating voltage is 3V to 6V. Itsoperating range is 2cm to 30cm with an operating angle of
35°.



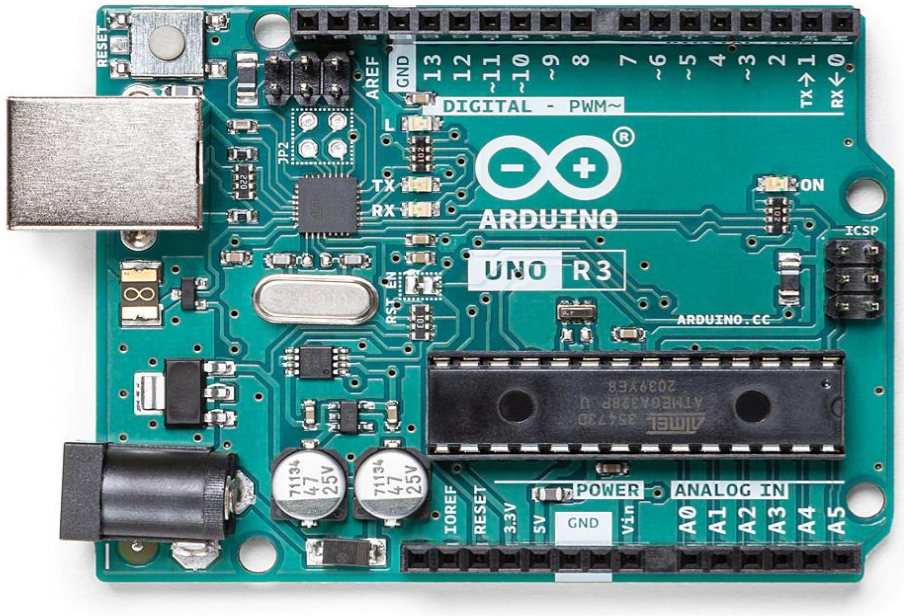


2.4 **Specification**

Board Size	3.2 x 1.4cm
Working voltage	3.3 to 5V DC
Operating voltage	3.3V: ~23 mA, to 5V: ~43 mA
Detection range	2cm – 30cm (Adjustable using potentiometer)
Active output level	The output is “0” (Low) when an obstacle **is detected**

Arduino Uno

The most commonly used board among the Arduino family is the Arduino Uno as it is easy to use and suitable for beginner and medium level projects. This board is equipped with a microcontroller of ATMEGA328P which belongs to ATMEL family. This board can operate on the voltage of 5-volts and has flash memory of 32 kilobytes. Whereas the static ram of the controller is 2 kilobytes and the EEPROM has memory of 1 kilobyte. The clock speed of the ATMEGA328P is 16 hertz. Below is the image of the Arduino Uno board.



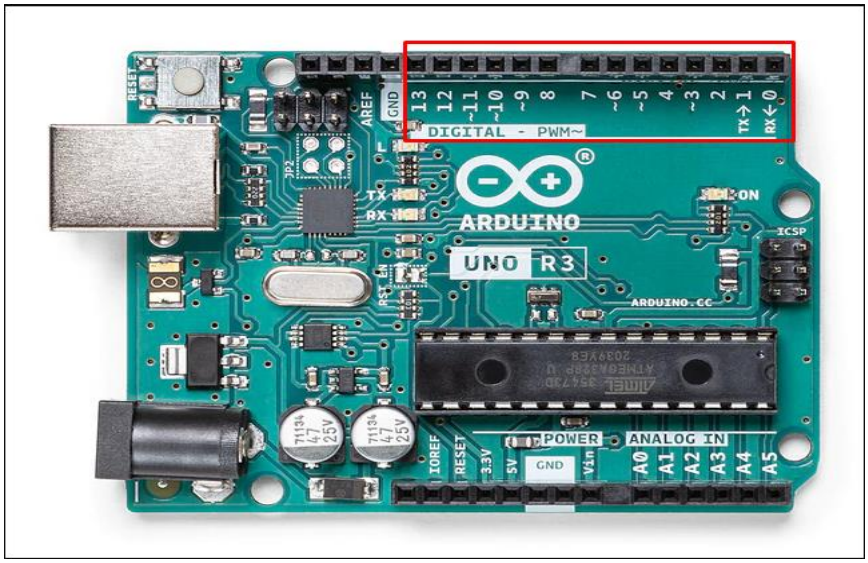
Arduino Uno pinout

The Arduino Uno has a total of 31 pins among which the 13 pins the digital pins that can be used for digital inputs and output. 6 of them are the analog pins that can be used for analog inputs and outputs and there are 10 pins that can be used to supply power to the connected devices.

Digital pins of the Arduino Uno

There are a total of 13 digital pins of the Arduino which can be used for connecting the devices that require digital input from the Arduino Uno and give the digital output as well. For the digital we mean that the information will be in the form of zero and one. The 0 and 1 pins in the digital pins are the communication pins of the Arduino labeled as TX and RX. Through these pins the Arduino communicates with the different communication devices and is also used when uploading the code to the Arduino board.

There is a built-in LED in the Arduino Uno that is connected to pin 13 but we can use this pin to connect other devices as well.



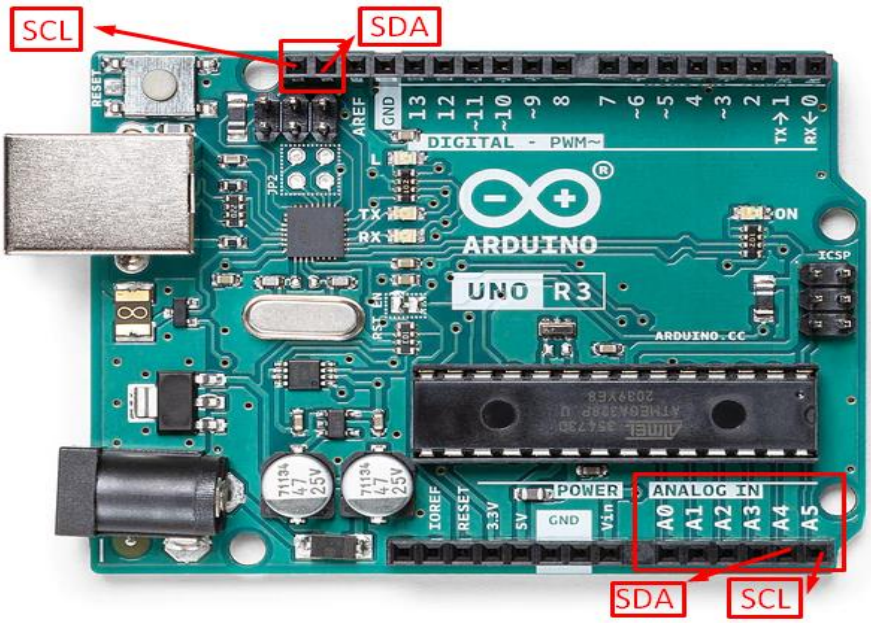
Analog pins of Arduino Uno

The Arduino Uno has 6 analog pins that are mainly used to connect the analog devices and have the resolution of 0 to 1024 that is 2^10. This means that the values will be in between 0 and 1024 and in terms of voltage the 5 volts will be 1024.

The pins A4 and A5 can be used as the SDA and SCL pins for the devices that used I2C and TWI (Two Wire Interface) communication protocols. The SDA pin is the data line for the connected device and SCL is the clock pin of the connected device. Similarly there are two

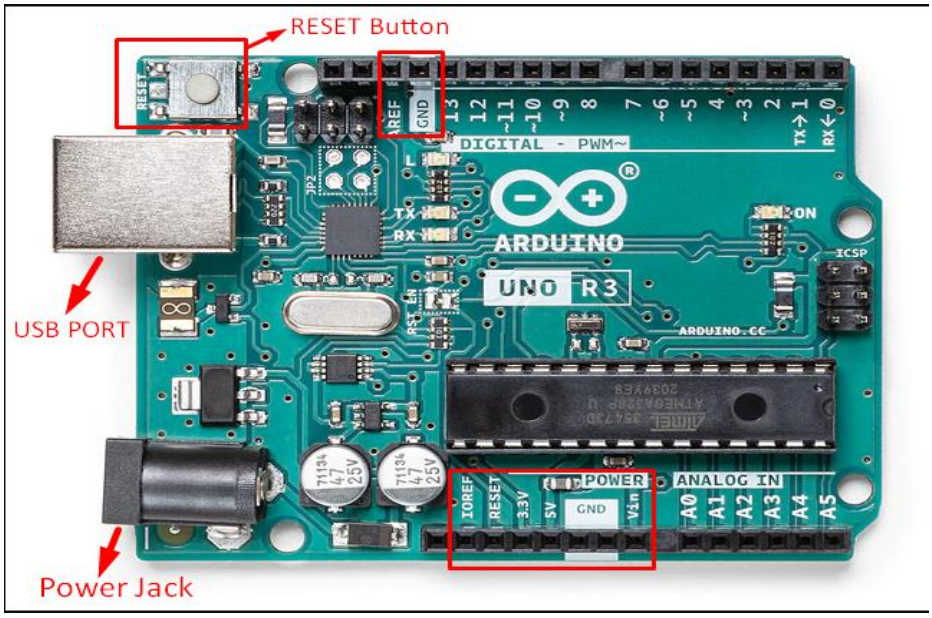
other pins next to the AREF pin that can be used for the data line and clock of the I2C devices as well.

The figure attached below shows the analog pins of the Arduino by highlighting it in red.



Power pins of Arduino Uno

The Arduino Uno has a total of 10 pins that are used for supplying power to the devices connected with Arduino. The maximum voltage the Arduino Uno can supply is 5 volts and minimum voltage of 3.3 volts and there are four ground pins in the board.

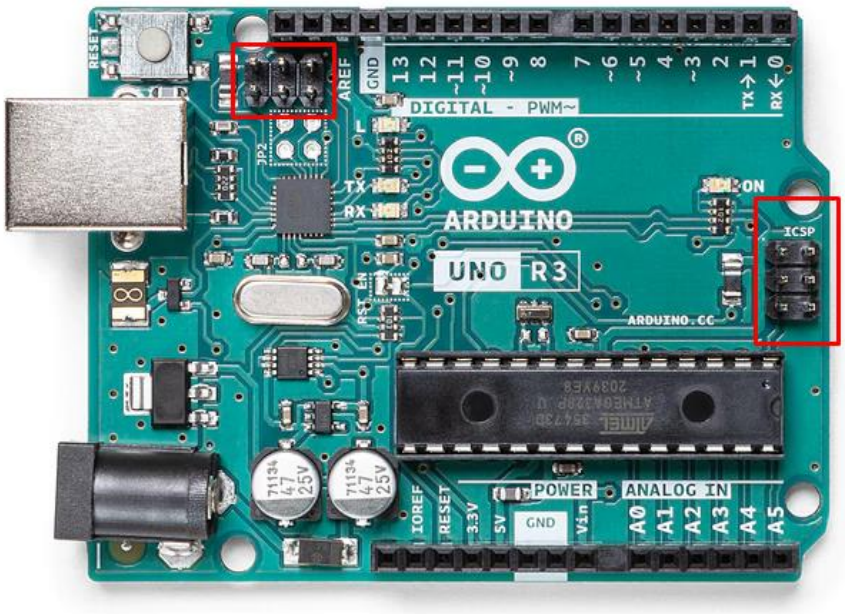


Similarly, there are IOREF and AREF pins that are used to provide reference voltage for the devices connected to Arduino Uno. The AREF is the voltage reference for the analog devices whereas the IOREF is the reference voltage to the other digital devices. There is also a reset pin given in the board to RESET the Arduino Uno using an external button. However, there is a dedicated RESET button given on the Arduino Uno board.

To connect the Arduino board with the supply voltage there is one USB port and a jack for power supply is also provided. The USB port can be used for power as well as to upload the code to the Arduino Uno. Whereas the jack provided for the supply is mostly used when the Arduino has to function in standalone mode. The image below shows the power supply pins and the RESET button of the Arduino u

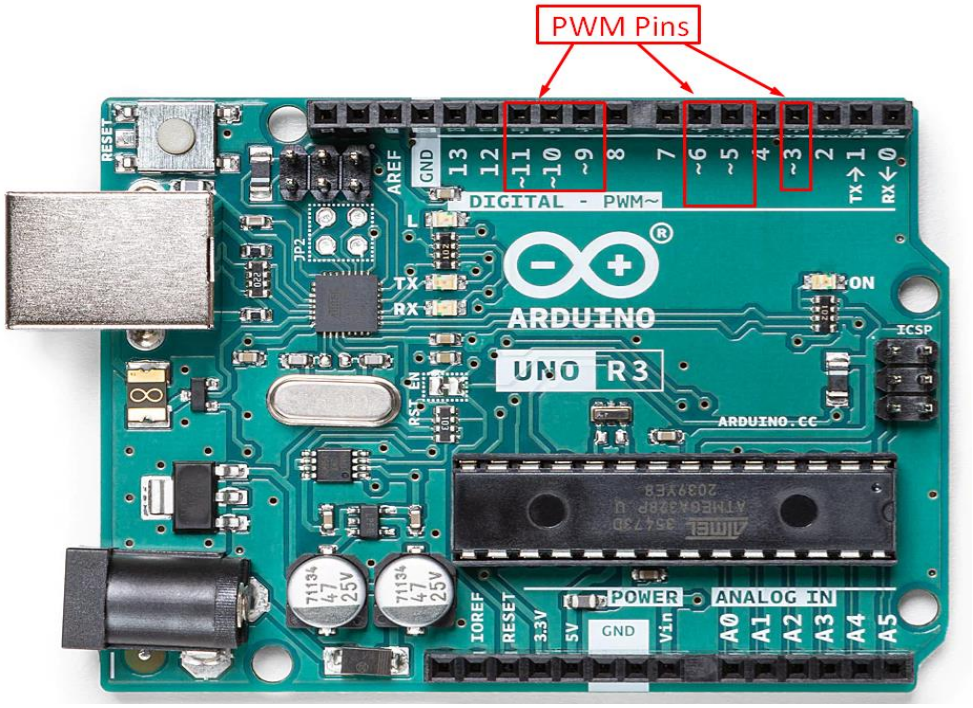
ICSP header pins of the Arduino Uno

To update or change the firmware of the Arduino Uno we can use the 12 header pins given on the Arduino Uno board. The in circuit system programming (ICSP) can be done by connecting Arduino with the device using a programming cord. We have encircled using square boxes the ICSP header pins of Arduino Uno in the image given below.



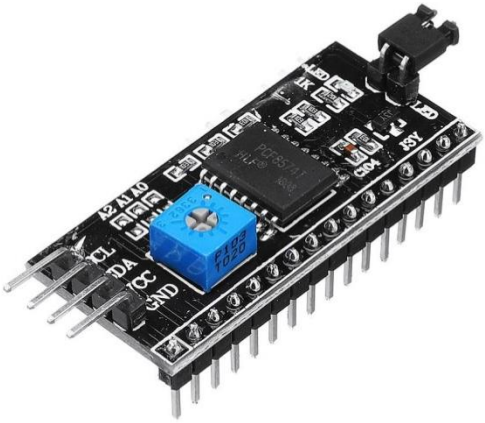
PWM pins of Arduino

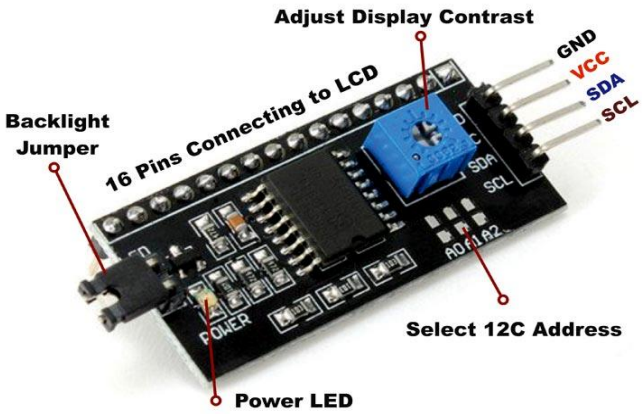
The pins that are used for making the inputs and outputs of the Arduino in the form of pulses are called the PWM pins and its duty cycle varies from 0 to 255. The pins dedicated for PWM in Arduino Uno are 11, 10, 9, 6,5, and 3. Below the image shows the PWM pins of Arc



I2C Module

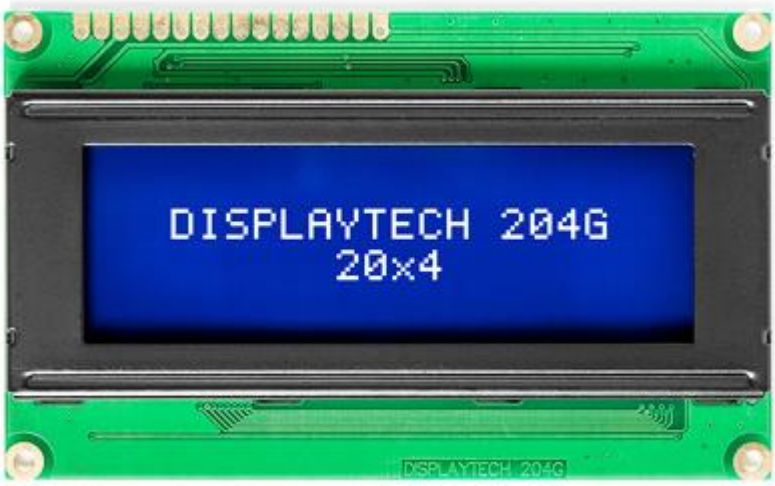
I2C Module serial interface adapter module - (High Quality) Description: Very useful module to interface serial connection to parallel data, specially used for LCD displays etc. I2C Module has inbuilt PCF8574 I2C chip that converts I2C serial data to parallel data for the LCD display.

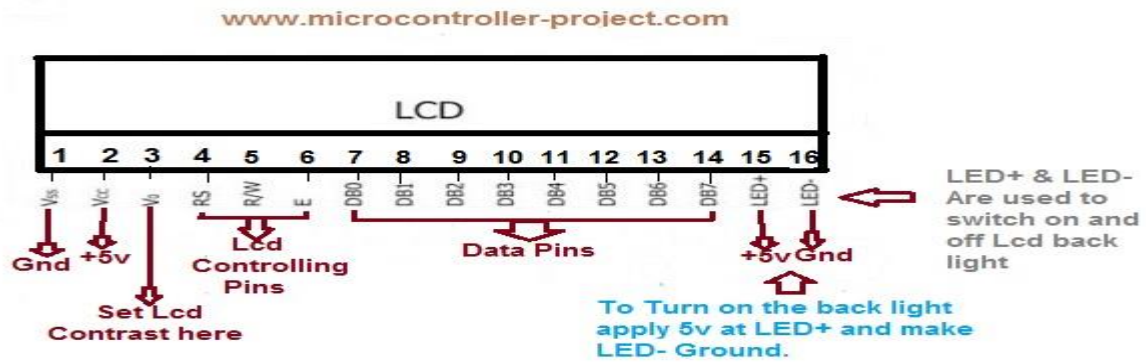




20x4 LCD display

A 20x4 LCD means it can display 20 characters per line and there are 4 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. This is standard HD44780 controller LCD.





Servo Motor

Here we used the servo motor to open and close the gate.servo motor is an electromechanical device that produces torque and velocity based on the supplied current and voltage. A servo motor works as part of a closed-loop system providingtorque and velocity as commanded from a servo controller utilizing a feedback device to closethe loopServo motors are able to operate at a wide range of speeds—both high and low—withoutoverheating and to maintain sufficient torque at zero speed to hold a load in place. They can also maintain a constant velocity, despite changes in the amount of torque acting on the system.

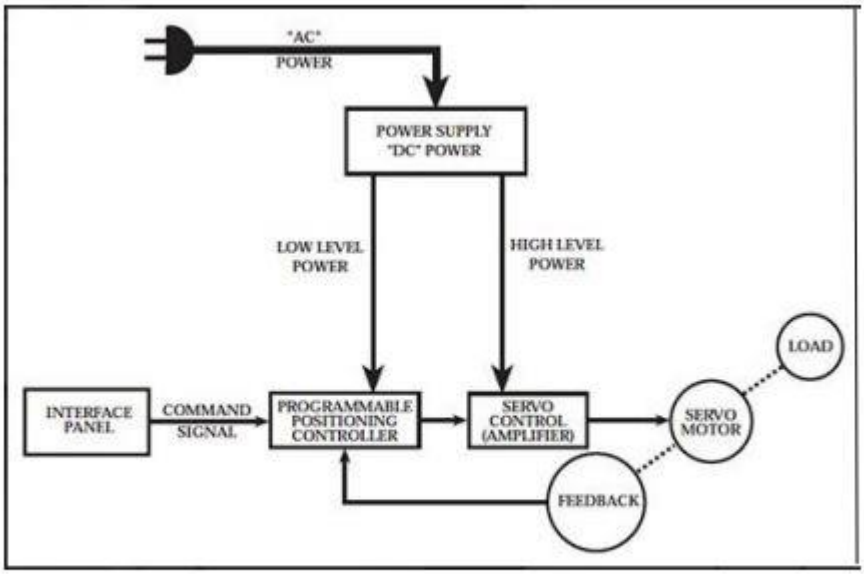


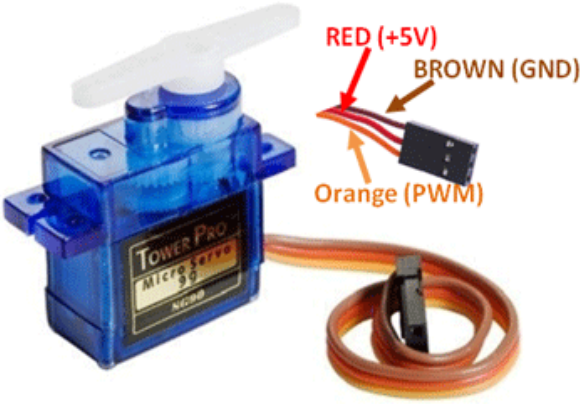
Fig: 2.2.6.1: Servo Motor Block Diagram

Servo Motor Wire Configuration

Wire Number	Wire Colour	Description
1	Brown	Ground wire connected to the ground of system
2	Red	Powers the motor typically +5V is used
3	Orange	PWM signal is given in through this wire to drive the motor

TowerPro SG-90 Features

- Operating Voltage is +5V typically
- Torque: 2.5kg/cm
- Operating speed is 0.1s/60°
- Gear Type: Plastic
- Rotation : 0°-180°
- Weight of motor : 9gm
- Package includes gear horns and screws

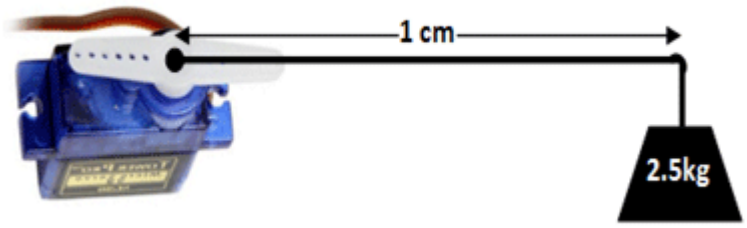


Selecting your Servo Motor

There are lots of servo motors available in the market and each one has its own speciality and applications. The following two paragraphs will help you identify the right type of servo motor for your project/system.

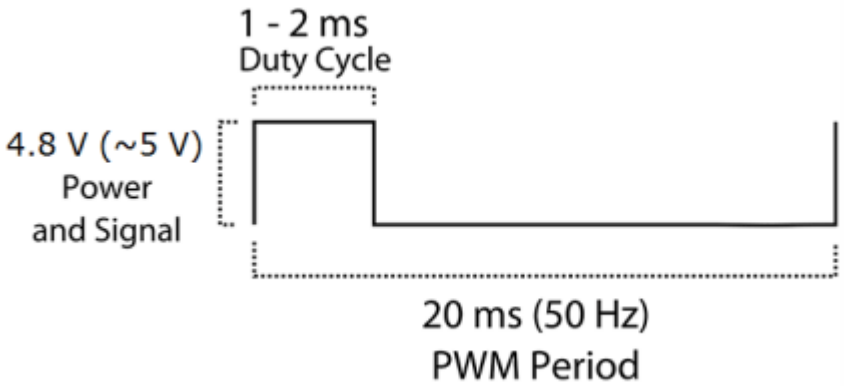
Most of the hobby Servo motors operates from 4.8V to 6.5V, the higher the voltage higher the torque we can achieve, but most commonly they are operated at +5V. Almost all hobby servo motors can rotate only from 0° to 180° due to their gear arrangement so make sure you project can live with the half circle if no, you can prefer for a 0° to 360° motor or modify the motor to make a full circle. The gears in the motors are easily subjected to wear and tear, so if your application requires stronger and long running motors you can go with metal gears or just stick with normal plastic gear.

Next comes the most important parameter, which is the torque at which the motor operates. Again there are many choices here but the commonly available one is the 2.5kg/cm torque which comes with the Towerpro SG90 Motor. This 2.5kg/cm torque means that the motor can pull a weight of 2.5kg when it is suspended at a distance of 1cm. So if you suspend the load at 0.5cm then the motor can pull a load of 5kg similarly if you suspend the load at 2cm then can pull only 1.25. Based on the load which you use in the project you can select the motor with proper torque. The below picture will illustrate the same.



How to use a Servo Motor

After selecting the right Servo motor for the project, comes the question how to use it. As we know there are three wires coming out of this motor. The description of the same is given on top of this page. To make this motor rotate, we have to power the motor with +5V using the Red and Brown wire and send PWM signals to the Orange colour wire. Hence we need something that could generate PWM signals to make this motor work, this something could be anything like a 555 Timer or other Microcontroller platforms like Arduino, PIC, ARM or even a microprocessor like Raspberry Pie. Now, how to control the direction of the motor? To understand that let us a look at the picture given in the datasheet.



From the picture we can understand that the PWM signal produced should have a frequency of 50Hz that is the PWM period should be 20ms. Out of which the On-Time can vary from 1ms to 2ms. So when the on-time is 1ms the motor will be in 0° and when 1.5ms the motor will be 90°, similarly when it is 2ms it will be 180°. So, by varying the on-time from 1ms to 2ms the motor can be controlled from 0° to 180°

Applications

Used as actuators in many robots like Biped Robot, Hexapod, robotic arm etc..

Commonly used for steering system in RC toys

Robots where position control is required without feedback

Less weight hence used in multi DOF robots like humanoid robots

jumper wire

are electrical wires with connector pins at each end. They are used to connect two points in a circuit without soldering.You can use jumper wires to modify a circuit or diagnose problems in a circuit. Further, they are best used to bypass a part of the circuit that does not contain a resistor and is suspected to be bad.This includes a stretch of wire or a switch. Suppose all the fuses are good and the component is not receiving power; find the circuit switch. Then, bypass the switch with the jumper wire.



Types of Jumper Wires

Jumper wires come in three versions:

- Male-to-male jumper
- Male-to-female jumper
- Female-to-female jumper

Power Supply

9V 1A AC/DC Adapter Charger Power Supply. 100% Generic New and High-Quality Compatible Charger. Input Voltage : AC 100-240V (Worldwide AC Input). Input Frequency: 50-60Hz. Output Voltage : DC 9V 2A. Center negative. Note: Please make sure the DC output and tip size of ac adapter are accordant before you bid. Industry Quality: Over Voltage Protection, Over Heat Protection



Lithium-ion battery

A lithium-ion or Li-ion battery is a type of rechargeable battery which uses the reversible reduction of lithium ions to store energy. The negative electrode of a conventional lithium-ion cell is typically graphite, a form of carbon. This negative electrode is sometimes called the anode as it acts as an anode during discharge. The positive electrode is typically a metal oxide; the positive electrode is sometimes called the cathode as it acts as a cathode during discharge. Positive and negative electrodes remain positive and negative in normal use whether charging or discharging and are therefore clearer terms than anode and cathode, which are reversed during charging



CHAPTER III
DESING & FEBRICATION

Introduction

In this chapter fully cover with discuss design and fabrication of this project. Here we will discuss about developed block diagram and briefly describe about the circuit description and also learn about working principle. Total project flow chart is also available in this chapter.

Block Diagram

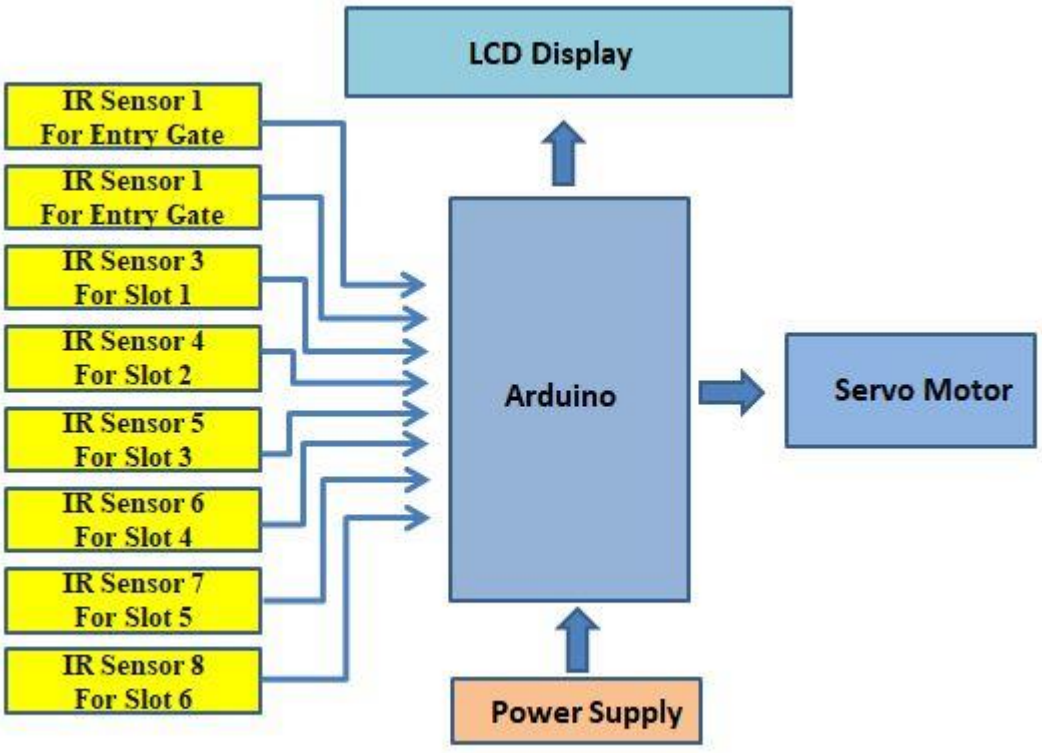


Fig: Block diagram of project

Circuit Description

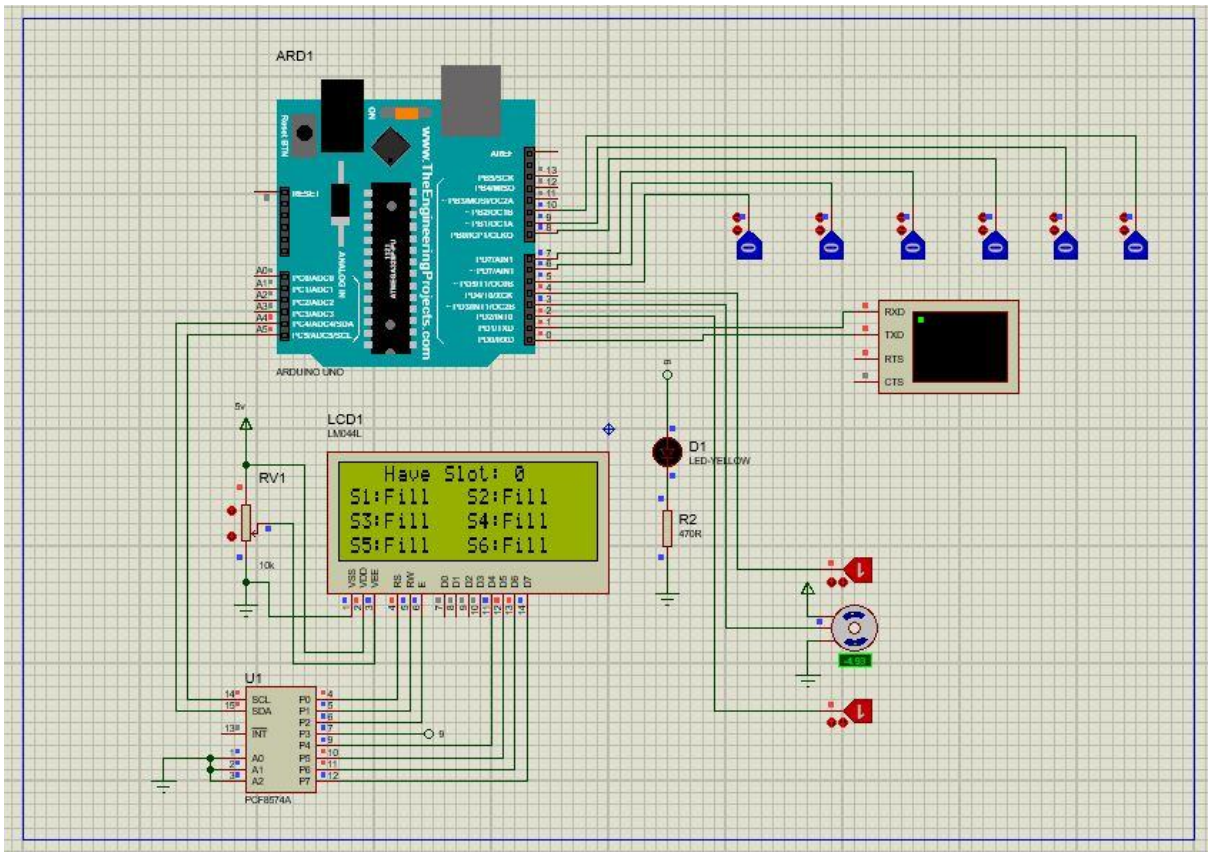


Fig: Circuit diagram of the Project

Working Principle

After assembling all components according to the circuit diagram and uploading the code to the Arduino board. Now place the sensors and servo motor at accurate positions.

There are four parking slots in this project, IR sensor-3, 4, 5, and 6 are placed at slot-1, 2, 3, and 4 respectively. IR sensor-1 and 2 are placed at the entry and exit gate respectively and a

servo motor is used to operate the common single entry and exit gate. The LCD display is placed near the entry gate.

The system used IR sensor-3, 4, 5, and 6 to detect whether the parking slot is empty or not and IR sensor-1, and 2 for detecting vehicles arriving or not at the gate.

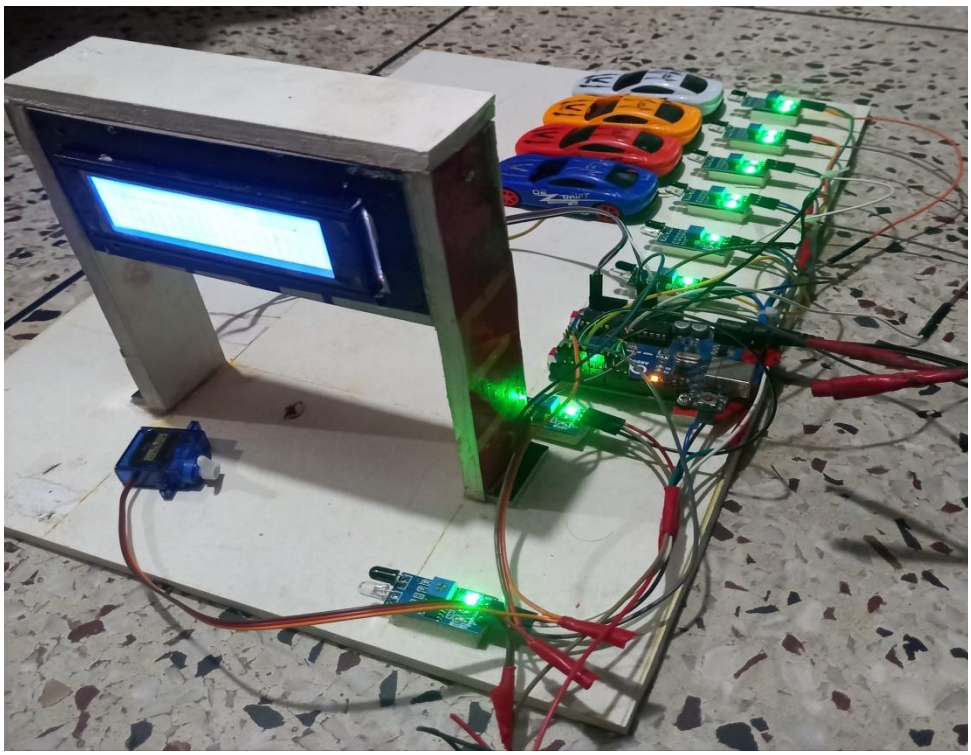
In the beginning, when all parking slots are empty, then the LCD display shows all slots are empty.

When a vehicle arrives at the gate of the parking area then the IR sensor-1 detects the vehicle and the system allowed to enter that vehicle by opening the servo barrier. After entering into the parking area when that vehicle occupies a slot then the LED display shows that the slot is full. In this way, this system automatically allows 4 vehicles.

In case the parking is full, the system blocked the entrance gate by closing the servo barrier. And the LED display shows that slot-1, 2, 3, and 4 all are full.

When a vehicle leaves a slot and arrives at the gate of the parking area then the IR sensor-2 detects that vehicle and the system open the servo barrier. Then the LED display shows that the slot is empty. Again the system will allow entering a new vehicle.

Image of the Project



Used Materials

SL. NO.	Materials Name	Quantity
1	Arduino Uno	1 pcs
2	IR Sensor	8 pcs
3	I2C display driver	1 pcs
4	jumper Wire	60 pcs
5	9v charger	1 pcs
6	Battary	1 pcs
7	LCD display 20*4	1 pcs
8	Servo Motor	1 pcs
9	Car	4 pcs

Conclusion

Our project detects the empty slots and helps the drivers to find parking space in unfamiliar city. 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. Our preliminary test results show

that the performance of the Arduino UNO based system

Chapter IV
RESULT & DISCUSSION

Introduction

This chapter contains the results obtained and discussion about the project. We have also covered discussions about advantages, disadvantages and limitation of current version of the protection system.

Advantags of Smart car parking

Following are the advantages of using Smart car parking

There is high parking efficiency (i.e. sf/space and cf/space).

There is no need for driving while looking for an available space.

There is a minimal staff requirement if it is used by known parkers.

There are less chances for vehicle vandalism.

The patrons wait for their car in a highly controlled environment

Chapter V
CONCLUSION

Applications

Define new parking areas, specify number of parking · Modify data of existing parking areas. · View the data of all registered parking

Conclusion

Our project detects the empty slots and helps the drivers to find parking space in unfamiliar city. 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. Our preliminary test results show
that the performance of the Arduino UNO based system.

Appendix

PROGRAM CODE:

```
#include <Servo.h> //includes the servo library

#include <Wire.h>

#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27,20,4);

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

#define ir_car5 9

#define ir_car6 10

int S1=0, S2=0, S3=0, S4=0, S5=0, S6=0;

int flag1=0, flag2=0;

int slot = 6;

void setup(){

lcd.backlight();

Serial.begin(9600);

pinMode(ir_car1, INPUT);
```

```
pinMode(ir_car2, INPUT);
pinMode(ir_car3, INPUT);
pinMode(ir_car4, INPUT);
pinMode(ir_car5, INPUT);
pinMode(ir_car6, INPUT);
pinMode(ir_enter, INPUT);
pinMode(ir_back, INPUT);
  myservo.attach(3);
myservo.write(90);
lcd.begin();
lcd.setCursor (0,0);
lcd.print("     WELCOME TO   ");
lcd.setCursor (0,2);
lcd.print("SONARGAON UNIVERSITY");
delay (2000);
lcd.clear();
lcd.setCursor (0,1);
lcd.print("   Car  parking  ");
lcd.setCursor (0,2);
lcd.print("       System     ");
delay (2000);
lcd.clear();
lcd.setCursor (0,0);
```

```
lcd.print("    This Project   ");
lcd.setCursor (0,1);
lcd.print("    Presented By   ");
lcd.setCursor (0,2);
lcd.print("   MD.Bodrul Alom   ");
lcd.setCursor (0,3);
lcd.print("    Anis Mollah     ");
delay (9000);
lcd.clear();
lcd.setCursor (0,0);
lcd.print(" MD.Shagor Mahmud  ");
lcd.setCursor (0,1);
lcd.print(" MD.Hafijur Rahaman ");
lcd.setCursor (0,2);
lcd.print(" Mahi Uddin Palas  ");
delay (9000);
lcd.clear();
Read_Sensor();
int total = S1+S2+S3+S4+S5+S6;
slot = slot-total;
}
void loop(){
Read_Sensor();
```

```
lcd.setCursor (0,0);
lcd.print("    Have Slot: ");
lcd.print(slot);
lcd.print("     ");
lcd.setCursor (0,1);
if(S1==1){lcd.print("S1:Fill ");}
    else{lcd.print("S1:Empty");}
lcd.setCursor (10,1);
if(S2==1){lcd.print("S2:Fill ");}
    else{lcd.print("S2:Empty");}
lcd.setCursor (0,2);
if(S3==1){lcd.print("S3:Fill ");}
    else{lcd.print("S3:Empty");}
lcd.setCursor (10,2);
if(S4==1){lcd.print("S4:Fill ");}
    else{lcd.print("S4:Empty");}
 lcd.setCursor (0,3);
if(S5==1){lcd.print("S5:Fill ");}
    else{lcd.print("S5:Empty");}
lcd.setCursor (10,3);
if(S6==1){lcd.print("S6:Fill ");}
    else{lcd.print("S6:Empty");}
if(digitalRead (ir_enter) == 0 && flag1==0){
```

```
if(slot>0){flag1=1;
if(flag2==0){myservo.write(180); slot = slot-1;}
}else{
lcd.setCursor (0,0);
lcd.print(" Sorry Parking 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, S5=0, S6=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;}

if(digitalRead(ir_car5) == 0){S5=1;}

if(digitalRead(ir_car6) == 0){S6=1;}
```