Smart Parking System using Internet of Things

A report submitted in partial fulfilment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY
in
Electronics and Communication Engineering

By
Ghayur Hamza (19221)
Rollin Yambem (19237)

SCHOOL OF ELECTRONICS

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY UNA
HIMACHAL PRADESH

NOVEMBER 2022

BONAFIDE CERTIFICATE

This is to certify that the project titled Smart Parking System Using Internet of Things is a bonafide record of the work done by

Ghayur Hamza (19221)
Rollin Yambem (19237)

in partial fulfilment of the requirements for the award of the degree of Bachelor of Technology in Electronics and Communication Engineering of the Indian Institute of Information Technology Una, Himachal Pradesh, during the year 2019 - 2023.

under the guidance of
Dr Ambigavathi M

Project viva-voce held on: _____

Internal Examiner External Examiner

ORIGINALITY / NO PLAGIARISM DECLARATION

We certify that this project report is our original report and no part of it is copied from any published reports, papers, books, articles, etc. We certify that all the contents in this report are based on our personal findings and research and we have cited all the relevant sources which have been required in the preparation of this project report, whether they be books, articles, reports, lecture notes, and any other kind of document. We also certify that this report has not previously been submitted partially or as whole for the award of degree in any other university in India and/or abroad.

We hereby declare that, we are fully aware of what constitutes plagiarism and understand that if it is found at a later stage to contain any instance of plagiarism, our degrees may be cancelled.

Ghayur Hamza (19221)
Rollin Yambem (19237)

ABSTRACT

This project presents a smart parking system using Internet of Things (IoT), which traffic authorities in many cities desire. Internet of Things is a system of interconnected computing devices, mechanical and digital machines or objects, each with a unique identifier and the ability to transmit data over a network without human intervention. Using IoT based devices such as actuators and IR sensors the vehicle's position is detected and transmitted to the microprocessor which makes IoT an integral part of the smart parking system. Major cities are facing a big challenge of traffic congestion and blockage on roads due to unauthorized parking. This project presents drivers with dynamic information on parking within controlled areas and directs them to vacant spots. Objective of this project is to guide the drivers in and out of the parking slot without any hassle, by providing real time information about vacant spots in the lot. The prototype developed in the project includes integration of Arduino, IR sensors, servo motor and LCD to provide an informative parking system with some automatic functions like displaying empty and filled slots and activating gate for entry and exit of vehicles. The smart parking system proposed has benefits like reducing time and effort of drivers for searching empty parking spaces and reducing congestion and pollution as an indirect effect.

***Keywords*:** Internet of Things, Sensors, Actuators and Smart Parking System

ACKNOWLEDGEMENT

We would like to thank the following people for their support and guidance without whom the completion of this project in fruition would not be possible.

We would like to express our sincere gratitude and heartfelt thanks to Dr Ambigavathi M for their unflinching support and guidance, valuable suggestions and expert advice. Their words of wisdom and expertise in subject matter were of immense help throughout the duration of this project.

We also take the opportunity to thank our Director and all the faculty of School of Computing/Electronics, IIIT Una for helping us by providing necessary knowledge base and resources.

We would also like to thank our parents and friends for their constant support.

Ghayur Hamza (19221)
Rollin Yambem (19237)

TABLE OF CONTENTS

LIST OF ACRONYMS

IoT Internet of Things

LCD Liquid Crystal Display

IDE Integrated development environment

I2C Inter-Integrated Circuit

LED Light emitting diode

IR Infrared

AC Alternating Current

DC Direct Current

USB Universal Serial Bus

PCB Printed Circuit Board

LIST OF TABLES

LIST OF FIGURES

Chapter 1
Introduction

1.1 Overview

On a daily basis, it is estimated that 30% of vehicles on the road in the downtown area of major cities are cruising for a parking spot and it takes an average of 7.8 minutes to find one. This causes not only a waste of time and fuel for drivers looking for parking, but it also contributes to additional waste of time and fuel for other drivers as a result of traffic congestion. For example, it has been reported that over one year in a small business district, cars cruising for parking created the equivalent of 38 trips around the world, burning 47,000 gallons of gasoline and producing 730 tons of carbon dioxide. Drivers searching for parking are estimated to be responsible for about 30% of traffic congestion in cities. Historically, cities, businesses, and property developers have tried to match parking supply to growing demand for parking spaces. It has become clear, though, that simply creating more parking spaces is not sufficient to address the problem of congestion. New approaches using smart parking systems look to provide a more balanced view of parking that better manages the relationship between supply and demand. Smart parking can be defined as the use of advanced technologies for the efficient operation, monitoring, and management of parking within an urban mobility strategy.

The global market for smart parking systems reached $93.5 million, with the United States representing 46% market share, and offering a strong growth opportunity for companies offering services in the United States and overseas. A number of technologies provide the basis for smart parking solutions, including vehicle sensors, wireless communications, and data analytics. Smart parking is also made viable by innovation in areas such as smartphone apps for customer services, mobile payments, and in-car navigation systems. At the heart of the smart parking concept is the ability to access, collect, analyse, disseminate, and act on information on parking usage. Increasingly, this information is provided in real-time from

intelligent devices that enable both parking managers and drivers to optimize the use of parking capacity.

1.2 Internet of Things

The Internet of things (IoT) is composed of physical objects or groups of objects and devices with sensors, processing ability, software and other technologies that connect and exchange data with other devices and systems over the Internet or other communications networks. Internet of things is considered to be misnamed because devices do not need to be connected to the internet, they only need to be connected to a network and be individually addressable.

The field has evolved due to the convergence of multiple technologies, including ubiquitous computing, commodity sensors, increasingly powerful embedded systems, as well as machine learning. Traditional fields of embedded systems, wireless sensor networks, control systems, automation (including home and building automation), independently and collectively enable the Internet of things. In the consumer market, IoT technology is most synonymous with products pertaining to the concept of the "smart home", including devices and appliances (such as lighting fixtures, thermostats, home security systems, cameras, and other home appliances) that support one or more common ecosystems, and can be controlled via devices associated with that ecosystem, such as smartphones and smart speakers. IoT is also used in healthcare systems.

1.3 Smart parking System

Smart Parking System is based on IoT devices and Arduino. IoT (Internet of Things) is a system of interrelated computing devices, mechanical and digital devices. IoT devices share sensor data they collect by connecting to other devices. The main purpose of these devices is to automate processes and reduce labour costs. Smart Parking is a parking strategy that combines technology and human innovation in an effort to use as few resources as possible,

such as fuel, time and space to achieve faster, easier and denser parking of vehicles for the majority of time they remain idle.

Smart Parking and its sister approach, Intelligent Transportation, are based on the fundamental ecological principle that we are all connected. Parking and transportation are both essential in the movement of people and goods. The Smart Parking and Intelligent Transportation vision and overlapping technologies are steadily melding into one integrated stream.

Chapter 2
Review of Literature

2.1 Technical and Research Papers

In [1], the research paper named Driver-Side and Traffic-Based Evaluation Model for On-street Parking Solutions is an evaluation model that is needed to verify the proposed parking solution. This paper presents a traffic based evaluation model for different parking solutions from the driver's perspective. It consists of two parts which are the driver's decision model and a simulation process. In the driver's decision model a group of policies are set to help drivers decide whether to park or not. The decision results and traffic data are taken as the inputs for the simulation process, which simulates the drivers' parking behaviour and estimates the parking status. The driver's decision model generates the parking decision based on real-time traffic conditions and driver's consideration. The simulation process takes driver's decisions derived from the decision model as inputs and then gives the prediction accuracy of the parking detection solution.

Finding an empty space in a multi-level parking garage is troublesome, particularly during the weekend or some occasions. Inadequate car parking space prompts activity blockage and driver discontent. The paper focuses on the car parking system using Arduino UNO. It aims to design, create and deliver a main edge stopping innovation called smart stopping. It is a vehicle stopping framework that helps drivers locate an empty spot. By using the ultrasonic sensors in each stopping space, it identifies the nearness or absence of a vehicle. Current research suggests that it takes about 8 minutes to stop the vehicle and look for a parking area in locations like shopping centres, lodgings and multiplexes. This project illustrates how to diminish the stopping issue and do a secured stopping by using the shrewd stopping under slot allocation strategy with the assistance of Arduino UNO [2].

This smart parking system provides better performance, low cost and efficient large scale parking system. The working of this system is such that, when a car enters the parking area, the driver will park the car in the nearest empty slot. When the slot is occupied the LED lights are turned on and when the slot is empty LED lights are turned off indicating that the parking slot is empty to be occupied. This eliminates the unnecessary travelling of vehicles across the filled parking slots in a city.

The paper referenced in [3] introduces a novel algorithm that increases the efficiency of the current cloud-based smart-parking system and develops a network architecture based on the Internet-of-Things technology. The manual method of finding a parking space takes time and effort, and in the worst case scenario the driver may fail to find any parking space. The system proposed in this paper [3] uses the WSN which consists of RFID technology to monitor car parks. RFID reader counts the percentage of free parking space in each car park. The system provides a mechanism which helps minimize disputes in parking and saves time. After logging into the system, the user can choose a suitable parking space. Information on the selected parking location will be confirmed to the user via notification. Then, the system updates the status of the parking space to "pending" during which time the system will not allow other users to reserve it. If after a certain period of pending time the system determines that no car is parked in that space, then it changes the status to "available". The system will update the status from the WSN node (the status of car park spaces) when a new car joins in the system. Therefore, the status of the overall parking system is always updated in real time. The proposed architecture and system has been successfully simulated and implemented in a real situation [3]. The results show that our algorithm significantly reduces the average waiting time of users for parking and the results closely agree with those of proposed mathematical models. The simulation of the system received the optimal solutions when most of the vehicle successfully found a free parking space, average waiting time of his car parked for service becomes minimal and the total time of his vehicle in its car park is reduced.

In [4], the proposed “smart parking” system adopts the basic structure of PGI systems. In addition, such a system includes a Driver Request Processing Center (DRPC) and a Smart Parking Allocation Center (SPAC). The Parking Resource Management Center (PRMC) collects and updates all real-time parking information and disseminates it via VMS or Internet. The DRPC gathers driver parking requests and realtime information, keeps track of driver allocation status, and sends back the assignment results to drivers. Based on the driver requests and parking resource states, the Smart Parking Allocation Center makes assignment decisions and allocates and reserves parking spots for drivers.

Drivers who are looking for parking spots send requests to the DRPC. A request is accompanied by two requirements: a constraint (upper bound) on parking cost and a constraint (upper bound) on the walking distance between a parking spot and the driver's actual destination. It also contains the driver's basic information such as license number, current location, car size, etc. The SPAC collects all driver requests in the DPRC over a certain time window and makes an overall allocation at decision points in time seeking to optimize a combination of driver-specific and system-wide objectives. An assigned parking space is sent back to each driver via the DRPC. If a driver is satisfied with the assignment, he has the choice to reserve that spot. Once a reservation is made, the driver still has opportunities to obtain a better parking spot. So, overall this “smart parking” system [4] exploits technologies for parking space availability detection and localization, which allocates optimal parking spots to drivers instead of only supplying guidance to them.

In [5], a prototype of a smart parkland arrangement was constructed in the urban domain by using the Internet of Things (IoT) and NodeMCU. The development of web correspondence with real equipment is a commonplace phenomenon. They are fixed with electronic components, web connectivity, and alternative sensors, the above-mentioned gadgets can broadcast and collaborate along with excess over the web, and they can hold control and observe remotely. In [5], the IoT is inter-associating with real gadgets, automobiles, apartments, and alternative items linked with electronic components, programming, sensors, actuators, and chain comparability that are found out by the

particular gadgets to save and swap information. Data is uploaded in the cloud so that the users can monitor whether the slots are free or not regularly.

Table 2.1: Summary of related studies

Year	Ref No.	Methodology	Pros	Cons
2017	[1]	Parking framework with IoT, Arduino, sensor, LCD display	Guarantees parking and recovery of vehicle	Limitations for a large number of parking spots
2022	[2]	Traffic based evaluation of parking by a driver	Confirms lack of proper parking system	Does not include random decisions by driver
2015	[3]	Cloud based smart parking system to find free parking and minimizing the cost of moving to parking space	Significantly reduces waiting time of users looking for parking	Complicated system requires maintenance and constant monitoring
2012	[4]	Real time parking guidance and allotment of parking space using PGI systems	Provides parking allotment instead of just giving guidance	Requires expensive PGI systems
2022	[5]	Cloud based parking monitoring system for users to check for availability	Real time data availability related to parking slots	Manual work is required for checking parking availability

Chapter 3
Motivation

3.1 Problem Identification and motivation

There was a surge in the demand for secure parking spaces because of trends in increasing urbanization and an increase in car ownership. This increased number of vehicles on the road has made parking experience adverse for the drivers. And on top of this, the traditional parking system, there were losses in terms of money, productivity and time which was wasted in search of parking spots in densely populated areas. All these factors led to frustration in drivers and increased traffic congestion on the road. So, it was concluded that traditional parking systems were not capable of providing a smooth parking system. Thus a better and advanced parking system was needed.

3.2 Benefits of smart parking system

There are many factors which would prove useful after the implementation of smart parking system. Most of them point to the idea of saving time, effort and resources. Some of the factors which motivated the development of smart parking system are mentioned below.

Optimized parking: Users find the best spot available, saving time, resources and effort. The parking lot fills up efficiently and space can be utilized properly by commercial and corporate entities.

Reduced traffic: Traffic flow increases as fewer cars are required to drive around in search of an open parking space.

Reduced pollution: Searching for parking burns around one million barrels of oil a day. An optimal parking solution will significantly decrease driving time, thus lowering the amount of daily vehicle emissions and ultimately reducing the global environmental footprint.

Enhanced User Experience: A smart parking solution will integrate the entire user experience into a unified action. Driver's spot identification, location search and time notifications, all seamlessly become part of the destination arrival process.

Increased Safety: Parking lot employees and security guards contain real-time lot data that can help prevent parking violations and suspicious activity. License plate recognition cameras can gather pertinent footage. Also, decreased spot- searching traffic on the streets can reduce accidents caused by the distraction searching for parking.

Real-Time Data and Trend Insight: Over time, a smart parking solution can produce data that uncovers correlations and trends of users and lots. These trends can prove to be invaluable to lot owners as to how to make adjustments and improvements to drivers.

Decreased Management Costs: More automation and less manual activity saves on labour cost and resource exhaustion.

Chapter 4

Proposed Work

4.1 Workflow of smart parking system

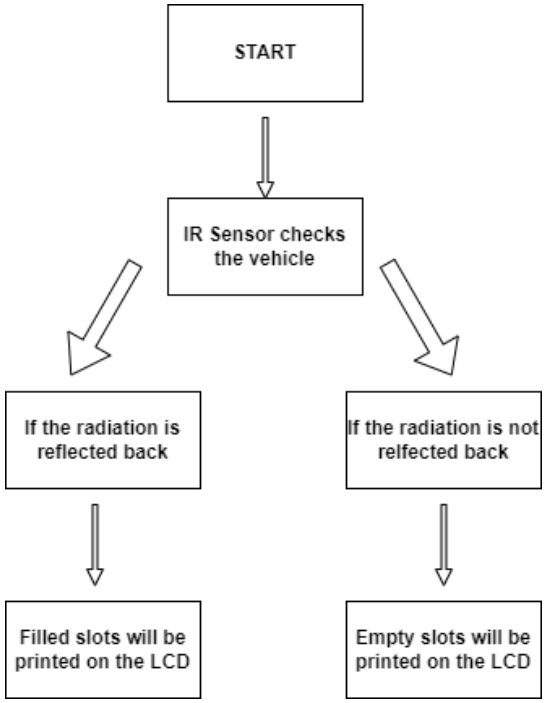

Figure 4.1: Workflow of the system

The flowchart in Fig.4.1, explains the basic principle involved in car detection and the display of empty and filled slots in the LCD. First the IR sensors present at the slots send rays to detect the vehicle. If the rays are reflected back, then this means that there is a vehicle present at the parking slot. This information is sent to the microprocessor which is then relayed back to the LCD for displaying the filled slot on the screen. Similarly, when the rays are not reflected back, the information for empty slots is displayed on the screen.

4.2 Technology and Software used

This project was completed by using the following concepts of technology and software for writing code and running the simulation.

IoT

An IoT ecosystem consists of web-enabled smart devices that use embedded systems, such as processors, sensors and communication hardware, to collect, send and act on data they acquire from their environments. IoT devices share the sensor data they collect by connecting to an IoT gateway or other edge device where data is either sent to the cloud to be analysed or analysed locally. Sometimes, these devices communicate with other related devices and act on the information they get from one another. The devices do most of the work without human intervention, although people can interact with the device to set them up, give them instructions or access the data.

Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino consists of a physical microprocessor board and IDE software. It is able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn them into an output - activating a motor, turning on an LED, publishing something online etc. We can tell the UNO board what to do by sending a set of instructions to the microcontroller on the board. To do so we use the Arduino programming language, and the Arduino Software (IDE), based on Processing.

The objective of this project is to reduce the time taken and to reduce the hassle factor of locating an available parking space. It also intends to accurately provide information to a driver of an available parking space. By helping to reduce on road traffic and unnecessary burning of fuel, indirectly, the project also aims to reduce CO2 emissions, noise, and other pollutants. Although the main goal is to decrease searching time for spaces, which in turn can reduce accidents by ensuring drivers maintain their attention on driving rather than browsing for spaces or making rash makeovers.

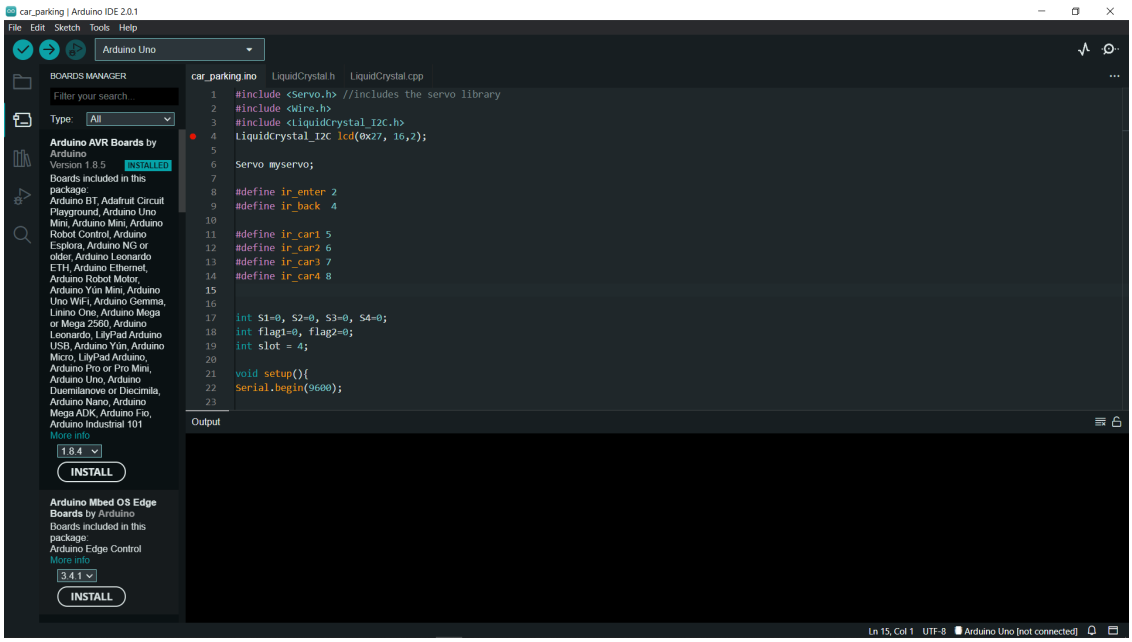

Figure 4.2: Arduino IDE

Proteus simulation software

Proteus is a simulation and design software tool developed by Labcenter Electronics for Electrical and Electronic circuit design. It also possesses a 2D CAD drawing feature. It is a software suite containing schematic, simulation as well as PCB designing. It also has a wide range of components in its library. Proteus has sources, signal generators, measurement and analysis tools like oscilloscope, voltmeter, ammeter etc., probes for real time monitoring of the parameters of the circuit, switches, displays, loads like motors and lamps, discrete components like resistors, capacitors, inductors, transformers, digital and analog Integrated circuits, semiconductor switches, relays, microcontrollers, processors, sensors etc.

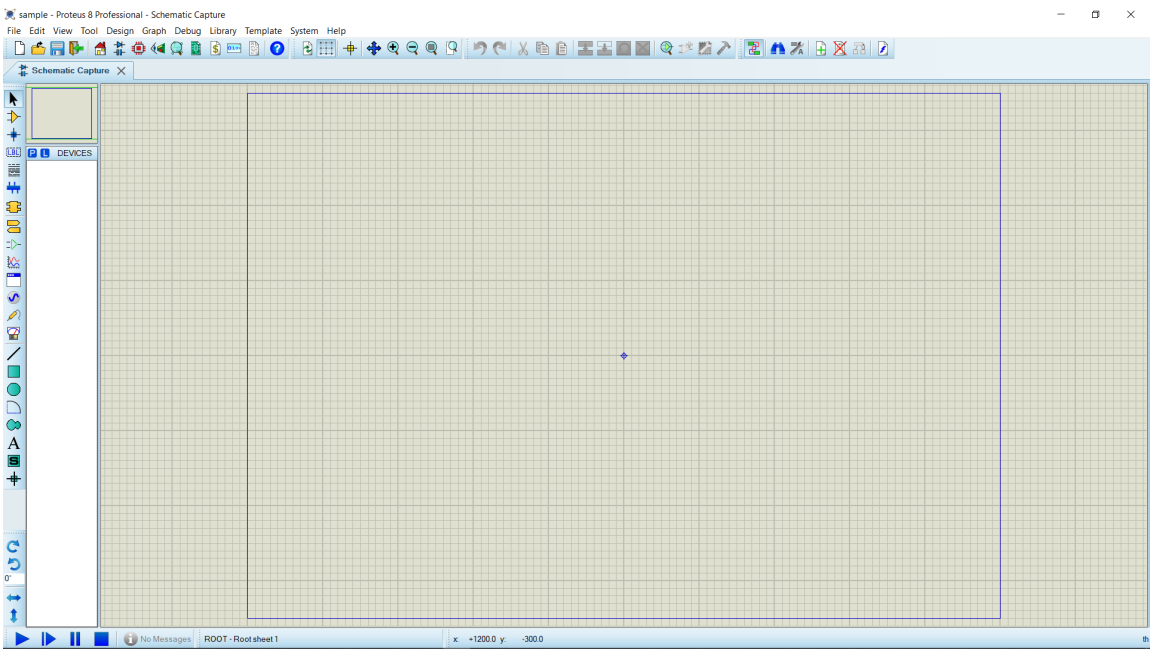

Figure 4.3: Proteus simulation software

4.3 Objectives

So, in this project we built what traffic authorities in many cities desire, they are called smart parking guidance and information systems for better parking management. These systems present drivers with dynamic information on parking within controlled areas and direct them to vacant parking spots. Smart Parking involves the use of low cost sensors, real-time data and applications that allow users to monitor available and unavailable parking spots. The goal is to automate and decrease time spent manually searching for the optimal parking floor, spot and even lot. Some solutions will encompass a complete suite of services such as online payments, parking time notifications and even car searching functionalities for very large lots. A parking solution can greatly benefit both the user and the lot owner.

4.4 Simulation of smart parking system

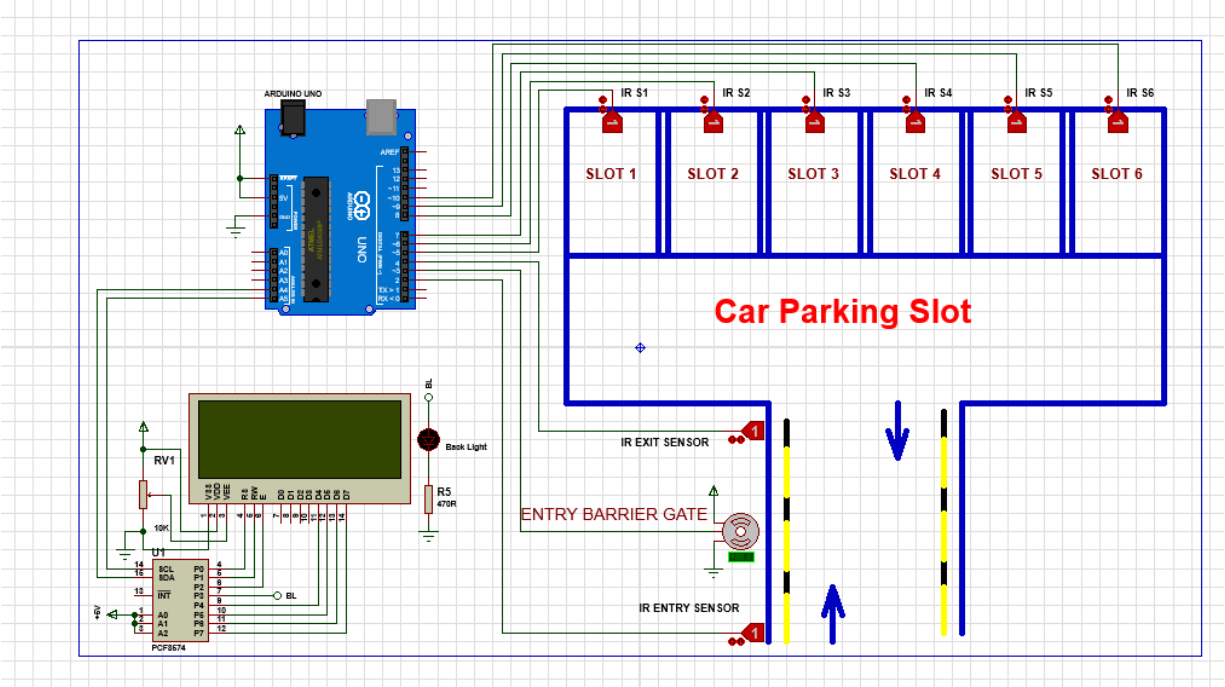

Figure 4.4: Simulation of smart parking system

4.5 Hardware Components

The major components used in the circuit are

- **Arduino Uno microcontroller**: Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller. We can simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.

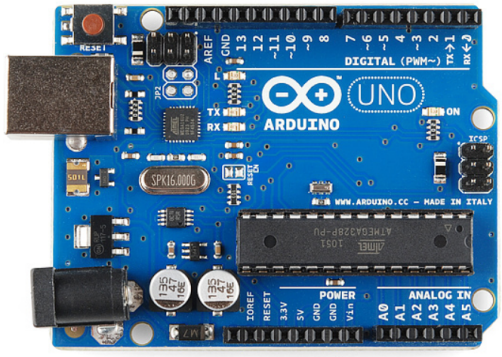

Figure 4.5: Arduino Uno microcontroller

- **LCD display:** 16x2 LCD display is an alphanumeric display. It is based on the HD44780 display controller, and ready to interface with most microcontrollers. It works on 5V and has a Green Backlight which can be switched on and off as desired.

Figure 4.6: 16 X 2 LCD

- **Servo motor:** A servomotor is a linear actuator or rotary actuator that allows for precise control of linear or angular position, acceleration, and velocity. Servomotor is designed to move to a given angular position. A typical servo motor has three connections. Two of them are the positive and 0V supply lines. The third connection carries the control signal pulses from the control circuit (the Arduino in this case).

  Servo motors may be classified, according to the torque it can withstand, as mini, standard and giant servos. Usually mini and standard size servo motors can be controlled by Arduino directly with no need for an external driver. The rotor of the motor has limited ability to turn. Generally, it can turn 60-90° on either side of its

central position. The control signal is a series of pulses transmitted at intervals of about 18 ms, or 50 pulses per second.

Figure 4.7: Servo motor

- **IR sensor (infrared sensor):** IR sensor is an electronic device that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detect the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiation are invisible to our eyes, but infrared sensor can detect these radiations. IR sensors have effective detection range from 2 cm to 80 cm.

Figure 4.8: IR sensor module

- **I2C_Module:** I2C Module has an inbuilt PCF8574 I2C chip that converts I2C serial data to parallel data for the LCD display. These modules are currently supplied with a default I2C address of either 0x27 or 0x3F. To determine which version you have check the black I2C adaptor board on the underside of the module.

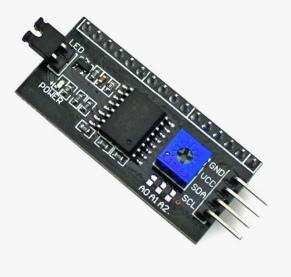

Figure 4.9: I2C module

Whereas the other components used are

- Power pin
- Resistance
- Jumper wires
- Bread board

4.6 Working principle

After assembling all components according to the circuit diagram and uploading the code to the Arduino board. Now the sensors and servo motor are placed 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.

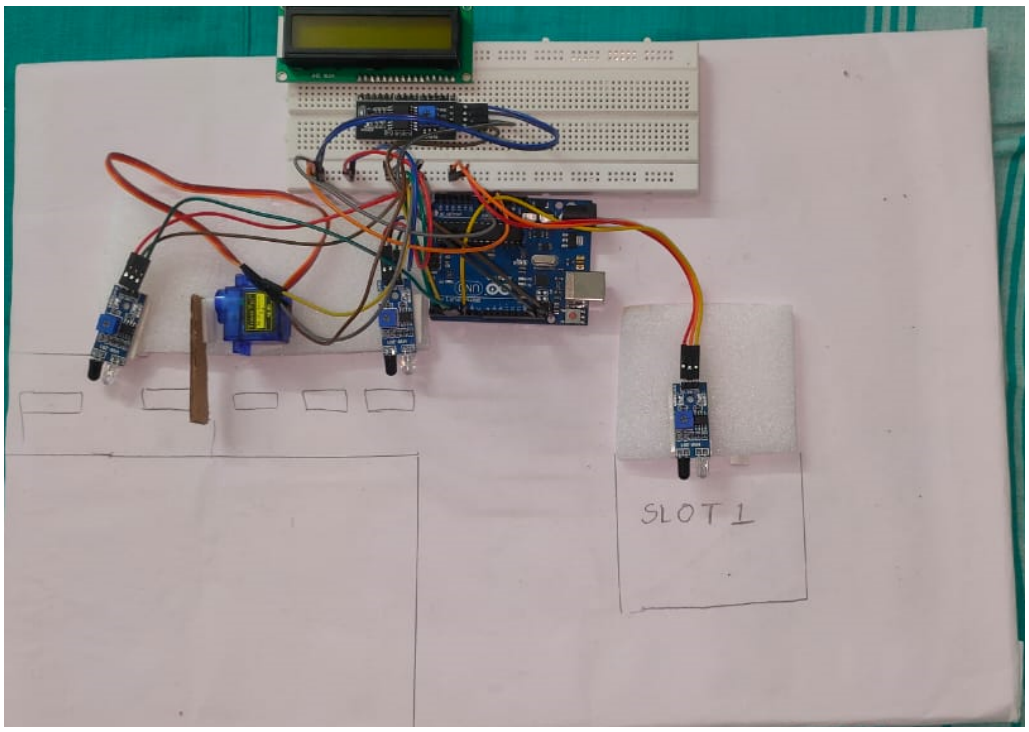

Figure 4.10: Smart parking system prototype

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 is allowed to enter that vehicle by opening the servo barrier. After entering into the parking area when that vehicle occupies a slot then the LCD 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 LCD 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 opens the servo barrier. Then the LCD display shows that the slot is empty. Again the system will allow entering a new vehicle. Fig. 4.8, shows the hardware implementation

of a smart parking system on cardboard using an Arduino, breadboard, servo motor and LCD display for showing the information.

Chapter 5

Conclusion

In this project, the issue of parking was addressed and an IoT based smart parking system was presented. The system that was proposed provides real time information regarding availability of parking slots in a parking area and displays them using LCD. The efforts made in this project are intended to improve the parking facilities of a city and thereby aim to enhance the quality of life of its people.

5.1 Future Work

The smart parking system can be enhanced to assist even more with traffic parking solutions. We can add a data collection method using NodeMCU, which can collect data in real time and display it online using firebase. Also by developing an application for reserving and viewing parking slots, smart parking systems can be taken to a new level. By collecting data on the number of vehicles arriving and leaving the parking station, we can use machine learning for analytics on traffic data.

5.2 Learning Outcomes

After completing this project, our perception of smart cities and smart parking system were changed. We came to know about the very simple and very advanced systems which are used in modern cities to monitor and manage traffic on the road and off the road. By reviewing various research papers, we came to know about cloud based parking system, machine learning in parking system, and various IOT based small scale parking systems. While developing a model of smart parking system, we learned about Arduino boards, working of I2C modules, designing circuits and Arduino IDE, and learned to design and

run circuits in Proteus software using hex code. Also by working together for the project we learned to collaborate and work together to accomplish the required outcomes.

References

[1] Qianyu Ou, Wenjun Zheng, Zhan Shi, Ruizi Liao, "Driver-Side and Traffic based Evaluation Model for On-street Parking Solutions", Shenzhen Key Laboratory of IoT Intelligent Systems and Wireless Network Technology, IEEE, March 2022.

[2] Suvarna Nandyal, Sabiya Sultana, Sadaf Anjum "Smart Car Parking System using Arduino UNO", International Journal of Computer Applications, July 2017.

[3] Thanh-nam pham, Ming-fong Tsai, Duc-binh Nguyen, Chyi-Ren Dow, "Cloud based smart parking system based on IOT Technologies", IEEE Access, July 2015.

[4] Yangeng Geng, Christos G.Cassandras, "A new smart parking system infrastructure and implementation", 15th meeting of EURO working group on transportation(EWGT),2012.

[5] Harpreet Singh Bedi, K V Krishnan Raju, M Venkata Sriram, Hiroshima Khoisnam, Kesavarapu Jahnavi, P Naga Sai, "Design and implementation of IoT based smart parking system using NodeMCU ESP8266", International Journal of Mechanical Engineering, Vol. 7, April 2022.

[6] Salman, Ahmed E & Hashem, Essam. (2017). Smart Parking System (Student Activity Project). 10.13140/RG.2.2.18187.28966.

Appendices

Appendix A

Code Attachments

The following is the partial / subset of the code. Code of some module(s) have been wilfully suppressed.

A.1 Arduino Code

```
#include <Servo.h> //includes the servo library
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 16,2);
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(20, 4);
lcd.setCursor (0,1);
lcd.print("    Car  parking  ");
lcd.setCursor (0,2);
lcd.print("       System     ");
delay (2000);
lcd.clear();
Read_Sensor();

int total = S1+S2+S3+S4;
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");}

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;

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;}
}
```