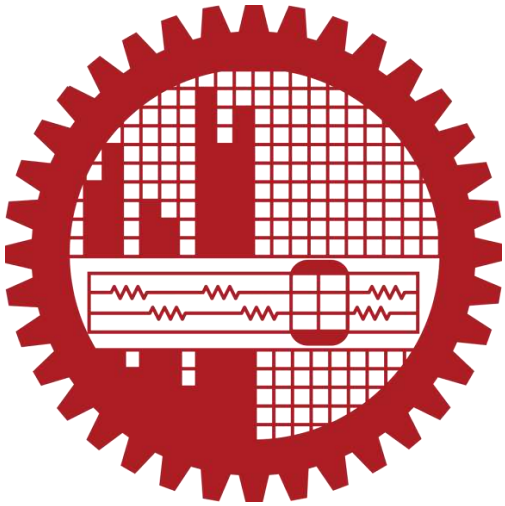
DESIGN OF A LOW COST EMBEDDED SYSTEM FOR A PARKING MANAGEMENT IN A SMART CITY

By

MD. NAYEMOR RAHMAN

ID: 0419311012

POSTGRADUATE DIPLOMA IN INFORMATION AND COMMUNICATION TECHNOLOGY



Institute of Information and Communication Technology

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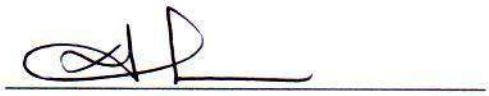

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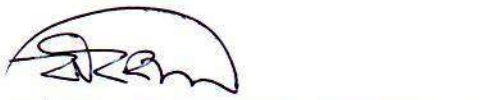

2. Dr. Md. Rubaiyat Hossain Mondal — Member
   Professor
   IICT, BUET, Dhaka-1000.

3. Dr. Md. Jarez Miah — Member
   Assistant Professor
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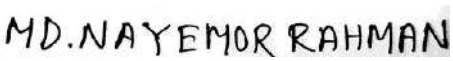

MD. NAYEMOR RAHMAN

Dedicated
To
My Parents

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LCD	Liquid Crystal Display
LED	Light Emitting Diode
IDE	Integrated Development Environment
USB	Universal Serial Bus
RFID	Radio Frequency Identification
GND	Ground
PWM	Pulse-Width Modulation
TX	Transmit
RX	Receive
IC	Integrated Circuit
DC	Direct Current
EMF	Electro Motive Force
AC	Alternating Current

Acknowledgement

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Abstract

Modern smart city is facing numerous technological as well as administrative challenges in many fronts involving man and machines. One of these is the smart transportation system aided with cutting edge public transit modes like bus, monorail, metro and so on so forth. However needless to say only having an adequate public transport system will not suffice the need of end to end mode of transport. Hence an efficient and hassle free parking system is inevitable for any modern day smart city. With advancements of technologies like Internet of Things (IoT) and cloud platforms it is now technologically feasible to design and deploy systems to incorporate automation in traditional parking systems and hence making vehicle parking more organized and hassle-free and would require very less human interventions. First I have explored the existing parking management system and specifications of the proposed system is prepared. Here Data flow diagram, Use case diagram and different modules of the system is figured out. Then software has developed to manage payments and issue NFC card. Arduino is used for the development of front end and google sheet used for backend. Then hardware circuit of the proposed system designed using the EDA software Proteus. The major components of the circuit is ESP32 processor, HC-SR sensor, servo motor etc. However R & D work carried out using alternative components to minimize the cost of the system. Then firmware is developed using Python language. When we connected the system to the power supply and connected the wifi module then we need smart card (RFID) to open the security protocol. when access RFID card then RFID send data to Google spreadsheet like going to make an attendance system based on RFID reader which is save attendance data in real-time to Google spreadsheet. Once the system is running then the functionality of the circuit has tested as per specifications. Then performance of the proposed system is compared with that of other researchers.

CHAPTER ONE

INTRODUCTION

1.1 Introduction

Park is a place where vehicles are stay for a certain time. Due to rapid increase in the vehicles there exist a problem for parking of vehicles, its lead to traffic congestion and also pollution [1]. So we have need to maintain the vehicle park management in the various places as like as shopping mall or public building, hospital, government building, private office in order to reduce the wastage of time and to safe their parking[2-3]. We see in the larger cities, the shopping malls or tourist places or any other commercial areas, there arises a problem for parking of vehicle [4]. We have so many methods of parking systems but we have design a project which is that "DESIGN OF A LOW COST EMBEDDED SYSTEM FOR A PARKING MANAGEMENT IN A SMART CITY" because of its smart, safety and secured. This project is helps to count the number of automobiles entering and leaving a parking, open the gate for authorized personnel, provide information about free parking spaces, create data base to provide statistics about vehicles entering and leaving the parking space in addition to using this system for security issues such as preventing violating vehicles to enter the parking space [5-8].

1.2 Motivation

Smart city is an emerging concept in this era of Information and Communication Technology (ICT) where modern technologies are used to manage and enhance resources effectively [1-3]. Urban parking facilities are one of the critical assets that need to be managed and so a design of a low cost embedded system for a parking management system has developed to solve parking issues efficiently to improve different aspects of smart cities. One of the most critical issue in parking is searching for parking which wastes significant amount of time and effort and leads to substantial financial costs as well as environmental pollution. This is particularly the case for the people who are always pressured to be on time. Other issues are reservation, payment, receiving notifications, showing statistics and monitoring parking states. There are a number of research on development of smart parking system however most of them did not address all the issues in developing the parking management system [4-8]. Moreover reduction of cost factor for the system is also not considered. Now a days embedded system technology has been emerged to play a vital role for automation in houses, offices, companies and to make product intelligent, smart which in turn saves

money and time, and generates more productivity and revenue [7-8]. However cost of the system is a major issue for a developing country like Bangladesh and others. To reduce the cost for any product or system, homegrown indigenous technology should be developed where each and every component can be engineered and reengineered. Although smart parking management system is not something new but there are scopes of research to customize it and make it low cost and suitable for our country.

1.3 Objectives with specific aims:

The project's goal is to design of a low cost embedded system for a parking management in a smart city. To realize the goal we have the following aims:

i. To develop software to manage payment and tracking time in the database and issue NFC card for a particular parking space
ii. To design the schematics of the circuit for the proposed system
iii. To develop the firmware of the proposed system and test functionalities

1.4 Project Outline

This Project is organized as follows:

Chapter 1 Introduced the report introduction, problem statement, objective of the project, scopes of the project, research methodology.

Chapter 2 Reviews the literature which are types of car parking system, parking security system, mechanism of security access system, types of access security system, smart access system, Briefly describes the components name and quantity. and History of car parking system.

Chapter 3 Describes the physical layout of smart parking system, block diagram of the project, full circuit diagram, connection and explanation of the whole system and working procedure.

Chapter 4 Presents the result found through the project and cost analysis and provides a discussion on the findings.

Chapter 5 Specified the limitations of the project, provides the future works that may be approached and conclusion.

CHAPTER TWO

FUNDAMENTALS OF INTELLIGENT CAR PARKING SYSTEM

2.1 Introduction

This chapter describes the smart parking systems. I have given a study on various design aspects for a IoT based smart parking system in their survey work and recommended a conceptual hybrid- parking model and briefly discuss about all of components that's we use in our project and they are Arduino Uno, ESP8266 processor, **HC-SR04 Ultrasonic (US) sensor** , RFID RC522 module, SG90 Servo motor, 16*2 LCD, Bread board, Potentiometer, LED, Buzzer, Resistor, Jumper wire and Power source.

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. [1]

2.2 Types of Car Parking System

Based on the authors' research, there are mainly four categories of car park guidance systems using different technologies - wired sensor-based, wireless sensor-based and image-based, counter- based.

2.2.1 Wired Sensor-Based

Wired sensor-based system is using detection sensors such as ultrasonic sensors which are installed at each parking lot. These sensors are wired to a central control unit that store and installed at each parking lot. These sensors are wired to a central control unit that store and manage the parking occupancy information. This information is then forward to display panels at intentional locations in the car park. The display panels provide information, direction and guide the drivers to vacant parking lots.

2.2.2 Wireless Based

With the advancement of wireless technologies, wireless based methods have been employed in parking guidance systems. Wireless sensors nodes are deployed and each parking lot is equipped with one node. The sensor board is equipped with the sensors of light, temperature, acoustic and a sounder. In using wireless technologies, disadvantage in employing sensor at each parking lot is still present and can be very costly as each sensing unit is usually attached with a processing unit and a transceiver.

2.2.3 Image based

Image based techniques or some people call it as video sensor techniques. There are arguments concerning the viability of using image-based techniques. The disadvantages are video sensor is energetically expensive and video sensor can generate large amount of data which can be difficult to transmit in a wireless network.

2.2.4 Counter-based

The last category of car park guidance systems use is Counter-based systems which use sensors to count the number of vehicles entering and exit a car park area. This can be gate-arm counters and induction loop detectors located at the entrances and exits. This system can give information on the total number of vacant lots in a closed car park area, but does not help much in guiding the driver to the exact location of the vacant lots. [2]

2.3 Parking Security System

The term parking security may refer to any of a range of measures used to harden gates against gate open or close, ram-raiding and prevent crimes such as stolen car or any kind of vehicles and any other accessories. Parking security system is used in shopping mall, college and university areas, private office building, commercial and government building as well as in residential settings.

2.4 Mechanism of Security Access System

Security access system runs on automated parking likewise on systems, which makes do with a smartcard device. When the smart card is inserted into it, it prompts the host for identification of card if confirmed access will be granted, if not access will be denied. Before it denies access completely to that smart card, the alarm gets activated when access is generated. The smart card sends a voltage signal of which triggers the relay causing it to activated the servo motor. The motor moves at 90-degree angle to allow a vehicle to enter the lot.

2.5 Types of Access Security System

There are different types of electric security devices, they are; switch activated security system, sound activated system, shadow access security system, light detector security system, pressure pad, sensitive security system, and smart card security access system etc. We used smart card security access system in our project.

2.6 Smartcard Access Systems

The card access control system secures an area using an electronic car parking mechanism that requires a card reader and valid card to access the area. Only vehicles which are permitted to access the area and which have been emerged valid cards may gain entry.

2.7 History of Car Parking System

Over the years, car parking systems and the accompanying technologies have increased and diversified. Car parking systems have been around almost since the time cars were invented. In any area where there is a significant amount of traffic, there are car parking systems. Car Parking systems were developed in the early 20th century in response to the need for storage space for vehicles.

In the 1920s, forerunners of automated parking systems appeared in U.S. cities

like Los Angeles, Chicago, New York City and Cincinnati. Some of these multi-story structures are still standing, and have been adapted for new uses. One of the Kent Automatic Garages in New York (now known as the Sofia Apartments) is an Art Deco landmark that was converted into offices and luxury condominiums in 1983. A system that is now found all over Japan — the "Ferris-wheel," or paternoster system — was created by the Westinghouse Corporation in 1923 and subsequently built in 1932 on Chicago's Monroe Street. The Nash Motor Company created the first glass- enclosed version of this system for the Chicago Century of Progress Exhibition in 1933, and it was the precursor to a more recent version, the Smart Car Towers in Europe. [3]

2.8 Description of Arduino Uno

Arduino is an open-source platform used for building electronics projects. Arduino consists of both a physical programmable circuit board (often referred to as a microcontroller) and a piece of software, or IDE (Integrated Development Environment) that runs on computer, used to write and upload computer code to the physical board.

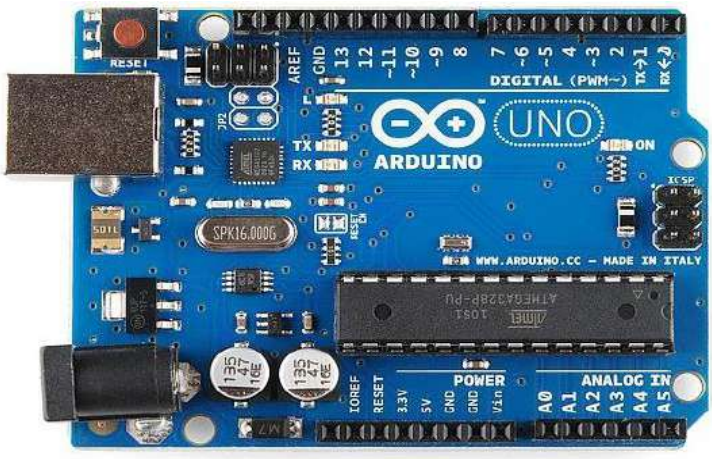


Fig 2.1 Arduino Uno

Figure 2.1 shows the Arduino Uno board.There are many varieties of Arduino boards that can be used for different purposes. Some boards look a bit different from the one below, but most Arduinos have the majority of these components in common.

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. The Arduino platform has become quite popular with people just starting out with electronics, and for good reason. Unlike most previous programmable circuit boards, the Arduino does not need a separate piece of hardware (called a programmer) in order to load new code onto the board – can simply use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks out the functions of the micro-controller into a more accessible package.

2.8.1 About Board

2.8.1A Power (USB / Barrel Jack)

Every Arduino board needs a way to be connected to a power source. The Arduino UNO can be powered from a USB cable coming from your computer or a wall power supply that exterminated in a barrel jack. The USB connection is also how it will load code on to Arduino board.

2.8.1B Arduino Pins (5V, 3.3V, GND, Analog, Digital, PWM, AREF)

The Arduino has several different kinds of pins, each of which is labeled on the board and used for different functions.

GND: Short for 'Ground'. There are several GND pins on the Arduino, any of which can be used to ground on circuit.

5V & 3.3V: The 5V pin supplies 5 volts of power, and the 3.3V pin supplies 3.3 volts of power. **Analog:** The area of pins under the 'Analog in' label (A0 through A5 on the UNO) are Analog in pins. These pins can read the signal from an analog sensor and convert it into a digital value that we can read.

Digital: Across from the analog pins are the digital pins (0 through 13 on the UNO). These pins can be used for both digital input and digital output.

PWM: The tilde (~) next to some of the digital pins (3, 5, 6, 9, 10, and 11 on the

UNO). These pins act as normal digital pins, but can also be used for something called Pulse-Width Modulation (PWM).

AREF: Stands for Analog Reference. It is sometimes used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

2.8.1C Reset Button

The Arduino has a reset button. Pushing it will temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino.

2.8.1D Power LED Indicator

Just beneath and to the right of the word "UNO" on the circuit board, there's a tiny LED next to the word 'ON'. This LED should light up whenever plug the Arduino into a power source. If this light doesn't turn on, there's a good chance something is wrong. Time to re-check circuit.

2.8.1E TX RX LEDs

TX is short for transmit, RX is short for receive. These markings appear quite a bit in electronics to indicate the pins responsible for serial communication.

2.8.1F Main IC

The black thing with all the metal legs is an IC, or Integrated Circuit. Think of it as the brains of our Arduino. The main IC on the Arduino is slightly different from board type to board type, but is usually from the AT mega line of IC's from the ATMEL company.

2.8.1G Voltage Regulator

The voltage regulator is not actually something it can interact with on the Arduino. But it is potentially useful to know that it is there and what it's for. The voltage regulator does exactly what it says – it controls the amount of voltage that is let into the Arduino board. Think of it as a kind of gatekeeper; it will turn away

an extra voltage that might harm the circuit. It has its limits, so don't hook up Arduino to anything greater than 20 volts. [5]

2.9 About ESP32 processor

Node MCU is an open-source based firmware and **development board** specially targeted for IoT based Applications. It includes firmware that runs on the ESP32 Wi-Fi from espressif Systems, and hardware which is based on the ESP-12 module.

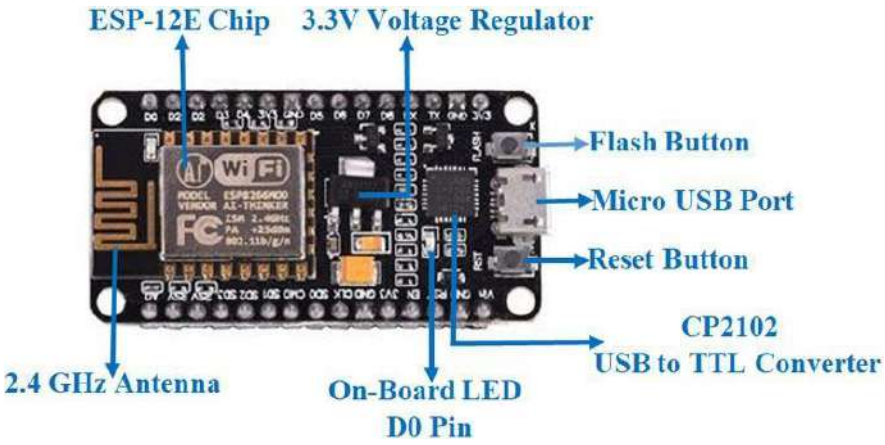


Fig. 2.2 Brief About node MCU ESP32

Figure 2.2 shows The Node MCU ESP32 board comes with the ESP-12E module containing the ESP32 chip having 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. Node MCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi/ Bluetooth and Deep Sleep Operating features make it ideal for IoT projects.

Node MCU can be powered using a Micro USB jack and VIN pin (External Supply Pin). It supports UART, SPI, and I2C interface.

2.9.1 Node MCU Development Board Pinout Configuration

Table No. 2.1 Specifications & Pin Details

Pin Category	Name	Description
Power	Micro-USB, 3.3V, GND, Vin	**Micro-USB:** Node MCU can be powered through the USB port **3.3V:** Regulated 3.3V can be supplied to this pin to power the board **GND:** Ground pins
		Vin: External Power Supply
Control Pins	**EN, RST**	The pin and the button resets the microcontroller
Analog Pin	A0	Used to measure analog voltage in the range of 0-3.3V
GPIO Pins	GPIO1 to GPIO16	Node MCU has 16 general purpose input-output pins on its board
SPI Pins	SD1, CMD, SD0, CLK	Node MCU has four pins available for SPI communication.
UART Pins	TXD0, RXD0, TXD2, RXD2	Node MCU has two UART interfaces, UART0 (RXD0 & TXD0) and UART1 (RXD1 & TXD1). UART1 is used to upload the firmware/program.
I2C Pins		Node MCU has I2C functionality support but due to the internal functionality of these pins.

Table 2.1 shows the specification and pin details of Node MCU Development Board where Node MCU can be powered through the USB port and Regulated 3.3V can be supplied to this pin to power the board.

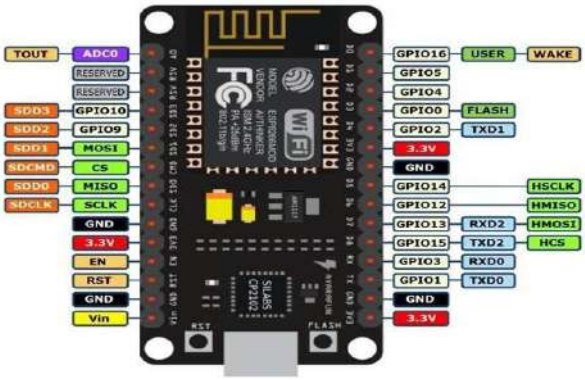


Fig:2.3 ESP32 processor

Figure 2.3 shows esp32 microcontroller board .There are totally 39 digital Pins on the ESP32 out of which 34 can be used as GPIO and the remaining are input only pins. The device supports 18-channels for 12-bit ADC and 2-channel for 8-bit DAC. It also has 16 channels for PWM signal generation and 10 GPIO pins supports capacitive touch features.

2.9.2 Node MCU ESP32 Specifications & Features

- Microcontroller: 32-bit RISC CPU LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL based on CP2102 is included onboard, Enabling Plug n Play
- PCB Antenna
- Small Sized module to fit smartly inside your IoT projects

2.10 About RFID RC522 Module

RFID is the abbreviation of ‘Radio frequency identification'. RFID RC522 is very simple yet effective module. It is an RFID module and is used for scanning RFID cards. It’s a new technology and is expanding day by day. Now-a-days it is extensively used in offices where employees are issued an RFID card and their attendance is marked when they touch their card to RFID reader.

We have seen it in many movies that when someone places one’s card over some machine then door opens or closes. In short, it’s a new emerging technology which is quite useful.

Figure 2.4 shows RFID module, it use electromagnetic fields to transfer data between card and the reader. Different tags are attached to objects and when we place that object in front of the reader, the reader reads that tags. Another benefit of RFID is that it doesn’t require to be in a line of sight to get detected. As in barcode, the reader has to be in the line of sight to the tag and then it can scan but in RFID there’s no such restriction. So, let’s get started with Interfacing of RFID RC522 with Arduino.[6]

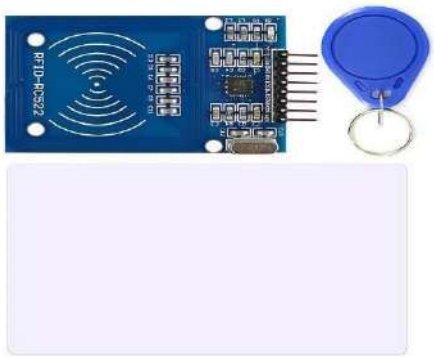


Fig. 2.4 RFID-RC52

2.10.1 RFID RC522 Module Features

Module Name: MF522-ED

Working current：

13—26mA/ DC

3.3V Standby

current：10-
13mA/DC 3.3V
sleeping current：
<80uA
peak current：<30mA

Working frequency：13.56MHz

Card reading distance ：0～
60mm（mifare1 card）
Protocol：SPI
Data communication speed：Maximum 10Mbit/s

Card types supported：mifare1 S50, mifare1 S70, MI fare
ultralight， MI fare Pro. Dimension：40mm×60mm
Working
temperature：-
20—80 degree
Storage
temperature：-
40—85 degree
Humidity：
relevant humidity
5%—95% Max SPI
speed: 10Mbit/s

2.10.2 Specifications & Pin Details

Table 2.2 shows The simple specifications of RC522 module from left to right first pins are as follows:

Table No. 2.2 Specifications & Pin Details

Pin	Name	Details
1.	3.3V	+3.3V Power Supply
2.	RST	Reset
3.	GND	Ground Pin
4.	IRO	Not Connected
5.	MISO	Serial Communication
6.	MOSI	Serial Communication
7.	SCK	TX/RX with Arduino
8.	SDA	TX/RX with Arduino

2.11 UART EM4100 RFID Card Reader

The 25KHZ EMID card reader module features small operating current and high stability. It can be used in attendance systems, access control systems, parking management systems, food sales systems, electronic security systems, community management, elevator control, lockers, toys, etc. The RFID reader module can read 125K EM4100 series (or compatible) RFID cards.

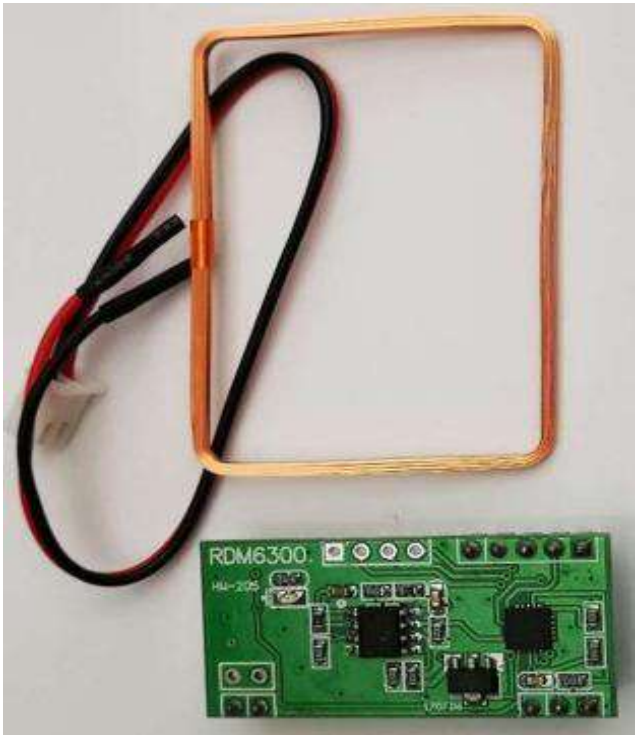


Fig 2.5 EM4100 RFID Card Reader

Figure 2.5 shows EM4100 RFID Card Reader. The module is very convenient to use, connected to the matching card reader antenna (coil) serial port to connect the single-chip microcomputer, turn on the power. When an RFID card enters the card reading range, the module automatically sends the card number through the serial port (UART), after receiving the MCU Can control the relay to achieve simple access control.

2.11.1 Pin-out instructions

1. GND: power ground
2. VCC: +5V
3. TXD: card number serial output
4. XH: Connect LED
5. LS: Connect the buzzer
6. L1: Receive card antenna
7. L2: Receive card antenna

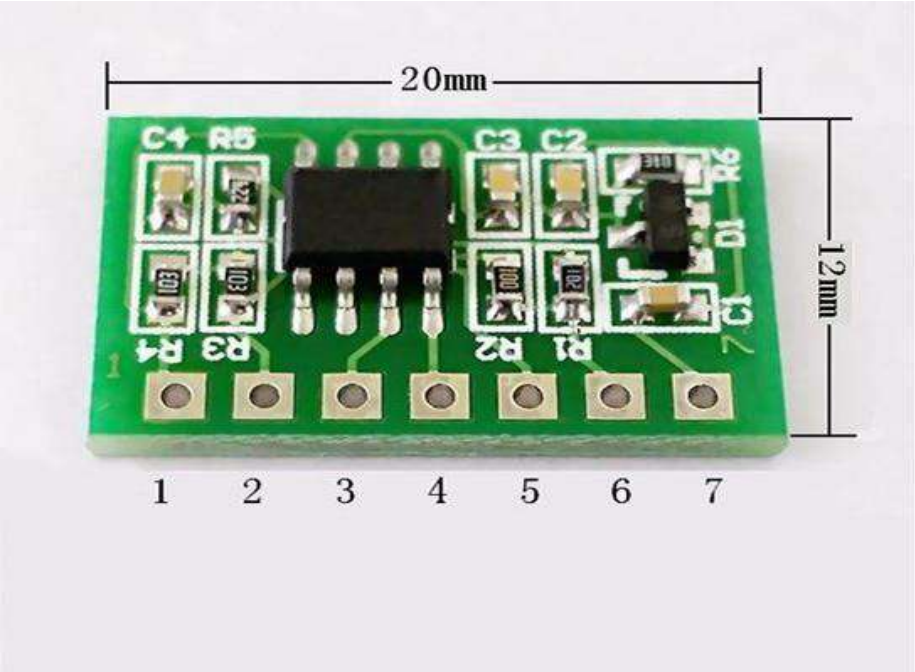


Fig 2.6 EM4100 board pin-out instruction

Figure 2.6 shows EM4100 board pin-out instruction where pin 1 is GND, pin 2 is VCC, pin 3 is serial output and pin 6, pin 7 is receive card antenna.

2.11.2 Parameter

Power: 3-5V, <25MA

Working frequency: 125KHZ±1KHZ

Card reading distance: <7CM distance is related to card and antenna size Output mode: serial port TTL-232 level

Card reading method: swipe the card once and output the card number once Card reading temperature: <100MS

Working temperature: -10~75 degree Coil inductance: 345uH

2.11.3 Application

Card reader module can be applied to attendance system, access control system, parking management system, food sales system, electronic anti-theft system, community management, elevator control, lockers, toys, etc.

2.12 Ultrasonic Sensor HC-SR04

Figure 2.7 shows **HC-SR04 Ultrasonic (US) sensor** is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

Distance = Speed × Time

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module.

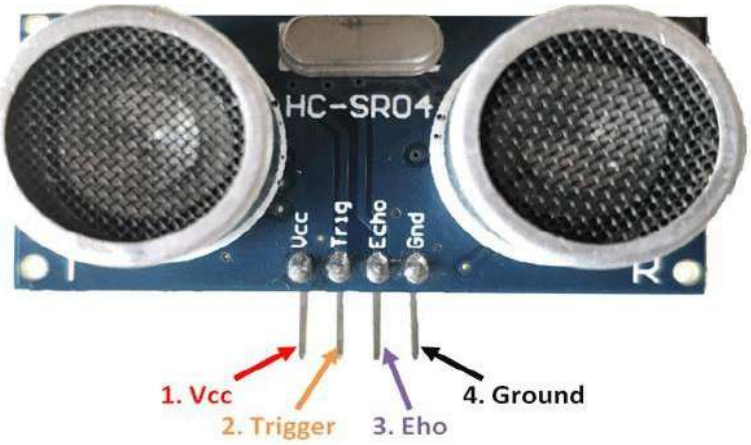


Fig 2.7 Ultrasonic Sensor HC-SR04

2.12.1 HC-SR04 Sensor Features

Operating voltage: +5V

Theoretical measuring

Distance: 2cm to 450cm Practical Measuring

Distance: 2cm to 80cm

Accuracy: 3mm

Measuring angle covered: <15°

- Operating Current: <15mA
- Operating Frequency: 40Hz

2.12.1 Ultrasonic Sensor Pinout Configuration

Table 2.3 shows the specification and pin details of ultrasonic sensor.

Table No. 2.3 Specifications & Pin Details

Pin Number	Pin Name	Description
1	Vcc	The Vcc pin powers the sensor, typically with +5V
2	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
3	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4	Ground	This pin is connected to the Ground of the system.

2.13 About SG90 Servo motor

Figure 2.8 shows servo motor is tiny and lightweight with high output power. This servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller. It can use any servo code, hardware or library to control these servos.It comes with a 3 horns (arms) and hardware. [7]

Fig.2.8 Servo motor

2.13.1 Specifications

Operating voltage: 4.8 V (~5V)

Operating speed: 0.1 s/60 degree Stall torque: 1.8 kg f cm

Dead band width: 10 µs Temperature range: 0 ºC – 55 ºC

2.13.2 Hardware and Software Required

SG90 Micro Servo motor Arduino Uno

Arduino IDE(1.0.6V)

2.13.3 Hardware connections

The SG90 micro servo motor has 3 wire interface in which the connections should made as follows: Red wire-5V

Brown Wire-Ground Yellow wire-digital pin A0

2.14 Details about LCD (Liquid Crystal Display)

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very generally used in various devices and circuits. These modules are preferred over seven segments and other multi segment

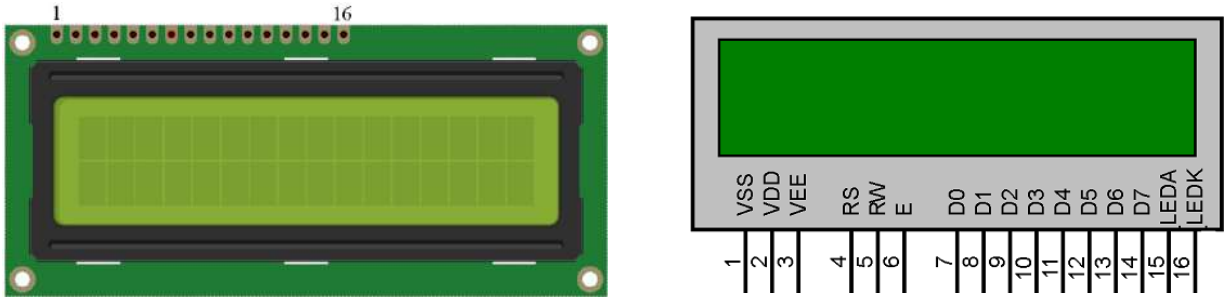


Fig. 2.9 LCD (Liquid Crystal Display)

LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters, animations and so on.

Figure 2.9 shows LCD and pin out configuration .A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD. [8]

2.14.1 Features of 16×2 LCD module

- Operating Voltage is 4.7V to 5.3V
- Current consumption is 1mA without backlight
- Alphanumeric LCD display module, meaning can display alphabets and numbers
- Consists of two rows and each row can print 16 characters.
- Each character is built by a 5×8-pixel box
- Can work on both 8-bit and 4-bit mode
- It can also display any custom generated characters

2.14.2 Pin Descriptions:

Table 2.4 shows pin description of 16×2 LCD module, Consists of two rows and each row can print 16 characters.

Table No. 2.4 Pin Description

Pin No	Function	Name
01	Ground (0V)	Ground
02	Supply Voltage; 5V (4.7V - 5.3V)	Vcc
03	Contrast adjustment; through a variable resistor	VEE
04	Selects command register when low; and data register when high	Register select
05	Low to write to the register; High to read from the register	Read/ write
06	Sends data to data pins when a high to low pulse is given	Enable
07	8-bit data pins	DB0
08	8-bit data pins	DB1
09	8-bit data pins	DB2
10	8-bit data pins	DB3
11	8-bit data pins	DB4
12	8-bit data pins	DB5
13	8-bit data pins	DB6
14	8-bit data pins	DB7
15	Backlight VCC (5V)	Led+
16	Backlight Ground (0V)	Led-

2.15 Bread Board

Figure 2.10 shows A breadboard is a solder-less device for temporary prototype with electronics and test circuit designs. Most electronic components in electronic circuits can be interconnected by inserting their leads or terminals into the holes and then making connections through wires where appropriate. The breadboard

has strips of metal underneath the board and connect the holes on the top of the board. The metal strips are laid out as shown below. Note that the top and bottom rows of holes are connected horizontally and split in the middle while the remaining holes are connected vertically.

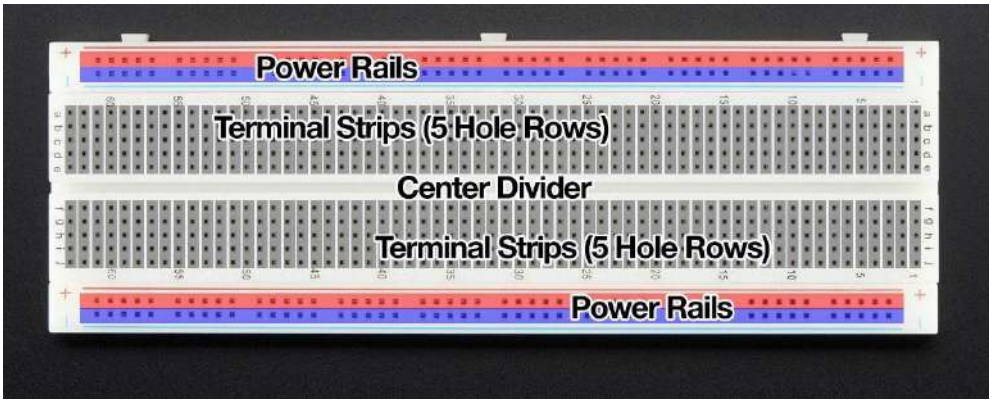


Fig. 2.10 Bread Board

2.16 Potentiometer

Figure 2.11 shows The Potentiometer, it is an electric instrument that used to measure the EMF (electro motive force) of a given cell, the internal resistance of a cell. And also it is used to compare EMFs of different cells. It can also use as a variable resistor in most of the applications. These potentiometers are used in huge quantities in the manufacture of electronics equipment that provides a way of adjusting electronic circuits so that the correct outputs are obtained. Although their most obvious use must be for volume controls on radios and other electronic equipment used for audio. [9]

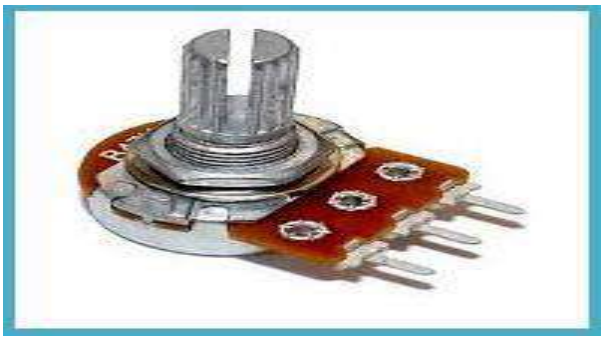


Fig. 2.11 Potentiometer

2.17 LED

Figure. 2.12 shows The Light emitting diode is a two-lead semiconductor light source. In 1962, Nick Holonyak has come up with an idea of light emitting diode, and he was working for the general electric company. The LED is a special type of diode and they have similar electrical characteristics of a PN junction diode. Hence the LED allows the flow of current in the forward direction and blocks the current in the reverse direction. The LED occupies the small area which is less than the 1 mm2. The applications of LEDs used to make various electrical and electronic projects.The lighting emitting diode is a p-n junction diode. It is a specially doped diode and made up of a special type of semiconductors. When the light emits in the forward biased, then it is called as a light emitting diode. [10]

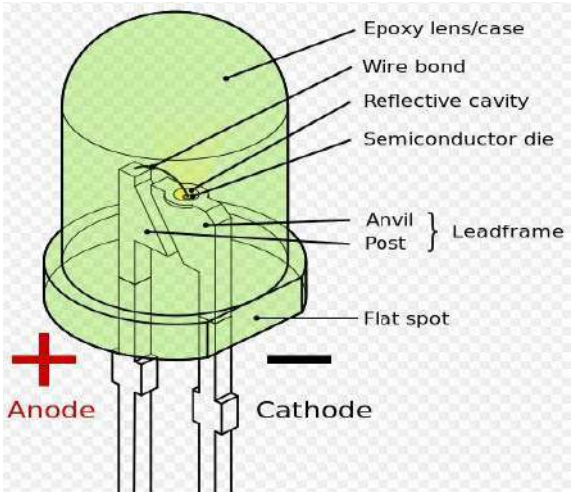


Fig. 2.12 LED

2.18 Buzzer

Figure 2.13 shows a buzzer or beeper is a signaling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, or game shows.

It most commonly consists of a number of switches or sensors connected to a control unit that determines if and which button was pushed or a preset time has lapsed, and usually illuminates a light on the appropriate button or control panel,

and sounds a warning in the form of a continuous or intermittent buzzing or beeping sound. Initially this device was based on an electromechanical system which was identical to an electric bell without the metal gong (which makes the ringing noise). Often these units were anchored to a wall or ceiling and used the ceiling or wall as a sounding board.

Fig. 2.13 Buzzer

2.19 Resistor

Figure 2.14 shows Resistor, the resistor is a passive electrical component to create resistance in the flow of electric current. In almost all electrical networks and electronic circuits they can be found. The resistance is measured in ohms. An ohm is the resistance that occurs when a current of one ampere passes through a resistor with a one volt drop across its terminals. The current is proportional to the voltage across the terminal ends. This ratio is represented by Ohm's law: formula with ohm's law: R=V/I

Fig. 2.14 Resistor

2.20 Jumper Wire

Figure 2.15 shows, The Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed.

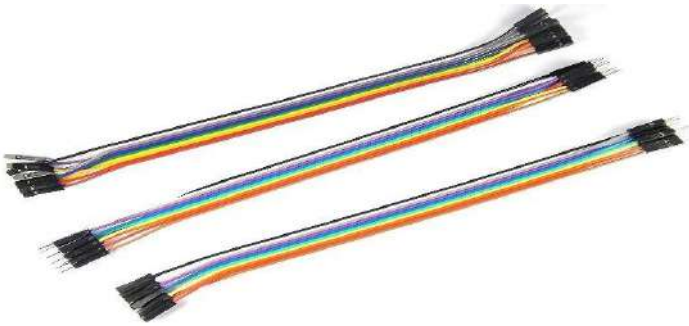


Fig. 2.15 Jumper wires

2.21 Power Source

A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that the power. There are two types of power supply; Alternating current (AC) and Direct current (DC) power supply. In our project we use 5V DC power supply by USB power cable.

2.22 Summary

In this chapter we discuss about Types of car parking system, Parking security system, Mechanism of security access system, Types of access security system, Smart card access system and history of car parking system and describe about all modules, equipment.

CHAPTER THREE

THEORETICAL MODEL

3.1 Introduction

As a typical component of a smart city application, smart parking is a good explication of how the Internet-of-Things will be pervasively spread out in our daily living environments to provide different services to different users. A smart parking system can provide efficient car parking management through (1) remote parking spot localization and reservation; (2) fast car retrieval;
(3) parking regulation using gate control and management; (4) car security and protection in the parking lot by associating car movement to a specific RFID tag; (5) parking gate management and many other services, such as parking billing and payment by replacing the paper-based ticketing by RFID tags.

Car parking management has been addressed using two models: parking gate monitoring and parking lot monitoring. Building upon an account of the entries/exits to/from the parking lot, smart parking management based on gate monitoring may provide important services for drivers, such as the capability of checking the availability of a free spot, reservation over the Internet, etc. In smart parking management based on parking lot monitoring, each parking spot is decorated with a sensor (camera or presence sensor or weight sensor) to detect the presence or absence of vehicles with the objective of building an availability map that can be used for parking guidance, reservation and the other services narrated above when combined with RFID identification devices [6].

3.2 Physical Layout of Smart Parking System

Figure 3.1 shows the physical layout of our project. Here the slot is defined the total slot number of the parking. The LCD is shows us the command of entry and exit, authorized access or access denied. The Control room is defined the room in which all operation of the project is operated and controlled and the LED is defined in which slot is free or busy.

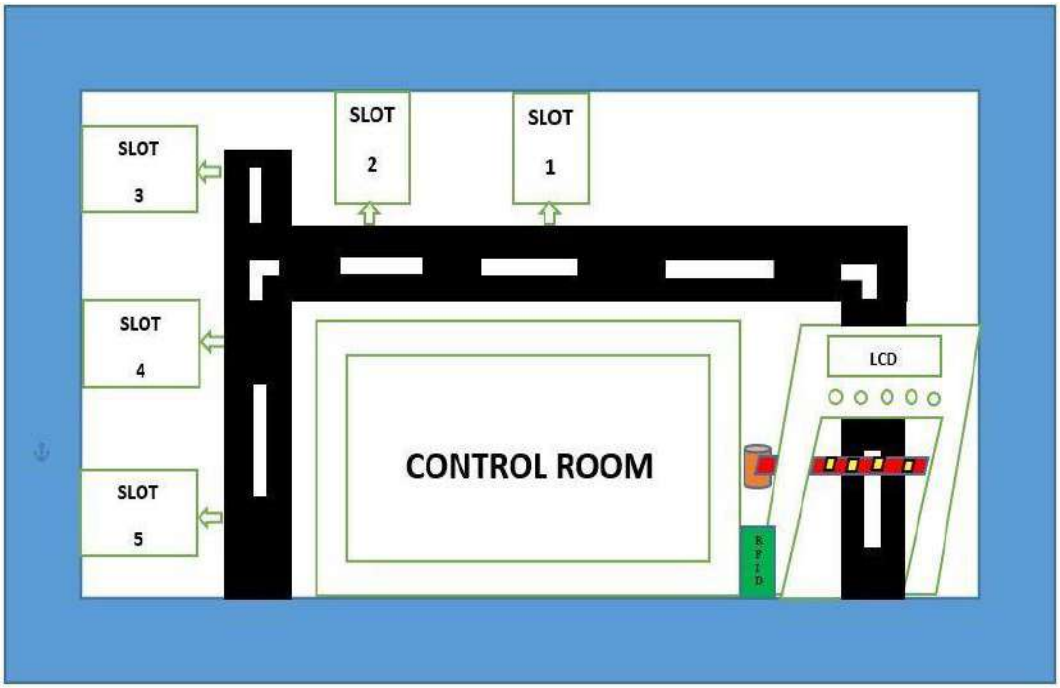


Fig. 3.1 Physical Layout of Smart Parking System

3.3 Full Circuit Diagram & Flowchart of This Project

Full circuit diagram means the total circuit connection of the component that we used in this project.

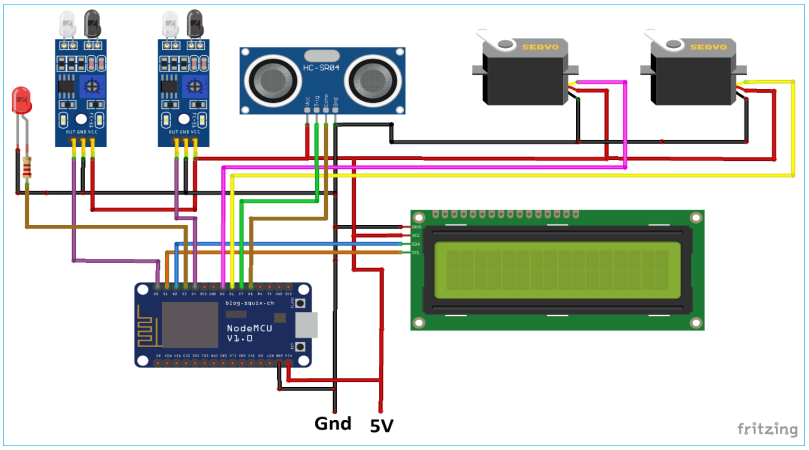


Fig. 3.2 Full Circuit Diagram of the Project

Figure 3.2 shows full circuit diagram of the project. In this project we used some

component that's are Arduino Uno, ESP32 processor, RFID module, TCRT5000 sensor, 16*2 LCD, potentiometer, servo motor, breadboard, buzzer, some LED and some connecting wire. We make this circuit diagram using "fritzing.0.9. 3b.32.pc" software.

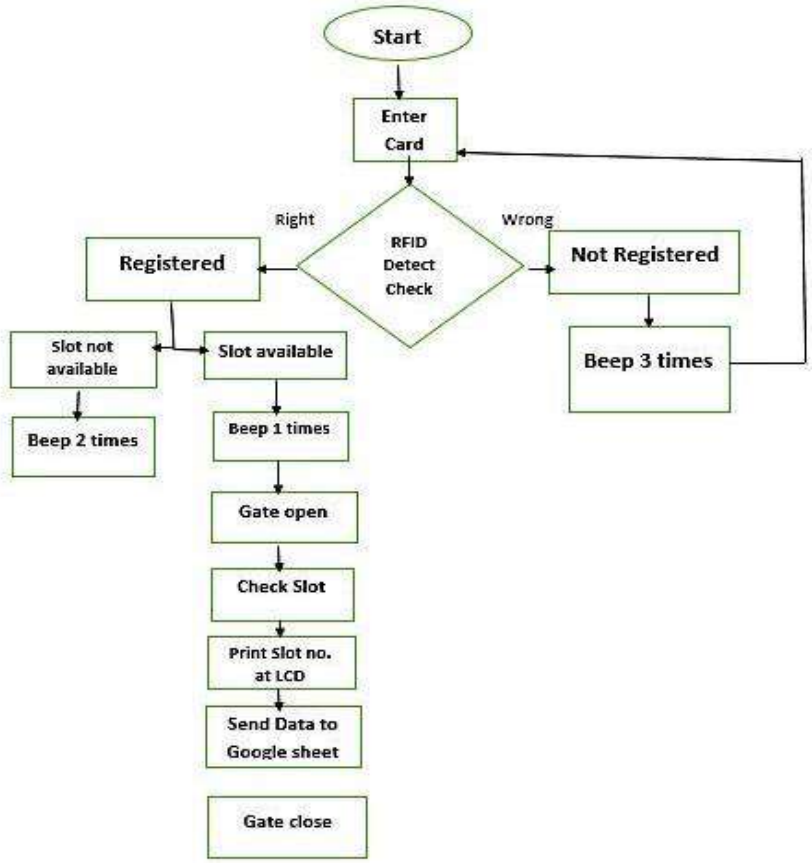


Fig.3.3 Flow chart of the project

In fig 3.3 shows the flow chart of the project. When we connected the system to the power supply and connected the wifi module we see the LCD print "Enter Card". We can see the parking gate is closed. So we need smart card (RFID) to open the security protocol. RFID module detect the right or wrong card .If detect wrong card then red led on and will alarm beep 3 times. If right card detect then green led is on and gate will open then print slot number and the slots are occupied by the vehicles then send data to google sheet of real-time parking list.

3.4 Connection and Explanation of the Whole System

Arduino Uno serves as the brain of the whole system. The Arduino Uno cab be linked with other circuits to perform some particular functions. It's works by entering the program that has been created and ready for instantly used.

Table No. 3.1: The function of system components

System Components	Function
Arduino Uno, ESP32 processor	As control the whole system by code
RFID	As identifier
LCD	As a printer
Servo Motor	As used for gate open or close
LED	As indicator
BUZZER	As used for alarming

Table 3.1 shows the whole component of the project is connected to the esp32. Here the RFID pin SDA, SCK, MOSI, MISO, GND, RST, 3.3V are connected according to the processor pin 3~, 13, 11, 12, GND, 5~, 3.3V. The LCD pin GND, VDD, VO, RS, RW, E, DB4, DB5, DB6, DB7, BLA, BLK are connected according to the esp32 pin GND, 5V, GND, 2, GND, 4, 6~, 7, 9, 10, 5V, GND. The Servo pin signal, +5V, GND are connected according to the esp32 pin A0, +5V, GND. The Buzzer pin +VE&-VE are connected according to esp32 pin A2 & GND. The green LED pin +VE & -VE are pursuant to the esp32 pin A3 & GND as well as the Red LED pin +VE and –VE are connected to the esp pin A4 and GND.

3.5 Block Diagram & Working Procedure

Here figure shows the whole project in a block diagram. This block diagram contains all the project component that's we used in our project which are connected to Esp32.

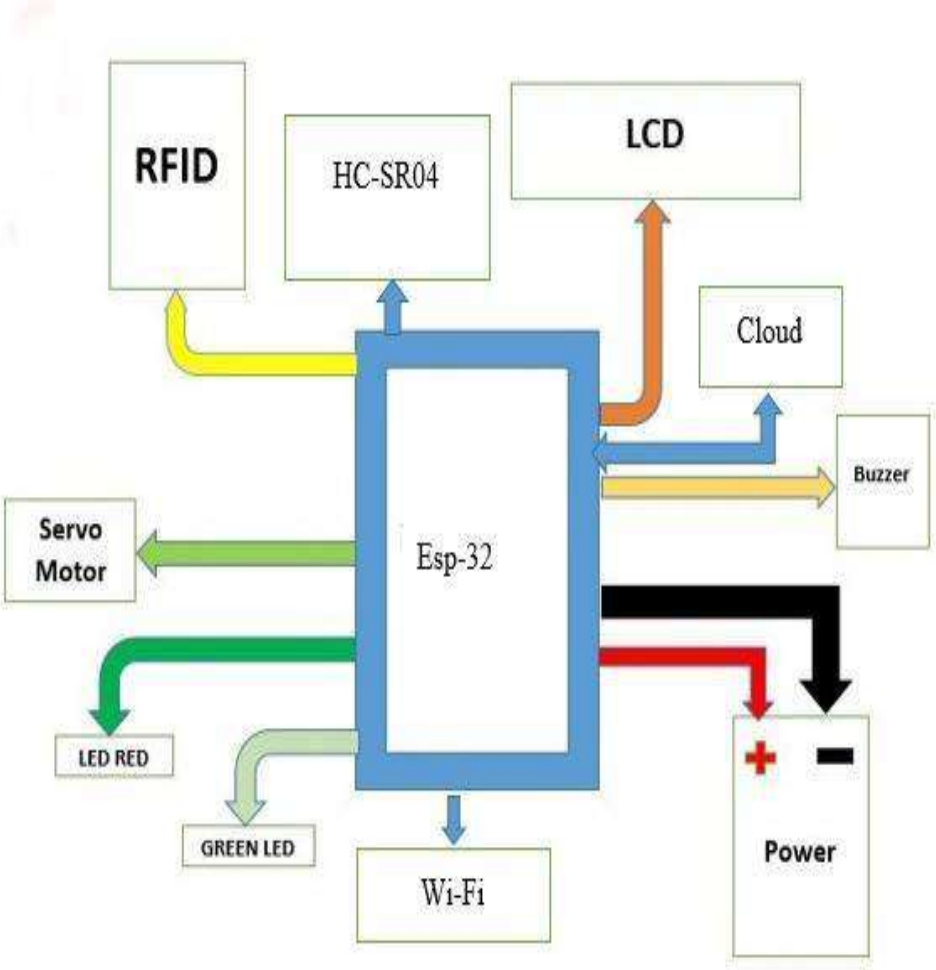


Fig. 3.4 Block Diagram of the Project

First of all, we think about our academic project then we listed some project idea and go to our supervisor sir and show him our project list. He selected a project that is "DESIGN OF A LOW COST EMBEDDED SYSTEM FOR A PARKING MANAGEMENT IN A SMART CITY" for our academic project. Then we research about our project with the help of google and YouTube then we make a final idea about our project and we listed which equipment's are needed to our project. We buy all of our equipment's and we started our work. At first we make a circuit diagram of our project. Though our project is Esp32 based so we need an

Arduino software and download this software from the official website of Arduino. Now and then we need RFID tag number for our project and we find out the RFID tag number by using Arduino software and RFID module.

Then we upload the code into the Arduino Uno. Then we connect the all components according to the full circuit diagram by connecting wire and connected to the power supply. Finally, we run our project and it works successfully.

3.6 Summary

Firstly, we showed the physical layout of smart parking system. Secondly, we showed the block diagram of the project. Thirdly we showed the full circuit diagram of the project. Fourthly, we describe the connection and explanation of the whole system and finally, we briefly discuss about the working procedure of this project.

CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.1 Introduction

Result is the final output of any project. Result presents the successful/unsuccessful output of a project. By the grace of Allah, we find out the successful result of our project.

4.2 Result and Discussion

4.2.1 Proteus Design

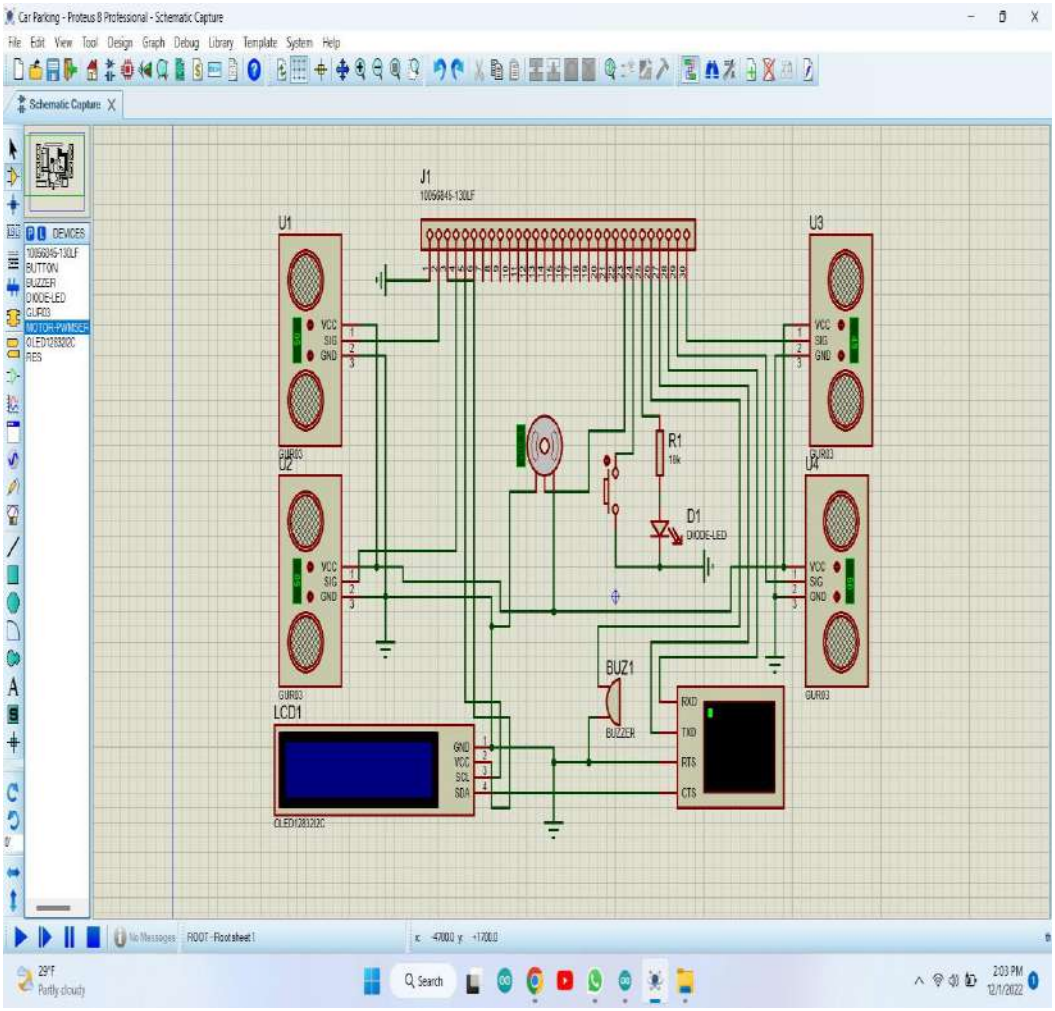


Fig. 4.1 Proteus design

Figure 4.1 shows the board is larger and designed to make it possible to add your own circuitry to make a complete IoT solution on one board. It includes a dual-

core 240 MHz ESP32 with WiFi and Bluetooth. You can use the WiFi both in station (device) mode and access point mode. It includes traditional Bluetooth as well as BLE 4.0. On-board is a 3.3V regulator and a battery charging device that enables you to switch between using USB or battery power.

The battery is automatically charged in the USB is plugged in. A status light shows if it is charging or fully charged. All ESP32 pins bar the flash pins are exposed and available for your use.

The board includes a large prototyping area that includes room for traditional DIP and through-hole components as well as SMD parts such as SOIC and SOT-23. A user LED and switch is included but not connected to any pins so you can use them how you wish. Two level shifters are included so you can interface with 5V devices.

The Proteus includes both 3.3V and 5V rails. Both these rails are available whether powered by the USB or the battery as the 5V is derived from the lower voltage.

Proteus is professional grade Electronic Design Automation (EDA) software, used in both educational and commercial environments. Simulation provides a fast development workflow which enables users to design with confidence.

4.2.2 Laboratory Test Result

Figure 4.2 and figure 4.3 shows when we connected the system to the power supply and connected the wifi module we see the LCD print “Enter Card”. We can see the parking gate is closed. So we need smart card (RFID) to open the security protocol.

Fig 4.2 Full setup

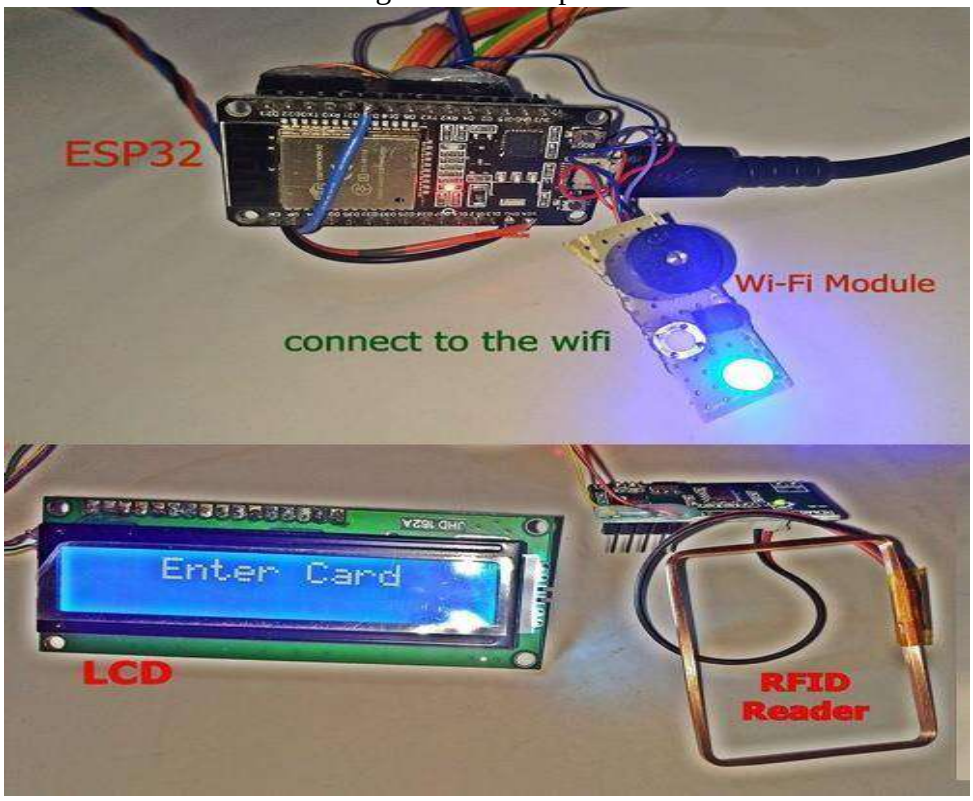


Fig 4.3 Connect system to the power supply & wifi

There are two types of RFID card which are right card (authorized access) & wrong card (authorized not access).

Figure 4.3 shows when we put the authorized access card the LCD print "Authorized Access". At that time The Green LED is on and the buzzer is being alarming and the gate is open at 90-degree angle (anti clock wise).

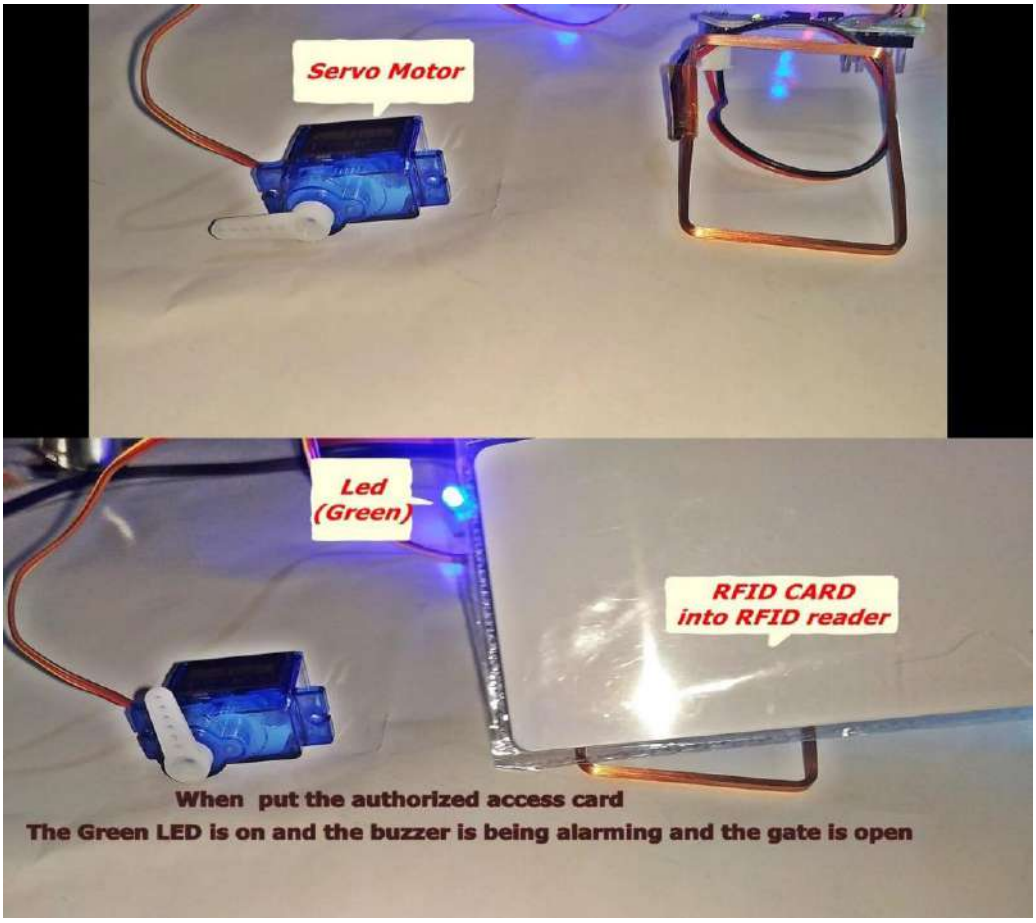


Fig 4.3 Gate security system using smart card (RFID)

When we put the wrong card the LCD print "Access denied". At that time The Red LED is on and the buzzer is being alarming and the gate is not open.

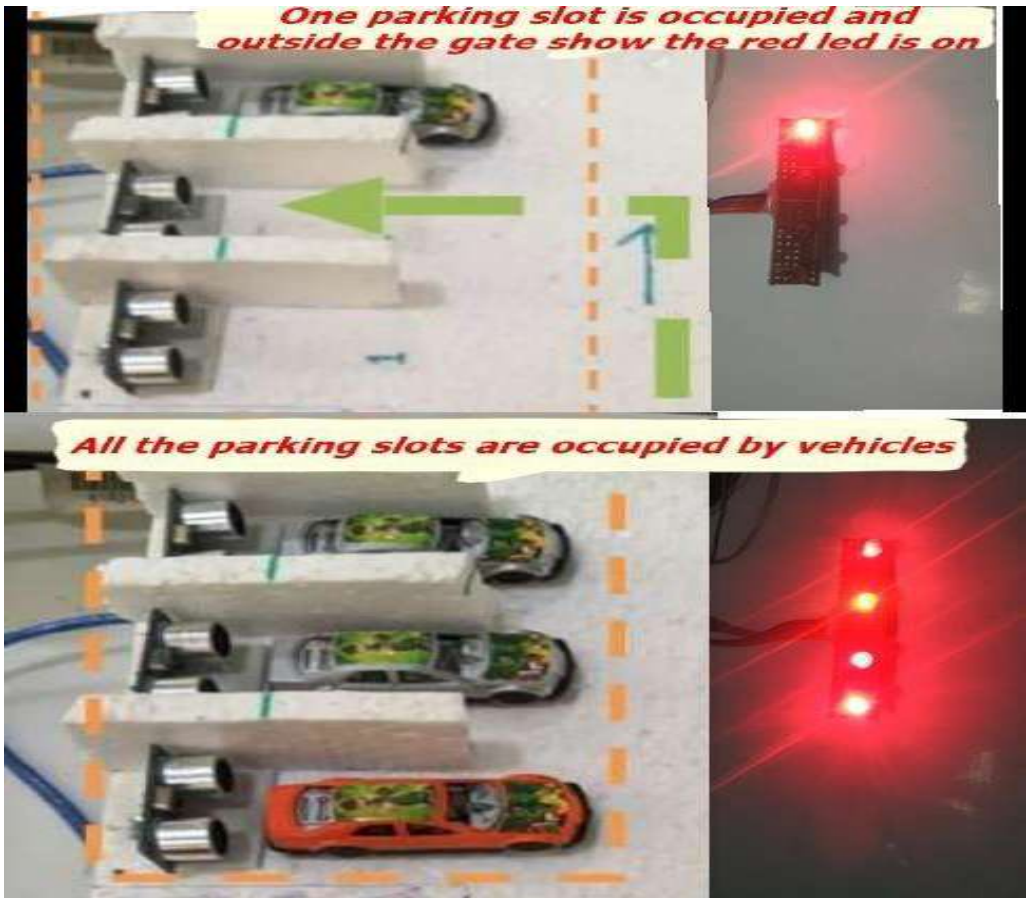
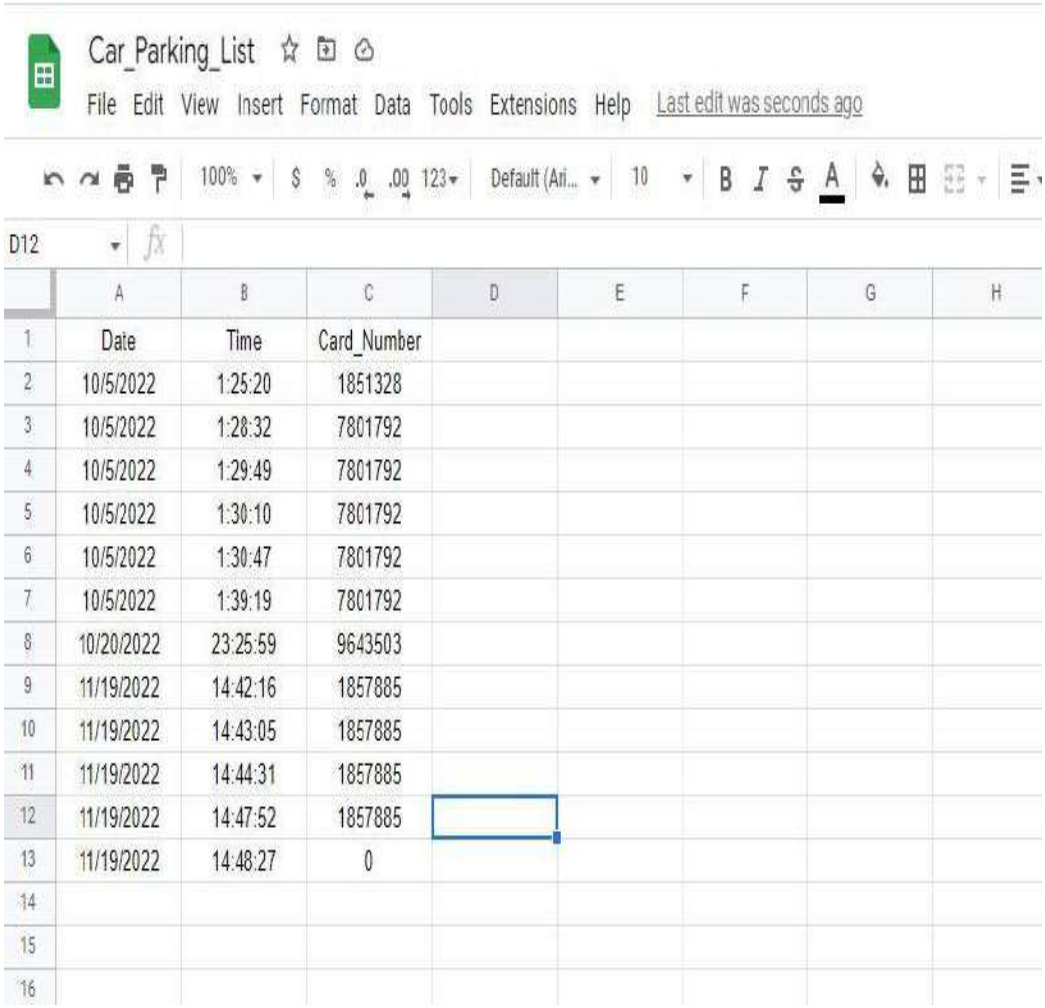


Fig 4.4 Identifying the Empty or Busy Slot

Figure 4.4 shows when a car is entering the slot of the parking lot that‘s the same number slot LED is on at the same time the same number display LED is on. That‘s mean that‘s the slot is busy. Similarly, we can identify every busy or empty slot for the parking. When every slot is busy.



	A	B	C	D	E	F	G	H
1	Date	Time	Card_Number					
2	10/5/2022	1:25:20	1851328					
3	10/5/2022	1:28:32	7801792					
4	10/5/2022	1:29:49	7801792					
5	10/5/2022	1:30:10	7801792					
6	10/5/2022	1:30:47	7801792					
7	10/5/2022	1:39:19	7801792					
8	10/20/2022	23:25:59	9643503					
9	11/19/2022	14:42:16	1857885					
10	11/19/2022	14:43:05	1857885					
11	11/19/2022	14:44:31	1857885					
12	11/19/2022	14:47:52	1857885					
13	11/19/2022	14:48:27	0					
14								
15								
16								

Fig 4.5 Google sheet data of car parking list

Figure 4.5 shows when we put the RFID card then RFID send data to Google spreadsheet like going to make an attendance system based on RFID reader which will save attendance data in real-time to Google spreadsheet.

4.3 Discussion

To design, construct, design analysis of the circuit, programming and hardware development is the basic purpose of our project. At first, to done our project we think an idea and clear the concept of this project by studying books, report paper,

searching internet, discussing with our advisor sir. At first we make a circuit diagram of our project. Though Our project is Esp32 based so we need an Arduino software and download this software from the official website of Arduino. Now and then we need RFID tag number for our project and we find out the RFID tag number by using Arduino software and RFID module. Then we upload the code into the Arduino Uno. Then we connect the all components according to the full circuit diagram by connecting wire and connected to the power supply. Finally, we run our project and it works successfully. The constructed project is very nicely working. Finally, our project is successfully completed and its operated properly.

4.4 Summary

Firstly, showed the full circuit diagram and proteus design of the project. Then describe the connection and explanation of the whole system and discuss about control parking gate security using smart card (RFID). Then discuss about what happened when we use a right card (authorized access) to open the gate and when use a wrong card (authorized not access). After that we explain about identifying the empty or busy slot.

CHAPTER FIVE
CONCLUSION

5.1 Conclusion

This structured, programmed smart parking system is fundamental, monetary, and gives a powerful answer to diminishing carbon impressions in the environment. It is very much figured out how to access and guide the status of parking openings from any distant area through an internet browser. In this manner, it decreases the danger of finding the parking spaces in any parking territory, and likewise, it wipes out pointless bridging the filled parking openings in a city. So it decreases time, and it is savvy moreover. It upheld the recognizable proof of entering and leaving vehicles in parking and retaining the vehicle parking area. Since the smartphone is utilized, the client has the practical help for the vehicle parking area. In our trials, the proposed system had demonstrated the precise parking area administration in parking parcels. Contrasted with the past strategy, the proposed system upheld the low usage cost.

This is an ongoing project. This project gives basic idea of how to control a parking lot security and safety and how to use it smartly. We use smart card (RFID) parking security system as a prototype for enter and exit the lot. It also provides a security and safety for the user. This project based on RFID and (Esp32) Arduino Uno platform both of which are free open source software. We describe the connection and explanation of the whole system and discuss about control parking gate security using smart card (RFID). Then discuss about what happened when we use a right card (authorized access) to open the gate and when use a wrong card (authorized not access). After that we explain about identifying the empty or busy slot. and finally, we briefly discuss about the working procedure of this project. The circuit was then modified to produce better response. Also the program was being modified. The implementation rate of this project is inexpensive and easy to install. So it can useful for private and public commercial purpose. In this project we have shown a simple prototype of smart parking system but in future it can be extensive implementation too many other regions.

5.2 Limitations of the Work

In our project, we use Esp Processor, which is easy to calibrate. But there are not so many output ports in this controller so we can‘t use more parking slot in our project.

5.3 Future Scopes of the Work

There are lots of scopes to develop this project like as:

- Not only it can be used in smart parking system purpose but also it can be used for smart door locked system and home automation system.
- It can also be used for private, public, government office security, and safety purpose.

- As we used smart card in our project so that it will be implemented online payable system by using smart card.
- The platforms can also be equipped with safety sensors guiding the movement of vehicles in the platforms
- It has a serial monitor data based that is temporary but it will be implemented for permanent data based by developing a data based software.

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