A Project report on

ADVANCED PARKING SYSTEM USING IOT

Submitted in partial fulfillment of the requirements

for the award of the degree of

BACHELOR OF TECHNOLOGY

in

COMPUTER SCIENCE & ENGINEERING
(ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)

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(ARTIFICIAL INTELLIGENCE & MACHINE LEARNING)

Certificate

This is to certify that the project report entitled ADVANCED PARKING SYSTEM USING IOT is the bonafide work carried out by **D. Revanth,** bearing Roll Number **204G1A3336,** in partial fulfilment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science & Engineering (Artificial Intelligence & Machine Learning)** during the academic year 2023-2024.

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We Mr. D. Revanth bearing reg no: 204G1A3336, student of **SRINIVASA RAMANUJAN INSTITUTE OF TECHNOLOGY**, Rotarypuram, hereby declare that the dissertation entitled “**ADVANCED PARKING SYSTEM USING IOT** ” embodies the report of our project work carried out by us during IV year Bachelor of Technology under the guidance of **Mr. A. Kiran Kumar** **MTech, (Ph.D),** Assistant Professor ,Department of CSE(AI&ML) and this work has been submitted for the partial fulfillment of the requirements for the award of the Bachelor of Technology degree.

The results embodied in this project have not been submitted to any other University of Institute for the award of any Degree or Diploma.

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ABSTRACT

In the face of rapid urbanization and the corresponding surge in vehicular density, effective parking management has become an increasingly complex challenge in metropolitan areas. Traditional systems prove inadequate in addressing the dynamic and multifaceted nature of modern urban parking demands.

To meet these challenges head-on, this paper introduces an IoT-based Advanced Parking System that integrates cutting-edge technologies to revolutionize urban parking management. This system employs strategically deployed sensors, such as ultrasonic or infrared, to provide real-time insights into parking slot availability and efficiently identify instances of improper parking. The collected data is transmitted to a central IoT platform, acting as the intelligence hub for processing and analysis. Through the integration of a Gate System, secure entry and exit are regulated based on dynamic parking conditions. User interaction is facilitated by Blynk applications, offering seamless access to real-time information and advanced reservation capabilities.

This project highlights the pivotal role of the sensor mechanism in triggering immediate alerts for swift intervention in cases of improper parking, emphasizing a comprehensive and technology-driven approach to address the complexities of contemporary urban parking challenges

Keywords: IoT (Internet of Things), Microcontroller Sensor Mechanisms, Blynk software, Real-time Parking Slot Availability, Improper Parking Detection.

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LIST OF ABBREVIATIONS

DC	Direct Current
IR	Infrared
RFID	Radio Frequency Identification
USB	Universal Serial Bus
IOT	Internet of Things
CAD	Computer Aided Design
OTP	One Time Password
SDLC	Software Development Life Cycle
AC	Alternative Current
LCD	Liquid Crystal Display
LED	Light-emitting diode
IDE	Integrated Development Environment
OS	Operating System

CHAPTER-1
INTRODUCTION

1.1 Internet of Things

The Internet of Things is a transformative network of interconnected devices and technologies that facilitate seamless communication and data exchange over the Internet. It empowers devices to gather and process data, enabling remote monitoring, control, and automation across diverse domains. From smart homes and healthcare to agriculture, transportation, and manufacturing, IoT has far-reaching applications. Despite its immense potential, IoT faces challenges such as security and privacy concerns, interoperability issues, scalability, and the need for standardization. Looking ahead, future trends in IoT include edge computing, integration with AI and machine learning, and leveraging high-speed 5G connectivity. IoT is reshaping the technological landscape, offering new avenues for efficiency,convenience, and innovation across various industries.

The project revolves around the development of a Smart Parking System, leveraging the Internet of Things for enhanced efficiency, cost savings, and environmental impact within a smart city context. The primary objective is to automate the process of finding the nearest available parking slot, thereby reducing time, fuel consumption, and the associated environmental footprint. The system incorporates a smart parking feature that assists users in locating parking spaces in cities or near shopping malls, addressing the common challenge of wasted time and fuel spent searching for parking. A key focus is placed on improving the overall standard of living by streamlining the parking experience. The system provides real- time data on parking availability, facilitating efficient parking management.

An embedded system is one kind of a computer system mainly designed to perform several tasks like to access, process, store and also control the data in various electronics-based systems. Embedded systems are a combination of hardware and software where software is usually known as firmware that is embedded into the hardware. One of its most important characteristics of these systems is, it gives the o/p within the time limits. Embedded systems support to make the work more perfect and convenient. So, we frequently use embedded systems in simple and complex devices too. The applications of embedded systems mainly involve in our real life for several devices like microwave, calculators, TV remote control, home security and neighborhood traffic control systems, etc.

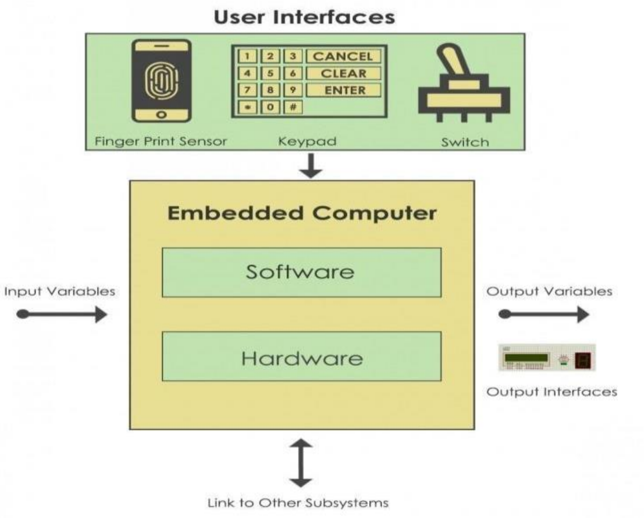

Fig 1.1: Overview of Embedded System

Embedded System

Embedded system includes mainly two sections, they are

1. Hardware
2. Software

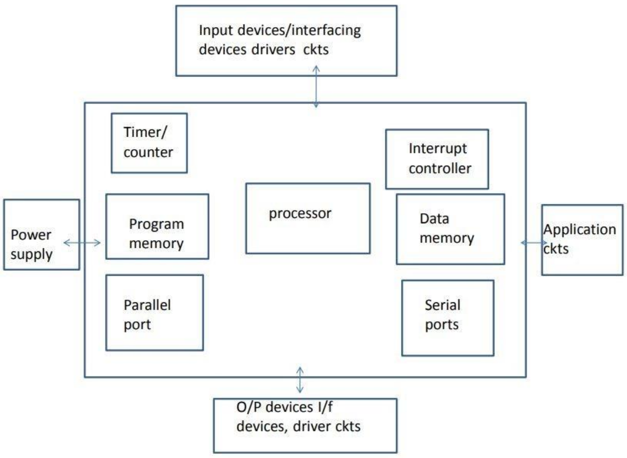

Fig 1.2: Block Diagram of Embedded System

Embedded System Hardware

As with any electronic system, an embedded system requires a hardware platform on which it performs the operation. Embedded system hardware is built with a microprocessor or microcontroller. The embedded system hardware has elements like input output (I/O) interfaces, user interface, memory and the display. Usually, an embedded system consists of:

- Power Supply
- Processor
- Memory
- Timers
- Serial communication ports
- Output/Output circuits
- System application specific circuits

Embedded systems use different processors for its desired operation.
Some of the processors used are

1. Microprocessor
2. Microcontroller
3. Digital signal processor

Embedded System Software

The embedded system software is written to perform a specific function. It is typically written in a high-level format and then compiled down to provide code that can be lodged within a non-volatile memory within the hardware. An embedded system software is designed to keep given the three limits:

- Availability of system memory
- Availability of processor's speed
- When the system runs continuously, there is a need to limit power dissipation for events like stop, run, and wake up.

1.2 Objectives

The objectives of this system

- To develop an IoT-based system that can accurately and efficiently detect parking slot availability in a defined parking area, providing real-time information to users and developing the Automated Gate System.
- It also to develop an effective parking management system using a sensor mechanism to detect and address improper parking instances and to implement aSlot Booking System using a software platform.

1.3 Problem Statement

- Scarcity of parking spaces in cities is causing significant challenges for vehicle owners, leading to increased congestion and frustration. There is a need for a solution leveraging the IoT setup & integrated platform to address this issue by providing real–time parking slot availability and allowing users to book their required slots in advance.
- Additionally, incorporating a sensor mechanism is crucial to identify and address instances of improper parking, contributing to better traffic flow and safety.

CHAPTER-2

LITERATURE SURVEY

[1]. The "Smart Vehicle Parking System" proposes an IoT-based solution for both users and administrators, employing Arduino and IR sensors for vehicle detection and cloud technology for data storage. It introduces two-tier parking for efficient space utilization and remote monitoring via Internet-connected computers, aiming to enhance connectivity, reduce time, and offer cost-effective parking solutions.

[2]. This paper explores IoT-enabled Intelligent Parking Systems (IPS) to tackle parking management challenges, leveraging Raspberry Pi, NodeMCU, RFID, and IR sensors for real-time data transmission, reservation, and efficient space utilization. Utilizing Firebase for slot availability updates and AWS RDS for data storage, the study underscores the potential of IoT-driven IPS and suggests future avenues for improvement.

[3]. The paper presents an IoT-based smart parking system using NodeMCU ESP8266, aiming to mitigate urban parking challenges and enhance sustainability. It offers automated payments, future plans for security enhancements, historical data utilization, pricing integration, and mobile app development, demonstrating potential for efficient urban parking management and environmental benefits.

[4]. This paper introduces a prototype of a real-time parking system aimed at efficiently managing parking spaces with minimal cost and effort. The system utilizes infrared sensors installed at entrances and exits to display available parking spots on a crystal display, reducing the time taken for vehicle inspection. Implemented with Arduino Uno, the system offers an automated solution for modern urban parking challenges.

[5]. An efficient parking management system utilizing IoT and mobile

technology connects physical parking infrastructure with cloud-based services. Users can check parking availability, book spots, and make payments through a mobile app, while sensors monitor occupancy and automate gate opening. This system addresses urban congestion by providing real-time information and streamlined parking services.

[6]. The paper introduces a parking recommendation system using ES Graph and convolution networks, yielding substantial reductions in search time. Experiments show upto 95.07% reduction in Hong Kong and 84.02% in San Francisco. Future work involves real- time implementation and exploring ES Graph's utility across civil infrastructure systems.

[7]. This paper presents a smart parking surveillance system utilizing edge artificialintelligence on IoT devices, achieving a 95.6% detection accuracy across various scenarios. The system efficiently reduces data transmission volume by shifting computing workload to the edge, with promising applications in smart cities and intelligent transportation systems.

[8]. This IoT-based smart parking system utilizes sensor circuitry and cloud infrastructure to alleviate traffic congestion. It's expanded to include automatic billing and multilayer parking, incorporating safety measures like vehicle tracking, driver face recognition, and unique OTPs to prevent slot misallocation, ensuring efficient and secure parking management.

[9]. This paper introduces a dual-lens MMW radar antenna system, utilizing a flat dielectricperforated lens for high-gain transmission and a dielectric rod lens for beam direction adjustment in reception. It achieves a transmitting antenna gain of 15.8 dB, receiving antenna gain of 7.9 dB, and a 3-dB beamwidth of approximately 65 degrees at 24GHz. The system demonstrates stable performance across various conditions, making it suitable for MMW radar smart parking applications.

[10]. This paper introduces an intelligent parking sensor system enabling real-time monitoring and payment without user interaction, enhancing detection and payment reliability while reducing costs and system complexity. Ongoing validation tests aim to further optimize the system for improved performance and efficiency.

[11]. In conclusion, IoT-based smart parking systems promise improved environmental sustainability, reduced traffic congestion, and optimized parking space utilization. Expectations for continued growth and innovation in this field are high, given its significant potential for shaping the future of urban transportation.

[12]. The online vehicle parking reservation system enhances efficiency in parking management by enabling users to reserve spots, reducing time wasted searching for parking and alleviating traffic congestion. Utilizing IoT-based hardware and software, along with a user-friendly webpage, the system facilitates easy access to parking information and mobile payment options, ultimately aiming to streamline the parking process and enhance user experience.

[13]. This article proposes a versatile approach for traffic management in smart cities, offering easy operation and maintenance with broad applicability. It suggests seamless integration of billing and driver notification systems into parking services, validated through MATLAB simulations, demonstrating effective performance and reliable output.

CHAPTER 3

DESIGN

3.1 Existing System

Efficient parking management is crucial for urban infrastructure, yet many existing systems lack autonomy, relying on manual checks for available parking slots. This approach leads to inefficiencies, including time consumption and fuel wastage. In this discourse, we delve into the drawbacks of current parking management systems, emphasizing the need for autonomous solutions to address these challenges.

The car parking system's architecture with the Node MCU involves the development board as central hub for wireless data transmission and interfacing with sensors and actuators. This facilitates parking space availability detection and barrier control. Wi-Fi connectivity enables communication with a central server or cloud platform, allowing real-time parking availability information dissemination to users via smartphone apps or websites

3.1.1 System Architecture

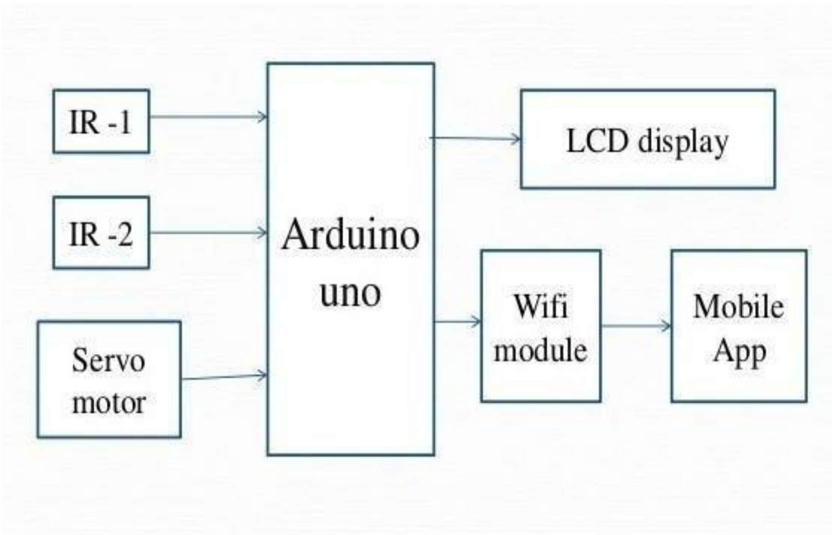

Fig3.1: Architecture of the Existing System

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3.1.2 Hardware:

- Arduino UNO
- IR Sensors
- WIFI Module
- LCD 16/2 Display
- Servo Motor

3.1.3 Disadvantages:

- Time Consumption: Manual parking management entails individuals physically inspecting parking locations to identify vacant slots. This process consumes significant time, both for users searching for parking and for authorities tasked with monitoring and regulating parking spaces. Time spent circling parking lots in search of available spots contributes to congestion, particularly in densely populated areas.
- Inefficiency and Frustration: Manual parking management systems often lead to frustration among drivers due to the uncertainty of finding a vacant spot. The lack of real-time information about parking availability results in inefficient use of time and resources. Additionally, the unpredictability of parking availability can deter individuals from visiting certain locations, impacting businesses and urban mobility.

3.2 PROPOSED SYSTEM

This project proposes smart parking system which detects and finds a parking when checking to parking. when was enter or exit the vehicle servo motor will open/close .it has beentwo floor. when was first floor filled checked to second floor whether parking perfect or not When will parking not properly buzzer alerted and alerts on red led, the slot will book to through the blynk app then showing slot book only on LCD.

The smart parking features, the system also includes a sensor mechanism for traffic management. This involves integrating sensors to identify instances of improper parking and unauthorized use of parking spaces. When such instances are detected, the system is designed topromptly notify relevant authorities through a notification system, such as a buzzer or alert, enabling swift and effective action to be taken in addressing these traffic management issues.

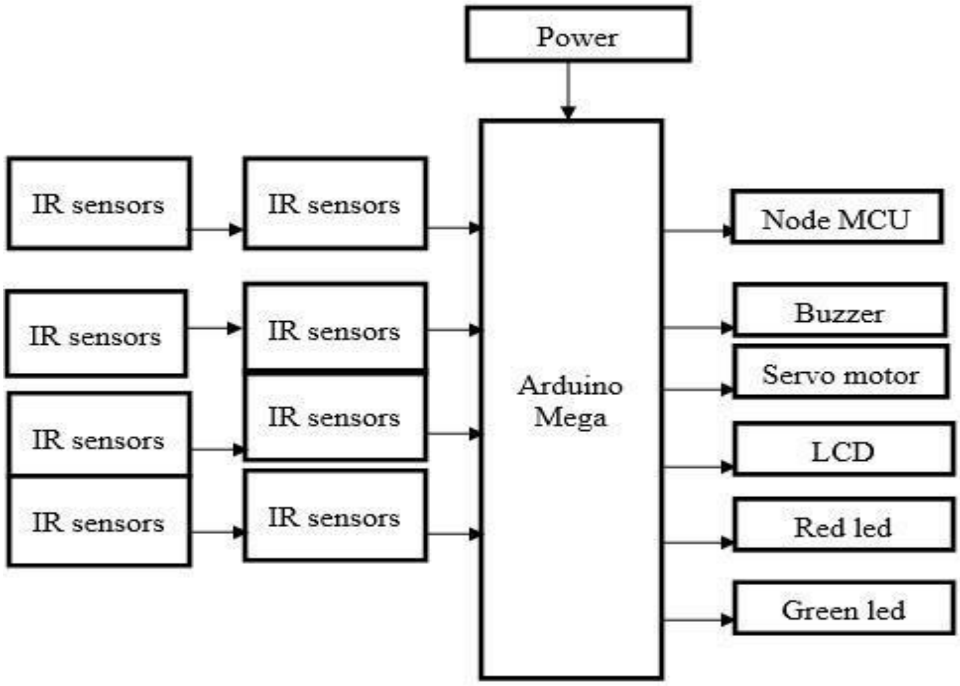


Fig:3.2: Architecture of the proposed system

3.2.1 Methodology

The IoT-Based Advanced Parking System employs a comprehensive approach to urban parking management, leveraging sensor technologies such as ultrasonic or infrared to detect real-time parking slot availability and improper parking instances. Data from these sensors is wirelessly transmitted to a central IoT platform, which acts as the intelligence hub for analysis and processing. A Gate System ensures secure entry and exit regulation based on current parking conditions, while user interaction is facilitated through Blynk applications, providing access to real-time parking information and the convenience of reserving parking slots in advance. Real-time alerts for improper parking instances enable swift intervention, enhancing overall parking management effectiveness and user satisfaction.

Continuous monitoring and evaluation metrics, including traffic congestion reduction and parking information accuracy, drive ongoing improvements to the system's hardware and software components, ensuring its continued optimal performance. This comprehensive and technology-driven methodology addresses the complexities of urban parking challenges, providing a robust solution for efficient and effective parking management.

3.3 Hardware

- Arduino Mega
- Node MCU
- IR Sensors
- Servo Motor
- LCD 16*2 Display
- Buzzer
- Power Supply 12 v Ac
- 12v 1A Adapter
- LED Indicators (Green and Red)
- Jumper wires

3.3.1 Arduino Mega

The Arduino Mega 2560 R3 is a powerful microcontroller board based on the ATmega2560, representing an updated version of the original Arduino Mega. Featuring an impressive 54 digital input/output pins and 16 analog inputs, this board offers extensive connectivity options. With 256 KB of flash memory and 8 KB of SRAM, the Mega 2560 provides significantly more storage space compared to the standard Arduino Uno, enabling the implementation of more complex programs and data handling. Moreover, its compatibility with shields designed for the Arduino Uno and other boards allows for easy expansion of capabilities through additional modules and sensors, enhancing its versatility and adaptability for diverse project requirements.

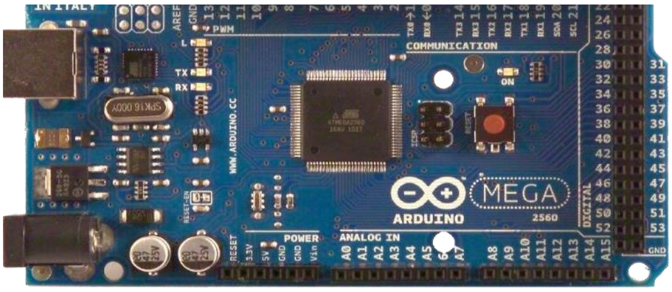


Fig 3.3: Arduino Mega 2560

3.3.2 Node MCU

The Node MCU development board boasts wireless data transmission abilities, enabling the dissemination of parking space availability information to a central server or cloudplatform, accessible via smartphone apps or websites. Equipped with multiple GPIO pins such as GPIO0, GPIO1, GPIO2, GPIO3, GPIO4, GPIO5, GPIO9, GPIO10, and more depending on the specific version, the Node MCU facilitates seamless integration with a range of sensors and actuators. Its Wi-Fi capabilities and compatibility with various components make it a versatile and efficient solution for augmenting the functionality of a car parking system, offering enhanced connectivity and data transmission capabilities for improved parking management.

Moreover, the Node MCU's Wi-Fi capabilities play a crucial role in facilitating communication with a central server or cloud platform. Through this wireless connectivity, real-time parking space availability information can be efficiently disseminated and accessed by users through smartphone applications or websites. It also provides users with valuable information to optimize their parking experience.

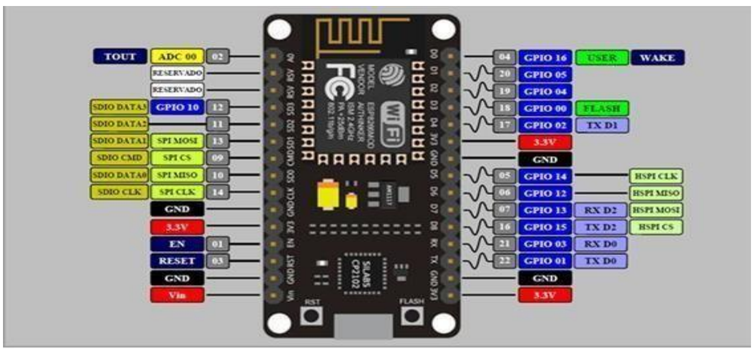


Fig 3.4: Node MCU

3.3.3 IR Sensors

IR sensors detect infrared radiation, invisible to the human eye due to its longer wavelength than visible light, and are crucial for applications like automation and security systems. By converting infrared signals into usable data, they enhance monitoring and control in various devices and industries, playing a significant role in improving efficiency and functionality.

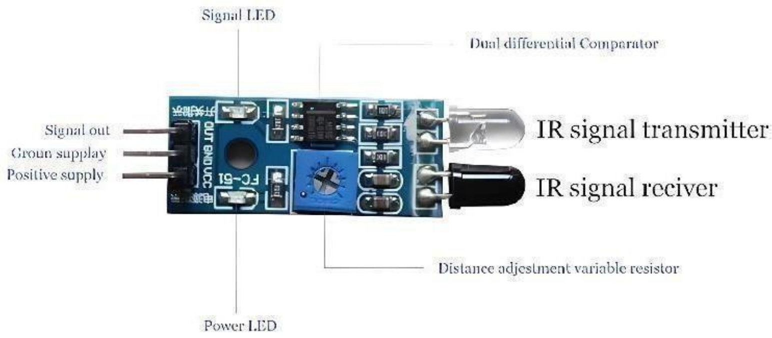


Fig 3.5: IR Sensors

3.3.4 Servo Motor

Servo motors are versatile components commonly found in robotics, RC vehicles, aerospace, and industrial automation systems. These motors offer precise positional control through feedback mechanisms, ensuring accurate and repeatable motion. By utilizing a closed-loop control system, servo motors can maintain their position even under varying loads or disturbances, enhancing overall system stability and performance.

Fig 3.6: Servo Motor

3.3.5 LCD Display

LCD stands for "Liquid Crystal Display." It is a type of flat-panel display technology used in a wide range of electronic devices, from televisions and computer monitors. The 16x2 LCD, a common type of liquid crystal display, features 16 columns and 2 rows of characters, making it suitable for displaying alphanumeric information. With their compact size and low power consumption, 16x2 LCDs serve as efficient and space-saving interfaces for providing real-time data and feedback in a diverse array of applications.

Fig 3.7: LCD 16*2

3.3.6 Buzzer

A buzzer in the context of IoT refers to a type of audible indicator that can be integrated into Internet of Things (IoT) devices or systems. It is typically used to produce sound alerts, notifications, or indications based on specific conditions or triggers within the IoT environment. This can include alerting users to events such as motion detection, system malfunctions, or successful operations.

Fig 3.8: Buzzer

3.3.7 12V AC Power Supply

A 12V AC Power Supply is an electrical power supply that provides power at a voltage level of 12 volts in the form of an alternating current (AC). AC power is the standard form of electrical power distributed to homes and businesses. it contains the following they are Transformers facilitate electrical energy transfer and voltage transformation in IoT, while regulators maintain constant output voltage for device stability. Capacitors store energy, provide power conditioning, and assist in noise filtering to ensure voltage stability in IoT application.

Fig 3.9: Power Supply

3.3.8 12V 1A Adapter

12V 1A Adapter is a power adapter that converts AC power from a wall socket to a lower voltage level (12V) and direct current (DC). The 1A specification indicates the current rating of the adapter, which in this case is 1 ampere. It is commonly used to power various electronic devices such as modems, small TVs, LED light strips, and many other low-power consumption devices. It's important to remember that when using the 12V 1A adapter, the total power consumption of the device being powered should not exceed 12 watts (12V x 1A).

Fig 3.10: 12V 1A Adapter

3.3.9 LED (Light Emitting Diode):

The LEDs (Light Emitting Diodes) are used to visually indicate the status of a device or to provide feedback to the user. They are often used in IoT projects to showcase the activation ofa sensor, the connection status of a device, or the output of a microcontroller. they are also commonly utilized in consumer electronics for power indicators on devices such as televisions, speakers, and chargers due to their low power consumption and long lifespan.

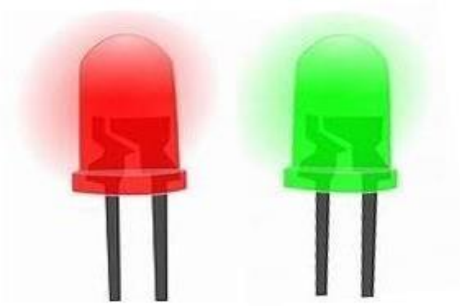


Fig 3.11: LED indicators

3.3.10 Jumper Wires

Jumper wires are used to create electrical connections between different components such as sensors, microcontrollers, and other electronic modules. They are crucial for establishing the necessary circuitry in IoT projects. Average modern advantage of 2 hundred. subsequently, a widespread base modern of 200 and has the capability to spark off the relay.

Fig 3.12: Jumper Wires

3.4 Software

- Arduino IDE
- Blynk IoT Platform
- Programming Language
- Tinker CAD

3.4.1 Arduino IDE:

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++. Here, IDE stands for Integrated Development Environment. The program or code written in the Arduino IDE is often called as sketching. We need to connect the Genuine and Arduino board with the IDE to upload the sketch written in the Arduino IDE software.

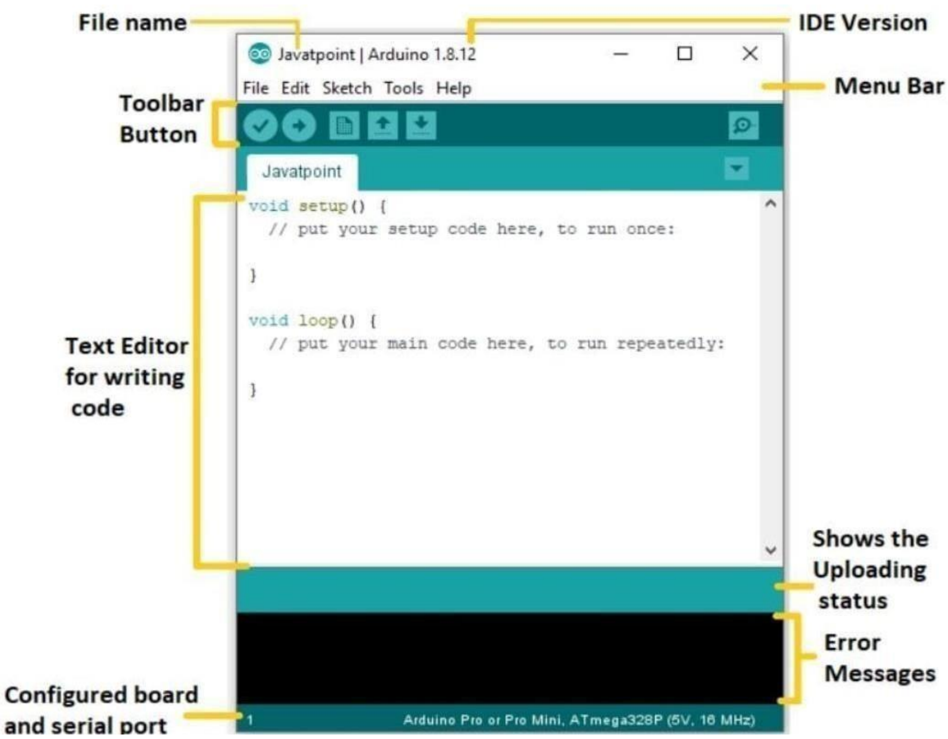


Fig 3.13: Arduino IDE

3.4.2 Blynk IoT Platform

Blynk is an Internet of Things (IoT) platform that allows users to easily build and control connected hardware projects. It provides a mobile app for both Android and iOS that enables users to create custom interfaces for their IoT projects without any complex coding. Blynk supports a wide range of microcontrollers, such as Arduino, Raspberry Pi, ESP32/ESP8266, Particle, and more.

Users can drag and drop widgets on the Blynk app to create a customized interface for controlling their connected devices, such as buttons, sliders, graphs, displays, and notifications. Blynk also offers features like data logging, notifications, and remote control over the internet. Overall, Blynk simplifies the process of creating IoT projects and provides a user-friendly interface for both beginners and experienced IoT enthusiasts.

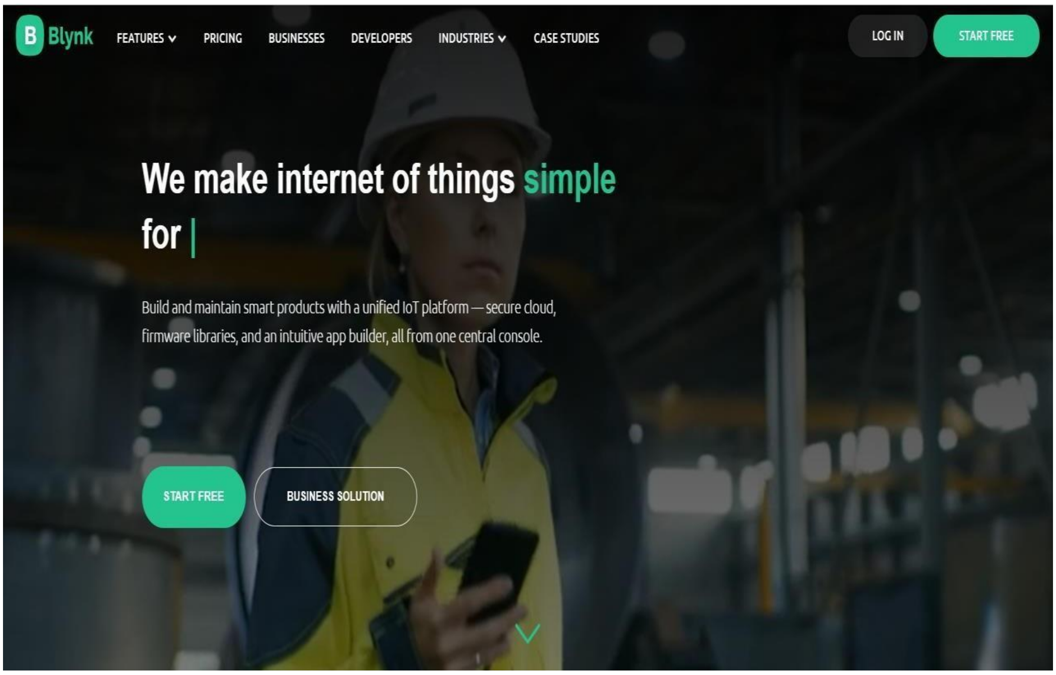


Fig 3.14: Blynk IoT Platform

3.4.3 Tinker CAD

Tinker cad is a web-based software that allows users to design, simulate, and prototype electronic circuits and IoT projects without the need for physical components. It is a popular platform for beginners, educators, and hobbyists interested in learning electronics and IoT development.

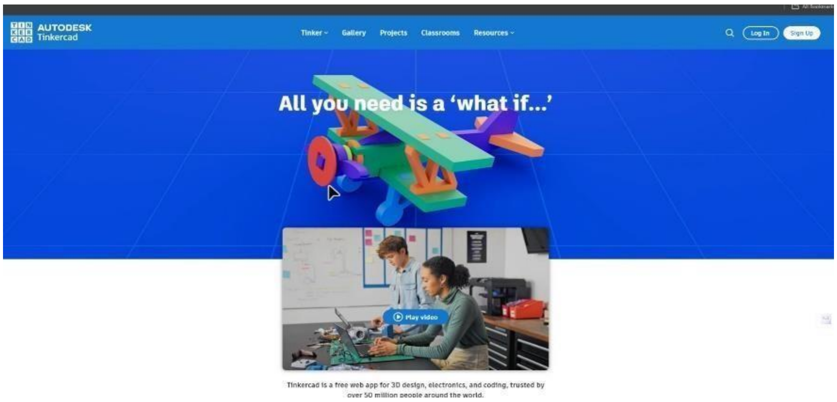


Fig 3.15: Tinker CAD

3.4.4 Programming Language

C programming language is a widely used programming language that is often used in embedded systems, including Arduino development. Arduino is an open- source platform thatprovides hardware and software tools for building and programming microcontroller-based projects.

To use C programming language with Arduino, you would typically use the Arduino Integrated Development Environment (IDE), which is a software tool that provides a user-friendly interface for writing, compiling, and uploading C code to Arduino boards.

Fig 3.16: C language

3.5 Functional Requirements

- The prototype should be capable of continuously checking the available parking slots inthe defined area.
- To ensure smart gate System which will provide security and access to the defined parking area
- To provide real-time alerts and notifications to address the improper parking instances.
- To implement slot booking using an software platform for the system.

3.6 Non-Functional Requirements

3.6.1 Portability

Blynk IoT Platform is accessible and functional across various mobile devices and platformsfor remote monitoring from anywhere.

3.6.2 Speed

This project is speed in sending alerts and notifications to the user when improper parking instances occur and also speed and accuracy in providing the status of the available parking slot in the defined area to the user.

3.6.3 Security

A smart gate system should be implemented to restrict timely access to the parking area and to provide login credentials to the booking platform to control unauthorized access to the system.

3.7 Methodology

To implement this project Iterative Model is used. It involves a continuous cycle of Planning, Analysis, Implementation, and Evaluation. The Iterative Model allows the accessing of earlier phases, in which the variations are made respectively. Each iteration involves the planning, analysis, design, implementation, testing, and deployment phases. The final output of the project is renewed at the end of the Software Development Life Cycle (SDLC) process.

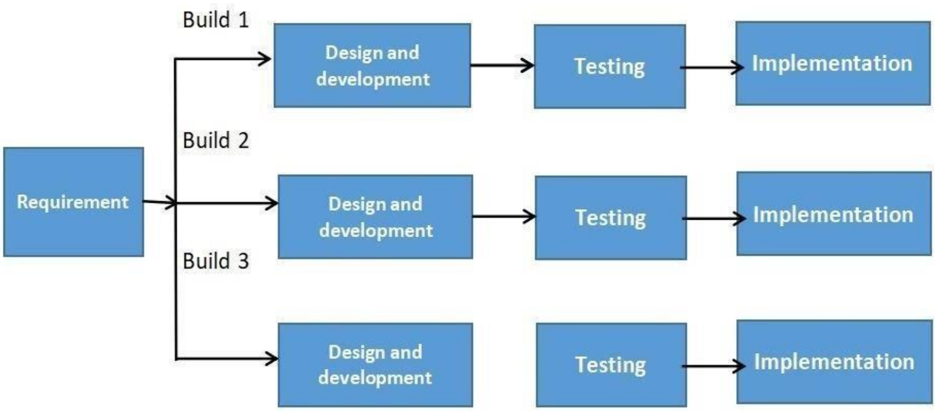


Fig 3.17: Iterative Model

Advantages:

- The iterative model allows for changes to be made at various stages of development.
- It helps in identifying and managing risks early in the development process.
- Users can provide feedback at multiple stages, leading to a system that bettermeets their needs.

3.8 Cost Estimation:

S. No	Equipment Name	Cost	Quantity
1.	Arduino Mega2560 R3-Board	4000	1
2.	Node MCU	1200	1
3.	Power supply 12v AC	300	2
4.	Servo Motor	500	3
5.	IR-Sensor	880	11
6.	LCD Display	250	1
7.	Buzzer	120	1
8.	LED Green (4) Red (4)	200	8
9.	Transformer	300	2
10.	Rectifier	100	1
11.	Capacitor (1000 µF/25v)	100	1
12.	Jumper Wires	250	20-30
13.	12v 1A Adapter	300	1
14.	Required amount of Sun sheet	500	
	Additional Costs	500	
	Total Cost	9790	

Table 3.18: Cost estimation

3.9 Time Estimation:

S.No	Activity	Duration
1	Gathering All the components	1 Week
2	Developing the Hardware system	4 Weeks
3	Connecting hardware and software	2 Weeks
4	Implementing the system	2 Weeks
5	Rectifying the drawbacks and finalizing the system	1 Week

Table 3.19: Time Estimation

3.10 System Architecture

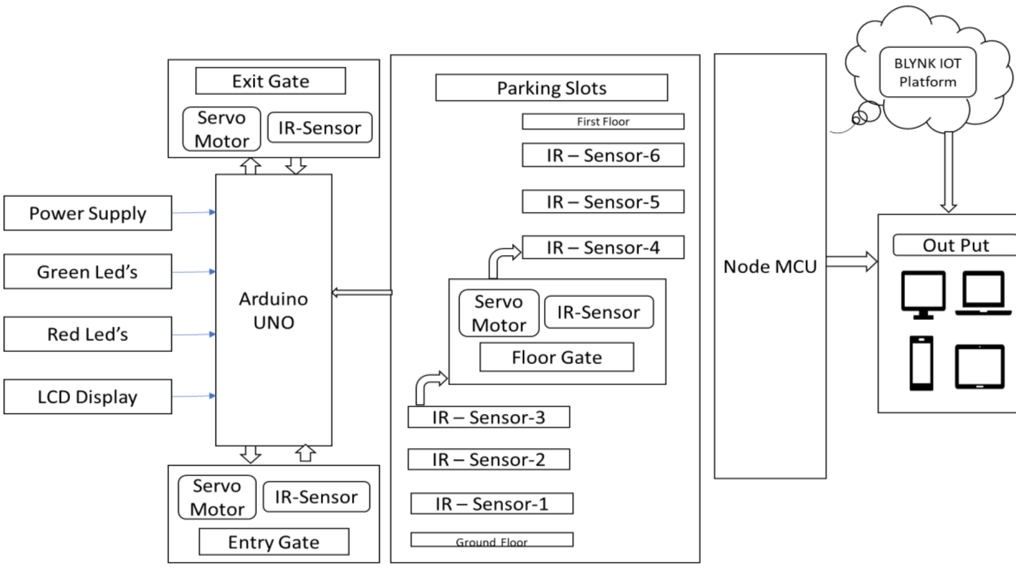


Fig: 3.20: Block Diagram

The IoT system depicted in the provided context comprises multiple elements, including the Power Supply, iR-Sensor-4, iR-Sensor-2, and NodeMCU, all interconnected to facilitate the seamless transmission and processing of data. The Power Supply serves as the primary energy source for the entire system, ensuring uninterrupted functionality. The iR-Sensor-4 and iR- Sensor-2 are instrumental components responsible for detecting and collecting environmental or specific data. The data collected by these sensors is then transmitted to the NodeMCU, acting as a central hub for processing and transmitting information. The connection of these elements forms a network that enables the efficient transfer of data within the IoT system.

The transmission of data in this IoT system follows a structured process. The sensors, iR-Sensor-4 and iR-Sensor-2, capture environmental or specific data according to their designated functionalities. Subsequently, this data is transmitted to the NodeMCU via a designated communication protocol, presumably using Wireless Sensor Network (WSN)technology or other wireless communication methods. The NodeMCU, equipped with processing capabilities receives and processes the incoming data. Following processing, the NodeMCU transmits the processed data to its intended destination, such as a data storage facility or another connected system. This seamless transmission and processing capacity within the IoT architecture enables efficient and effective data management, thereby enhancing the overall functionality and performance of the system.

The architecture of this IoT system demonstrates a sophisticated network of interconnected components, facilitating the smooth transmission and processing of data. The robust connection and data transmission capacities enable the system to efficiently capture, process, and transmit data, contributing to its overall effectiveness and functionality. The structured flow of data within the IoT system underscores its capacity to manage and utilize information, thereby fulfilling the intended objectives of the system with proficiency.

3.11 Circuit Architecture

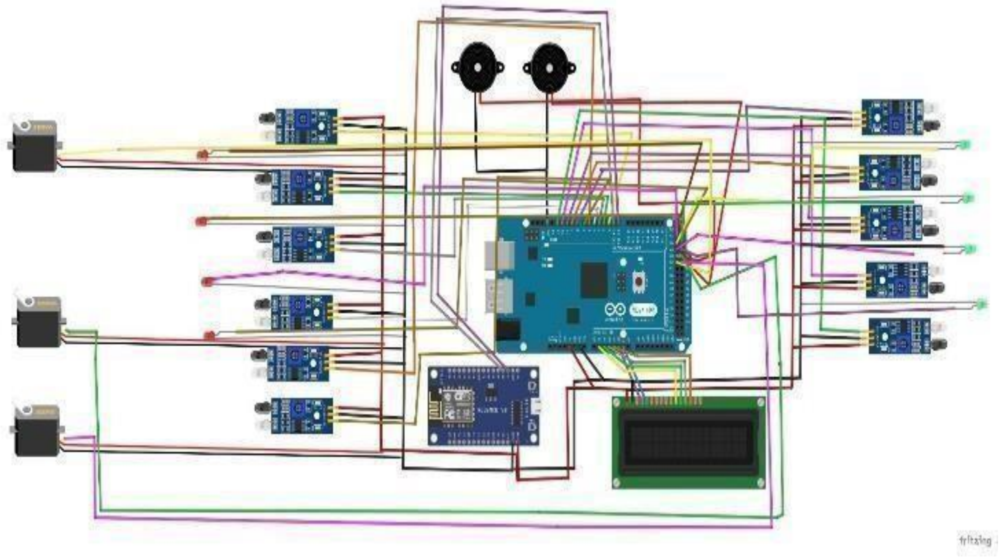


Fig 3.21: Block Diagram of Circuit Architecture

The IoT system circuit setup encompasses several key components, each with distinct numerical measures and capacities. The primary component of the system is the Arduino Mega,a pivotal microcontroller renowned for its extensive capabilities, including a large number of digital and analog pins, ample memory, and varied communication interfaces. The Arduino Mega serves as the central processing unit and the communications hub, coordinating the functionality of the entire IoT system, and providing the necessary computational power and interfacing capacity.

In addition to the Arduino Mega, the system comprises iR-Sensor-4 and iR-Sensor-2, both capable of capturing environmental or specific data, and transmitting it to the NodeMCU. The iR-Sensor-4 and iR-Sensor-2 possess distinct numerical measures, such as detection range, precision, and response time, which are integral to their sensor capabilities. These sensors are complemented by the NodeMCU, which acts as a pivotal intermediary between the component sensors and the Arduino Mega, facilitating the seamless transmission of data. Furthermore, thesystem's Power Supply, key to sustaining uninterrupted operation, provides the necessary electrical energy for the entire system's functionality and is equipped with its unique numerical measures, including voltage output capacity and current rating. These distinctive numerical measures and capacities of each component collectively contribute to the IoT system's efficientand effective operation, further underscoring its comprehensive functionality and diverse applications.

The elaborate configuration and numerical measures of the IoT system's components, includingthe Arduino Mega, iR-Sensor-4, iR-Sensor-2, NodeMCU, and Power Supply, collectively establish an efficient and versatile system architecture tailored to facilitate seamless data capture, transmission, and processing. The robust capabilities of these components, in tandem with the computational power and interfacing capabilities of the Arduino Mega, ensure the system's ability to handle diverse data types and operational requirements, reinforcing its position as a highly proficient IoT framework for various application.

CHAPTER 4

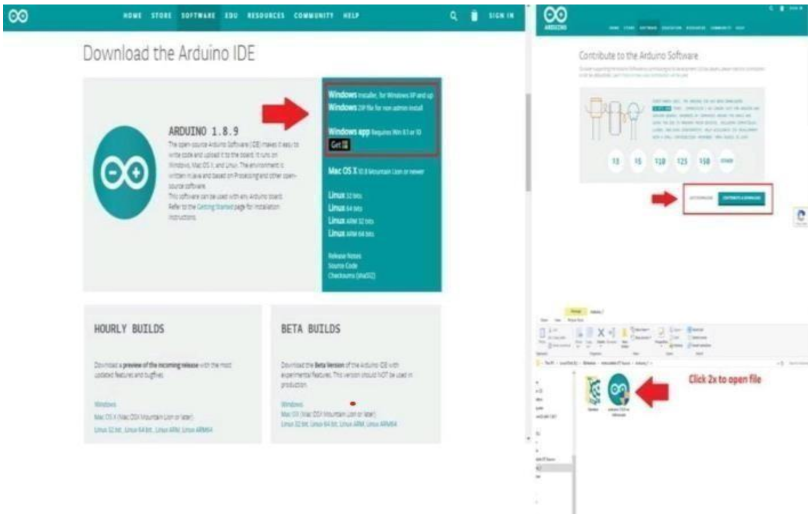
IMPLEMENTATION

4.1Software implementation

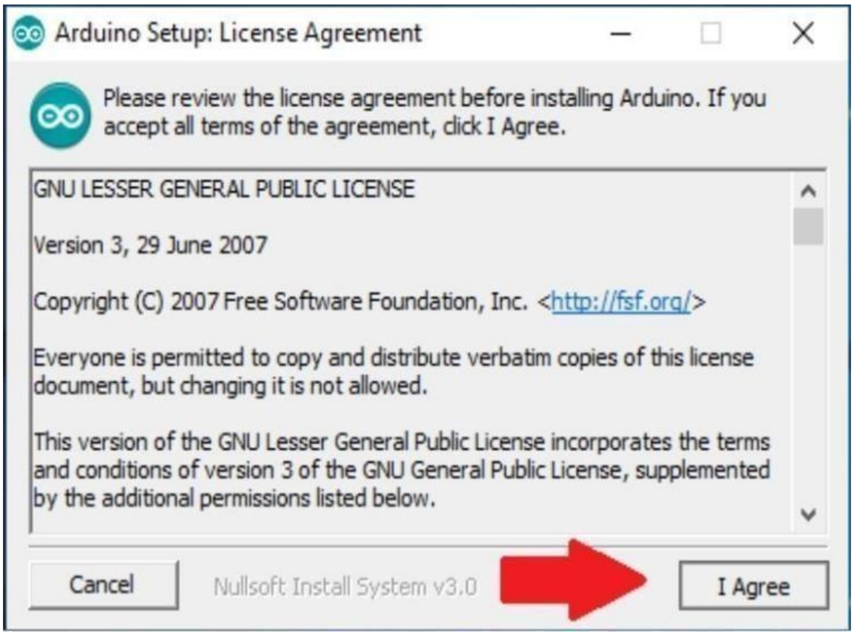
4.1.1 Installation of Arduino Mega IDE.

To install Arduino Mega IDE on your Windows PC, follow the next instructions:

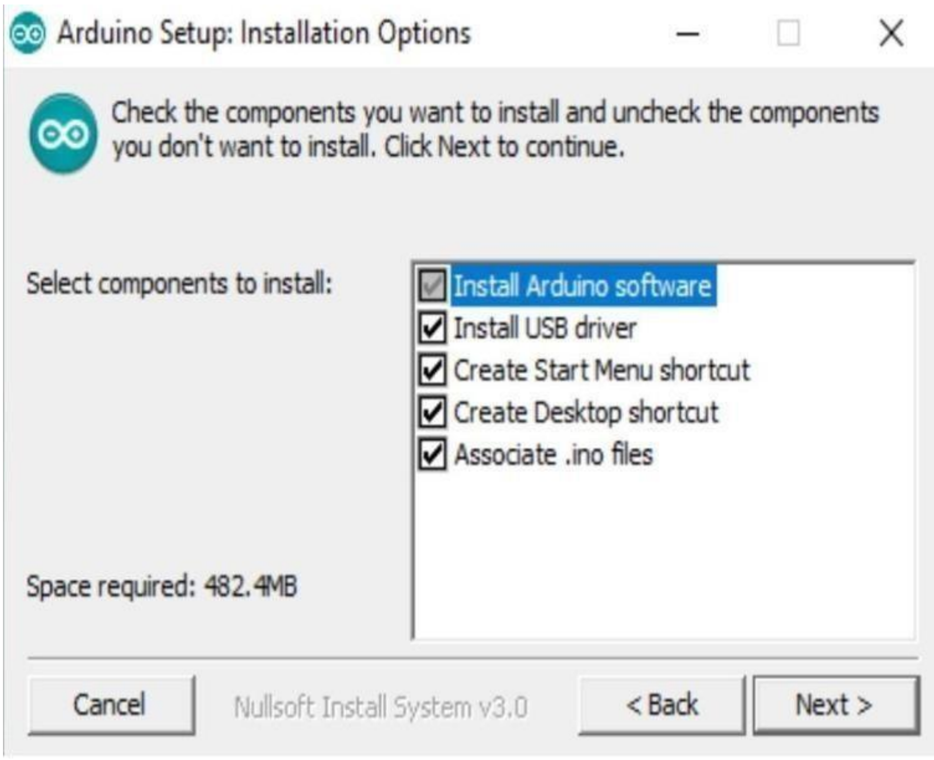
Step 1: Download File Arduino IDE



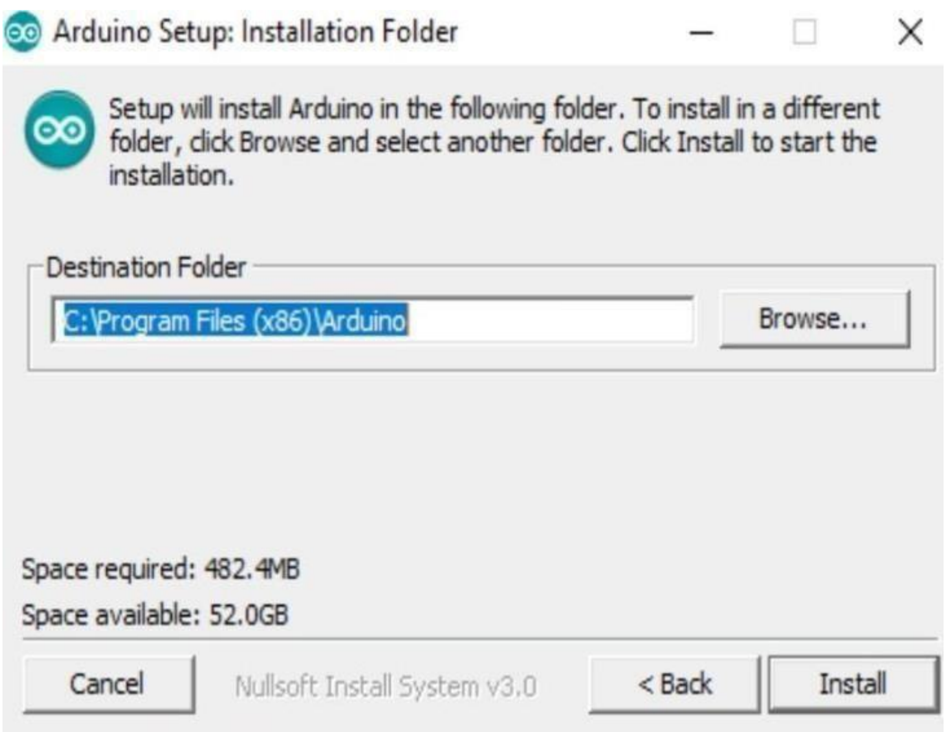
Step 2: License Agreement



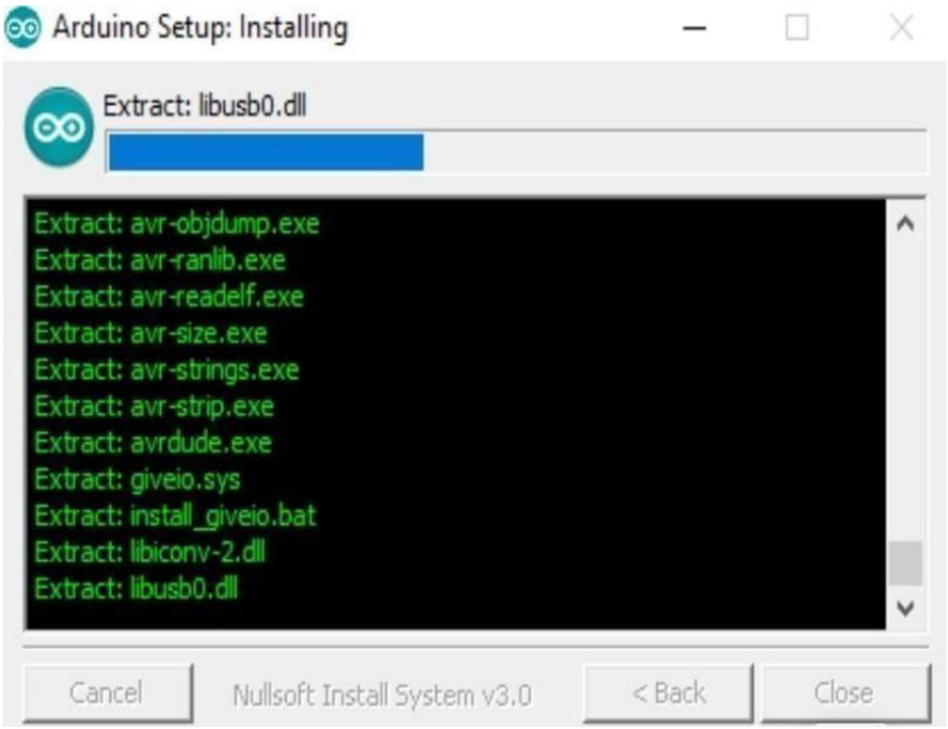
Step 3: Installation Option



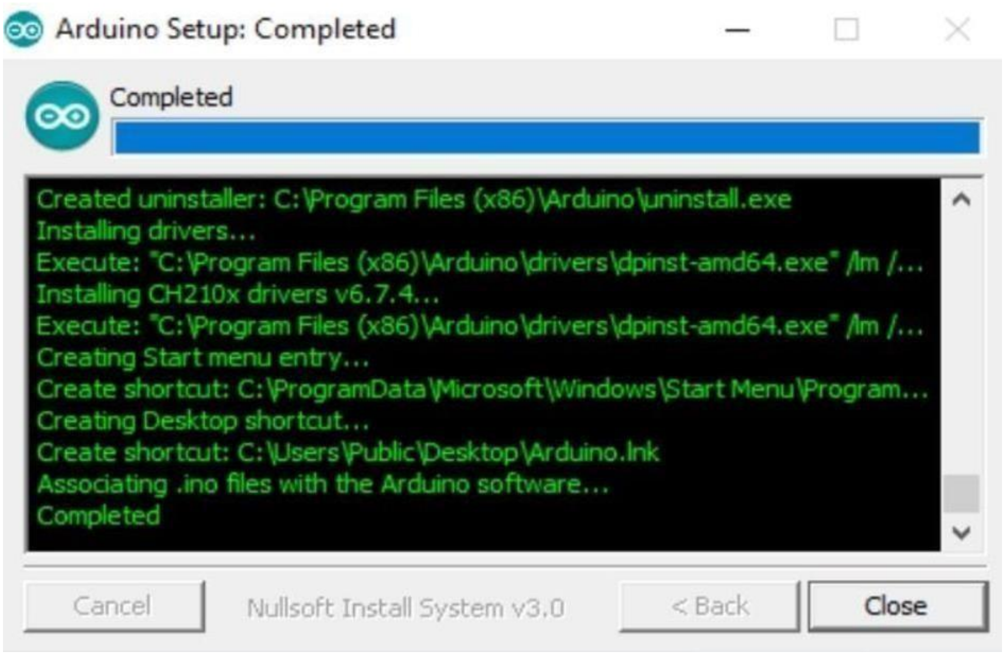
Step 4: Installation Folder



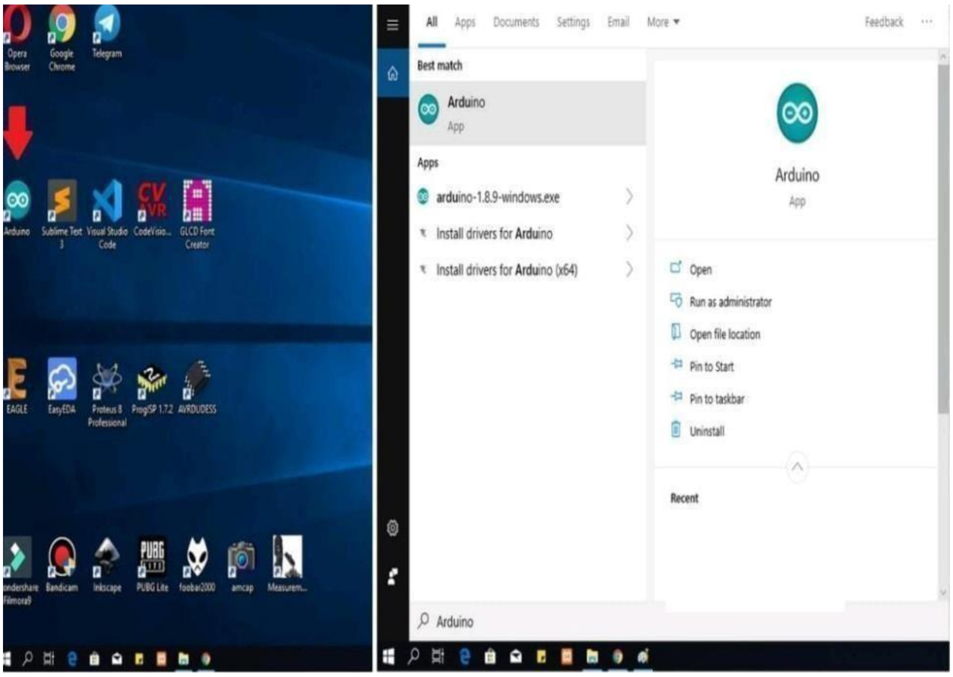
Step 5: Installing Process



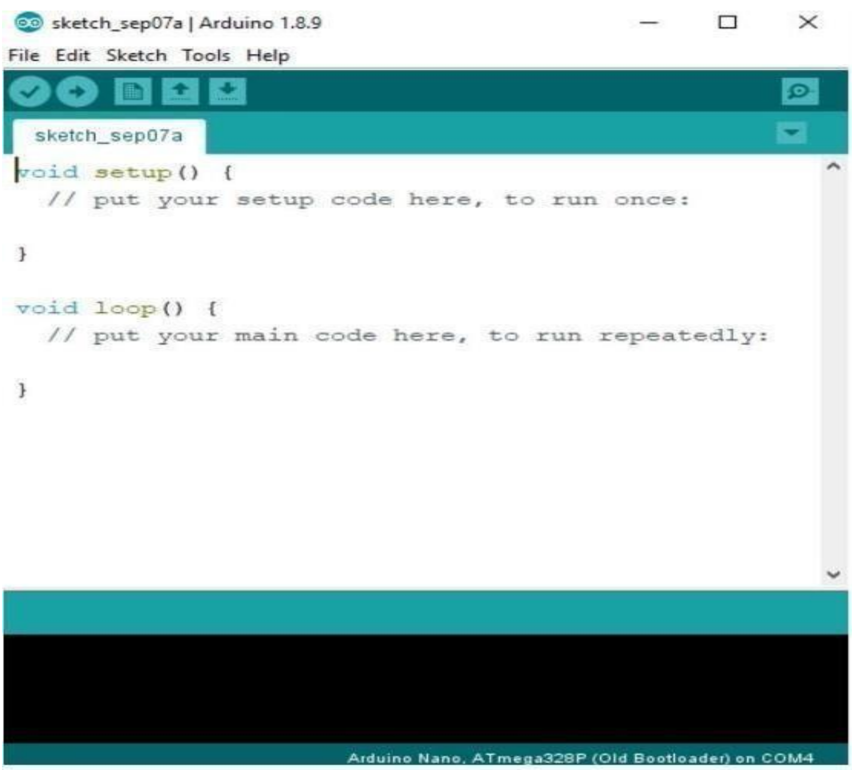
Step 6: Installation Complete



Step 7: Open Arduino IDE

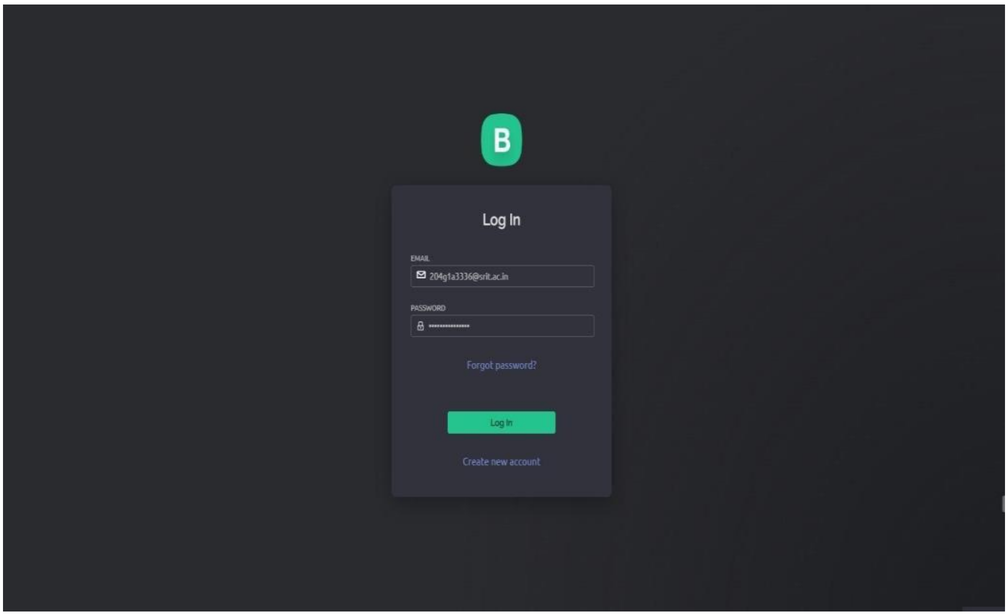


Step 8: Display Arduino IDE

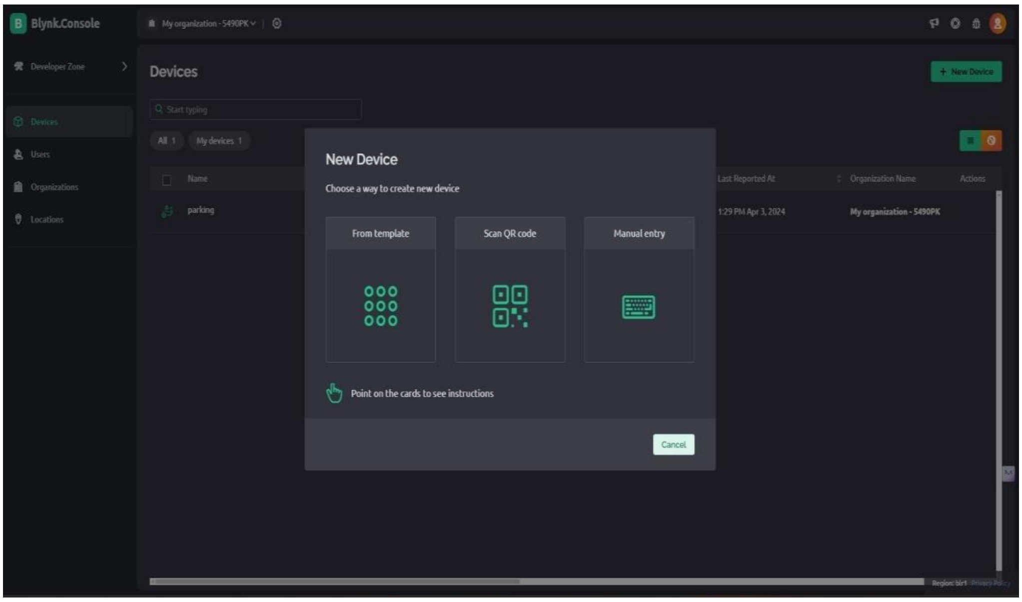


4.1.2Blynk IoT Setup

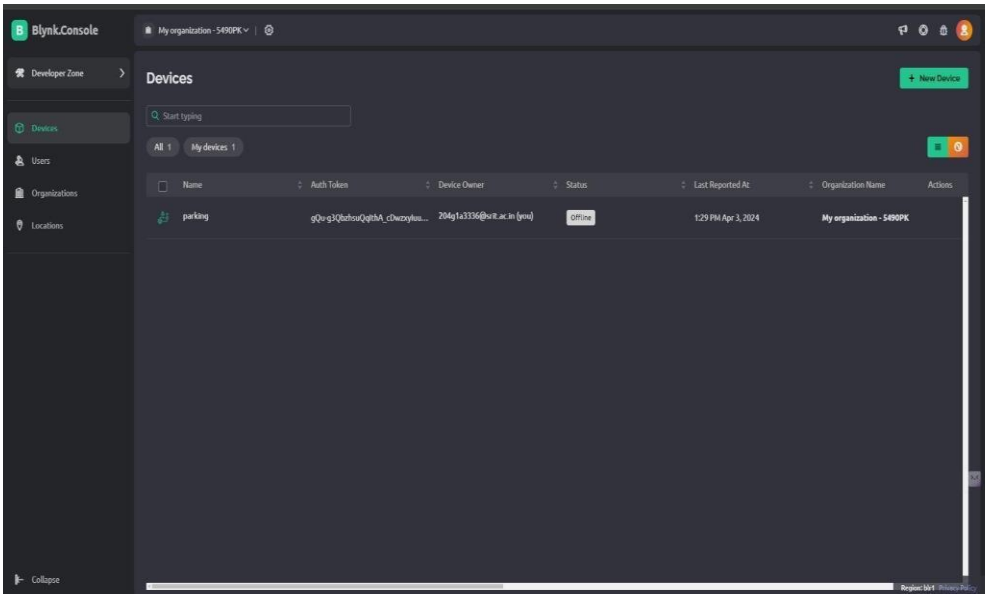
Step-1: Register for a Blynk account on the Blynk website and log in to access the dashboard.



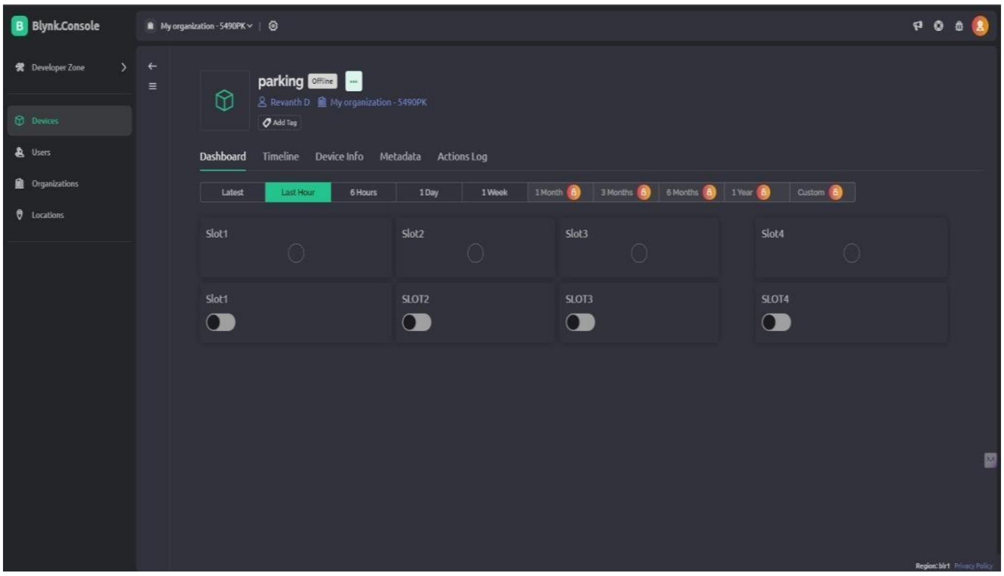
Step-2: Create a new project and select the type of hardware you will be using. Add variouswidgets to your project such as buttons, sliders, displays, and graphs.



Step-3: Obtain the Auth Token for your project from the project settings. This token is necessary to connect your hardware to the Blynk platform.



Step-4: Install the Blynk library on your hardware device and upload the code to establish a connection between your hardware and the Blynk platform.



Step-5: Once the hardware is connected to Blynk, you can interact with your IoT project through the Blynk app or web dashboard to monitor sensor data, control actuators, and visualizereal-time information.

4.1.1 Hardware Code

```
#include           <LiquidCrystal.h>
#include <Servo.h>
int ir1 = 2; int ir2 = 3; int ir3 = 4;
int ir4 = 5; int ir5 = 6; int ir6 = 7;
int ir7 = 8; int ir8 = 9; int ir9 = 10;
int ir10 = 11;int ir11 = 12;
int ledg1 = 22; int ledg2 = 23; int
ledg3 = 24; int ledg4 = 25; int
ledr1 = 26; int ledr2 = 27; int ledr3
= 28; int ledr4 = 29; int buzzer1 =
30; int buzzer2 = 31; String uno;
String uno1;
const int rs = A6, en = A5, d4 =
A1, d5 = A2, d6 = A3, d7 = A4;
LiquidCrystal lcd(rs, en, d4, d5,
d6, d7);
Servo myservo1; Servo myservo2;
Servo myservo3; int servo1 = 32;
int servo2 = 33;

int servo3 = 34;int cmd1;
void setup() {
Serial.begin(9600);
lcd.begin(16, 2);
pinMode(ir1, INPUT);
pinMode(ir2, INPUT);
pinMode(ir3, INPUT);
pinMode(ir4, INPUT);
pinMode(ir5, INPUT);
pinMode(ir6, INPUT);
pinMode(ir7, INPUT);
pinMode(ir8, INPUT);
```

```
pinMode(ir9, INPUT);
pinMode(ir10, INPUT);
pinMode(ir11, INPUT);
pinMode(ledg1, OUTPUT);
pinMode(ledg2, OUTPUT);
pinMode(ledg3, OUTPUT);
pinMode(ledg4, OUTPUT);
pinMode(ledr1, OUTPUT);
pinMode(ledr2, OUTPUT);
pinMode(ledr3, OUTPUT);
pinMode(ledr4, OUTPUT);
pinMode(buzzer1,
OUTPUT);
pinMode(buzzer2,
OUTPUT);
myservo1.attach(servo1);
myservo2.attach(servo2);
myservo3.attach(servo3);
digitalWrite(buzzer1,
LOW);
digitalWrite(buzzer2,
LOW); digitalWrite(ledg1,
HIGH); digitalWrite(ledg2,
HIGH); digitalWrite(ledg3,
HIGH);
digitalWrite(ledg4,
HIGH);
digitalWrite(ledr1, LOW);
digitalWrite(ledr2, LOW);
digitalWrite(ledr3, LOW);
digitalWrite(ledr4, LOW);
lcd.setCursor(0, 0);
lcd.print("ADVANCED
PARKING");
lcd.setCursor(0, 1);
```

```
  lcd.print("SYSTEM
  USING IOT");
  delay(1000);
}
   void loop() {
   if (Serial.available() > 0) {
   String command = Serial.readStringUntil('\n');
   //
          Serial.println(co
  mmand); int
  command1 =
  command.toInt();

   if (command1 == 1) {
   //
  Serial.println("led is
  high");
  digitalWrite(ledg1,
  LOW);
  digitalWrite(ledr1,
  HIGH); lcd.clear();
  lcd.setCursor(0,0);
   lcd.print("SLOT1 BOOKED");

   //     int irv1=1;
   //     irv2 = 0;
   //     slot1=irv1;
   } else if (command1 == 2) {

   digitalWrite(led
  g2,          LOW);
  digitalWrite(ledr
  2,           HIGH);
  lcd.clear();
```

```
delay(2000);
int irv1 =
digitalRead(ir1);
int irv2 =
digitalRead(ir2);
int irv3 =
digitalRead(ir3);
int irv4 =
digitalRead(ir4);
int irv5 =
digitalRead(ir5);
int irv6 =
digitalRead(ir6);
int irv7 =
digitalRead(ir7);
int irv8 =
digitalRead(ir8);
int irv9 =
digitalRead(ir9);
int irv10 =
digitalRead(ir10)
;int irv11 =
digitalRead(ir11)
;if (irv1 == 0) {
lcd.clear();
lcd.setCursor(
0, 0);
lcd.print("ENTRY GATES OPEN");
lcd.setCursor(0, 1);
lcd.print("VECHILE
ENTER");
myservo1.write(90);
//      Serial.println("entry gate1 open");
} else if
(irv10 ==
```

```
//      Serial.println("gate close");
//      Serial.println(irv1);
}
if (irv2 == 0) { lcd.clear();
lcd.setCursor(0, 0);lcd.print("slot1");
lcd.setCursor(0, 1);
lcd.print("vechile parked");
//      Serial.println("slot1 is parked");
//      Serial.println(irv2);
digitalWrite(ledg1, LOW);
digitalWrite(ledr1, HIGH);
digitalWrite(buzzer1, HIGH);
delay(150); digitalWrite(buzzer1,
LOW);
} else if (irv4 == 0) {lcd.clear();
lcd.setCursor(0, 0);

delay(150); digitalWrite(buzzer2, LOW);
} else if (irv3 == 0) { lcd.clear();
lcd.setCursor(0, 0); lcd.print("vechile
worng");lcd.setCursor(0, 1);
lcd.print("parked");
//      Serial.println("slot1 is wrong
parking");
//      Serial.println(irv3);
digitalWrite(buzzer1, HIGH);delay(3000);
digitalWrite(buzzer1, LOW);
} else if (irv5 == 0) { lcd.clear();
lcd.setCursor(0, 0); lcd.print("vechile
worng");lcd.setCursor(0, 1);
lcd.print("parked");
//      Serial.println("slot2 wrong parking");
//      Serial.println(irv5);
digitalWrite(buzzer1, HIGH);delay(3000);
digitalWrite(buzzer1, LOW);
```

```
} else if (irv7 == 0) { lcd.clear();
 lcd.setCursor(0, 0); lcd.print("vechile
 worng");lcd.setCursor(0, 1);
 lcd.print("parked");
 //       Serial.println("slot3 is wrong
 parked");
 //       Serial.println(irv7);
 digitalWrite(buzzer2, HIGH);delay(3000);

 digitalWrite(buzzer2, HIGH);delay(500);
 digitalWrite(buzzer2, LOW);
 }
 uno = "a" + String(irv2) + "b" +
 String(irv4) + "c" + String(irv6) + "d" +
 String(irv8) + "e";Serial.println(uno);
 delay(1000);
 // Your other code for handling IR sensors
 can go here
 }
```

Software code

```
##define BLYNK_TEMPLATE_ID

"TMPL3UWonsh-H"

#define BLYNK_TEMPLATE_NAME

"parking"

#define BLYNK_AUTH_TOKEN

"7gjGBkGA298F3i31RJYZ_QcETk

85maw1"

#define BLYNK_PRINT Serial #include

<ESP8266WiFi.h> #include

<BlynkSimpleEsp8266.h>char ssid[] =
```

```
"Lora";
char pass[] = "123456789";int da;
int db;
int dc;int dd;
BLYNK_WRITE(V5) {
int switchStatus1 = param.asInt();
Serial.println(switchStatus1);
if (switchStatus1 == 0) {Serial.println("1");
}
} BLYNK_WRITE(V6) {
int switchStatus2 = param.asInt();
Serial.println(switchStatus2);
if (switchStatus2 == 0) {Serial.println("2");
} else { Serial.println("22");
}
} BLYNK_WRITE(V7) {
int switchStatus3 = param.asInt();
Serial.println(switchStatus3);
if (switchStatus3 == 0) {Serial.println("3");

} else { Serial.println("33");
}
} BLYNK_WRITE(V8) {
int switchStatus4 = param.asInt();
Serial.println(switchStatus4);
```

```
if (switchStatus4 == 0) {Serial.println("4");


} else { Serial.println("44");
  }
  }
  BlynkTimer timer;void myTimer() {
  Blynk.virtualWrite(V1,                    da);
  Blynk.virtualWrite(V2,                    db);
  Blynk.virtualWrite(V3,                    dc);
  Blynk.virtualWrite(V4, dd);
  }
void setup() { Serial.begin(9600);


  Blynk.begin(BLYNK_AUTH_TOKEN,
  ssid, pass);


  timer.setInterval(1000L, myTimer);
  delay(3000);
  Send();
  }
  void loop() {
while (Serial.available() > 0) {
  Serial.write(Serial.read());
  }
  if (Serial.read() == 'a')
```

```
; //// full string

{

String uno = Serial.readString();String a =

uno.substring(1, 2); da = a.toInt();

// Serial.println(da);

String b = uno.substring(3, 4);db =

b.toInt();

// Serial.println(db);

String c = uno.substring(5, 6);dc = c.toInt();

// Serial.println(dc);

String d = uno.substring(7, 8);dd =

d.toInt();

// Serial.println(dd);

}

delay(1000);Blynk.run();

// delay(1000);timer.run();

}

void Send() {

// Serial.println(dd); Blynk.virtualWrite(V5,

1);

Blynk.virtualWrite(V6, 1);

Blynk.virtualWrite(V7, 1);

Blynk.virtualWrite(V8, 1);

}
}
```

4.2 Hardware implementation

4.2.1 Objective 1 implementation

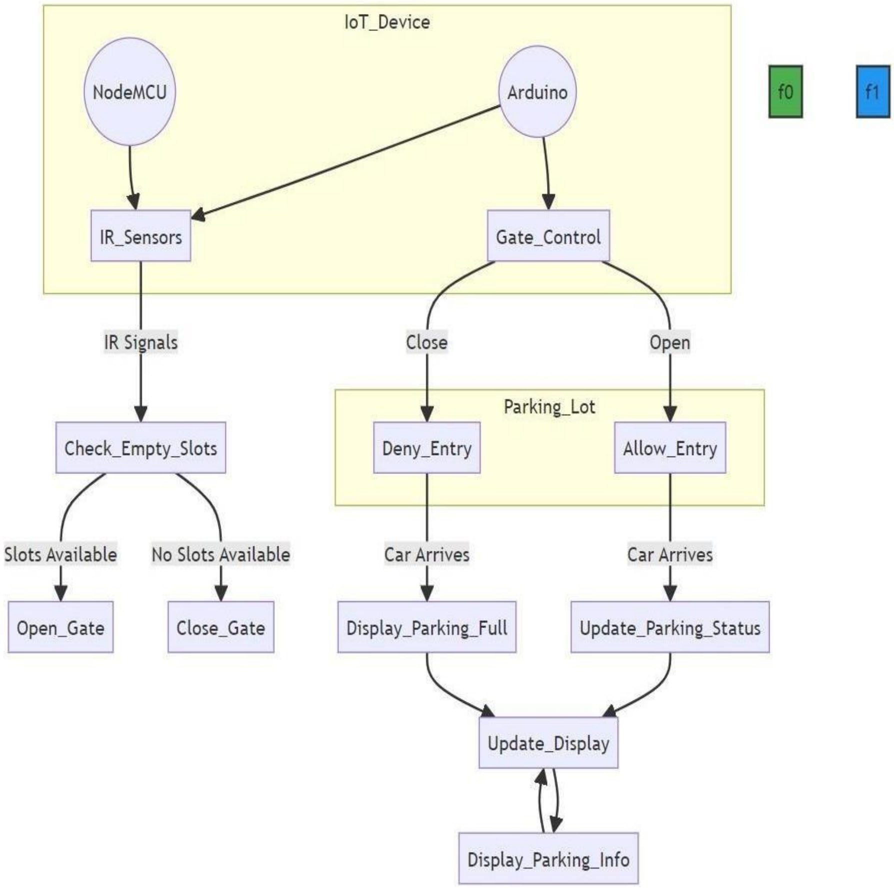


Fig 4.1: Flow diagram of first objective

In this first part of the Objective 1, involves strategically deploying cutting-edge sensors, such as ultrasonic or infrared, in the defined parking area. These sensors are crucial for accurately detecting real-time parking slot availability. The collected data from the sensors is then transmitted wirelessly to a central IoT platform, which serves as the intelligence hub for processing and analysis. This integrated approach ensures that users have access to up-to date information about parking availability. Additionally, the deployment includes the integration of an Automated Gate System to regulate secure entry and exit based on the real time parking conditions and user interaction is facilitated through Blynk applications. This allows users to seamlessly access real-time parking information and conveniently reserve parking slots in advance. The Blynk applications enhance the user experience and contribute to the overall efficiency of the IoT-based parking system. This part of the objective emphasizes the user- centric design aspect of the system, ensuring that the technology not only accurately detects parking availability but also provides a user-friendly interface for interaction and convenience

4.2.2 Objective 2 implementation

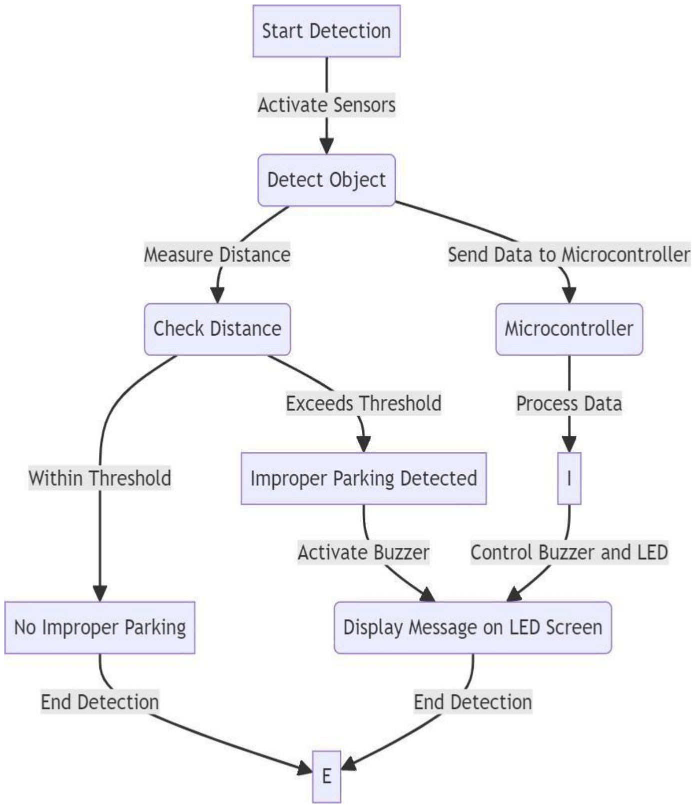


Fig 4.2: Flow diagram of second objective

The initial focus of the objective 2, is the implementation of a sensor mechanism to detect and address improper parking instances. This component is critical for maintaining order in the parking area and triggering immediate real-time alerts for swift intervention. The sensor mechanism, in conjunction with the overall IoT system, plays a key role in enhancing the security and efficiency of the parking management system and the emphasis shifts to the practical implementation of the system's capabilities. Violations such as occupying multiple slots, parking in restricted zones, or exceeding time limits lead to immediate alerts. These real-time notifications, including buzzer alerts, are transmitted to security personnel or administrators. This part underscores the system's ability to actively address and rectifyimproper parking behavior promptly, contributing to the overall effectiveness

CHAPTER 5

TESTING

5.1 Testing Approach

We will conduct testing for our project in two stages: software and hardware. The software testing will be performed using the Arduino IDE, while the hardware testing will involve physical verification of components. It is essential to ensure that the system functions correctlyand meets the specified requirements.

5.2 Features to be tested

After assembling the entire system, we will test several key features to ensure functionality:

- Verify that the microcontroller is connected to the specified WIFI address and can communicate with Blynk IOT Platform and Node MCU.
- Monitor your Blynk IoT project template to ensure that real-time data is being displayed correctly. Whenever the improper parking instance occurs the buzzer should be activated and also Alert Message should be displayed on LCD Screen.
- Sensor Mechanism should be functioned properly to implement Smart Gate System inthe project.
- LCD should display the appropriate message for the respective actions happened in thesystem.
- Real-time data present in the system should be updated spontaneously and accurately in Blynk IoT platform.

5.3 Testing tools and environment

Arduino IDE: Used to upload and debug the Arduino code for the Advanced parking system.

Mobile device with WIFI capability: Used to connect to the parking system via WIFIModule in Node MCU and take actions according to it.

5.4 Test cases

5.4.1 Inputs

This project requires two inputs:

1. Power supply is the basic need of any electronic circuit. Here we use 12V of DC currentand we convert it into 5V of AC power.
2. Providing wrong parking instances to check the improper parking alert mechanism.
3. Different types of physical objects require to check the overall Sensor Mechanism.

5.4.2Expected Output

The following are considered as the expected outcomes of the proposed project:

- Real-time detection of parking slot availability with in the defined parking field.
- Implementation of Smart Gate System improves overall security &effectiveness of thesetup at entry and exit levels.
- Developing an Accurate Improper parking instance detection with integrated alertsystem and a User-friendly Slot Booking System interface.

5.4.3Testing Procedure

For testing, first connect the circuit to the power supply is given to the IoT system using 12vadapter. In this way the whole testing circuit is built.
Summary of the testing procedure –

- Connect the circuit according to the diagram shown in **Fig4.2**.
- Provide power to the parking system using 12v adapter.
- Set the smart gate system by exposing the vehicle to the respective IR sensors.

- Get the output from the LCD display with according to the proper physical action takenby the servo motors.
- Check the available parking slot in the system by exposing the vehicle to the parking area defined by the respective parking sensor and check the real – time data parallellyin Blynk IoT platform.
- Get the output from the LCD display and the parking status specified by LEDintegrators in the system.
- Provide the wrongly parked test cases to check the improper parking alert mechanisms.
- Get the output as an alert message from the LCD display with integrated buzzer sound.
- Finally, test the slot booking mechanism in the Blynk IoT platform.

CHAPTER 6

RESULTS

The IoT-Based Advanced Parking System has demonstrated significant success in urban parking management. Real-time monitoring using advanced sensors has reduced the search time for parking spaces. Integration of a Gate System enhances security, regulating entry and exit based on current parking conditions. User-friendly Blynk applications provide convenient access to real-time information and allow for advance parking slot reservations.

The system's swift detection of improper parking instances, coupled with immediate alerts, has led to improved traffic flow and overall parking efficiency. Continuous monitoring ensures optimal hardware and software performance, with ongoing evaluations showing reduced Traffic congestion and increases user satisfaction which in the end results in the Effective vehicle parking system.

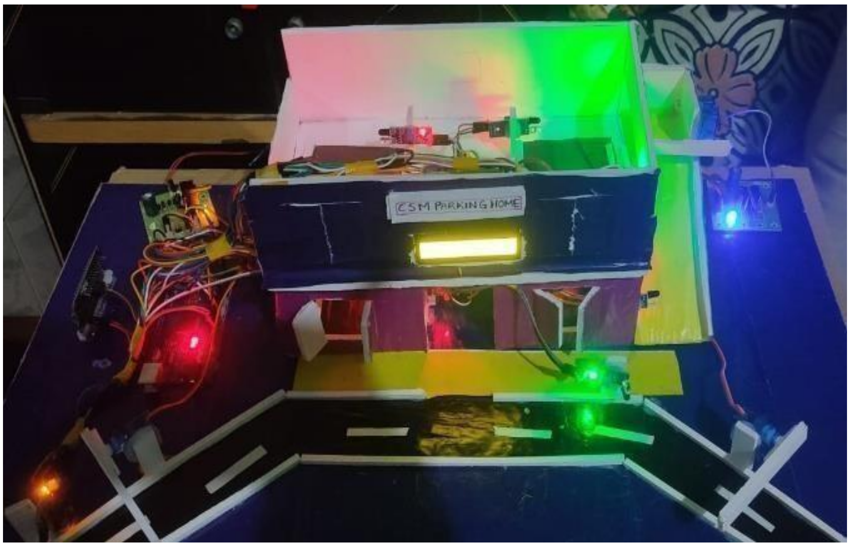


Fig 6.1: Final Hardware Prototype of Proposed System.

Improper parking can be detected through the implementation of a sensor mechanism. This system alerts the user by sounding a buzzer every three seconds until the car is parked in a proper parking area. Additionally, the message 'Vehicle wrong parked' will be displayed on the LED screen

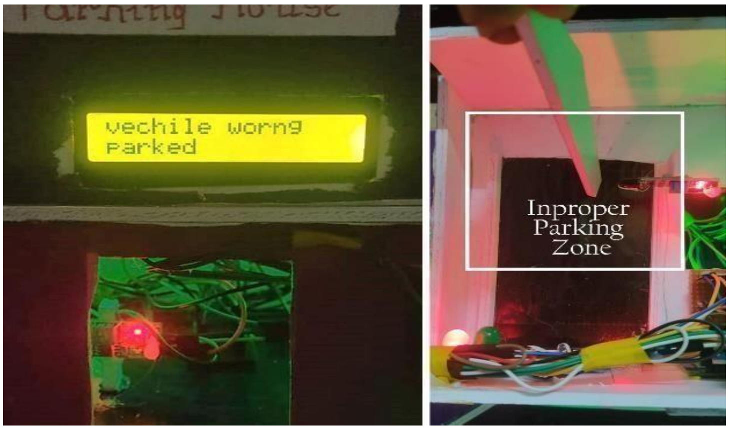


Fig 6.2: Improper Parking Instances and Alert Mechanisms

For a better user experience, updates will be displayed on the LED screen, such as 'Slot 1 vehicle parked.' Every time the entrance gate is opened or the exit gate is activated, this information will also be shown on the LED screen. Additionally, slot vacancies will be displayed as 'S1: FULL' or 'S2: EMPTY

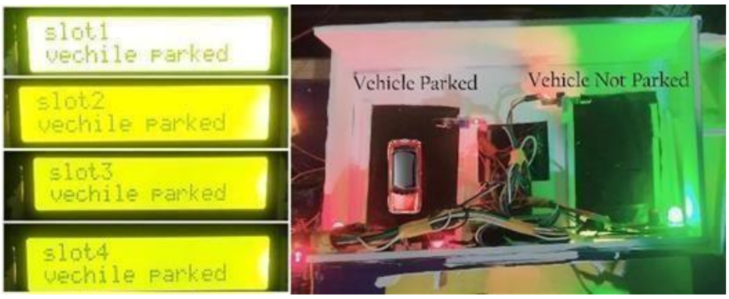


Fig 6.3: Vehicle Parked message

Fig 6.4: Gate activation message

Fig 6.5: Availability Of Parking Slot Checking

By utilizing the Blynk application, user interaction is facilitated, allowing users to seamlessly access real-time parking information and conveniently reserve parking slots in advance.

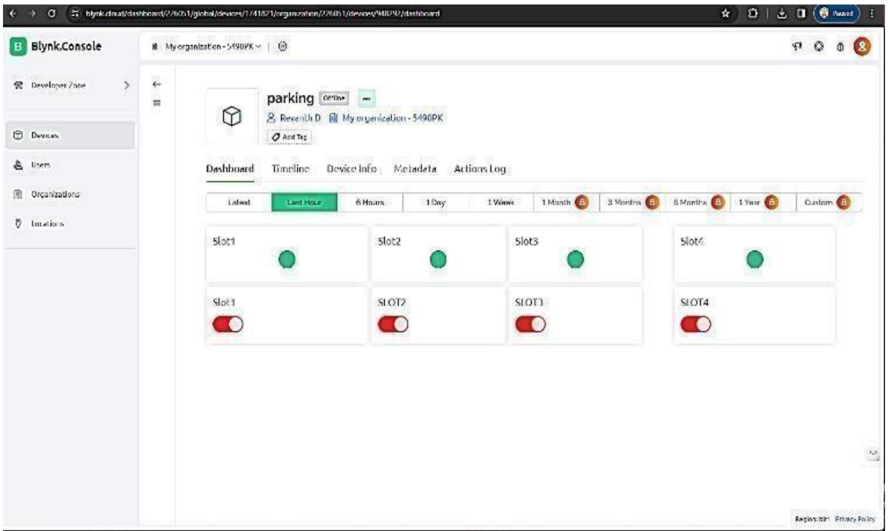


Fig 6.6: Slot Booking System using Blynk IoT Application.

CONCLUSION

In conclusion, the development of an IoT-based parking management system presents a robust solution to address the challenges of urban parking. By accurately and efficiently detecting parking slot availability in real-time, users are empowered with timely information, reducing congestion and frustration. The integration of an Automated Gate System streamlines access control, enhancing the overall user experience. Additionally, the implementation of sensor mechanisms enables the system to effectively detect and address instances of improper parking, contributing to improved traffic flow and safety. the system's real-time monitoring capabilities enable data-driven insights for better decision-making and resource allocation. To address the urban parking challenges, promoting sustainability, and enhancing the quality of urban life. The deployment of an IoT-based parking management system not only addresses urban parking challenges but also contributes to sustainability efforts. By reducing the time spent searching for parking spaces, the system leads to a decrease in vehicle emissions, thus positively impacting air quality in urban areas. Moreover, the real-time monitoring capabilities allow for the optimization of parking space usage, promoting efficient utilization of urban infrastructure and reducing the need for extensive urban expansion, which in turn helps in preserving green spaces and natural habitats within cities. This commitment to sustainability aligns with global initiatives to reduce carbon emissions and create eco-friendly urban environments.

The IoT-based parking management system can serve as a foundation for future enhancements and scalability. As technology continues to advance, the system can integrate predictive analytics to forecast parking demand, allowing for proactive management of parking resources. Furthermore, the incorporation of smart parking meters and cashless payment systems can improve convenience for users and streamline revenue collection for city authorities. The scalable architecture of the system also paves the way for potential integration with autonomous vehicles, enabling seamless navigation and parking assistance. These future enhancements signify the system's adaptability to emerging technologies and its potential to continually enhance urban living standards.

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