Jahangirnagar University

Smart Parking: An IOT Based Solution for University Parking

CSE 460

Submitted by

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Introduction

In response to the growing challenges of parking on university campuses, our project proposes a cutting-edge solution: "Smart Parking."

With the power of the Internet of Things (IoT), our innovative system aims to streamline and optimize parking spaces, providing a hassle-free and efficient parking experience for students, faculty, and staff.

With real-time monitoring and smart technology integration, Smart Parking is designed to revolutionize parking management at our university.

1.1 Background

Urbanization coupled with the exponential increase in vehicle ownership has posed unprecedented challenges to traditional parking management systems. Conventional methods, reliant on manual monitoring and limited data availability, struggle to cope with the dynamic demands of modern urban environments. The consequences include traffic congestion, inefficient space utilization, and user dissatisfaction. Recognizing this pressing need for innovation, the Department of Computer Science and Engineering (CSE) at Jahangirnagar University (JU) is embarking on a pioneering endeavor to revolutionize parking management through the deployment of an IoT-based Car Parking System integrated with cloud computing.

1.2 Significance

The integration of Internet of Things (IoT) technology with cloud computing heralds a new era in parking management, offering a myriad of benefits. By deploying IoT sensors and leveraging cloud-based analytics, parking administrators gain unprecedented visibility and control over parking facilities. Real-time data collection enables accurate monitoring of parking availability, leading to reduced congestion and improved user experience. Moreover, cloud integration empowers remote access and scalability, enhancing the system's adaptability to changing needs. The significance of this initiative extends beyond mere convenience, encompassing environmental sustainability, economic efficiency, and urban planning.

1.3 Objectives

The objectives guiding the implementation of the IoT-based Car Parking System within the CSE department of JU are multifaceted and strategic:

1.3.1 Automation of parking space monitoring and management to alleviate manual intervention and enhance operational efficiency.

1.3.2 Provision of real-time availability status of parking slots to users, facilitating informed decision-making and reducing search time.

1.3.3 Enablement of remote access and control of parking facilities, fostering flexibility and scalability in resource management.

1.3.4 Optimization of parking resource utilization and revenue generation through data-driven insights, promoting economic sustainability.

1.3.5 Enhancement of overall user experience and satisfaction through seamless and intuitive parking solutions, fostering a positive perception of the institution.

1.4 Scope

This report serves as a comprehensive exploration of the IoT-based Car Parking System tailored for the CSE department of JU. Encompassing the technical intricacies of hardware components, software architecture, communication protocols, and cloud integration, it delves into the system's design, implementation, and evaluation. Furthermore, it evaluates the potential benefits and challenges inherent in deploying such a system within an academic institution setting, offering insights into its efficacy and feasibility. The scope extends beyond immediate operational concerns to encompass broader implications for urban planning, transportation management, and technological innovation.

1.5 Motivation

The motivation behind implementing the IoT-based Car Parking System at Jahangirnagar University stems from a recognition of the pressing challenges faced by the university community in managing parking spaces. As urbanization continues to rise and vehicle ownership becomes more prevalent, traditional parking management systems struggle to keep pace with the increasing demand. This leads to congestion, frustration, and inefficient use of parking resources, ultimately impacting the overall experience of students, faculty, and staff.

Moreover, manual monitoring of parking spaces is not only labor-intensive but also prone to errors and delays in updating parking availability information. This lack of real-time data further exacerbates the problem, making it difficult for individuals to locate parking spots quickly and effectively.

In light of these challenges, there is a compelling need for a smarter and more efficient parking management solution. The integration of IoT technology with cloud computing presents an opportunity to revolutionize the way parking spaces are monitored and managed. By deploying IoT sensors and leveraging cloud-based analytics, the proposed system aims to provide real-time insights into parking availability, optimize resource allocation, and enhance user experience.

Furthermore, the implementation of the IoT-based Car Parking System aligns with Jahangirnagar University's commitment to innovation and sustainability. By embracing cutting-edge technologies and adopting sustainable practices, the university demonstrates its dedication to enhancing the quality of life for its community members while minimizing its environmental footprint.

Overall, the motivation behind this project is to address the pressing parking challenges faced by Jahangirnagar University and to create a more efficient, user-friendly, and sustainable parking environment for all stakeholders. Through the deployment of the IoT-based Car Parking System,

we aim to streamline parking management, reduce congestion, and improve the overall experience of individuals navigating the university campus.

1.6 Problem Statement

In the dynamic environment of a university campus, managing parking spaces efficiently can be a daunting task.

The traditional approach to parking management often leads to congestion, frustration among students, faculty, and visitors, and inefficient space utilization.

To address these challenges, there is a pressing need for a smart solution that optimizes parking space allocation, enhances user experience, and integrates seamlessly with the university's existing infrastructure.

1.7 Structure of the Report

The structure of this report is delineated to provide a thorough examination of all aspects related to the IoT-based Car Parking System project:

- Literature Review
- Methodology
- Results
- Conclusion

Through this holistic exploration, we endeavor to furnish valuable insights into the transformative potential of integrating IoT and cloud technologies in parking management within academic institutions like Jahangirnagar University, catalyzing progress and sustainability in urban environments. With the aim of enhancing parking efficiency, user experience, and institutional reputation, this project represents a significant step towards a smarter, more connected future.

Literature Review

2.1 IoT-based Smart Parking Systems

"IoT-based Smart Parking System: " by CHINT Global (2020)

- This review paper comprehensively explores the architecture, components, and functionalities of IoT-based smart parking systems.
- It discusses various deployment scenarios, communication protocols, and sensor technologies used in IoT-based parking solutions.
- The paper highlights the advantages of IoT-based parking systems, including real-time monitoring, improved space utilization, and enhanced user experience.

2.2 Cloud-enabled IoT-based Parking Systems

"Cloud-Enabled IoT-based Smart Parking System: Design and Implementation" by A Khanna et al. (2016)

- Zhang et al. present a detailed study on the design and implementation of a cloud-enabled IoT-based smart parking system.
- The system utilizes wireless sensor networks and cloud computing to automate parking management processes and optimize resource allocation.
- The paper discusses the architecture, implementation challenges, and performance evaluation of the system, demonstrating its effectiveness in reducing parking congestion and improving user satisfaction.

"Integration of IoT and Cloud Computing for Smart Parking Applications:"
by Hardik Tanti et al. (2018)

- In this paper, explore the integration of IoT and cloud computing technologies for smart parking applications through a case study.
- The paper emphasizes the benefits of cloud computing in data storage, analysis, and scalability for IoT-based parking systems.
- It demonstrates how the integration of IoT and cloud computing can provide real-time insights, optimize resource utilization, and enhance overall efficiency in parking management.

Methodology

In this Smart Parking System using IOT, we are using four IR Sensors and two servo motors. IR sensors and Servo motors are connected to the NodeMCU. NodeMCU controls the complete process and sends the parking availability and parking time information to Blynk so that it can be monitored from anywhere in the world using this platform. Two IR sensors are used at entry and exit gate so that it can detect the cars at entry and exit gate and automatically open and close the gate. Another three IR sensors are used to detect if the parking slot is available or occupied and send the data to NodeMCU.

3.1. Components

We have purchased all components from TechshopBD, Daraz, Robiul Electronics and local shops.

Additional components for designing the layout of the project includes: Paper boards, color papers, colors, glue guns, brushes, scissors, anti-cutter etc.

Components	Quantity	Rate	Total (BDT)
NodeMCU ESP8266	1	404	404
IR Sensor	4	90	360
Servo Motor	2	150	300
Jumping Wires	1 set	140	140
Bread Board	1	150	150

USB cable	1	190	190
Toy cars	3	30	90
LCD Display 16x2	1	255	255
Plywood Board Sheets	10 pcs set	800	800
Others			1600
		Total=	4289

3.2. Circuit Diagram

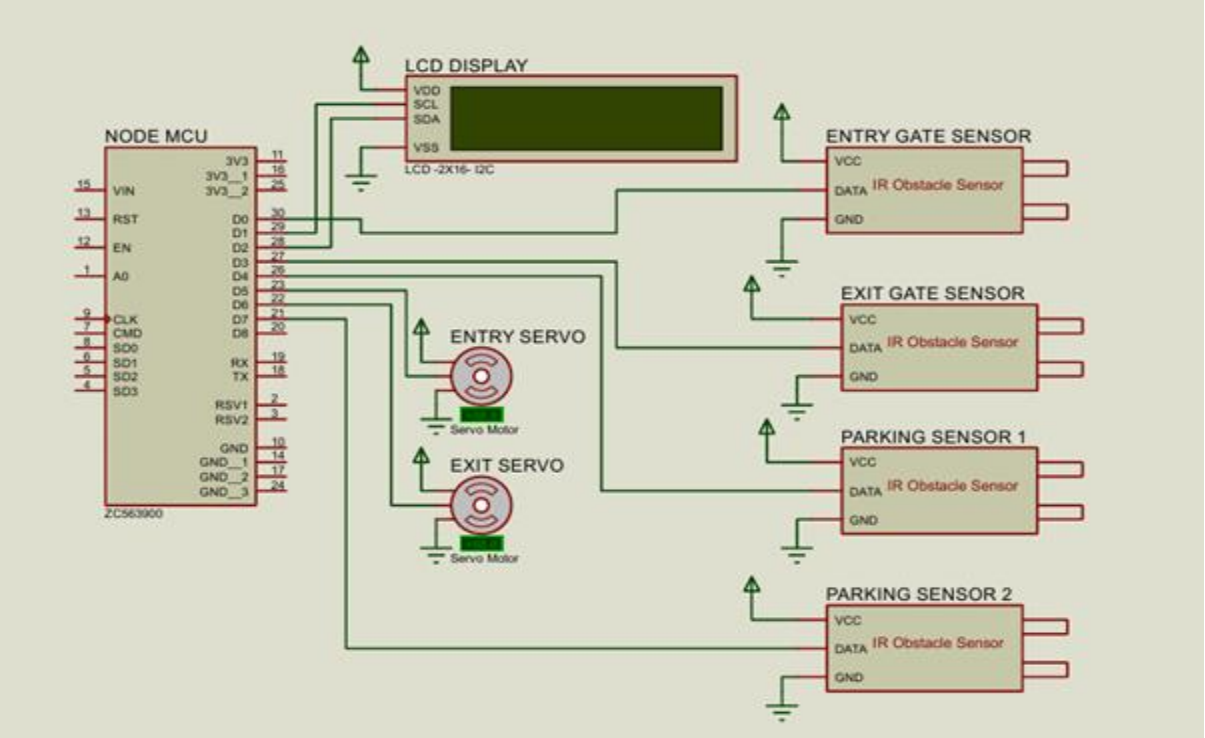
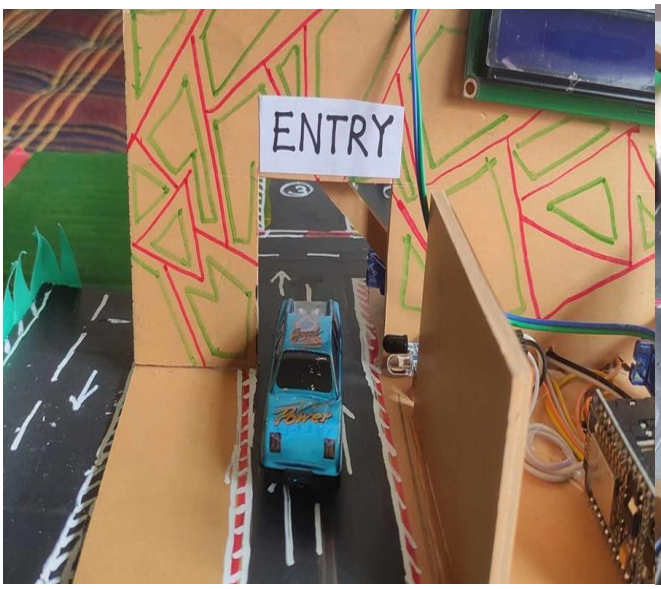


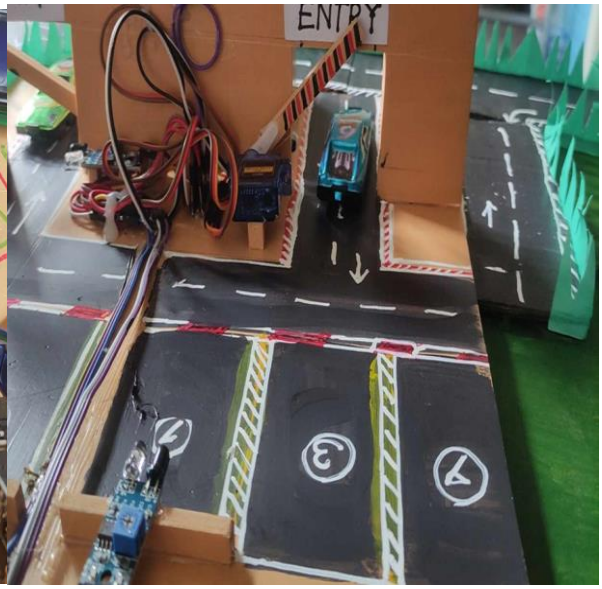
Fig: Circuit Diagram

3.3. Steps of Methodology

3.3.1. Step 1:

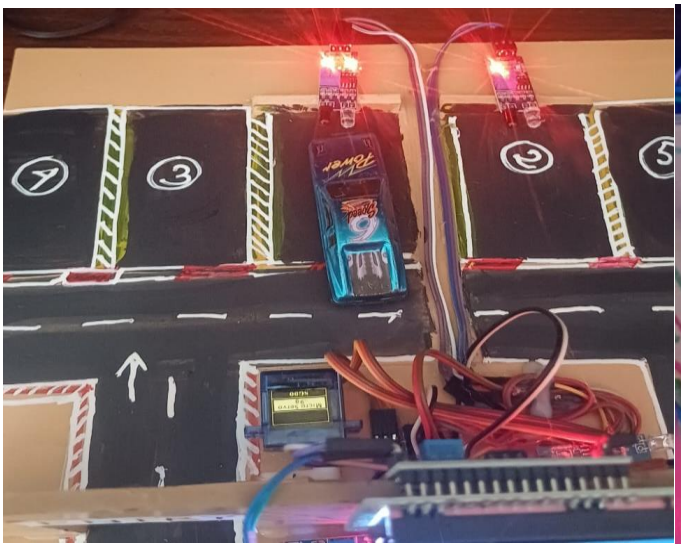
When the car enters the parking area, the IR sensor in Entry Gate will detect the passing vehicle and the entry gate will be opened automatically.





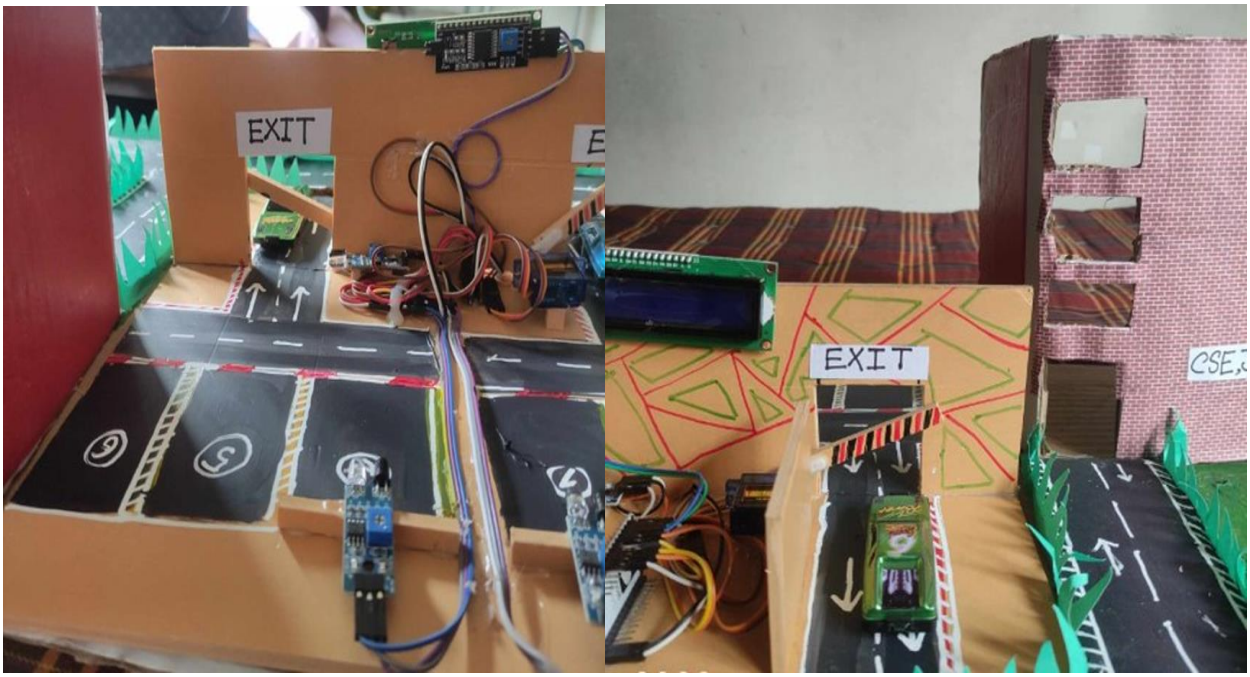
3.3.2. Step 2:

When the car enters the parking slot, the IR Sensor in the slot will detect the car and send slot "FULL" signal to the nodeMCU.



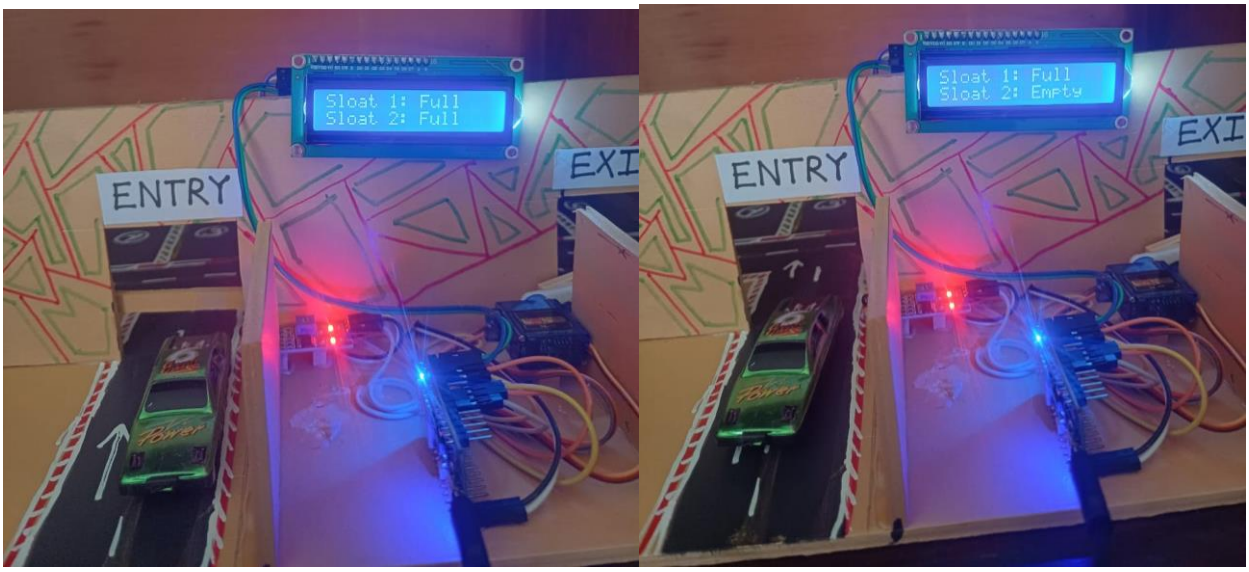
3.3.3. Step 3:

When the car is leaving the parking area, the IR sensor at EXIT Gate will sense the passing car and then sends slots "EMPTY" signal to the nodeMCU. Then the EXIT Gate will be opened automatically.



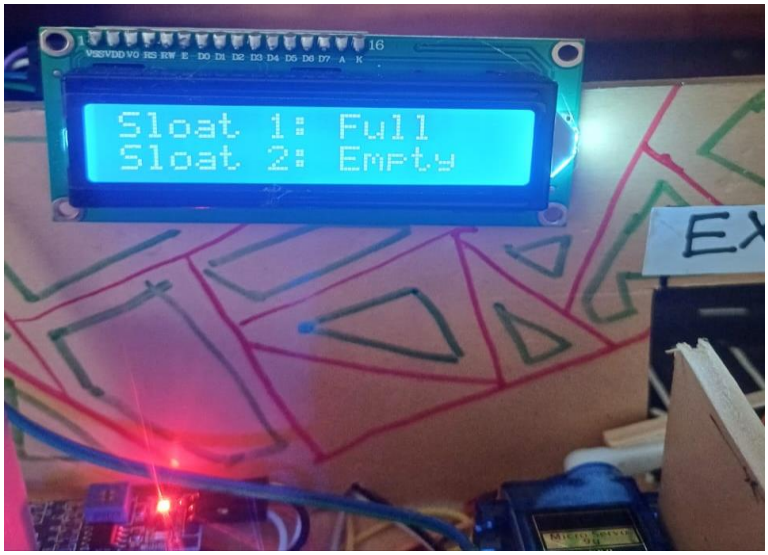
3.3.4. Step 4:

If all the slots are full, then the entry gate will not open unless there is at least an empty slot. The car needs to wait for a while or look for another parking slot.



3.3.5. Step 5:

In front of the parking area there will be an LCD Display which will show the status of the parking slot, whether slot is "FULL" or "EMPTY" .



3.3.6. Step 6:

The main advantage of our system is, the user will register on Blynk website/application.

From this application/website, the user will be able to see the status of the parking area. The application, web dashboard will show the parking status of each slot individually.

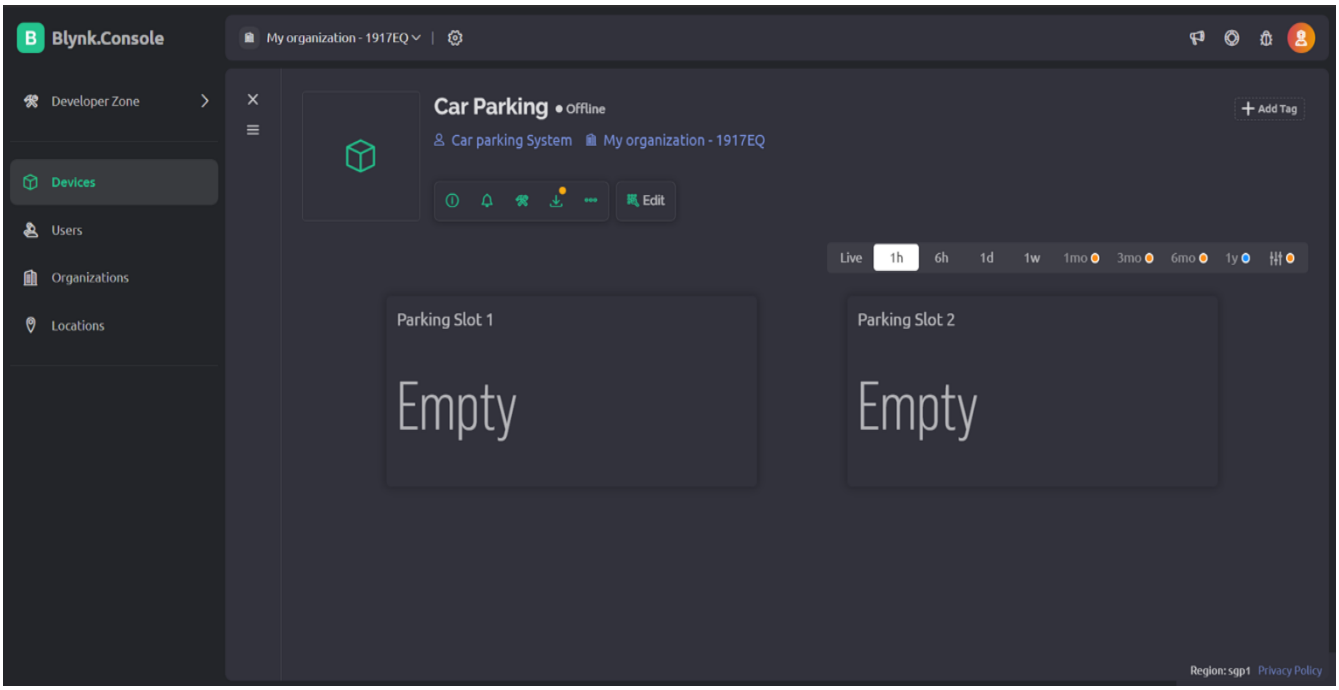


Fig: Blynk Web Dashboard

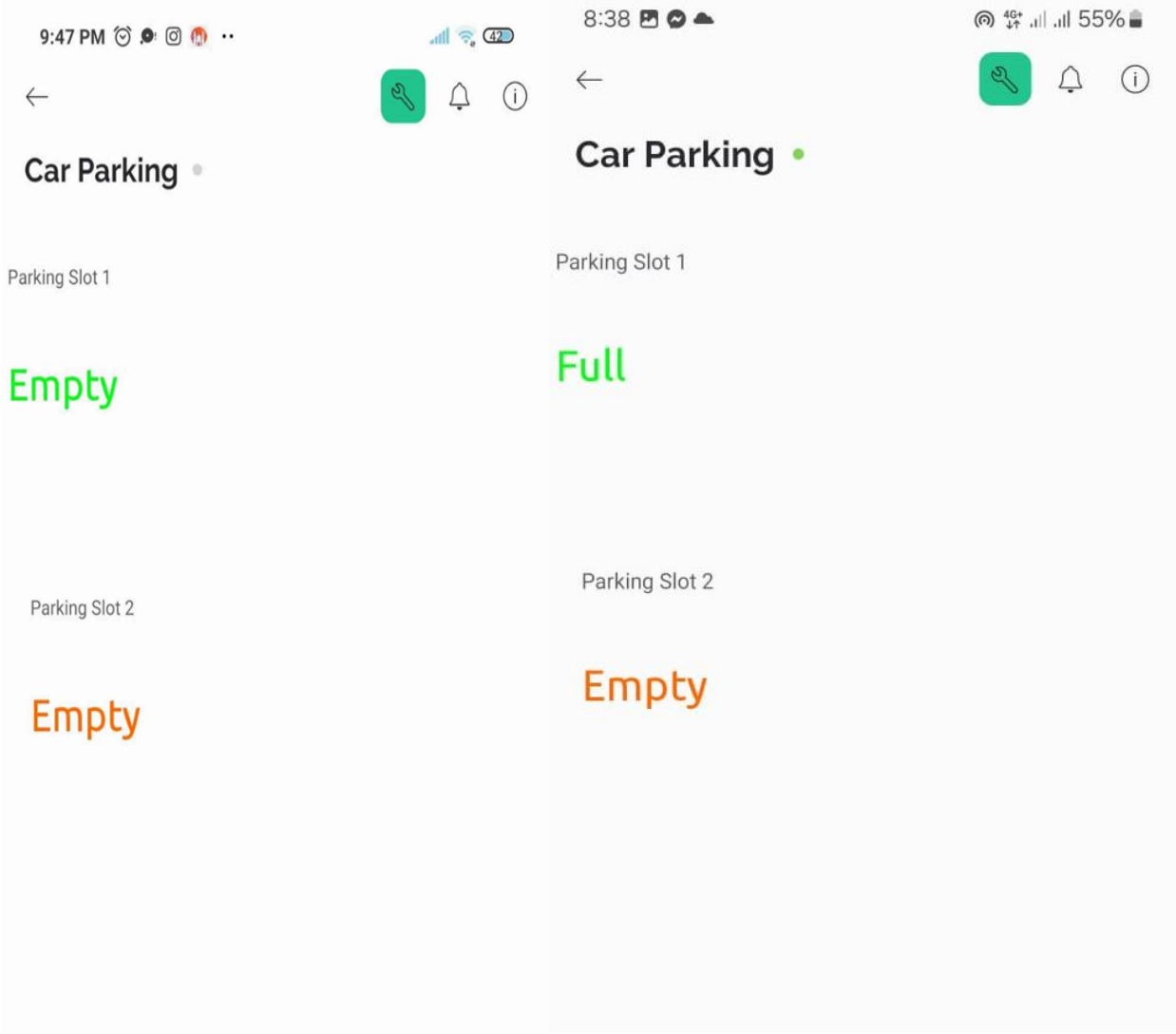


Fig: Blynk App Interface

3.4. Methodology Workflow

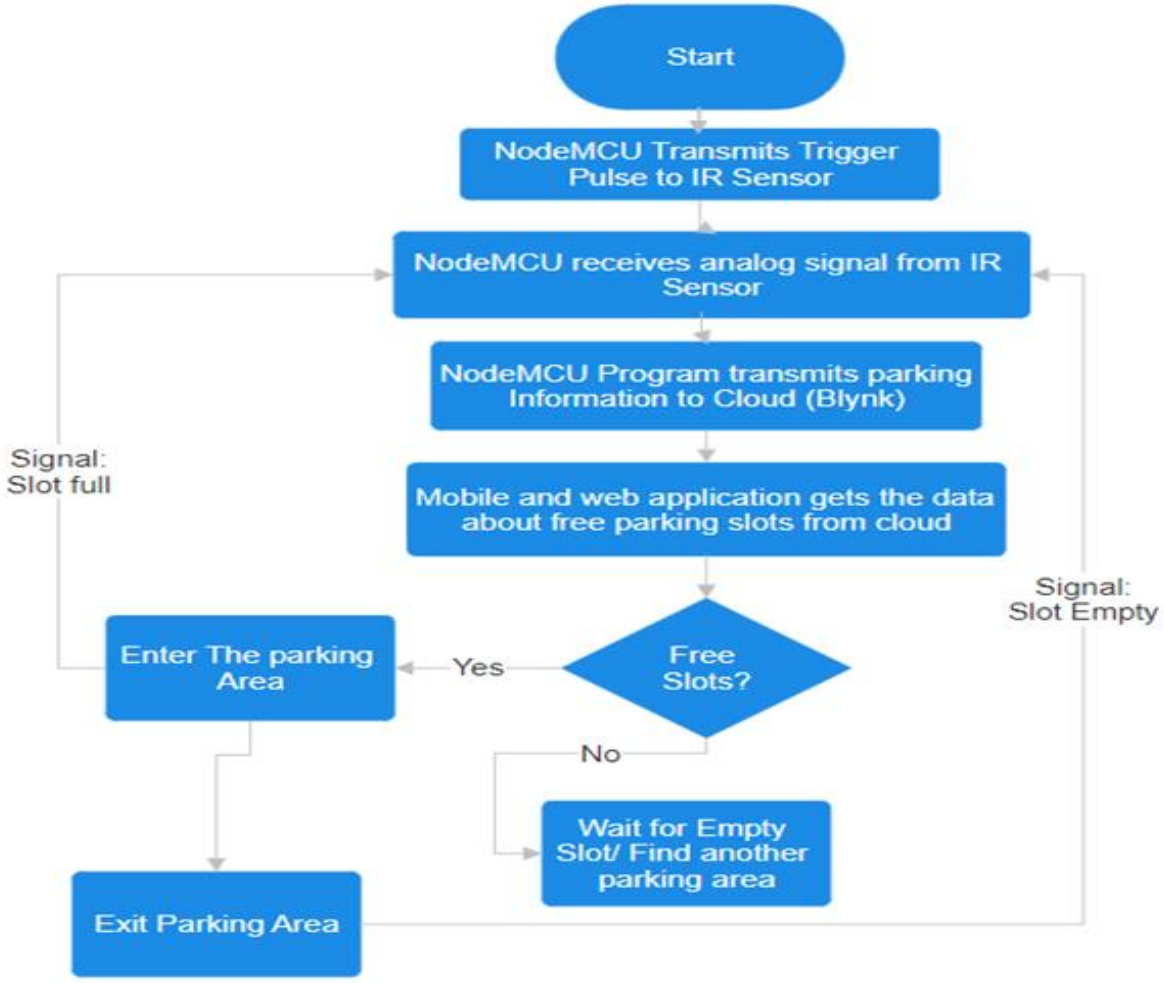


Fig: Methodology Workflow

3.5. Code

```
#define BLYNK_TEMPLATE_ID "TMPL6fhXAZLDz"
#define BLYNK_TEMPLATE_NAME "Car Parking"
#include <ESP8266WiFi.h>
#include <BlynkSimpleEsp8266.h>
#include <Servo.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 16, 2);

// Go to the Project Settings (nut icon).
```

```
char auth[] = "68OGJYJTHvxnTBCx5we9DUNYX-yH_7zi";

// Your WiFi credentials.
char ssid[] = "student";
char pass[] = "iotstudent";

Servo myservo;
Servo myservo1;
int open_g = D0;
int opendata;

int exit_g = D3;
int exitdata;

int One = D4;
int onedata;

int Two = D7;
int twodata;

int flag = 0;

void setup() {
  Serial.begin(9600);
  pinMode(open_g, INPUT);
  pinMode(exit_g, INPUT);
  pinMode(One, INPUT);
  pinMode(Two, INPUT);

  myservo.attach(D6);
  myservo1.attach(D5);
  myservo.write(180);
  myservo1.write(180);
  lcd.init();
  lcd.backlight();

  Blynk.config(auth);
  delay(10);
}

void loop() {
  opendata = digitalRead(open_g);
  exitdata = digitalRead(exit_g);
  onedata = digitalRead(One);
  twodata = digitalRead(Two);

  if (opendata == 0 && flag == 0) {
    myservo.write(30);
    delay(3000);
    myservo.write(180);
  }

  delay(500);
  lcd.clear();
```

```
  if (onedata == 0) {
    lcd.setCursor(0, 0);
    lcd.print("Sloat 1: Full");
    Blynk.virtualWrite(V0, "Full");
  }

  if (onedata == 1) {
    lcd.setCursor(0, 0);
    lcd.print("Sloat 1: Empty");
    Blynk.virtualWrite(V0, "Empty");
    flag = 0;
  }

  if (twodata == 0) {
    lcd.setCursor(0, 1);
    lcd.print("Sloat 2: Full");
    Blynk.virtualWrite(V1, "Full");
  }

  if (twodata == 1) {
    lcd.setCursor(0, 1);
    lcd.print("Sloat 2: Empty");
    Blynk.virtualWrite(V1, "Empty");
    flag = 0;
  }

  if (onedata == 0 && twodata == 0) {
    flag = 1;
  }

  if (exitdata == 0) {
    myservo1.write(30);
    delay(3000);
    myservo1.write(180);
  }
}
```

Result & Discussions

4.1. Result

- The smart parking system successfully detects vehicle presence using IR sensors.
- The Blynk app interface accurately reflects the real-time parking availability.
- Servo motors effectively control the barrier gates, allowing for seamless entry and exit of vehicles.
- Users can easily navigate and find vacant parking slots using the mobile app.

Fig: (1) Front View, (2) Back View, and (3) Top View

4. 2. Discussion

- Accuracy and Reliability: The IR sensors consistently detect vehicle presence with high accuracy, minimizing false positives and negatives.
- Real-Time Updates: The integration with the Blynk cloud platform ensures real-time updates on parking availability, enhancing user experience.
- Scalability: The system can be easily scaled up to accommodate a larger number of parking slots by adding more IR sensors and servo motors.
- User-Friendly Interface: The Blynk app provides a user-friendly interface for users to interact with the system, making parking hassle-free.

- Maintenance and Support: Regular maintenance and technical support ensure the system operates smoothly and addresses any issues promptly.

Conclusion

5.1. Limitations

- In big parking lots, the system may have trouble handling a lot of parking spaces at once.
- Environmental factors like direct sunlight may affect IR sensor accuracy.
- Security considerations for cloud data storage and remote access need to be addressed.

5.2. Future Work

- **Multiple parking lot deployment:** Design the system for scalability and implementation across multiple parking locations.
- **Payment System Implementation:** Integrate payment system using RFID tag to vehicles, Automated billing with cards, b-kash, prepaid accounts, and so on.

5.3. Conclusion

This IoT-based car parking system offers a promising solution to the ongoing parking dilemma.

By using the power of sensors, cloud platforms, app and web interfaces, we can create a smarter and more efficient parking experience for drivers and parking lot operators alike.

References

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6.2. *iotdesignpro.com*
6.3. *Ultimate Guide to IoT Based Smart Parking System*
6.4. *A. Khanna and R. Anand, "IoT based smart parking system," 2016 International Conference on Internet of Things and Applications (IOTA), Pune, India, 2016, pp. 266-270, doi: 10.1109/IOTA.2016.7562735.*
6.5. *Hardik Tanti , Pratik Kasodariya , Shikha Patel , Dhaval H Rangrej, 2020, Smart Parking System based on IOT, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) Volume 09, Issue 05 (May 2020),*