DAYANANDA SAGAR COLLEGE OF ENGINEERING

(An Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE & ISO 9001:2008 Certified)Accredited by National Assessment & Accreditation Council (NAAC) with 'A' grade

Shavige Malleshwara Hills, Kumaraswamy Layout, Bengaluru-111

A Project Report On

Smart Parking System using IOT with Blynk and RFID

Submitted in partial fulfillment of the requirement for the 8th semester

Bachelor of Engineering

in

Computer Science and Engineering

Submitted By

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2023 - 2024

Department of Computer Science and Engineering

DAYANANDA SAGAR COLLEGE OF ENGINEERING

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VISVESVARAYA TECHNOLOGICAL UNIVERSITY

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CERTIFICATE

This is to certify that the project entitled **Smart Parking System using IOT with Blynk and RFID** is a bonafide work carried out by **Vignesh N [1DS20CS130], Manoj M [1DS21CS119], Suhaas P Reddy [1DS20CS159] and Koushik Reddy [1DS20CS099]** and in partial fulfillment of 8th semester, Bachelor of Engineering in Computer Science and Engineering under Visvesvaraya Technological University, Belgaum during the year 2023-24.

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Smart Parking System using IOT with Blynk and RFID

Vignesh N, Manoj M, Suhaas P Reddy,
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Abstract

This project presents a Smart Parking System tailored to address the unique parking challenges of organizations and restricted-access entities. It integrates Infrared (IR) sensors, Radio-Frequency Identification (RFID) tags, and Cloud connectivity. IR sensors monitor parking space occupancy in real-time, while RFID tags serve as secure physical credentials for authorized personnel, enhancing access control. The system incorporates a Blynk app for authorized users to access real-time parking data, check availability, and helps users make informed decisions about parking. This app acts as a centralized hub for efficient parking management, improving the overall parking experience. Architecturally, the system utilizes a centralized control unit controlling interactions between IR sensors, RFID authentication, and the Blynk cloud server. This approach allows only authorized users to access thee parking lot, resulting in a scalable and adaptable solution prioritizing exclusivity, efficiency, convenience, and security in parking management for specialized environments.

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1. Introduction

With urbanization on the rise, the challenge of efficient parking management has become more important than ever. Traditional parking setups often lead to congestion, wasted time, and increased environmental impact. Smart Parking Systems emerge as a solution to these challenges, offering real-time monitoring and streamlined access. This introduction explores the necessity for Smart Parking Systems and how the integration of Infrared (IR) sensors, Radio-Frequency Identification (RFID) tags [1], and the Blynk mobile application [2] can revolutionize parking, providing a seamless and intelligent solution for modern urban environments.

1.1 The Problem

Conventional parking infrastructure is plagued by inefficiencies, causing frustration for drivers and contributing to increased traffic congestion. Smart Parking Systems are crucial for transforming this landscape, offering real-time monitoring and secure access control. These systems not only alleviate the stress of parking but also contribute to a more sustainable and organized urban environment.

1.2 Real World Application

Integrating Infrared (IR) sensors, Radio-Frequency Identification (RFID) tags, and the Blynk mobile application addresses the shortcomings of traditional parking systems. IR sensors provide real-time occupancy data, RFID tags ensure secure identification, and the Blynk app acts as an intuitive interface for users to check availability of parking slots and helps the users identify empty parking spots with real time data. Together, these components form a Smart Parking System that enhances user experience and improves parking management for a more connected and sustainable urban future.

1.3 Organisation of Project Report

The project report is organized as follows: In Chapter (2) we discuss the problem statement and the proposed solution. Chapter (3) takes a more in-depth look at various technology based solutions that exist, with a survey on existing literature available. Chapter (4) looks at the architecture of the proposed solution with an overview of thesystem design. Chapter (5) dives into the Implementation of the solution, by describing the hardware and software requirements, along with detailed descriptions and implementation details including system block diagrams and data flow diagrams. Chapter (6) looks at obtained results. Chapter (7) summarizes our findings and concludes the paper.

2. Problem Statement and Proposed Solution

2.1 Problem Statement

Urban areas face a common headache: too many cars and not enough parking spots. The problem gets worse because the old parking systems aren't doing a good job. They make drivers waste time driving around, use more gas, and make the roads busier. The big issue is that we're not using parking space very well. This causes problems for everyone. It makes people frustrated and stressed when they can't find a spot. Plus, all the extra driving makes the air dirtier with more pollution from car exhausts. But it's not just about inconvenience. Bad parking systems hurt businesses too. When customers can't find parking, they might go somewhere else, hurting sales and jobs in the area. That's why it's so important to find better ways to deal with parking problems. We need smarter ways to use parking spaces, like sensors that tell us when spots are free or apps that help us find parking easily.

By fixing parking problems, we can make life better for everyone. Less time spent circling for parking means less traffic on the roads and cleaner air. It also means more customers for businesses, helping them grow and create more jobs. So, finding better parking solutions isn't just about convenience; it's about making cities better places to live and work. It's about cutting down on pollution, reducing stress, and helping businesses thrive.

2.2 Existing Systems

In cities around the world, parking is a big deal. You've got your traditional parking lots with painted lines, maybe a meter or two. Then there are those pay-and-display machines where you stick in some coins and hope for the best. And let's not forget about those time-limited zones where you have to rush back before you get a ticket. But it's not all old-school. Some places offer valet parking, where someone else parks your car for you. And there are those fancy parking guidance systems that use cameras and sensors to tell you where the empty spots are.

Each of these systems has its pros and cons. Traditional parking lots are simple but can get crowded. Pay-and-display machines are straightforward but can be a hassle if you don't have exact change. Time-limited zones help keep turnover but can be a pain if you lose track of time.

Valet parking is convenient but might not be available everywhere, and it can be pricey. Parking guidance systems are cool with their high-tech sensors, but they're not everywhere yet, and they can be expensive to set up.

Overall, parking systems are trying to make life easier for drivers, but there's still room for improvement. We need systems that are easy to use, affordable, and available everywhere. That way, we can spend less time circling the block and more time enjoying our day.

2.3 Proposed Solution

Imagine a parking system that makes finding a spot as easy as a breeze. That's what a smart parking system does. It's like having your own personal parking assistant right in your pocket.

How it works:

At the heart of this system are smart sensors installed in parking spots. These sensors use Infrared (IR) technology to detect whether a spot is occupied ornot. When a car parks in a spot, the sensor sends a signal to the system indicating that the spot is taken.

Each car is equipped with a Radio Frequency Identification (RFID) tag. This tag is used to verify only authorised vehicles are allowed to enter the parking lots. When a car enters the parking lot, the RFID tag is scanned, and the system knows which car it is and where it's parked.

The Blynk Mobile App:

The whole system is connected to a mobile app called Blynk. This app lets users see real-time information about available parking spots. You can open the app. The information is available on both mobile app and website dashboard.

With this smart parking system, finding a spot is no longer a guessing game. You don't have to drive around endlessly looking for a space. The system guides you to the nearest available spot, saving you time and frustration.

Benefits:

- Reduced Traffic Congestion: With fewer cars circling around, traffic congestion is reduced.

- Improved User Experience: Users can easily find and reserve parking spots with the mobile app.
- Efficient Space Utilization: The system optimizes parking space usage, ensuring every spot is utilized effectively.
- Enhanced Security: RFID tags provide secure access control, preventing unauthorized vehicles from entering the parking lot.

2.4 Requirements

2.4.1 Hardware Components Required

- ESP8266
- IR Sensor (LM393)
- Servo motor (MG995)
- 16x2 LCD Display (LCD2004)
- RFID Scanner (EM-18)
- RFID Card
- Breadboard
- Connecting wires
- Power Source (Micro USB)
- Mobile phone with WI-Fi

2.4.2 Software Components Required

- Arduino IDE
- Blynk app on Playstore or App store

3. Literature Survey

3.1 Technological Survey

Smart Parking Systems are solutions designed to optimize the management of parking space providing more efficient, user-friendly, and sustainable urban parking experiences. These systems leverage various technologies, including sensors, communication networks, and mobile applications, to address the challenges associated with traditional parking methods. Smart Parking Systems have emerged as a solution to address the challenges associated with traditional parking management. Key findings from recent studies have been included in this survey, highlighting the benefits and advancements offered by smart parking technologies.

In the survey conducted, it was found that there have been many proposals for a smart parking system. IR Sensors have been extensively used for the detection of vehicles present in the parking slots. In Smart Parking Systems, Infrared (IR) sensors emerge as a highly effective solution due to their real-time occupancy detection, accuracy, and cost-effectiveness. These sensors are equipped with photocells tuned to detect infrared light and offer information about parking space availability, ensuring accurate and reliable data for users. A paper noted that IR sensors are notably used for remote control detection, IR sensors exhibit low power consumption, as evident in electronic devices such as TVs and DVD players [3]. Another paper noted their ease of integration, durability, and applicability to diverse parking configurations make them a practical choice for smart parking infrastructure, aligning with the key requirements of scalability and efficient parking management [4].

As a result, IR sensors contribute significantly to optimizing parking space utilization and enhancing the overall user experience in smart parking environments. In a paper published in 2016 [5], it was found that smart parking systems that utilize IR sensors are the most common and standardized method of utilizing smart parking systems.

RFID tags have also been used for Smart Parking Systems for the purpose of authentication. A paper delves into the Radio Frequency Identification (RFID) tags and its libraries [6]. The operation of RFID tags involves the tab, antenna, and coupler. The antenna creates a magnetic field around it. Whenever the tag enters the RF field, the antenna's RF signal activates the tag. The coupler sends a modulated signal. The tag demodulates the signal and then returns its data to the computer. The computer sends new data through the coupler to the tag. Different applications of RFID in various fields are discussed in this paper.

Another paper [7] provides a comprehensive examination of Radio-Frequency Identification (RFID) technology and its diverse applications. The paper begins by offering a detailed explanation of RFID technology, explaining its core principles,components.They discuss RFID's role in supply chain management, healthcare, retail, and transportation, emphasizing its capacity to enhance efficiency, accuracy, and traceability in diverse operational contexts. The authors draw attention to RFID's ability to revolutionize inventory management, streamline logistics, and improve patient care in the healthcare sector.

Blynk is a versatile and user-friendly Internet of Things (IoT) platform that allows individuals, developers, and businesses to build custom applications for controlling and monitoring connected devices. The Blynk app is a central component of this platform, providing a visual interface through which users can create customizable dashboards for their IoT projects. The app is available for both iOS and Android devices. With the Blynk app, users can design interactive and responsive graphical interfaces, known as Blynk apps or dashboards, by dragging and dropping widgets. These widgets include buttons, sliders, graphs, displays, and more, each corresponding to specific functionalities or data points in the connected devices. The app facilitates real-time communication with IoT hardware using a variety of connectivity options,including WiFi,Bluetooth,and cellular networks.

A paper [8] dives into the use of Blynk framework for IOT systems. The primary focus of the paper is to crate an IOT based smart home using the Blynk framework. They use many sensors like HC -SR04 to detect the water level in the tank, and pump water whenever the water level is below a certain level, a PIR sensor that detects motion of humans, then opens the door automatically when it detects motion, a temperature sensor that detects the ambient temperature in each room and then turns on the fan whenever it detects that the temperature has gone above a certain temperature. All these readings and data has been integrated into the Blynk app. The dashboard shows the real time data and also offers the options to toggle the actuators for each actuator.

A paper from 2020 [9] proposes a system that utilizes IoT (Internet of Things) technology and IR (Infrared) sensors for managing car parking. The system aims to develop a Car Parking Management System that utilizes IoT technology to display the availability of parking slots. IR sensors are used in the system to detect the presence or absence of a car in a parking slot. The system utilizes an LCD screen to display the vacant parking slots in real-time. The implementation of the system using Arduino, IR sensors, and ESP8266 WiFi module with Blynk integration is discussed, highlighting its efficiency in managing car parking by providing real-time information about available parking slots

4. Architecture and System Design

4.1 Block Diagram

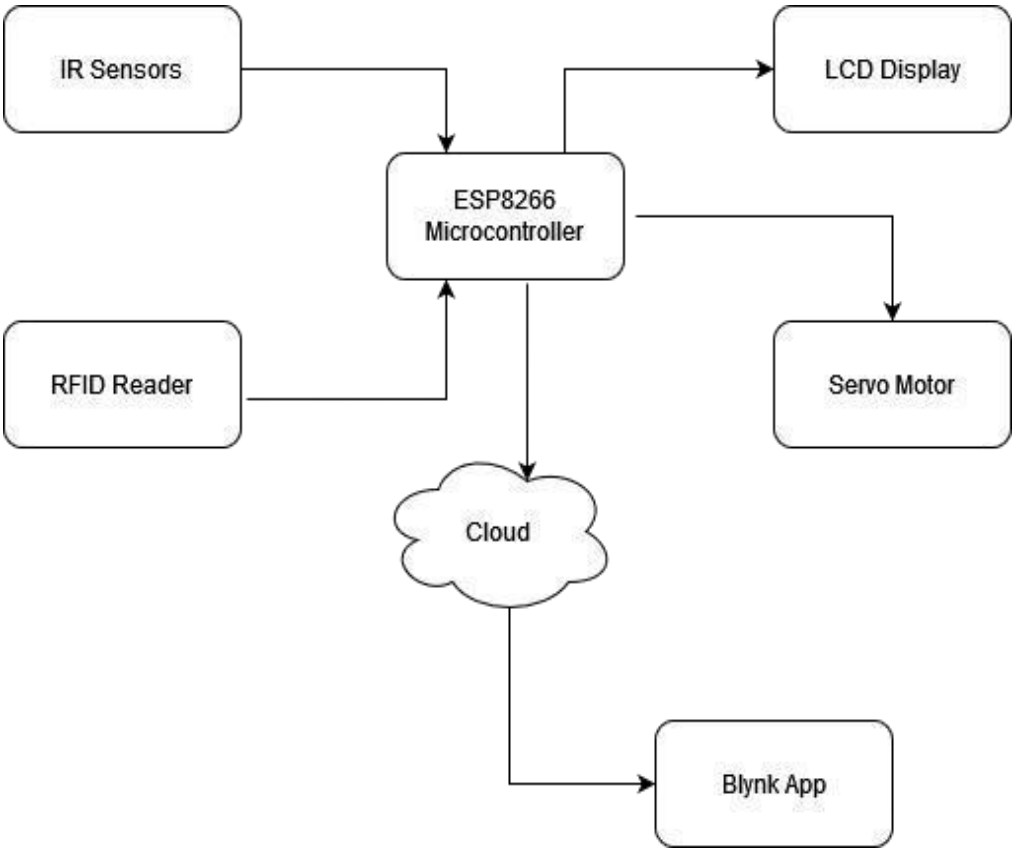

Figure 4.1 Block Diagram

Figure 4.1 shows the block diagram of the entire smart parking system, where the ESP8266 acts as the main control unit. The Infrared (IR) sensors, Radio-Frequency Identification (RFID) scanner, LCD display, and the servo motor are all linked to the ESP8266.The IR sensors provide real-time data on parking space occupancy. The RFID scanner acts as a security control measure allowing only the authorized users to access the parking lot. The servo motor acts as a physical barrier that denies entry to unauthorized personnel.

The LCD display shows the real time parking data to the users. The Blynk app is cloud based IOT platform, it shows the real time parking data virtually through the mobile app or the website, the users can either view the parking status on the mobile app or the website version of the app.

4.2 Circuit Diagram

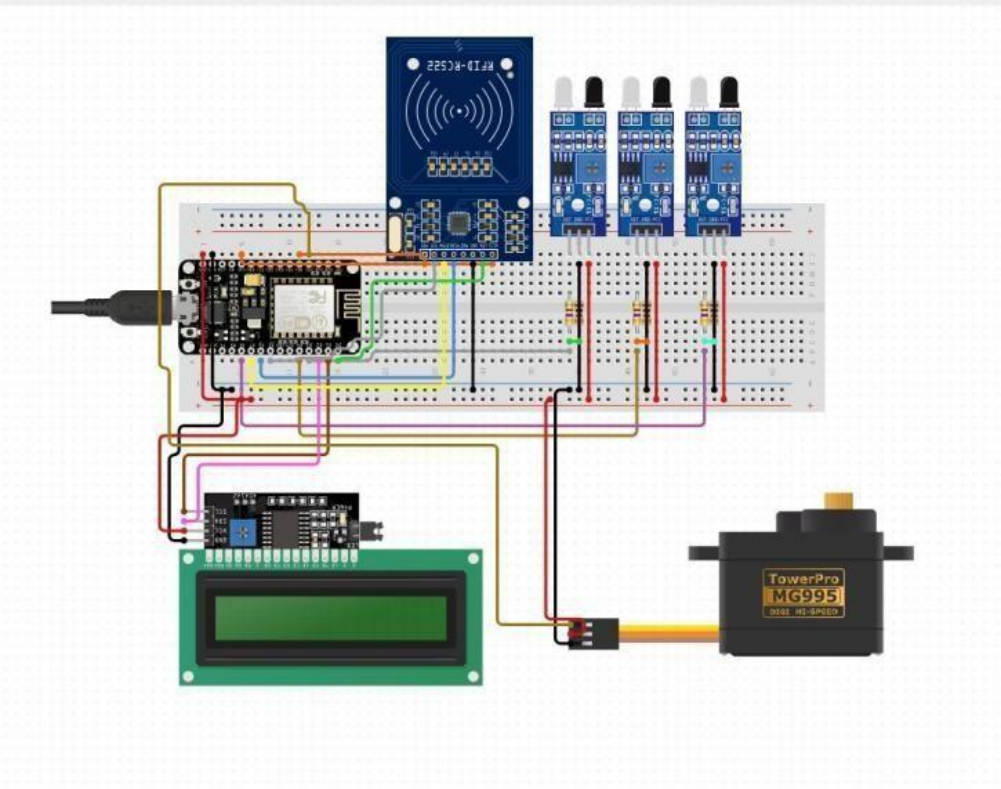

Figure 4.2 Circuit Diagram

Figure 4.2 shows the circuit diagram of the whole smart parking system. The Micro controller ESP8266 is mounted onto a breadboard. The LCD display, servo motor, RFID scanner are all connected to the same breadboard on different gpio pins as seen in figure 2. The pins next to the green line are the ground pins, the pins next to the red wires are the live pins. The IR sensors are mounted separately on another breadboard which is in turn connected to the breadboard which has the ESP8266 mounted on it. This is done for the purpose of extending the length of the connection and allowing the IR sensors to be mounted on the parking spots.

5. Implementation

5.1 Setup

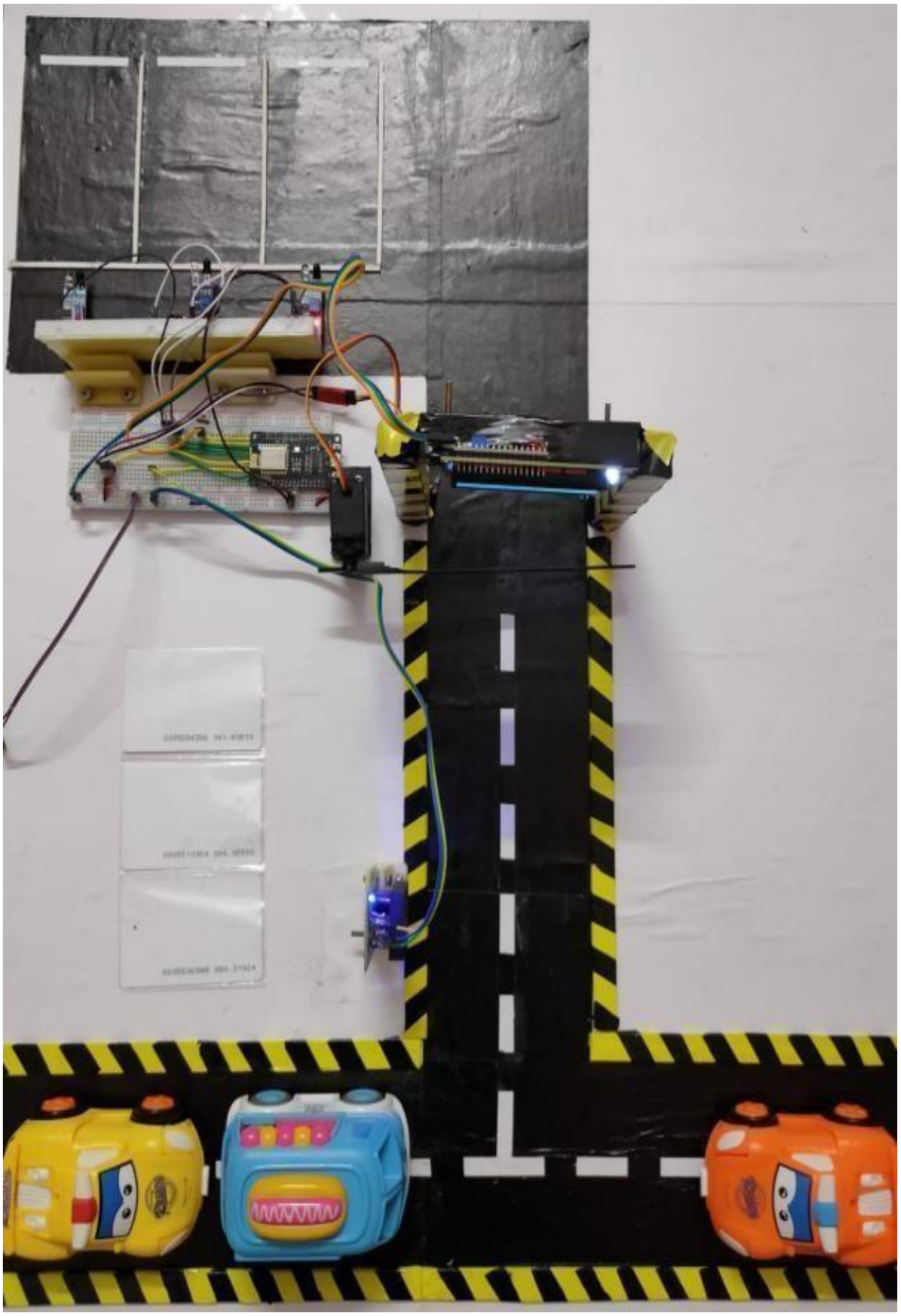

Figure 5.1 Overall Setup

Figure 5.1 shows the overall setup of the system. The breadboard containing the ESP8266 and all its connections is placed at 1 corner which is near the parking slot as well as the parking lot entrance.

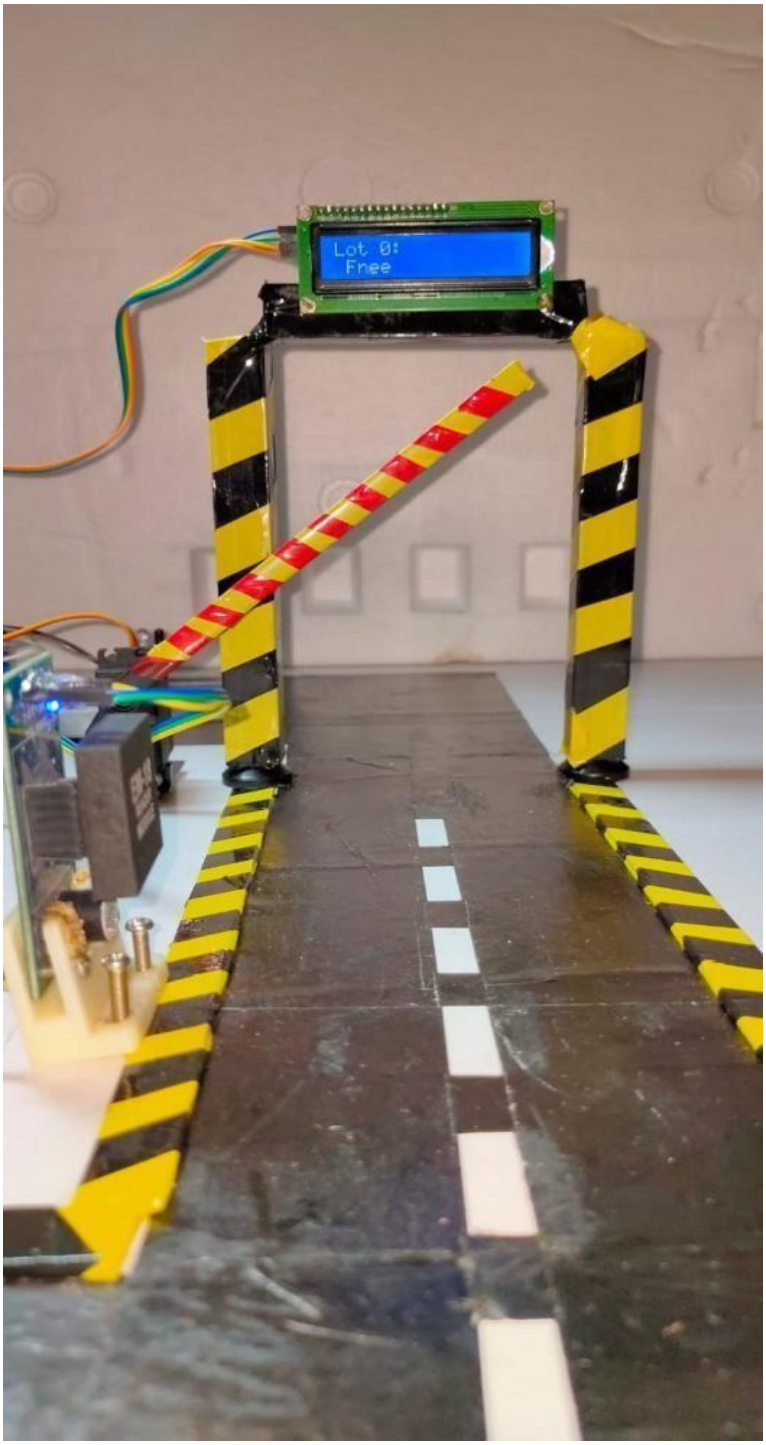

Figure 5.2 RFID scanner, LCD Display, Servo Motor at the gate

The RFID scanner, servo motor, LCD display are kept near the entrance of the parking lot as seen in Figure 5.2. The LCD display is mounted on an elevation for ease of visibility for users, the users can check the display to see if there are empty parking slots.The LCD display cycles through each parking slot. A bigger LCD display can be added to show all parking slots concurrently. The servo motor is placed right in front of the entrance to the parking lot.

This acts as a gate which allows only authorized users to enter the parking lot. The RFID scanner is mounted vertically at the entrance so that it is easier for users to place the RFID card and the gate opens while the user can remain in their vehicle.

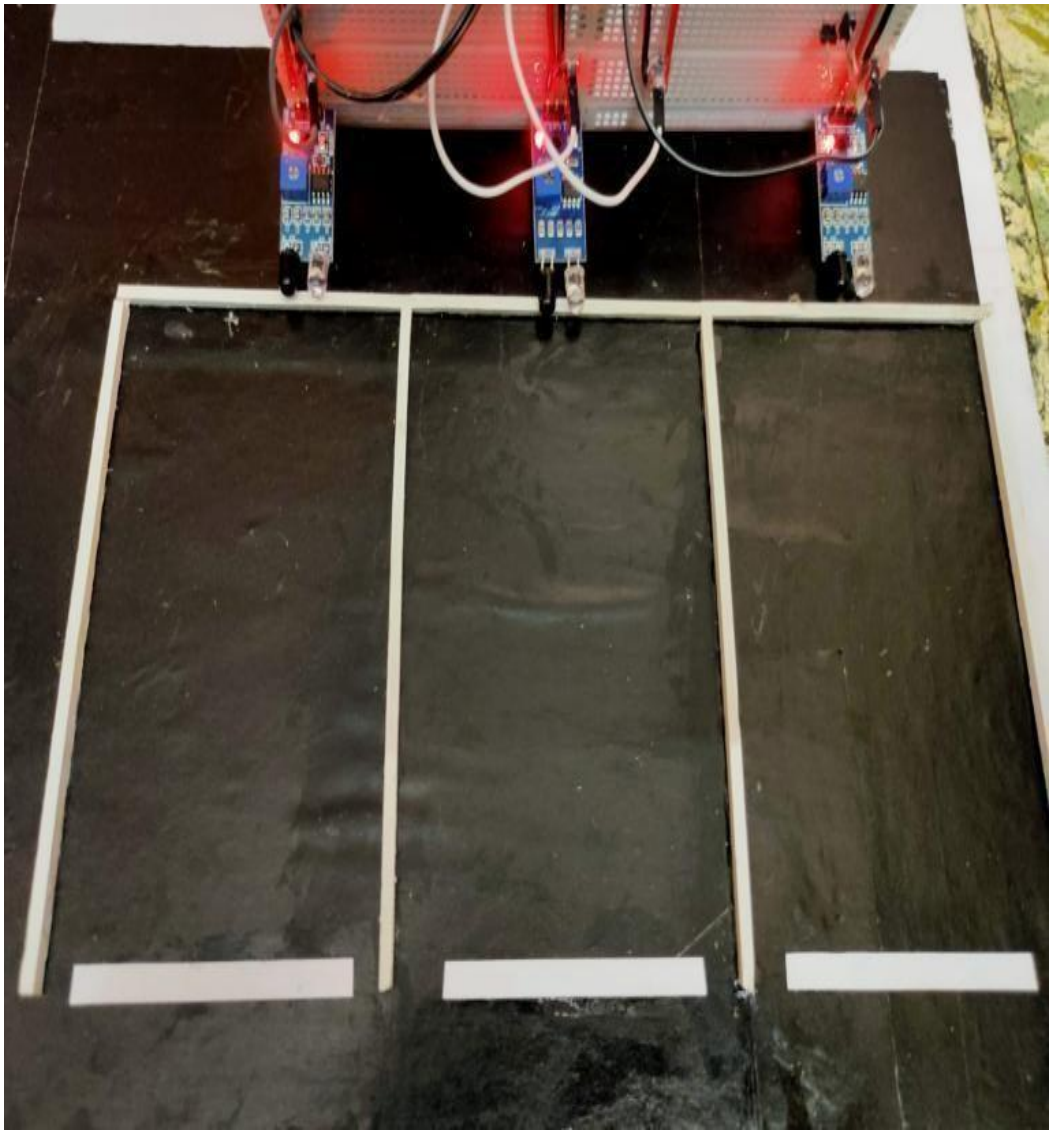

Figure 5.3 Parking Slot with IR Sensors

The Breadboard containing the IR sensors is placed near the parking slots as seen in Figure 5.3.

5.2 Working

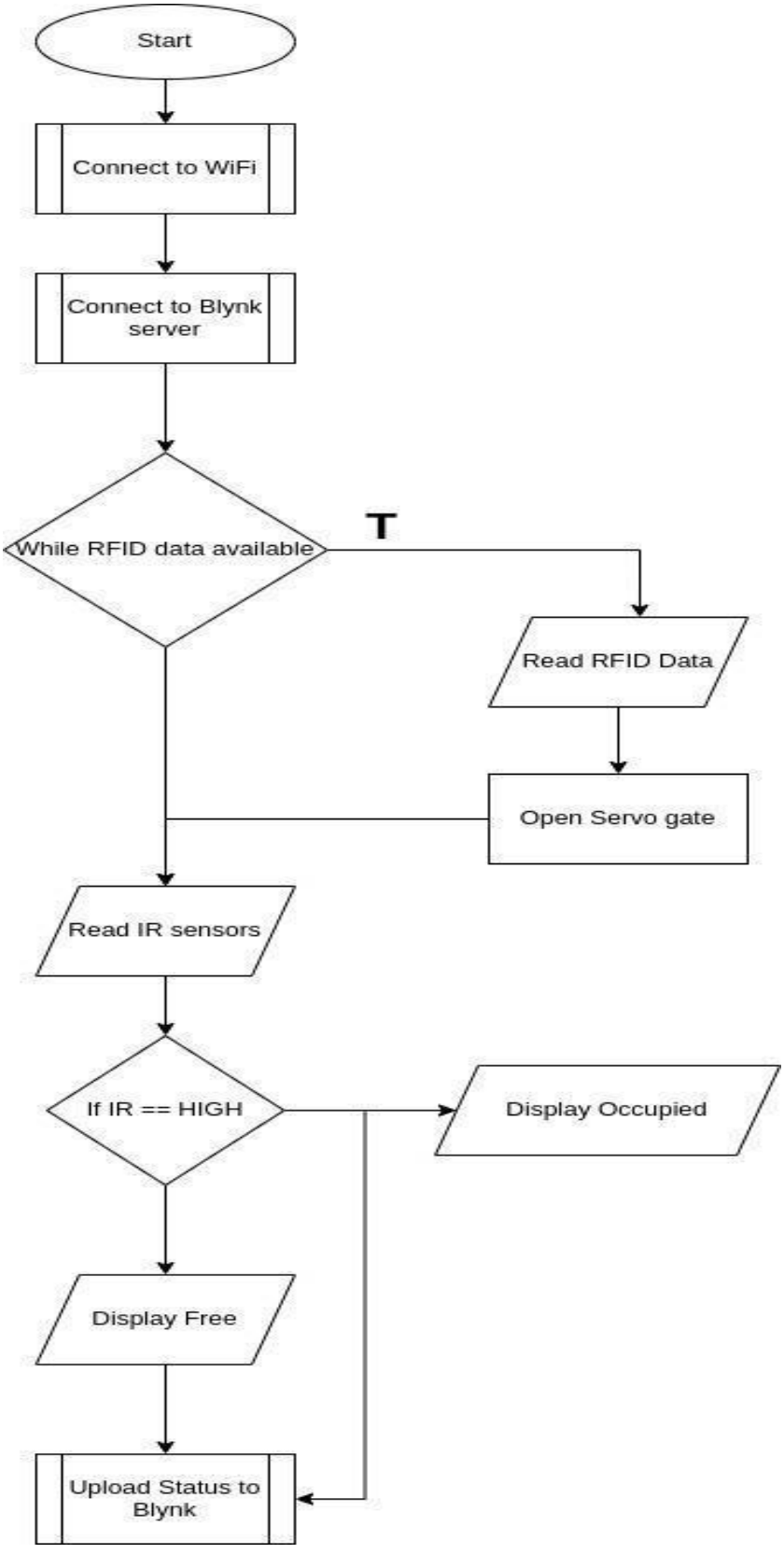

Figure 5.4 Flowchart

As seen in Figure 5.4,Once the system is turned on, the system first connects to a WIFI signal for internet. After connecting to the internet, the system is now online. The system then connects to the Blynk cloud server. The RFID scanner is always online as the RFID field is always active.

Whenever an RFID card is placed near the RFID scanner, the signal is sent to the ES8266. The ESP8266 then sends another signal to the servo motor. The servo motor then raises the barrier allowing the user to enter the parking lot. After a while the servo lowers the barrier. Whenever the IR sensors detect the presence of a vehicle, the status of that parking slot is changed from free to occupied. Whenever the IR sensor detects the absence of a vehicle, the status of that parking slot is changed from occupied to free.

6. Results

Figure 6.1 Slot Status on LCD Display

Whenever an authorized user approaches the entrance of the parking lot, they can view the status of each parking slot in the LCD display that is mounted at the top (Figure 6.1).

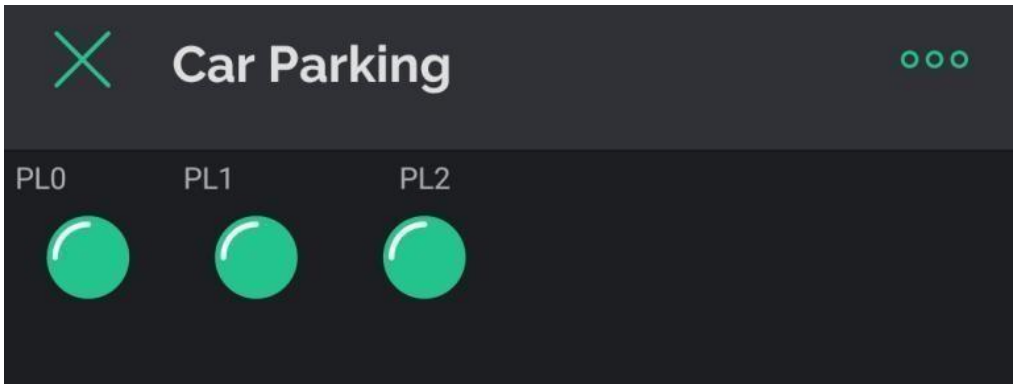

Figure 6.2 Parking slot status on Blynk Dashboard

The user can also view the status of parking slots on the Blynk app on their mobile phone (Figure 6.2).

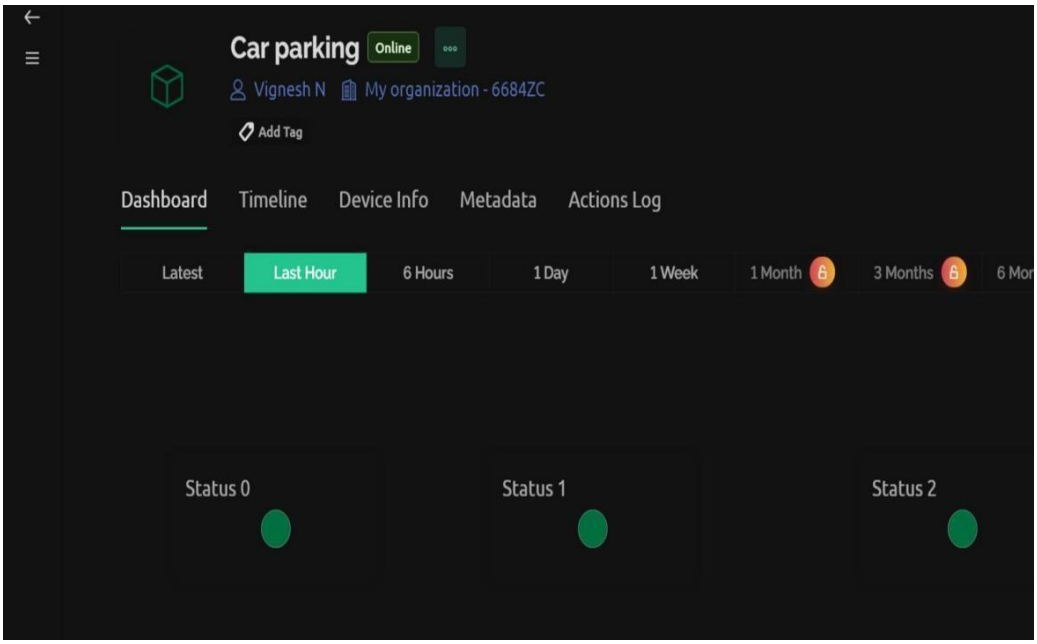

Figure 6.3 Parking slot status on Blynk Dashboard

The user can also view the status on the web version of Blynk (Figure 6.3)

Figure 6.4 Gate is Closed

The gate is closed (servo motor barrier is lowered) by default (Figure 10) to prevent unauthorized access to parking lot.

Figure 6.5 Gate is Open

Whenever an authorized user with RFID tag places their RFID card near the RFID scanner, the gate is opened (servo motor barrier is raised) (Figure 6.5). After a while the gate is closed (the servo motor barrier is lowered) (Figure 6.4).

Figure 6.6 RFID Tag kept near the scanner

The user can enter the parking lot after the barrier opens when they place the RFID card near the RFID scanner (Figure 6.6).

The user can park their vehicle in any of the empty parking spots (Figure 6.7). Once they park their vehicle in an empty parking slot, the IR sensor present at that parking slot will detect the presence of the vehicle and then send a signal to the ESP8266 which will then change the status of that parking slot from free to occupied.

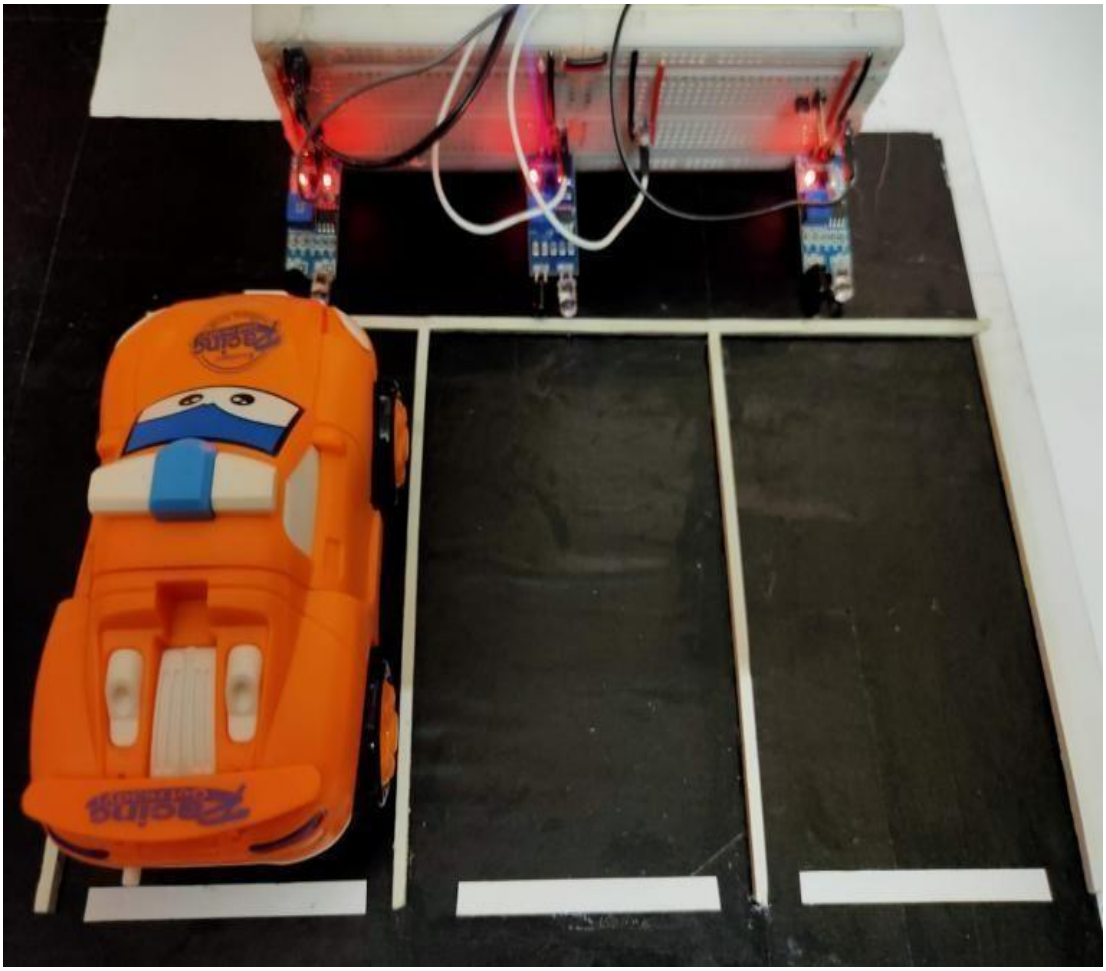

Figure 6.7 Parking Slot occupied

Figure 6.8 Occupied on LCD Display

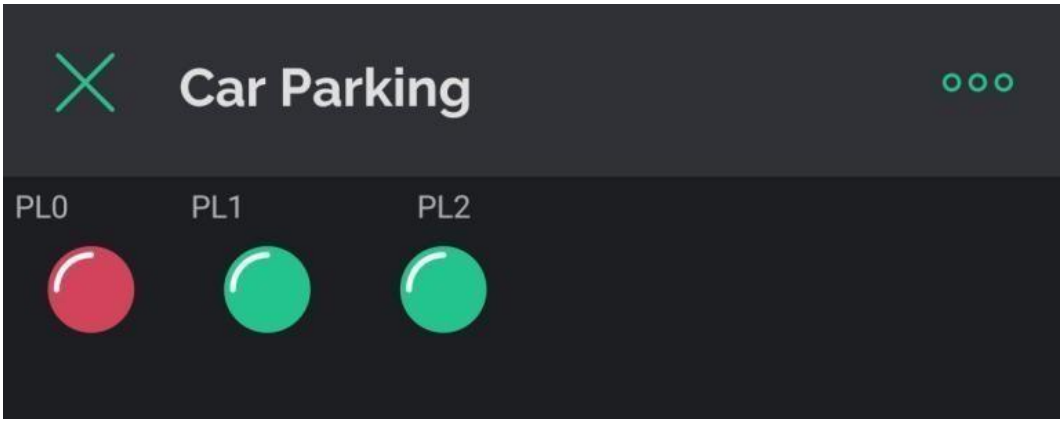

Figure 6.9 Occupied on Blynk Mobile App

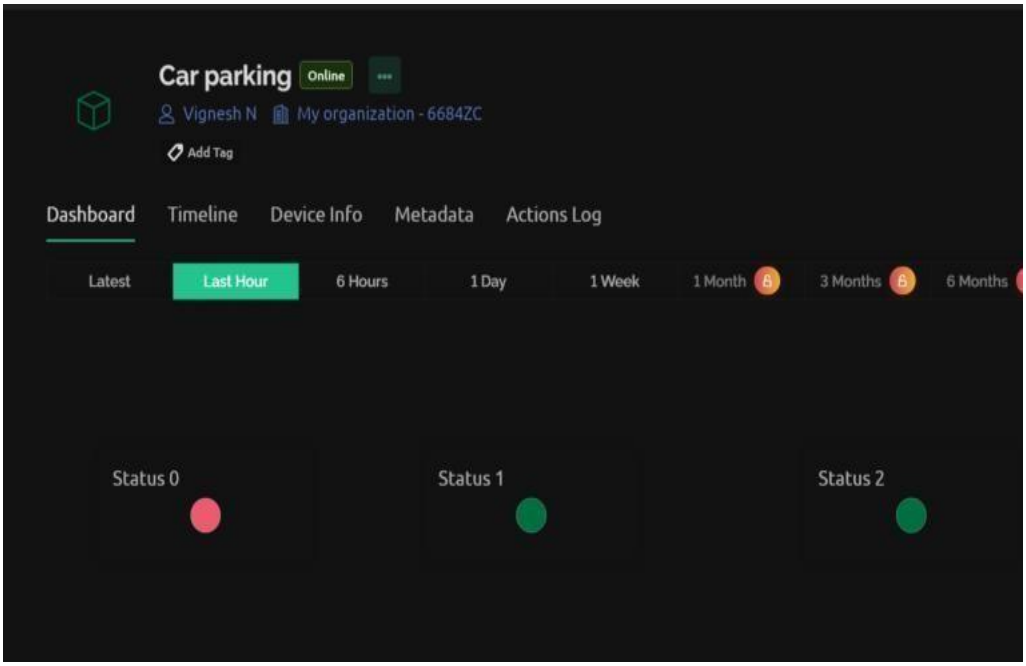

Figure 6.10 Occupied on Blynk Web Dashboard

This change is displayed on both the LCD display at the entrance (Figure 6.8) and the Blynk app on mobile phone (Figure 6.9) and the dashboard on the web (Figure 6.10).

Whenever the user wants to, the user can remove their vehicle from the parking slot and the IR sensor will detect the absence of the vehicle and send a signal to the ESP8266 which will in turn change the status of that parking slot from occupied to free on LCD and Blynk.

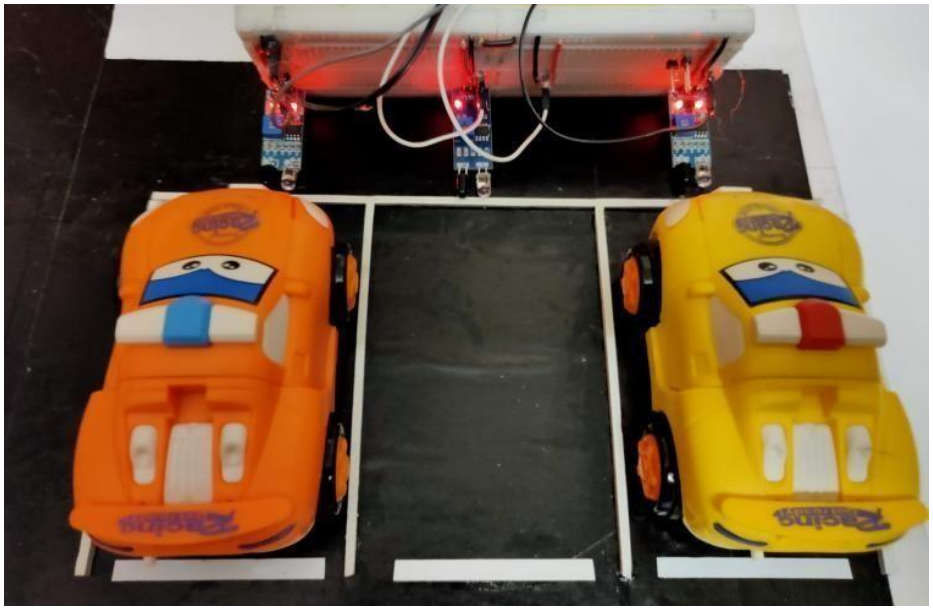

Figure 6.11 Multiple cars parked in parking slots

Whenever there are multiple cars parked in parking slots (Figure 6.11) , the correspond parking status is shown as occupied and the status of rest is shown as free (Figure 6.12).

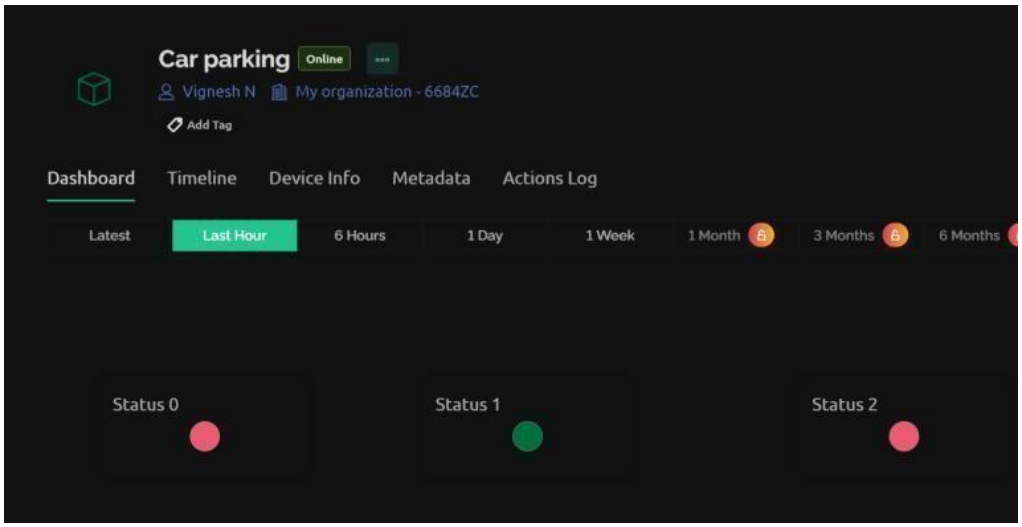

Figure 6.12 Multiple parking spots occupied on Blynk Web Dashboard

Figure 6.13 Parking Full on LCD Display

Whenever all the parking slots are full, the LCD Display shows that the parking is full (Figure 6.13).

7. Conclusion

In conclusion, the implementation of a smart parking system utilizing IoT with Blynk and RFID technology isn't just about making parking easier – it's about addressing several pressing issues in our urban environments. By bringing together sensors, mobile apps, and RFID tags, we're not only streamlining the parking process but also tackling problems like traffic congestion, air pollution, and security concerns.

Think about it: with this system in place, drivers spend less time circling around looking for parking spots, which means fewer cars idling on the roads, emitting harmful pollutants into the air. That's a win for the environment and for public health. Plus, by providing real-time information about parking availability and using RFID tags for secure access, we're making parking lots safer and more efficient spaces for everyone.

But it doesn't stop there. A smart parking system like this also has ripple effects throughout the city. By reducing congestion and emissions, it can help alleviate traffic jams and improve overall mobility for residents and visitors alike. And when people can park easily and safely, they're more likely to choose sustainable modes of transportation like public transit, walking, or biking, further reducing the carbon footprint of our cities.

Moreover, this technology has the potential to transform the way we think about urban planning and development. By collecting data on parking usage patterns and trends, city planners can make more informed decisions about where to build new parking facilities, how to allocate parking spaces more efficiently, and even how to incentivize alternative modes of transportation.

In short, the benefits of a smart parking system extend far beyond just finding a spot for your car. It's about creating cleaner, safer, and more livable cities for everyone. And as we continue to innovate and improve upon this technology, we're taking meaningful steps towards a more sustainable and equitable future.

8. Future Enhancements

A robust notification system should be integrated to alert users, either through the Blynk app or SMS, whenever a parking slot becomes available. Collaborating with popular navigation apps will enable the provision of real-time directions to these available parking slots, ensuring a seamless journey from the entrance to the designated spot. Additionally, adapting a reservation model will empower users to reserve parking slots in advance.

Additionally, incorporating real-time traffic data from external sources could enable the system to dynamically adjust parking rates based on demand and traffic conditions, encouraging optimal utilization of parking spaces and minimizing traffic congestion in surrounding areas. This could be especially beneficial for urban areas where parking demand fluctuates throughout the day.

To streamline transactions, a payment gateway should be integrated to automate parking fee transactions. This system can charge users based on the duration of their parking session, with payments processed conveniently through the Blynk app. Artificial Intelligence features such as number plate scanning can be added for enhanced functionality. Moreover, advanced security features like biometrics should be implemented to ensure the safety and security of the parking system.

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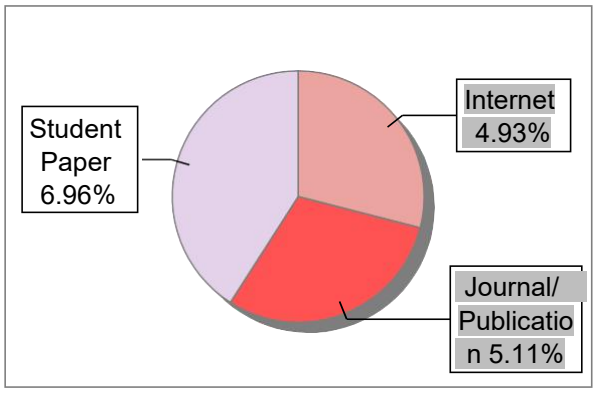

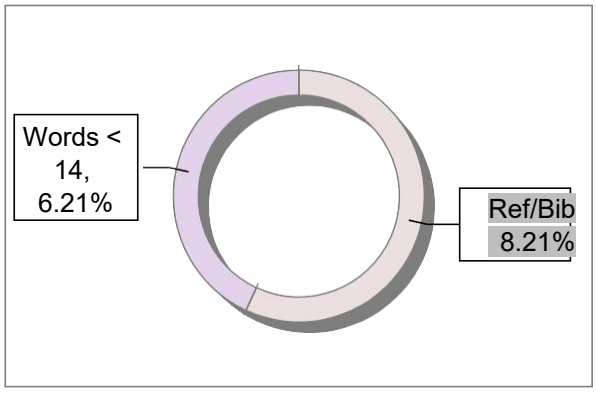

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Smart Parking System using IOT with Blynk and RFID

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Abstract- This project presents a Smart Parking System tailored to address the unique parking challenges of organizations and restricted-access entities. It integrates Infrared (IR) sensors, Radio-Frequency Identification (RFID) tags, and Cloud connectivity. IR sensors monitor parking space occupancy in real-time, while RFID tags serve as secure physical credentials for authorized personnel, enhancing access control. The system incorporates a Blynk app for authorized users to access real-time parking data, check availability, and helps users make informed decisions about parking. This app acts as a centralized hub for efficient parking management, improving the overall parking experience.

Architecturally, the system utilizes a centralized control unit controlling interactions between IR sensors, RFID authentication, and the Blynk cloud server. This approach allows only authorized users to access thee parking lot, resulting in a scalable and adaptable solution prioritizing exclusivity, efficiency, convenience, and security in parking management for specialized environments.

Keywords- Blynk App, IOT, RFID, Smart Parking Systems

1. INTRODUCTION

With urbanization on the rise, the challenge of efficient parking management has become more important than ever. Traditional parking setups often lead to congestion, wasted time, and increased environmental impact. Smart Parking Systems emerge as a solution to these challenges, offering real-time monitoring and streamlined access. This introduction explores the necessity for Smart Parking Systems and how the integration of Infrared (IR) sensors, Radio-Frequency Identification (RFID) tags **[1]**, and the Blynk mobile application **[2]** can revolutionize parking, providing a seamless and intelligent solution for modern urban environments.

Conventional parking infrastructure is plagued by inefficiencies, causing frustration for drivers and contributing to increased traffic congestion. Smart Parking Systems are crucial for transforming this landscape, offering real-time monitoring and secure access control. These systems not only alleviate the stress of parking but also contribute to a more sustainable and organized urban environment. Integrating Infrared (IR) sensors, Radio-Frequency Identification (RFID) tags, and the Blynk mobile application addresses the shortcomings of traditional parking systems. IR sensors provide real-time occupancy data, RFID tags ensure secure identification, and the Blynk app acts as an intuitive interface for users to check availability of parking slots and helps the users identify empty parking spots with real time data. Together, these components form a Smart Parking System that enhances user experience and improves parking management for a more connected and sustainable urban future.

2. RELATED WORKS

Smart Parking Systems are solutions designed to optimize the management of parking spaces,

providing more efficient, user-friendly, and sustainable urban parking experiences. These systems leverage various technologies, including sensors, communication networks, and mobile applications, to address the challenges associated with traditional parking methods. Smart Parking Systems have emerged as a solution to address the challenges associated with traditional parking management. Key findings from recent studies have been included in this survey, highlighting the benefits and advancements offered by smart parking technologies.

In the survey conducted, it was found that there have been many proposals for a smart parking system. IR Sensors have been extensively used for the detection of vehicles present in the parking slots. In Smart Parking Systems, Infrared (IR) sensors emerge as a highly effective solution due to their real-time occupancy detection, accuracy, and cost-effectiveness. These sensors are equipped with photocells tuned to detect infrared light and offer information about parking space availability, ensuring accurate and reliable data for users. A paper noted that IR sensors are notably used for remote control detection, IR sensors exhibit low power consumption, as evident in electronic devices such as TVs and DVD players **[3]**. Another paper noted their ease of integration, durability, and applicability to diverse parking configurations make them a practical choice for smart parking infrastructure, aligning with the key requirements of scalability and efficient parking management **[4]**.

As a result, IR sensors contribute significantly to optimizing parking space utilization and enhancing the overall user experience in smart parking environments. In a paper published in 2016 **[5]**, it was found that smart parking systems that utilize IR sensors are the most common and standardized method of utilizing smart parking systems.

RFID tags have also been used for Smart Parking Systems for the purpose of authentication. A paper delves into the Radio Frequency Identification (RFID) tags and its libraries **[6]**. The operation of RFID tags involves the tab, antenna, and coupler. The antenna creates a magnetic field around it. Whenever the tag enters the RF field, the antenna's RF signal activates the tag. The coupler sends a modulated signal. The tag demodulates the signal and then returns its data to the computer. The computer sends new data through the coupler to the tag. Different applications of RFID in various fields are discussed in this paper.

Another paper **[7]** provides a comprehensive examination of Radio-Frequency Identification (RFID) technology and its diverse applications. The paper begins by offering a detailed explanation of RFID technology, explaining its core principles,components.They discuss RFID's role in supply chain management, healthcare, retail, and transportation, emphasizing its capacity to enhance efficiency, accuracy, and traceability in diverse operational contexts. The authors draw attention to RFID's ability to revolutionize inventory management, streamline logistics, and improve patient care in the healthcare sector.

Blynk is a versatile and user-friendly Internet of Things (IoT) platform that allows individuals, developers, and businesses to build custom applications for controlling and monitoring connected devices. The Blynk app is a central component of this platform, providing a visual interface through which users can create customizable dashboards for their IoT projects. The app is available for both iOS and Android devices. With the Blynk app, users can design interactive and responsive graphical interfaces, known as Blynk apps or dashboards, by dragging and dropping widgets. These widgets include buttons, sliders, graphs, displays, and more, each corresponding to specific functionalities or data points in the connected devices. The app facilitates real-time communication with IoT hardware using a variety of connectivity options, including Wi-Fi, Ethernet, Bluetooth, and cellular networks.

A paper **[8]** dives into the use of Blynk framework for IOT systems. The primary focus of the paper is to crate an IOT based smart home using the Blynk framework. They use many sensors like HC -SR04 to detect the water level in the tank, and pump water whenever the water level is below a certain level, a PIR sensor that detects motion of humans, then opens the door automatically when it detects motion, a temperature sensor that detects the ambient temperature in each room and then turns on the fan whenever it detects that the temperature has gone above a certain temperature. All these readings and data has been integrated into the Blynk app. The dashboard shows the real time data and also offers the options to toggle the actuators for each actuator.

A paper from 2020 **[9]** proposes a system that utilizes IoT (Internet of Things) technology and IR (Infrared) sensors for managing car parking. The system aims to develop a Car Parking Management System that utilizes IoT technology to display the availability of parking slots. IR sensors are used in the system to detect the presence or absence of a car in a parking slot. The system utilizes an LCD screen to display the vacant parking slots in real-time. The implementation of the system using Arduino, IR sensors, and ESP8266 WiFi module with Blynk integration is discussed, highlighting its efficiency in managing car parking by providing real-time information about available parking slots.

3. IMPLEMENTATION

3.1 Hardware Components used-

- ESP8266
- IR Sensor (LM393)
- Servo motor (MG995)
- 16x2 LCD Display (LCD2004)
- RFID Scanner (EM-18)
- RFID Card
- Breadboard
- Connecting wires
- Power Source (Micro USB)
- Mobile phone with WI-Fi

3.2 Software components used-

- Arduino IDE
- Blynk app on Playstore or App store

3.3 SYSTEM ARCHITECTURE

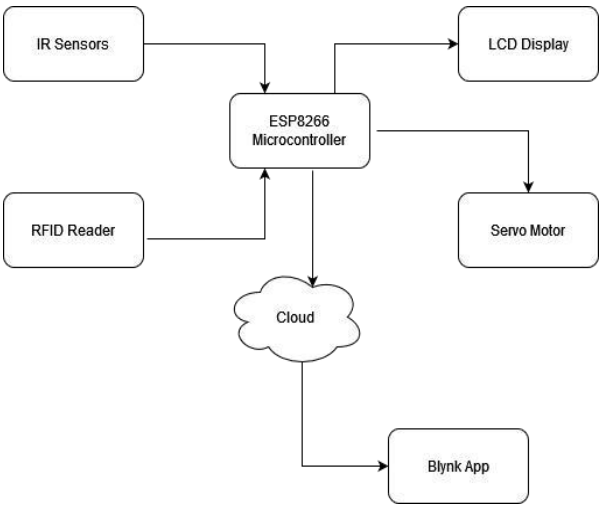

Figure 1 Block Diagram

Figure 1 shows the block diagram of the entire smart parking system, where the ESP8266 acts as the main control unit. The Infrared (IR) sensors, Radio-Frequency Identification (RFID) scanner, LCD display, and the servo motor are all linked to the ESP8266.The IR sensors provide real-time data on parking space occupancy. The RFID scanner acts as a security control measure allowing only the authorized users to access the parking lot. The servo motor acts as a physical barrier that denies entry to unauthorized personnel. The LCD display shows the real time parking data to the users. The Blynk app is cloud based IOT platform, it shows the real time parking data virtually through the mobile app or the website, the users can either view the parking status on the mobile app or the website version of the app.

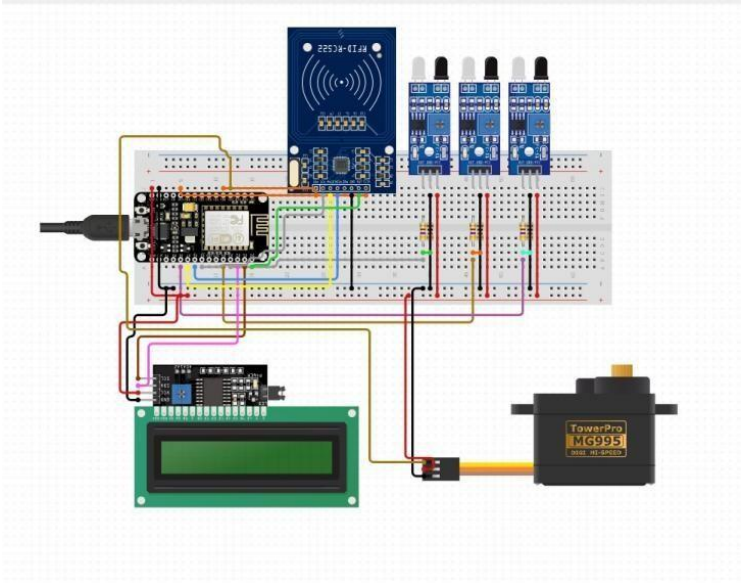

Figure 2 Circuit Diagram

Figure 2 shows the circuit diagram of the whole smart parking system. The Micro controller ESP8266 is mounted onto a breadboard. The LCD display, servo motor, RFID scanner are all connected to the same breadboard on different gpio pins as seen in figure 2. The pins next to the green line are the ground pins, the pins next to the red wires are the live pins. The IR sensors are mounted separately on another breadboard which is in turn connected to the breadboard which has the ESP8266 mounted on it. This is done for the purpose of extending the length of the connection and allowing the IR sensors to be mounted on the parking spots.

3.4 SETUP

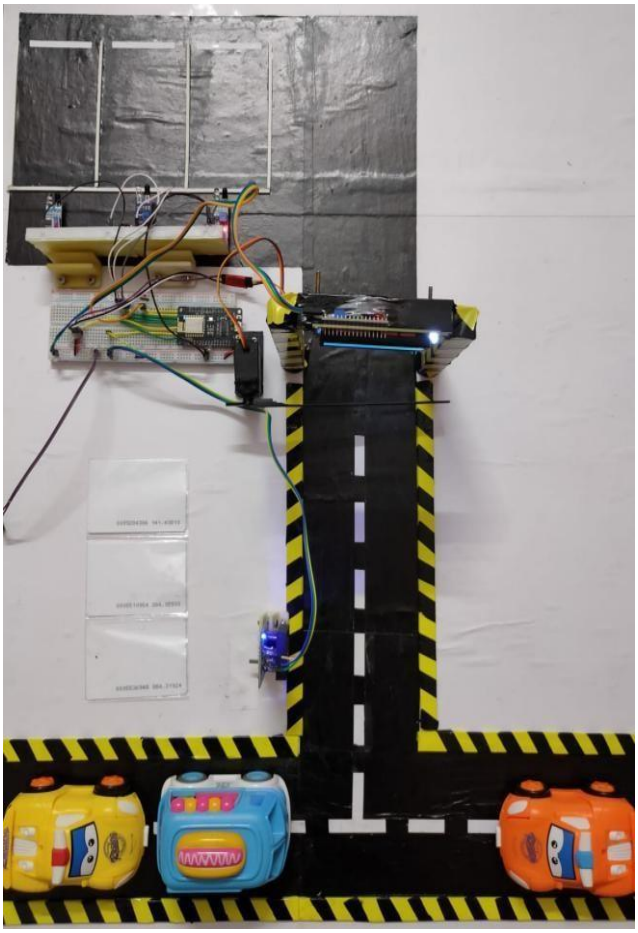

Figure 3 Overall Setup

Figure 3 shows the overall setup of the system. The breadboard containing the ESP8266 and all its connections is placed at 1 corner which is near the parking slot as well as the parking lot entrance.

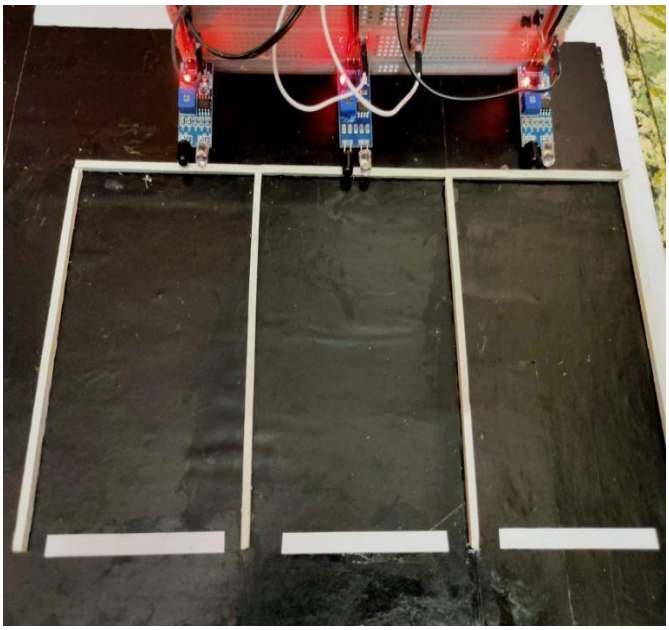

Figure 4 Parking Slot with IR Sensors

The Breadboard containing the IR sensors is placed near the parking slots as seen in Figure 4.

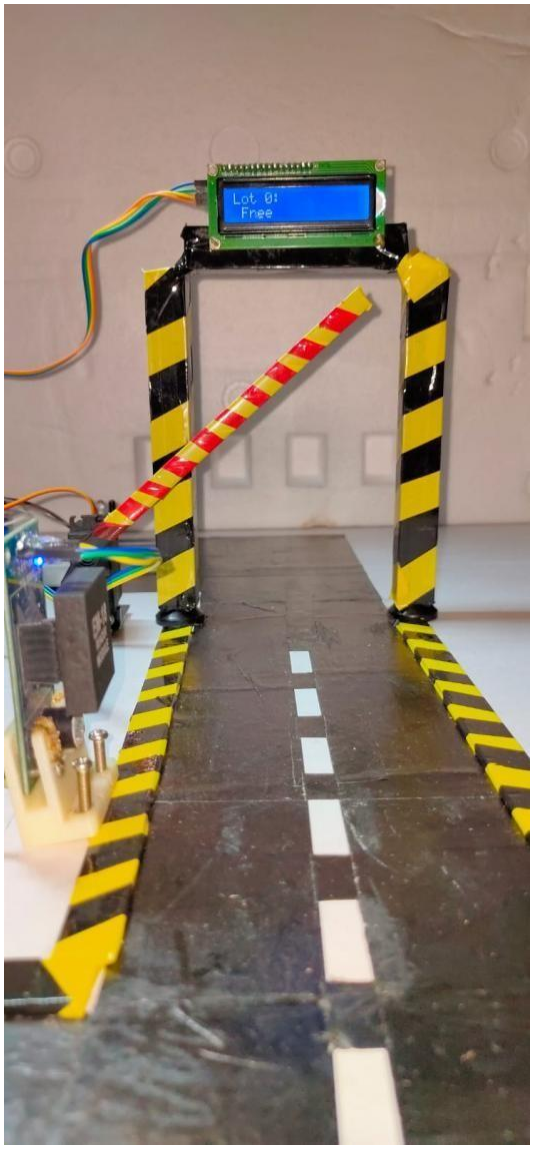

Figure 5 RFID scanner, LCD Display, Servo Motor at the gate

The RFID scanner, servo motor, LCD display are kept near the entrance of the parking lot as seen in Figure 5. The LCD display is mounted on an elevation for ease of visibility for users, the users can check the display to see if there are empty parking slots.The LCD display cycles through each parking slot. A bigger LCD display can be added to show all parking slots concurrently. The servo motor is placed right in front of the entrance to the parking lot. This acts as a gate which allows only authorized users to enter the parking lot. The RFID scanner is mounted vertically at the entrance so that it is easier for users to place the RFID card and the gate opens while the user can remain in their vehicle.

3.5 WORKING

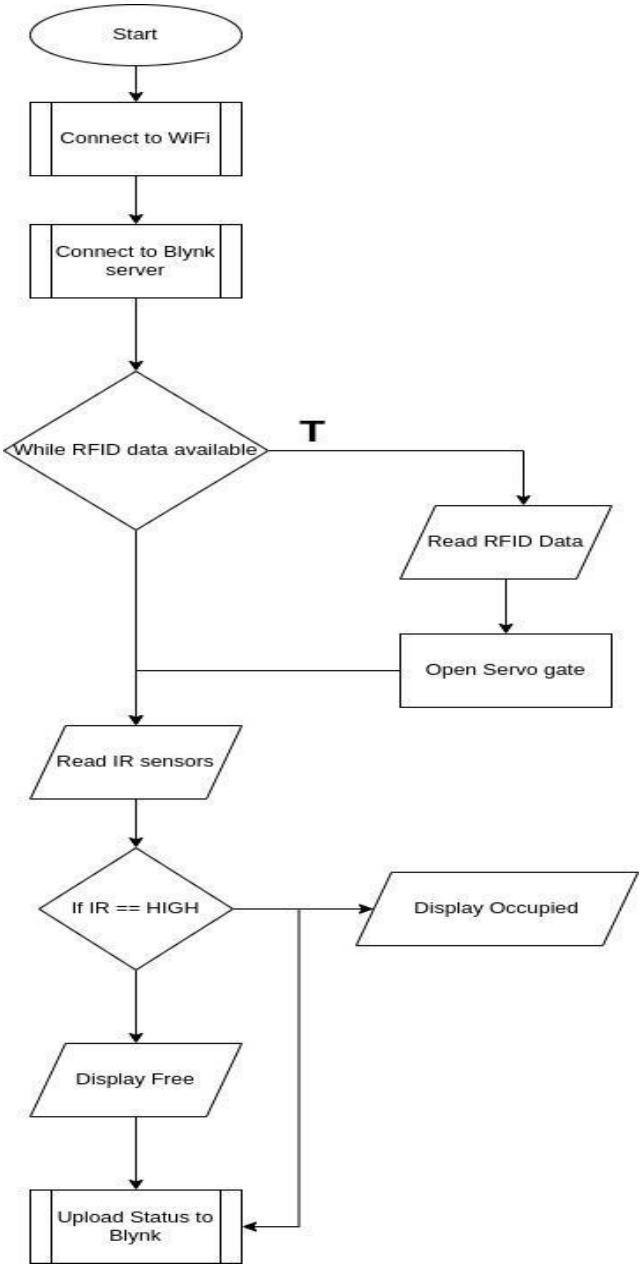

Figure 6 Flowchart

As seen in Figure 6,Once the system is turned on, the system first connects to a WIFI signal for internet. After connecting to the internet, the system is now online. The system then connects to the Blynk cloud server. The RFID scanner is always online as the RFID field is always active.

Whenever an RFID card is placed near the RFID scanner, the signal is sent to the ES8266. The ESP8266 then sends another signal to the servo motor. The servo motor then raises the barrier allowing the user to enter the parking lot. After a while the servo lowers the barrier. Whenever the IR sensors detect the presence of a vehicle, the status of that parking slot is changed from free to occupied. Whenever the IR sensor detects the absence of a vehicle, the status of that parking slot is changed from occupied to free.

4. RESULTS

Figure 7 Slot Status on LCD Display

Whenever an authorized user approaches the entrance of the parking lot, they can view the status of each parking slot in the LCD display that is mounted at the top (Figure 7).

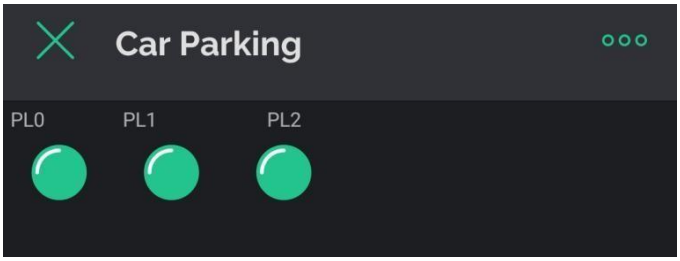

Figure 8 Slot status on Blynk Mobile App

The user can also view the status of parking slots on the Blynk app on their mobile phone (Figure 8).

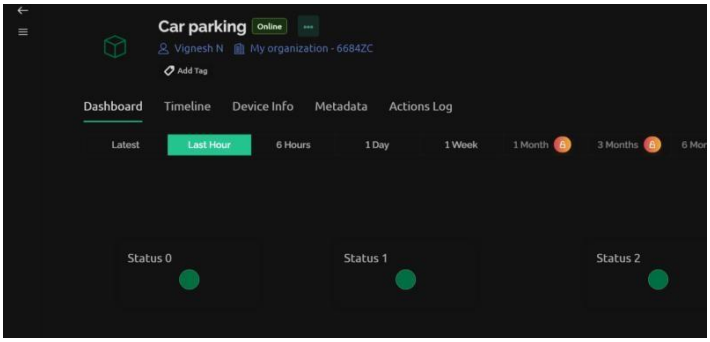

Figure 9 Parking slot status on Blynk Dashboard

The user can also view the status on the web version of Blynk (Figure 9)

Figure 10 Gate is Closed

The gate is closed (servo motor barrier is lowered) by default (Figure 10) to prevent unauthorized access to parking lot.

Figure 11 Gate is Open

Whenever an authorized user with RFID tag places their RFID card near the RFID scanner, the gate is opened (servo motor barrier is raised) (Figure 11). After a while the gate is closed (the servo motor barrier is lowered) (Figure 10).

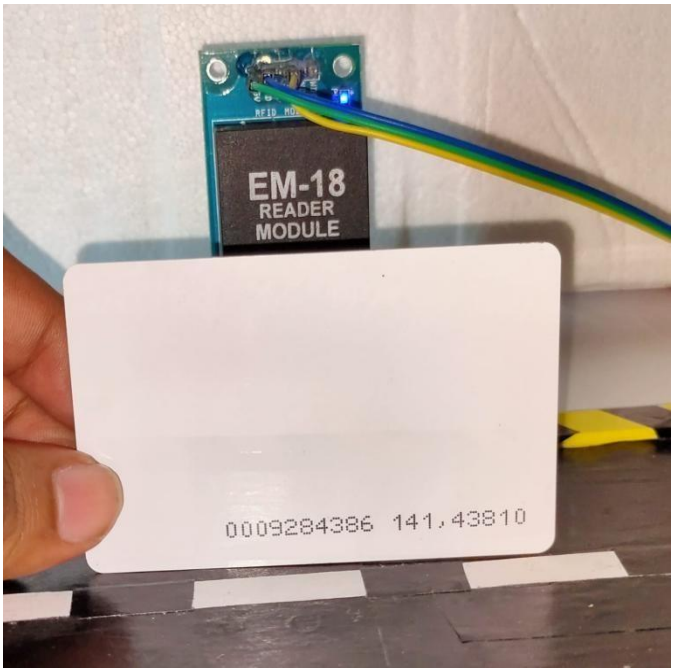

Figure 12 RFID Tag kept near the scanner

The user can enter the parking lot after the barrier opens when they place the RFID card near the RFID scanner (Figure 12).

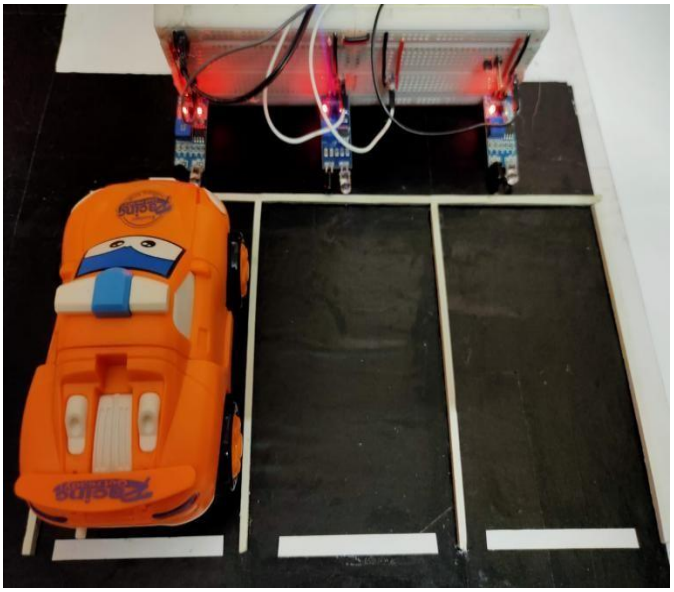

Figure 13 Parking Slot occupied

The user can park their vehicle in any of the empty parking spots (Figure 13). Once they park their vehicle in an empty parking slot, the IR sensor present at that parking slot will detect the presence of the vehicle and then send a signal to the ESP8266 which will then change the status of that parking slot from free to occupied.

Figure 14 Occupied on LCD Display

This change is displayed on both the LCD display at the entrance (Figure 14) and the Blynk app on mobile phone (Figure 15) and the dashboard on the web (Figure 16).

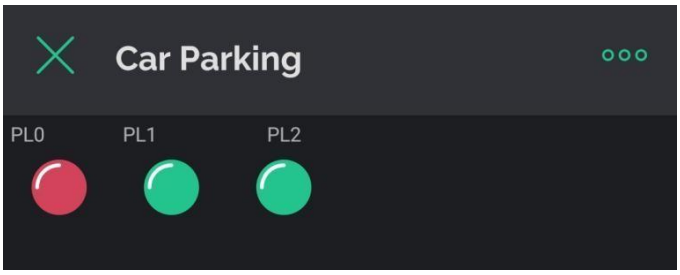

Figure 15 Occupied on Blynk Mobile App

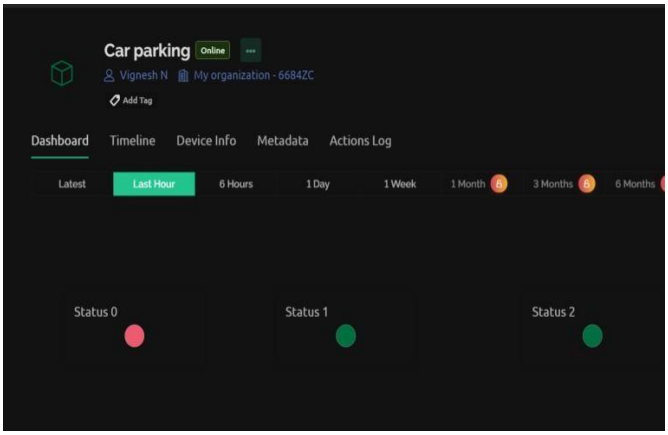

Figure 16 Occupied on Blynk Web Dashboard

Whenever the user wants to, the user can remove their vehicle from the parking slot and the IR sensor will detect the absence of the vehicle and send a signal to the ESP8266 which will in turn change the status of that parking slot from occupied to free on LCD and Blynk.

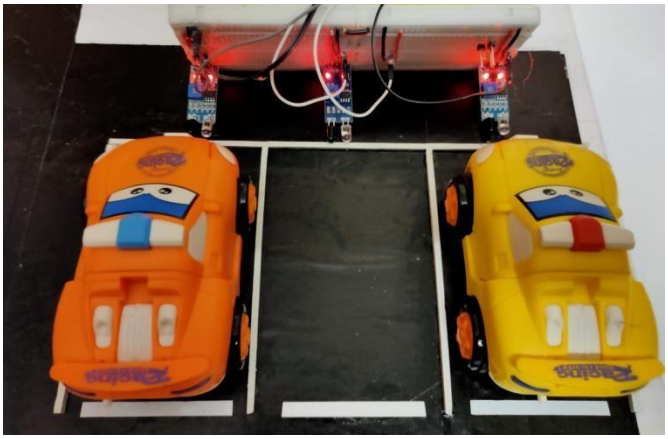

Figure 17 Multiple cars parked in parking slots

Whenever there are multiple cars parked in parking slots (Figure 17) , the correspond parking status is shown as occupied and the status of rest is shown as free (Figure 18).

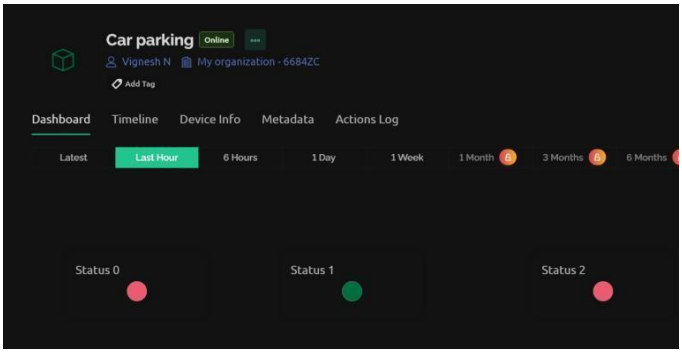

Figure 18 Multiple parking spots occupied on Blynk Web Dashboard

Whenever all the parking slots are full, the LCD Display shows that the parking is full (Figure 19).

Figure 19 Parking Full on LCD Display

5. CONCLUSION

In conclusion, the smart parking system achieves its goal of combining IOT, Smart Parking, RFID technology and Blynk to create an intelligent, safe, secure parking system for private organizations, private societies, and similar restricted-access entities. The system is secure as RFID scanners and tags allow only authorized personnel to access the parking lot. The system is Intelligent as it can detect the status of each parking slot. The system is safe as there are no security risks associated with it. The Smart parking system prioritizes user convenience, access time and real time status to provide a clever solution to the parking problem faced by private organizations, private societies, and similar restricted-access entities.

6. FUTURE ENHANCEMENTS

A robust notification system should be integrated to alert users, either through the Blynk app or SMS, whenever a parking slot becomes available. Collaborating with popular navigation apps will enable the provision of real-time directions to these available parking slots, ensuring a seamless journey from the entrance to the designated spot. Additionally, adapting a reservation model will empower users to reserve parking slots in advance.

To streamline transactions, a payment gateway should be integrated to automate parking fee transactions. This system can charge users based on the duration of their parking session, with payments processed conveniently through the Blynk app. Artificial Intelligence features such as number plate scanning can be added for enhanced functionality. Moreover, advanced security features like biometrics should be implemented to ensure the safety and security of the parking system.

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