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# IoT based Smart Car Parking System using RFID ina Community

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***Abstract*— With the growth of technology in the current decade, we are confronting a parking challenge. Because large towns have a dense population, there are many vehicles on the road, which causes parking and traffic problems. The globe is confronted with a new challenge that is vehicle parking. It is estimated that one million automobiles use oil on a daily basis. This paper proposes an RFID based car parking system in a community. This system was created with the assistance of the internet of things (IOTs). IoT mainly involves the exchange of information or data between two physical devices. In the suggested system, an Arduino Uno microcontroller, ESP32, RFID sensors and IR sensors are used. The value of automation is growing every day. The primary function of Arduino in the proposed system is to serve as a platform for communicating digital devices and interactive objects capable of sensing and controlling physical components. The proposed system was built using an Arduino Uno board for vehicle parking and a ESP32 to connect the parking area to the web. In order to obtain information regarding the vacancy position of the parking slot, the suggested system included an infrared sensor in each slot. Therefore, to determine whether or not a person is in the database for the car parking system, RFID sensors are used. If the driver is listed in the database, the car will be allowed to enter the parking lot and the gate will open when the motors rotate in a clockwise direction. When the gate closes, the door will rotate in an anticlockwise direction and shows the user via led. From this proposed system, we get the information about the vacancy position of parking spot and notify the user through website.***

***Keywords—IOT, RFID, IR Sensors, ESP32, Arduino***

## I. INTRODUCTION

The expanding urban population has resulted in an increase in the number of automobiles on the road, causing congestion and making parking difficult. Traditional parking systems are inefficient, resulting in long wait times and traffic congestion, as well as posing a security risk. To address these issues, the Internet of Things (IoT) has presented a new and novel solution that uses RFID technology to create a smart car parking system. The Internet of Things (IOTs) is an important technology that plays an important role in people's daily lives. Humans may now produce effective results with little effort because to this technology. It minimizes the number of human-made errors caused by neglect. Smartphones are becoming an unavoidable part of everyday life as technology improves. The proposed parking system successfully manages the parking space while also managing car collisions. The parking lot was very neatly arranged thanks to IoT-based smart parking.

## II. LITERATURE REVIEW

[1] This project aims to create a reserve-based parking system to secure the parking places for the disabled. It uses IoT and mobile applications to distinguish between healthy people and people with disabilities, and an alarm system to warn non-disabled vehicles who attempt to park in disabled slots. It is envisioned for outdoor parking as it is simpler to deploy and maintain the process of receiving real-time data on parking spaces via mobile devices.

[2] This study proposes a parking spot allocation and management system that is IOT enabled and overcomes the parking system's flaw. It uses an ultrasonic sensor, an Arduino Uno, and a cloud server to exchange data between mobile and sensor circuitry. Advantages include optimizing parking space, free flow of traffic, ecofriendly system, and real-time prediction of parking spaces. Limitations include lack of billing system and few safety measures.

[3] This paper proposes a smart car parking system based on IoT, image processing and an iOS mobile application. It uses LEDs to detect the availability of parking spaces and alert drivers with the availability status. A comparative studyfound that the proposed system outperformed the typical parking space system in terms of usability and efficiency in finding a parking spot.

[4] The proposed system consists of three modules: one at the entrance counter, one at the parking lot, and one connected to the client online. An RFID scanner is used at the entrance to scan and validate the RFID tag of the reserved car. The information of the users is stored in the database and the cards allocated to them. A Cloud-Based website was created to register, log-in, and choose the location where they would like to park their vehicle.

[5] This paper proposed an intelligent parking system that employs an electronic device to detect the status of parking space availability and assists drivers in finding and selecting

the desired parking space. It uses a NodeMCU, RFID module, servomotor, LCD display, I2c module, and 12volt adaptor. The primary goal was to create a smart parking system that allows payment and operation online using Firebase. Different cards are supplied to different users, and admins can alter user information and pricing/cost from the database.

[6] This paper proposed a Smart parking system that uses an LCD with an I2C module, an RFID card and reader, a servo motor, and IR sensors, as well as an ESP32 Node MCU. The system displays the number of slots available, a counter is started, and the parking fee is computed based on how long the vehicle was parked. IR sensors are employed to gather data and identify whether a car is parked in a slot.

[7] This paper proposes an automated real-time system for autonomous vehicle parking, using an Arduino Uno microcontroller and a Node MCU to connect the parking area to the web or internet. An infrared sensor is used to obtain information regarding the vacancy position of the parking slot. The user reserves a parking space in advance and the server sends a message to the phone about the number of free slots available.

[8] This paper provides a cloud-based solution with IoT to identify free parking places in urban regions. It employs GPS and various sensors to identify automobiles and send data to a server. At the exit, users gain admission through RFID Card and Token, while vehicle users scan their QR Code and payment is automatically deducted.

[9] This proposed system uses RFID technology to monitor entry and exit of parking lots. The NodeMCU board distinguishes between permitted and illegitimate cars, providing a reliable means of giving or rejecting access. Registered ID tags are saved in the board and database, and if the IDs match, the barrier will automatically open without the need for buttons or remote controls.

[10] This study presents a smart parking system to reduce fuel loss, user time and efficiency, and the overall cost of petrol consumed when looking for a parking space. The data from the sensor is collected, analyzed, and processed to produce the output. The Arduino device extracts the necessary information and delivers it to the servo motor, which gives instructions and notifications. The cloud web services are updated based on parking space availability, and the user can interact with both the cloud and the parking lot.

[11] This project combines RFID technology, IoT and a website to create an SPS with IoT. The system offers real-time information on the availability of parking spaces in a parking area and a mobile application allows users in remote areas to reserve a parking space. It contributes to resolving traffic congestion.

[12] This paper proposes a smart automobile parking mobile application based on RFID and IoT, enhanced by microcontrollers, Arduino ESP8266, and Sensor Ultrasonic Module HY-SRF05 Distance. The sensor detects the condition of each parking place and determines whether or not a vehicle is there. The system updates the state in the database and when a user enters the area, the sensor identifies the vehicle and sends the data to the microcontroller, which then stores the data in the database and displays the status on the mobile application and Line application.

[13] This project aims to provide customers with a user-friendly online platform to book the nearest parking spots for their vehicles before arrival. The app requires first-time users to collect RFID tags and relies on constant internet connectivity to function. If the RFID tag is stolen, the system should scan the number plate of the car through a camera for confirmation.

[14] This paper uses RFID tags mainly for tracking systems, monitoring systems, and parking systems. When a vehicle arrives, an RFID entry sensor reads the information, and an Ultrasonic sensor detects an empty slot. The entry time is recorded, and the parking fee is deducted from the linked account. Advance booking of parking lot can be done through App or web services.

[15] This paper focuses on reducing human interference in allocating parking slots, providing information about empty slots, restricting entry of vehicles when the parking area is full, and regulating the entry of vehicles entering the parking garage systematically. The system requires low maintenance cost and requires high end microprocessors with safety wall to collect parking charges.

[16] Smart Parking System uses RFID reader to sense authorized vehicles and allocate available parking slots. Controller is Arduino Uno and other sensors are RFID module, IR sensors, servo motor, and LCD. Block diagram and algorithms are easy to understand and installation cost is minimal. No database is maintained, but can be useful for studying various aspects.

## III. PROPOSED SYSTEM

This paper proposes an IoT-based Smart Vehicle Parking System for an apartment complex that uses RFID technology. The system makes use of RFID tags embedded in cars as well as RFID readers located at the parking lot's entry and exit. Each vehicle that requires the smart parking system will be outfitted with an RFID tag. This tag will include unique identification information about the vehicle and will be used to identify the vehicle when it enters and exits the parking lot, and an RFID reader will be put at the parking lot's entry and exit. This reader will read the RFID tag's information and communicate it to the central system. The central system will subsequently be in charge of administering the parking lot. It will utilize the information from the RFID reader to assess whether the automobile is permitted to park in the lot. If the vehicle is allowed, the central system will route it to an available parking slot. The authenticity of the RFID tag is determined using two different color LEDs and a buzzer.

Each parking space will include a parking sensor. This sensor will identify whether the space is used or vacant and will broadcast this information to the central system. A website will be created for community members to access. This

allows customers to check the availability of parking spots in advance and receive real-time updates.

The proposed system includes a feature that enables user to log-in using their credentials. This allows them to be aware of the number of vacant slots and gives the user a more detailed view of the parking slot vacancy.

The suggested system not only removes the need for manual ticketing, but it also ensures effective parking space use, decreases congestion, and improves parking lot security. This paper describes the suggested system's design, development, and implementation, as well as its performance and efficacy in managing parking in an apartment complex. The results show that the system delivers a dependable, cost-effective, and long-term solution that has the potential to alter the way we park our automobiles in residences.

**Flowchart:**

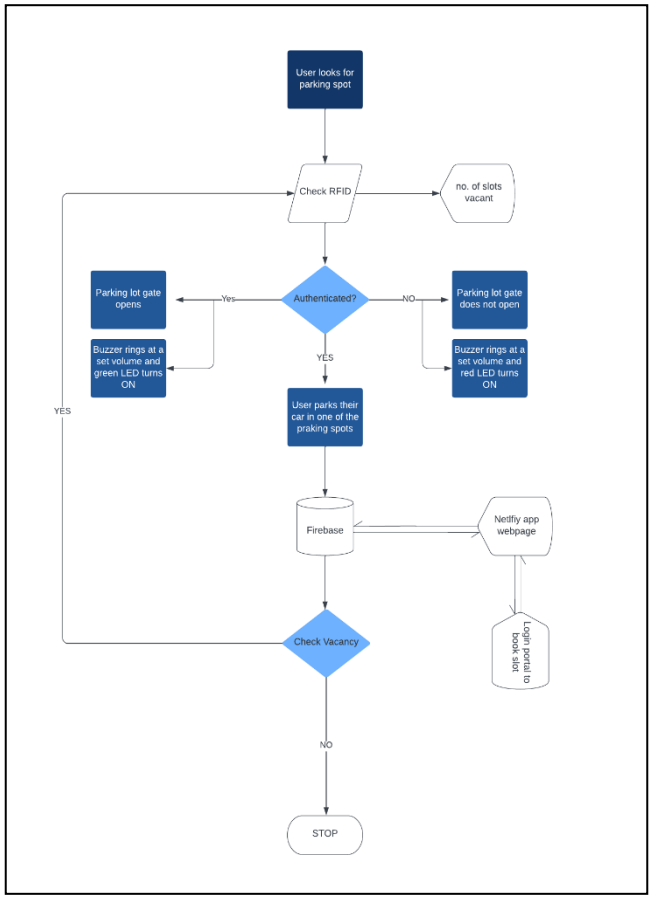


**Figure 1**

## IV. COMPONENTS USED

**IR sensor:**

An infrared sensor is an electronic device that is used to detect the present of an object. An IR sensor can monitor an object's heat while also spotting movement. These kinds of sensors are referred to as passive IR sensors since they do not emitinfrared radiation; instead, they merely measure it.The section of the electromagnetic spectrum with wavelengths longer than those of visible light is known as infrared radiation. The infrared spectrum spans from 0.75 to 1000 μm.

**Arduino UNO:**

A microcontroller board called Arduino UNO is based on the ATmega328P. It contains 6 analogue inputs, a 16 MHz ceramic resonator, 14 digital input/output pins (six of which can be used as PWM outputs), a USB port, a power jack, an ICSP header, and a reset button. Everything required to support the microcontroller is included in it.

**ESP32:**

The ESP32 microcontroller is a low-cost, low-power system-on-a-chip (SoC) designed for Internet of Things (IoT) applications. It comes with a dual-core processor, 520KB SRAM, 4MB Flash memory, Wi-Fi, Bluetooth, and a variety of peripheral connectors. The Arduino IDE, MicroPython, and FreeRTOS are among the operating systems and programming languages supported by the ESP32.Because of its low cost, low power consumption, and rich functionalities, ESP32 is extensively utilised in different IoT applications including as smart homes, industrial automation, wearable devices, and more

**RFID RC522:**

RFID RC522 is a popular RFID reader module that uses the RC522 chip. It is commonly used in Arduino and other microcontroller projects for reading and writing data to RFID tags. The 13.56 MHz frequency is used by the RC522 chip to connect with RFID tags, and it supports both Type A and Type B ISO/IEC 14443 protocols. Depending on the type of tag and the antenna being used, it can read and write data to RFID tags up to 10 centimeters away.
An RFID tag is a tiny electronic device that uses RFID technology to identify and track items. It is attached to or inserted in an object and typically consists of a microchip and an antenna. An RFID reader or scanner may read the microchip's unique identification number or other information.

**Servo motor MG90S:**

Popular tiny servo motors like the MG90S are utilized in remote-control toys, robotics, and DIY projects. It is a tiny, light motor that can provide up to 2.2 kg-cm of torque and weighs just 13.4 grammes. It can rotate up to 180 degrees and runs on a power range of 4.8V to 6.0V.

## V. EXPERIMENTAL SETUP

The experimental setup is comprised of two components divided into hardware and software respectively. The ARDUINO board, RFID sensor, IR sensors, and servo motor constitute the hardware components of the proposed project.

These are responsible for sensing, collecting and transmitting data either to another hardware component or to the software components (NETLIFY app). The NETLIFY app, Wi-Fi module (ESP 32) and the ARDUINO IDE are constituents of the software aspect of the proposed system. These are used to acknowledge the existence of free parking spaces, which

allows users to confirm the availability of parking spaces from a distance.

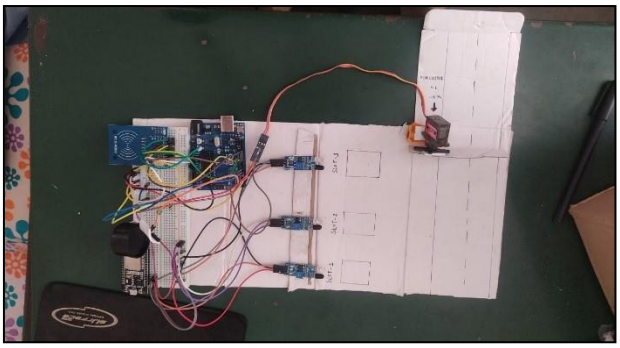

**Figure 2**

The IR sensors are connected to GPIO pins 15,2 and 4 of the ESP 32 module respectively. The information obtained from these IR sensors is transmitted to the firebase server, from where the information is displayed onto netlify webpage. A login portal is created to access parking slot information as well as to book the slots.

The RFID and LED connections are made to the Arduin UNO board. The RST and SS pins of the RC522 module are connected to digital pins 9 and 10 respectively. The Green LED is connected to digital pin 4 and the Red LED to pin 5 of the Arduino UNO board. The buzzer is connected to digital pin 2 of the Arduino board, and is set to ring at different frequencies for different RFID cards. The servo motor is connected to digital pin 3 of the Arduino board and its initial start position is initialized to 0, which turns to 180 degrees for every successful RFID scan.

## VI. RESULTS

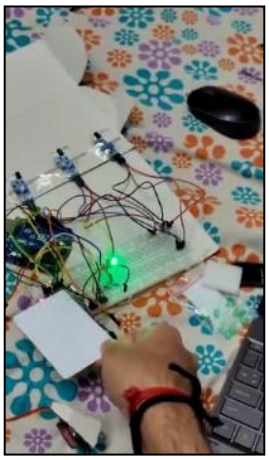

**Figure3**. Green LED glows and gate opens when unidentified tag is scanned

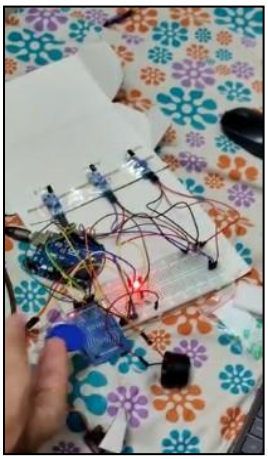

**Figure 4.** Red LED glows and gate does not open when unidentified tag is scanned

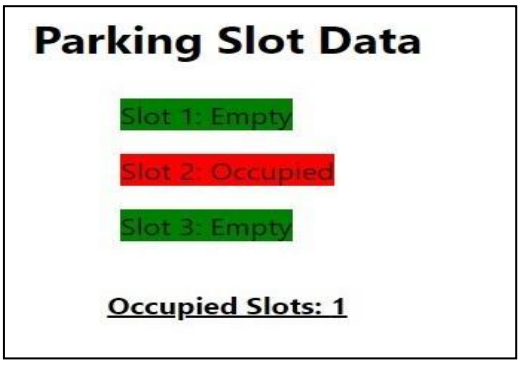


**Figure 5.** Data about parking slots as displayed on the webpage

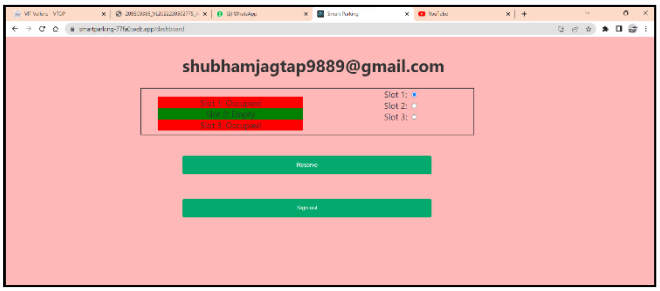


**Figure 6**. Booking SLOT 2 on the login portal

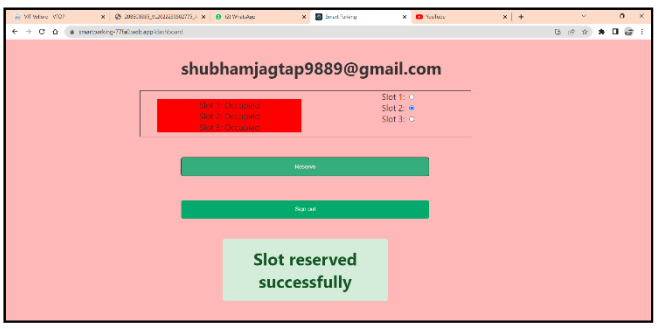


**Figure 7.** SLOT 2 shows its reserved after the booking

## VII. CONCLUSION

In conclusion, an IoT-based smart auto parking system with RFID in a community provides an efficient and convenient solution to parking issues. The system can reliably detect the presence of vehicles and update the availability of parking spaces in real-time using RFID technology, allowing users to see the available parking slots in advance. To avoid misuse or illegal access, the system also includes additional security features such as user authentication and monitoring.

In terms of future scope, the system can be enhanced further by incorporating new functions such as payment processing and automatic parking fee calculation. The technology can also be linked to other smart city efforts to form a more comprehensive and interconnected smart city infrastructure. Furthermore, the system can be expanded to serve larger towns or even entire cities. Overall, the IoT-based smart auto parking system with RFID offers enormous promise for tackling urban parking difficulties and contributing to the development of smart cities.

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## IX. APPENDIX

| TOPIC | CONTENTS |
|---|---|
| INTRODUCTION | Proposal of a SMART RFID based parking system |
| LITERATURE REVIEW | I. Internet of Things (IoT) use: The majority of articles suggest using IoT technology in parking systems. IoT offers real-time monitoring, data collecting, and analysis by allowing the devices and sensors to connect with one another and with a central server or cloud.<br>II. Integration of sensors: A lot of the papers use a variety of sensors, including RFID, ultrasonic, IR, and GPS, to track the movement of cars, find permitted entry points, and find out whether parking spots are available.<br>III. Mobile apps: A number of publications suggest using mobile applications to let drivers find and reserve parking spots, get up-to-the-minute updates on parking availability, and submit payments.<br>IV. The majority of papers recommend adopting Internet of Things (IoT) technology in parking systems. IoT enables the connectivity of the devices and sensors with one another, with a central server or cloud, and with each other to provide real-time monitoring, data collection, and analysis.<br>V. Integration of sensors: Many studies watch the movement of automobiles, locate authorized entrance points, and determine the availability of parking spaces using a range of sensors, including RFID, ultrasonic, infrared, and GPS.<br>VI. Mobile applications: According to a number of publications, drivers may identify and reserve parking spaces using mobile applications, as well as receive real-time information on parking availability and make payments. |
| PROPOSED SYSTEM | I. The proposed system functions as follows:<br>II. When a car approaches the parking lot, the RFID sensor scans the car to determine if the driver is listed in the database.<br>III. If the driver is listed in the database, the gate will open when the motors rotate in a clockwise direction.<br>IV. Once the car has entered the parking lot, the IR sensor will detect if the parking slot is vacant or occupied.<br>V. If the slot is vacant, the driver will be directed to park the car in the available slot.<br>VI. If the slot is occupied, the driver will be notified and directed to another available slot.<br>VII. Once the car is parked, the gate will close, and the door will rotate in an anticlockwise direction, indicating that the slot is occupied.<br>VIII. The system will update the website with the vacancy position of the parking slot, allowing users to easily find available parking spots. |
| COMPONENTS USED | I. IR SENSOR<br>II. SERVO MOTOR<br>III. ESP 32<br>IV. ARDUINO UNO<br>V. RFID TAG AND READER |
| EXPERIMENTAL SETUP | The experimental setup is composed of two components: hardware and software. The hardware components are the ARDUINO board, RFID sensor, IR sensors, and servo motor, while the software components are the NETLIFY app, Wi-Fi module (ESP 32), and the ARDUINO IDE. The IR sensors are connected to GPIO pins 15,2 and 4 of the ESP 32 module, while the RFID and LED connections are made to the Arduino UNO board. The buzzer is connected to digital pin 2 and the servo motor is connected to digital pin 3. |
| RESULTS | I. Figure3<br>II. Figure4<br>III. Figure5<br>IV. Figure6<br>V. Figure7 |
| CONCLUSION | The IoT-based smart auto parking system with RFID offers an efficient and convenient solution to parking issues, allowing users to see available parking slots in advance. It can be enhanced further with new functions and linked to other smart city efforts. |