



IoT Based Smart Vehicle Parking System Using RFID

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ABSTRACT

The "IoT-Based Smart Vehicle Parking System Using RFID" project introduces an intelligent and efficient solution for modernizing vehicle parking management. Leveraging the Internet of Things (IoT) and Radio-Frequency Identification (RFID) technologies, this system optimizes the parking process, enhances user experience, and provides real-time monitoring and control. The project aims to address the challenges of urban parking by improving accessibility, reducing congestion, and streamlining the parking experience.

The Internet of things (IOTs) is a vital technology, it is playing a crucial role in the day-to-day life of human beings. With the help of this technology, now day's humans are getting effective output with very little effort. It reduces the man-made errors made by humans due to negligence. As technology advances, smartphones are an inevitability for every human being. The proposed parking system effectively manages the parking space and it will manage collision among the vehicles at the same time.

Keywords: NodeMCUESP8266, RFID Sensor, IR sensors, LCD, Servo motors.

1. INTRODUCTION

Nowadays in many public places such as malls, multiplex systems, hospitals, offices, market areas there is a crucial problem of car parking. The car-parking area has many lanes/slots for car parking. So to park a car one has to look for all the lanes. Moreover, this involves a lot of manual labor and investment. So, there is a need to develop an automated parking system that indicates directly the availability of vacant parking slots in any lane right at the entrance. It involves a system including infrared transmitter- receiver pair in each lane and a display outside the car parking gate.

So the person desirous to park his vehicle is well informed about the A lot of time is wasted in searching vacant slot for parking and many a times it creates jams. Conditions become worse when there are multiple parking lanes and each lane with multiple parking slots. The use of parking management system would reduce the human efforts and time with additional comfort. In the proposed system, the display unit displays a visual representation of the parking and it shows the empty and occupied slots which help the user to decide where to park their car. The system would not only save time but the software and hardware would also manage the Check-in and checkouts of the cars under the control of

RFID readers/ tags with additional features of automatic billing, Entry exit data logging.

The users go through a onetime registration process where there are asked to fill in their personal details and an account is created for them, this account has information about them and also has money in it which they can recharge at kiosks present in the vicinity. In this system, the users are guided to the vacant slot for parking using Video Displays at the entrance of the parking floor, these displays show a visual representation of the parking lot with empty and occupied slots which are green and red respectively. The user is provided with a tag which he receives on registration, this tag is linked with his prepaid account and includes his personal information, and this tag uses Radio Frequency identification (RFID) technology and is placed on the top of the user's windshield. The parking charges are automatically deducted from the user's account based on the time spent inside the parking area.

Now days in many public places such as malls, multiplex systems, hospitals, offices, market areas there is a crucial problem of car parking. The car-parking area has many parking system that indicates directly the availability of vacant parking slots in any lane right at the entrance. It involves a system including infrared transmitter- receiver pair in each lane and a display outside the car parking gate. So the person desirous to park his vehicle is well informed about the status of availability of parking slot.

2. LITERATURE REVIEW

1. Ashna Viji Alex, Amina Abdul Rasheed, Shaun Thomas, Salmanil Farisi, AnsiaS, (Android Application for Smart Parking using IoT ,2021).

In this paper we are study the smart parking system using android. User safety is ensured by license plate detection. The aim of this approach is to reduce the time spent searching for available parking and also to offer hands-free payment. This intelligent parking system can be implemented in parks, shopping malls, hospitals. This app provides advanced parking reservation feature for users. Navigation is also provided for further assistance. IoT or Internet of Things plays an important role in our day today life. Parking assistance is provided to find the user's parked vehicle from the parking space via the application. On each car park, LED indications make it possible to identify occupied and unoccupied spaces. Users can make

payment using two methods: online transaction and RFID technology. The IR proximity sensor is used to detect whether the parking lot is occupied or not.

2. S. RahmathNisha ,C.Shyamala ,S. Pooja , Pilo Abarnia A , Sabnam Shajeetha M (RFID Based Smart Car Parking System Using IoT and Cloud ,2020).

This article introduces the concept of using RFID and cloud-based technology in parking services in cities. It provides a solution that uses the RFID concept with the Internet of Things (IoT) connected to a cloud-based system. These features provide the nearest available parking for the user. In order to provide an easy-to-use environment , a website is being developed which provides information to the user on the availability of parking spaces. Finding a place to park vehicles in a densely populated geographic area wastes time and fuel when trying to find a parking spot. There is therefore a need for assistive technologies, which could communicate the availability of parking spaces to registered users. With the use of RFID, the reader module scans it, and further the implementation proceeds. The number of free and reserved parking spaces is displayed graphically on the web page, the WIFI module is used for communication between the web page and the reader module. In the past two years, a huge development has been made in the creation of smart cities. The proposed system provides real-time information on the availability of parking spaces in a parking area. Remote users can reserve a parking space for them through our mobile app. The efforts made in this document aim to improve the parking facilities of a city and therefore aim to improve the quality of life of the inhabitants .

3. Ankita Gupta, Ankit Srivastava, Rohit Anand, Paras Chawla, (Smart Vehicle Parking Monitoring System using RFID , 2019).

With the growing influx of population into developed, industrially, and technologically sound urban cities, the urgent need to make cities smart is becoming obsolete. Cities are being made intelligent through data sharing, artificial intelligence, machine learning, analytics, and thousands of RFIDs, tags and sensors. One of the main concerns of smart cities today is the growing need to manage vehicles on the road and create enough well-managed parking spaces to avoid traffic congestion in urban areas. Autonomous system to guide the driver to a free parking space in the vicinity. In this article, a real-time prototype

of the intelligent parking system based on the Internet of Things (IoT) is discussed .

3. EXISTING SYSTEM

Traditional vehicle parking systems often rely on manual ticketing or barrier-based access control, leading to inefficiencies, congestion, and inconvenience for both operators and users. The lack of real-time monitoring and efficient utilization of parking spaces contributes to suboptimal parking management and increased traffic in urban areas.

The number of vehicles are now increasing over the number of total persons in the family. • This problem is increasing at such an extend that 40% of the roads are being used for parking in normal working days

Traditional parking systems involve customers taking a ticket upon entry and paying for their parking upon exit. Parking fees are paid via the pay station, and this system requires the customer to keep track of their ticket, which can be lost, and results in time-consuming queues.

4. PROPOSED SYSTEM

The main aim of this project is reduces the risk of finding the parking slots in any parking area.It eliminates the unnecessary travelling of vehicles across the filled slots in a city

The proposed "IoT-Based Smart Vehicle Parking System Using RFID" introduces a comprehensive solution with the following key features:

Key Features

4.1.1RFID Tags and Readers:

Integrates RFID tags on vehicles and RFID readers at entry and exit points to enable seamless and secure identification

IoT Connectivity:

Utilizes IoT connectivity for real-time communication between RFID readers, sensors, and a central control system. **Parking Space Monitoring:**

Implements sensors to monitor the occupancy status of parking spaces, providing real-time data on available spaces.

Automated Entry and Exit:

Enables automated entry and exit processes by associating RFID tags with user accounts or payment methods for a seamless parking experience.

Alerts and Notifications:

Incorporates an alert system to notify users of parking availability, approaching reservation expirations, or any issues related to their vehicles.

Central Control System:

Establishes a central control system to manage and monitor parking operations, ensuring optimal utilization of parking spaces.

4.2 Required components used for this project:

4.2.1 NodeMCUESP8266

4.2.2 Servo Motor

4.2.3 RFID

4.2.4 IR sensors

4.2.5 LCD

1) 4.2.1 NodeMCUESP8266:

The NodeMCU ESP8266 development board comes with the ESP-12E module containing the ESP8266 chip having Tensilica Xtensa 32-bit LX106 RISC microprocessor. This microprocessor supports RTOS and operates at 80MHz to 160 MHz adjustable clock frequency. NodeMCU has 128 KB RAM and 4MB of Flash memory to store data and programs. Its high processing power with in-built Wi-Fi / Bluetooth and Deep Sleep Operating features make it ideal for IoT projects.



Figure 1:NodeMCUESP8266

NodeMCU is an open-source firmware for which open-source prototyping board designs are available. The name "NodeMCU" combines "node" and "MCU" (micro-controller unit). Strictly speaking, the term "NodeMCU" refers to the firmware rather than the associated development kits.Both the firmware and prototyping board designs are open source.

4.2.2 SERVO MOTOR:

When a car arrives, the IR sensors sends signal toArdiuno and it decodes the signal and then the servo motor opens the gate for the car to pass.

The second IR sensor is used to indicate the cars which are going outside and the value of the spots is incremented by Ardiuno.

The function of the servo motor is to convert the control signal of the controller into the rotational angular displacement or angular velocity of the motor output shaft. Servo motor is used to drive the joints.



Figure 2: Servo Motor

4.2.3 RFID:

Real-time Parking Space Monitoring: RFID sensors embedded in parking spaces detect the presence or absence of vehicles. This information is relayed to the central management system, providing real-time data on available parking spaces.

RFID (radio frequency identification) is a wireless communication technology that uses electromagnetic fields to identify and track tags attached to objects via RFID readers. IoT (Internet of Things) brings together a myriad of smart devices and software, enabling communication, monitoring, and real-time control.

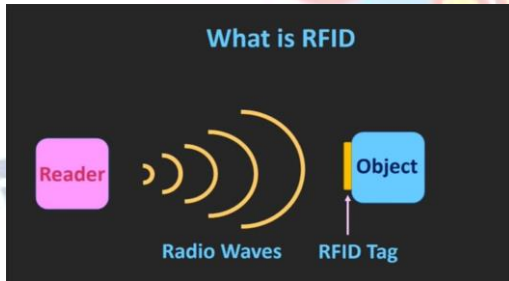


Figure 3: RFID

4.2.3.1 EM18 RFID chip:

It is used to read unique ID from RFID tags. Whenever RFID tags comes in range, RFID reader reads its unique ID and transmits it serially to the microcontroller or PC. RFID reader has transceiver and an antenna mounted on it. It is mostly fixed in stationary position.

Basically, RFID systems categorized as active and passive based on how they are powered and their range. EM18 is a RFID reader which is used to read RFID tags of frequency 125 kHz.

After reading tags, it transmits unique ID serially to the PC or microcontroller using UART communication or Wiegand format on respective pins. EM18 RFID reader reads the data from RFID tags which contains stored ID which is of 12 bytes



Figure 4.2.3.1 RFID Reader.

4.2.3.2 RFID Tags:

RFID tag includes microchip with radio antenna mounted on substrate which carries 12 Byte unique Identification number.

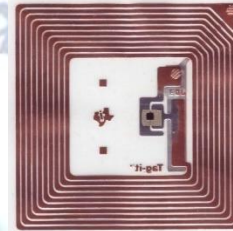


Figure 4.2.3.2: RFID tag

4.2.4 IR sensors

When the IR sensor detects the presence of a car, the servo motor operates as a gate at the entrance, opening and closing. The parking places that are available for car drivers are displayed on the LCD. The presence is detected by the infrared sensors.

IR sensors are now widely used in motion detectors, which are used in building services to switch on lamps or in alarm systems to detect unwelcome guests. In a defined angle range, the sensor elements detect the heat radiation (infrared radiation) that changes over time and space due to the movement of people.

An infrared sensor is a device that detects infrared radiation in its environment and outputs an electric signal. An infrared sensor can detect movement as well as to measure the heat of an object. The Infrared Sensor can detect infrared radiation, which is invisible to our eyes.

An IR sensor is a type of motion detector that is used as a physical security measure to detect intruders on your property.

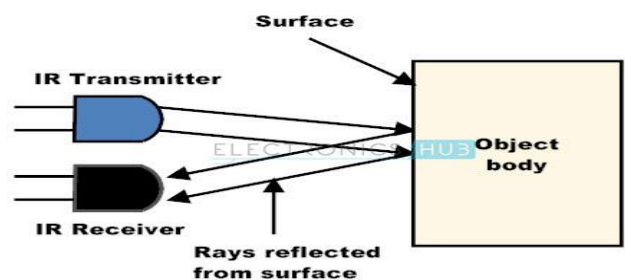


Figure 4 :IR sensors

4.2.5 LCD (Liquid Crystal Display):

Liquid Crystal Display (LCD) and the Internet of Things (IoT) are related in that LCDs are often used as display devices for IoT devices and systems.

For example, LCD screens can be used to display real-time data from IoT sensors or to provide a user interface for controlling IoT devices.

Liquid-crystal displays (LCD) are flat-panel displays that use the light-modulating properties of liquid crystals to produce images. This technology is often used in TVs, computer monitors, and mobile devices.



Figure 5:LCD

5. RESEARCH METHODOLOGY

Research methodology for a smart vehicle parking system using RFID involves several steps to ensure a systematic approach to gathering data, conducting experiments, and analyzing results. Here's a basic outline of the methodology:

Literature Review: Review existing literature on smart parking systems, RFID technology, and related research to understand the current state of the art, existing solutions, and potential gaps in knowledge.

Problem Definition: Clearly define the research problem, objectives, and research questions. Determine the scope of the study, including the types of RFID technologies to be used, the target environment (e.g., urban parking lots, campus parking), and the specific aspects of parking management to be addressed.

5.1 CircuitDiagram:

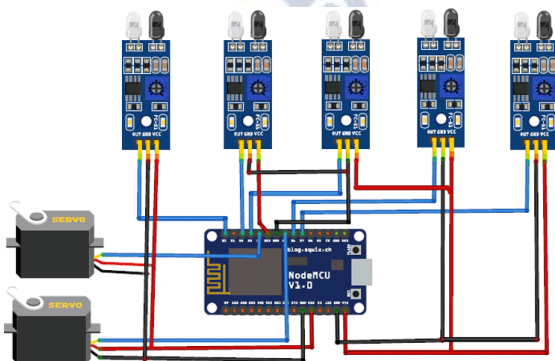


Figure 5.1 : CircuitDiagram:IOT-based smart vehicle parking system using RFID

5.2 Flowchart:

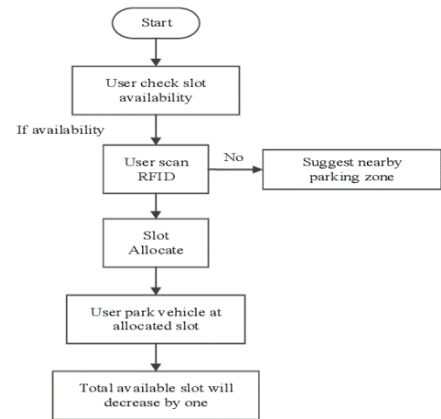


Figure 5.2 :IoT-based smart vehicle parking system using RFID flowchart

6. RESULTS & DISCUSSION

To discuss experimental results for an IoT-based smart vehicle parking system using RFID, we'll outline the key metrics typically evaluated and the findings that could be reported:

RFID Tag Readability: Measure the success rate of RFID tag detection when vehicles enter and exit the parking lot. Report the percentage of successful reads and any instances of failed reads or missed detections.

Vehicle Identification Accuracy: Assess the accuracy of vehicle identification based on RFID tag data. Determine the percentage of correctly identified vehicles compared to the total number of vehicles passing through the RFID readers.

Response Time: Measure the time taken for the RFID system to detect a vehicle entering or exiting the parking lot and update the parking management system accordingly. Report the average response time and any observed variations or delays.

Parking Space Availability: Monitor the availability of parking spaces in real-time using RFID technology. Report the percentage of occupied and vacant parking spaces at different times throughout the day.

Occupancy Rates: Calculate the occupancy rates of the parking lot based on RFID data. Analyze patterns of parking demand over time and identify peak usage periods or areas of congestion.

Turnover Times: Evaluate the average duration of time vehicles spend parked in the lot before exiting. Compare turnover times between different parking zones or categories (e.g., regular parking, reserved parking).

7. CONCLUSIONS

Our system minimizes the parking waiting time in a large-sized parking facility. It also helps in maximizing there venue generation for the parking facility owners. It would also help reduce the need for man-power in the parking facility which would greatly reduce the cost and errors in the process. Also this method would minimize the usage of paper ensuring a green system. This work can be further extended to booking of parkings lots over a period of time from advance. The mobile application can be extended up on other operating systems such as iOS, Windows ,etc. In the server , services can even be extended to the safety measures such as fire, theft, etc. This project focuses on implementation of car parking place detection using Internet of Things .The System benefits of Smart parking go well beyond avoiding time wasting.

Developing a smart parking solution with in a city solves the pollution problem.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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