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IoT Based Smart Parking System

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Abstract
As the population is growing rapidly day by day, the number of vehicles is also increasing. So, with the increase in the vehicles in metropolitan cities, road congestion is the major problem that is being faced. The aim of this paper is to resolve the issue related to the parking system using IoT. The user usually wastes his time and efforts in search of the availability of the free space in a specified parking area. In this paper, we present an IoT based Car parking system which uses different sensors, cameras, and communication technology to show drivers vacant parking spaces and offer real-time information on where spots are available. The parking information is sent to the user via notification. Thus, the waiting time for the user in search of parking space is minimised**.**

Keywords: Arduino, IR Sensors, Algorithm, Iot.

1. INTRODUCTION

According to the recent data from United Nations, now India has 1,428.6 million people and is the most populous country in the world, outstripping China's population. So due to increase in urbanization, most of the people does not depend on the public transport rather they prefer their own vehicles to travel, as a result traffic increases. Recent study suggests that finding a parking place is quite difficult for drivers. It tends to be becoming highly difficult as the number of private vehicle user increases. This issue drew strategic investment from various industries to boost parking revenues through-technology enabled solutions.

Problem related to parking and traffic congestion can be solved if the driver can be informed in advance about the availability of parking sports before reaching to their destination. Some study shows that more than 66% of drivers are willing to pay parking fare for their vehicles during the working hours. This directly adds value the car parking business. So, this directly indicates that the development of smart parking system should be there.

In current scenario, one of the major car parking systems is lack of available parking slots, especially in densely populated regions. This leads to several problems such as congestion, traffic jams, and illegal parking (which is quite common) which may compromise the safety for pedestrians and other drivers. Another problem is the inefficiency of existing parking system, which totally rely on the human operations such as ticketing and payment. These methods is too time consuming which leads to frustration for drivers as well as attendants.
The smart parking system aims at providing users with services such as finding, allocating, and reserving the 'best' available slots for a user in a particular area and in a particular time.

2. LITERATURE REVIEW

Numerous research has been conducted on smart parking system, which explores various topics such as System architecture, Design, Implementation, and evaluation. In this particular section we will cover some of the important findings from these studies.
Many researchers have suggested various smart parking system architectures. A common architecture includes the deployment of sensors to detect parking spot occupancy which sends the data to a central

server for processing, then the processed data is displayed through mobile applications. Huang et al. (2019) proposed a multi-level parking system that directs vehicles to available parking spaces using real-time data from cameras and sensors.

Some of the factors to consider while designing a smart parking system includes quantity and positioning of sensors, communication protocols, and UI design. Wang et al. (2020) proposed a novel sensor placement technique that uses a genetic algorithm to optimize the placement of sensors in a parking lot. And this study found that the proposed technique resulted in a more accurate and efficient parking system as compared to traditional sensor placement methods.

Several studies have evaluated the implementation of smart parking system in real world scenarios. For example: Zhou et al. (2021), for example, implemented a smart parking system in a university campus and evaluated its effectiveness in reducing parking search time and congestion. And the study finds that the smart parking technology reduced parking search time significantly and enhanced the overall parking experience for drivers.\

Surveys, simulations, and field trials have all been used to evaluate the performance of smart parking systems. For example: Liu et al. (2019), for example, conducted a field experiment to evaluate the performance of a smart parking system at a shopping mall. The study found that the smart parking system improved parking spot occupancy and decreased driver parking search time.

Objectives

Some of the objectives for Smart Parking System includes:

1. Reducing the risk of finding parking slots in any particular area.
2. Eliminates the unnecessary travelling of vehicles across the filled parking slots in a particular region.
3. Using the IoT-based parking system you can easily check parking spot availability over the internet.
4. Enhance the security by simplifying the parking system.
5. Smart system that parks many vehicles in the smallest amount of area feasible.

Specifications & Description

A. Hardware Requirement

1. Arduino UNO: Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. The Arduino UNO board is used for an electronics project.
2. NodeMCU: It is an open-source platform, its hardware design is open for edit/modify/build. NodeMCU Dev Kit/board consist of ESP8266 Wi-Fi enabled chip. The ESP8266 is a low-cost Wi-Fi chip developed by Espressif Systems with TCP/IP protocol. It can be used for a wide variety of IoT applications.
3. Jumpers Wire: Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering.
4. Servo Motor: Servos are mainly used on angular or linear position and for specific velocity, and acceleration.
5. IR Sensors: The IR sensor or infrared sensor is one kind of electronic component, used to detect specific characteristics in its surroundings through emitting or detecting IR radiation.
6. Bread Board: It is a thin plastic board used to hold electronic components that are wired together.

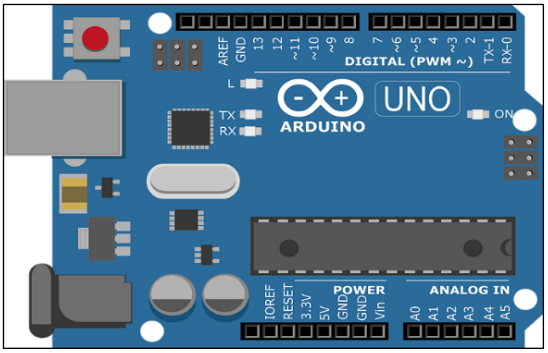


Figure 1 (Arduino UNO)

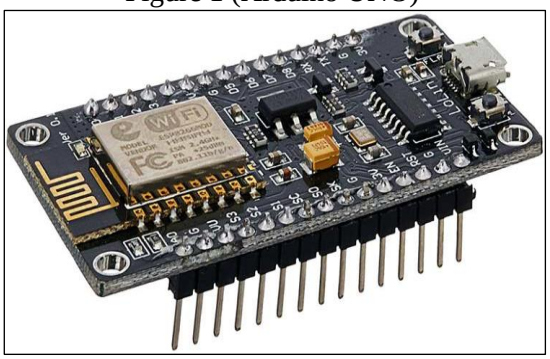


Figure 2 (NodeMCU)

B. Software Requirement

1. Blynk App

Blynk is an IoT platform for iOS or Android smartphones that is used to control Arduino, Raspberry Pi and NodeMCU via the Internet. This application is used to create a graphical interface or human machine interface (HMI) by compiling and providing the appropriate address on the available widgets.

2. Arduino IDE

It contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino hardware to upload programs and communicate withthem.

Circuit Diagram

A circuit diagram is a graphical representation of an electrical circuit that shows the various components and their connections. The following circuit shows the how the connection is established using the various IoT components.

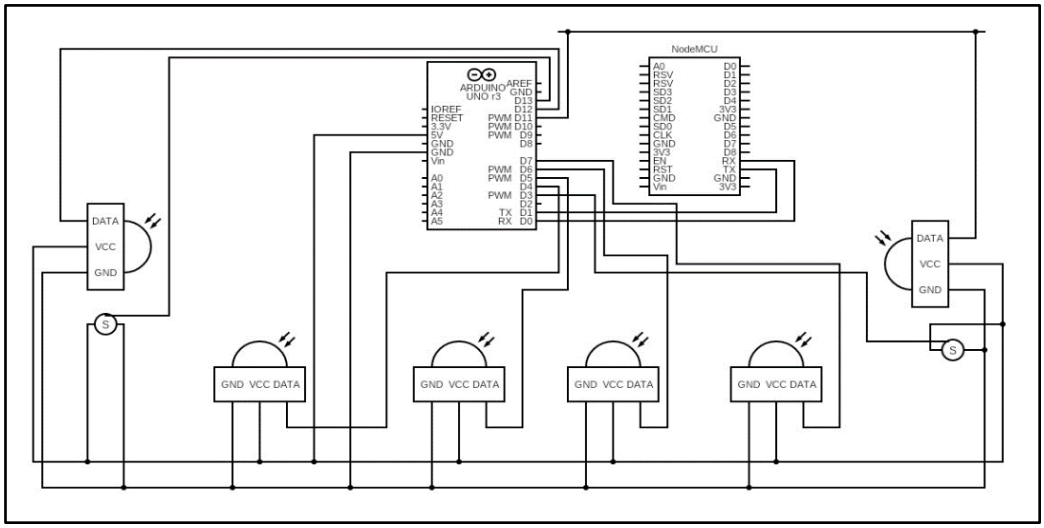


Figure 3 (Circuit Diagram of IoT Based Smart Parking System)

Connection Specifications:

1. Connect the IR Sensors to the Arduino Uno according to the circuit diagram.
2. Connect the Relay Module to the Arduino Uno according to the circuit diagram.
3. Connect the LED Lights and Buzzer to the Arduino Uno according to the circuit diagram.
4. Upload the Arduino code to the Arduino Uno using the Arduino IDE.
5. Connect the NodeMCU to the Arduino Uno according to the circuit diagram.
6. Flash the NodeMCU firmware using the NodeMCU Flasher.
7. Upload the NodeMCU code to the NodeMCU using the Arduino IDE.
8. Connect the power supply to the circuit to power up the system.

Pseudo Code for IoT based parking system.

1. Include the necessary libraries for the Servo motor and Software Serial communication.
2. Define variables for the Servo motors, Software Serial object, and pins for the infrared sensors, entrance and exit gates.
3. Set the initial position for the Servo motors.
4. Set up the Serial and software Serial communication.
5. In the loop, call functions for each parking slot and gate.
6. In each parking slot function, read the corresponding infrared sensor and set the value of a string variable depending on the state of the sensor.
7. In the gate function, check the state of the entrance and exit gates and move the Servo motor accordingly.
8. Combine the values of the sensor variables into a string separated by commas.
9. Send the string to the Software Serial port and reset the string variable.
10. Delay the loop for a period.
11. Set all pins too high to prevent interference.

3 RESULTS AND DISCUSSION

In this study, we developed an IoT-based smart parking system that utilizes various sensors to detect the presence of vehicles in parking spots and provides real-time data to drivers about the availability of parking spaces. The system consists of two main components: the sensor network and the user interface.

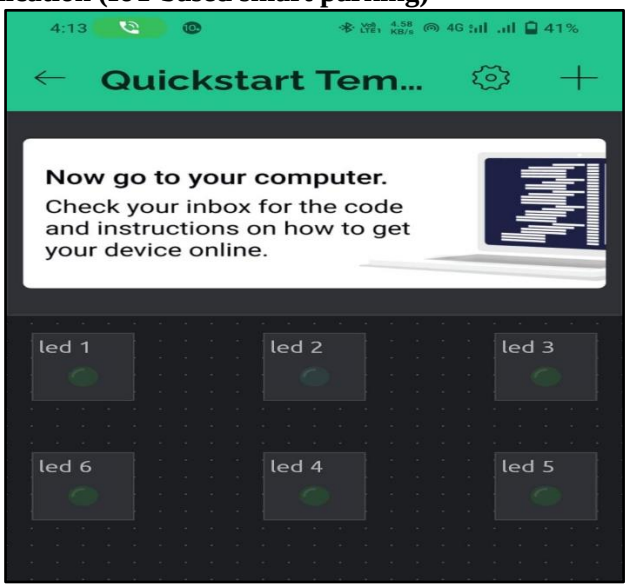
The sensor network in an IoT-based smart parking system consists of sensors installed in parking spots that detect the presence of vehicles and send signals to a central server to update the parking availability status. The user interface is the part of the system that drivers interact with, providing

real-time information about parking availability through a mobile app, website, or electronic displays in the parking lot. Together, the sensor network and user interface create a seamless parking experience for drivers, optimizing the use of parking resources and reducing the time and effort required to find a parking spot.

Our study demonstrates the feasibility and effectiveness of an IoT-based smart parking system in improving the efficiency and convenience of parking. The high accuracy rate of the sensor network suggests that the system is reliable and can be deployed in a wide range of parking settings. In addition, while the system can help improve parking efficiency, it may also raise concerns about privacy and data security. It is important to ensure that the system complies with relevant privacy and security regulations and that user data is protected from unauthorized access or use.

Overall, our study provides a proof-of-concept for an IoT-based smart parking system that has the potential to revolutionize the way we park and drive in urban areas. Future research can explore ways to optimize the system and integrate it with other smart city technologies to create more efficient and sustainable urban environments.

Working of Blynk Application (IoT based smart parking)



Following are some points which explains the working of the cloud applications i.e Blynk in IoT based smart parking system:

1. The smart parking system is equipped with sensors that detect the presence of a vehicle in a parking spot. These sensors are connected to a microcontroller or a single-board computer like Arduino in our case.
2. The microcontroller or single-board computer is connected to the internet via Wi-Fi or Ethernet. This allows it to communicate with a cloud-based platform like Blynk.
3. The Blynk platform provides a user-friendly interface for the smart parking system. Users can download the Blynk app on their smartphones and connect to the smart parking system.
4. When a user wants to find a parking spot, they can open the Blynk app and see the availability of parking spots in real-time. The app can display a map of the parking lot with color-coded markers indicating the availability of each spot.
5. When a user selects a parking spot, the smart parking system reserves that spot for them. The app can display a confirmation message and provide directions to the reserved spot.
6. When the user arrives at the parking spot, the sensor detects the presence of their vehicle and sends a signal to the microcontroller which will open the entry/exit barrier so the the user can park the vehicle.

3. CONCLUSION

In conclusion, the deployment of smart parking systems using IoT technology can result in better environmental sustainability, less congested traffic, and more effective use of parking spaces. We can anticipate continuing growth and innovation in this subject over the next years because it has so much potential for the future of urban transportation.

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