"Automated Car Parking System Using IoT Technology"

Minor Project Report

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Bachelor of Technology

In

Internet Of Things (IOT)

Submitted By

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UNDER THE SUPERVISION AND GUIDANCE OF

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ABSTRACT

The Car Parking Management System utilises an **ESP32**, **Infrared Sensors**, and A **16 X 2 Character LCD DISPLAY** to depict the availability of the parking slot. This proposed system is developed based on the IR sensors that are able to detect the existence of vehicles in four parking spaces. The ESP32 is connected to Wi-Fi and it uses **Blynk app** for using the parking's status and, therefore, users can see the available slots with their smartphones. The **IR sensors** are connected by the help of input ports of GPIO, it is used to get the information of any slot as vacant or occupied. There is one LCD screen which shows general information about the status of every parking place – it can be empty or filled. The design of the system includes a healthy **18650 lithium-ion battery** pack for mobility and modest power consumption. The Blynk app also supports update feature and the whole system is set with 500ms timer to update the statuses. With regards to reminding the context of this paper, it is is important to note that this paper aims at analyzing the hardware and IoT implementation about parking management.

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ACRONYMS

S.no	Abbreviation	Full form
1.	LCD	Liquid Crystal Display
2.	Wi-Fi	Wireless Fidelity
3.	GPIO	General Purpose Input/Output
4.	RS	Register Select
5.	IR Sensor	Infrared Sensor
6.	EN	Enable
7.	PCB	Printed Circuit Board

LIST OF FIGURES

CHAPTER 1: INTRODUCTION

The **Car Parking Management System** is an Internet of things-enabled solution meant to keep track of the availability of parking slot and relay real time information to the users. The system incorporates an **Electronic System with an ESP32 microcontroller** that controls the entire process, and communicates with **IS sensors** for the detection of objects that are in the proximity, **a 16 x 2 char LCD** that displays the state of the system at any particular time and **Blynk application** for monitoring the system remotely.

Core of the system is to recognize existence or absence of vehicles in four parking slots through **IR sensors**. The IR sensors are used in the parking slot and determine whether a parking slot is occupied or not. It is where the **ESP32** measures the states of the sensors to change the parking status. The status of the parking slots is updated on the **16x2 LCD screen** and a message is displayed if the slot is EMPTY or **FULL**.

Moreover, the system interfaced with the **Blynk app** that can be used to track parking status using a smartphone. The **Blynk application** gets data in real-time from the ESP32 and a mobile device shows the state of each parking space. A **18650 Lithium ion battery** is employed to make the components mobile and energy efficient for incorporation in the system.

This work thus incorporates both hardware and aspects of IoT to ensure it develops a reliable and effective parking space management system to enable management of local and remotely available parking slots. Real time update of parking status of a parking slot real time update of parking status of a parking slot is suitable for modern parking solutions because it eliminates the stress of looking for an available parking unit.

CHAPTER 2: LITERATURE SURVEY

1. The system used in the automated car parking includes; ESP32 Board, IR sensors, IoT technology to identify, control, and alert on parking slots. It uses CMOS and ultrasonic sensors to detect vehicles and also parking slot occupancy to communicate wirelessly with a server. A Liquid Crystal Display (LCD) display is used to show real-time local feedback and the Blynk application provides online over the smartphone application. To promote energy efficiency, it uses 18650 Lithium-ion batteries in its design, and it is implemented on a zero PCB for compactness. Findings in real-time monitoring and status display of parking slots achieved a conclusive level of productivity. Information regarding parking can be retrieved, people can reserve physical spaces from the comfort of their homes as well as engage with machine interfaces to an extent. This system reduces human control and intervention and provides a long-term solution to parking difficulties inherent in urban environments and creates the grounds for scalable and effective smart parking services in smart cities.

2. Smart car Parking system involves the use of Internet of Things, ESP32 microcontroller and infra-red sensors in the operations of parking. Information on the availability of slots in real-time is given by a mobile application and an LCD screen. The system uses high-performance qualities such as the CMOS sensors, ultrasonic detectors, and Blynk for proper monitoring and communication system. Features such as pre-booking, and license plate recognition, increases the level of automation to limit intrusions of manual interactions and time. Here the outcomes indicate enhanced efficiency in parking, reduction in traffic jam and gain in user friendly. Other features such as OTP based slot access and automated billing only amplify the effectiveness of the proposed model, making it a reliable solution for parking management in smart cities – a smart, sustainable solution.

3. IoT, ESP32, IR sensors, and LCD display are used in the proposed smart car parking system to manage parking slots. Using Blynk for remote control, the slot availability is immediately updated when someone books it. Initial orders, automated charging, and number-plate recognition work for this purpose. It specifies if a vehicle is present and alters the app and the display as a result of it. Outcomes show decreased traffic, enhanced customer satisfaction and limited consumption of fuel. This efficient, effective, and by far sustainable idea solves the problems of parking successfully in the urban areas hence contributes to smart city. Future updates the upgrade of solar power supply, artificial intelligence analysis, and the connection with the parking barriers for automated parking procedure.

Chapter 3: System Design

The "Car Parking Management System" comprises of various sub-systems such as **ESP32 microcontroller, IR sensors, 16x2 LCD display, and Blynk mobile application** that forms a smart parking system to allow the identification and consequent display of available parking slot. Below is the detailed system design:

1. System Overview

The Car Parking Management System consists of the ESP32 microcontroller, IR sensors, a 16 x 2 LCD display, and Blynk mobile app that offers an effective way of controlling parking slots. It identifies whether a parking slot is available or taken, and gives instant feedback on its state on an LCD screen locally, and the Blynk app for remote control. The complete design works on 18650 Lithium-ion battery which makes the device energy efficient and portable.

2. Components and Connections

ESP32 Microcontroller: The ESP32 performs tasks that include capturing data from the IR sensors, updating the LCD panel, and sending status through WI-FI to the Blynk application. It runs on 3.3V and controls all the communication between hardware and mobile application**.**

IR Sensors: In this particular design, four IR sensors are incorporated for a single parking slot to check if a car is parked or not. These sensors utilize concepts of light infrared for their operation.. The sensor periodically sends out HIGH if it senses a car and merely sends out LOW otherwise.

16x2 LCD Display: Instead of just light indicators, there are numbers on the LCD screen to indicate the parking slot status as EMPTY or FULL, of the 4 slots available. It is connected to the ESP32 using the following pins:

RS: GPIO 13 EN:

GPIO 12 D4-D7:

GPIO 25, 26, 27, 14

It refreshes every 500 ms depending on the input from the IR sensors as the input device.

Blynk App: The main features of the system are implemented with the help of Blynk application for its controlling remotely. The app also interacts with the ESP32 via Wi-Fi and shows the status of parking slots in the car. The status is updated using virtual pins on the app (V0 to V3). This enables the user to get real time update on parking availability without physically having to go there.

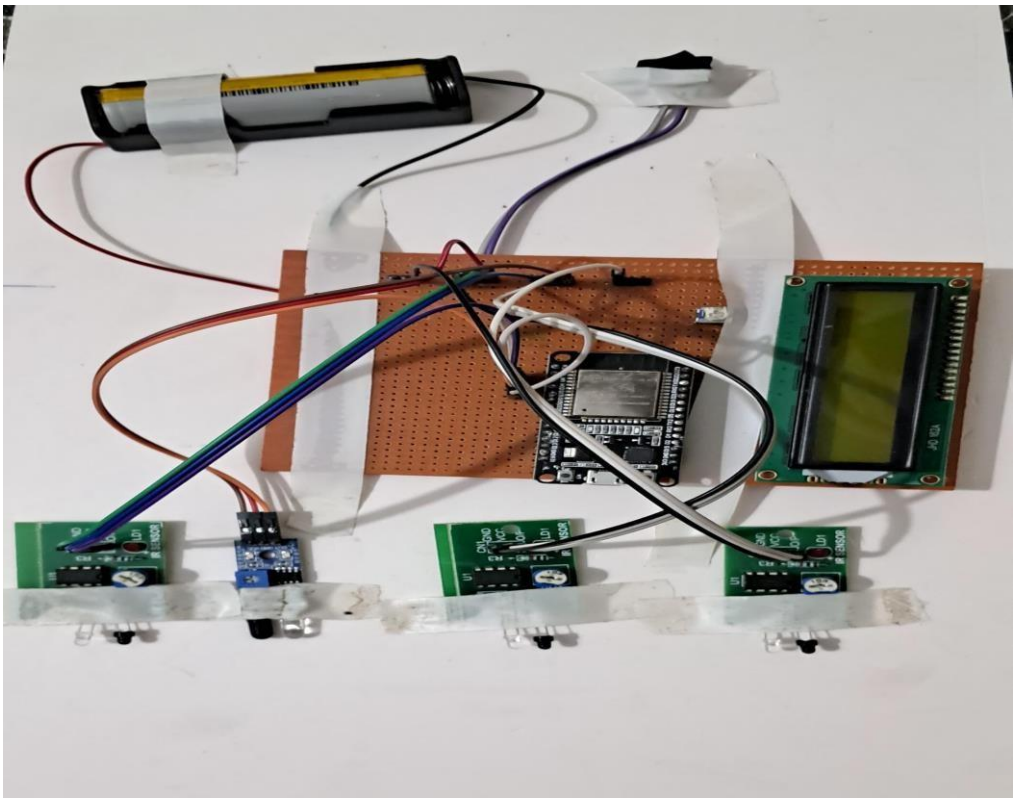
18650 Lithium-ion Battery: The system is driven by an 18650 lithium-ion battery with sufficient energy storage to keep the system running for long periods without an external power

source. A voltage regulator helps to regulate a 5V source to the required one for the ESP32 of 3.3V.

3. Pin Configuration:

The system involves the following components and their corresponding pin assignments on the ESP32:

Component	**Pin on ESP32**
IR Sensor 1	**GPIO 36**
IR Sensor 2	**GPIO 39**
IR Sensor 3	GPIO 34
IR Sensor 4	GPIO 35
LCD RS	GPIO 13
LCD EN	GPIO 12
LCD D4	GPIO 25
LCD D5	GPIO 26
LCD D6	GPIO 27
LCD D7	GPIO 14



CHAPTER 4: SYSTEM FUNCTIONALITY

1. **WI-FI CONNECTIVITY:**

The ESP32 is on a Wi-Fi network where it can send and receive information from the Blynk application. This makes a certain that the system is always online to update parking space avails and that the availability can be updated remotely.

2. Parking Slot Detection:

To tell whether there is an existing car on a parking slot, the system employs IR sensors. If a car is present in a specific parking lot, the output of a specific sensor is affected and the system designates the slot as "FULL". where a slot is left 'EMPTY' in case no vehicle is detected in the process of scanning through all slots.

3. Real-time Monitoring:

The ESP32 also computes the data obtained from the sensors and forwards the same to the Blynk app for users to track available parking space. The information is also portrayed to the 16x2 LCD to indicate the status of every parking bay. For example, if Slot 1 is occupied, the LCD displays "1: "FULL", and
on the related virtual pin in the Blynk interface, one can view the status.

4. Blynk Integration:

With the help of the Blynk app, the users receive an opportunity to control and monitor the parking space availability in real-time. Each parking slot is associated with a virtual pin number on the Blynk application, hence enabling any user to view status of the parking lot at any time.

Chapter 5: Implementation

This project contains a smart car parking system via ESP32 and shows the availability of parking slots in real-time. The system utilizes an ESP32 microcontroller, a 16x2 LCD display, four IR sensors, a zero PCB with an incorporated rechargeable battery of 18650 lithium-ion type.

Hardware Setup:

1. **ESP32:** serves as the control canter of the model and connected to Wi-Fi for interaction with the Blynk application controls input-output.

2. **16x2 LCD:** Makes the availability status of the parking slots known.

3. **IR Sensors:** Located in four parking slots to inspect the presence of cars. These sensors output HIGH or LOW in line with the occupancy of equivalent slots.

4. **Zero PCB:** Facilities support for placing and interconnecting the parts in an effective manner.

5. **18650 Battery:** I mean the part which supplies the ESP32 and the peripherals to power in a portable and continuously manner. Software Implementation:

The system then uses the Blynk platform to display data from the remote side. ESP32 scans states of IR sensors and sends it to Blynk through virtual pins 9, 10, and 11. Locally, the LCD has a real-time slot status that changes between 'FULL' and 'EMPTY.' The Blynk timer is responsible for periodic update of information, and Wi-Fi connection allows monitoring information as close to real-time as possible.

Features:

- There is the constant update of available slots in real-time.
- Convenient to carry always and does not require much power through its utilization of a rechargeable battery.
- The use of Blynk application to provide easy to use displays and remote control.

CHAPTER 7: CONCLUSION AND FUTURE SCOPE

Conclusion: In this paper, the smart car parking system using ESP32 provide efficient evidence of a real-time parking systems. Powered by an ESP32 microcontroller, four IR sensors, 16×2 LCD display and Blynk IoT Platform, the developed system effectively controls and visualizes the occupancy of parking slots. With reference to the adopted design features, there is a zero PCB, which • guarantees compact and stable connections • the 18650 Lithium-ion battery make the setup portable and energy-efficient. The parking availability is indicated locally on the controller LCD and on remote Blynk application where users can check conveniently. The work focuses on the application of IoT and embedded systems when addressing typical real-life problems, minimizing the workload, and enhancing parking systems.

Future Scope:

Scalability: The system can also be expanded, to accommodate large parking lots, by installing several sensors, and more ESP32 modules.

Automation: It can be fully integrated with motorized barriers and RFID based access controls it will fully automate entry and exit.

Power Efficiency: The system can be made green through addition of solar panels in order to convert solar energy into electricity.

Advanced Analytics: AI techniques can be employed that will help evaluate parking characteristics, set parking management, and expect a parking inventory.

Mobile App Enhancements: Some possibly enhancing the usability of available slots include slot reservation and navigation on to slots.

It is practical to imagine this system to revolutionalize parking not only in residential, commercial and public areas, but to lay the foundation to smart city programs as well.

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