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SMART CAR PARKING SYSTEM USING IOT

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Abstract: The research aims to develop a smart car parking system using IoT technologies to optimize parking space management and enhance user convenience. It focuses on utilizing ESP8266 microcontroller and IR sensors integrated with the Blynk app to provide real-time notifications to users about parking space availability. It also indicates the duration for which the vehicle has been parked and the associated amount. The research methodology involves the deployment of IR sensors in each parking space to detect the presence of vehicles. When a vehicle passes by a specific pole, the light ON that pole is illuminated while the rest of the pole lights remain OFF. The ESP8266 microcontroller is used to communicate with the sensors and send notifications to the Blynk app via Wi-Fi connectivity. The Smart Car Parking System using IoT offers real-time monitoring of parking spaces, accurate data collection, and efficient communication between drivers and parking lot operators. Users receive instant notifications on their smartphones, enabling them to find available parking spaces quickly and enhancing their overall parking experience. The system contributes to optimized parking space utilization, reduced search time for parking, and potential fuel and environmental savings.

IndexTerms **–Blynk App, ESP8266, MQTT.**

I. INTRODUCTION

The rapid growth of urbanization and the increasing number of vehicles have led to parking space shortages and difficulties in finding available parking spots. [1] The primary objective of the research is to develop a smart car parking system using IoT technologies to optimize parking space management and enhance user convenience. The system aims to provide real-time monitoring of parking spaces, accurate data collection, and communication between drivers, parking lots, and operators. Traditional parking management systems face challenges in efficiently monitoring and utilizing parking spaces.[2] The research addresses the need for efficient parking solutions in urban areas, contributing to improved traffic flow and reduced congestion.

The integration of IoT technologies into the parking infrastructure offers benefits such as real-time notifications, optimized space utilization, and enhanced user satisfaction. The use of ESP8266 microcontroller and IR sensors, along with the Blynk app, demonstrates the application of IoT and wireless communication in the parking domain. [3]

The Smart Car Parking System using IoT is a revolutionary solution that aims to optimize and enhance the parking experience for both drivers and parking lot operators. With the rapid growth of urbanization and the increasing number of vehicles on the road, finding a parking space has become a major challenge in many cities. This system leverages the power of the Internet of Things (IoT) to create an intelligent and efficient parking management system. [4]

By integrating IoT technologies into traditional parking infrastructure, this smart system offers real-time monitoring, accurate data collection, and communication between parking lots, drivers, and operators. It utilizes various IoT devices such as sensors and communication networks to automate and streamline the parking process. Users receive instant notifications on their smartphones whenever a parking space becomes occupied or vacant, allowing them to find available parking quickly. The system enhances the overall parking experience by providing timely information about parking space availability. [5] The system helps optimize parking space utilization by notifying users when spaces become available; reducing the time spent searching for parking. y minimizing the time spent searching for parking, the system reduces fuel consumption and carbon emissions, contributing to cost and environmental savings.

The Smart Car Parking System utilizes the MQTT (Message Queuing Telemetry Transport) protocol to enable bidirectional communication between the ESP8266 microcontroller and the Blynk app. MQTT is a lightweight messaging protocol commonly used in IoT applications for efficient and reliable data transfer. In the Smart Car Parking System, the ESP8266 microcontroller acts as an MQTT client, subscribing to relevant topics to receive commands and instructions from the Blynk app. The Blynk app, functioning as another MQTT client, can send messages and commands to the ESP8266 microcontroller, allowing users to interact with the parking system remotely. Through this bidirectional communication, users can not only receive real-time notifications about parking space availability but also remotely trigger actions such as reserving a parking space or activating specific functionalities within the parking system. The integration of bidirectional communication using MQTT and the Blynk app enhances the interactivity and control available to users, providing a seamless and convenient parking experience.

II. LITERATURE REVIEW

The sensors used in IoT based smart parking system stores and accesses data from remote locations with the help of the cloud these factors give raise to cloud of things (COT). The nodes could be monitored and controlled from any location the system that we propose provides information regarding the availability of the parking slots with the help of the mobile application the users from the remote location can book the parking slots. [1]

An algorithm is used to increase efficiency of cloud-based parking system and network architecture technology is used. This algorithm is used to find the lowest cost parking space. Considering the number of parking space available and also considering the distance of the parking space from the user. The user can directly access the cloud-based server and find the information on the parking space. The user can also install an application in their mobile phones to access this information. With the help of this algorithm, waiting time of the user to find a parking space can be minimized. Security aspects are not included in this paper. [2]

A wireless sensor node along with smart phone application is being used to find the parking space. Since, wireless technology is used here the system has high accuracy and efficiency. In this system, onboard units are used to communicate with other vehicles. The user parks his vehicle in any one of the several bays available a mechanical lift lifts the vehicle out. A ticket key and id are given to the user and it is only known to the user which is used to retrieve the vehicle. The user need not carry any paper ticket since an RFID card is given to the user. The technology used here is economical. Security features must be improved to protect the user's privacy. [3]

An effective and clever use of internet of things technology to automate the operation of the parking system that allows a useful parking place. The Internet of Things (IoT) offers wireless connectivity to the system, allowing the user to monitor the parking lot's availability. With a growth in the number of vehicles in major cities. [4] This paper's goal is to find a solution to this problem. The user typically wastes his or her time and energy trying to find a vacant place in a designated parking lot. The user receives a notification with the parking information. As a result, the user's waiting time while looking for a parking spot is minimized. To prevent auto theft, RFID technology is being utilized. [5]

A Smart Parking Energy Management solution for a structured environment such as a multi-storied office parking area. The system proposes implementation of state-of-the-art Internet of Things (IoT) technology to mold with advanced Honeywell sensors and controllers to obtain a systematic parking system for users. Unoccupied vehicle parking spaces are indicated using lamps and users are guided to an empty parking space, thus eliminating need for searching for a parking space. The occupied parking spaces are virtually stored to the cloud to be accessed by central system and direct the upcoming cars to empty spaces. [6]

The latest advancement in the Information and Communication Technologies and consists of four layers: Application, Middleware, Networking, and sensor layer. It offers environmental friendly, reduces harmful emissions during parking, and is a computerized system pre-programmed without human intervention. The comparison of traditional parking system with smart parking system using IoT. The paper also proposes a framework for smart parking system. [7]

The monitoring is done through an ultrasonic sensor or infrared sensor to get real time parking space. The data sensed by the sensor is transmitted to NODEMCU ESP8266 and in turn with the help of internet it is also transferred to web page. The web page will help the user in finding the available parking slot by displaying the vacant slots. Therefore, it decreases the fuel consumption which in turn reduces carbon impressions in the environment. [8]

III. PROPOSED METHODOLOGY

ESP8266: The ESP8266 microcontroller module provides a set of general-purpose input/output (GPIO) pins that can be used for both input and output operations. MQTT (Message Queuing Telemetry Transport) is a lightweight messaging protocol commonly used in IoT applications. The ESP8266 supports MQTT, enabling seamless communication between devices and IoT platforms. It has 11 (digital) GPIO pins and 1 analog pin.

IR sensor: An IR (Infrared) sensor also known as an IR detector or IR receiver is an electronic device that detects infrared radiation in its surrounding environment. IR sensors can be used to detect and count objects passing through a specific area. It has three terminal vcc, gnd and out pins. It operates on 5v dc.

Blynk App: Blynk is an Internet of Things (IoT) platform that simplifies the process of creating mobile applications to control and monitor IoT devices. It provides a user-friendly interface and a drag-and-drop app builder, allowing users to create custom mobile apps.

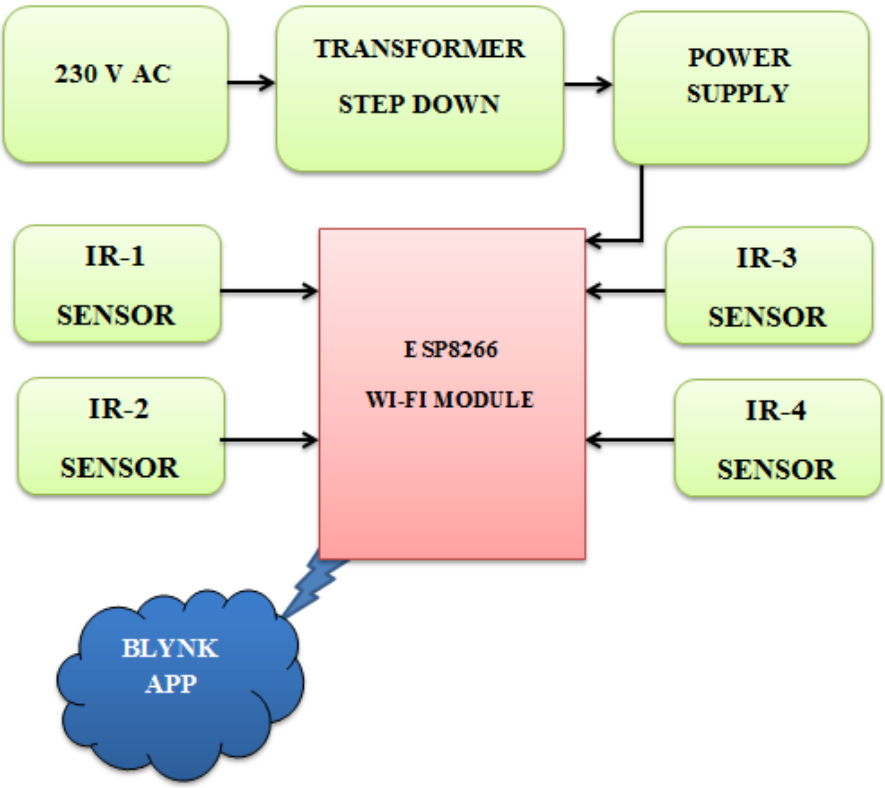


Fig.1: Block diagram

The transformer steps down (or up) the input AC voltage to the desired level. The bridge rectifier converts the AC voltage into pulsating DC voltage. The capacitor smooth's out the pulsations, resulting in a relatively stable but unregulated DC voltage. The voltage regulator further refines the voltage, providing a precise and regulated output voltage (e.g., 5V in the case of an LM7805). A 5v DC supply is connected to the ESP8266 VCC and GND pin. Connect the IR sensor to the ESP8266. There are four IR- sensors each connected to ESP826 pin D0, D1, D2 and D4.

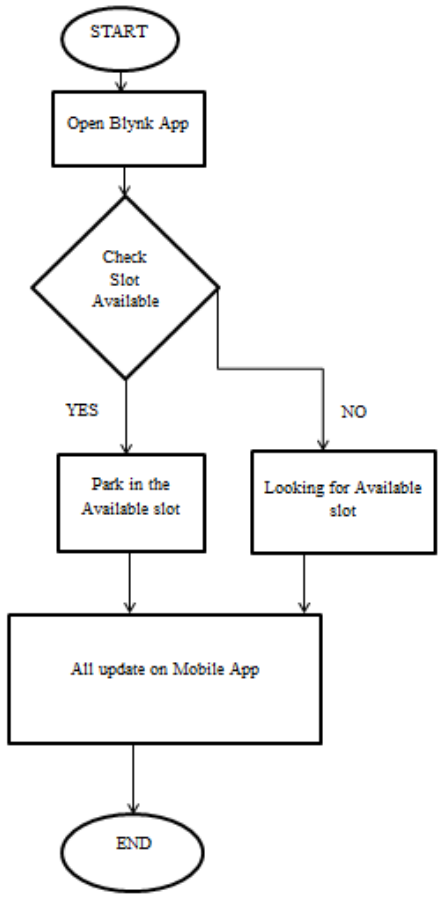
MQTT (Message Queuing Telemetry Transport) is a lightweight communication protocol commonly used in Internet of Things (IoT) applications to facilitate communication between devices and servers. In the context of your project, the "Smart Car Parking System," you can use MQTT to connect your IoT devices to the Blynk app, enabling remote monitoring and control of the parking system. First, you'll need IoT devices such as sensors and controllers for your parking system. These devices should be capable of connecting to the internet and communicating using MQTT. An MQTT broker is a server that acts as an intermediary between your IoT devices and the Blynk app. Configure your IoT devices to connect to the MQTT broker. This involves specifying the broker's address, port, and credentials (username and password) for authentication.

In the code running on your IoT devices, publish data (e.g., sensor readings) to the appropriate MQTT topics and subscribe to topics that receive control commands from the Blynk app. This involves specifying the MQTT broker's details (address, port, username, and password) within the Blynk app so that it can communicate with the MQTT broker. With everything set up, now monitor the status of your parking system in the Blynk app and send control commands to your IoT devices.

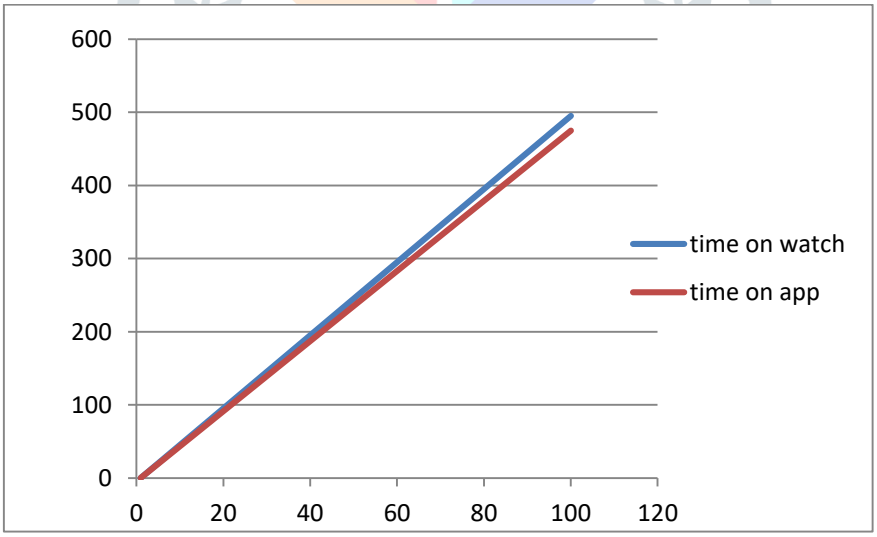
System Workflow

- Install the IR sensor in each parking space to detect the presence of a vehicle. Connect the IR sensor to the ESP8266. There are four IR- sensors each connected to ESP826 pin D0, D1, D2 and D4.
- Write the code for the ESP8266 to monitor the status of the IR sensor. Whenever a vehicle is detected or leaves a parking space, the ESP8266 sends a notification to the Blynk app and it also indicates the duration for which the vehicle has been parked and the associated amount.
- Connect it to the Wi-Fi network so that it can communicate with the Blynk app.
- Create a Blynk account and create a new project. Add a button widget in the Blynk app to trigger the notification when a parking space becomes occupied or vacant.
- In the Blynk app, set up a notification widget to receive the notifications from the ESP8266. Customize the notification message to indicate whether the parking space is occupied or vacant.
- Users can install the Blynk app on their smartphones and log in using the same credentials used to create the Blynk project. They can then receive real-time notifications about the availability of parking spaces.

Flow Chart



A system accuracy of 96% is a measure of how well a system performs in correctly classifying or predicting outcomes in a given task or dataset. It indicates that the system is accurate in its predictions or classifications 96% of the time.



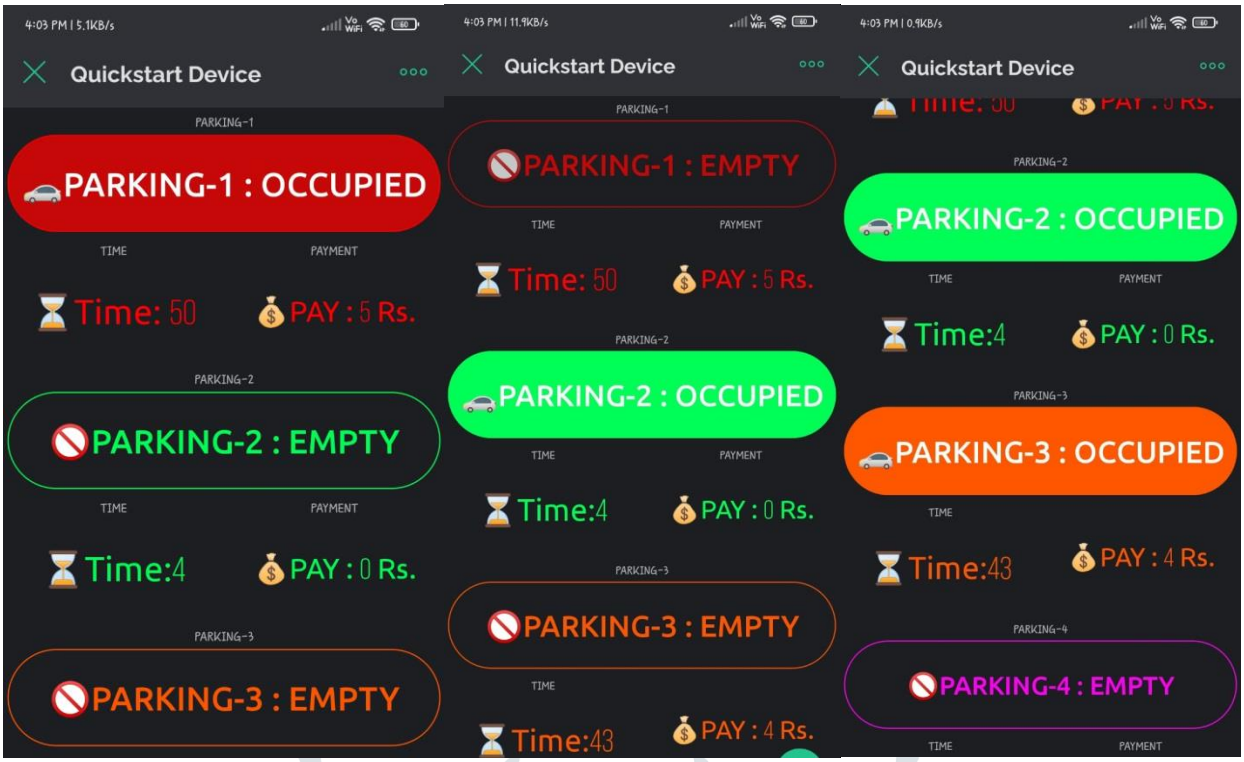
Graph 1: Time on app vs time on watch

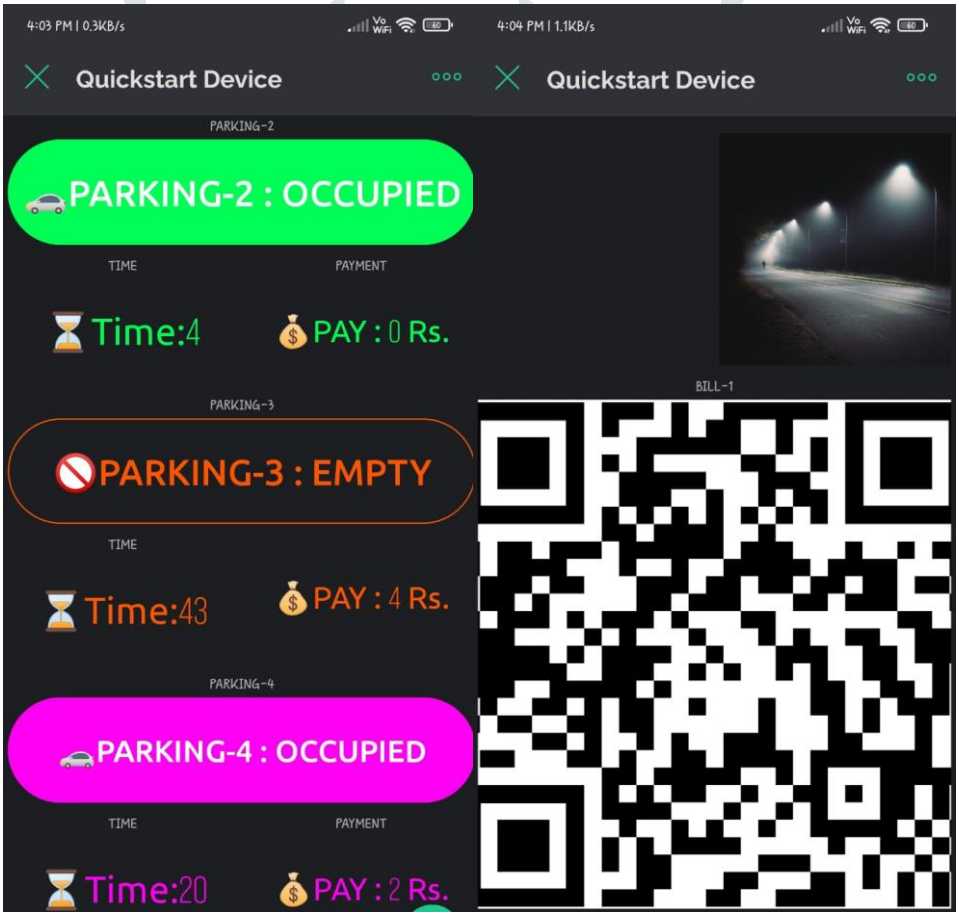
VI. RESULTS AND DISCUSSION

The implementation of the system using the ESP8266 microcontroller module and IR sensor was successful in detecting the presence of vehicles in each parking space. The integration of the Blynk app allowed for real-time notifications to be sent to users' smartphones, providing them with up-to-date information on parking space availability. The system effectively provided real-time monitoring of parking spaces, allowing users to receive immediate notifications when a space became occupied or vacant. The timely notifications facilitated quick and efficient parking spot selection, reducing the time and effort spent searching for available spaces. By informing users about the availability of parking spaces, the system contributed to optimized parking space utilization. It also indicates the duration for which the vehicle has been parked and the associated amount. They can pay and park the vehicles.

Users were able to make informed decisions and find parking spots more efficiently, leading to reduced congestion and improved overall parking management. The integration of the Blynk app enhanced user convenience by providing a user-friendly

interface for accessing parking information. Users appreciated the ease of finding available parking spaces and the ability to receive notifications directly on their smartphones, resulting in increased user satisfaction.





As shown in Table 1 and Table 2, you can see that there is a direct relationship between the parking duration and the amount charged: more time parked results in a higher cost. For example, the parking was occupied for 100 seconds. The cost of parking for 100 seconds was 10 rupees. This suggests that the parking fee was calculated based on time, and it cost 10 rupees for every 100 seconds (or 1 minute and 40 seconds) of parking.

Table 1: Parking Status

Sr. No.	Parking-1 Status	Time-1 (Sec)	Amount-1 (Rs.)	Parking-2 Status	Time-2 (Sec)	Amount-2 (Rs.)
1	Empty	0	0	Empty	0	0
2	Occupied	100	10	Occupied	600	60
3	Occupied	150	15	Occupied	450	45
4	Occupied	300	30	Occupied	200	20
5	Occupied	500	50	Occupied	350	35

Table 2: Parking Status

Sr. No.	Parking-3 Status	Time-3 (Sec)	Amount-3 (Rs.)	Parking-4 Status	Time-4 (Sec)	Amount-4 (Rs.)
1	Empty	0	0	Empty	0	0
2	Occupied	450	45	Occupied	200	20
3	Empty	0	0	Occupied	150	15
4	Occupied	430	43	Occupied	100	10
5	Occupied	500	50	Empty	430	43

VII. CONCLUSION

In this study, we have presented a Smart Car Parking System using IoT with ESP8266 and IR sensor, integrated with the Blynk app, as an efficient solution for parking space management and user convenience. By leveraging IoT technologies and integrating them into traditional parking infrastructure, we have developed a system that offers real-time monitoring, accurate data collection, and seamless communication between parking lots, drivers, and operators. The Smart Car Parking System using IoT offers a practical and effective solution for addressing parking challenges in urban areas. By harnessing the power of IoT and integrating it with user-friendly mobile applications, we have created an intelligent parking management system that improves efficiency, convenience, and sustainability. This research contributes to the growing body of knowledge in smart city development and demonstrates the potential for IoT-based solutions to transform traditional infrastructure into smart and interconnected systems.

Future Improvements

- While our system demonstrated successful implementation, there are opportunities for further enhancements.
- Integrating advanced technologies like license plate recognition or integrating with navigation systems can further streamline the parking experience.
- The system's security features could be strengthened to protect user privacy and prevent unauthorized access to the IoT infrastructure.

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