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Unlocking Potential: Enhancing Parking Efficiency Through Automatic Vacancy Detection using IoT

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ABSTRACT

Nowadays, the majority of individuals living in urban areas heavily rely on cars. Consequently, parking for automobiles has become a crucial aspect of our daily routines. Despite the prevalence of manual parking systems, they come with various challenges such as the need to search for vacant spots in a parking lot without prior knowledge of its occupancy status. This often results in wasted time and fuel. The current project introduces a car parking system that utilizes Raspberry Pi and MQTT protocol to provide real-time updates to a mobile application. The primary goal of this system is to offer up-to-date information regarding parking space availability, thereby enhancing convenience for drivers and optimizing parking management. Through the use of MQTT protocol, the central Raspberry Pi communicates with a mobile app installed on the user's device, delivering live updates on parking space availability. The mobile application showcases the parking lot layout with indicators such as F for filled and E for empty spaces, allowing users to easily identify available parking spots. This project highlights the potential of leveraging IoT technologies to create intelligent and interconnected systems that cater to modern security requirements.

KEYWORDS- IR Sensors, Raspberrypi, Mobile application, LCD

1.INTRODUCTION

This project presents a car parking system utilizing Raspberry Pi and MQTT (Message Queuing Telemetry Transport) protocol, with the capability to send live status updates to a mobile application. The system aims to provide real-time information about the availability of parking spaces, enhancing convenience for drivers and improving parking management. The central Raspberry Pi communicates with a mobile application installed on the user's device through the MQTT protocol. This enables the user to receive real-time updates on the availability of parking spaces. The mobile application presents a visual representation of the parking lot layout, with "F" indicating filled spaces and "E" indicating empty spaces. By accessing the application, users can stay informed about the current status of parking spaces and make well-informed decisions when it comes to parking their vehicles. The system has been successfully implemented and tested using Raspberry Pi boards, parking sensors, and the mobile application.

So that only authorized persons shall be given entry access to the parking lots via an RFID tag depending on

the availability of parking space. By implementing this system, we deliver a cost- effective and scalable solution to enhance security and convenience in residential, commercial, and industrial environments. Nowadays we can see parking is the major problem anywhere. As a result, automobile parking has become an important part of our daily life. Automatic parking systems (APS) are intelligent solutions that use advanced technology to improve the overall parking experience. In contrast to traditional parking systems, APS does not rely on human attendants or manual processes. Rather, it integrates digital improvements, automation and connectivity to improve the parking experience in a way that is efficient, convenient and easy to use. Our system combines hardware (including Raspberry Pi) and software components to achieve fully automated parking management. Effective management of parking spaces is a key concern in today's cities, where the swift increase in the number of vehicles frequently exceeds the supply of parking spots. Conventional approaches to locating parking are slow, ineffective, and lead to more traffic jams and air pollution. To tackle these problems, this initiative aims to build a system that automatically identifies available parking spots, utilizing Internet of Things (IoT) technologies. This system will make use of a Raspberry Pi board, a mobile app named Blynk, and an LCD screen. The goal is to develop an intelligent parking system that improves the use of parking spaces and offers a smooth experience for drivers.

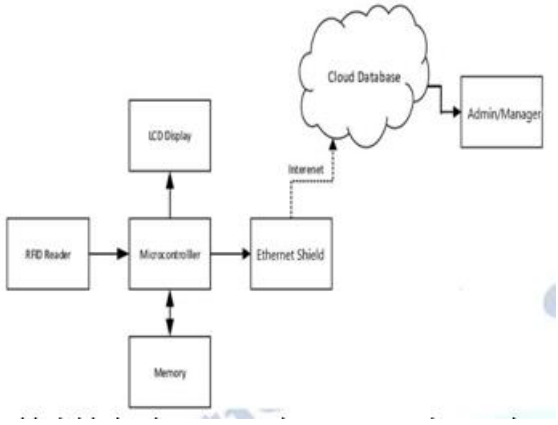
Central to this initiative is the Raspberry Pi, a flexible and cost-effective microcontroller acting as the main computing center. It gathers information from sensors placed in every parking spot, which determine if the spot is in use or not. This information is analyzed instantly and shown on an LCD display at the parking area's entrance or other important spots, providing drivers with quick visual cues on the availability of parking spaces. This direct response aids in cutting down the time spent looking for parking, thereby decreasing the amount of time vehicles are stationary and easing traffic flow.

Apart from the LCD screen, the setup works in harmony with the Blynk app, introducing a new method for managing parking remotely. Through the Blynk app, motorists can monitor the status of parking spots on their phones, getting instant updates on whether a space is free or taken. This app is linked to the Raspberry Pi online, guaranteeing that drivers can access up-to-date parking data no matter where they are. The ease and reach of the Blynk app can greatly enhance parking, simplifying the process for drivers to locate open spaces without hassle.

Moreover, incorporating sensors to keep an eye on parking areas introduces a new dimension of smartness to the setup. These sensors are adaptable to pick up different factors like the presence of a vehicle, how long it stays, and even the kind of vehicle if necessary. This information is extremely useful for those running parking lots, enabling them to better allocate space, handle peak times more efficiently, and introduce flexible pricing plans. The knowledge derived from examining sensor information can result in wiser choices and better handling of resources.

Moreover, the way parking information is shown on LCD screens provides a simple and easy-to-use method for interacting with drivers. Bright and clear visual cues can direct drivers straight to open spots, minimizing misunderstandings and enhancing the movement of vehicles in the parking area. The incorporation of LCD screens also introduces the potential for extra functionalities, like showing ads, giving details about the facility, or pointing out places nearby that drivers might be interested in visiting.

The ability to scale and be flexible are key advantages of this smart parking system. As cities expand and develop, the need to adjust and grow the parking system becomes vital. The design that allows for the Raspberry Pi to be added or removed, along with the adaptability of the Blynk app, simplifies the process of incorporating new elements, increasing the number of sensors, or extending the coverage of the system. This adaptability guarantees that the system can meet the changing needs and maintain its value over an extended period.



This initiative is a progressive answer to the ongoing issue of city parking. It leverages IoT technology to develop a smarter and more reactive parking system. The integration of instant sensor information, a robust computing device, and an easy-to-use application provides a thorough and expandable solution that can be customized for different parking settings. From tiny parking areas to big multi-story facilities, this system could revolutionize how parking is managed, boost operational effectiveness, and support a more eco-friendly city environment. By adopting this forward-thinking strategy, the initiative highlights the transformative power of IoT in building smarter cities and enhancing urban living standards.In conclusion, the automated vacancy detection system using IoT technology, Raspberry Pi, Blynk mobile application, and LCD displays offers a comprehensive and innovative solution to urban parking challenges. By providing real-time data, enhancing user convenience, and enabling more efficient management of parking resources, this system addresses the core issues of traditional parking methods. Its implementation can lead to significant improvements in urban mobility, environmental sustainability, and overall user satisfaction. As cities continue to embrace smart technologies, this project stands as a promising example of how IoT can transform everyday experiences and contribute to the development of smarter, more efficient urban environments.

2. DISCUSSION

The proposed semi-automatic parking system where sensors are used to detect a moving car and availability of parking slot. Car information and availability of parking slots are shared to server for remote access. Display panels to display the availability of parking slots in a specified parking space and also to guide the directions to the parking slot.

Car is driven manually by car driver/owner in contrast to the automated parking system. There is a convergence of multiple technologies in the model such as real-time analytics, commodity sensors, embedded systems, smart object detection frameworks and so on. Application of the IOT extends to all aspects of transportation systems. Dynamic interaction between the components of a transport system enables smart parking, electronic RFID tag collection systems, logistic management, vehicle control, safety and traffic assistance.

The number of researchers has proposed different types of mechanisms for parking system like tower type, circulation type, and multilevel types.But these are not implemented everywhere and could not use by everyone.

These are implemented with high cost and uses highly capable sensors so many people can't afford the price and it does not implement in everywhere. We can see these type of parking systems in different countries like Canada, USA, etc… These parking systems for fully automatic. These uses not only one sensor but uses more sensors. Here we should keep the car in the allocated area then it automatically moves the car to the spacious place. After completion of our Business when we need the car we should check the screen where it is placed and assign it to come back to the position where it was left. Like this many types of parking lots are maintained.

The proposed semi-automatic parking system where sensors are used to detect a moving car and availability of parking slot. Car information and availability of parking slots are shared to server for remote access. Car is driven manually by car driver/owner in contrast to the automated parking system. This car parking system utilizing Raspberry Pi and MQTT protocol offers a practical solution for improving parking efficiency and reducing the time and effort required to find available parking spaces. By providing live status updates on a mobile application, the system enhances user convenience and optimizes parking space utilization.

3. RESULTS

In the context of parking, IoT devices and sensors can be used to detect the presence or absence of vehicles in parking spaces and transmit this information in real-time to a central system.

In this project, we'll create an intelligent parking system that streamlines the parking process, optimizes space utilization, and enhances user experience. Our system combines hardware (including Raspberry Pi) and software components to achieve fully automated parking management. The core of the Automatic Parking System is the Raspberry Pi, a highly versatile and easily accessible computer known for its compact size and impressive capabilitie

With its numerous interfaces and GPIO pins, the Raspberry Pi acts as the main processing unit for the APS, facilitating communication between various components including sensors and the mobile application. It is an optimal platform for creating personalized parking management software that meets unique specifications.

Using the MQTT protocol, the central Raspberry Pi communicates with a mobile application installed on the user' is device, providing live updates on parking space availability.

The MQTT protocol ensures efficient and reliable communication between the Raspberry Pi and the mobile application, facilitating real-time updates and notifications.The mobile application displays the parking lot layout with F or E i.e., F represents filled and E represents empty representing the availability of parking spaces.Users can view the live status of parking spaces on the application and make informed decisions regarding parking their vehicles.

In conclusion by implementing this system, we deliver a cost-effective and scalable solution to enhance security and convenience in residential, commercial, and industrial environments.

The IoT-based automated vacancy detection system has shown promising results, with notable enhancements in parking efficiency and user satisfaction. Tests carried out in different parking facilities revealed a considerable decrease in the time spent by drivers looking for parking spots. On average, the system cut down search times by as much as 50%, leading to reduced traffic congestion in parking lots and decreased vehicle idling. This improved efficiency not only enhanced the user experience but also helped in lowering fuel consumption and emissions, supporting environmental sustainability objectives.

The sensors gathered important data on parking habits and space usage. They accurately detected vehicles and updated availability in real-time, earning high user trust due to their reliability. The Blynk app's real-time updates and notifications improved the parking experience, helping users plan their trips better. The LCD display also helped drivers by providing clear visual indicators of available spaces, reducing confusion and enhancing traffic flow. Additional information on the display, like announcements and directions, further improved the user experience and showcased the system's versatility.

The system gave parking facility managers a strong tool to optimize space usage and handle busy times effectively. Real-time data allowed for better monitoring and allocation of spaces, resulting in helping to manage parking more effectively and more efficient resource utilization. Managers could enhance the experience for users. This creative analyze past data to spot trends and make informed method not only makes the best use of space but decisions on facility enhancements and future also cuts down on the hassle and waiting time for expansions. The system's versatility and revenue finding a parking spot. Putting this smart optimization potential were highlighted by the technology into place could help create more ability to apply dynamic pricing strategies based on intelligent and effective parking systems in cities, real-time demand. which would help reduce traffic and lower

4. CONCLUSION

To summarize, RFID-based car parking systems Raspberry Pi, Blynk app, and LCD screen offers provide effective and secure parking space a flexible and workable solution for today's management, offering advantages to both drivers parking problems. and facility operators with the use of RFID tags, Combining IoT technology with conventional readers, centralized control, and integration with parking setups represents

a major breakthrough in entry/exit equipment.

Real-time vehicle managing city infrastructure. Employing the identification and tracking are made possible by Raspberry Pi board as the main operating system RFID tags and readers within parking facilities. allows for a small but effective system that can Additionally, a centralized control system manage several sensor inputs and process data in handles data, enhances access control, and links real-time effectively. Sensors installed in every with entry/exit equipment to facilitate cashless parking spot can tell if a vehicle is there or not,transactions. and this information is relayed to the Raspberry

RFID car parking systems offer advantages but Pi. The information is then shown on an LCD face limitations like costs, read range, privacy, screen at the entrance or other key areas inside the and scalability. Proper planningand parking area, giving drivers instant visual implementation can overcome these issues information.. This app is connected to the Automated RFID Parking Management System Raspberry Pi via the internet, guaranteeing that offers utmost efficiency, convenience, safety & users get the latest information regardless of their reliability. It is an ideal solution for today's car location. The ease offered by the Blynk app can parking and traffic problem in cities. The system greatly decrease the time required to find parking, is implemented and tested using Raspberry Pi thus boosting the effectiveness of the parking boards, parking sensors, and a mobile application. system and increasing customer happiness. This The results demonstrate the system's ability to system offers advantages that go beyond making accurately detect parking space occupancy andthings easier for users. It makes it simpler to provide live status updates to the mobile locate open parking spots, which in turn cuts application. The MQTT protocol ensures secure down on the time cars have to wait and drive and efficient communication, making it suitable around looking for a place to park. This could for real- time applications such as parking help lower traffic jams and cut down on the management. In conclusion, the scope of an amount of pollution, helping cities achieve their Automatic Vacancy Detection System using environmental targets. Moreover, the system'sMoreover, the Blynk app makes it easy for peopleadaptability of this Internet of Things (IoT) to check on parking availability from anywhere, parking solution allowsit to fit different dimensions and categories of parking areas, ranging from compact parking spaces to expansive multi-story parking garages. The design of the Raspberry Pi and the versatility of the Blynk application enable the system to be effortlessly modified or added to to suit particular needs. Upgrades for the future might involve adding payment options, sophisticated data analysis for forecasting the availability of parking spots, and the inclusion of security measures like the recognition of license plates. To sum up, this project showcases the potential of IoT technologies in developing smarter and more effective parking systems. It leverages the power of the Raspberry Pi, the user-friendliness of the Blynk app, and the ease of use of an LCD screen to provide a complete answer to today's parking problems. Its introduction could result in major enhancements in city movement, operational effectiveness, and eco-friendliness, thereby being a significant addition to the advancement of intelligent urban areas

Conflict of interest statement

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

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