Microcontroller-Based Parking Management

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Abstract: *With increase in urbanization , all over the world , people are facing parking problems in the cities. Due to the dense population a lot of vechicles are running on the roads leading to parking problem, traffic problem. The new challenge with which the society is dealing is the problem of vehicle parking. This paper proposers a automatic real-time parking system. With the help of the internet of things (IOTs) we the system is implemented. IOT exchanges information or data between different physical devices. Arduino Uno is a microcontroller used in the system. The use of Arduino in the system is to provide a communicate platform between the digital devices and interactive objects that senses and controls physical devices. The system incorporated an infrared sensor at the entry for getting information about the vacancy position of the parking slot. The suggested approach focus to facilitate the economical and effective location of available parking slots. The results for the proposed system is recorded and presented, to demonstrate its significant performance and showing great accuracy for the tested scenarios.*

Keywords- Internet of things (Iot), IR Sensor, Ardunio, RFID tags, Radio frequency identification(RFID).

I. INTRODUCTION

The Internet of things (IOTs) technology, plays a crucial role in todays world for the life of human beings. With the help of IOT, humans are getting effective output with very little effort in todays world. It reduces the errors caused by humans due to negligence. Manually seeeking for parking slots in crowded areas (like malls parking space) is challenging and inefficient for drivers. Traditional methods of locating vacant or occupied spaces are unreliable. There is often a tendency to park as near as possible to the destination to avoid wastage time in searching for free parking slots. The parking system effectively manages the parking space and it will manage collision among the vehicles at the same time. IoT-based parking organizes the parking slot very efficiently. The empty slots will be displayed on the lcd board which will help the drivers/users to find vacent space in the parking area within very less time or in no time. It will ultimately resuld to save the time

and fuel for the user's. For developing a automated parking system, a Wireless Sensor Network(WSN) [6] represent two of the most common and capable IoT technologies i.e. Ultra-High Frequency (UHF) and Radio Frequency Identification (RFID), etc. Due to low-cost and low-power technology RFID is used. [1] RFIDs are used to transmit data once powered by the electromagnetic field generated by a reader involving passive devices, named tags. In the technique used, the customers are also guided to the vecant parking space using video displayed on the lcd board on the entrance of the parking structure. As the empty and occupied slots, are displayed on the LCD, which show a visual representation of the parking slot, which is be green and red respectively . The customer has furnished with such a tag that he gets because once he registers, this tag has been connected with his prepaid account as well as contains confidential information, and this tag uses an Fig.1: IOT based smart Vehicle parking system-using RFID Block Diagram

RFID system and has been mounted on the surface of the windshield of the customer. A parking fee has been instantly deducted from the user's account based on the period consumed inside the parking area[1]. RFID is used to register to every customer for once, as well as RFID tag is attached to the registered vehicle instead creating a token.

The RFID tag is given to each the user who has registered , the tag which stores various data of the vehicle such as Vehicle number; name of the vechicle owner, the contact number of the registered user to communicate, and the available amount in the vehicle. The card reader system gets the details(data of the user) stored in the vehicle as soon as the vehicle enters and exits the parking area. The LCD board will display the important messages to the vehicle driver/owner. ESP12 Node MCU which has an inbuilt IOT module will also use the internet to provide an interface with the website. IOT module is used to tell continuous real-time that are to be reflected on to the website. The LCD board is used to display available slots in the

parking. The Circuit diagram which involves a Node MCU[4] development board. A I2C Pins which are used to hooking up all the sorts of the I2C sensors and peripherals. It supports both of the 12C sensors which are I2C Master and I2C Slave. a program will help to check the I2C interface functionality. The frequency which is generated by the clock signal is to be 100 kHz. It also involves LCD display, a servomotor, a IR sensors, and a RFID.

II. LITERATURE REVIEW

1.   Adnan Zahid, Naveed Mufti, Sadiq Ullah has published a paper based on vacent parking slot which is an IOT based system which proposed a novel approach to solve the problem of parking congestion in cities. The authors gave an iot based approach to solve the parking problem. It is an iot-based system which utilizes inkjet-printed RFID tags to accurately determine the occupancy status of parking spaces. In this paper the author reviews existing methods for parking slot detection with the help of the camera-based system, magnetic sensors and ultrasonic sensors.

The authors highlights the RFID technology to detect parking slot detection because of its low cost, ability and durability to operate in crowed environment. The authors come across the challenges associated with RFID tags in parking applications, like tag interference and the need for reliable tag reading.

2.   J. Yang, J. Portilla, T. Riesgo [6] has gave the approach for address the challenges of parking congestion in cities where population is over crowded by utilizing Wireless Sensor Networks(WSNs) to provide a smart parking service. The authors propose a system that enables drivers to efficiently locate available parking spaces, reducing the time and energy spent on searching.

The authors highlight the potential of WSNs for improving parking management due to their low cost, flexibility, and ability to provide real-time information. The authors conducted tests in a parking area to evaluate the accuracy of vehicle detection and the responsiveness of the system. The results indicate that the WSN-based approach can accurately detect vehicle presence and provide real-time information to users. By leveraging WSN technology, the proposed system offers a more efficient, convenient, and informative solution for drivers.

3.   P. Sadhukhan has proposed an IoT-based e-parking system[4] that utilizes sensors and mobile applications to provide real-time parking information and enable efficient parking management. The author reviews all existing methods for parking management, including traditional methods based on physical signs and manual monitoring. These methods are often inefficient and time-consuming.

The author highlights the of IoT technology for improving parking management due to its ability to provide real-time data, enable remote monitoring, and facilitate efficient resource allocation.

Proposed work of the author: A network of sensors is deployed throughout the parking area to detect the presence or absence of vehicles. The gateway collects data from the sensors and transmits it to a central server. The server processes the data, updates the parking status, and provides information to users through a mobile application. The application allows users to view real-time parking availability, navigate to available spaces, and potentially reserve parking spots.

The results indicate that the IoT-based approach can accurately detect vehicle presence and provide real-time information to users.

Literature Review

s.no	Author	Methodology used	Research Gap
1	Adnan Zahid, Naveed Mufti, Sadiq Ullah, "IoT-Enabled Vacant Parking Slot Detection System Using Inkjet-Printed RFID Tags ", IEEE SENSORS JOURNAL, VOL. 23, NO. 7, 1 APRIL 2023	RFID Sensor, RFID tags	It is inefficiency and unreliability of traditional parking systems, with this system offering a low-cost, efficient alternative using passive RFID and IoT integration
2	J. Yang, J. Portilla, T. Riesgo, "Smart parking service based on Wireless Sensor Networks", 38th Annual Conference on IEEE Industrial Electronics Society (IECON 2012), pp. 6029 – 6034, Oct. 2012. Oct. 2012	Wireless sensor network	Optimizing energy consumption through techniques like adaptive sampling, duty cycling, and low-power modes remains a crucial area of research. Research on secure communication protocols, encryption techniques, and intrusion detection systems is necessary.
3	P. Sadhukhan, "An IoT-based E-parking system for smart cities,"Int. Conf. on Advances in Computing, Communications and Informatics (ICACCI), Udupi, 2017, pp. 1062-1066, doi: 10.1109/ICACCI.2017.8125982. Jan. 2017	RFID tags and sensors to collect data that enhances decision-making processes in farming,	Optimizing energy consumption through techniques like adaptive sampling, duty cycling, and low-power modes is essential for long-term sustainability.

III. PARTIAL PROPOSED WORK
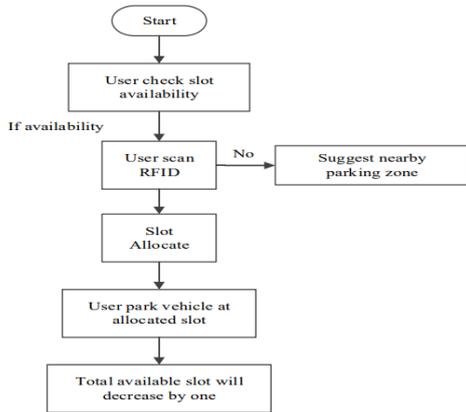
A. Vehicle Allocation Flow Chart

Fig.2: vehicle allocation flow chart

Algorithm

Start: Begin the process.

Check Slot Availability: The system checks if any parking slots are available.

Slot Availability Decision:

- If Available: Proceed to the next step.

- If Not Available: Suggest a nearby parking zone and terminate the process.

User Scans RFID: User scans their RFID for identification.

Allocate Slot: The system allocates a parking slot to the user.

Park Vehicle: The user parks their vehicle in the allocated slot.

Update Available Slots: The total number of available slots is decreased by one.

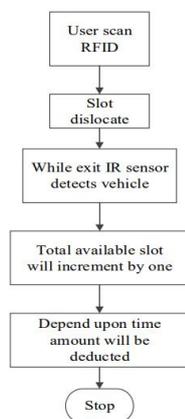End: The process is completed.

B. Vehicle dislocation Flow Chart

Fig.3: vehicle dislocation fow chart for

Algorithm:

User scans RFID to begin the parking process.
After successful RFID scan, a parking slot is dislocated (allocated).
The user parks the vehicle in the dislocated slot.
On exit, the IR sensor detects the vehicle leaving the parking area.
The total number of available parking slots is incremented by one.
Based on the time the vehicle spent in the parking lot, calculate the total duration.
The parking fee is deducted based on the calculated time.
The process is completed and the system stops.

IV. PARAMETERS SET FOR THE TOOLS USED

- trigPin (Pin 2): The pin used to send a trigger signal to the IR sensor.
- echoPin (Pin 3): The pin used to receive the reflected echo signal from the IR sensor.
- lcdPin1, lcdPin2, lcdPin3, lcdPin4 (Pins 4, 5, 6, 7): The pins used to control the LCD screen.
- servoPin (Pin 9): The pin controlling the servo motor.

V. EQUATION

- The formula used to calculate the distance is:

$$distance = pulse\ duration/29 \times 2$$

it is based on the speed of sound in air, where the pulse duration in microseconds is divided by 29 to get the distance in centimeters and divided by 2 because the sound travels to the object and back.

VI. WORKING OF THE PARKING SYSTEM

Various modules are explained individual as following:

I. Entering the parking slot

At the gate RFID Reader is installed, the RFID vehicle of the Driver is scanned, as soon as the vechicle enters the parking area. Once the authentication is sucessfully completed, the system will check for the free space available in the parking area. As soon as the checking is completed the available and most suitable slot is displayed on the LCD screen and the slot is alloted to the vechicle. The counter is acitivated and the free slot counted will be decremented by one. All the important information is made available on the website once updated so that the other vechicles owner is benefitted.The users can pre-book the empty slot by

using the advanced pre-booking option available on the website.

II. *Exit from the parking area*

Once the vechicle is exit parking slot the counter will increase the count of the vacent slot by one and the amount of booking will be deducted from the owners account.The website is synchronized with the system.

III. *Identification message for the free slot*

The available parking slot of the perticular location is displayed on the website once the using ip address which is generated by the Node MCU is entered on the address bar of the browser.

VII. CONCLUSION

The proposed effective parking system that ensures to reduce vehicle traffic in the smart cities. There is a Significant advancements in the Internet of Things(IoT) and Cloud technology have taken place. The model parking issue, which is integrated with smart parking system based on the IOT cloud could be resolved. Through the website the Realtime parking communication is done with both the user. Which Ultimately, improves the standard of living of the consumers.

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