IOT Based Smart Parking System Using Android

P. Shalini[1],
M. Mounika[2], E. Sravani[3], V. Navya Teja[4], S. Gowri[5], T. Sandeep Reddy[6]
[1]*Assistant Professor, Department of ECE, PBR Visvodaya Institute of Technology And Science, India*
[2345] *UG Student Department of ECE, PBR Visvodaya Institute of Technology And Science, India*

***Abstract*—The Smart Parking System is an advanced, automated solution designed to manage vehicle parking efficiently using IoT and embedded technology. The system is equipped with IR sensors to detect vehicle entry, exit, and individual slot occupancy for four parking spaces. An Arduino UNO acts as the central controller, coordinating the data received from sensors and managing the operation of DC motors, which open and close the parking gate. A servo motor is also integrated to handle finer gate control or restricted access mechanisms. To enhance security and authorized entry, an RFID module is added. Vehicles must scan a valid RFID card before being allowed into the parking area. Once verified, the servo motor operates to grant access. Additionally, a slide switch is implemented to manually override or reset the system in case of maintenance or emergencies. If all parking slots are full, the system automatically restricts entry, displaying a "Parking Full" message on a 16x2 LCD display, which also shows the real-time count of available slots. For remote monitoring, a NodeMCU module is integrated to upload sensor and occupancy data to ThingSpeak, enabling users and administrators to view live parking availability online. Further, an Android application is included in the system to provide users with a more interactive and user-friendly experience, allowing them to check parking slot availability in real time, receive notifications, and possibly even control certain features like gate status or alerts. This smart system not only optimizes parking space usage but also minimizes human intervention, enhances convenience, and improves security through RFID-based access control, real-time IoT monitoring, and Android connectivity.**

***Keywords*—Smart Parking, Android, RFID tags, Servo Motor, Thingspeak, Internet Of Things, LCD.**

I. INTRODUCTION

In today's fast-paced urban environment, managing parking spaces efficiently has become a significant challenge due to the increasing number of vehicles. Traditional parking systems often rely on manual monitoring and control, leading to congestion, delays, and mismanagement of available space. To address these issues, this project presents a Smart Parking System that utilizes IoT, RFID technology, and embedded systems to automate and optimize the parking process. The system uses IR sensors to monitor vehicle entry, exit, and the occupancy status of individual parking slots. A NodeMCU module is employed to upload real-time parking data to ThingSpeak, enabling remote access and monitoring through the internet. The core of the system is managed by an Arduino UNO, which controls the components such as sensors, motors, display, and communication modules.

An RFID module is integrated to enhance security by allowing only authorized vehicles to enter. When a valid RFID card is scanned, a servo motor operates the gate to allow access. If the parking slots are full, the gate remains closed, preventing further entries. A slide switch is added to offer manual control over the gate during system maintenance or emergencies. A 16x2 LCD displays the number of available parking slots and system status messages like "Parking Full" or "Access Denied". To improve user interaction, the system includes an Android application that provides users with real-time updates about parking slot availability and gate status. This combination of technologies not only automates the parking process but also ensures enhanced security, user convenience, and optimal space utilization.

II. LITERATURE SURVEY

Previous research in smart parking systems has explored the use of IR sensors for detecting vehicle presence and microcontrollers like Arduino for managing slot occupancy. Several systems integrated IoT platforms such as ThingSpeak using NodeMCU to provide real-time slot status monitoring over the

internet. Others focused on enhancing security through RFID-based access control, allowing only authorized vehicles to enter. However, most existing systems lacked full integration of these technologies and often did not provide complete automation or user interaction features. In some cases, Android applications were developed to display parking data, but they were not connected to physical control systems like gates or sensors. Manual override mechanisms, such as slide switches, were also rarely included for maintenance or emergency purposes. These limitations highlight the need for a more comprehensive system. This project addresses the gaps by combining IR sensors, RFID authentication, servo motor-based gate control, slide switch manual override, IoT-based cloud monitoring, and a user-friendly Android app into a single, reliable, and automated smart parking solution.

Title: Smart Parking: A Literature Review from the Technological Perspective
Authors: Carlos E. Palacios, Juan C. Cano, Carlos T. Calafate, Pietro Manzoni
Abstract: The growth of the Internet of Things (IoT) has enhanced quality of life and strengthened various societal sectors. Many cities aspire to become smart, with smart parking solutions being a popular use case. These solutions optimize time, reduce fuel consumption, and lower CO_2 emissions. This paper reviews several works related to smart parking solution deployment, identifying commonly used components and highlighting usage trends. The analysis provides a valuable source of information for the scientific community in selecting components for implementing smart parking solutions.

Title: A Review on IoT-based Electric Vehicle Charging and Parking System
Authors: S. S. Thorat, et al.
Abstract: The integration of IoT in smart city initiatives has led to the development of cloud-integrated smart parking systems. This paper presents an IoT-based model that monitors and provides information about parking space availability. Utilizing sensors like infrared and ultrasonic, and processing units such as Raspberry Pi, the system communicates between the cloud and sensors. A mobile application enables users to check real-time parking availability and make reservations. The study highlights the system's potential to reduce the time spent searching for parking and improve overall efficiency.
Title: RFID-Cloud Integration for Smart Management of Public Car Parking Spaces
Authors: Umar Yahya, Ndawula Noah, Asingwire Hanifah, Lubega Faham, Abdal Kasule, Hamisi Ramadhan Mubarak
Abstract: Effective management of public shared spaces, such as car parking, is a significant challenge for many cities, especially in the developing world. By leveraging sensing technologies, cloud computing, and Artificial Intelligence, cities are increasingly managed smartly. This paper presents a framework integrating IoT and cloud computing for managing public car parking spaces. Reservations are made through a cloud-hosted application, while access is controlled via RFID technology, updating parking slot availability in real-time. This approach aims to enhance convenience for city dwellers and contributes to the realization of sustainable smart cities.

III. EXISTING MODEL

Traditional parking management systems rely heavily on manual monitoring and ticket-based entry, which are often inefficient and prone to human error. In conventional systems, parking attendants manually check available spaces, guide vehicles, and control entry and exit points. This approach leads to delays, congestion, and mismanagement, especially in high-traffic areas. Additionally, static signage indicating availability is often outdated, causing frustration for drivers searching for vacant spots. The absence of real-time monitoring and automated controls results in poor space utilization and increased operational costs. Furthermore, without IoT integration, there is no remote access to parking data, making it difficult for authorities to optimize space usage and improve user experience

IV PRAPOSED MODEL

The Smart Parking System leverages IoT and embedded technology to automate parking management and enhance efficiency. It utilizes IR sensors to detect vehicle entry, exit, and parking slot occupancy, ensuring real-time monitoring of available spaces. A DC motor-driven gate operates automatically based on parking availability, preventing excess vehicles from entering when slots are full. The system displays real-time updates on an

LCD, providing users with clear information about slot availability. Additionally, a NodeMCU module uploads data to ThingSpeak, enabling remote monitoring of parking status. Arduino UNO acts as the central controller, coordinating sensors, motors, and displays for seamless operation. By automating parking space management, the system minimizes manual intervention, reduces congestion, optimizes space utilization, and enhances user convenience.

Block diagram:

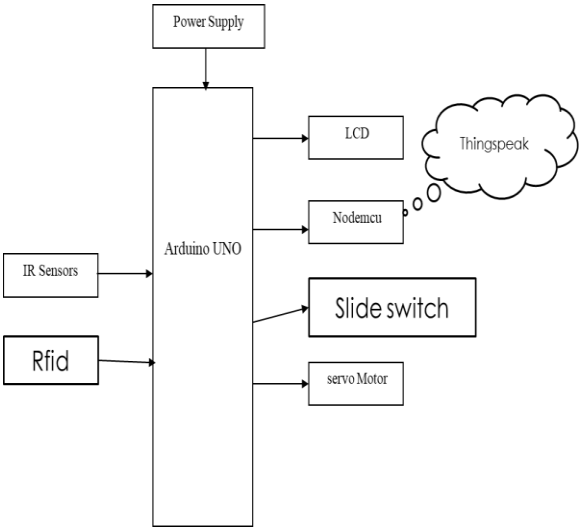


Fig 4.1:-.Block diagram

V HARDWARE

A. IR Sensor

IR Sensor An infrared sensor is basically an electronic device which is used to detect the presence of objects. Infrared light is emitted by this device. If this device does not detect any IR light reflected back that means there is no object present. If the light is detected by the sensor there is an object present.

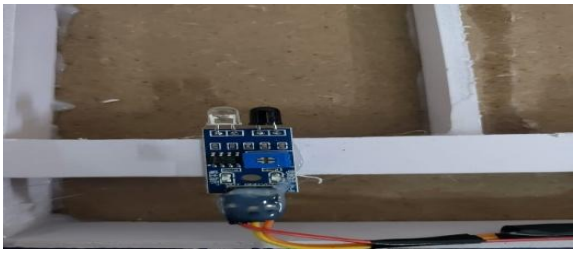


Fig 4.2:- IR Sensor

B. RFID Card

RFID tags are made up of integrated circuit (IC), an antenna, and a substrate. It is an identification badge or credit card that transfers its contents about an object to the reader module. RFID tag transfers data about an object through radio waves. When RFID tags are attached to devices they can also be used for tracking.

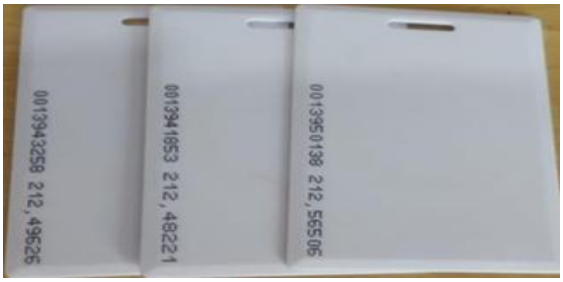


Fig 4.3:- RFID Card

C.READER Module

This module is a device which scans and gathers the information from the RFID Card. This card can be used to track objects. As the car enters the parking area, the user scans the RFID card and all the information stored in card is transferred to the admin through this module.

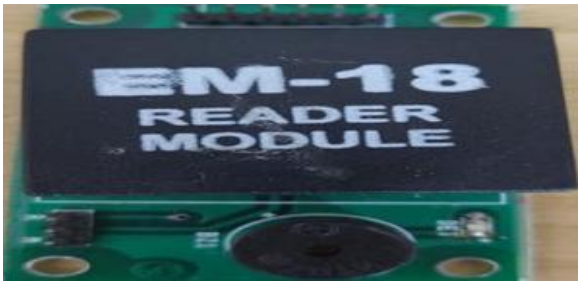


Fig 4.4:- Reader Module

D. Servo Motor

It is a rotator device that allows the control of angular as well as linear motion. A servo motor is used for the opening and closing of the gate. Servo drive transmits electrical signals to the servo motor for producing motion.

Fig 4.5:- Servo Motor

E. Arduino Uno

It is a compact board which can be used in various devices and various field. It has overall 22 input/output pins out of which 14 pins are digital pins. It has a flash

memory of about 32 kb. These pins can control the operations of digital pins as well as analogy pins. This module is a breadboard friendly board which can be easily used anywhere.

Fig 4.6:- Arduino

F. NODEMCU

It is used to send data from embedded system to the internet using URL by HTTP POST method using TCP/IP protocol. It is developed by espressif systems. It is a 32 bit microcontroller with 80kb user data. It contains 16 gpio pins.

Fig 4.7:- WiFi Module

G. LCD 16x2 display:

The LCD display in an automatic smart parking system briefly shows Available parking slots The number of empty spaces. Parking full status Indicates when no spaces are left. Slot-specific info (sometimes) Whether individual numbered slots are free or occupied.

V RESULT

The arrangement of an SDIOT-like smart parking system can be visualized as a layered architecture with interconnected components. This system use IR sensors in each parking spot and RFID verifies access at gated spots. This data is instantly transmitted by NodeMCU over a smart SDN network to a central server. This system updates a android app showing real-time parking availability and controls gates. The arrangement of this system using embedded systems as shown below.

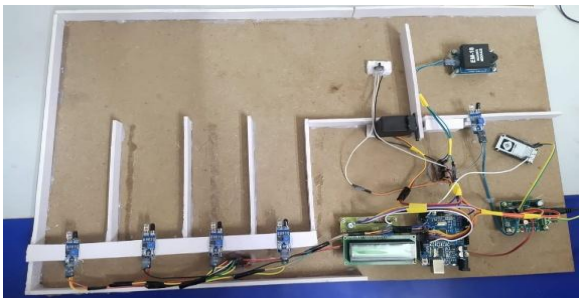


Fig 5.1:- Arrangement of the system

- Opening the gate when vehicle is detected using IR Sensor at Entrance of Parking area

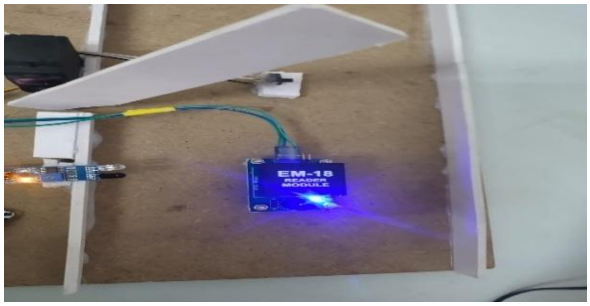


Fig 5.2:- Gate is opened

- After entering the vehicle, it is parked in selected slot then the filled slot is displayed in both LCD and android app.
- Available parking slots: The number of empty spaces.

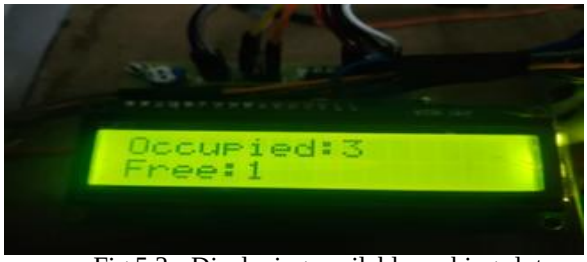


Fig 5.3:- Displaying available parking slots

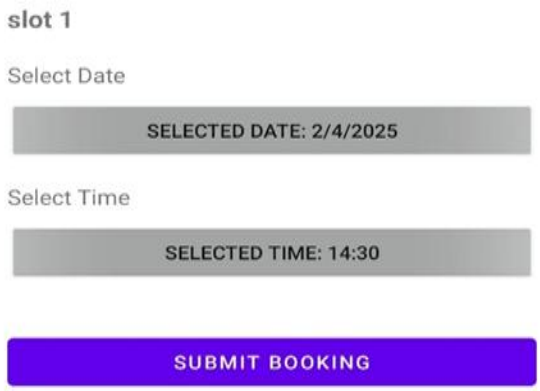
Fig 5.4:- Displaying parking full status

Gate is opened: it indicates when gate is opened

Fig 5.5:-. Displaying gate is opened

Fig 5.6:- Android app

Clicking on the book option it will show the date and time page as shown in below fig.



Once we enter the date and time and click submit booking the slot will be booked successfully. And we can also view our booking history. The data is also we can view on thing speak. Slots data is also displayed in thing speak.

Fig 5.7:- Displaying available slots

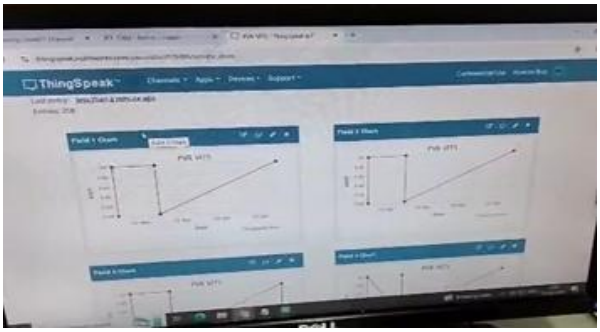


Fig 5.8:- Displaying data on thing speak

VI CONCLUSION

The integration of IoT and embedded technologies in parking management systems addresses the pressing challenges of urban congestion and inefficient space utilization. The "Smart Parking System" exemplifies this integration by automating vehicle detection, gate control, and real-time status updates. Employing components such as IR sensors, DC motors, Arduino UNO, and NodeMCU for data transmission to platforms like Thingspeak, the system enhances operational efficiency and user convenience. As urban centers continue to grow, the adoption of such automated solutions is imperative for sustainable and efficient parking management.

VII FUTURE WORK

The future of smart parking system is expected to be significantly influenced by the arrival of automated

vehicles (AVs). Several cities around the world are already beginning to trial self-parking vehicles, specialized AV parking lots, and robotic parking valets. The automated parking fee system would allow people to travel without cash. Also, as it would reduce the waiting time, long queues, tension, stress and increase the efficiency of the parking system. The smart parking management system can be applied for plane, ship and fleet management. For residential and domestic parking system the device can be interfaced with Home Automations which can control the various home appliances by sensing whether the user is arriving or departing from the parking space.

REFERENCE

[1] Biyik, C., Allam, Z., Pieri, G., Moroni, D., O'Fraifer, M., O'Connell, E., Olariu, S., & Khalid, M. (2021). Smart Parking Systems: Reviewing the Literature, Architecture and Ways Forward. Smart Cities, 4(2), 623-642.

[2] Palacios, C. E., Cano, J. C., Calafate, C. T., & Manzoni, P. (2019). Smart Parking: A Literature Review from the Technological Perspective. Applied Sciences, 9(21), 4569.

[3] Cahyadi, N., Dorand, P., Rozi, N. R. F., Haq, L. A., & Maulana, R. I. (2023). A Literature Review for Understanding the Development of Smart Parking Systems. Journal of Informatics and Communication Technology (JICT), 5(1), 46-56.

[4] Thorat, S. S., et al. (2020). A Review on IoT-based Electric Vehicle Charging and Parking System. International Journal of Engineering Research & Technology (IJERT), 9(8), 361-364.

[5] Yahya, U., Noah, N., Hanifah, A., Faham, L., Kasule, A., & Mubarak, H. R. (2022). RFID-Cloud Integration for Smart Management of Public Car Parking Spaces. arXiv preprint arXiv:2212.14684.

[6] Allam, Z., & Jones, D. S. (2020). On the Future of Smart Cities: Smart Parking as a Mobility Indicator. Urban Science, 4(4), 51.

[7] Idris, M. Y. I., Leng, Y. Y., Tamil, E. M., Noor, N. M., & Razak, Z. (2009). Car Park System: A Review of Smart Parking System and its Technology. Information Technology Journal, 8(2), 101-113.