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Parking System using RFID

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ABSTRACT: The global population is growing in the present day. People who use cars increase in number in conjunction with the population. There are numerous problems brought on by the large number of automobiles, including traffic jams, pollution, and inappropriate parking. Roads become extremely congested when cars are parked on the side of the road, especially in cities. Hardware sensors are utilized through the structure to identify open slots and instantly notify drivers of them. IoT technology is a crucial factor in real-time data collecting and analysis, in addition to cost and travel time savings. This paper describes Parking System Using RFID which mainly uses RFID technology, primarily to automate and effectively manage the parking procedures. It keeps tabs on slot occupancy and recognizes cars through RFID tags. In the recommended arrangement, an Arduino UNO microcontroller is used. It is mostly utilized to build connections with interactive objects, such as digital devices and objects that can perceive and manipulate physical objects. This device includes an ultrasonic sensor that detects the existence of a vehicle.

KEYWORDS: RFID Module, Arduino, Ultrasonic Sensor, Servo Motor.

I. INTRODUCTION

In today's hectic urban environments, drivers may find it extremely stressful to find parking spaces, which may cause them to greatly delay their trips. Our idea uses RFID (Radio Frequency Identification) technology must put in place an effective parking system to deal with this widespread problem. The goal of implementing RFID in parking systems is to reduce labour costs, retain car records, and offer straightforward solutions to issues that arise in parking lots[8]. Our project's primary intent is to lessen parking congestion in cities by utilizing cutting edge smart technologies. Traditional parking systems are sometimes plagued by inefficiencies since they still rely on human operations and outdated methodologies. Our Parking System, a clever and effective substitute, is designed to improve the overall parking experience for drivers and parking lot management by optimizing parking spot utilization. Our system's primary originality is its use of RFID technology, which means that it is possible for cars to be automatically and contactlessly identified as they enter and exit parking lots. Every car has an RFID tag that connects to RFID scanners positioned thoughtfully across the parking lot. This setup makes it possible to track parking space occupancy in real-time and provides instant information on available spots. This instantaneous information is helpful to drivers since it makes it easy for them to find open spaces, which reduces the stress and time that come with looking for parking in crowded urban locations.

Beyond just being convenient, our Parking System has major positive effects regarding the surroundings and the economy. Our objective is to speed up the parking process to reduce traffic generated by automobiles searching for spots. This will assist in reducing the percentage of emissions that comes from moving vehicles that are idling and circling. Insightful information about real-time data also helps parking lot managers make accurate choices on the maintenance of their facilities.

II. RELATED WORK

In [1], Mohan P. Thakre describes a Internet of Things based smart vehicle parking system. The system utilizes an ESP12 Node MCU, RFID vehicle readers, RFID tags, an I2C module, and an LCD to manage and display parking information. The ESP12 Node MCU acts as the system's central unit, connecting to the web to provide real-time updates on parking slot status, which are displayed on the LCD. RFID readers at the ingress and egress locations scan RFID tags with vehicle and owner details. The I2C module ensures efficient communication between the sensors and peripherals within the system.

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In [2], Yadnesh Joshi covers the use of RFID and OCR technology in a smart parking management system. When a vehicle arrives, the RFID reader checks its authorization status. If authorized, the reader scans the vehicle's tag, logs the arrival time, opens the boom barrier, and allocates a parking spot. For unauthorized vehicles, a temporary tag is issued and scanned by the RFID reader, while OCR captures the vehicle's license plate and converts it into text. This information, along with the arrival time, is stored in the system records, the barrier opens, and parking is allocated. Upon departure, the RFID reader updates the departure time for authorized vehicles in the system records. For unauthorized vehicles, the temporary tag is read, the departure time is updated, and the temporary tag is removed before the boom barrier opens, freeing up a parking spot.

In [3], Muneeb Hasan Khan presents a smart parking solution utilizing RFID and GSM technology. The solution aims to prevent vehicle theft and reduce transaction costs through automation. The setup comprises a GSM kit, RFID readers and tags, barrier gates, computers, software, and LED lights. It manages vehicle check-ins and check-outs using smart cards and RFID tags, controlling barriers and activating LEDs as necessary. In the event of a theft, authorized members receive SMS alerts, and an alarm sounds for security. This autonomous setup can be deployed in any organization, offering secure vehicle parking for its members

In [4], L. H. Chowdhury describes a smart car parking management setup using components such as an RFID booth for arrivals, barrier gate, camera, server PC, payment counter, and departure booth. The automated parking solution employs RFID technology and various hardware components to manage vehicle arrivals and departures. When a vehicle arrives, the user either receives or scans an RFID card, and the setup records the arrival details and captures an image for security. Once verified, the barrier gate opens to allow entry. The setup includes web and database servers for data management and adjusts the available parking spaces accordingly. Upon departure, regular users return their cards, while VIP users scan their cards to leave, with all components connected via Wi-Fi for seamless operation.

In [5], D. Ashok presents an IoT-based smart parking and energy management solution for multi-story business parking lots. This study employs Honeywell sensors and controllers to detect unoccupied parking spaces, which are then indicated to users through lamps, guiding them to available spots and eliminating the need for manual searching. The solution stores occupancy data in the cloud, allowing a central system to efficiently direct incoming vehicles. Overall, it aims to enhance user convenience and time efficiency while minimizing manpower and energy usage.

In [6], L. Wei provides an RFID and Internet-based parking management system. This system uses a control computer shared by the automated railing machine, entry control system, signal receiver, card scanner, card retrieval machine, ticket printers, and other components. The solution addresses parking problems by utilizing RFID to identify specific targets and read/write related data via radio transmissions without physical or visual interaction. The two basic portions of the parking management system are the parking spaces management subsystem and the internet parking information management system. The parking spaces management subsystem uses RFID tags for managing vehicle access, locating parking spaces, displaying availability, and controlling vehicle departures. It also manages parking guidelines and costs in specific lots. Details about parking spaces is managed in an integrated manner across several lots via the internet parking information management system.

In [7], L. Mainetti explains a WSN and RFID integrated smart parking solution. An IEEE 802.15.4-based WSN is utilized to automatically monitor paid parking spots. The WSN's coordinator, router, and reader nodes are in charge of gathering information about parking spot occupancy. This data is transmitted to a central server through a smart gateway, which also enables NFC payment. The central server analyzes the data to track parking space utilization and user payments, notifying traffic officers of any unlawful use or expired payments via a smartphone app. Additionally, drivers can use the solution to pay parking fines using a dedicated smartphone application.

In [8], A. Chatterjee describes an RFID-based automated vehicle parking system. The system utilizes an RFID tag, 8051 microcontroller, LCD display, DC motor, and USB to UART cable. It employs a database to manage vehicle check-ins and check-outs in a parking lot. Each vehicle has an attached tag, and readers at the doorway and exit read these tags. When a vehicle arrives, the reader transfers the tag information to software that compares it with the database. If the tag is authorized, the barrier opens; otherwise, it remains closed or triggers an alarm. Similarly, when a vehicle checks out, the setup verifies its authorization before allowing it to leave. Unauthorized vehicles are denied access at both points.

In [9], H. Chandra describes a smart parking management system integrating RFID, ALPR, and WSN technologies. The system collects data on parking space occupancy and transmits it to a central server. Customers can use a mobile

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application to retrieve this data, which facilitates NFC-based user authentication, online payment, and parking space reservations.

III. SYSTEM DESIGN

The advanced solution of the Arduino Uno-designed RFID based parking system is to guarantee safe and effective management of parking services. It uses RFID technology to restrict entry to the parking slot to authorized staff who have valid RFID cards. The RFID reader reads the unique identification number on the tag as a vehicle that is permitted approaches and sends this details to the Arduino Uno microcontroller. As the central processing unit, this microcontroller indicates that the RFID number received matches one in a database of approved IDs that has been previously saved. Access is granted by the microcontroller sending a signal to open the gate in the event that the RFID number matches a record in the database. In the case that no match is found, the gate stays locked, preventing unwanted access and upholding the parking facility's security.

It is equipped with an ultrasonic sensor to track each parking space's occupancy status. The ultrasonic sensor senses the existence of a vehicle when it parks in the assigned spot. It then causes an LED to illuminate to indicate that the space is occupied. The LED stays off to show that there is room if no vehicle is detected. Besides giving vehicles a clear visual indication of available spaces, this real-time monitoring of parking slot occupancy ensures that the parking services operates as efficiently as possible.

The Arduino Uno microcontroller integration has a number of benefits, including as cost effectiveness, flexibility in component integration, and ease of programming. Future improvements, such adding more sensors or increasing the database's ability to hold more RFID tags, are made possible by the system's modular architecture. Because of its scalability, the method can be applied to a variety of parking scenarios, ranging from small residential lots to massive commercial garages. Utilizing ultrasonic sensors for real-time occupancy monitoring and RFID technology for secure entry, the system offers a comprehensive solution that optimizes parking space use, boosts security, and increases user experience overall. This creative solution tackles frequent parking-related urban issues, making it a useful tool for contemporary cities aiming for sustainability and efficiency.

IV. PROPOSED METHOD

The Arduino UNO, LEDs, Servo Motor (Tower Pro MG996R), RFID Module, and Ultrasonic Sensor are utilized in the proposed solution. Parking system uses RFID technology to effectively automate and control parking procedures. It tracks parking slot occupancy and recognizes cars with RFID tags. An LED shows if a automobile is parked in the designated space. The microcontroller is an Arduino board that connects with ultrasonic sensors to determine whether a automobile is there and occupied. It also uses motors and servo motors to manage the trays to ensure correct alignment and movement.

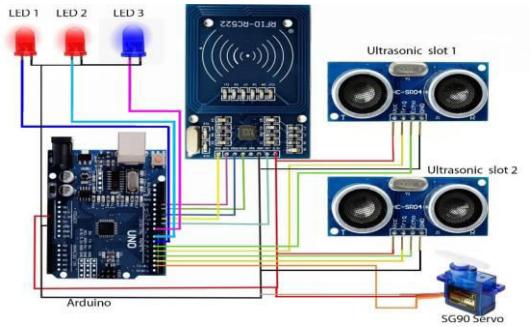

Figure 1: Block Diagram

A. Components:
RFID Module: An RFID module is a device that reads and writes data to RFID tags using radio waves. Transceiver, controller, and antenna are commonly found, which can function at LF, HF, or UHF frequencies. The spectrum of communication varies from centimeters to meters, based on power and frequency. They typically run from 3.3V to 5V and communicates with microcontrollers using protocols like UART or SPI. RFID modules are widely used in

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inventory management, access control, and adaptive parking plans. In setups that combine microcontrollers like Arduino, RFID modules allow admission and exit by reading RFID cards.

Ultrasonic Sensor: An ultrasonic sensor is a gadget that uses ultrasonic sound waves to gauge how far away something is. It is composed of a transmitter that uses more frequency (usually above 20 kHz) to produce sound waves and a receiver that detects echoes, or reflected waves, from the object. The sensor measures the distance to the object by calculating the interval of time between emitting the sound wave and getting the echo. These sensors are frequently employed in various applications, including robotics, automotive systems, and industrial automation, since they can estimate distance accurately without physical contact. For simple integration and programming, well-known devices like the HC-SR04 are frequently used with microcontrollers like Arduino.

Arduino UNO: Arduino is an open-source electronics platform that includes a programmable circuit board, a microcontroller. Arduino boards are made to enable artists, designers, and hobbyists to connect various types of sensors, motors, and other components through digital and analog input/output ports. These boards are adaptable for many applications since they can converse with their surroundings and regulate numerous outputs. Code writing and mvbIDE, a streamlined C++ environment. Arduino is a favourite among novice and seasoned developers because to its low cost, simplicity of usage, and robust community support, which has encouraged broad invention and creativity in electronics.

LED: Light Emitting Diodes, or LEDs, are semiconductor devices that, when an electric -current flows through them, emit light. These devices are greatly appreciated for their tenacity, longevity, and energy economy. Compared to conventional incandescent and fluorescent bulbs, they are more energy efficient because they use a lot less power and convert the most of energy into light rather than heat. Furthermore, LEDs have a less upkeep expenses and minimal environmental impact because of their durability, stress resistance, and tens of thousands of hours of operation. LEDs are crucial to real-time information provision in parking systems. They can show if a parking slot is engaged or vacant. Incorporating them into guiding systems can also help to improve traffic flow and lower emissions by directing drivers to open spaces.

Servo Motor: A well-liked and dependable high-torque servo motor, the Tower Pro MG996R is frequently utilized in RC cars, robots, and other do-it-yourself electronics applications. With a maximum speed of 0.17 seconds per 60 degrees of rotation at 4.8V and 0.13 seconds at 6.0V, it operates within a voltage range of 4.8V to 7.2V. Metal gears are a feature of the MG996R that ensure long lasting performance even while carrying high loads. Additionally, it may rotate between 120 and 180 degrees, and PWM (Pulse Width Modulation) signals can be utilized to adjust this range. This servo is a viable option for various mechanical and robotic projects because of its sturdy design, which can endure shocks and provide stable, smooth performance. To regulate the movement of gates or barriers in parking systems that use RFID, servos like the Tower Pro MG996R can be employed. To provide safe and regulated access to parking spots, these servos can be wired to Arduino boards and configured to rotate the gates at a particular angle.

B. Implementation:

Secure access is ensured by the Arduino Uno-designed RFID-based parking system, which only permits authorized workers with valid RFID cards to park. The authorized person wearing an RFID tag can access the parking space after the system is activated. Once the ID card is detected by the RFID reader, the microcontroller receives the unique card number. After that, the microcontroller compares the number on the card with the numbers it has stored in memory or its database. The microcontroller allows the automobile to park in the secured area if the numbers match. If the numbers don't match, though, the gate stays closed, keeping people from entering the parking lot without authorization. When a vehicle is detected using an ultrasonic sensor, an LED turns on or off depending on whether the vehicle is present.

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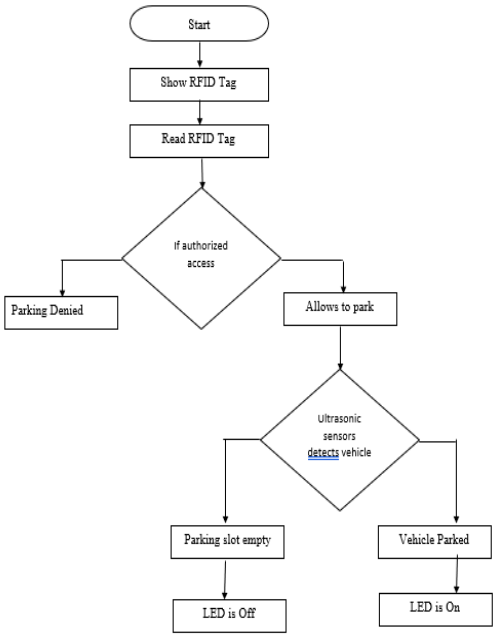

Figure 2: Flowchart

V. RESULTS AND DISCUSSIONS

With the help of Arduino Uno and RFID technologies, the parking system makes sure of secure access by restricting entry to only authorized staff who possess valid RFID cards. Upon activation, the RFID reader recognizes an approaching person's unique ID card number and transmits it to the microcontroller. After that, the microcontroller compares this number to the database it has saved. The gate stays closed for unauthorized cards, prohibiting access, but the system allows the automobile to enter if the card number matches an allowed entry. With this configuration, parking management security is improved overall, wait times are decreased, and authorized users can enter quickly and easily. It also operates efficiently and automatically. All admissions and exits can also be logged by the system, providing useful information for auditing and monitoring needs.

VI. CONCLUSION

In summary, controlling access to parking places is made safe and effective with the Arduino Uno-based RFID parking system. The technology protects the facility by strengthening security and preventing unwanted access by only permitting entry to authorized staff who have valid RFID cards. The RFID reader and microcontroller provide an automated entrance process that minimizes wait times and congestion at entry points, providing users with a fast and smooth experience. This effectiveness optimizes the parking facility's overall functioning while also increasing user happiness. Further enhancing security and operational planning is the system's capacity to log entries and exits, which provides useful data for auditing and tracking usage patterns. This project successfully illustrates how microcontrollers and RFID technology may be combined to develop a dependable, strong, and user-friendly parking management system that takes efficiency and security issues into account.

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