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RFID BASED SMART CAR PARKING SYSTEM

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Abstract:

Parking management in high-security areas presents unique challenges due to the need for security measures and restricted access control. In such environments, traditional parking systems often struggle to efficiently manage vehicle movements while maintaining security protocols. This paper proposes an RFID-based smart car parking system specifically designed for deployment in security-sensitive areas.The system addresses the problem of parking and security by monitoring the availability of parking spaces and guiding vehicles to vacant slots in real-time. Additionally, it incorporates features for pre-reservation of parking slots and optimizing parking operations. its utilization of RFID technology for user identification and access control. Each user undergoes a one-time registration process where an RFID tag, containing unique identification information, is attached to their vehicle. This eliminates the need for repetitivetoken generation and ensures seamless access for authorized users.

Key Words: RFID Module, IR Sensor, Arduino uno,Lcd display, Servomotor

1. INTRODUCTION:

The "RFID based Car Parking System" offers a tailored solution for parking management in private places, addressing the specific needs and challenges associated with such environments. In private areas, such as residential complexes, office buildings, and gated communities, efficient parking management is essential to ensure optimal space utilization, convenience for residents or employees, and enhanced security measures. This system introduces an automated approach to parking management, leveraging RFID (Radio Frequency Identification) technology to streamline vehicle entry and exit processes. By deploying RFID tags on vehicles, the system enables seamless identification and authentication, allowing for swift check-ins and check-outs without

the need for manual intervention. One of the key benefits of the RFID based Car Parking System in private places is its ability to enhance security and access control. With RFID tags assigned to authorized vehicles, the system ensures that only permitted vehicles can enter the parking facility, thereby reducing the risk of unauthorized access and enhancing overall security measures. Moreover, the system provides real-time monitoring of parking occupancy, allowing residents or employees to quickly identify available parking spaces and optimize their parking experience. By displaying parking availability information on an LCD screen or through a mobile application, users can efficiently navigate the parking facility and minimize the time spent searching for parking spots.

2. LITERATURE SURVEY:

In 2017, Feng Yuan Wang and Yi Liu introduced a paper on the 'Mechanical Parking System.' This system featured a rotary mechanism enabling all cars to move in a rotary motion for loading and unloading. It was designed for 8 to 12 cars, offering easy operation and efficient parking. However, drawbacks included the necessity for all cars to rotate to access one vehicle, along with high initial costs, high maintenance requirements, and a complex structure. Another significant contribution in the field came from Robin Grodi, Danda B. Rawat, and Fernando Rios-Gutierrez with their 2017 paper titled 'Smart Parking Occupancy Monitoring and Visualization System for Smart Cities.' They developed a system using RFID sensors to detect vehicle presence in allocated slots Despite the advancements, the absence of reservation capability in open parking lots posed challenges in assisting drivers with parking decisions.

3. PROPOSED SYSTEM:

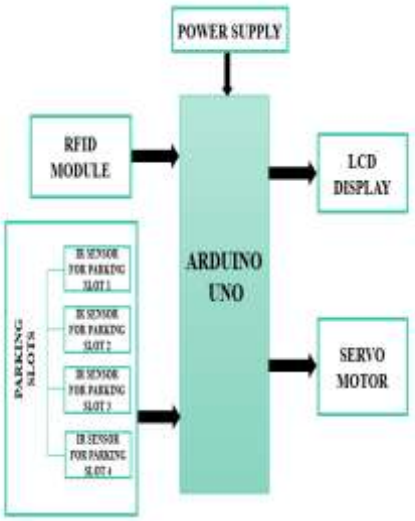

Fig 3.1 Block Diagram

The system begins with the installation of RFID tags on each vehicle, containing unique identification codes. As a vehicle approaches the entry point, RFID readers placed strategically detect the tag's signal, initiating the data collection process. This information is relayed to a centralized database, where the availability

of parking spaces is constantly monitored and updated in real-time. Upon verification, an available parking slot is allocated to the vehicle, ensuring seamless access for authorized users while preventing unauthorized entry. Throughout the parking duration, the system continues to monitor occupancy status, providing users with up-to-date information through an LCD display located at the entry point. When a vehicle exits, another RFID reader confirms the authorized exit, maintaining security protocols. The system also facilitates maintenance and reporting, generating valuable insights into parking usage and operational efficiency. By streamlining access control, enhancing security measures, and optimizing parking space utilization, the RFID-based smart car parking system offers a comprehensive solution tailored to the specific needs of private environments.

4. COMPONENTSPECIFICATIONS:

A. Arduino Uno:

The Arduino Uno is a versatile microcontroller board powered by the ATmega328P, boasting a robust set of features suitable for a wide range of electronics projects. Operating at a standard voltage of 5 volts, with a recommended input voltage range of 7-12 volts, it offers flexibility in power supply options. With 14 digital I/O pins, including 6 PWM pins, and 6 analog input pins, it facilitates seamless interfacing with external components for diverse functionalities. Its generous memory resources, including 32 KB of flash memory, 2 KB of SRAM, and 1 KB ofEEPROM, support complex program logic and data storage. Running at a clock speed of 16 MHz, it ensures efficient performance in executing instructions and handling input signals.

Fig 4.1 Arduino Uno

B. RFID Module:

The RFID module, branded as EM18, operates at a frequency of 125 kHz and plays a pivotal role in the smart car parking system. With an operating voltage range of 4.5V to 5.5V and a current consumption of 50 mA, it ensures reliable performance within varying power constraints. The module can withstand temperatures ranging from 0°C to +80°C,

making it suitable for deployment in diverse environmental conditions. Its effective range extends up to 5 cm, allowing for efficient detection and communication with RFID tags attached to vehicles. The RFID tag, affixed to each vehicle, holds unique identification information, which is wirelessly transmitted and backscattered when itinteracts with the transceiver/reader's high-frequency electromagnetic field. This seamless interaction facilitates access control and slot occupancy detection, enabling streamlined management of parking spaces within the system.

Fig 4.2RFID Module

C. IR Sensor:

The infrared (IR) sensor is a crucial element within the smart car parking system, adept at detecting heat and motion within its environment by measuring infrared radiation emitted by objects. Primarily used for motion detection, these sensors serve various applications, including monitoring parking slot occupancy. Comprising an IR LED emitter and an IR photodiode detector, the sensor operates by emitting IR light and detecting its reflection off objects, such as vehicles. The sensor operates at a voltage of 5V DC, with compatibility for both 5V and 3.3V I/O pins, and boasts a detection range of up to 5 cm. Its compact dimensions of 48 x 14 x 8 mm, coupled with a built-in ambient light sensor, further enhance its utility and reliability in the parking system, ensuring accurate and efficient monitoring of parking slot occupancy.

Fig 4.3IR Sensor

D. Servo motor:

A servo motor plays a pivotal role in the smart car parking system, offering precise rotational control essential for tasks like gate opening and closing. Operating on Pulse Width Modulation (PWM), it responds to applied pulses to its

control pin, allowing precise angle adjustments. Typically powered by +5V, the servo motor boasts a torque of 2.5 kg/cm and an operating speed of 0.1 s/60°, ensuring efficient performance. With a plastic gear type and a rotation range of 0°-180°, it delivers controlled movements with reliability and accuracy.

Fig 4.4Servo motor

E. LCD Display:

The LCD 16x2 display is a widely used electronic device known for its ability to display data and messages effectively. Featuring 16 columns and 2 rows, it can accommodate a total of 32 characters, each composed of 5x8 pixel dots.. The characters are constructed with a font size of 0.125 width x 0.200 height, ensuring clarity and readability. Additionally, the backlight, available in green or blue LED color, enhances visibility in different lighting conditions. Overall, the LCD 16x2 display is an indispensable component in electronic projects, providing a convenient and efficient means of displaying data and messages.

Fig 4.5 LCD Display

5. Results:

To indicate whether a parking slot is empty or full, the system can display specific messages on the LCD display or utilize LED indicators. When a parking slot is empty, the display can show a message such as "Slot full" or "Empty Slot," accompanied by a corresponding LED indicator that lights up or changes colour to green.

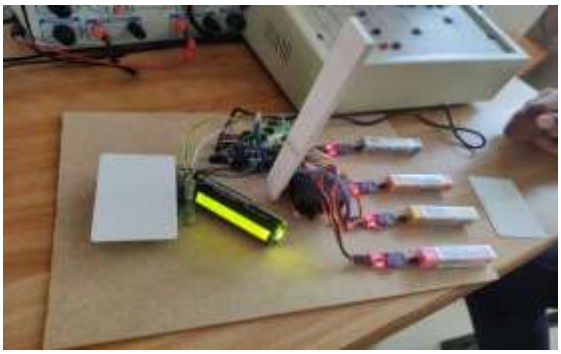

Fig5.1 System Prototype

Fig 5.1 LCD Display indicating slot empty before car parking

Fig 5.2 LCD Display indicating slot Full after car parking

If an authorized car attempts to enter the parking area but all slots are already full, the system will display a message on the LCD display indicating that the parking slots are full. This message serves as a notification to the driver that there are no available parking spaces at the moment.

6. CONCLUSION:

This project addresses the challenges of traditional parking systems by providing real-time vehicle detection and identification. The RFID tags enable seamless authentication of vehicles, while the IR sensors ensure precise detection of parked vehicles within each parking space. The benefits of this integrated approach are numerous. It enhances security by verifying both the identity and presence of vehicles, reduces congestion by optimizing space allocation, and improves the overall parking experience for users with guided parking assistance. Overall, this project represents a significant advancement in parking management technology, offering a reliable and efficient solution to address the growing challenges of secure parking.

7. FUTURE SCOPE:

The future scope of smart car parking systems is extensive, offering avenues for innovation and advancement. Potential areas for development include the integration of AI and machine learning to optimize space allocation and enhance system efficiency. Enhanced security features like facial recognition and license plate recognition can bolster access control and ensure safety. Integration with IoT can enable real-time monitoring and remote management, while smart payment solutions and dynamic pricing strategies can streamline transactions and revenue generation. Eco-friendly initiatives, such as electric vehicle charging stations and bike-sharing facilities, can promote sustainability. Moreover, seamless integration with broader smart city initiatives can optimize urban mobility and improve overall quality of life. Embracing technological advancements and prioritizing user experience will pave the

way for more efficient, secure, and sustainable urban environments.

8. REFERENCES:

[1] Mechanical Parking System Feng Yuan Wang, Yi Liu, Department of Mechanical Engineering Blekinge Institute of Technology, Karlskrona Sweden, 2017.

[2] Robin Grodi, Danda B. Rawat, Fernando Rios- Gutierrez 'Smart Parking:Parking Occupancy Monitoring and Visualization System for Smart Cities.', IEEE, 2017.

[3] Karma Tsheten Dorjee, DeepakRasaily, Bishal Cintury, RFID-Based Automatic Vehicle Parking System Using Microcontroller, IJETT, Volume 32, Number 4, February 2016.

[4] R.Kannadasan,A.Krishnamoorthy,N.Prabakaran, K.Naresh, V.Vijayarajan, G.Sivashanmugam, RFID Based Automatic Parking System , Australian journal of basic and Applied Sciences , Volume 10(2) ,Pages: 186-191,February 2016.

[5] S.C. Hanche, Pooja Munot, Pranali Bagal, Kirti Sonawane & Pooja Pise, Automated Vehicle Parking System using RFID, ISSN (PRINT): 2320 – 8945, Volume -1, Issue -2, 2013.