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ParkGuard AN EFFICIENT SOLUTION TO SAFEGUARD RESERVED AREA

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ABSTRACT:

In this paper, we will discuss the impact of IoT, which has made significant strides across various sectors such as education, healthcare, transportation, etc. One particular area of focus is parking area reservation, which plays a pivotal role in helping individuals locate the nearest available parking spots and reserve them beforehand through dedicated applications. Such services offered by numerous companies have contributed to alleviating traffic congestion and facilitating convenient parking solutions for users. However, a pertinent issue arises when individuals unfamiliar with these applications inadvertently park in reserved areas, causing inconvenience to those who have invested in reserving their spots. To mitigate this problem, a proposed solution involves alerting unauthorized parkers while notifying authorized users to prevent such conflicts. ParkGuard is the name given to the proposed system.

INTRODUCTION :

In our ever-evolving digital landscape, the Internet of Things (IoT) stands as a beacon of innovation, revolutionizing the way we interact with technology and the world around us. At its core, IoT is a network of interconnected devices, sensors, and systems that communicate and exchange data seamlessly, without human intervention. Imagine a world where your morning routine is seamlessly synced with your home environment: the thermostat adjusts to your preferred temperature, the coffee machine starts brewing your favourite blend, and your car autonomously preps for your commute. This interconnectedness epitomizes the essence of IoT, where everyday objects are imbued with intelligence and connectivity. As we delve deeper into the era of IoT, the possibilities are boundless. From smart cities to industrial automation, from personalized healthcare to environmental sustainability, IoT is poised to redefine the way we live, work, and interact with our surroundings .

LITERATURE REVIEW :

Paper 1: "Smart Parking Management System Using IoT Technology"

➢ **GLIMPSE OF THE PAPER:** This paper proposes a smart parking management system that utilizes IoT technology to improve parking efficiency. The system includes sensors for detecting parking occupancy, a centralized database for reservation management, and a mobile application for users to reserve parking spaces. Unauthorized parking is detected using real-time alerts sent to parking enforcement authorities.

- **Publisher:** IEEE
- **Year of Publication:** 2019

Paper 2: "Enhancing Parking Security with Automatic License Plate Recognition"

➢ **GLIMPSE OF THE PAPER:** This study focuses on enhancing parking security through the implementation of automatic license plate recognition (ALPR) technology. ALPR cameras are deployed in parking areas to capture vehicle license plate information, allowing for automatic identification of authorized vehicles and detection of unauthorized parking. Real-time alerts are generated for parking administrators to take appropriate action.

- **Publisher:** ACM
- **Year of Publication:** 2020

Paper 3 : "Efficient Parking Space Allocation Using Machine Learning Techniques"

➢ **GLIMPSE OF THE PAPER:** This research explores the application of machine learning techniques for efficient parking space allocation. The study analyze historical parking data to predict parking demand patterns and dynamically allocate

➢ parking spaces accordingly. By optimizing parking space utilization, the system aims to reduce congestion and improve the overall parking experience.

- **Publisher:** Springer
- **Year of Publication:** 2018

Paper 4: "Smart Parking Reservation System with Unauthorized Parking Detection"

➢ **GLIMPSE OF THE PAPER:** This paper presents a smart parking reservation system integrated with unauthorized parking detection capabilities. In addition to allowing users to reserve parking spaces in advance, the system utilizes sensors and video surveillance to detect unauthorized vehicles in reserved areas. Real-time alerts are sent to both parking administrators and authorized users to prevent conflicts.

- **Publisher:** Elsevier
- **Year of Publication:** 2021

Paper 5"Real-Time Parking application Monitoring and Alerting System"

➢ **GLIMPSE OF THE PAPER:** This study introduces a real-time parking availability monitoring and alerting system designed to alleviate parking congestion. Using IoT sensors installed in parking spaces, the system continuously monitors parking occupancy and updates centralized dashboard with real-time availability information. Users receive alerts via mobile applications when parking spaces become available in their desired locations.

- **Publisher:** Taylor & Francis
- **Year of Publication:** 2017

PROBLEM STATEMENT :

Unauthorized parking in reserved and restricted areas poses significant challenges for parking management, leading to frustration for authorized users and potential security risks. Traditional methods of monitoring and enforcing parking regulations, which often rely on manual patrolling and physical permits, are inefficient, time-consuming, and prone to human error. These inefficiencies result in unauthorized vehicles occupying reserved spaces, causing inconvenience and disruption for legitimate users who have pre-booked their parking spots.

Additionally, the lack of immediate notification systems for both parking administrators and vehicle owners further exacerbates the issue, leading to delayed responses and unresolved violations.

EXISTING SYSTEM :

An IOT Based Parking System to Prevent Unauthorized Vehicles

The IoT-based parking system proposed here aims to revolutionize parking security by preventing unauthorized vehicles from accessing reserved spots. While smart parking streamlines the process by allowing users to prebook spots via a mobile app and make e-payments, it falls short in ensuring exclusive access. The primary objective of the plan is to devise a robust solution to this challenge. It introduces a comprehensive system employing advanced technology, including IR sensors, RFID reader, LCD display, servo motor, and Arduino. At its core, the system utilizes IR sensors strategically placed at entry and exit points to detect vehicle presence and movement accurately. The LCD display serves as a real-time indicator of parking spot availability and status. The barricades are ingeniously designed with servo motors, offering dynamic control over vehicle access. Authorized vehicles trigger the barricades to open, seamlessly granting them entry. Conversely, unauthorized vehicles face a closed gate, effectively thwarting any attempt at unauthorized access. In essence, this paper delves into the intricate workings of this cutting-edge parking system, emphasizing its ability to safeguard reserved parking spots effectively and efficiently.

Figure 1

ADVANTAGES OF EXISTING SYSTEM:

1.**Enhanced Security:** By employing advanced technology such as IR sensors, RFID readers, and servo motors, the system provides robust security measures to prevent unauthorized access to reserved parking spots. This significantly reduces the risk of theft or misuse of parking spaces.

2.**Seamless User Experience:** The integration of smart features like prebooking via a mobile app and e-payments streamlines the parking process for users. They can conveniently reserve spots in advance and make payments electronically, saving time and effort.

3. **Real-time Monitoring:** The LCD display serves as a real-time indicator of parking spot availability and status, allowing users to quickly identify vacant spots and navigate to them efficiently. This helps optimize parking space utilization and reduces congestion.

4. **Customizable Access Control:** The use of RFID technology enables the system to identify authorized vehicles by scanning RFID tags attached to their number plates. This allows for customizable access control, ensuring that only registered users can access reserved parking spots.

DISADVANTAGES OF EXISTING SYSTEM

1. **Initial Cost:** Implementing advanced technology such as IR sensors, RFID readers, servo motors, and Arduino systems can entail a significant initial investment. This may pose a barrier to adoption for some parking facilities, particularly smaller businesses or organizations with limited budgets.

2. **Maintenance Complexity:** The use of multiple components and sophisticated technology in the system increases its complexity and maintenance requirements..

3. **Vulnerability to Technical Issues:** Like any electronic system, the IoT-based parking system is susceptible to technical malfunctions, software bugs, or hardware failures. These issues could disrupt the parking process, leading to inconvenience for users and potential revenue loss for parking operators.

4. **Reliance on Power and Connectivity:** The proper functioning of the system relies on a stable power supply and uninterrupted internet connectivity. Power outages could render the system temporarily inoperable, affecting parking operations until the issues are resolved.

PROPOSED SYSTEM :

In addition to existing solutions, this proposed system offers another way to overcome the problem of unauthorized parking in reserved spaces. This idea incorporates the use of IR sensors, RFID readers, and LCD displays. IR sensors are primarily used to detect the presence or absence of vehicles. The proposed system operates as follows: When an unauthorized person parks in a reserved area, a warning message is sent to the unauthorized individual, stating, "You have parked in a reserved area." Simultaneously, an alert is sent to the authorized person, informing them, "Your reserved space is occupied by someone else." This proposed system aims to enhance the management of reserved parking spaces by promptly notifying both unauthorized parkers and the rightful owners of the spaces.

Figure 2

METHODOLOGY

1.HARDWARE DESIGN

- **ALPR Cameras and Sensors**

Deploy high-resolution ALPR cameras at strategic entry points and critical areas within the parking facility. These cameras are equipped with optical character recognition (OCR) capabilities to capture clear images of vehicle license plates as they enter the premises.

- **Microcontroller Unit**

Use a microcontroller (e.g., Arduino, Raspberry Pi) as a central processing unit to interface between ALPR cameras, backend server, and SMS gateway. Equip the microcontroller with communication interfaces such as Ethernet, Wi-Fi, or GSM/GPRS modules for seamless integration with backend servers and SMS gateway services.

- **Backend Server**

Set up a backend server with adequate processing power and storage capacity to handle incoming ALPR data, manage reservation records, and perform real-time validation against the database.

- **SMS Gateway Service**

Choose a reliable SMS gateway service provider (e.g., Twilio, Nexmo) that offers robust APIs for sending SMS alerts. Develop scripts or functions on the microcontroller to format SMS messages with relevant details (e.g., license plate number, violation timestamp) before transmitting them to the SMS gateway for delivery.

- **Power Supply and Network infrastructure**

Ensure stable power supply for all components, considering the operational requirements of ALPR cameras, microcontroller units, backend servers, and networking equipment

Figure 3

2. DATABASE MANAGEMENT

Implement a relational database management system (e.g., MySQL, PostgreSQL) to store and retrieve reservation information, including vehicle details, reservation IDs, and time windows for authorized parking. Design a relational database schema that accommodates the necessary tables for storing reservation data, ALPR records, and user information. Consider the following tables:

- **Reservations**: Stores information about parking reservations made through the app, including reservation ID, vehicle details (license plate number, make, model), user contact information, reserved parking space details, and reservation time window.
- **ALPR Records**: Logs ALPR data captured at entry points, including timestamp, image reference, and extracted license plate information.
- **Users**: Contains details of registered users, such as username, contact information, and authorization status (e.g., admin, regular user).

Integration with ALPR System: Develop mechanisms to populate the ALPR Records table with data captured by ALPR cameras. This involves automated processes or APIs that transfer image data and extracted license plate information to the database in real-time.
Reservation Management: Implement functions or stored procedures to manage reservation records, including CRUD operations (Create, Read, Update, Delete) to handle user bookings, modifications, and cancellations.

3.DATA PROCESSING

- **Image Capture and Preprocessing**

ALPR Camera Capture: High-resolution ALPR cameras capture images of vehicles entering the parking area. These cameras are strategically placed at entry points to ensure maximum coverage and clear image capture. **Image Preprocessing**: Upon image capture, preprocessing techniques are applied to enhance the quality and clarity of the image.

- **License Plate Recognition (LPR)**

OCR Algorithms: Optical Character Recognition (OCR) algorithms analyse the pre-processed images to extract alphanumeric characters from the license plate region. **Character Segmentation**: Segmenting the extracted characters from the license plate image to accurately identify the license plate number. **Character Recognition**: Applying pattern recognition and machine learning techniques to recognize and interpret the alphanumeric characters, converting them into a textual format for further processing.

- **Database Query and Validation**

Query Database: The recognized license plate number is queried against the reservation database to verify if it matches any existing reservation records. **Validation Process**: Compare the extracted license plate data with

reservation details, including vehicle information, reservation ID, and time window. This validation determines whether the vehicle is authorized to park in the reserved area. **Validation Results**: Based on the validation outcome, the system makes a real-time decision regarding the status of the vehicle (authorized or unauthorized).

FLOW CHART REPRESENTING THE DATA PROCESSING

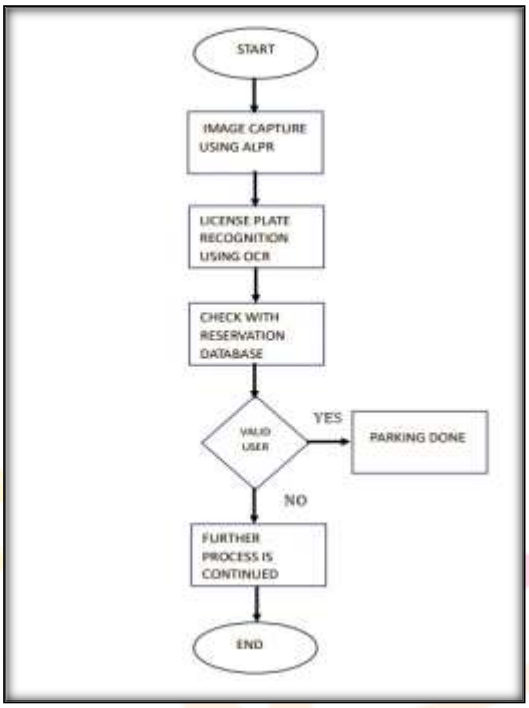

Figure 4

4. ALERT GENERATION

Unauthorized Person: If the unauthorized vehicle's owner is registered in the system (e.g., from previous violations or a user database), their contact number can be fetched from the database using the license plate number as a key.
Authorized Person: The reserved space owner's contact number is retrieved from the reservation record in the database, which contains details such as the reserved time slot and the owner's phone number.
Unauthorized Person: The SMS message to the unauthorized parker includes Notification of the parking violation. License plate number. Time and date of the violation. Instructions to vacate the reserved space.
Authorized Person: The SMS message to the reserved space owner includes
Notification of the intrusion. License plate number of the unauthorized vehicle. Time and date of the violation.

5. SMS Gateway Integration:

Choosing an SMS Gateway:

Purpose: An SMS gateway service facilitates the sending of SMS messages from your application to mobile phone numbers. It acts as a bridge between your system and mobile networks. **Examples**: Popular services include Twilio, Nexmo (now part of Vonage), and Plivo. These services provide reliable infrastructure for sending bulk or individual SMS messages globally.

API Setup:

Need: The SMS gateway's API allows your system to programmatically send SMS messages. Using the API, you can automate the sending of alerts and notifications without manual intervention.

Secure Communication: APIs are accessed using secure protocols (HTTPS) to ensure that sensitive data (like phone numbers and message content) is transmitted securely over the internet.

Authentication: SMS gateway services typically require authentication using API keys or tokens. This ensures that only authorized users can access the service and send messages.

Figure 5

6. PRACTICAL IMPLEMENTATION

The provided code is designed to send SMS alerts using the Twilio API, targeting both unauthorized parkers and the owners of reserved parking spaces. The process involves capturing unauthorized license plates using an ALPR system, extracting relevant phone numbers from a database, and sending SMS notifications. The core function **send_sms** takes Twilio credentials, the recipient's phone number, the sender's Twilio number, and the message content. It then constructs a POST request to Twilio's API endpoint, authenticates it using the provided credentials, and sends the SMS. To use this system, you need to sign up for a Twilio account and obtain your account SID, auth token, and Twilio phone number. Integrate the code into your backend server where the ALPR system processes license plates. When an unauthorized vehicle is detected, the backend retrieves the necessary phone numbers and uses the **send_sms** function to send alerts. This ensures that unauthorized parkers are notified to move their vehicles and the reserved space owners are alerted about the intrusion.

FLOW CHART REPRESENTING THE WHOLE WORKFLOW

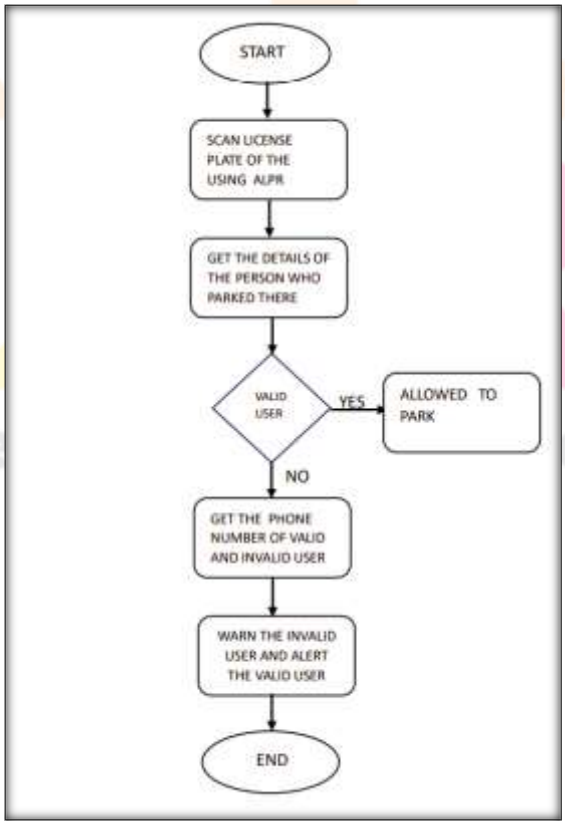

Figure 6

RESULT AND DISSCUSSIONS

The implementation of the ALPR-based system for detecting unauthorized parking and sending SMS alerts proved to be effective in managing reserved parking spaces. By utilizing high-resolution ALPR cameras and a microcontroller to process license plate data, the system successfully identified unauthorized vehicles. Integration with Twilio's SMS gateway enabled prompt notifications to both unauthorized parkers and the owners of the reserved spaces. The automated alerts led to quicker resolutions of parking violations, minimizing inconvenience for authorized users. Moreover, the system's database management ensured accurate and timely retrieval of contact information, enhancing overall efficiency. The combination of ALPR technology and SMS communication offers a practical and scalable solution for maintaining the integrity of reserved parking areas.

Figure 7

ADVANTAGES OF PROPOSED SYSTEM :

 Enhanced Parking Management:

The system automates the process of monitoring reserved parking spaces, reducing the need for manual checks and patrolling .Efficiently handles large parking areas with multiple reserved spaces.

 Immediate Notification:

Real-time SMS alerts to unauthorized parkers and reserved space owners ensure quick resolution of parking violations. Minimizes the time unauthorized vehicles occupy reserved spots, reducing inconvenience to authorized users.

 Increased Security:

Deters unauthorized parking through prompt detection and notification. Provides a digital record of parking violations, enhancing overall security and accountability.

- **Cost-Effective:**

Lowers operational costs by automating the detection and notification processes.

CONCLUSION :

The developed system for protecting reserved parking areas using ALPR and SMS alert integration offers a robust solution for managing parking violations. By leveraging high-resolution cameras and automated license plate recognition, unauthorized vehicles are promptly identified. The integration with an SMS gateway service like Twilio ensures that both unauthorized parkers and reserved space owners receive immediate notifications, facilitating swift resolution of parking conflicts. The implementation of this system not only enhances the efficiency of parking management but also significantly reduces the inconvenience faced by authorized users. Overall, the combination of advanced technology and automated communication presents a scalable and effective method for safeguarding reserved parking areas, contributing to improved parking enforcement and user satisfaction.

FUTURE ENHANCEMENTS :

Future enhancements could focus on integrating additional features to further improve system functionality and user experience. For instance, incorporating real-time GPS tracking and navigation assistance within the app could

help guide users to their reserved spaces more efficiently. Implementing machine learning algorithms could enhance the accuracy and speed of license plate recognition, especially in challenging conditions like low light or adverse weather. Expanding the system to support multiple languages and providing voice-based notifications could cater to a more diverse user base. Additionally, integrating payment gateways for automated billing and fine collection from unauthorized parkers could streamline the financial aspects of parking management. By continuously evolving the system with these enhancements, the solution can become even more comprehensive and user-friendly.

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