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Smart Parking Management System

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ABSTRACT:

The growth of cities, coupled with rising car ownership, has created a parking nightmare in most cities. Older systems of parking management do not work efficiently and tend to add to the problems of congestion, fuel waste, and security. This paper proposes the design of a Smart Parking System based on IoT technology, real-time observation, and automation for proper utilization of parking spaces. The proposed automatically managed parking system makes use of RFID tags, sensors for real-time access control, and AI-based license plate recognition for automated access control and data analysis. This paper focuses on the effectiveness, scalability, and advantages associated with these systems concerning the reduction of traffic congestion, fuel consumption, and carbon emissions.

Keywords: Smart Parking, IoT, ANPR, Automation, Urban Mobility, Traffic Management.

Introduction:

1.1 Background

As cities expand and develop, traffic congestion along with the demand for parking space has increased drastically, which results in pollution and fuel wastage. Conventional parking systems do not provide real time monitoring or automated access. This leads to unsatisfactory management both in time and space.

1.2 Challenges of Traditional Parking Systems

1. Not being able to constantly track the availability of parking space→Time is wasted by drivers looking for vacant spaces.
2. Manual ticketing systems→ Inefficient and prone to multiple errors.
3. Fuel wastage and congestion→Vehicles are left idle and are wasting fuel as drivers search for places to park.
4. Security issues → Vehicles that are not authorized have access because of no automated access control.

1.3 Evolution of Smart Parking Solutions

1. Improved RFID and Barcode based access control systems → better management of vehicle entry and exit.
2. Use of IoT sensors to detect free parking spaces → Helps in locating free parking spaces.
3. ANPR (AI-based License Plate Recognition) → Vehicle identification is carried out without user intervention.
4. Mobile applications use for payment and booking of parking spaces → Facilitates ease of use.

Methodology:

2.1 The System's Components

In order to track the system in real time, a smart parking system combines hardware, software, and cloud-based analytics.

(a) Parts of Hardware
The sensor that detects open parking spaces is an example of an ultrasonic/IR Internet of Things sensor.
ANPR and RFID cameras are cameras that automatically identify cars for automated entry and leave.
LED digital sign boards are screens that point cars in the direction of open parking spaces.
Barriers that automatically open or close in response to restrictions on vehicle access are known as automated barrier gates.

(b) Components of Software
Web portals and mobile applications are platforms that let users order, view, and pay for the available slots.
AI and Cloud Data: The system that gathers and examines data to find parking patterns and allocate spaces efficiently.

2.2 Method of Implementation

(i) Space monitoring using sensors
use IoT-enabled infrared and ultrasonic sensors to detect parking slot usage and transmit that data to the central processing unit.

(ii) Automatic Number Plate Recognition, or ANPR
AI OCR systems that read vehicle registration numbers are used for automatic entry and exit at the parking lot gates, eliminating the need for human involvement.

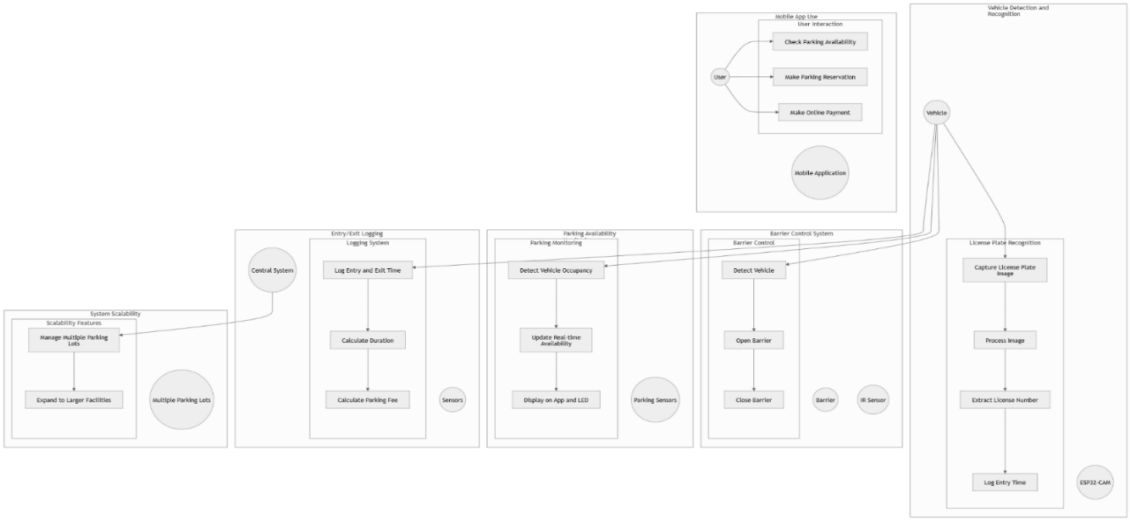
(iii) Intelligent Reservation and Payment Processing
Parking spaces can be reserved via smartphone apps, and payments are made using integrated digital wallets.

System Design and Diagrams :

3.1 Use Case Diagram

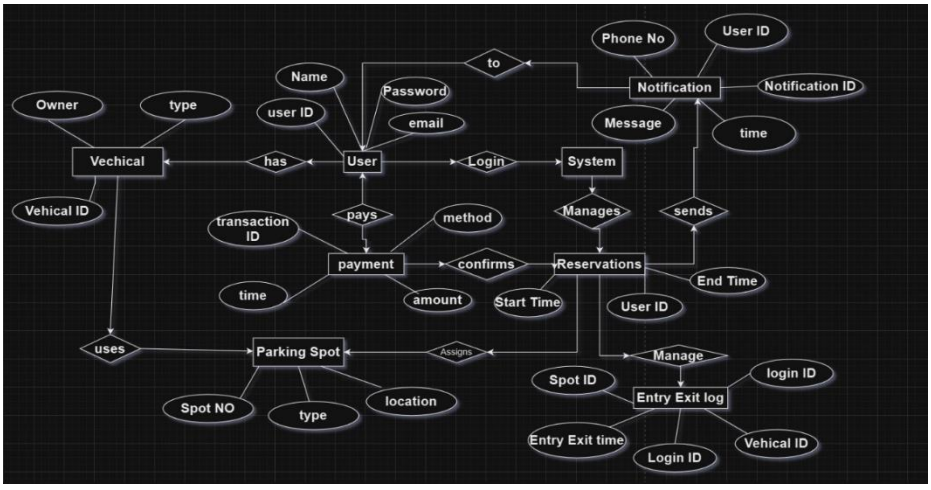
Actors:
User (Driver) – Searches for parking, makes reservations, makes payments.
Admin (Parking Authority) – Manages parking slots, monitors occupancy.
Sensors & ANPR System – Detects vehicle entry/exit, tracks availability.

Use Case Diagram:

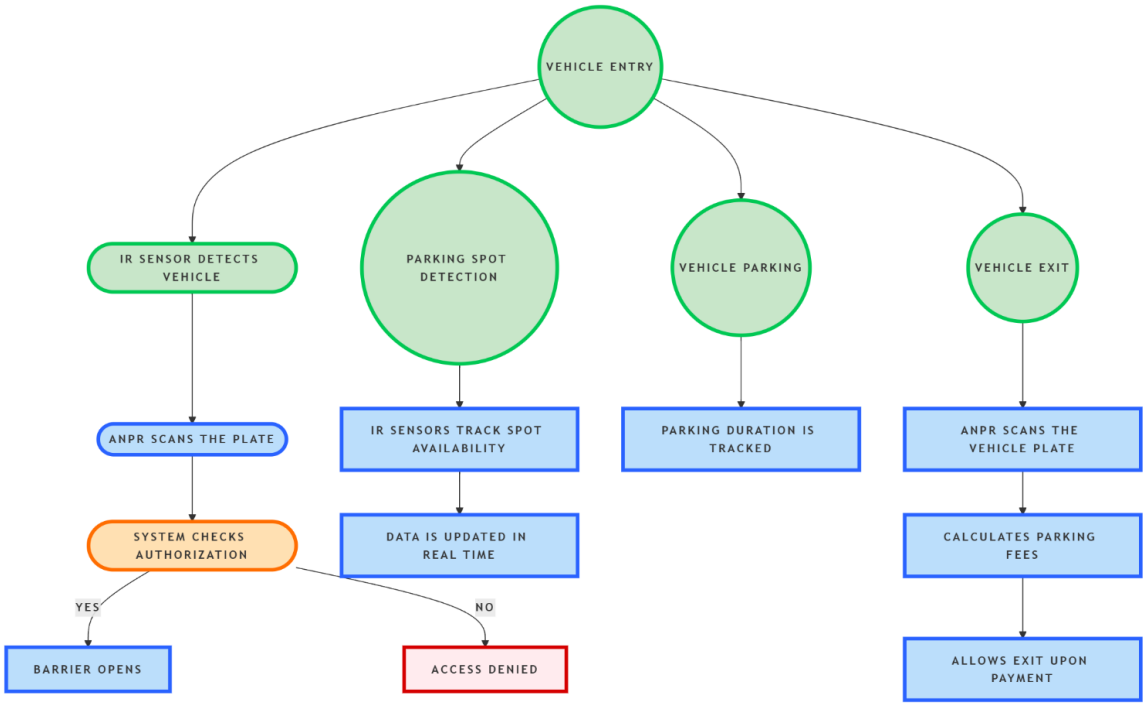


3.2 Entity-Relationship (ER) Diagram

Entities and Relationships:
User (Driver) – Can reserve a parking spot.
Parking Spot – Is allocated to a vehicle.
Vehicle – Enters and exits the parking lot.
Payment – Is made by a user for a parking spot.
Admin – Manages parking and monitors transactions.
ER Diagram:

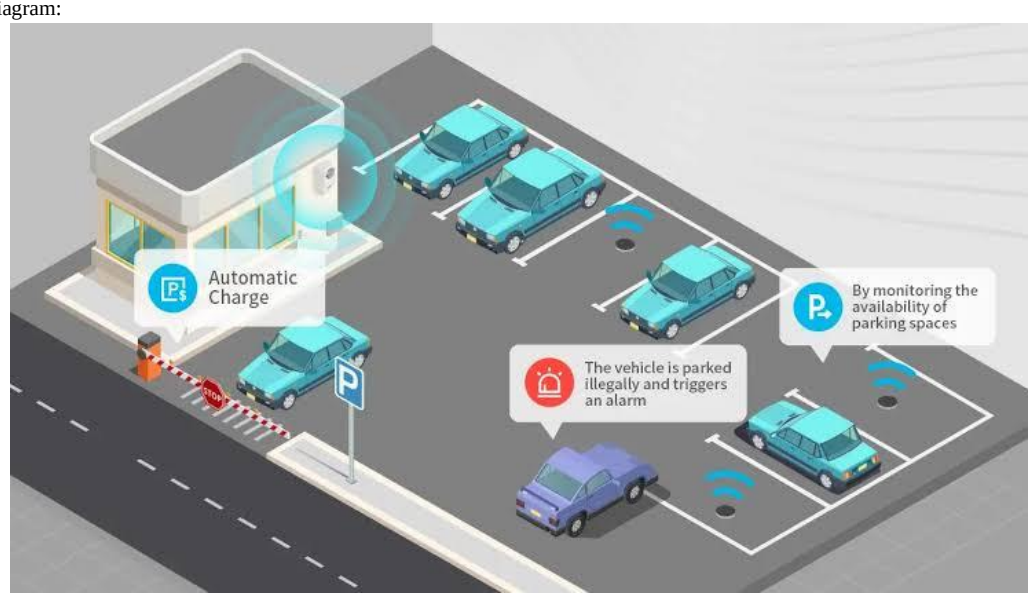


3.3 System Flowchart :



3.4 System Architecture Diagram

Illustrates interactions between users, IoT sensors, ANPR cameras, cloud databases, payment gateways, and admin panels.
Architecture Diagram:

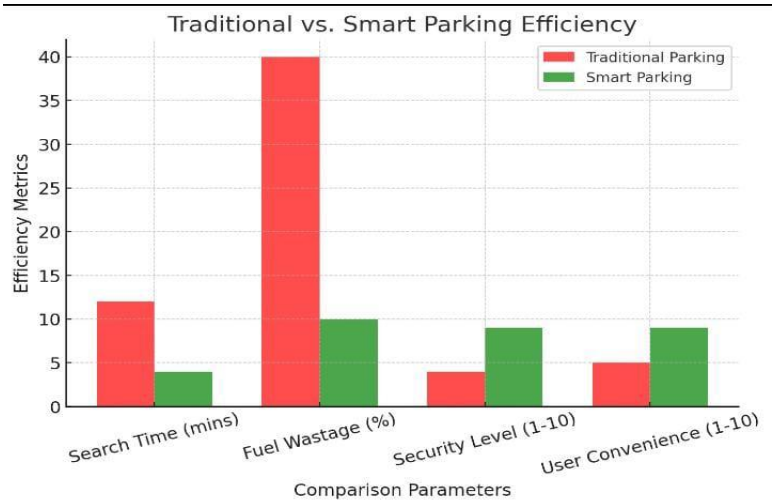


Results and Analysis :

4.1 Smart Parking Systems Effectiveness

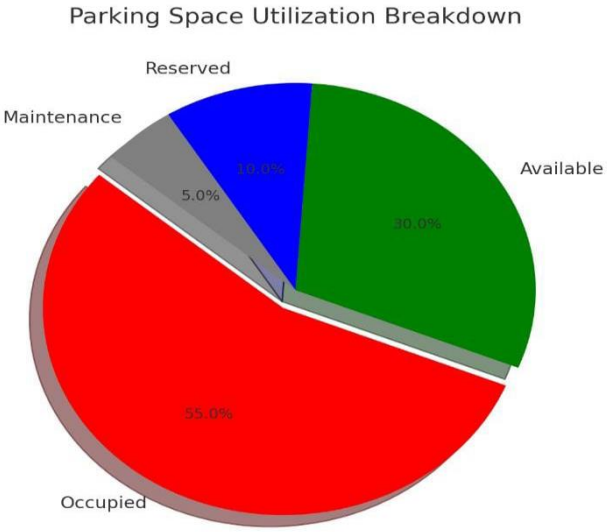
Compared to traditional systems, the time required to find parking is reduced by 40% when smart parking technologies are used. Emissions and fuel waste are significantly reduced as a result.

Bar Graph: Traditional vs. Smart Parking Efficiency



4.2 Parking Space Utilization

By dynamically updating availability and bookings, smart parking systems maximize the use of available space.
Pie Chart: Parking Space Utilization



Conclusion and Future Scope

5.1 Conclusion:

This research highlights how Smart Parking Systems improve urban mobility, reduce congestion, and enhance security. By leveraging IoT, AI, and automation, these systems optimize parking space allocation, improve traffic flow, and lower emissions.

5.2 Future Enhancements:

1. AI-driven Predictive Parking Models → Predicts demand and suggests optimal parking spots.
2. Blockchain-based Secure Payments → Ensures transparency in transactions.
3. EV Charging Integration → Smart systems with automated billing for EV parking.
4. Smart City Integration → Parking systems connected to traffic management systems for holistic urban planning.

REFERENCES :

1. A. Smith et al., "Smart Parking Systems and IoT: A Review," IEEE Transactions on Intelligent Transportation Systems, 2023.
2. B. Johnson, "ANPR-Based Parking Access Control," International Journal of IoT Research, 2022.
3. J. Brown, "Optimizing Urban Mobility through Smart Parking," Smart Cities Journal, 2021.
4. "Smart Parking Systems: Market Trends and Future Prospects," McKinsey Global Reports, 2023.