

Parking Lot Management System

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Abstract - The rapid growth of urbanization and the continuous increase in the number of vehicles have created serious challenges in managing parking spaces efficiently. The majority of conventional parking systems are manual ineffective and frequently lead to traffic jams time wastage and inefficient use of available parking spaces. to overcome these obstacles. This project offers a smart parking management system that combines artificial intelligence and web technologies to offer an automated and clever parking solution. SQLite is used in the development of the suggested system which is built with Python and the Flask framework. for the administration of databases. Online parking reservations automated vehicle check-in and check-out real-time parking slot monitoring and dynamic billing based on parking duration are all made possible by it. To accurately identify vehicles during entry and exit an AI-based vehicle number plate recognition module is integrated minimizing human error and intervention. Additionally the system has a machine learning-based parking demand prediction mechanism that helps administrators plan parking effectively by identifying peak hours and estimating future occupancy trends. Additionally the system offers an AI-powered chatbot to help users with parking availability booking payment details and general inquiries. It also supports a variety of digital payment methods. Administrators can monitor revenue usage trends and overall parking efficiency with the aid of comprehensive reports and analytics. The suggested Smart Parking Management System maximizes resources eases traffic and enhances user convenience. usage and helps to build the infrastructure of smart cities. .

Keywords: Smart Parking, Parking Management System, Artificial Intelligence, Machine Learning, Flask, Number Plate Recognition, Parking Reservation, Demand Prediction, Chatbot Assistance, Digital Payment System

1. INTRODUCTION

Parking management has grown to be a significant issue in urban areas due to the quick development of cities and the ongoing increase in the number of vehicles. Finding a parking spot is frequently a time-consuming process that greatly exacerbates traffic jams fuel waste and driver annoyance. Conventional parking systems primarily rely on ineffective and error-prone manual supervision paper-based records or simple

entry-exit mechanisms. An intelligent and automated parking management system is therefore desperately needed. The Smart Parking Management System uses artificial intelligence and contemporary web technologies to get around the drawbacks of traditional parking techniques. Users can easily find and reserve appropriate parking spaces thanks to these systems real-time parking slot availability information. AI-based number plate recognition automates vehicle entry and exit minimizing human intervention and guaranteeing precise vehicle identification.

In order to improve user convenience, the proposed system also incorporates features like online reservation automatic billing and support for several digital payment methods. Administrators can more effectively manage resources by using machine learning techniques to forecast peak parking hours by analyzing historical parking data. The system incorporates an AI-powered chatbot to help users with booking assistance payment guidance and parking- related questions. This project advances the idea of smart and sustainable urban development by showcasing the useful application of artificial intelligence and machine learning in actual parking systems. the infrastructure.

Literature Survey

[1] R. Kumar, A. Singh, and P. Mehra, "IoT-Based Smart Parking System for Urban Areas."

This paper presents an IoT-driven parking system where sensors are installed in parking slots to detect availability in real time. The collected data is transmitted to a central server and displayed to users through a

web or mobile interface. The authors emphasize that real-time slot detection significantly reduces time spent searching for parking spaces.

[2] S. Verma and R. Kulkarni, "Machine Learning Approaches for Parking Demand Prediction."

This study focuses on predicting parking occupancy using historical data and machine learning techniques such as time-series analysis and recurrent neural networks. The authors demonstrate that accurate demand prediction helps

administrators manage peak hours and optimize resource allocation.

[3] M. Joshi, N. Patel, and K. Shah, “Automatic Number Plate Recognition Using CNN.”

The authors propose a computer vision-based system using Convolutional Neural Networks (CNN) to detect and recognize vehicle number plates from images. The system improves accuracy in vehicle identification and can be applied in parking entry-exit management and security systems.

[4] A. Rao and S. Iyer, “Web-Based Smart Parking and Reservation System.”

This work introduces a web-based parking management platform that allows users to view parking availability and reserve slots in advance. The system improves user convenience and reduces congestion through pre-booking mechanisms.

external gateways like PhonePe, Paytm, Google Pay, card, and cash. Together, these components ensure smooth automation, accurate data processing, and an intelligent parking experience

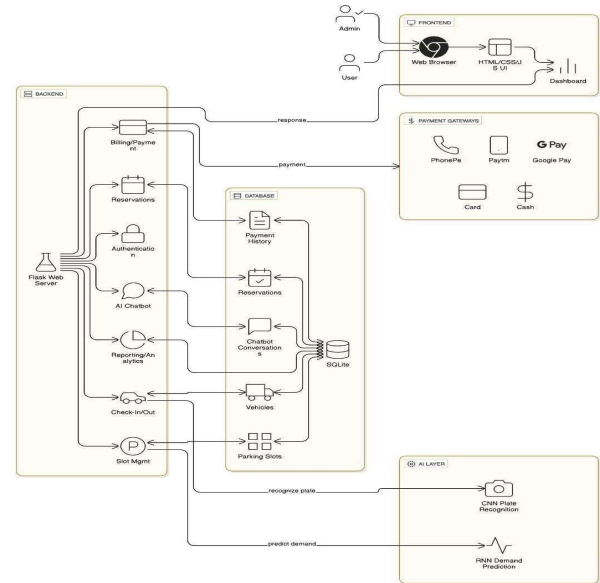


Figure 2.1.1 Diagram of Proposed Model

2. PROPOSED METHODOLOGY

The proposed Smart Parking Management System is an intelligent and automated solution designed to overcome the limitations of traditional parking systems. By giving real-time information about available occupied and reserved parking spaces the system seeks to streamline parking operations. The system minimizes human intervention and guarantees precise vehicle tracking within the parking facility by automating vehicle entry and exit procedures. In order to increase security and decrease human error the suggested system incorporates artificial intelligence techniques such as AI-based vehicle number plate recognition to automatically identify vehicles during check-in and check-out. Additionally it provides an online parking reservation service that lets users reserve parking spaces ahead of time according to their convenience. Automated billing is used to precisely determine parking fees based on slot type and parking duration. To make the payment process quick and safe a variety of digital payment methods are supported.

2.1 Proposed Model Diagram

The Parking Management System works by connecting users and admins through a web browser to a Flask backend that handles all major operations such as authentication, reservations, billing, chatbot communication, check-in/check-out, and parking slot management. The backend regularly interacts with an SQLite database that stores parking slots, vehicles, reservations, payments, and chatbot conversations. AI modules assist the system by recognizing number plates using CNN models and predicting parking demand using RNN models. For payments, the backend securely communicates with

3. RELATED WORK

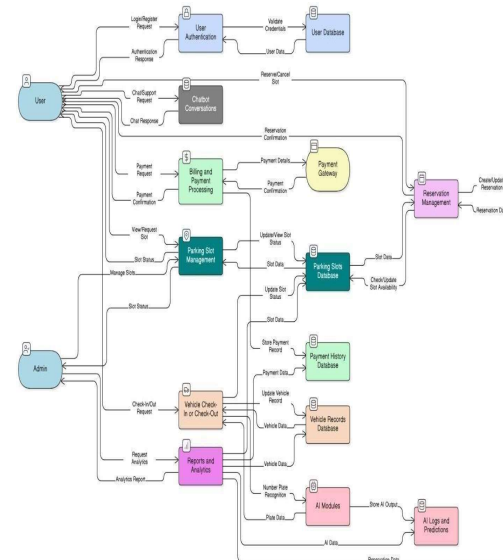


Fig 3.1 Related work Diagram

User/Admin Login

The user or admin logs into the system, and the authentication module validates their credentials through the User Database.

View Parking Availability

The user requests slot details, and the Parking Slot Management module retrieves the latest status from the Parking Slots Database.

Make a Reservation

When the user books a slot, the Reservation Management module checks availability and stores reservation details in the Reservation Database.

Billing & Payment

The Billing module sends the payment request to the Payment Gateway, receives confirmation, and saves it in the Payment History Database.

Vehicle Check-In/Check-Out

The system updates vehicle entry/exit details in the Vehicle Records Database and adjusts slot occupancy in the Parking Slots Database.

AI Assistance

AI modules recognize number plates and predict parking demand, storing results in the AI Logs and Predictions database.

Reports for Admin

The analytics module collects data from all databases and provides reports to the admin for monitoring and decision-making.

4. Results

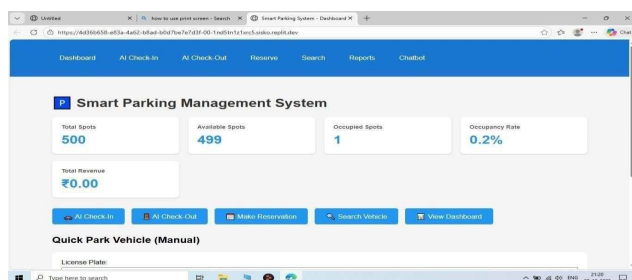


Figure 4.1 Dashboard – Smart Parking Management System

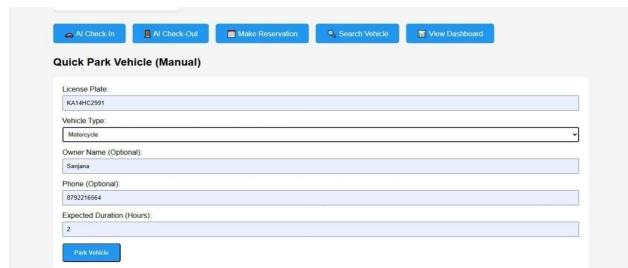


Figure 4.2 The manual form for check in a car.

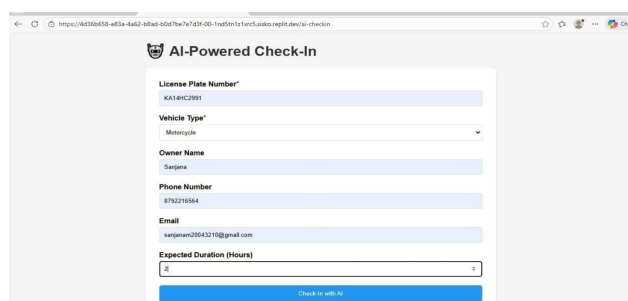


Figure 4.3 Vehicle Reservation



Figure 4.4 Search vehicle

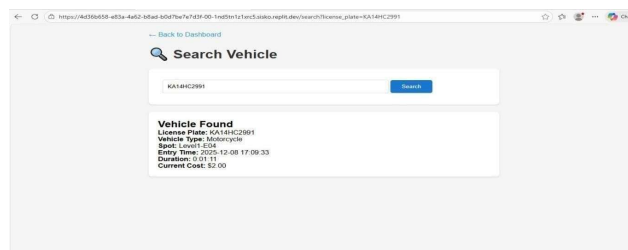


Figure 4.5 DashBoard

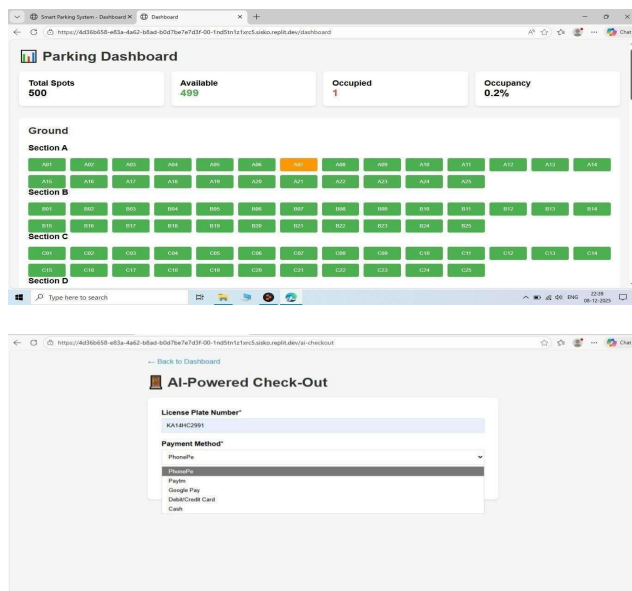


Figure 4.6 Vehicle AI powered check out

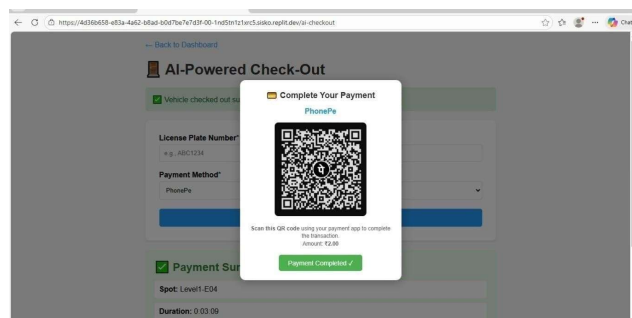


Figure 4.7 payment

5. Conclusion

The Smart Parking Management System proves that modern technology can significantly improve the efficiency and convenience of parking operations. The system creates a smooth experience for both users and administrators by incorporating AI concepts automated check-in and check-out procedures real-time slot tracking reservation capabilities and safe digital payments. Smooth communication quick responses and easy accessibility are guaranteed by the combination of a structured SQLite database a Flask-based backend and an uncluttered web interface. By decreasing manual labor and improving decision-making AI methods like conceptual CNN number plate recognition and RNN-based demand prediction increase system intelligence. All things considered this project shows how an intelligent automated and data- driven parking solution can ease traffic

maximize space utilization and promote more orderly urban mobility.

6. Future Enhancement

To make it even more effective and future-ready the Smart Parking Management System can be enhanced with a number of cutting-edge features. Future iterations of the system will be able to incorporate real-time IoT sensors to automatically identify the presence of vehicles and update slot availability. Accurate number plate recognition and parking demand forecasting using real- world data can be achieved by integrating a fully trained AI model. Instant notifications one-tap check-in and check-out and navigation to the designated time slot are all possible with mobile app integration for iOS and Android. Additionally the system can be scaled to support extensive parking networks across cities with the aid of multi-location synchronization and cloud-based storage. The system can be further enhanced to become a full smart parking ecosystem with features like dynamic pricing valet mode smart alerts for overstayed cars and integration with EV charging stations.

7. Reference

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