

Smart Parking System with CNN and Piezoelectric Technology

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INTRODUCTION & AIM

- Current parking system in the society has become a daily challenge for the students, staff and visitors.
- Issues such as no certain place for parking, unauthorized parking, no sign boards, and safety of the vehicle.
- A feedback survey was conducted to understand experience of users and gather the information about issues they are facing and suggestions from the user.
- The goal is to use feedback to recommend a Smart parking System that can solve problems facing by the users and improve the convenience of the user.

Objectives:

- To develop a smart parking system with ANPR technology.
- To enhance the image that has been captured using CNN technology.
- To develop a webpage for this smart parking system that helps the user to see the slot availability and booking facility.
- To implement the Piezoelectricity technology in the smart parking system.

METHOD

Working of the proposed Smart Parking System:

The software methodology integrates image processing, IoT communication, and web application development to automate parking operations. A CNN-based model enhances captured number plate images, and an OCR module extracts vehicle numbers for record-keeping. The backend, developed using Flask or Django, manages data exchange between sensors, database, and user interface. Real-time parking data is stored in a central database and displayed on a web platform, allowing users to view and book available slots remotely. The integrated software ensures accurate monitoring, secure data handling, and a smooth user experience.

Prototype development for proposed Smart Parking System:

The hardware methodology of the Smart Parking System involves the integration of piezoelectric energy harvesting, IoT sensors, and camera-based vehicle monitoring. Piezoelectric sensors embedded beneath the parking surface convert the mechanical pressure of moving vehicles into electrical energy, which is rectified, regulated, and stored to power the system. Ultrasonic sensors detect vehicle presence in each slot and send data to an ESP32 microcontroller, which transmits real-time slot information to the server via Wi-Fi. A high-resolution camera at the entry captures vehicle number plates for identification, while an LED display shows available slots, ensuring efficient, automated, and sustainable parking management.

RESULTS & DISCUSSION

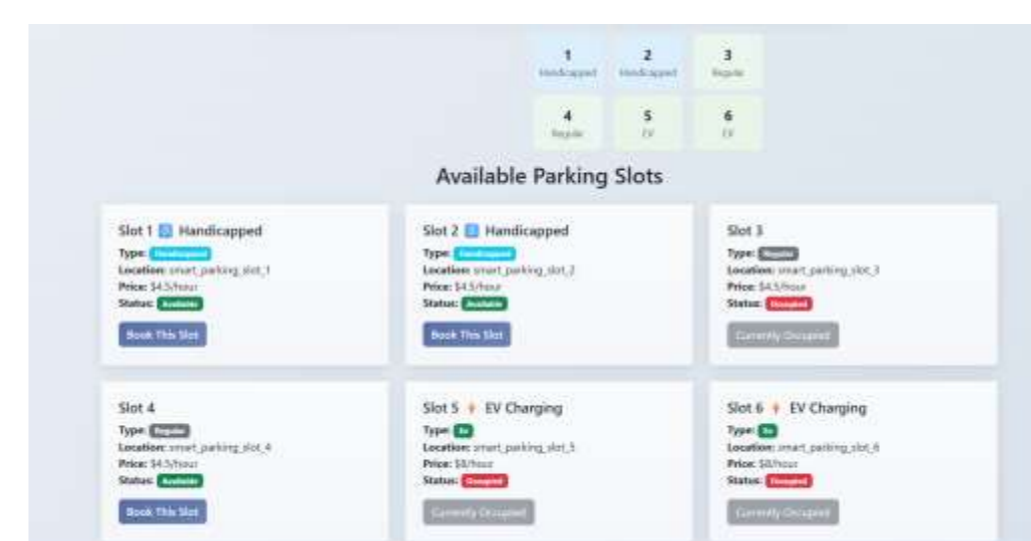
Smart Parking System with the Convolution Neural Network Technology and Piezo Electric Technology has been implemented successfully. Web page with User Dashboard by allowing the user to look into the slot availability and access to book the slot for a particular time period with including the payment gateway. Admin Dashboard where admin can monitor all the process, admin can look into history of bookings and the slot availability and section to monitor the CNN process. Hardware is implemented using some sensors and microcontrollers, IR sensor is used to detect the slot status and the microcontroller ESP32 to control this process and send the data to the backend and ESP32 cam and Mobile is used to capture the Vehicle Number plate and send it to the backend and process it and give access to the vehicle to enter the parking.



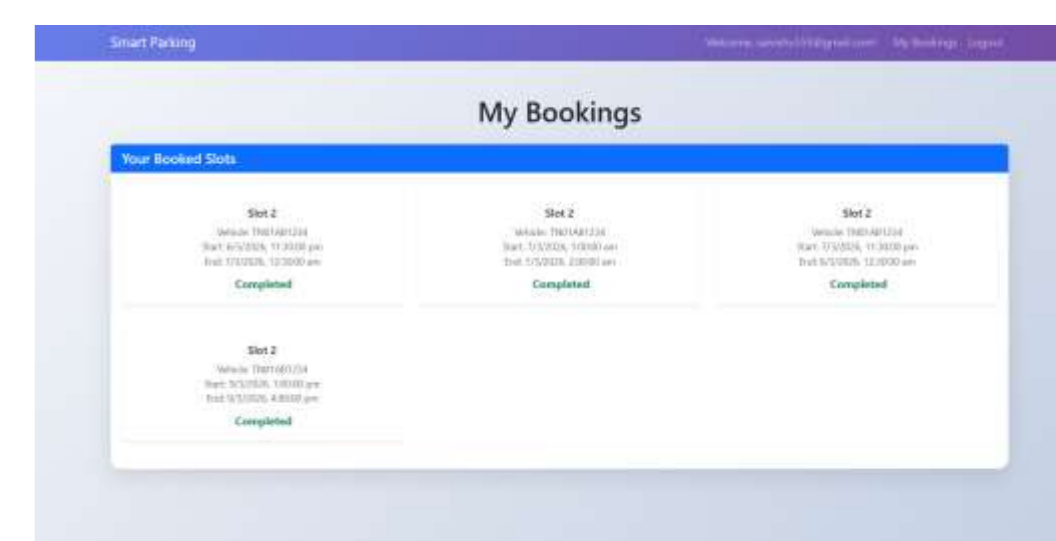
Login Page



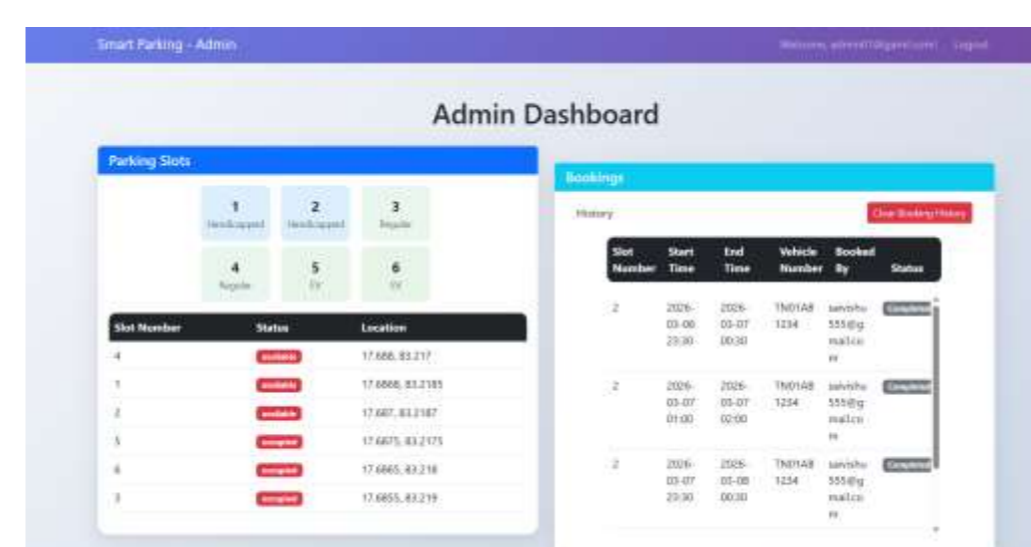
Registration Page



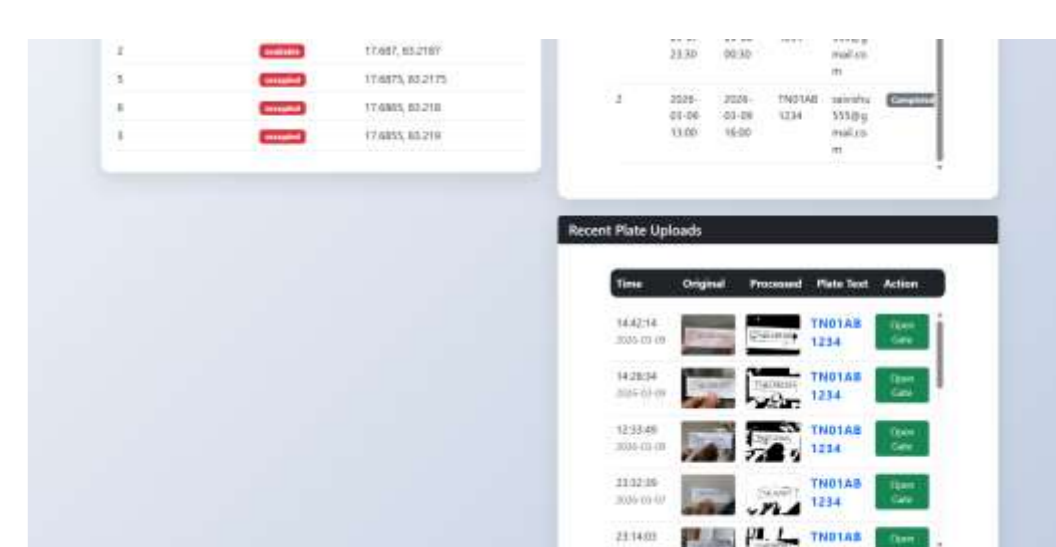
User Dashboard



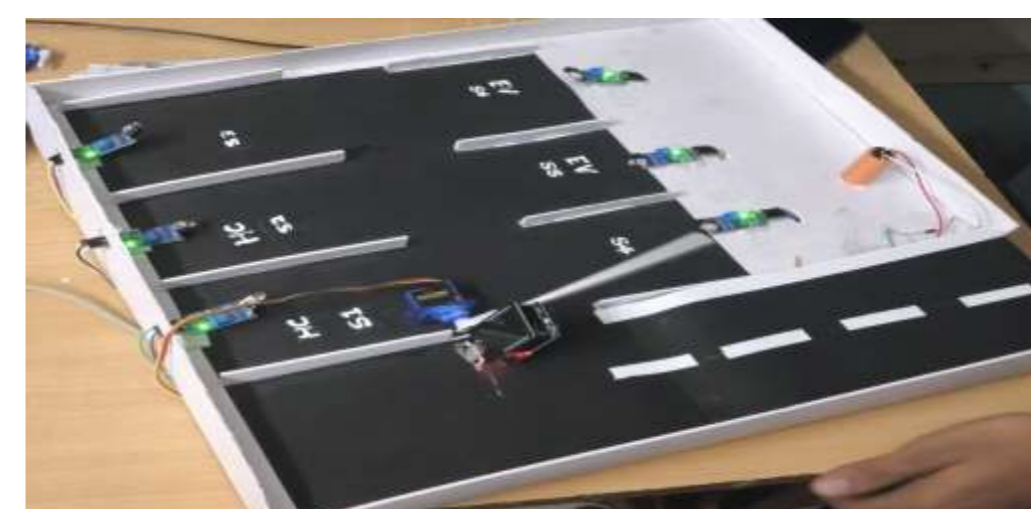
User's My Bookings Section



Admin Dashboard



(Admin) ANPR Result Section



Hardware Setup

CONCLUSION

This project presents an IoT-based smart parking system integrating real-time slot monitoring, CNN technology for image enhancement, cloud-based ANPR for vehicle identification, and automated gate control using ESP32. The system improves parking efficiency, reduces manual intervention, and enhances user convenience through seamless booking verification. Experimental results demonstrate reliable character extraction and successful gate automation, making the solution suitable for scalable urban parking applications.

FUTURE WORK / REFERENCES

Future enhancements of the system can include deep learning-based vehicle recognition, real-time video analytics, and mobile application integration for improved automation and user experience. The piezoelectric energy harvesting module can also be optimized and integrated with renewable energy sources for sustainable smart parking infrastructure.

[1] H. A. Abu-Asaad, "CNN-Based Smart Parking System," *International Journal of Interactive Mobile Technologies (IJIM)*, vol. 17, no. 11, pp. 45-58, 2023.