

ABSTRACT

Conventional parking systems still face various issues, such as limited real-time information on parking availability, lack of reservation features, and minimal automation in vehicle entry and exit processes. These problems often lead to long queues, extended search times, and difficulty in monitoring vehicles. To address these challenges, a Simulated Parking Reservation and Automated Barrier System Using QR and ANPR was developed as an Internet of Things (IoT)-based solution. The system integrates slot booking via a mobile application, QR code scanning for entry authentication, and license plate recognition (ANPR) for automated exit validation.

The simulation utilizes a Raspberry Pi 4 as the central controller, 10 ultrasonic HC-SR04 sensors to detect the presence of miniature vehicles, an Eyesec webcam for license plate reading, and an additional camera for scanning QR codes. Two servo motors and two additional sensors are placed beneath the barrier to ensure that the gate does not close while a vehicle is still underneath. A license plate input feature is also provided through the app, which is revalidated using ANPR upon exit. All data is transmitted in real-time to Firebase and displayed via both a mobile app and an admin web dashboard.

Simulation results indicate that the average processing time from reservation to gate opening is approximately 3–5 seconds. QR code recognition accuracy exceeded 90% under stable lighting conditions. ANPR testing on real vehicles was conducted using a camera mounted at 42 cm height, achieving up to 85% accuracy during daytime. However, performance dropped significantly at night due to glare from vehicle headlights. With its stable performance and modular system architecture, the prototype is considered suitable for further development toward real-world implementation in high-density parking environments.

Keywords : ANPR, Firebase, Internet of Things, QR Code, Raspberry Pi 4, Parking Reservation System, Vehicle Validation..