

AI Autonomous Parking System

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Abstract: *Rapid urban development and the rising dependency on private vehicles have intensified parking challenges in metropolitan regions. Inefficient parking systems often result in prolonged traffic, wasted fuel, and reduced commuter efficiency. This paper presents the **AI-Based Autonomous Parking Framework (AAPS)** — a unified, vision-driven model employing **YOLOv8** for dynamic slot detection, a **Genetic Algorithm (GA)** for optimized slot allocation, and an adaptive **Llama 3–based virtual assistant** for user communication. The multi-layer design integrates a Python-powered backend, a React–TypeScript administrative interface, and Redis–PostgreSQL data management for seamless performance. Experimental results from a 100-space test environment reported an average detection precision (mAP@50) of 96.8%, a 40% reduction in vehicle search duration, and a 90% user satisfaction rate. The system offers an extensible and economically feasible approach to smart-parking management, promoting automation, reliability, and real-time adaptability.*

Keywords: AI Parking, YOLOv8, Genetic Algorithm, Computer Vision, Smart Cities, Automation

