AUTOMATED SMART PARKING SYSTEM

Capstone Project | VIT Chennai

Computer Vision • Deep Learning • IoT Integration

The Problem Context

Manual Inefficiency

Traditional gate checking relies on manual verification of stickers, leading to long queues during peak college hours and human error in tracking unauthorized vehicles.

Space Mismanagement

Lack of real-time data results in students circling for spots. Cars frequently occupy bike zones, and there is no centralized system to track occupancy in the hostel vs. academic zones.

Project Objective

To design an automated parking system for the college campus that uses **image processing** and **object detection** to manage parking efficiently, verify vehicles instantly, and display real-time parking status at the gate.

System Workflow

Entry

Vehicle approaches the automated gate camera.

Detection

System detects Sticker (RFID/Visual) & License Plate.

Verification

Cross-check plate with VIT Database.

Allocation

Check availability & classify vehicle type.

Access

Gate opens & Display updates slot count.

Automated Entry & Verification

College Sticker Detection

The system utilizes a specialized camera setup to detect authorized college stickers (similar to FASTag) on the windshield.

- Eliminates the need for physical ID card checks.
- Reduces entry processing time to under 3 seconds.
- Ensures only registered student/faculty vehicles enter restricted zones.

License Plate Recognition

OCR & Database Integration

Using Optical Character Recognition (OCR) via EasyOCR/Tesseract, the system extracts the alphanumeric number from the vehicle plate.

This data is instantly queried against the **College Firestore Database**. If the plate matches a registered student, the gate trigger is activated. Unregistered plates trigger an alert for manual security intervention.

Real-Time Parking Status

Live Slot Tracking

Cameras monitoring the parking zones utilize object detection to count occupied vs. free slots.

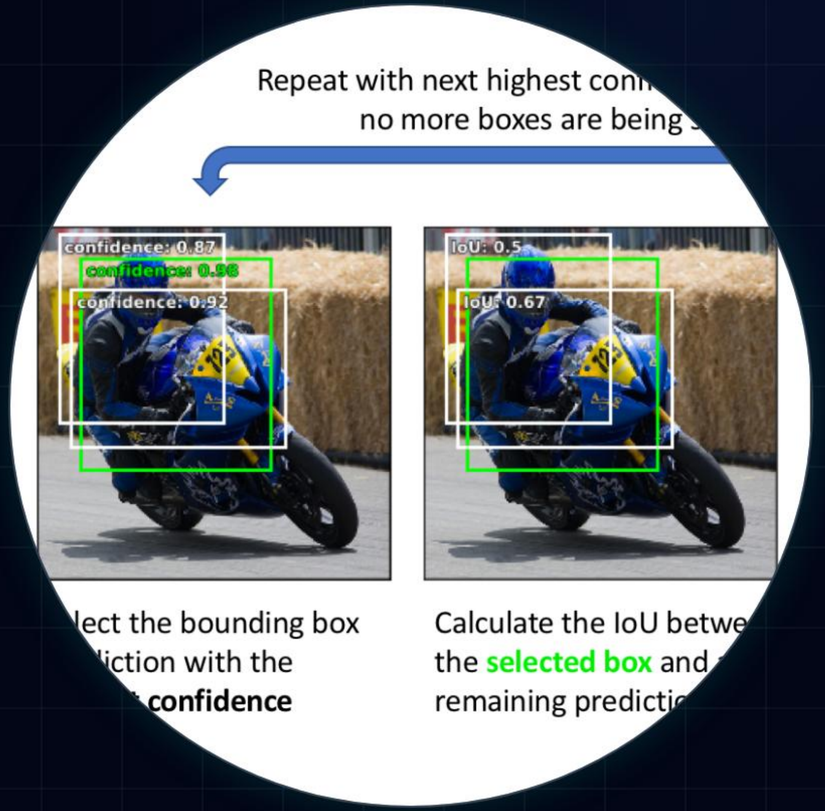
Digital Gate Display:
A screen at the entrance dynamically updates to show "Student Parking: 15 Slots Available" or "Hostel Zone: FULL", preventing unnecessary traffic inside the campus.

Intelligent Categorization

Deep Learning Classification

The system doesn't just see a vehicle; it understands the type. Using a trained YOLO model, it distinguishes between **Two-Wheelers (Bikes)** and **Four-Wheelers (Cars)**.

This ensures efficient space utilization by directing cars to larger bays and bikes to designated compact zones, maximizing the campus parking capacity.



Technology Stack

Core Logic

Python is used for all backend processing, integrating the AI models with the hardware sensors.

Computer Vision

OpenCV for image processing and YOLOv8 for high-speed, real-time object detection.

Database

Google Firebase (Firestore) for real-time data syncing between the gate, cameras, and web app.

System Prototype

Web-Based Control Panel

We have developed a functional prototype allowing students to register their vehicles remotely.

- Student Login & Registration Portal.
- Document upload (Driver's License).
- Admin view for real-time slot occupancy.
- Live status updates via Firebase listeners.

Future Scope

- **Mobile App Integration:** Developing a dedicated React Native app for students to book slots in advance.
- **Digital ID Entry:** Integrating with the college's existing digital ID infrastructure for seamless pedestrian verification.
- **Predictive Analytics:** Using historical data to predict peak parking hours and suggest alternate parking zones automatically.

THANK YOU

Questions?

VIT Chennai Capstone Project
Automated Parking System Team

Image Sources

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