IoT Parking Monitoring System System

Team El manajek | Internet of Things and Applied Data Science | Fall 2025

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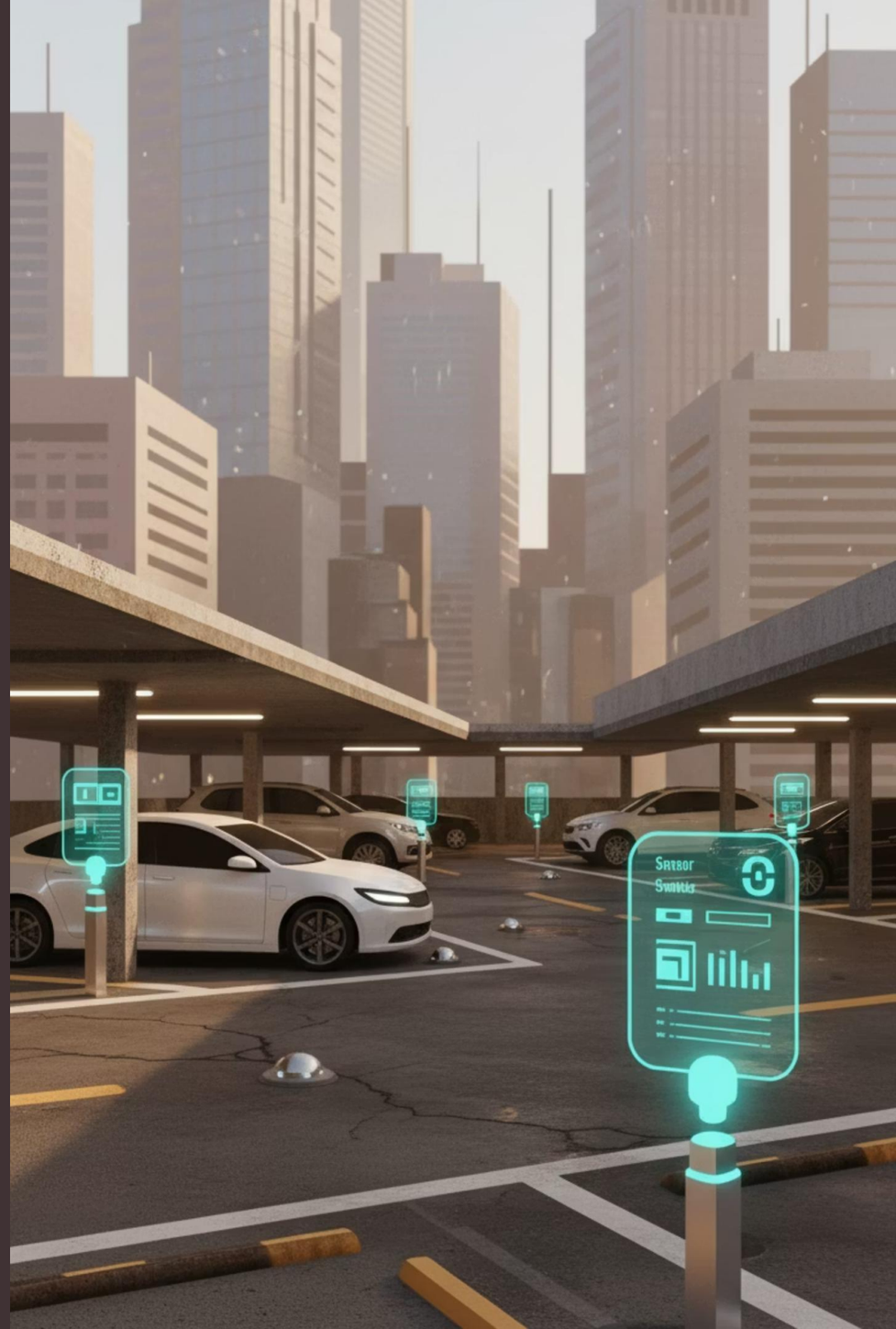


The Urban Mobility Challenge

Modern cities face a critical disconnect between parking availability and driver information, leading to severe congestion and inefficiency.

Congestion

Up to 30% of urban traffic is caused by drivers circling for circling for parking, increasing carbon emissions and commute times.

Inefficiency

Without real-time data, space utilization remains unbalanced, leaving some areas empty while others overflow.

Data Gap

Municipalities lack the granular, sensor-based insights needed to optimize infrastructure planning.

Dataset & Methodology

Leveraging granular sensor data to build a responsive monitoring architecture.

- **Source: Kaggle IoT Smart Parking**

  A comprehensive dataset capturing real-time parking states across multiple zones.

- **Scale: 2,769 Records**

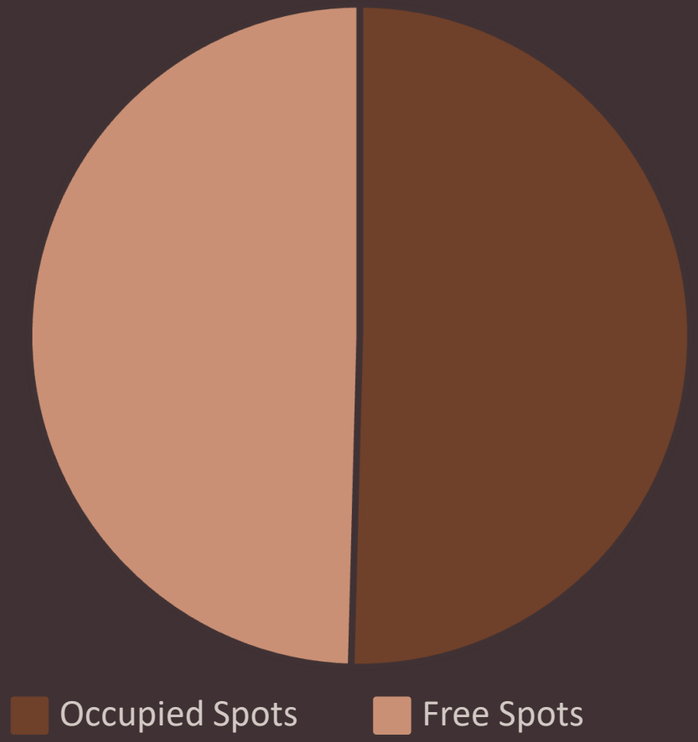
  High-frequency data points providing a robust foundation for pattern analysis.

- **Hardware: 50 Infrared Sensors**

  Simulated sensor array tracking presence/absence in individual parking bays.

Analysis of Parking Occupancy

Our analysis revealed a highly balanced utilization rate across the monitored sector.



50.4%

Occupancy Rate

The system maintains a near-perfect equilibrium between availability and usage.

2,769

Total Data Points

Processed records validating the sensor network reliability.

Real-Time Dashboard Interface

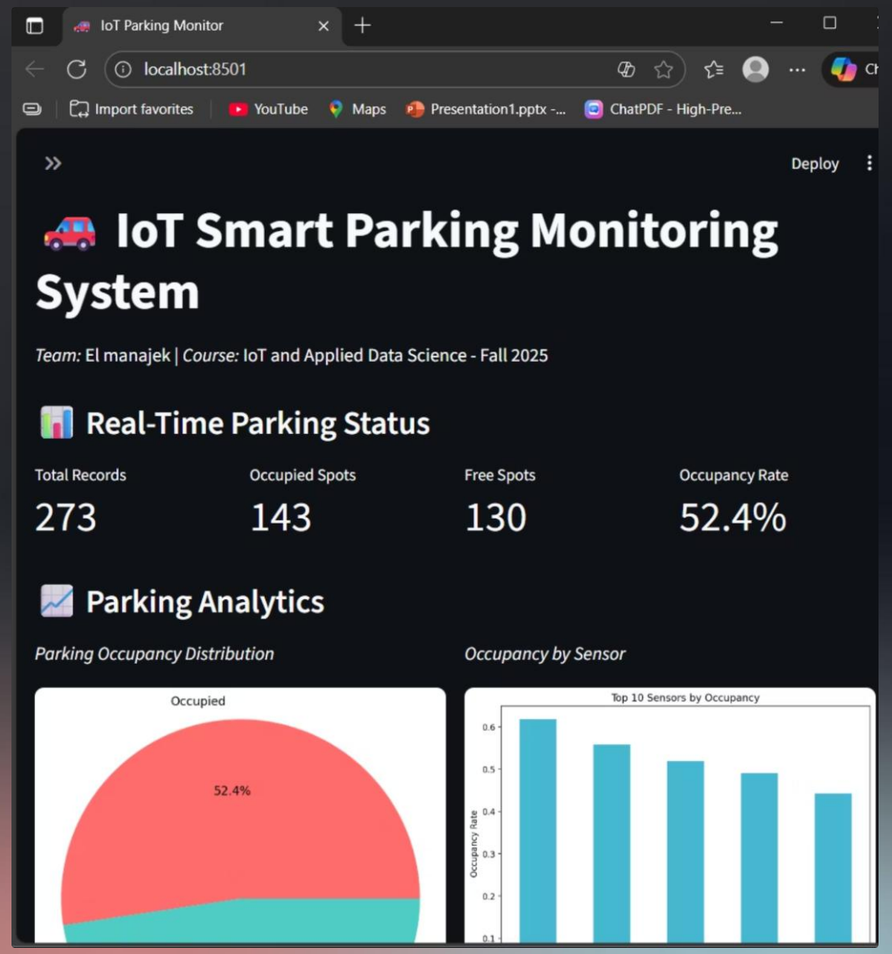
We developed an interactive command center using Streamlit to visualize sensor streams instantly.

Live Analytics

Real-time visualization of occupancy trends and peak hours.

Dynamic Filtering

Isolate specific sensor clusters or timeframes for detailed inspection.



Technical Architecture

A modular tech stack designed for scalability and rapid data processing.

Core Logic: Python

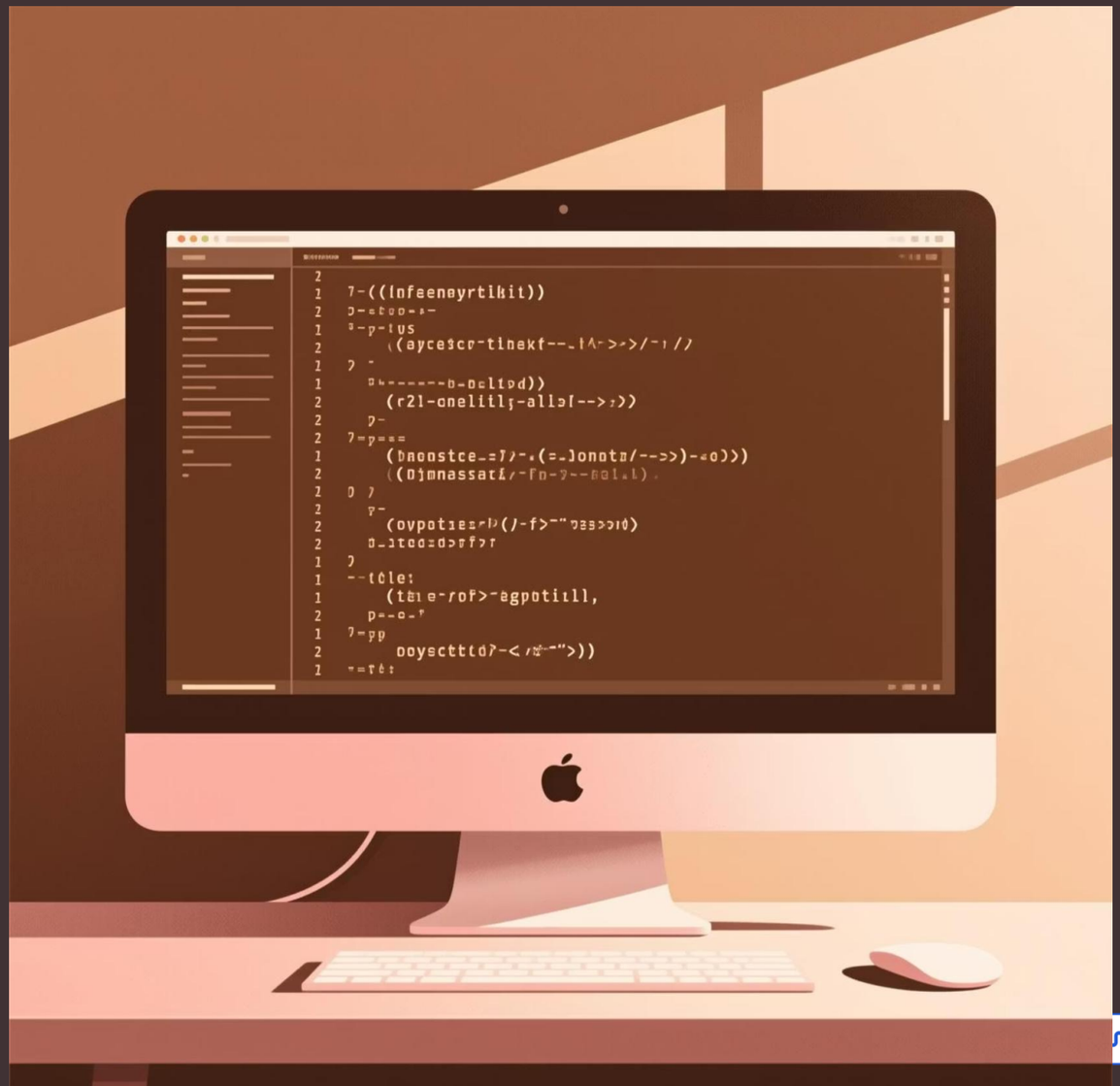
The backbone of our data processing and backend logic.

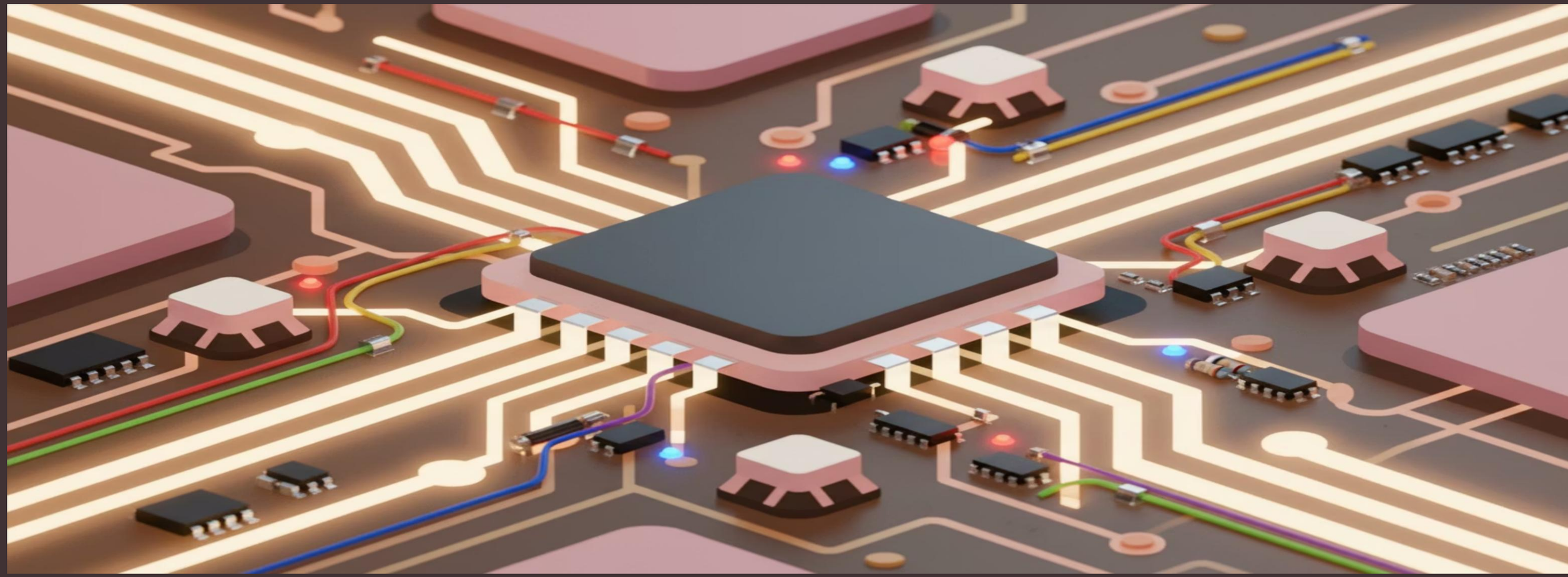
Data Handling: Pandas

Efficient manipulation of large sensor datasets and state cleaning.

Frontend: Streamlit

Rapid deployment of the interactive web application.





Challenges & Key Learnings

The development process highlighted critical insights into IoT data management.

Data Consistency

Cleaning raw sensor logs required handling null values and false positives from infrared signal noise.

Real-time Latency

Optimizing Streamlit's refresh rate was crucial to ensure the dashboard reflected "live" conditions without lag.

Modular Collaboration

Adopting a component-based architecture allowed the team to develop backend and frontend modules simultaneously.

Conclusion & Future Scope

Our prototype demonstrates that low-cost sensor networks can effectively solve urban parking density issues through data transparency.

Future Improvements

- Integration of predictive ML models
- Mobile app for driver navigation
- LoRaWAN hardware implementation

Explore the Code:github.com/osamanabil283-design/IOT-Parking-Monitoring-system system

Team El manajek

Thank you for your attention.