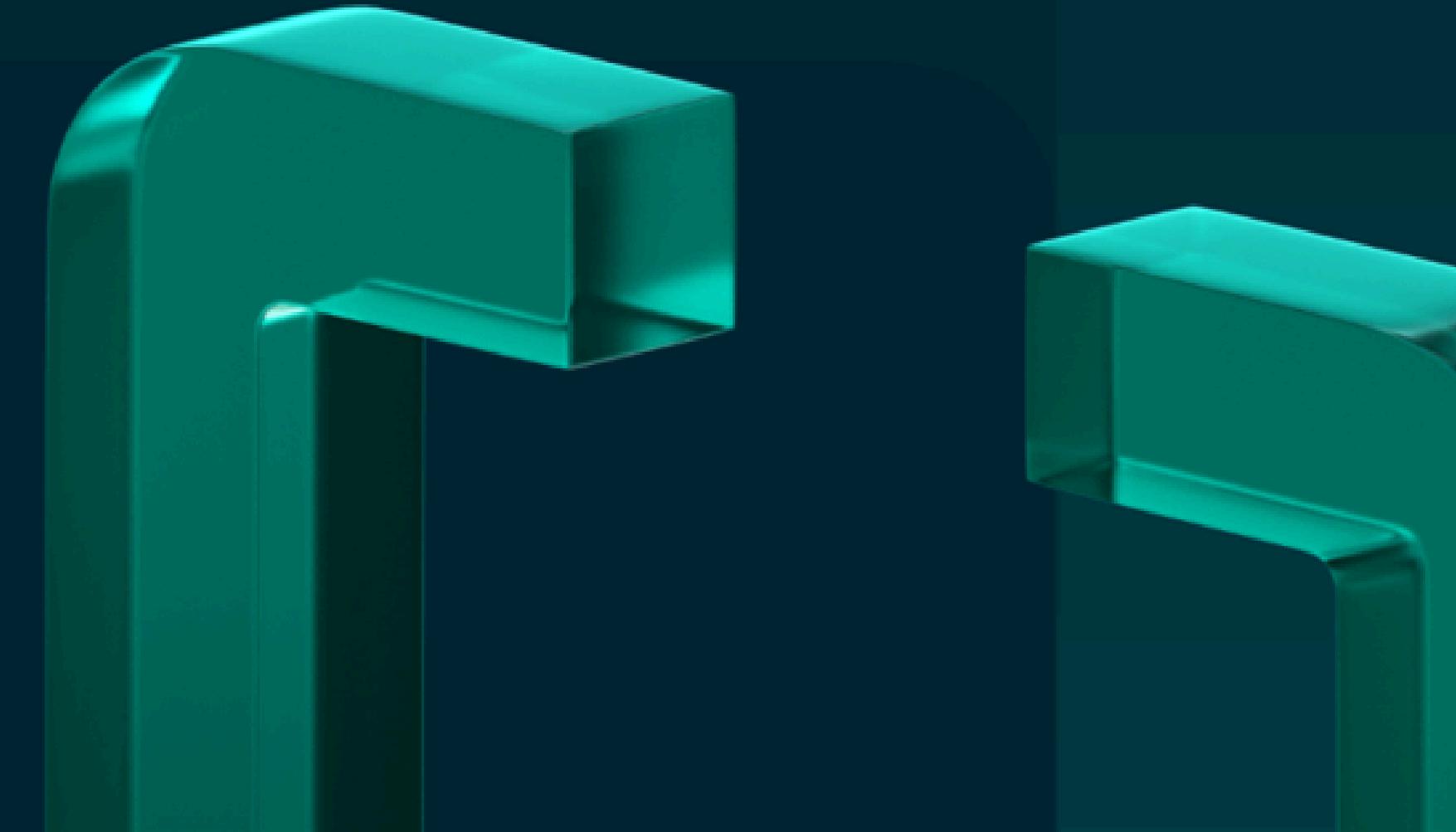


# i.mobHthon 5.0

Driving innovation to create **smarter,**  
**scalable solutions**



## Team Details

- a. Team name: techwagon
- b. Team leader name: Arpan Agrawal
- c. Problem Statement: Predictive Parking Space Marketplace

# Our Solution

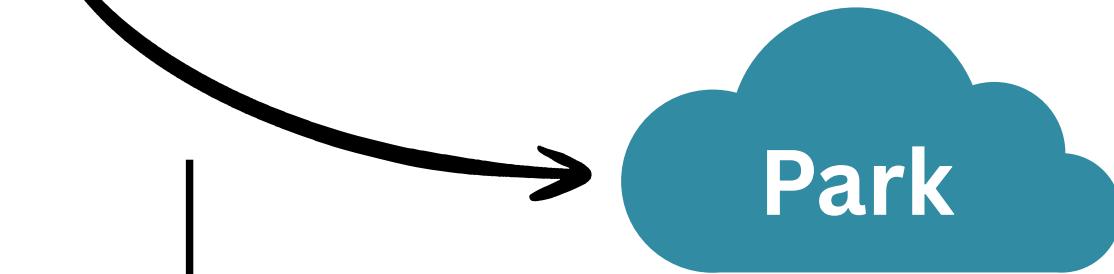
A Self-Learning, In-Car Ecosystem We don't just find parking; we eliminate the entire problem. VolksPark integrates AI prediction, real-time ground truth, and a seamless in-car + Mobile interface to create a zero-friction experience.



- We give drivers the **power of foresight**.
- **AI-Powered Forecasting:** Generates a "Parking Confidence Score" for any parking lot at any future time.
- **Proactive Planning:** Users plan their entire journey knowing a **spot is 85% likely to be waiting**.



- Our unbeatable advantage: a system that **learns and adapts**.
- The Ground-Truth Feedback Loop: **CV cameras provide a high accurate, live feed of every single parking slot's status**.
- **Unmatched Accuracy:** This live data feeds our AI 24/7. The system learns, adapts, and gets smarter with every car that parks.



- **Native In-Car Experience:** A native **CarPlay/Android Auto** interface with voice as the primary control.
- **Intelligent Voice Command:** Understands intent, like "**Get me parking at Jio World Drive in 30 minutes**."

# Opportunities & Differentiation

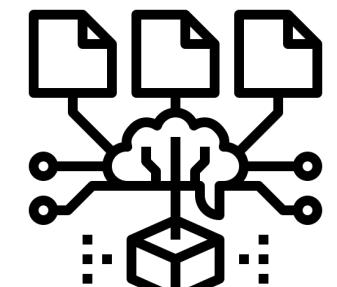
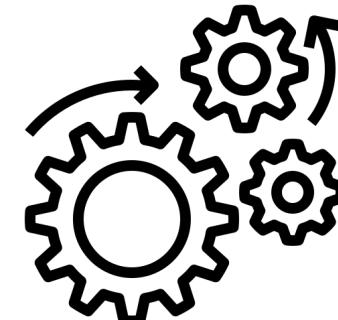
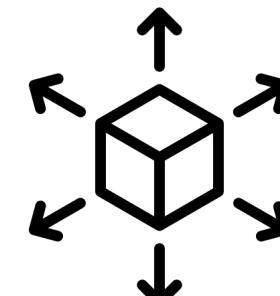
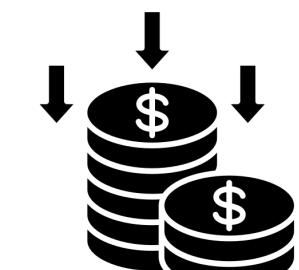
## Opportunity & Problem solved

- Integration with **municipal smart parking** systems.
- Collaboration with **real-estate developers** and **mall managements**.
- Commercialization as a **plug-and-play parking analytics API** for CCTV networks.

## Key Differentiators & USP

- Uses a **camera-based YOLO + ML model** to detect free or occupied slots automatically. Can work with existing CCTV cameras, reducing hardware costs.
- The prediction model uses historical patterns to forecast upcoming availability.
- **Unified Agentic AI** experience in app and CarPlay.

## How will it be able to solve the problem



Real - Time  
Monitoring

Reduced  
Search Time

Cost  
Efficiency

Scalability

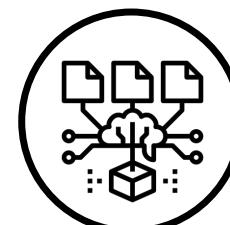
Automation  
Ready

ML Prediction  
Model



## Real-Time Monitoring

Automatically detects whether a **parking slot is free or occupied** using a **YOLO-based vision model**.

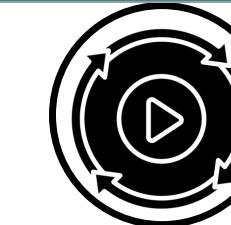


## Predictive Parking Availability

Uses a **ML prediction model** to forecast the **availability of parking slots** which helps users plan their arrival time for **higher chances of finding a parking space**.

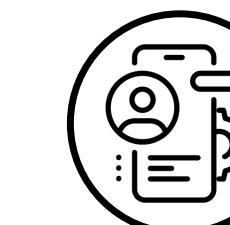
## Dynamic Pricing

Parking prices increase or decrease **dynamically** based on the **user's distance from the parking lot and current demand**.



## Extend Parking Duration

Allows users to extend their **parking slot time** directly through the app before it expires.

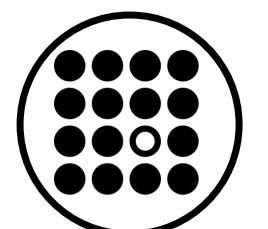


## Mobile App & CarPlay Integration

Provides a user-friendly mobile interface and **Apple CarPlay/Android Auto compatibility** for in-car access.

## Agentic AI Assistance

Enhances app with **intelligent, context-aware automation** that anticipates user needs, learns from driving and parking habits, and **allows quick slot booking through intuitive voice commands**.



## Unique Slot Identification

Every slot is assigned a **permanent ID**, enabling consistent tracking across sessions and accurate data logging.

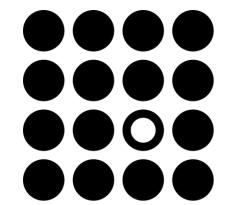
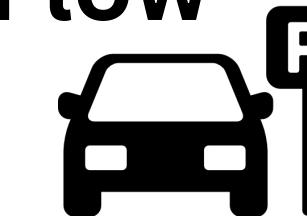
## Scalable Cloud & Backend

Uses Prisma with **PostgreSQL, Redis caching**, and **Kubernetes** for fast, reliable, and scalable deployment across multiple parking sites.

## PRE-PAID



## Process Flow



**New User Signup** to the app and **register** their vehicle

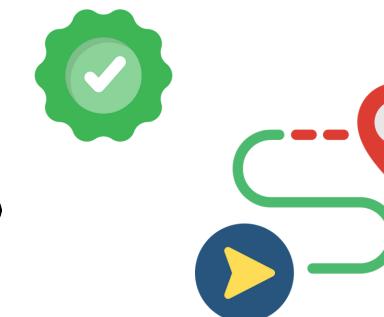
Receives the **nearby Parking lot** on the map

Selects a parking lot  
(slot available probability is fetched from **redis/ML model**)

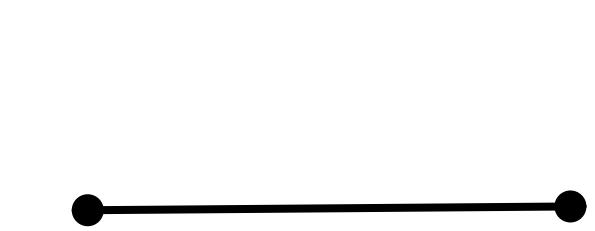
User selects a parking slot  
(Which are real-time updated from the computer vision & kubernetes )



If time Exceeds



If user needs to extend the parking slot time then the amount is deducted from wallet

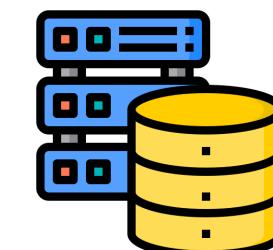


User navigates to the parking slot through provided GMaps



User plays the parking fee through Wallet or payment gateway

## POST-PAID



New User Signup to the app and register their vehicle

Using Entry gate camera & CNN model to extract number plate

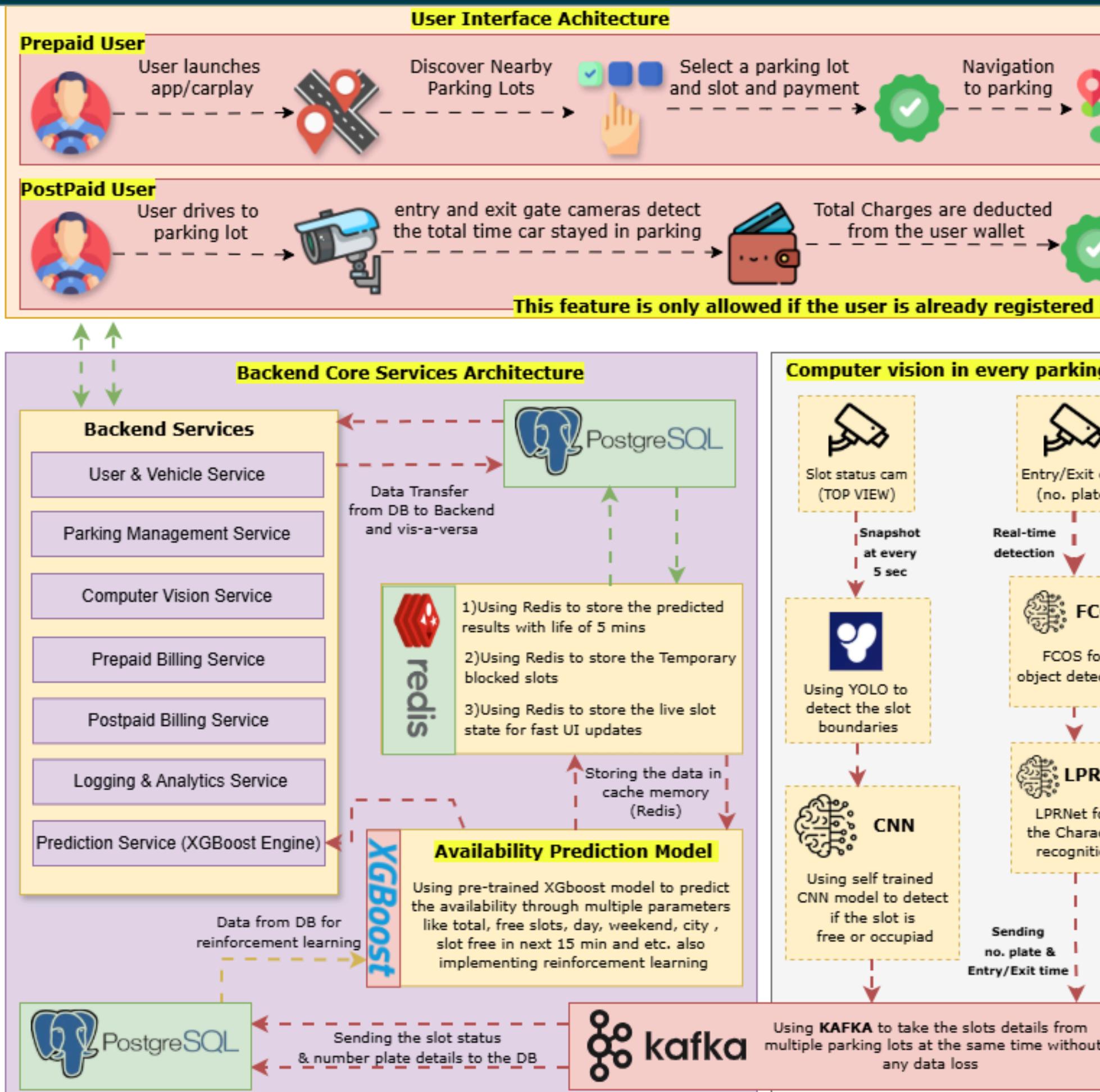
Using Exit gate camera & CNN model to extract number plate

Send the entry & exit time with the number plate to the Server

Deduction of the money from the wallet

# Wireframes/Mock diagrams of the proposed solution

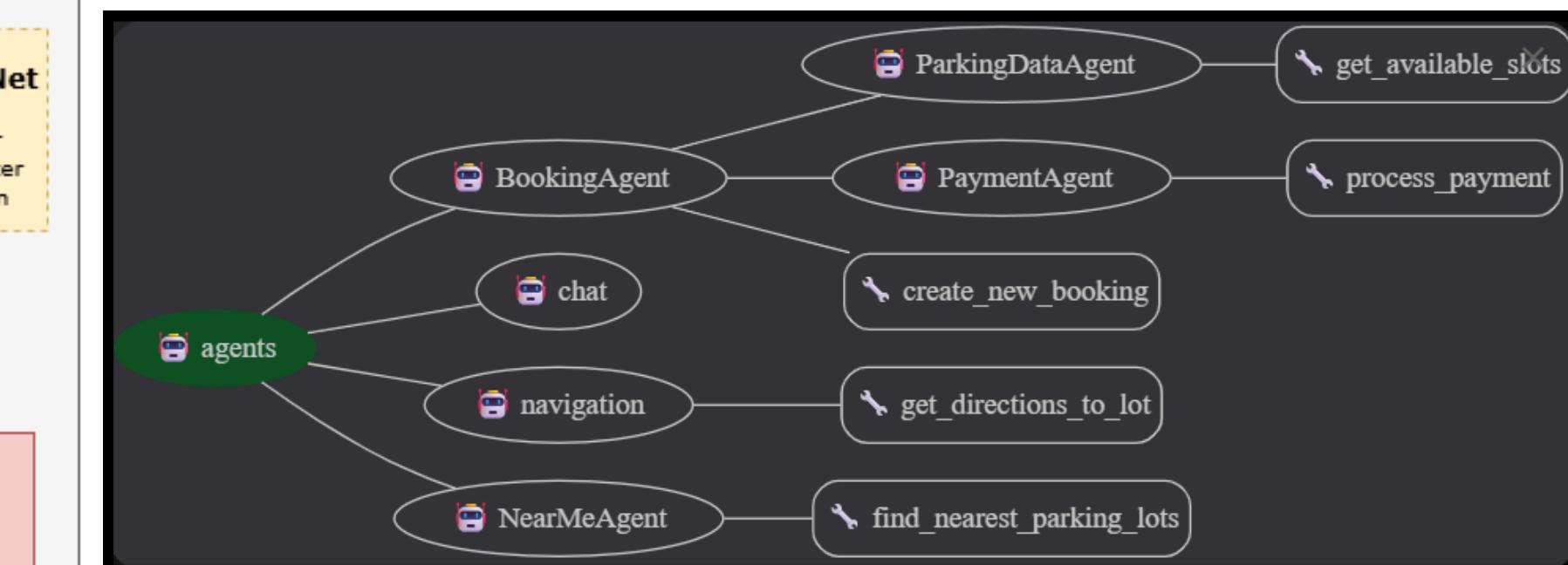




# Architecture Diagram

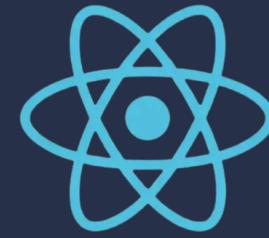
- The system caters to both **prepaid users** who book and pay in advance, and **postpaid users** with **automated entry/exit detection and wallet deductions**.
- A **modular backend architecture** uses **PostgreSQL** for persistent data and **Redis** for fast, temporary storage of predicted or blocked slots.
- AI-driven models like **XGBoost** predict slot availability, while **YOLO**, **FCOS**, and **CNN/LPRNet** handle real-time object and license plate detection via **computer vision**.
- Dedicated cameras at each parking lot monitor slot status (top-view) and vehicle movement/license plates (entry/exit) with frequent updates.

# Agentic Workflow



# Tech Stack

## Frontend tech stack



React



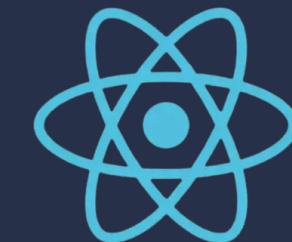
CarPlay



TailwindCSS

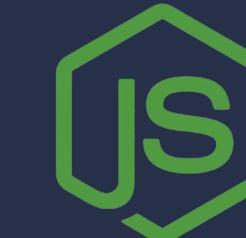


Expo



React Native

## Backend tech stack



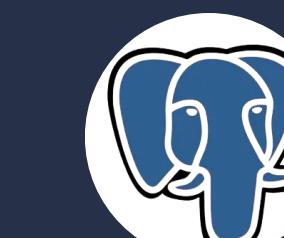
Nodejs



Prisma ORM



Redis (Cache)



PostgreSQL



Kubernetes

## ML & Computer Vision



YOLOv8



Python



TensorFlow

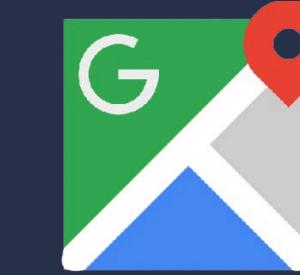


OpenCV

## Cloud , Devops & third party



Docker



Gmaps API

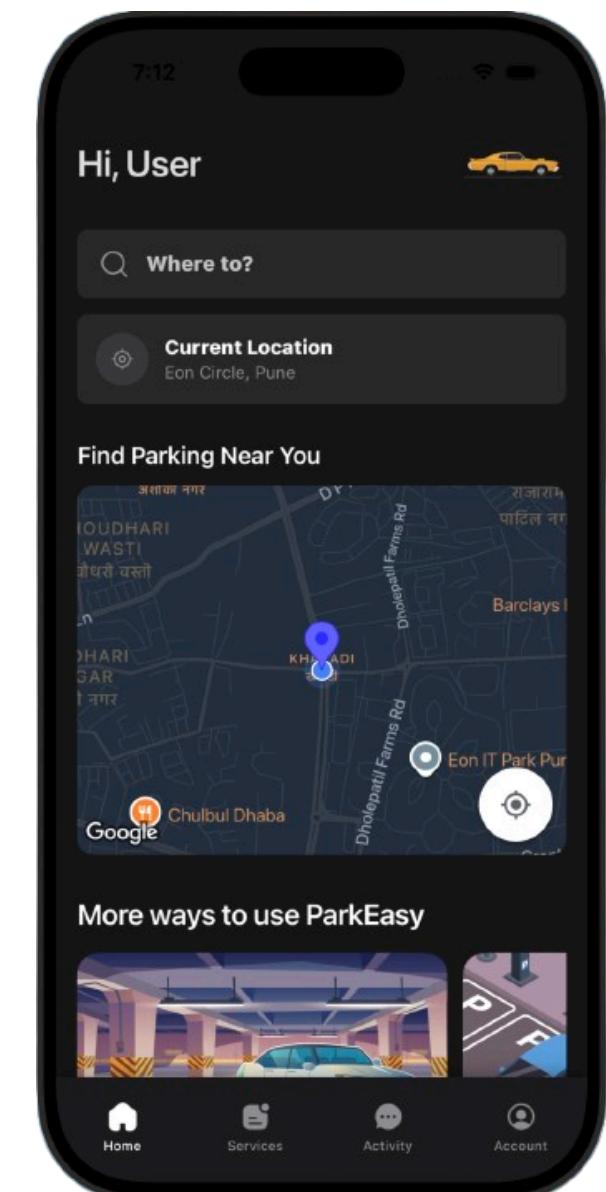


google adk

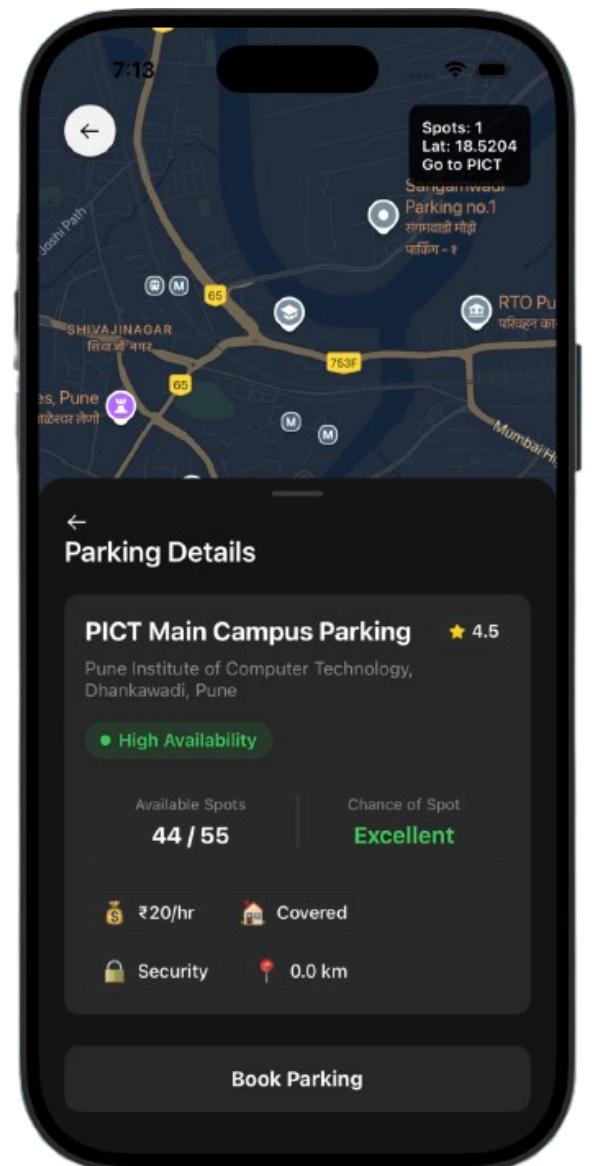
## Estimated Cost (On large Scale)

Services	Cost
<b>Cloud &amp; Deployment</b> <ul style="list-style-type: none"><li>• Kubernetes Cluster(AWS/GCP/Azure)</li><li>• PostgreSQL + Redis Hosting</li></ul>	<b>30,000 – 65,000 /month</b>
<b>Operations &amp; Maintenance</b> <ul style="list-style-type: none"><li>• Model Retraining &amp; Updates</li><li>• Server &amp; App Maintenance</li></ul>	<b>20,000 – 40,000 /month</b>
<b>Total Cost</b>	<b>50,000 - 1,00,000 /month</b>

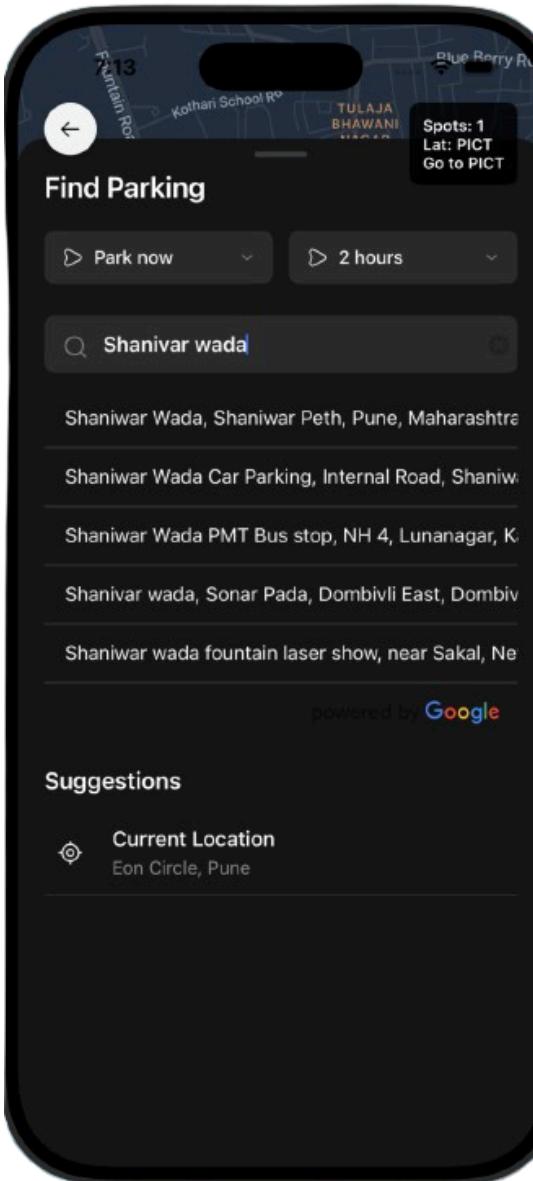
# Snapshots of the Prototype App UI



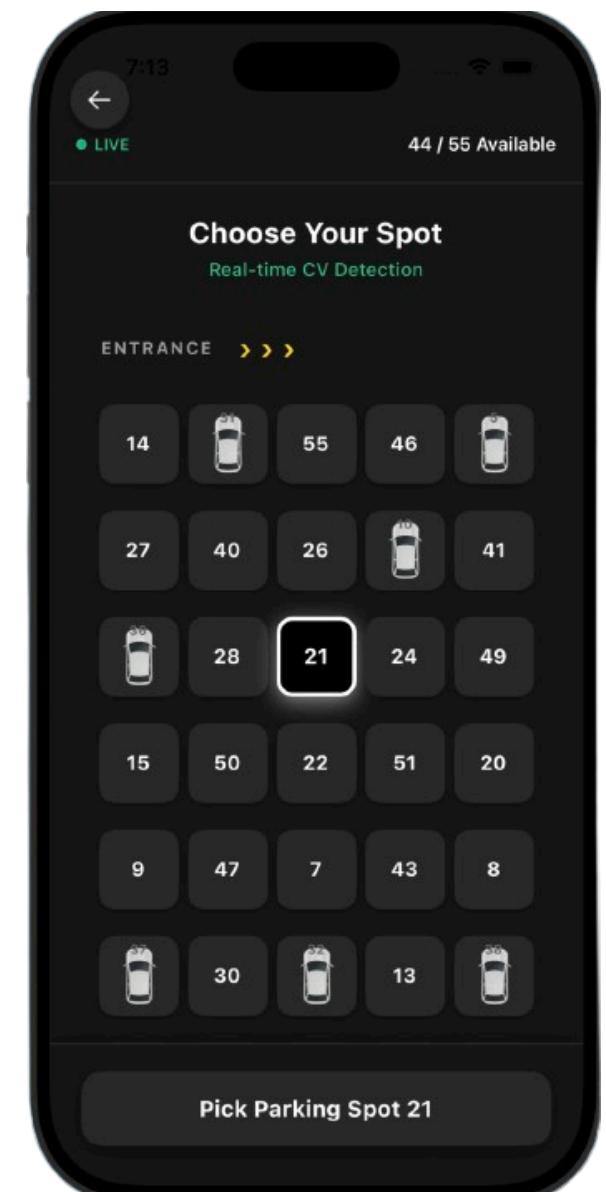
Home Page



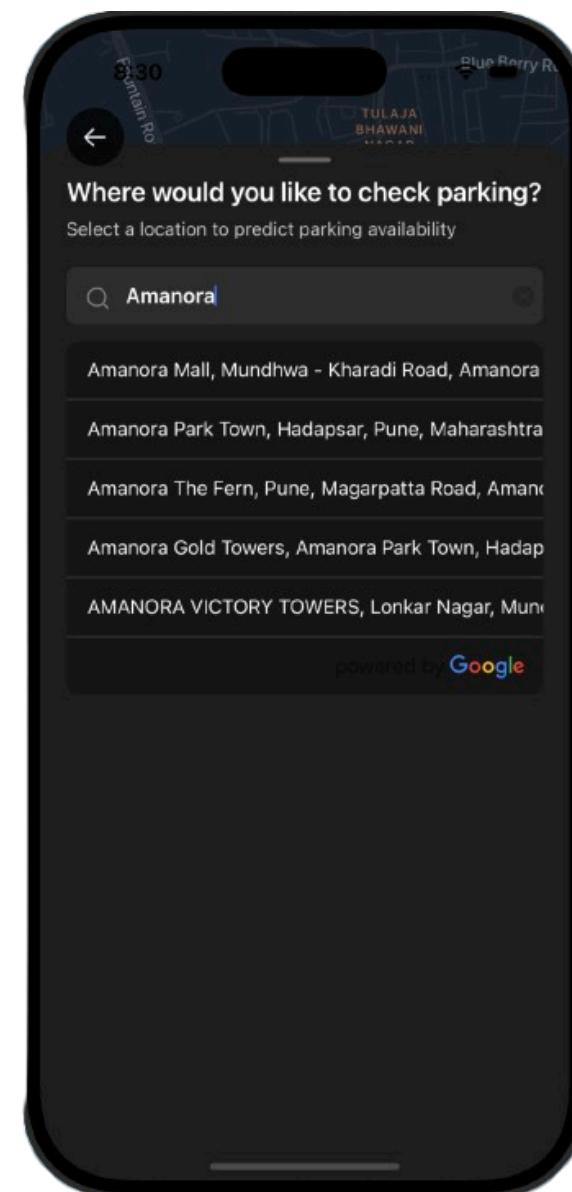
ML prediction of  
particular spot



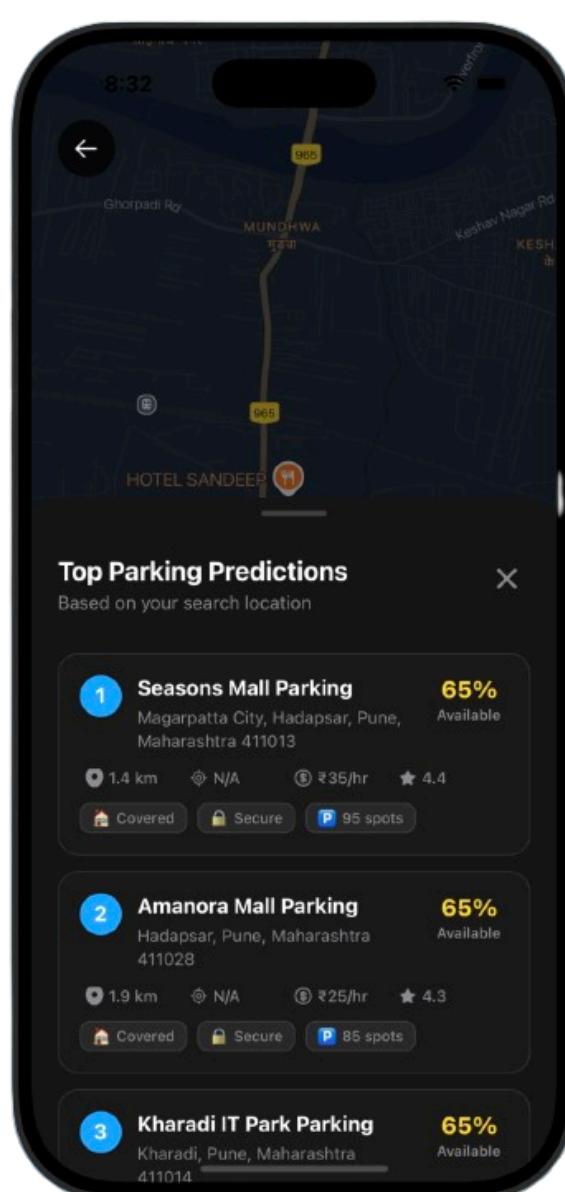
Search specific  
Location



Parking spots



Search using Location  
and time



Top 3 results for that  
specific location

# Snapshots of the Prototype

## Parking lot dashboard

Live tracking of the free and the available slots



**Parking Management Dashboard**

**Vehicle Management**  
Track and manage all vehicle entries, exits, and payments

- Total Vehicles: 3
- Currently Parked: 3
- Completed Today: 0
- Overstay Alerts: 0

Search by vehicle number or owner name...

**Vehicle Records**  
Detailed view of all vehicle entries and exits

All (3)	Active (3)	Completed (0)	Overstay (0)					
Vehicle Info	Owner	Slot	Entry Time	Duration	Fare	Status	Payment	Actions
MH12QB2053 Car	Abhijeet	PICT Pune Smart Parking	11/9/2025, 6:31:21 PM	1h 54m	₹40	active	pending	⋮
MH12AB1234 Car	Abhi	PICT Pune Smart Parking	11/8/2025, 3:43:07 PM	28h 42m	₹40	active	pending	⋮
MH12AB1234 Car	Abhi	PICT Pune Smart Parking	11/8/2025, 3:36:41 PM	28h 49m	₹40	active	pending	⋮

System Online

**Parking Management Dashboard**

**Parking Slots**  
Visual overview of TechWagon Parking

50 Total Slots | 49 Available | 1 Occupied | 0 Maintenance | 0 Reserved

Search by slot number, license plate, or owner...

Available Occupied Premium Disabled Access Maintenance Reserved

**Parking Layout**  
Click on any slot to view details

A01	A02	A03	A04	A05	A06	A07	A08	A09	A10
A11	A12	A13	A14	A15	A16	A17	A18	A19	A20
A21	A22	A23	A24	A25	A26	A27	A28	A29	A30
A31	A32	A33	A34	A35	A36	A37	A38	A39	A40
A41	A42	A43	A44	A45	A46	A47	A48	A49	A50

System Online

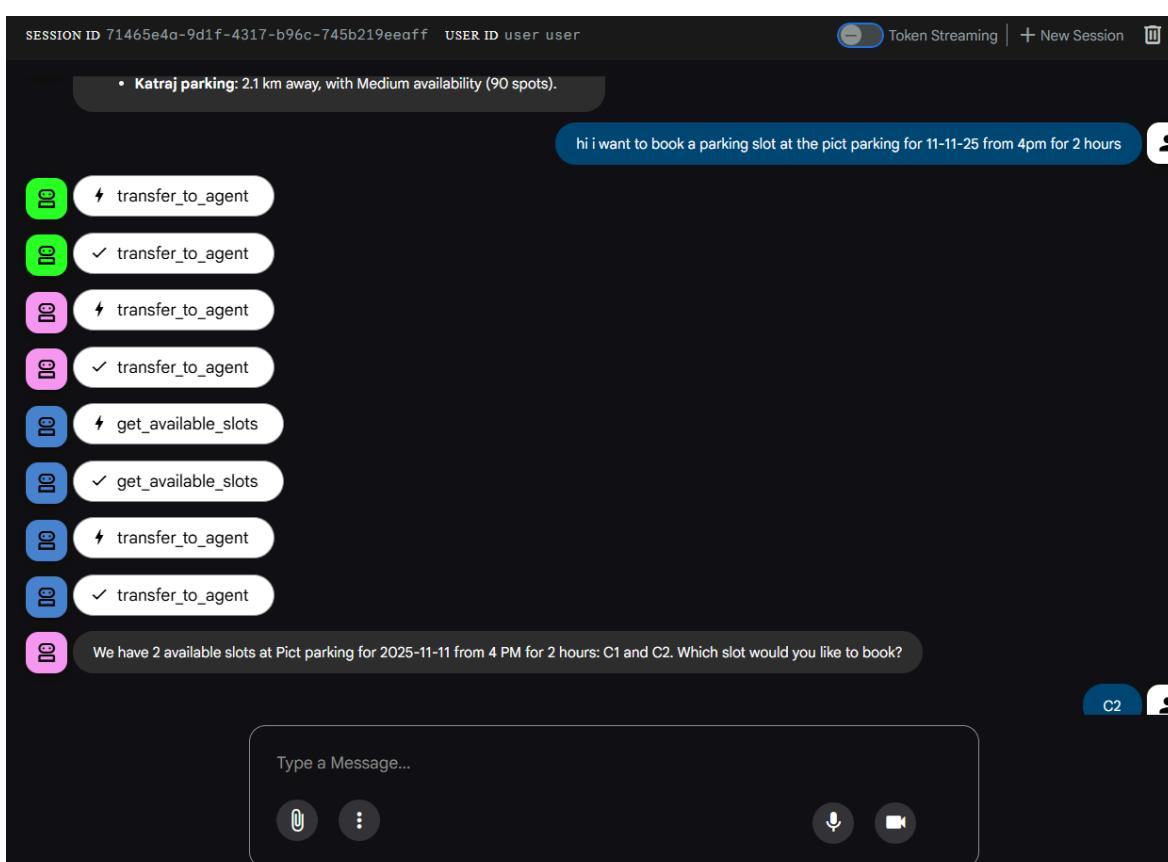
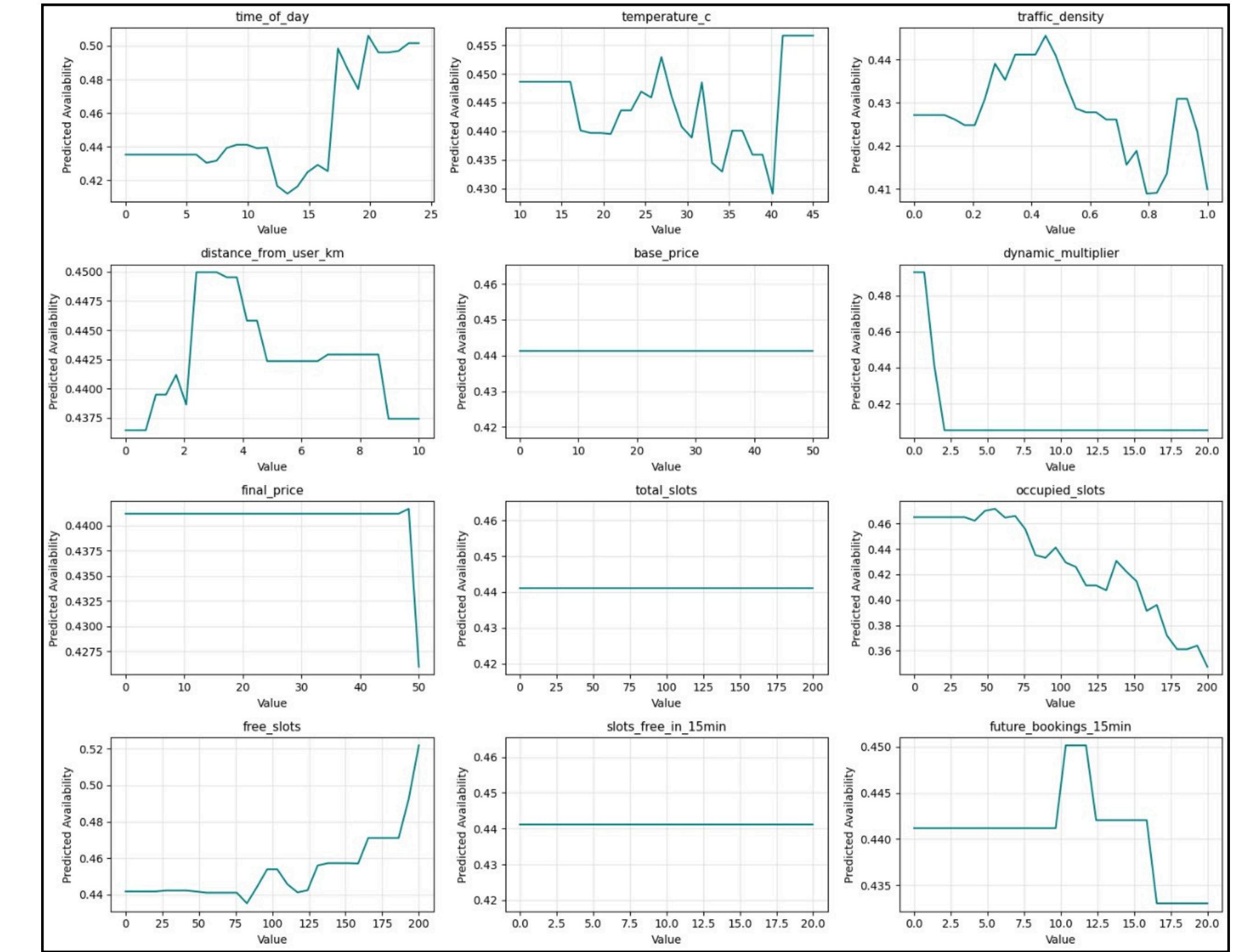
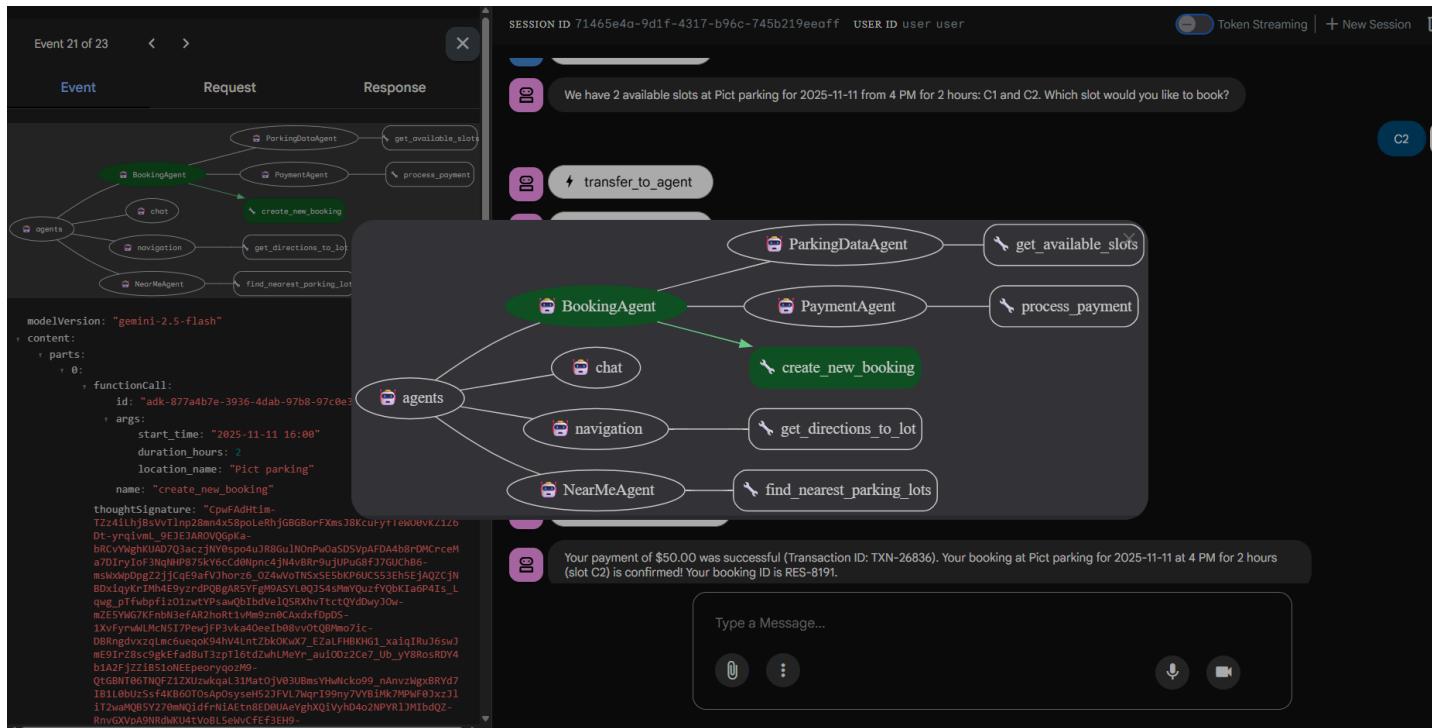


Real time number plate recognition of incoming and outgoing vehicles and showing the logs to the admin

# Snapshots of the Prototype

## Agentic Workflow UI (car play)

## Parking Prediction model



# Prototype Performance Report

## OpenCV

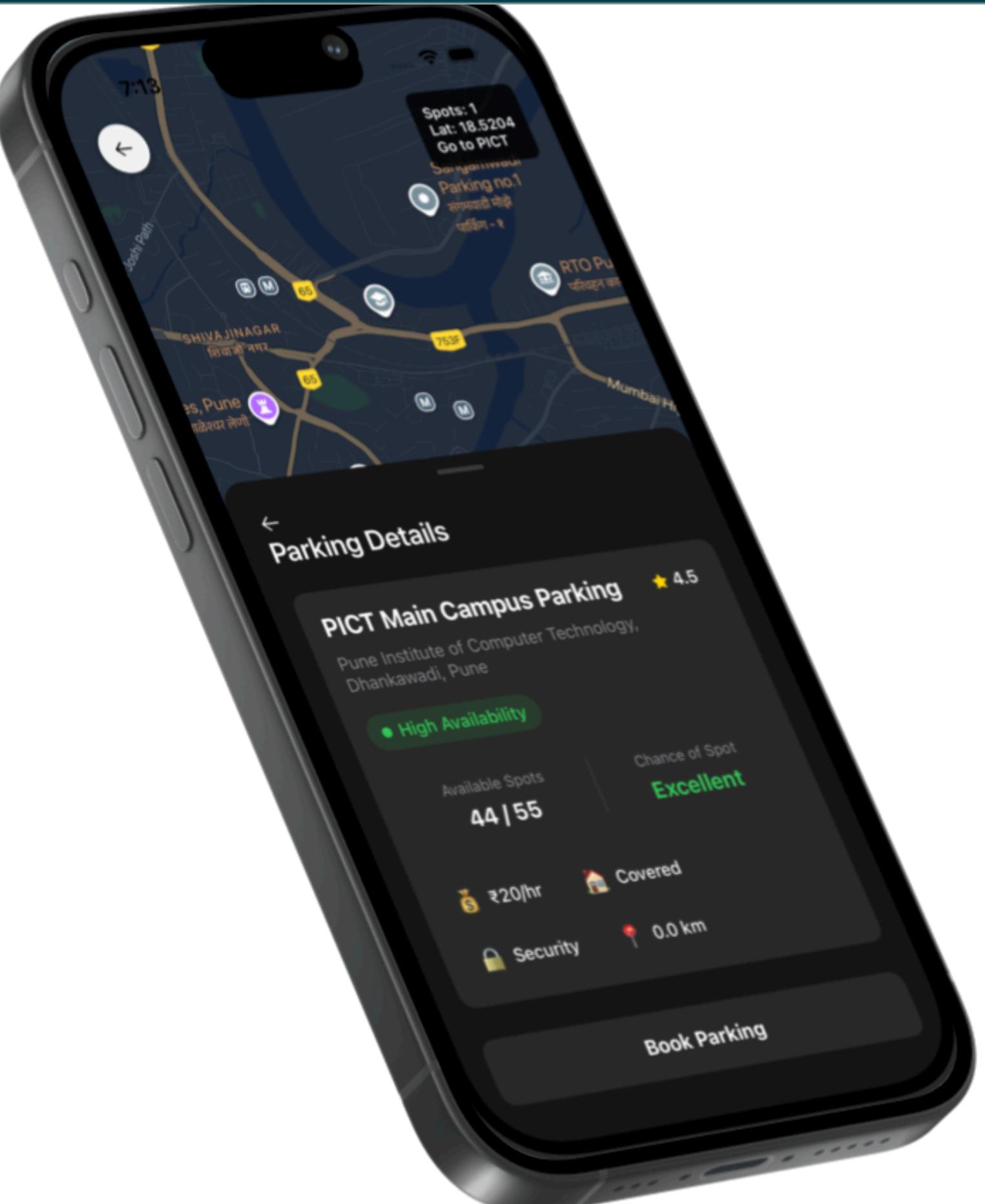
- We trained a **YOLOv8** model for **parking slot detection using our custom dataset**. The model was able to **accurately identify and classify parking slots**. After multiple training iterations and hyperparameter tuning, the YOLOv8 model achieved an overall detection **accuracy between 90% and 95%**, indicating that it can reliably detect parking slots under various lighting and environmental conditions.
- Once the slots are localized by YOLOv8, each slot region is cropped and passed to a **Convolutional Neural Network (CNN) classifier**. This CNN model determines whether the slot is “**Empty**” or “**Occupied**.” It was trained on labeled images of individual slots and learns visual differences such as presence of a vehicle, shadow, or color patterns with a accuracy of **95% - 98%**.

## Predictive ML model

- We used a **XGboost model** to generate the prediction of the future availability of the parking lot. We used the **synthesis dataset** to train the model and led to a stunning **93% of the accuracy**

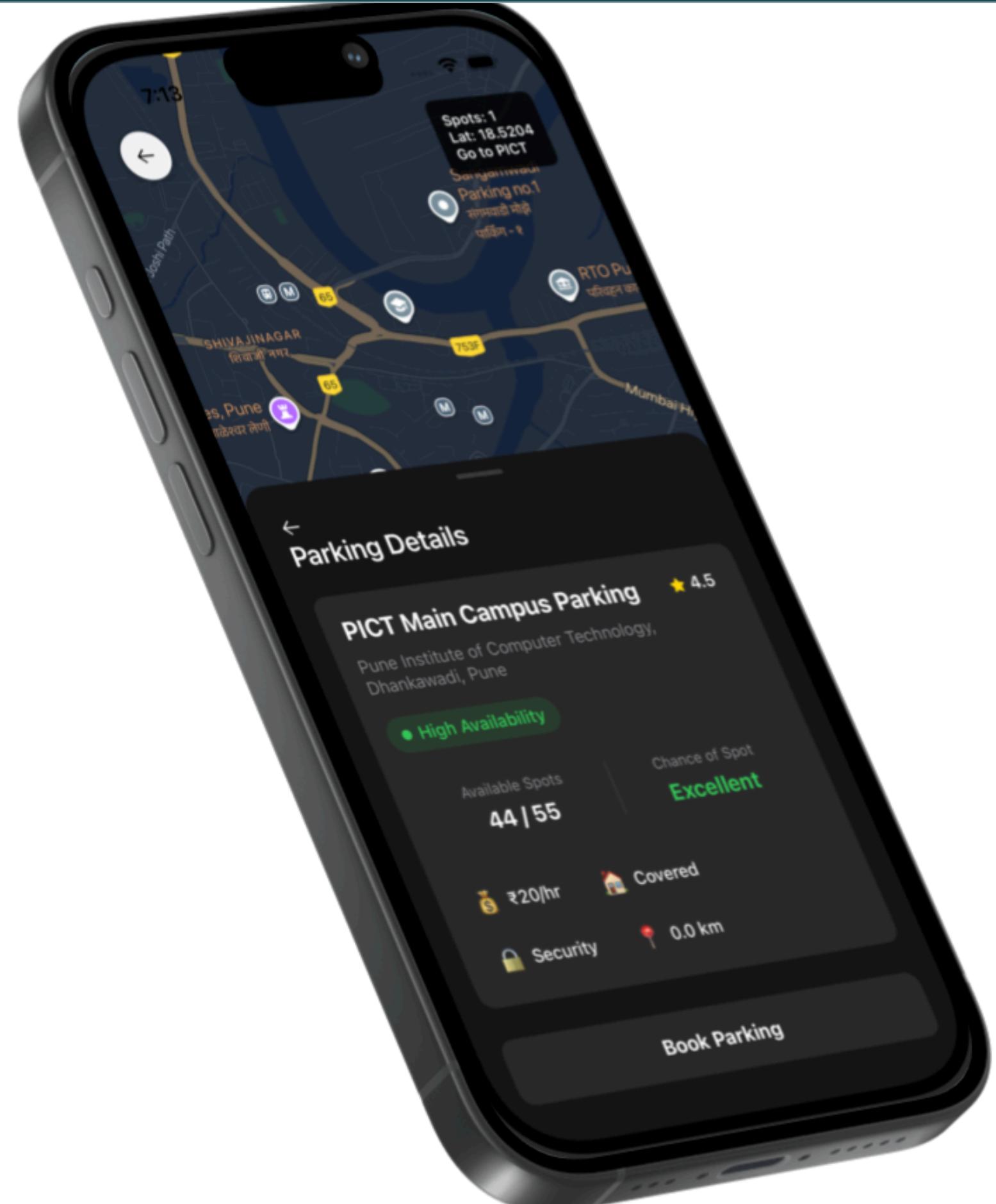
# Future Development

- **IoT Integration:** Leverage **ESP32 modules with precision weight sensors** to complement the **OpenCV vision system**, enabling real-time, **hardware-level validation** of parking slot occupancy.
- **Hybrid Detection:** Implement a **sensor–vision fusion model** that intelligently blends image data and sensor feedback for **unmatched accuracy, even under poor lighting or partial obstruction.**
- **Agentic AI Upgrade:** Elevate the system with context-aware intelligence that delivers **proactive slot recommendations, adaptive pricing insights, and effortless voice-command-based booking through app and CarPlay.**
- **Scalable Architecture:** Deploy using Kubernetes-powered microservices and RESTful APIs, ensuring seamless expansion across **multiple parking sites with high reliability and minimal latency.**



# Conclusion

- Our **AI-powered Smart Parking System** combines **real-time detection, ML-based predictions, and dynamic pricing** to optimize parking efficiency.
- The solution **reduces search time, traffic congestion, and fuel wastage** while providing convenient user experience via mobile apps and voice assistants.
- Scalable backend using **Prisma, Redis, and Kubernetes** ensures **high availability** and smooth operation across **multiple parking sites**.



 [Video](#)

 [Github link](#)



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