Team Details

a. Team name: Prakhar
b. Team leader name: Omkar Lolage
c. Problem Statement: Predictive Parking Space Marketplace

Brief about the idea

What if **parking felt as effortless** as booking a cab? Our app is a **predictive parking marketplace that shows you where a spot will be free at your ETA**, lets you pre-book it with confidence, and auto-handles payments - so you just drive, park, and go.

Powered by a **spatiotemporal ML engine that forecasts bay-level availability** at your ETA with calibrated confidence, f**uses live signals** (ETA, events, weather, sensors), and auto-triggers **backup swaps** when risk rises.

How it works:

- **Ingests live signals** (inventory, ETA, events, weather) into a unified feature stream.
- Uses a **spatiotemporal ML model to predict spot availability** at arrival time with confidence bands.
- **Ranks** parking offers **by distance, price, and success probability, with EV and accessibility filters** built in.
- Lets users book guaranteed or **lower-cost “smart hold” spots**; automatically reserves a **backup** if confidence is low.
- Enables **seamless entry** via QR, NFC, or license plate, with **guided navigation** for smooth last-meter access.
- Handles payments automatically, pre-auth at booking, **capture on exit with instant receipts** and invoices.

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What if **parking felt as effortless** as booking a cab? Our app is a **predictive parking marketplace that shows you where a spot will be free at your ETA**, lets you pre-book it with confidence, and auto-handles payments - so you just drive, park, and go.

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Why it works:

- Moves beyond guesswork with **calibrated probabilities**, showing users a trustworthy "**chance of spot**" instead of static pins.
- **Smart backup-swap** automatically switches to the best nearby option if the first isn't ready, backed by an SLA to reduce failure anxiety.
- **Demand steering** through small time or price nudges smooths peaks, cutting cruising and improving availability.
- A continuous learning loop (arrivals, overstays, no-shows) refines predictions daily, boosting accuracy, utilization, and revenue.

Opportunities – USP and "How It Solves" the problem

Predictive Availability at ETA

A spatiotemporal **ML model forecasts block face availability for your exact arrival time** and displays a **calibrated probability with a confidence band** (e.g., "86% ±5%"). It fuses live signals (**ETA changes, bookings, events/weather, optional sensors**) so users see trustworthy, latest availability.

Smart Hold & Automatic Backup-Swap (Reliability)

Book with a lower-cost Smart Hold or full Guarantee. The system pre-auths payment, watches risk in transit, and **proactively activates the best nearby backup** if confidence drops - preserving price and SLA - so the journey remains reliable without over-reserving inventory.

Hardware-Lite Access & Fast Onboarding

Works day one with QR validation; plate and sensors are optional add-ons. Providers self-serve to publish locations, stalls, EV/accessible flags, pricing, and blackouts - going live in hours. Signals from devices/feeds can be ingested later to boost accuracy.

Demand Steering, EV/Accessibility & Seamless Payments

Subtle time/price nudges (e.g., arrive +10 min) raise success odds and smooth peaks; **EV and accessibility filters are first-class in every search**. Payments are pre-authorized at booking and automatically captured/refunded on exit, with instant receipts and clear status.

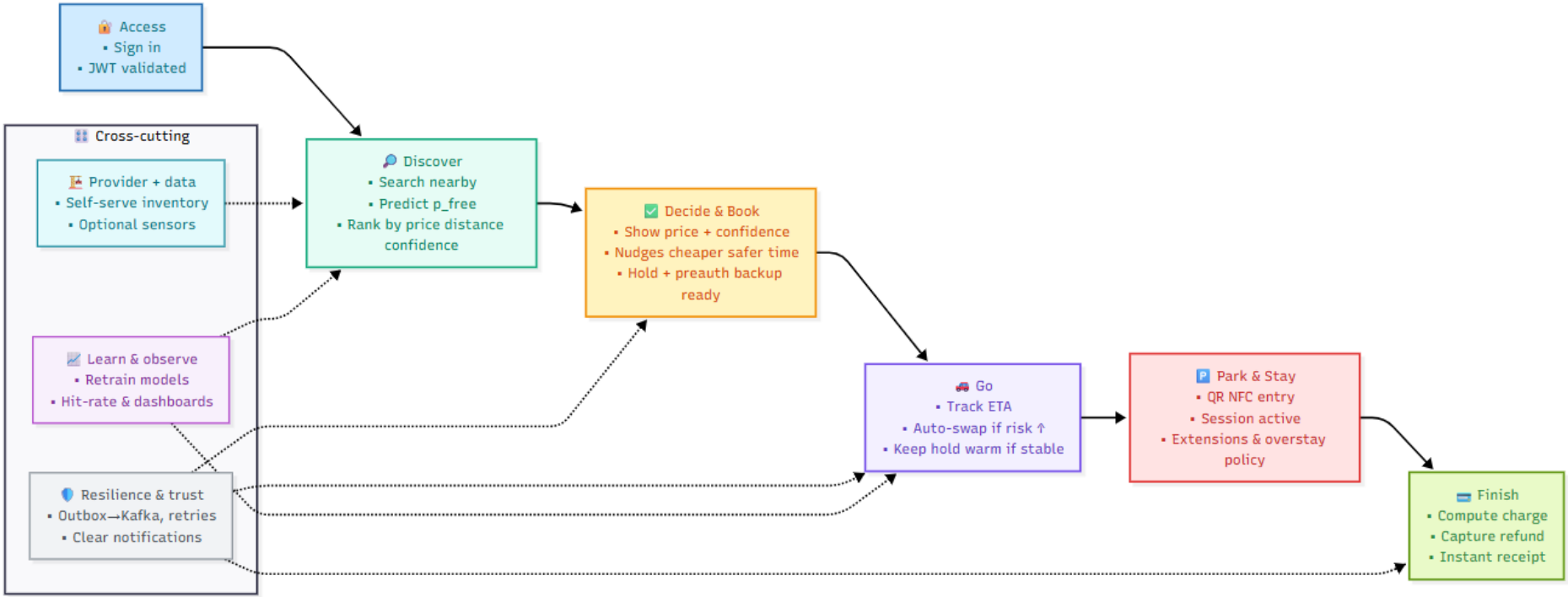
City-Scale Performance & Continuous Learning

Fast geospatial search (PostGIS) and hot caching keep results snappy; event-driven updates refresh availability within seconds. The **ML loop retrains from real outcomes** (arrivals, overstays, no-shows) and **hot-reloads safely**, while observability ensures stable operations as the network grows.

List of features offered by the solution

“Fast Search & Offers” Real-time discovery	Ranked nearby options with map + list, rich cards (price, distance, rules, EV/accessible), entrance info, and quick filters for time, price cap, and amenities.
“One-Tap Booking & Payments” Hold → confirm	Choose Guaranteed or Smart Hold, see clear price breakdown and policy, confirm with saved payment; pre-auth status shown inline with friendly error recovery.
“Provider Console & Ops” Self-serve supply and insights	Onboard locations/stalls, set pricing/blackouts, monitor live sessions and bookings, and view utilization/revenue basics; changes reflect quickly in customer search.
“Session Control & Exit” Manage your stay	Live timer, extend stay, cost estimator, gentle overstay/grace alerts; end session to auto capture/refund and receive an itemized receipt instantly.
“Guided Arrival & Access” Navigate and validate	Turn-by-turn to the correct entrance, arrival checklist, and hardware-lite access via QR/NFC (plate entry fallback); bay/level guidance on success.
“Proactive Alerts & Support” Stay informed end-to-end	Clear notifications for confirmations, swap notices, reminders, and extension prompts; instant receipts and quick help.

Process flow diagram or Use-case diagram



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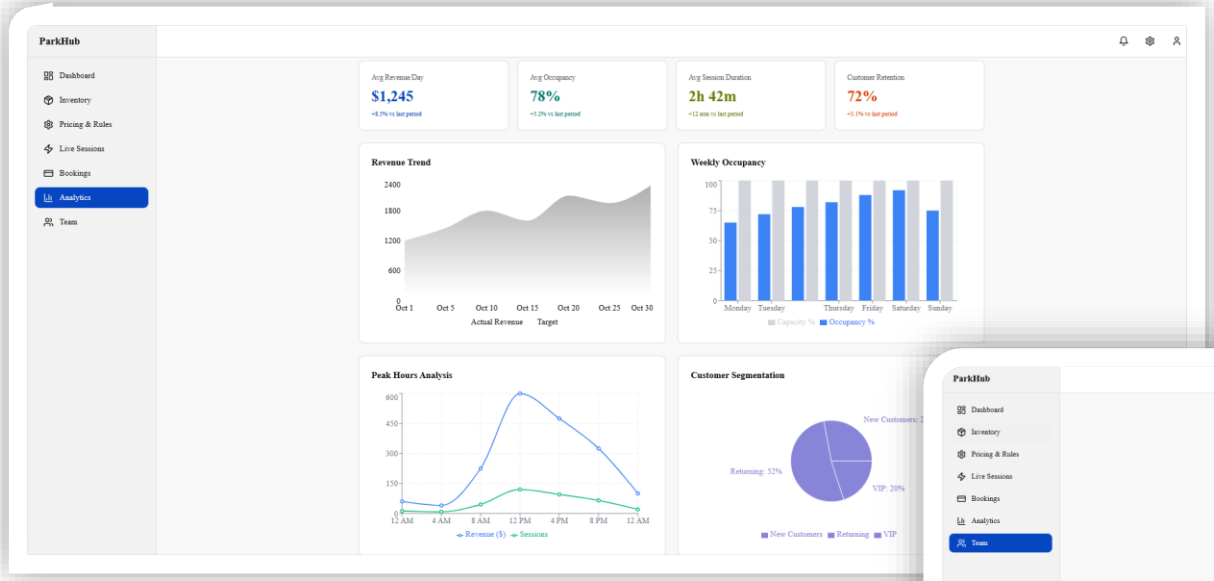
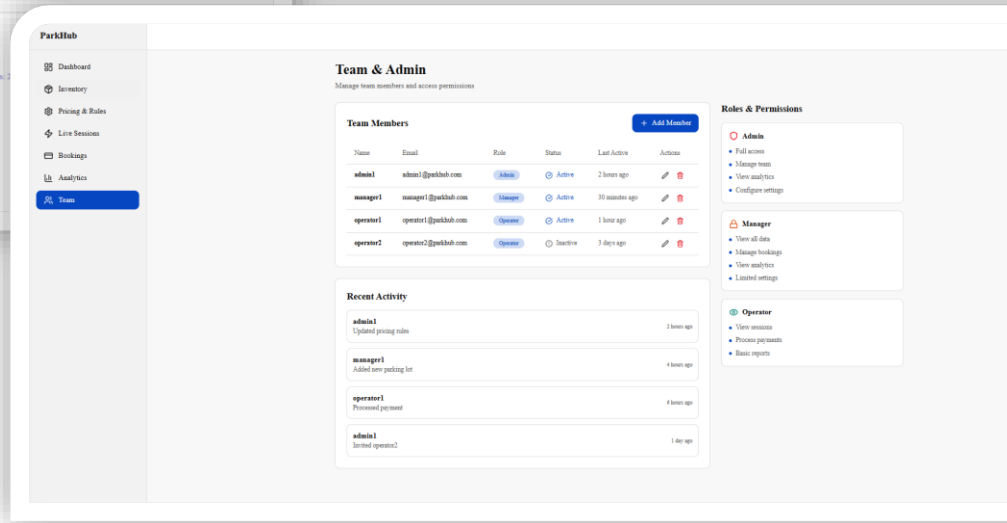
Mock – UI for Provider Web Application





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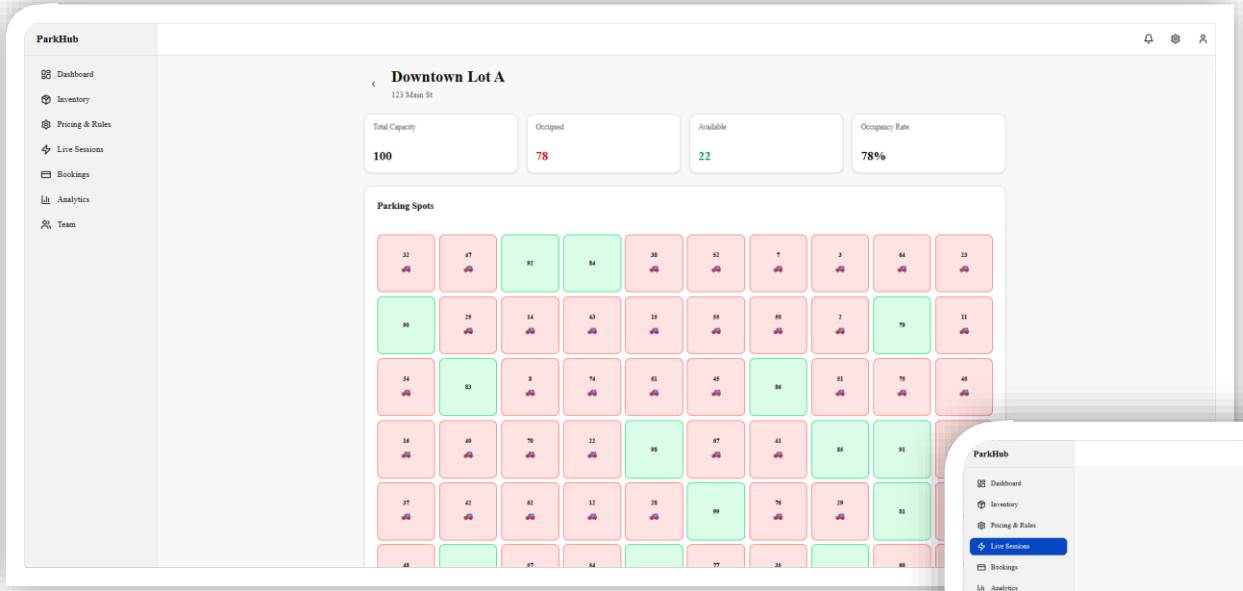

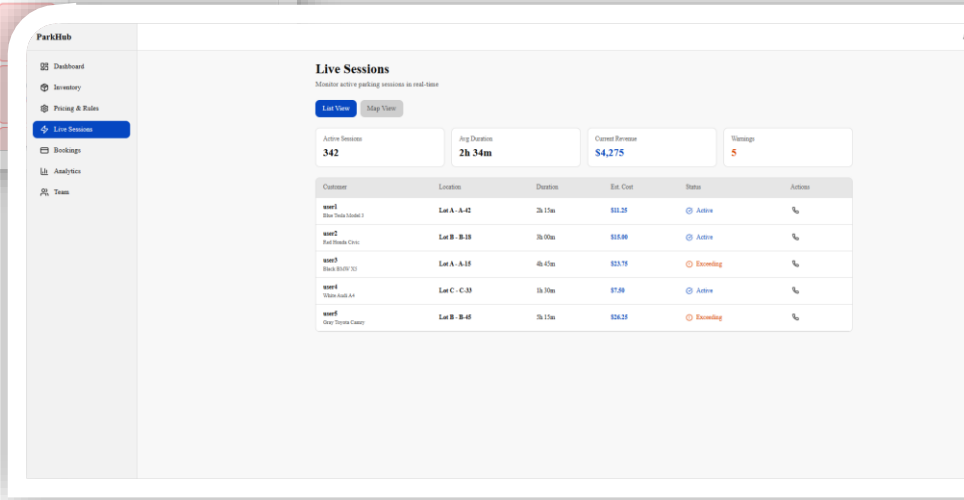

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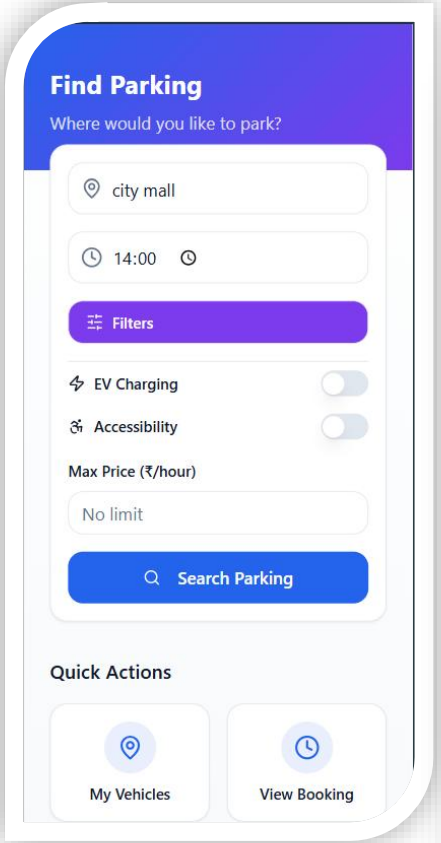
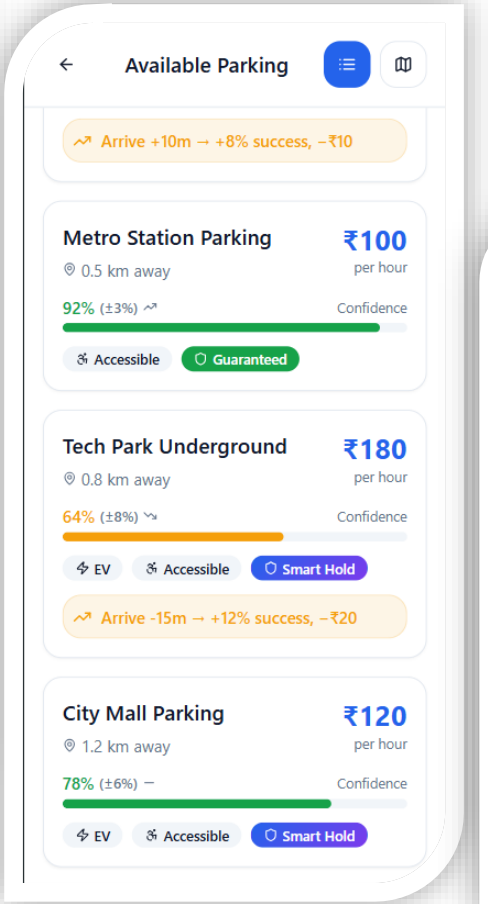
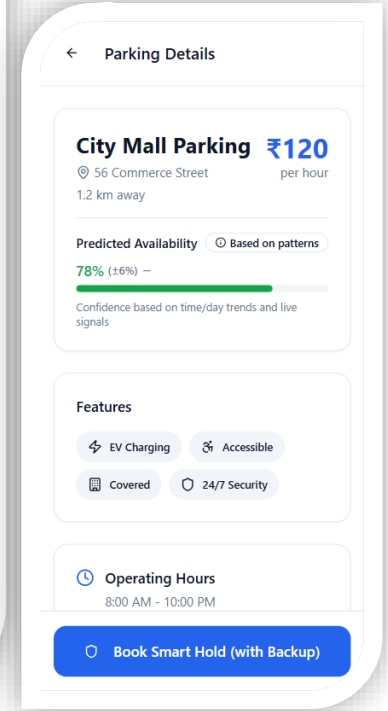
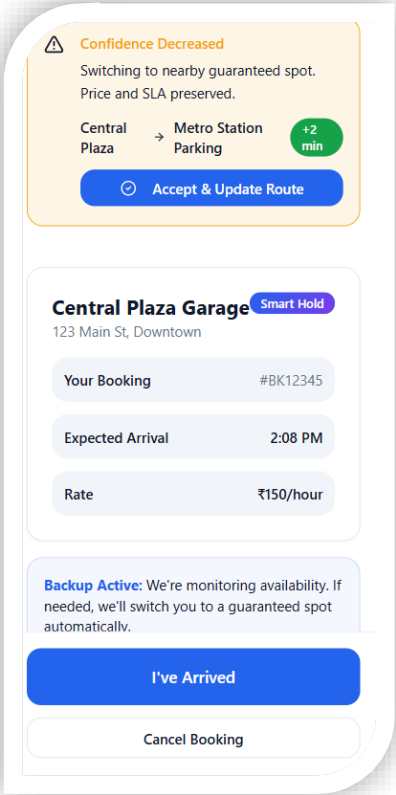
Mock – UI of Users(car-owners) Mobile App









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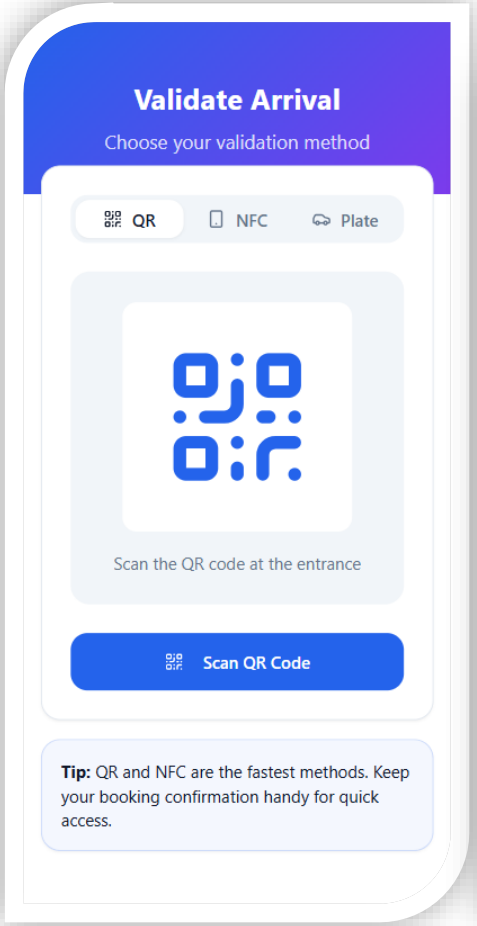
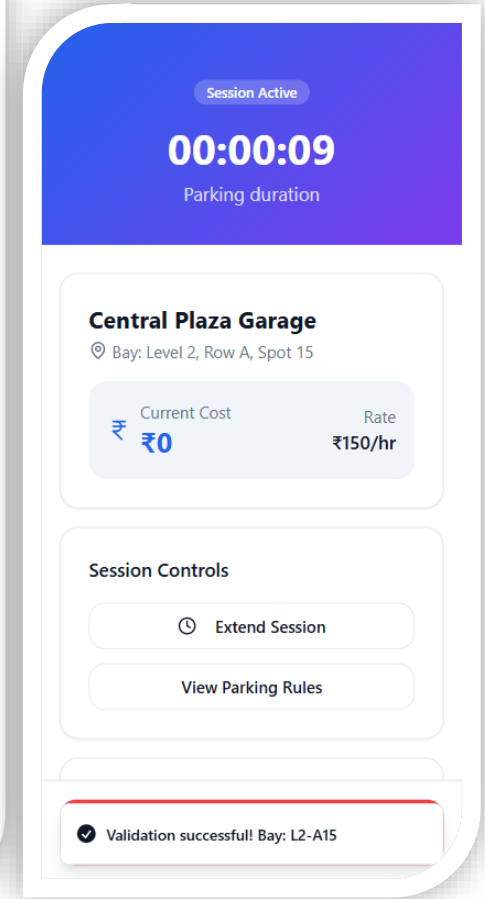
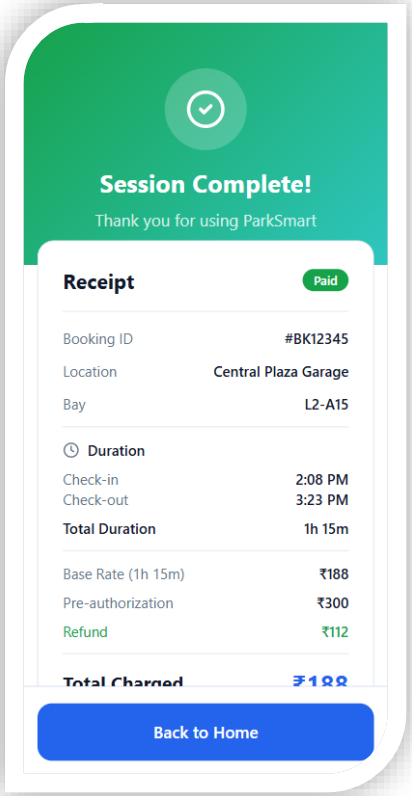
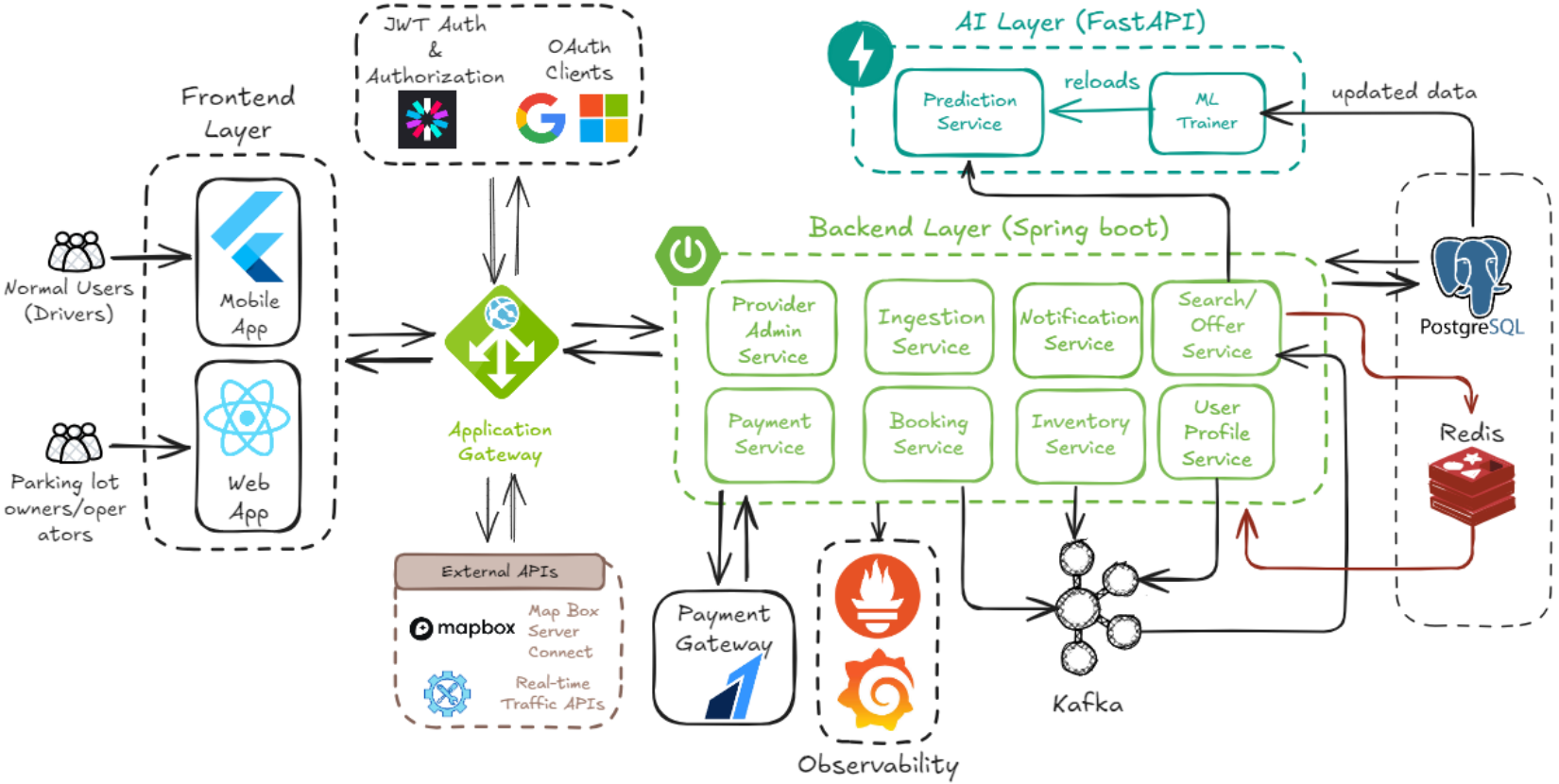






Architecture diagram of the proposed solution



Technologies to be used in the solution

Flutter:
Cross-platform driver app for search, booking, validation, and receipts.

React.js:
Lightweight and interactive for provider web portal for onboarding, pricing, and live operations.

Spring boot:
Stateless microservices with secure API routing and rate limiting.

JWT/OAuth:
entralized authentication/authorization with roles and token issuance.

PostgreSQL/MySQL:
System of record with geospatial queries for nearby inventory.

Redis
Hot cache for availability, short-lived holds, sessions, and rate limits.

FastAPI (Python) + PyTorch/XGBoost
Real-time prediction API with offline training and hot-reload.

Kafka
Event backbone for bookings, payments, inventory updates, and telemetry.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