DOMAIN

AI · IoT · Robotics

01

THE
CHALLENGE

OPERATIONAL CONTEXT

MONITORING HAZARDS ACROSS VAST, DANGEROUS TERRAIN

Oil field environments present monitoring challenges that are uniquely hostile to conventional inspection approaches. Gas leaks are invisible to the human eye, oil contamination on land surfaces can span large and irregular areas, and security threats can emerge anywhere across expansive, often remote sites. Personnel patrols are expensive, slow, and expose workers to the same hazards they are trying to detect.

The client required a system capable of continuous, automated reconnaissance — one that could detect gas leaks, identify surface oil spills across varied terrain, and dynamically redirect flight paths to investigate emerging security events without human intervention in the loop.

⬡

GAS LEAK DETECTION

Multi-spectral imaging identifies gas concentrations not visible to the human eye, enabling rapid detection across large field areas.

◈

OIL SPILL IDENTIFICATION

AI models trained to recognize oil contamination signatures on diverse land surface types — soil, gravel, vegetation, and concrete.

◎

ADAPTIVE RECONNAISSANCE

Flight plans adjust in-mission based on detected anomalies, directing the drone to close-range investigation of flagged security events.

3× DETECTION MODALITIES	**0** PERSONNEL IN HAZARD ZONE
24/7 AUTONOMOUS COVERAGE	**∞** SCALABLE TO ANY FIELD SIZE

02

SOLUTIONS ENGINEERING

ARCHITECTURE DECISION

ON-DRONE AI: A DELIBERATE CHOICE

Soledad's Solutions Engineers conducted a structured assessment of the client's operational environment, hardware constraints, connectivity conditions, and data turnaround requirements. In field security contexts, latency is mission-critical: a drone that must stream data to an edge server and wait for inference results before adjusting flight behavior is a slower, less capable system than one that reasons autonomously.

! ASSESSMENT NOTE

Deploying AI inference directly onto the drone hardware was determined to be the appropriate architecture — not only to eliminate streaming latency, but to deliberately advance the team's understanding of power consumption and thermal management under increased onboard processing loads in active flight conditions.

This distinction matters. The decision to go on-drone rather than edge-streamed was not simply pragmatic — it was also a research-informed choice to gather real-world data on the power and performance characteristics of embedded AI workloads in flight. That knowledge is now part of Soledad's proprietary capability set.

01 CONNECTIVITY ASSESSMENT

Field environments frequently have degraded or absent cellular/network connectivity. On-drone inference eliminates reliance on stream uptime for real-time decisions.

02 LATENCY REQUIREMENT MAPPING

Security use cases demand flight path adaptation within seconds of threat identification. Round-trip streaming latency was evaluated and deemed unacceptable for this mission profile.

03 POWER & THERMAL PROFILING

On-drone AI compute increases battery draw and heat generation. Engineers characterized these impacts during flight testing, building benchmarks now applicable to future engagements.

04 HARDWARE SELECTION & EMBEDDED SOFTWARE DEPLOYMENT

AI software was deployed directly to the selected drone compute module, with flight planning logic and image processing pipelines embedded and validated pre-deployment.

03

SYSTEMS ARCHITECTURE

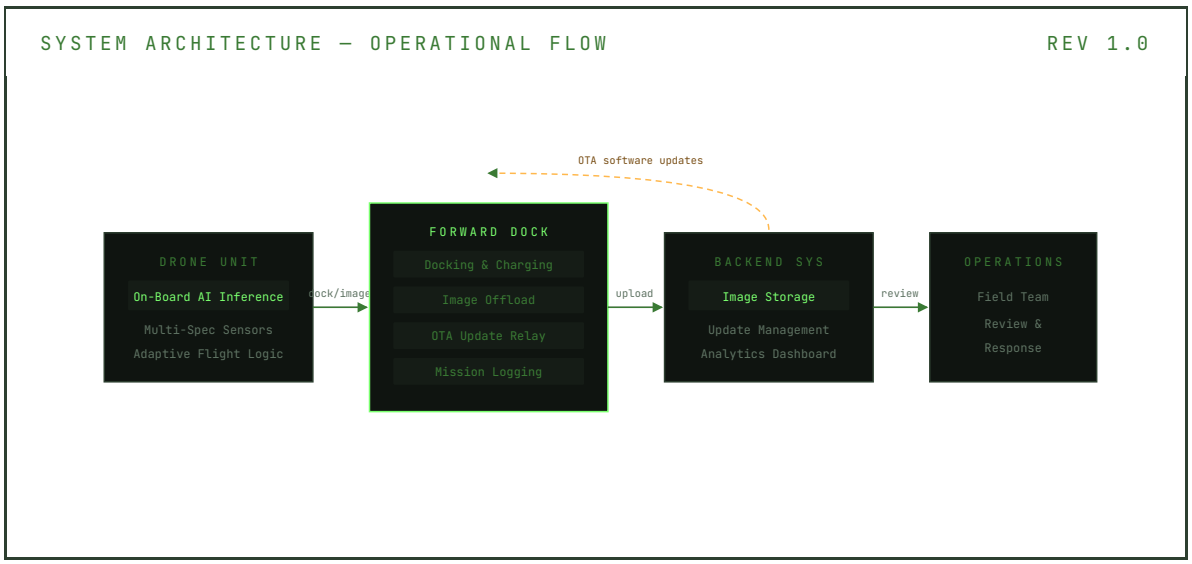
INFRASTRUCTURE

FORWARD DOCKING STATION AS THE FIELD OPERATIONS HUB

Soledad's systems architects designed and deployed a field infrastructure layer centered on a **forward docking station** — a field-positioned hub used for drone docking, battery management, image offloading, and over-the-air software updates. This architecture eliminates the need for drones to return to a central facility between missions, maximizing operational uptime in remote field locations.

The docking station connects to backend systems for image download, mission logging, and the delivery of software updates to drone hardware — enabling Soledad and the client's operations team to iterate on model performance, update flight logic, and push patches without physical retrieval of the drone

fleet.



Embedded AI | On-Drone Inference | Forward Docking Station | OTA Updates | Multi-Spectral Imaging | Adaptive Flight Planning | Image Processing Pipeline | IoT Integration

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04

OUTCOMES &
SIGNIFICANCE

IMPACT

SAFER, FASTER, AND MORE CONSISTENT THAN ANY MANUAL ALTERNATIVE

This system provides a direct and scalable supplement — and in many scenarios a complete replacement — for manual inspection methods that are costly, slow,

and place field personnel in proximity to hazardous gases, volatile surfaces, and unpredictable security conditions. A drone can cover ground that would take a team of inspectors hours, and it does so continuously, without fatigue, and with sensor capabilities the human eye cannot match.

Consistency is a major operational gain. Human inspection frequency is limited by scheduling, weather tolerance, staffing, and cost. An autonomous drone system with a forward docking station can operate on regular cadences regardless of personnel availability, building a longitudinal dataset of field conditions that enables trend detection over time.

✓ **HAZARD DETECTION WITHOUT HUMAN EXPOSURE**

Gas leaks and oil spills are identified by sensor-equipped drones before personnel need to enter potentially dangerous zones, enabling targeted, informed response rather than broad-area search.

✓ **ADAPTIVE IN-FLIGHT RESPONSE**

When a security event or anomaly is detected, the drone autonomously adjusts its flight pattern to capture close-range imagery of the flagged area — without awaiting human instruction or a new mission file.

✓ **CONTINUOUS FIELD INTELLIGENCE**

The forward docking infrastructure enables high-frequency mission cycles. The field is never dark — the system operates on schedule, building a consistent record of site conditions.

✓ **EMBEDDED AI KNOWLEDGE ADVANCEMENT**

Real-world data collected on power consumption, thermal management, and inference performance under flight conditions advances Soledad's capability to deploy increasingly sophisticated on-drone AI systems in future engagements.

AI & IOT MEETS ROBOTICS. THE FUTURE IS NOW.

This engagement represents Soledad Data Solutions' expertise at the intersection of artificial intelligence, IoT infrastructure, and autonomous robotics — an integration that is no longer experimental but operational. We bring this capability to any cloud, any environment, any field.

ENGAGE SOLEDAD

ENVIRONMENTS WE DEPLOY INTO

- Oil Fields
- Pipelines
- Highways
- Stadiums
- Skyscrapers
- Bridges
- Remote Sites

› Any Cloud

Client identity has been withheld at the client's request. All project details have been reviewed and approved for public disclosure. Operational metrics and outcomes are specific to this engagement's scope, hardware configuration, and field environment. Results will vary based on site conditions, drone payload specifications, connectivity infrastructure, and mission parameters. This document is produced for marketing and business development purposes and does not constitute a warranty of specific outcomes.