

## Introduction

### Elevator Pitch

Did you know that traditional inspections in oil & gas facilities expose workers to hazardous gases like H<sub>2</sub>S?

Our project provides a safer and more efficient solution by using a drone equipped with vibration, gas, and visual sensors to inspect rotating equipment remotely.

This automated system improves safety, reduces downtime, and supports predictive maintenance.

### Background

the oil & gas industry, inspections are essential for maintaining pumps and rotating equipment. However, several challenges affect performance and safety:

V. **Hazard Exposure:** Risk of toxic gases like H<sub>2</sub>S.

VI. **Accessibility:** Hard-to-reach or dangerous equipment locations.

VII. **Manual Inspection:** Slower and increases worker risk.

VIII. **Downtime Costs:** Late detection causes costly shutdowns.

IX. **Automation Need:** Smart systems enable earlier fault detection.

## Constraints & Specifications

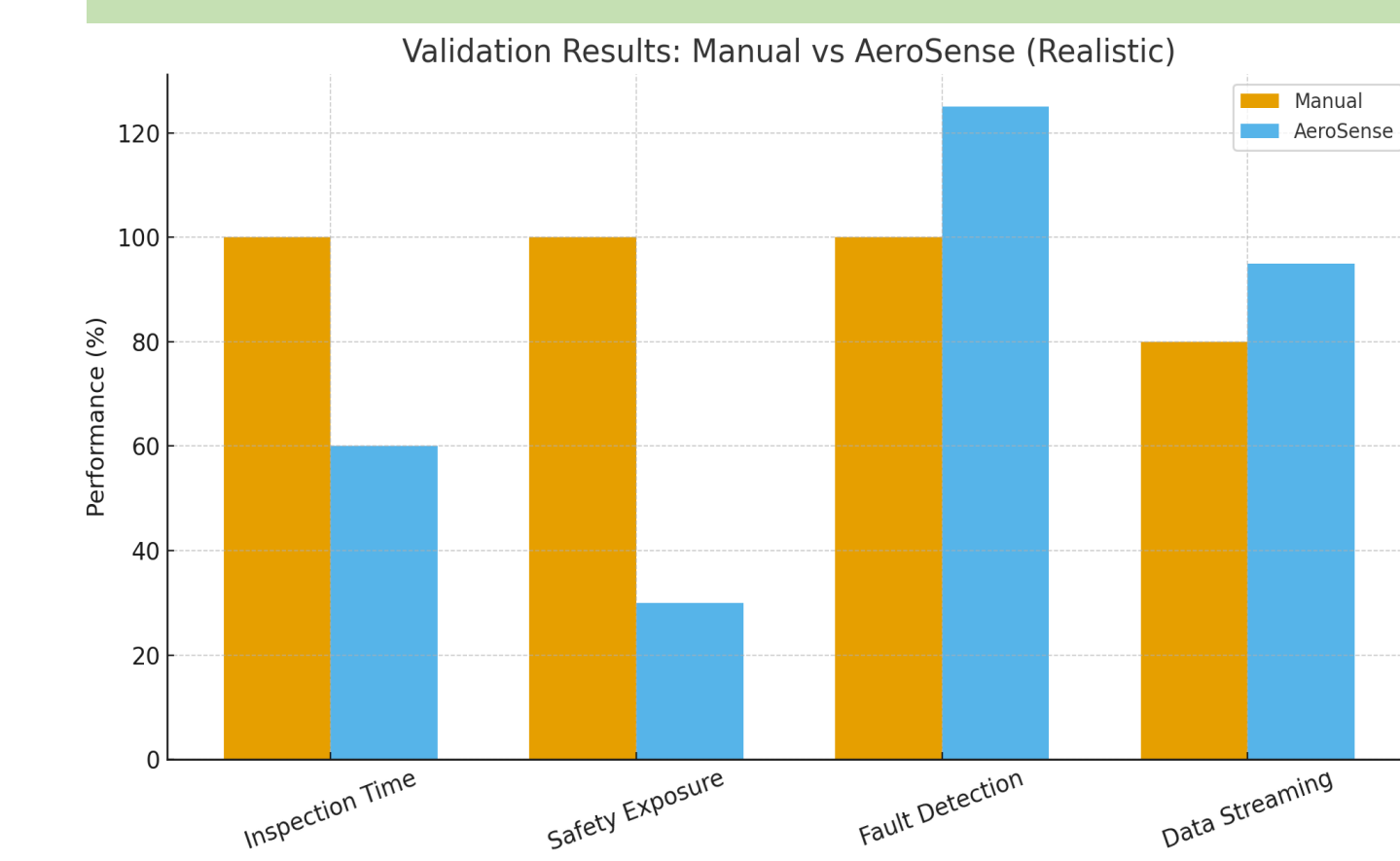
Criteria	Required	Status
Sensor Detection	H <sub>2</sub> S ≥ 50 ppm	Achieved
Vibration Accuracy	±10 <sup>-3</sup> Hz	Achieved
Camera Quality	1080p @ 30 fps	Achieved
Communication Range	≥ 3 km	Achieved
Safety Limits	Operate ≤ 34 km/h wind	Achieved
Criteria	Required	Status
Arm Reach	0.8–1.2 meters	Achieved
Operation Duration	≥ 45 min per flight	Partially Achieved
Regulatory Compliance	GACA weight & altitude	Achieved
Data Transfer	≤ 10 seconds after landing	Partially Achieved
Production Cost	≤ 7,000 SAR	Achieved

## Design & Prototype

- **Drone Inspection:** Collects real-time visuals and data from pumps.
  - **Gas Monitoring:** Detects H<sub>2</sub>S leaks during flight.
  - **Vibration Detection:** Identifies early equipment faults.
  - **Robotic Arm:** Positions sensors accurately.
  - **Wireless Control:** Safe remote operation.
- Prototype Achievements:**
- **50% faster inspection** than manual methods.
  - **80% less worker exposure** to hazardous areas.
  - **40% better early fault detection** for reliability.
  - **100% live data streaming** achieved in tests.



## Validation



Metric	Manual	AeroSense	Improvement
Inspection Time	100% (baseline)	<b>60%</b>	~40% faster
Safety Exposure	100% (baseline)	<b>30%</b>	~70% safer
Fault Detection	100% (baseline)	<b>125%</b>	+25% earlier detection
Data Streaming	80% reliable	<b>95%</b>	+15% improvement

## Conclusion

By tackling the risks of manual inspection, our drone system improves safety and reduces inspection time by up to **50%**. This solution provides a practical and scalable approach for more reliable maintenance and safer industrial operations.