

TEAM M094

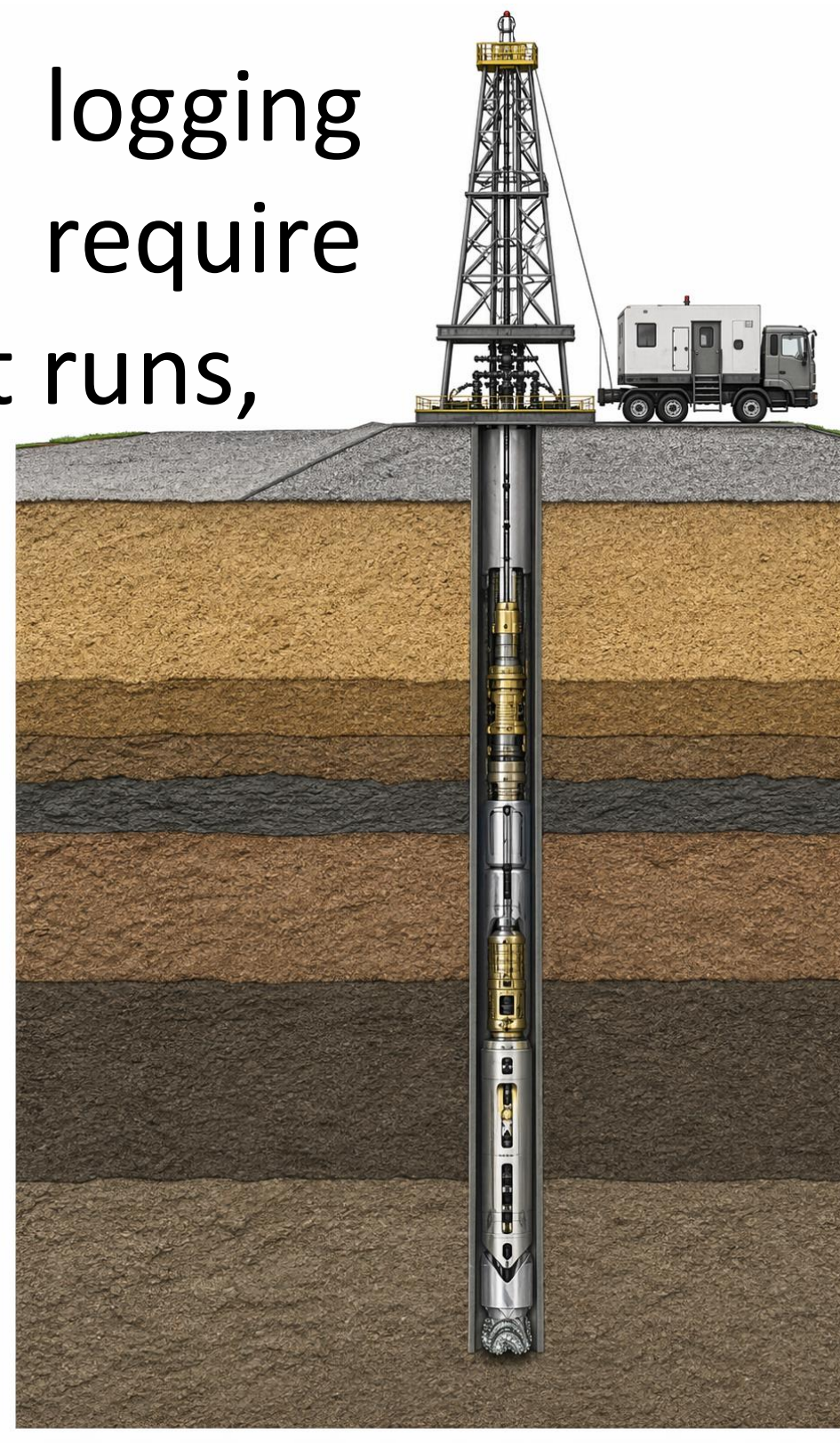
Smart Autonomous Downhole Vision & Logging System (SADV-Log)

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Background

Conventional well logging systems are costly, require multiple deployment runs, and lack real-time visual inspection and automated data interpretation, resulting in delayed decision-making, increased operational costs, and incomplete subsurface characterization.

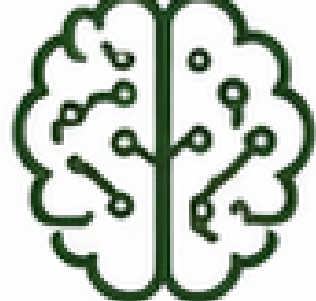


subsurface


Key Innovation




Integrated Vision + Logs



AI-Powered Interpretation



Cost-effective



Reliable & Robust Operation

Specifications & Constraints

- Lithology accuracy $\geq 60\%$
- Real-time processing ≤ 4 s
- Diameter 5 in | Length < 2 m
- Operates up to 160 psi
- Integrated sensors + camera
- AI-based real-time interpretation
- Budget $\leq 10,000$ SAR
- Reduce rig time $\geq 15\%$

Prototype Design



Testing

TESTING & VERIFICATION

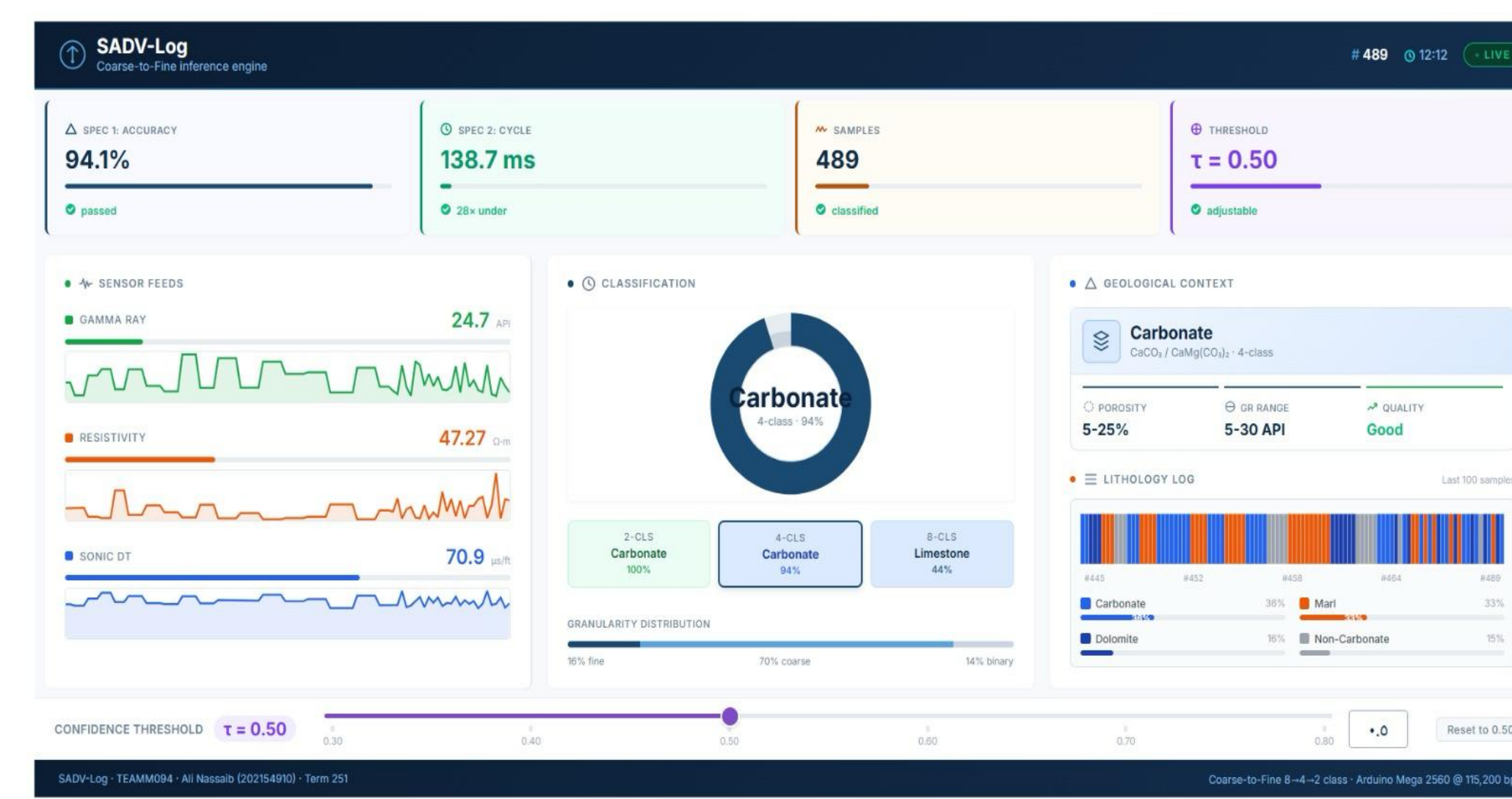
- TEST SETUP:** Environmental Lab (Horizontal Box)
 - SAND
 - CORE SAMPLE
 - SAND

Simulates formation conditions | Tool moves through channel | Data collected from sensors
- SENSORS USED:**
 - CAMERA:** Visual inspection of formations
 - RESISTIVITY:** Measures electrical properties
 - GAMMA-RAY:** Natural radioactivity (design level)
- TEST PROCEDURE:**
 - Prepare sand and core samples
 - Place samples in environmental lab
 - Run tool through the channel
 - Record video and sensor data
 - Compare with expected behavior
- TEST RESULTS:**
 - A. VISUAL LOG (From Camera):**

Depth (cm)	Lithology
0 - 25	Limestone
25 - 50	Sandstone
50 - 75	Limestone
75 - 100	Sandstone
 - B. STATIC LOGS USING LAYER-SPECIFIC READINGS:**

Depth (cm)	Resistivity ($\Omega\cdot m$)	GR (API)
0 - 25	3.47	20.2
25 - 50	2.30	35.3
50 - 75	2.61	29.0
75 - 100	1.78	43.3
 - C. LITHOLOGY SUMMARY:**
 - Clear lithology contrast (Limestone vs Sandstone)
 - Boundaries detected at correct depths
 - Logs consistent with lithology changes
 - Repeatable results across all runs
- VERIFICATION OF SPECIFICATIONS & CONSTRAINTS:**
 - SPECIFICATIONS (ALL MET):**
 - LITHOLOGY CLASSIFICATION: $\geq 60\%$ accuracy (MET)
 - BOUNDARY DETECTION: $\geq 80\%$ detection (MET)
 - MECHANICAL PERFORMANCE: Stable movement in channel (MET)
 - POWER REQUIREMENT: Within allowable limit (MET)
 - DATA ACQUISITION & PROCESSING: Reliable & synchronized (MET)
 - CONSTRAINT (MET):**
 - Relay on camera and log responses only
 - (No core in interpretation) (MET)
 - INTEGRATED SPECIFICATION (MET):**
 - Good agreement between sensors and interpretation with minor mismatches at transitions (MET)
- TEAM COLLABORATION:**
 - GEOLOGY / GEOPHYSICS:** Material selection, Data interpretation
 - MECHANICAL ENGINEERING:** Lab setup design, Tool structure & movement
 - ELECTRICAL ENGINEERING:** Sensor integration, Data acquisition
 - COMPUTER SCIENCE:** Data processing, Visualization & analysis
 - PETROLEUM ENGINEERING (PETE):** Formation evaluation, Application & field relevance

Dashboard



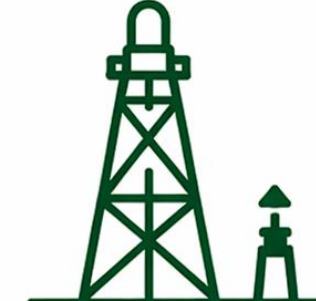
Conclusions

- SADV-Log successfully integrates visual inspection with key geophysical sensors into a single autonomous tool.
- AI-based real-time interpretation enables fast and accurate lithology classification ($\geq 60\%$).
- The hybrid design ensures cost-effectiveness while maintaining high reliability.
- The prototype met all critical design specifications in lab-scale testing.

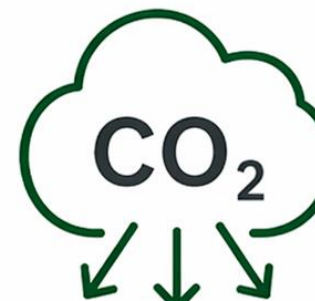
Future Work

- Integrate additional sensors, develop wireless telemetry, and validate performance under field and extreme conditions.

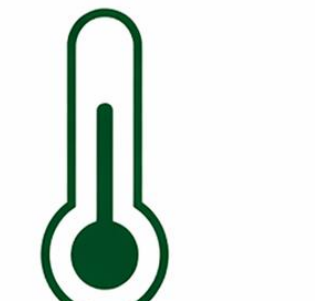
Applications




Oil & Gas Well Monitoring



CO₂ Storage Well Integrity Monitoring



Geothermal Well Characterization



Research & Education

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