

Advanced Pipeline Integrity and Monitoring System (APIMS)



Capstone 2.0 - Team 07

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Introduction & Background

Pipelines encounter a significant corrosion challenge that could result in crack and even lead to an explosion. Consequently, our APIMS will employ a mobile remote-control system incorporated with ultrasonic sensors to assess the pipeline's thickness, subsequently identifying corrosion and addressing it before it spreads throughout the pipeline, all while maintaining continuous pipeline operations.

Prototype Design



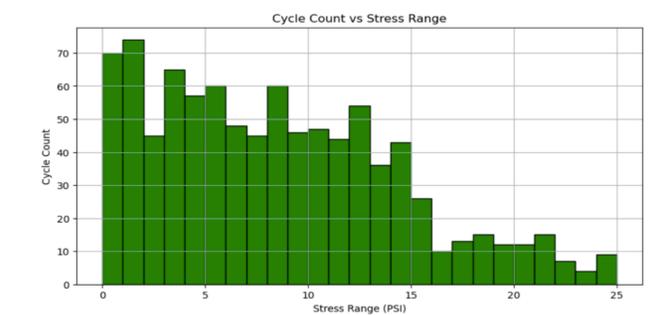
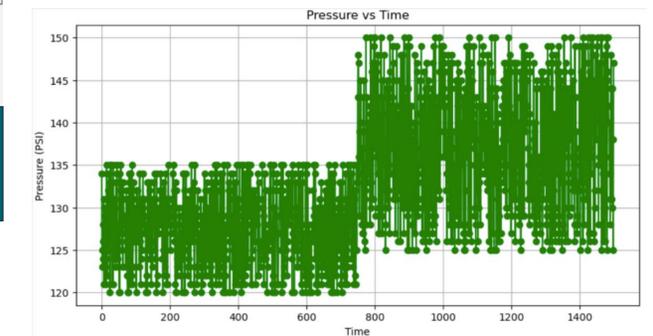
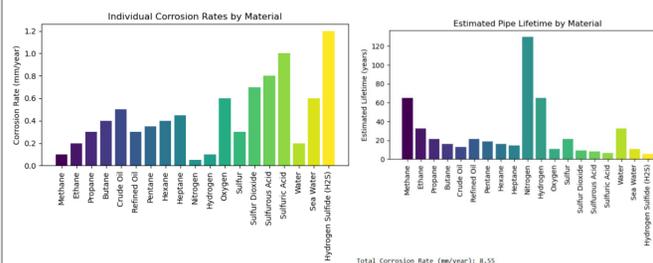
Constraints

- Cannot modify or bypass existing pipeline supports.
- Cannot detect all types of standardized pipe sizes.
- Low signal Areas may delay data transmission.

Testing & Validation

Comprehensive List of Prototype Constraints and Specifications Validation & Testing	Constraints/Specifications: Met YES	Constraints/Specifications: Met NO
Specification 1: The APIMS system must be able to withstand the harsh conditions outside the pipelines, up to 80°C temperature from the pipeline.	The material that has been used for the frame was ABS which can handle a temperature up to 100 °C.	
Specification 2: The ultrasonic sensors used in the probe must achieve a measurement accuracy of at least ±0.004 inches in wall thickness.	The accuracy of ±0.004 is achieved	
Specification 3: Detector sensor with frequency of either 2.5 or 5 MHz to detect a range of 0.04-8.85 inches.	The detecting range of 0.04-8.85 inches	
Specification 4: The frame of (APIMS) inner diameter range is 12-16 inches.		The system can't detect the common sizes used in industry between 12 and 16 inches. But only 16 inches
Constraint 1: Our system does not have the capability to modify or bypass existing pipeline supports.	The APIMS cannot get over the support of the pipeline.	
Constraint 2: Our system cannot detect all types of standardized pipe sizes.	The system can detect only the common sizes used in industry between 12 and 16 inches.	
Constraint 3: Areas with low signal, the system may delay data transmission reliably.	Time to receive thickness data around 45s. System response time < 5 min.	As the system use Wi-Fi to transmit data, low signal will affect the process.

Data Analysis



Problem Statement

Pipeline corrosion is a significant concern in the oil and gas industry. A device is required which can detect corrosion effectively without interrupting operations.

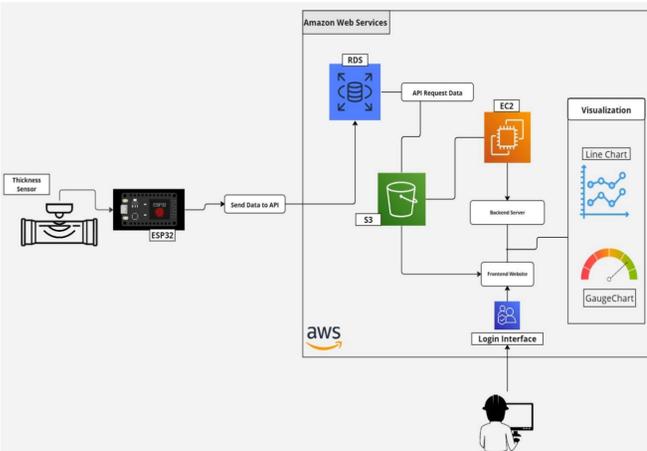
Proposed Solution

We provide a device that identifies corrosion with an ultrasonic thickness sensor, featuring a real-time cloud-based monitoring system that is capable of moving around and along the pipeline and can endure severe circumstances without disrupting pipeline operations.

Cloud Server

Developed and deployed a cloud-based monitoring system using AWS services:

- S3:** Frontend Interface
- RDS:** Database.
- EC2:** Backend Processing.



Specification

- Withstand pipelines harsh conditions up to 100°C temperature.
- Accuracy of at least ±0.004 inches in wall thickness.
- Detect a thickness range of 0.04-8.85 inches.
- Frame inner diameter range is 12-18 inches.

Conclusion

- The APIMS complied to the standards and offers several analyses.
- The APIMS demonstrated its reliability as a solution for detecting pipeline corrosion. It adheres to ASME, ASTM, and API standards.
- Unlike alternative methods, none provide the capability like our APIMS, all at a minimal cost with our APIMS.