AI-Based Leak Detection System for Petroleum Pipelines

TEAM M053

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ME EE 4 ICS PETE

Background

- Pipeline systems are essential for fluid transport, but leaks can cause economic losses, safety risks, and environmental damage. Detecting small leaks is challenging, which highlights the need for reliable early detection systems.

Problem Statement

- Small pipeline leaks are difficult to detect using conventional methods, leading to inefficiencies and potential hazards. Therefore, a system is needed to accurately detect leaks in real time with reliable performance.

Constraints

- Pipe: 6 in, 2m , PVC
- Medium: Refined oil (20–25°C)
- Robot: 90-95 mm
- Power: dc ≤ 12 v
- Data: Web streaming and securing
- Signals: Low noise

Specifications

- Pressure range: 1-1.14 bar
- Leak detection size: 2-3mm hole
- Tank capacity: 300-500 L
- Pump power rating: 2 HP
- Data acquisition rate: ≥ 100 Hz
- Continuous operation: ≥2 hr
- System update rate: ≤ 2 s
- Detection accuracy: ≥ 80%

Simplified Flow

- fluid circulation → leak generation → sensor detection → data acquisition → signal processing → leak identification → output display → monitoring system

Engineering Contributions

- **Mechanical Engineering (ME)**
  - pipeline system design
  - flow control & leak simulation
  - system assembly
- **Electrical Engineering (EE)**
  - data acquisition system
  - sensor integration
  - signal processing
- **ICS (Information & Computer Science)**
  - real-time monitoring system
  - system control & automation
  - data communication
- **Petroleum Engineering (PETE)**
  - fluid behavior analysis
  - leak impact evaluation
  - system application in oil pipelines

Prototype Design

Test / Validation