TEAM

008

Intelligent Heat Exchanger Fouling Prevention Management System

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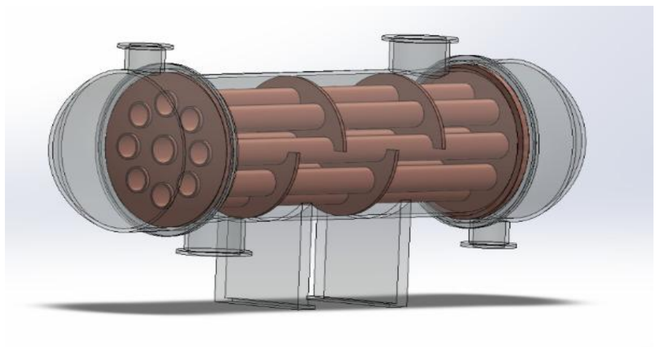
Introduction

Heat exchangers are key to thermal energy management in chemical plants.
Fouling—unwanted material buildup—reduces efficiency, increases costs, and causes unplanned shutdowns.
Our project presents an intelligent system that combines real-time monitoring, machine learning, chemical dosing, and automated filtration to prevent fouling and optimize performance.

Problem Statement

Traditional maintenance is reactive and costly, often addressing fouling too late.
This leads to more energy use, downtime, and emissions.
Current solutions are expensive or lack prediction.
We propose a smart, cost-effective system to detect fouling early and respond automatically.

Final Target Specification



Specification : Target	
ML Model Prediction Accuracy: ≥ 80%	Heat Transfer Efficiency: ≥ 70%
Chemical Dosing Rate: 0.2–0.4 mL/min	Cost Reduction: ≥ 15%
Sensor Range: −30 °C to 70 °C Accuracy: ±0.1 °C to ±1 °C	

Project Constraints

Budget: Capped at 4000 SAR (prototype ~5500 SAR).	Size: Fits within 18m³
Data: Limited to 6200 historical records.	Power: 127V / 220V, 60HzPressure: Must operate < 1.5 bar

Project Impacts

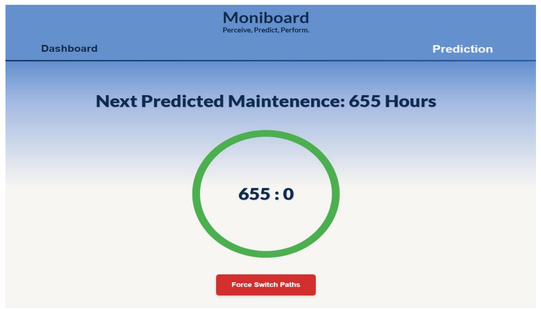
- **Efficiency:** Extends intervals, reduces shutdowns.
- **Cost:** Lowers maintenance and energy waste.
- **Sustainability:** Cuts emissions and waste.
- **Scalability:** Easy to deploy across industries.

Testing & Validation

- **91.75%** ML prediction accuracy
- Sensor update delay: < **10 seconds**
- Heat transfer efficiency monitored using U-value charts
- Prototype confirmed system responsiveness

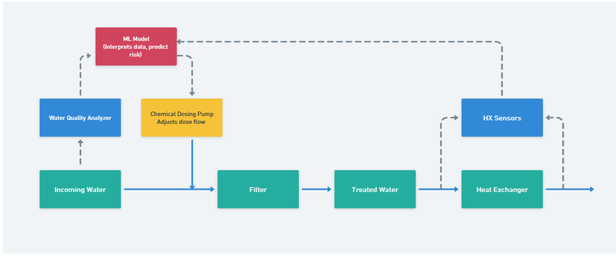
Results

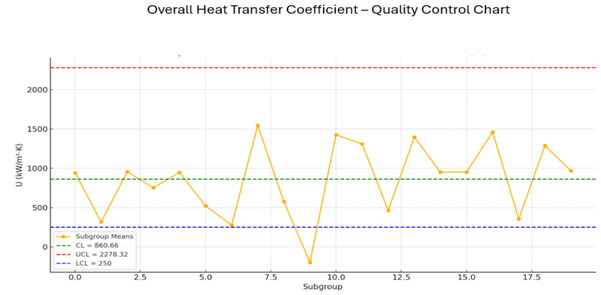
- **91.75%** prediction accuracy
- Maintenance cycles extended by **20%**
- Operational cost reduction: **15%**



System Overview

- Sensors (temperature, pressure, flow)
- Raspberry Pi for real-time processing
- ML model for fouling prediction
- Smart pump and filter for intervention
- Dashboard for monitoring





Conclusion

The system proved to be accurate, fast, and scalable.
It reduces costs, improves reliability, and supports sustainability.
This approach enables predictive maintenance in industrial environments.