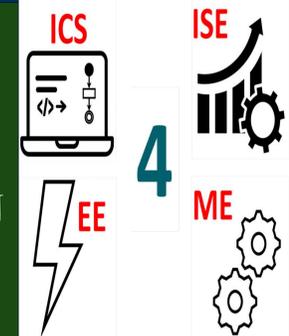# Team 004

VIBRATION BASED ENERGY MONITORING/HARVESTING

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COACH: NAVEED IQBAL

Project description:

Centrifugal pumps often face faults like cavitation, overheating, and seal leakage. Our project introduces a self-powered monitoring system that harvests vibration energy and visualizes real-time health data to detect problems before failure occurs.

Problem statement:

Most pump monitoring systems depend on external power and manual checks, failing to detect early faults in real time. There's a clear need for a self-powered, continuous solution that identifies issues before damage occurs.

| Specification	/ Constraints
Harvest voltage to a stable 3.3V or 5V DC output using a buck-boost converter with an efficiency of at least 85%	Energy Harvesting Minimum Power of 2 W.
Reduce unplanned downtime by ≥ 15%	Data processing and fault classification within 2-3 seconds.
Using AWS cloud architecture, ensuring alerting the user in ≤3 seconds	Must withstand 80% relative humidity (non-condensing) to ensure sensor and circuit stability in damp environments.
Integrate mechanical damping systems to attenuate high-frequency noise (above 200 Hz) to improve signal accuracy	Placement must be within ±5% of the optimal energy point to maximize sensitivity and efficiency.

Prototype Design
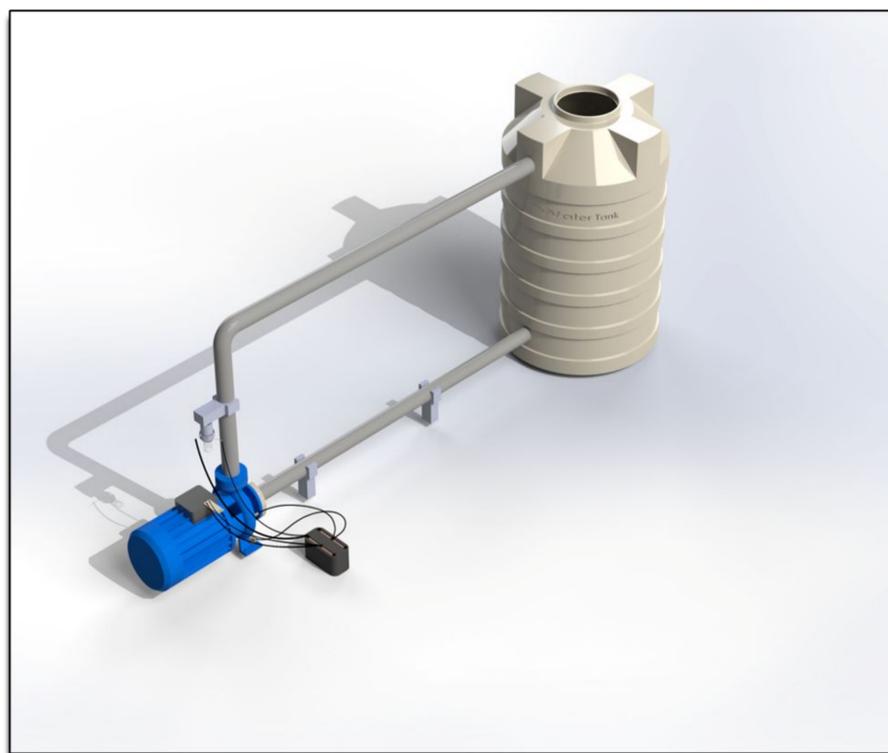
Test and Results
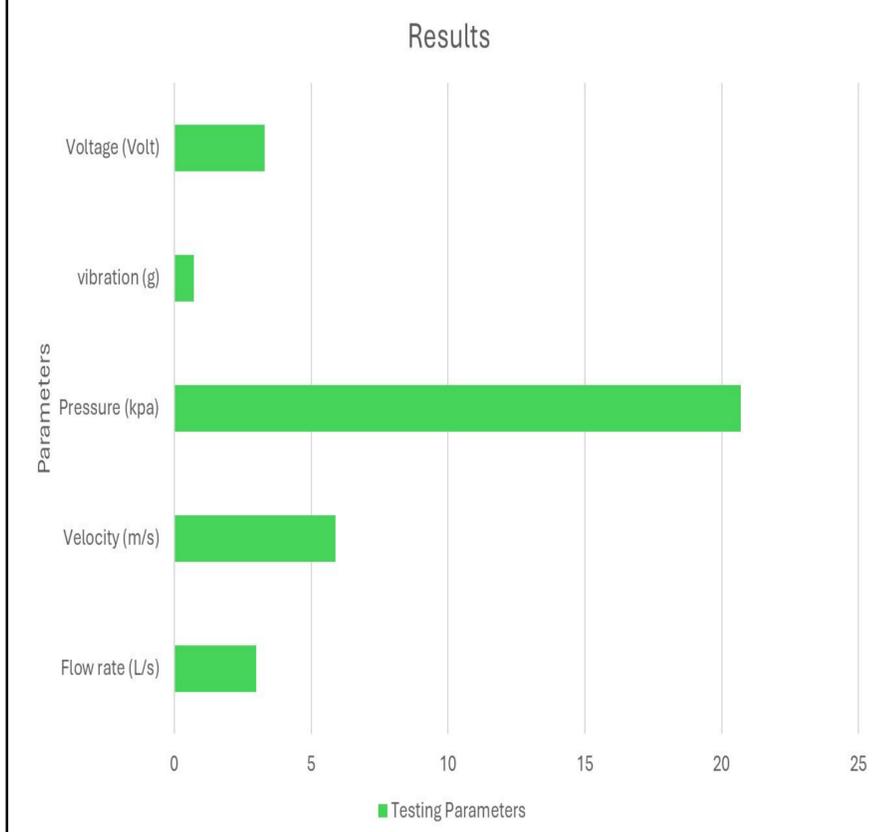
Verification/Validation

The VMHS prototype was tested and verified. It successfully harvested energy from pump vibrations using: Piezoelectric ($Q = d * F = d * \sigma * A$) and Electromagnetic ($V = -N * (d\Phi/dt)$).And meet goals of Predictive Maintenance
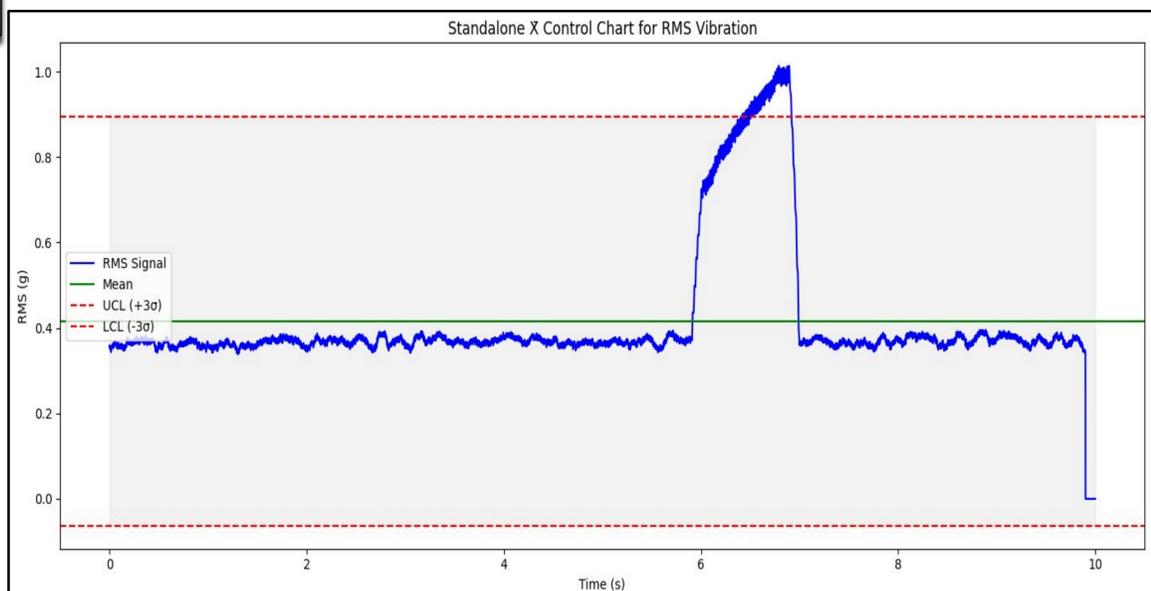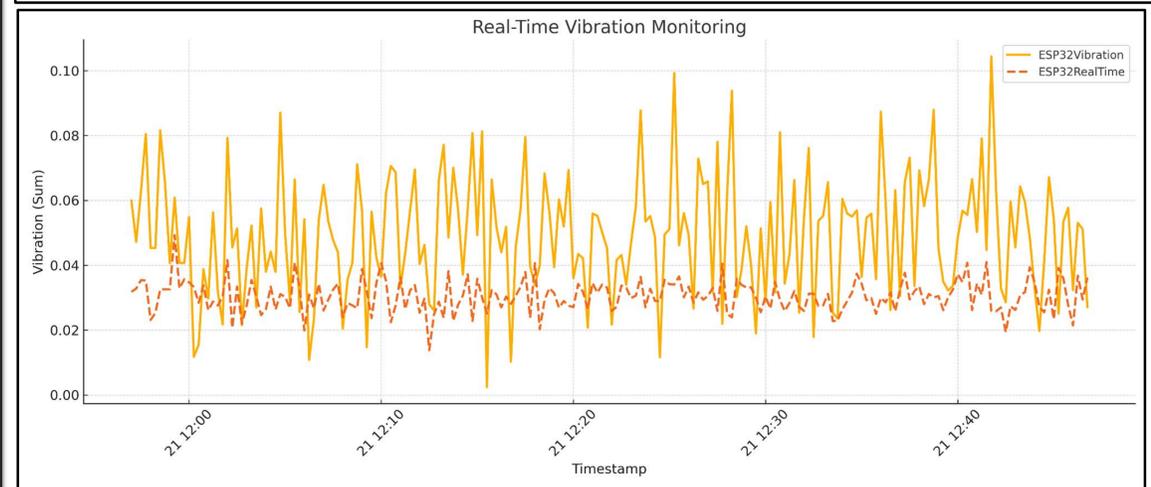
Conclusion

This project introduces a self-powered system for real-time monitoring and predictive maintenance. By combining vibration harvesting, smart sensing, and mechanical damping, it enables early fault detection without external power—enhancing reliability and reducing downtime. The system is designed to be scalable and applicable to real-world industrial settings, offering a practical step toward autonomous pump health monitoring.