Electrical Engineering

Abnormality-Diagnosis System Powered by Energy Harvesting

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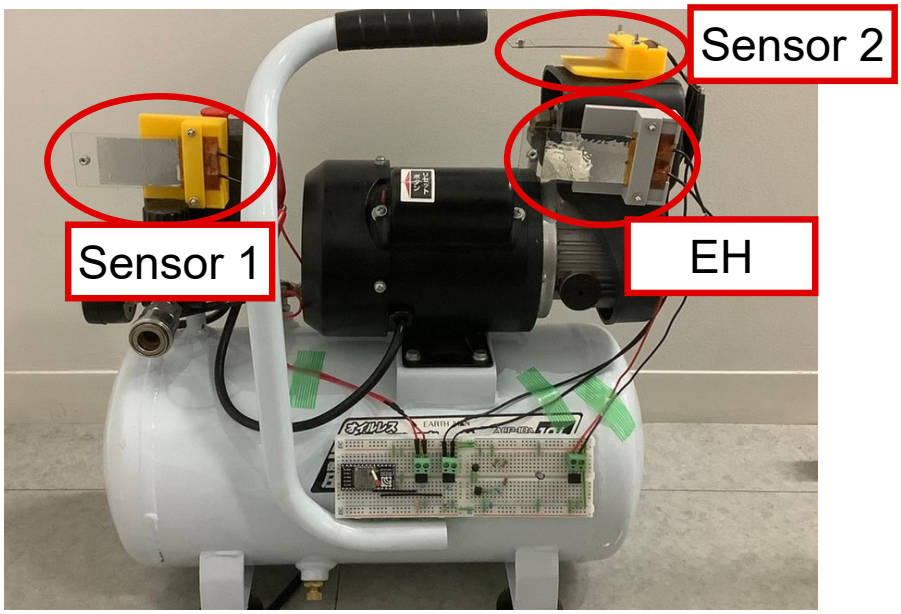
Purpose of Research

The goal of this study is to realize a wireless abnormality-diagnosis sensor that can operate continuously in either battery-less or battery-assisted mode by integrating retrofit-friendly energy-harvesting (EH) devices with an ultra-low-power intermittent-transmission circuit.

Summary of Research

A piezoelectric vibration energy harvester charges a capacitor every few tens of seconds. A custom intermittent-operation circuit then wakes the MCU and wireless device only when the stored voltage exceeds a threshold. Using the transmission interval and two sensor-voltage channels as features, we developed machine-learning algorithms that classify compressor fault. When a supplemental battery is attached, LTE communication enables long-range data transmission.



Points

・Energy harvesting × intermittent radio enables fully battery-less diagnostics.
・Ultra-low-power architecture.
・ high-precision anomaly detection.

Comparison with Conventional or Competitive Technologies

Establishes both completely battery-less and battery-assisted operation schemes.

Expected Applications

・Continuous abnormality monitoring in factories.
・monitoring of seismic or other disaster events.

Challenges in Implementation

・Full integration of EH module and circuit
・Expansion of training data and push toward 100 % accuracy.

What We Expect from Companies

・Collaboration on mass production. processes and ASIC implementation
・Joint proof-of-concept projects to create real-world use cases.

Future Developments

・Hybridization with other EH sources such for multi-environment operation.
・ Enhanced prognostic maintenance via autonomous model updates through edge AI and cloud linkage.

■ Awards: JST PRESTO / CREST
■ Intellectual Property: JP7107492, JP Appl. 2024-144567
■ Prototype: Yes

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