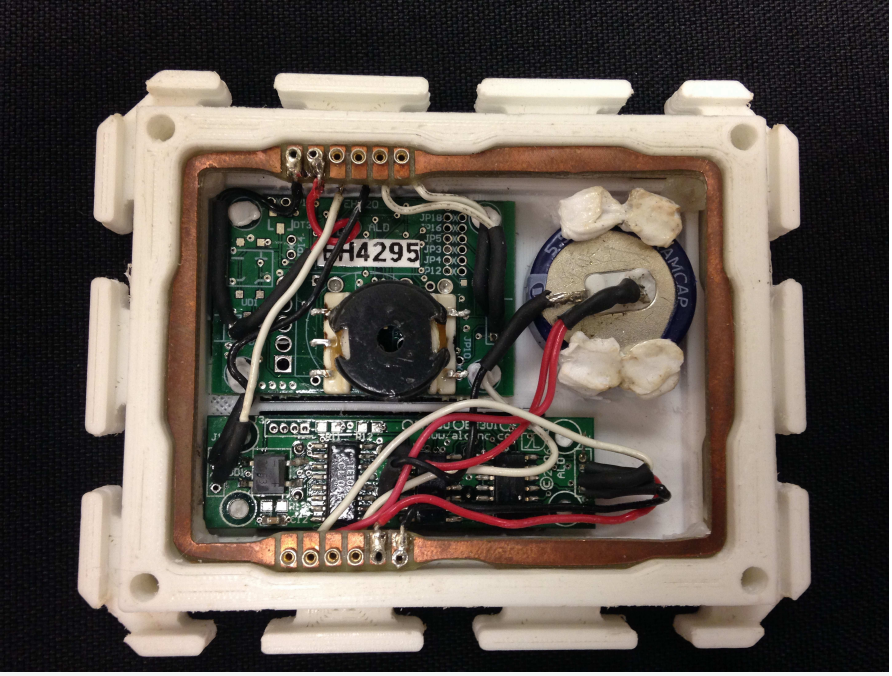


National Aeronautics and
Space Administration

Sensors

Energy Harvesting Smart Sensor

Using Asynchronous, One-Way Transmission from Sensor to Base Station

The energy harvesting smart sensor is a highly power conservative monitoring system consisting of a base station and wireless sensor units. The sensors lay fully unpowered within a dormant state until they receive a trigger energy which consumes no stored power. When activated, the sensor takes a measurement, transmits the data to the base station with a synchronized time stamp, and then returns to its dormant state. The system can be utilized in commercial applications that require long term monitoring of events associated with different types of strain, temperatures, limit switches, currents, voltages and magnetic fields. Though designed to improve the monitoring of high-geared ball and linearly-actuated valves used in propulsion testing to predict valve life span and failure, its use is not limited to valves. It can monitor the operational data of any suitable structure, such as temperature in a particular location in a building, or the strain at a specific point on a bridge.

BENEFITS

- Monitor Critical Systems in Challenging Environments
- Zero Standby Power
- Event Triggered
- Energy Harvesting
- Wireless Tx/Rx
- Explosion Proof Housing

APPLICATIONS

- The system can be utilized in commercial applications that require long term monitoring of events associated with different types of strain, cryogenic/ambient temperatures, limit switches, 4-20 milliamps signals, 0-10 volt signals and magnetic fields
- Automotive industry
- Cryogenics
- Petroleum industry
- Chemical industry

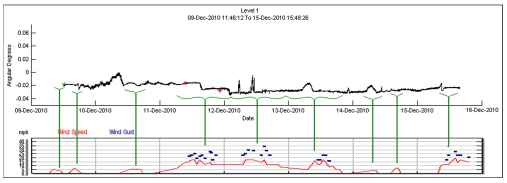
technology solution

THE TECHNOLOGY

This technology was developed to enable a practical method of monitoring critical systems in harsh environments. Ambient energy is harvested to power smart sensors that monitor critical systems and components. Sensors lay fully unpowered until triggered by an appropriate event. When activated, the smart sensor takes a measurement, timestamps the data, wirelessly transmits it to a base station, and returns to its dormant state. All data read events are passed to the base stations main processor with a time stamp within one millisecond for correlating any other applicable data such as temperature. A data read can be configured to collect a single value, averaged value, data burst, or a continuous data stream. The event log and data is stored on a removable flash card and can be broadcasted over Ethernet for remote access. The sensors can also go into a sleep mode or become fully dormant to conserve power. The sensor system can be used in harsh environments, and constructed to meet MIL-SPEC and MIL-STD. The system can be utilized in commercial applications that require long term monitoring of events associated with different types of physical strain, stress, cryogenic/ambient temperatures, limit switches, 4-20 milliamps signals, 0-10 volt signals and magnetic fields. Sensors are capable of monitoring all types of facility components and systems, as well as:

- Synchronous and asynchronous data collection
- Wireless data transmission eliminates the need for wiring
- Energy harvesting capability eliminates dependency on batteries

Energy harvesting smart sensor system deployed for structural integrity monitoring at the cryogenic barge docks.



Minute angular displacement observations (black) were captured with vibrational friction induced creaking events (red marks) and data was correlated to wind levels (red) and gusts (blue).

PUBLICATIONS

Patent No: 8,618,933

Jensen, Scott. "Wireless, One-Way, Sensor to Base Station Monitoring System for Explosive and Non-Hazardous Environments." TechConnect World Innovation Conference & Expo, June 17, 2015, Washington, DC.

Jensen, Scott. "Energy Harvesting Smart Sensor." NOBIC (New Orleans BioInnovation Center) Technology Showcase, Innovation Louisiana 2015 Conference, November 18, 2015, New Orleans, LA

More Information

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NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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