VTMS

Vacuum and Temperature Monitoring Sensor

ELECOMP Capstone Design Project 2020-2021

Sponsoring Company:

Seascan Inc
348 Gifford Street, Unit E
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Company Overview:

Seascan Inc is a small manufacturer of oceanographic instrumentation and equipment. Our customer base is primarily involved in scientific research and development.

Technical Directors:

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Consulting Technical Director:

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Project Motivation:

Seascan Inc manufactures a number of pressure tolerant enclosures (pressure housings) for electronic equipment and battery packs. A pressure housing may have several o-ring seals protecting the equipment from sea water intrusion. Typically, we will hydrostatically pressure test every newly designed housing prior to installing the electronics. We pull a vacuum on the housing as a pre check to pressure testing and will monitor the vacuum for 12 to 24 hours. We use a vacuum pump, ball valve and vacuum gage attached to the pressure housing for this test. The vacuum is an inexpensive means of checking for leaks.

Our customers will access the equipment inside the pressure housing by removing a sealed end cap and pulling out the electronics or battery. The customer has no way of knowing if the pressure housing is properly sealed after opening and closing the housing so we would like to solve this problem with a vacuum monitoring sensor.

The vacuum monitoring sensor could be easily installed inside the pressure housing or connected to LEDs located on the outside of the pressure housing end cap.

Anticipated Best Outcome:

The Anticipated Best Outcome consists of the delivery of a prototype vacuum and temperature monitoring sensor system that meets all of the requirements. Test results and a demonstration of all features will also be required.

Other deliverables to accompany the prototype hardware include:

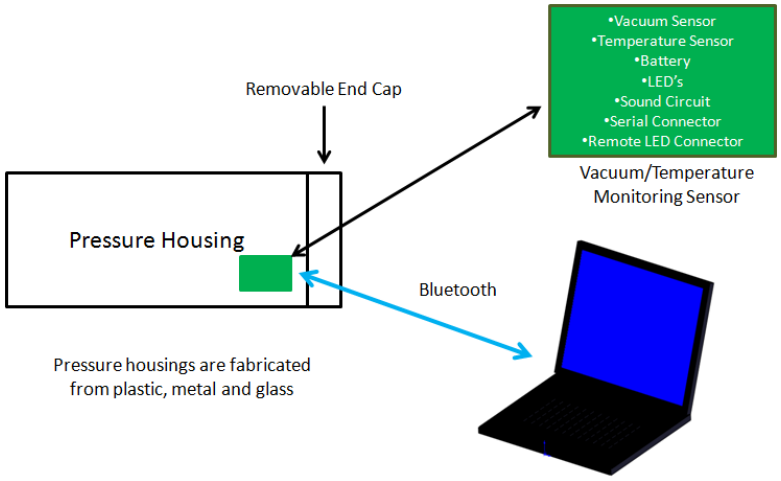
- Schematics, layout, fabrication, and assembly files for two PCBs
- A complete bill of materials for the system
- Well commented firmware and software source code and compiled binaries
- A system user manual describing the hardware and software

Project Details:

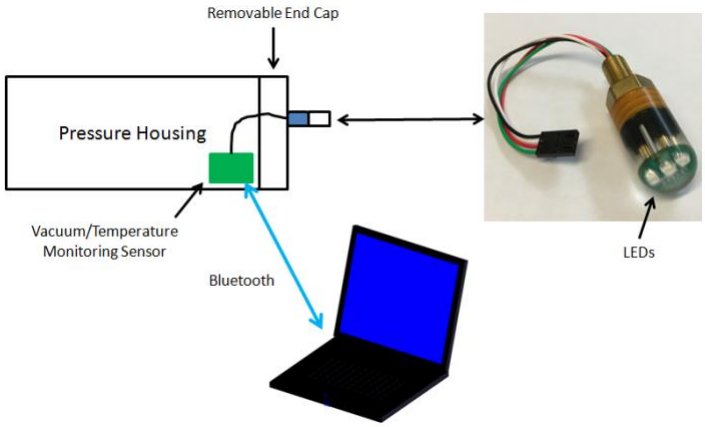
Vacuum/Temperature Monitoring Sensor

- Develop a main circuit board with a vacuum and temperature sensor that uses a small primary cell battery for power.
- The user will mount the main circuit board on the inside of the pressure housing either using double sided adhesive tape or no. 4 hardware.
- The user will wake the main circuit board by swiping a magnet near the circuit board.
- The user will communicate with the main circuit board using Bluetooth.
- The main circuit board will use a series of LEDs and sound notifications for alerts, and set points.
- The main circuit board will keep a history of the vacuum and temperature over time on a user defined interval.
- The main circuit board will use a series of LEDs and/or sound to indicate that the vacuum and temperature are within a user defined range.
- The user will use a graphical user interface to set the name for the sensor, the date and time, vacuum range, temperature range, and the schedule for checking the vacuum and temperature.
- The user will use the GUI to view the vacuum and temperature history.
- The GUI will display the remaining battery life.
- The main circuit board will have a connector for transferring serial data to the user's electronics within the pressure housing.
- The main circuit board will have a female connector to mate with an LED circuit board mounted on the outside of the pressure housing end cap.
- A circuit board with LED's is required for the end cap mounted device when a transparent pressure housing is not used. This circuit board will be soldered to a standard underwater connector and potted in urethane.

Transparent Pressure Housing Configuration



Opaque Pressure Housing Configuration



Hardware and Electrical Tasks:

- Identify potential solutions for the major system components: the vacuum and temperature sensor(s), embedded processor, and Bluetooth module
- Develop schematic for vacuum/temperature monitoring circuit board and external LED board, identifying how all system requirements are being met
- PCB layout for vacuum/temperature sensor board and external LED board
- Build and test prototype sensor board and LED board
- Document all aspects of the hardware development and subsequent testing

Firmware Development and Software Tasks:

- Establish communication between the vacuum/temperature board and the user's computer via Bluetooth.
- Transmit serial data to the user's internal electronics via a board mounted connector.
- Activate the LEDs and audio signals.
- Monitor the vacuum and temperature sensor and store data to non-volatile memory
- Monitor Battery Life
- Develop graphical user interface

Composition of Team:

2 Electrical Engineers (ELE) and 1 Computer Engineer (CPE)

Skills Required:

Electrical Engineering Skills Required:

- Low power embedded circuit design
- Micro processor circuit development
- Schematic capture
- PCB layout

Computer Engineering Skills Required:

- Embedded firmware for Arduino or similar to meet the design requirements
- UART, I2C and/or SPI interface development
- Bluetooth pairing
- GUI development using Qt or similar framework

Anticipated Best Outcome's Impact on Company's Business, and Economic Impact:

Having a functioning prototype for lab testing and further development would allow Seascan to ultimately add this sensor to their product line.

Broader Implications of the Best Outcome on the Company's Industry:

By including the Vacuum and Temperature Monitoring Sensor with their pressure housings, Seascan's customers would have a more reliable solution for their research and development needs.