Senior Design Project in Electrical Engineering

DYNAMIC STRESS MEASUREMENTS OF A SHIP'S PROPELLER SHAFT

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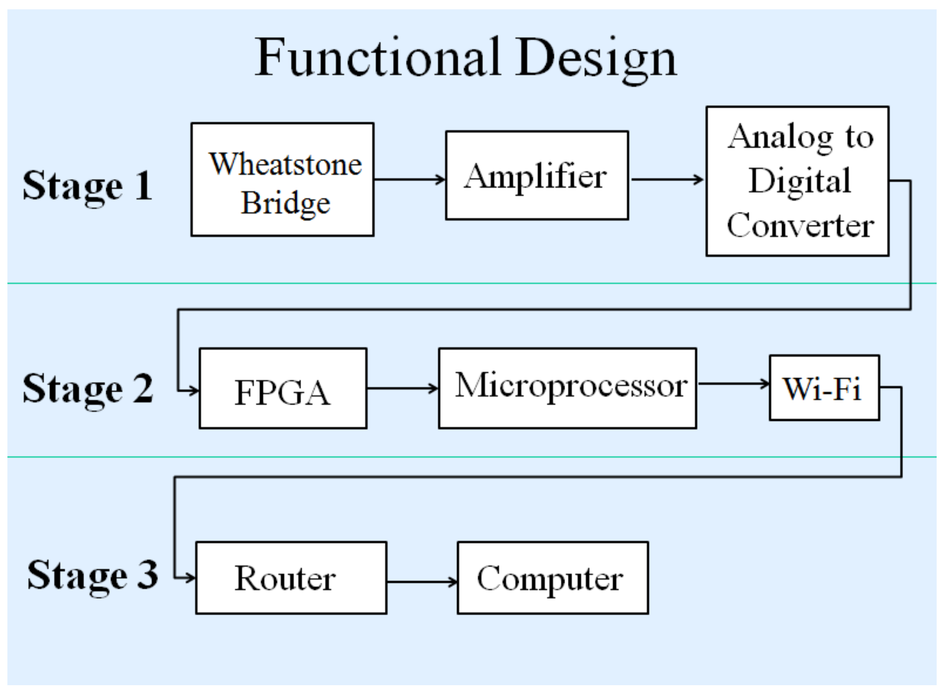
Sponsor: USCGA Mechanical Engineering Department (Liaison: LCDR Burns)

Project Background

The objective of this project is to provide Coast Guard engineers and contractors with a tool to analyze the status of any stresses being exerted on a ship's propeller shaft. The project develops a system that may be used to dynamically model the stress in a ship's propeller shaft to prevent future casualties by identifying loads being placed on the shaft.

FPGA and Microprocessor Role

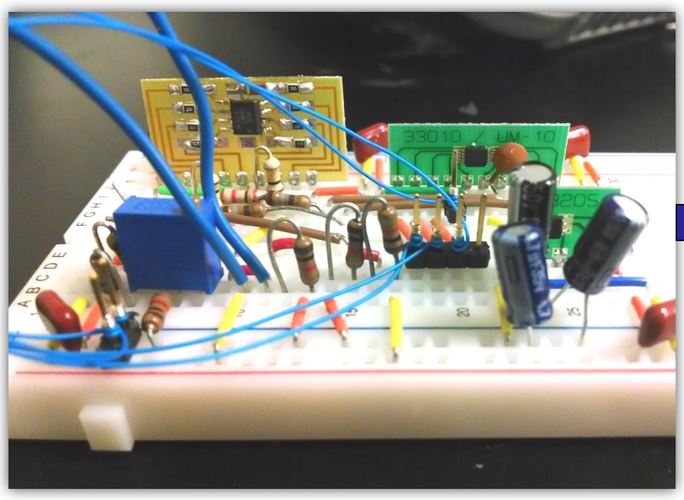
Connecting the circuit card and the Raspberry Pi Microprocessor is a Field Programmable Gate Array (FPGA). The FPGA contains a dual port random access memory that is a buffer for the data incoming from the strain gauge's. The FPGA allows the Raspberry Pi to read the data from the dual port memory or to read it straight from the output pins of the analog to digital converter on the circuit card.



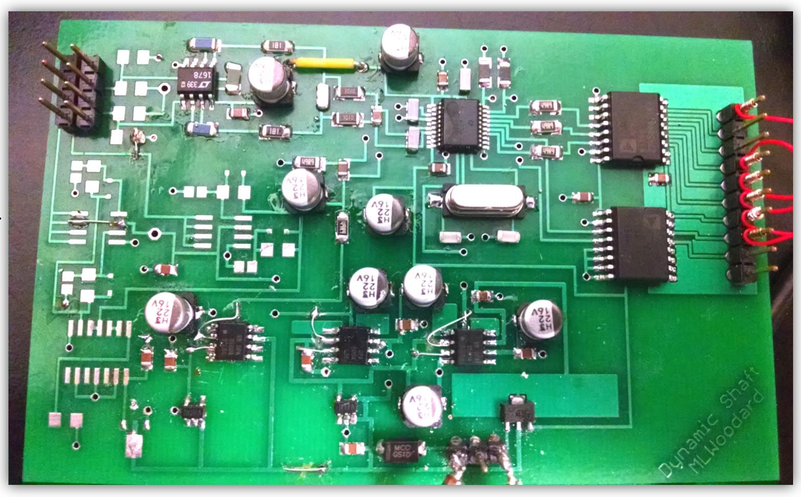
Project Requirements

- Detect dynamic stress exerted on a rotating stress
- Wirelessly transmit data from shaft
- Display results of measured stress
- Durability to withstand speeds of up to 500 RPM
- Small in size, not to exceed 0.5 lbs and 1 inch tall
- Store data for post analysis

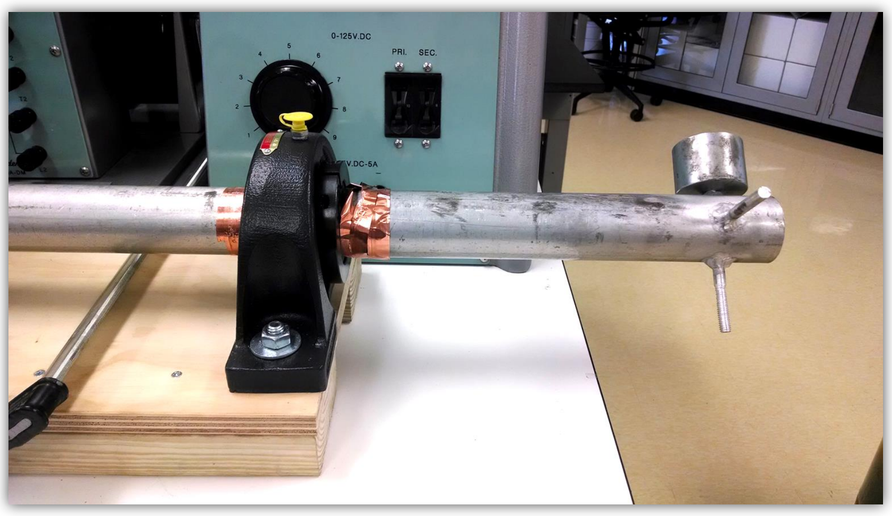
Circuit on Bread Board



Circuit Card Designed in Eagle CAD



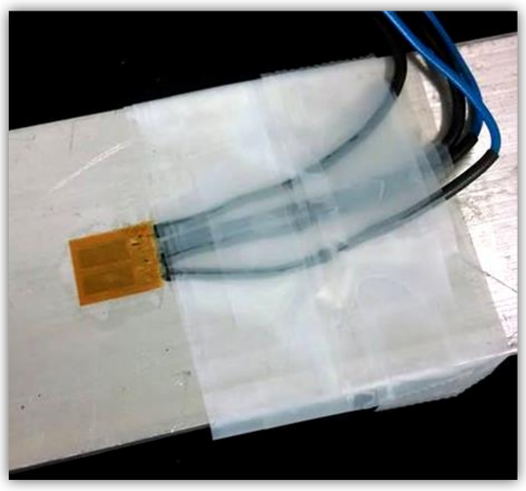
Model Shaft with Weight

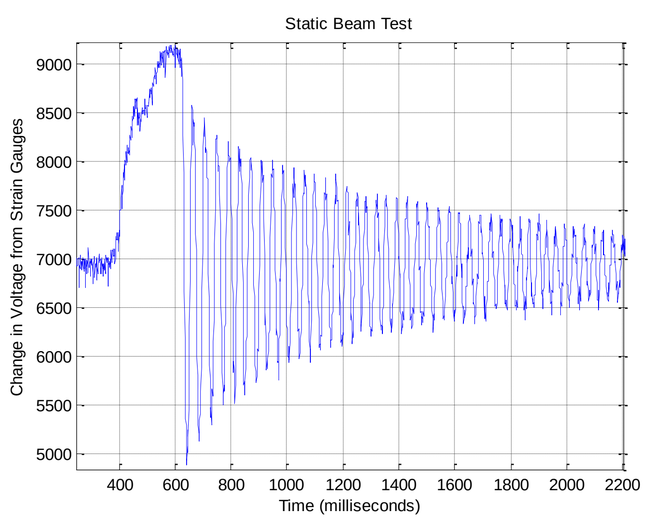


Project Deliverables

The project goals are as follows:

- Design a circuit that amplifies and digitizes the voltage coming of the strain Wheatstone bridge
- FPGA and Microprocessor collect data from the strain gauge circuit
- Display of stress being exerted on model shaft



Strain Gauge Beam Test

This test was completed during the Fall semester. The purpose of the strain beam test was to gain familiarity with strain gauges and integrate our breadboard circuit with the microprocessor. An amplifier and analog to digital circuit was built on a breadboard, which was then connected to a Raspberry Pi microprocessor. To complete the test, we struck the beam and wirelessly transmitted the data being collected off the beam from a microprocessor to a computer. The plot to the left is the data we received from the microprocessor after plotting it in MATLAB.