DC Brushless Motor Fan Acceleration Response Test

Software Design Document Proposal

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* Introduction
* Purpose

This software design document describes how we will measure the acceleration of a fan motor under different applied voltages and analyze the results using a laser and phototransistor circuit as an accelerometer. The experiment will be designed to allow for a wide variety of conditions determined by the user; i.e. objects obstructing the flow of air, voltages from 0 – 14 VDC, power loss etc..

* Scope

Our experimental set up will measure the acceleration curve of an AFB0612MC CPU Cooling fan. Our VI architecture has been designed to record and display the signal data at a user determined sampling rate, graphically display the input signal and corresponding acceleration data in RPMs, and save the data to a spreadsheet.. A sub VI has also been included to graphically display previously recorded data directly from the spreadsheet files.

* Definitions and Acronyms

LV: LabVIEW 2015 32-bit

* System Overview

System will consist of a typical computer CPU fan mounted to a 12V DC brushless motor. For this project we have selected the model AFB0612MC by Motorola. We will measure the acceleration profile of the fan using a laser & phototransistor circuit configured to act as an accelerometer, collect the data, graphically display it, and save it to spreadsheets for comparison, analysis, and presentation.

* System Architecture
* Architectural Design

The basic components include a standard lab grade visible red light laser, 5V DC phototransistor/ 270 Ohm-resistor circuit, LabVIEW 2015 32-bit platform for Windows and interfaced USB-63XX DAQ device. The test hardware will be configured such that the laser will pass through the fan blades and be aligned with the phototransistor on the other side, such that as the blades pass through the path of the laser, a corresponding change in voltage will appear across the resistor at the phototransistor collector and ground. This voltage signal will directly represent the instantaneous velocity of the fan (divided by the number of blades per rotation) and will be wired to the analog output channel 1 of the DAQ. Our main VI will be configured to sample the signal from the DAQ, detect the number of signal peaks corresponding to blade passes, build a data array of these peaks, then calculate the acceleration using an iterative averaging routine of subarrays taken from the main array, and finally save the acceleration data to a spreadsheet file while displaying both an acceleration curve and the phase of the original waveform graphically on the front panel. The user will be able to select the applied fan voltage from the DC power supply, and sampling rate and number-of-samples from a cluster the front panel. A file creation name prompt window will also be built in to the front panel. A sub VI will allow previous data files to be graphically displayed as well.

Design Rationale

Our design is primarily determined by resources available to us in the physics lab. Additionally, this proposal aims to demonstrate the use of the LabVIEW platform, along with the National Instruments USB-63XX DAQ device and a variety of skills learned in PHYS 434. We feel our design achieves these objectives in a meaningful, easy to understand format, in addition to achieving the purpose of the experiment itself.

* Human Interface Design
* Overview of User Interface

The interface will include customizable controls for fan motor operation including a variable DC power supply to run the fan through a range of different voltages, a VI front panel including sampling rate and number-of-samples DAQ control, data file creation prompt, and numerical indicators and graphical displays of the acceleration profile. A sub VI will allow for graphical display of previously recorded data files. The main VI itself will also contain detailed documentation on each subroutine for ease-of-use.