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A Non-contact Rotary Position Sensor Using Embedded Technology

Final Project Report
Date: December 12, 2008
Terry Bender

Submitted to:

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Abstract

Tuthill Controls Group, headquartered in New Haven, Indiana, specializes in the manufacture of products related to motion control. The company currently markets an electronic foot pedal that features a non-contact rotary position sensor, but the pedals are purchased from an outside source. To eliminate their dependency on a single supplier, Tuthill is collaborating with Indiana-Purdue University Fort Wayne to develop their own electronic foot pedal assembly.

Tuthill supplied IPFW with six output signal configurations that the new position sensor should be capable of producing. This report documents the research, design, and test methods used to develop the electronics for a single circuit design capable of producing four of the specified output signals. A testing system is also being provided to accommodate output signal testing of prototype foot pedal assemblies.

Major components and subsystems that comprise the position sensor include a magnet, field concentrator, Hall-effect sensor, microcontroller, RC low-pass filter, and a solid-state relay switching network. Development tools from National Instruments used during the schematic and printed circuit board design include Multisim and Ultiboard. Cadence Pspice was used to evaluate transient response of the low-pass filter design, while The Mathworks MATLAB allowed assessment of the Fourier series and harmonics associated with the microcontroller's pulse width modulated output signal.

Embedded C language firmware for the microcontroller was developed using Microchip MPLAB version 8.10 and a PIC C compiler from Custom Computer Services. Unified modeling language diagrams were used during firmware development to model the dynamic behavior of the system.

To test the output signals produced from a complete prototype foot pedal assembly, a test system was developed featuring a foot pedal holding fixture used in conjunction with a LabVIEW graphical user interface. The fixture design was accomplished using AutoCAD 2008, while the user interface and associated programming were developed through LabVIEW version 8.5.

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