Fan Diagnostic Tool

Ethan Haynes Conner Vick Tucker Basham Jacob Brewer Layne Bowman

Tennessee Technological University

Project Overview

Lochinvar tasked the team with developing a multifunctional boiler/fan diagnostic tool, with the primary focus on fan simulation. The tool accepts a pulse-width modulated (PWM) input signal and produces a tachometer output that indicates fan speed. During the development of the fan simulator, the team also designed and built hardware capable of boiler simulation and data logging.

Capabilities

- Take in a Pulse Width Modulation (PWM) signal from the boiler controller, and output a tachometer signal.
- Users can modify settings that are directly linked to the simulated fan's behavior.
- Save the user modified settings to a SD-Card and load the most recent save back into the tool.

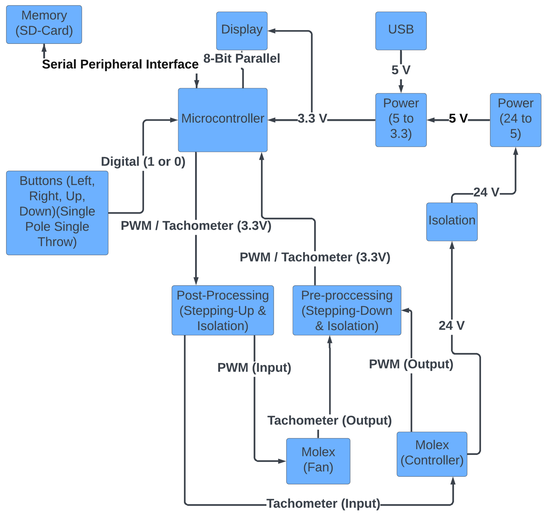

Figure 1. Block Diagram

Figure 2. (Left to Right) Ethan Haynes, Jacob Brewer, Tucker Basham, Conner Vick, Layne Bowman

Design

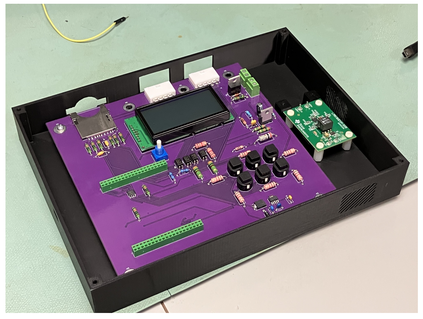

Figure 3. Diagnostic Tool

Power: The power subsystem converts and distributes regulated power to the Fan Diagnostic Tool's components. It supports dual input sources (24 V and USB).

Memory: The memory subsystem can save and load the inputted user parameters for the Fan Simulation mode.

Pre-Processing: The pre-processing system takes in 24 V PWM and tachometer signals. It then electrically isolates both signals and steps them down to a 3.3 V for the microcontroller.

Post-Processing: The post-processing system takes 3.3 V tachometer and PWM signals from the microcontroller, electrically isolates them, and steps up the tachometer signal to 10 V and the PWM signal to 24 V.

User Interface: The user interface displays user parameters and subsequent simulation modes, allowing for alterations to these parameters.

Experimental Results

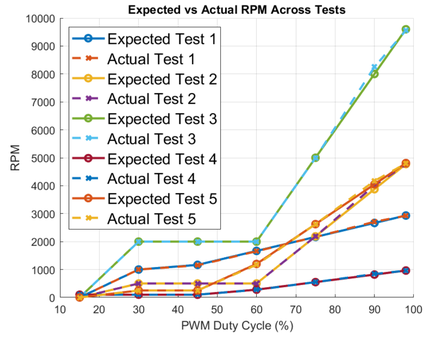

Figure 4. Expected vs Actual RPM Test Results

In the figure to the left, the expected and actual results for the fan speed simulation tests are compared with one another. For each test, using different user parameters, there are corresponding solid and dashed lines. The solid line represents the actual values, and the dashed line represents the expected values. As seen in the graph, the expected values and actual values align closely with one another. Therefore, the simulated fan speeds are within a close margin of an ideal fan.

Conclusion and Future Work

The team successfully created a Fan Diagnostic Tool that meets the sponsor's primary objective of simulating fan behavior in boiler systems. In addition to Fan Simulation mode, the tool's hardware supports the Signal Pass-Through and Fan Driving modes. Future work may focus on expanding the software to encompass the Signal Pass-Through and Fan Driving modes. Further work could be done with testing real fans to incorporate realistic data into the tool.

Acknowledgments

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Scan me!