Automated Industrial Wind Tunnel Network Control with LabView

Functional Requirements List and
Performance Specifications

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Introduction

The purpose of this project is to upgrade the controls on the Mechanical Engineering Department's wind tunnel. The end goal is to create an easy to use automated user interface that will allow for both manual control of the wind tunnel and predefined tests to control the wind tunnel. In addition, the project will include adding the ability for remote operation of the wind tunnel for use in high schools.

System Block Diagram

Figure 1 shows the overall block diagram for the system. The remote computer will connect over the internet to through the router to the National Instruments cRIO (compact reconfigurable I/O) and webcams. Users will control the wind tunnel from a remote computer running a LabView application that will connect to the web server hosted by the real time controller on the cRIO. The cRIO will have several I/O cards installed to control wind tunnel's varies parts and receive feedback from the wind tunnel. The control program will run on the real time controller and FPGA of the cRIO.

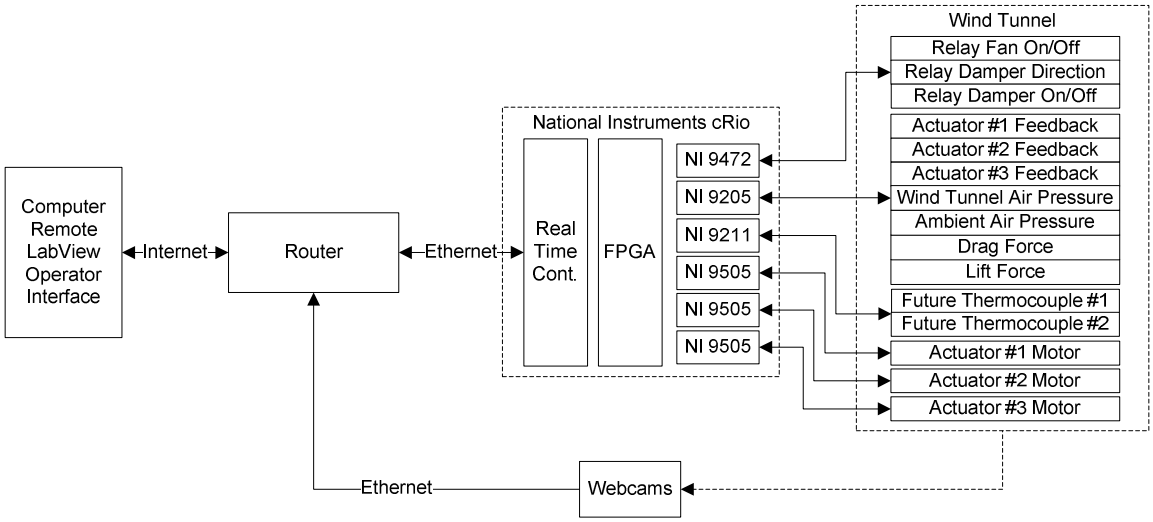

Fig. 1 - System Block Diagram

Functional Requirements

Computer Remote LabView Operator Interface

- Run LabView operator interface with LabView engine
- Internet connection able to connect to router

Router

- Internet connection
- Ethernet network connection to cRIO
- Ethernet network connection to four webcams

Webcams
- Right, left, front-right, back-left views of the object in the wind tunnel

National Instruments cRIO
- Run LabView control application
- Host LabView server
- PID control of actuators with accuracy of ±1mm
- Three digital outputs (NI9472) ranging from 12-24V DC, output delay max 1s, 800mA
- Five analog inputs ranging from (NI9205) 0 - 5 V with ±5 V, 16-Bit, 250 kS/s
- Two analog inputs ranging from (NI9205) 0 - 650 mV with ±1 V, 16-Bit, 250 kS/s
- Thermocouple inputs for future temperature monitoring (NI9211)
- Three motor controllers (NI9505) with +/- 12 volt output to a single actuator with an operating current of 3 amps and inrush current of 7 amps.

Wind Tunnel
- Three linear actuators with 12 volt motors and linear potentiometer feedback
- 12 volt solid state relay for damper control on/off
- 12 volt mechanical relay for damper direction
- 12 volt solid state relay for fan control on/off
- Two force sensors (drag and lift) 0 - 1 volt output
- Two air pressure sensors (ambient and inside wind tunnel) 0-5 volt output
- Two future thermocouples

References
[1] Ben Morrison and Mike Firman. “Web Enabled Wind Tunnel System”, Senior Project, Electrical and Computer Engineering Department, Bradley University, March 2010, http://cegt201.bradley.edu/projects/proj2010/webwind/

[2] Nick Detrempe and Daniel Monahan. “Automated Industrial Wind Tunnel Controller”, Senior Project, Electrical and Computer Engineering Department, Bradley University, April 2012, http://cegt201.bradley.edu/projects/proj2012/aiwt/

[3] NI CompactRIO, National Instruments, [Online] 2012, http://www.ni.com/compactrio