Remote Control Airflow Using Compressed Air & LabVIEW

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The Highlights

- Executive Summary
- Background
- Statement of Need
- Statement of Solution
- Hardware System Design
- Software System Design
- Testing
- Validation
- Lessons Learned
- Acknowledgments

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Executive Summary

- Airflow chamber @ Regal-Beloit – Airflow performance of HVAC equipment, electric motors
- Flow rate – The difference measured between nozzle inlet and nozzle outlet planes
- 5 Calibrated nozzles – Old method of opening and closing, aluminum caps and duct tape
- New method of opening & closing nozzles – Uses LabVIEW, Solid State Relays, 120v AC relays, and compressed air.

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Airflow Chamber

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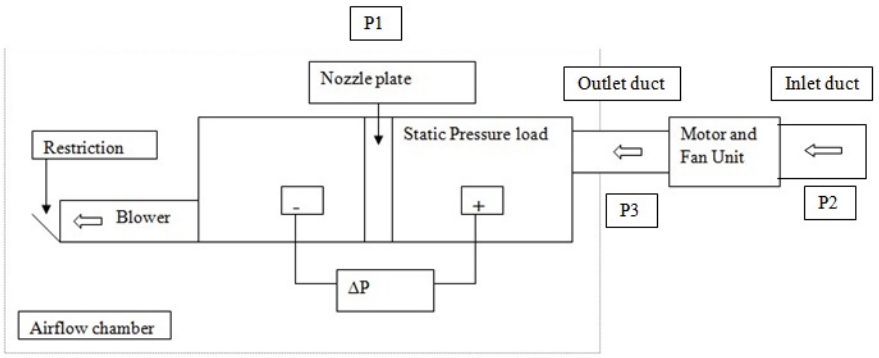
Basic Airflow Diagram



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Statement of Need

- Redesign old method of sealing nozzles, done manually
- Desire to automate for the future
- Save money for the future

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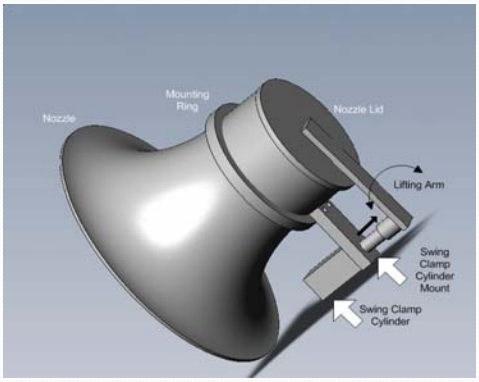
The Solution

- Develop software control for new lid design
- Create a switch circuit
- Write software to control with LabVIEW
- Assemble and test



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Hardware Design

- Design a switch circuit
- Integrate Solid State Relay
- Switch on and off 120v AC with 5v DC
- 120v AC relays & an air controlled valve
- Swing Clamp Cylinder

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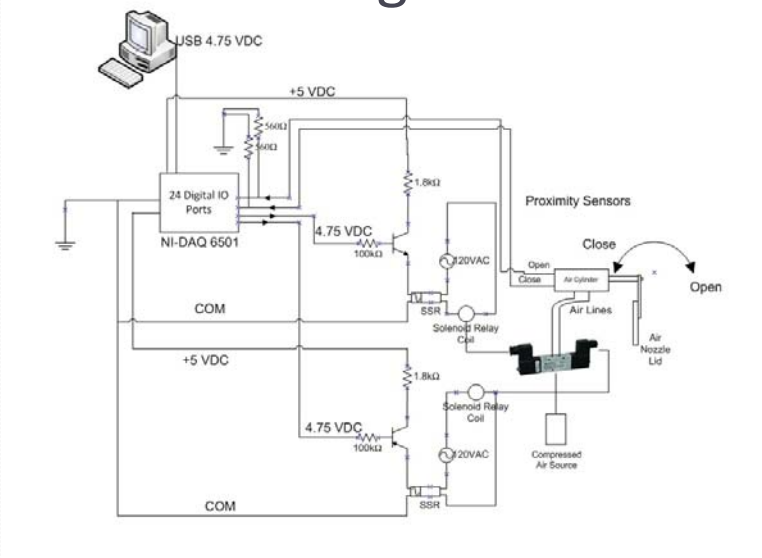
System Flow Diagram



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Calculations – Switch Circuit

- Current Usage (measured w/4.5v DC input)
  - Transistor Circuit: (4.5v DC applied to base)
    - Base = 0.042 mA
    - Collector = 3.15 mA
    - Emitter = Base + Collector => 3.192 mA
- Voltage Drops
  - R1 Resistor = 2.07v DC
  - CE Junction = .11v DC
  - SSR = 2.68v DC
  - Total = 4.52v DC

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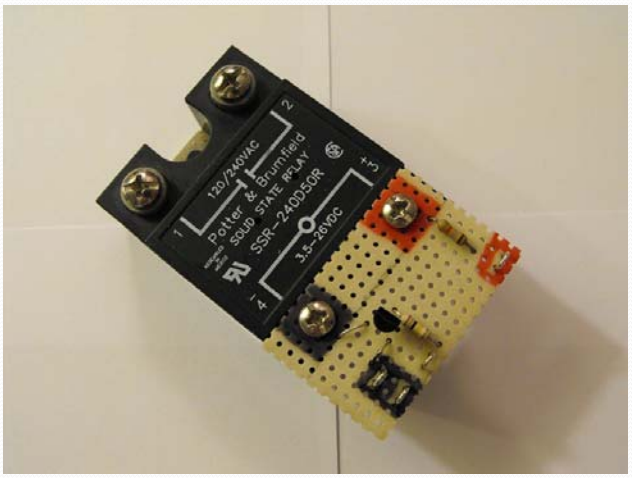
Switch Circuit attached to SSR



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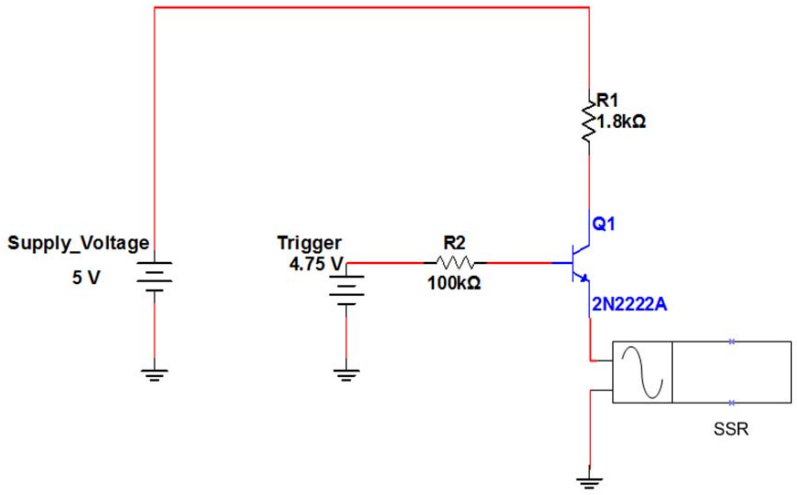
Switch Circuit Schematic



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Calculations – Proximity Sensor

- Voltage Drops:
  - Drop needed below .8v DC
  - 4.75v DC input
  - 1.53v DC in “off” condition
  - Proximity Sensor Drop = 3.2v DC
  - Pull down 560Ω Resistor in series

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Proximity Sensors Mounted

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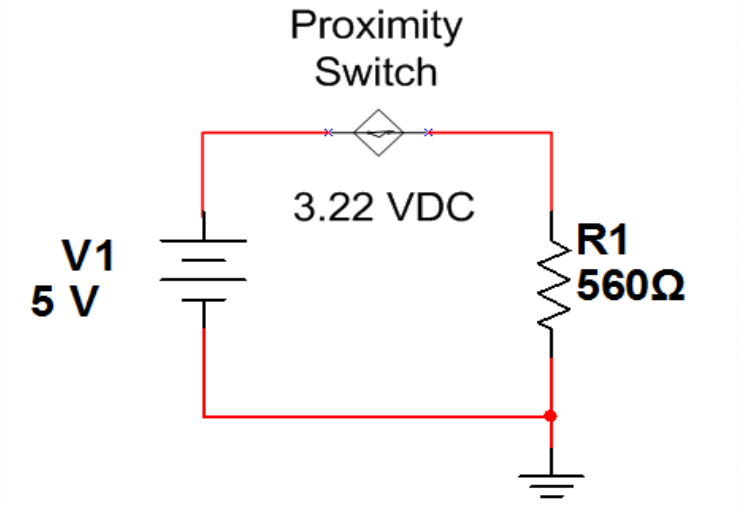
Proximitv Sensor Circuit



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Software Design

- Implementing software control
  - Human Machine Interface
  - Data Acquisition Device
    - 24 Digital I/O Ports
  - Interfaces PC with switch circuit
  - LabVIEW software control
  - Why LabVIEW

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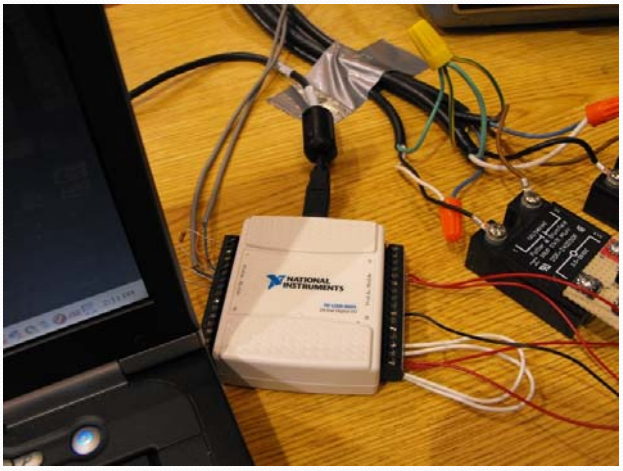
Software to Hardware Interface



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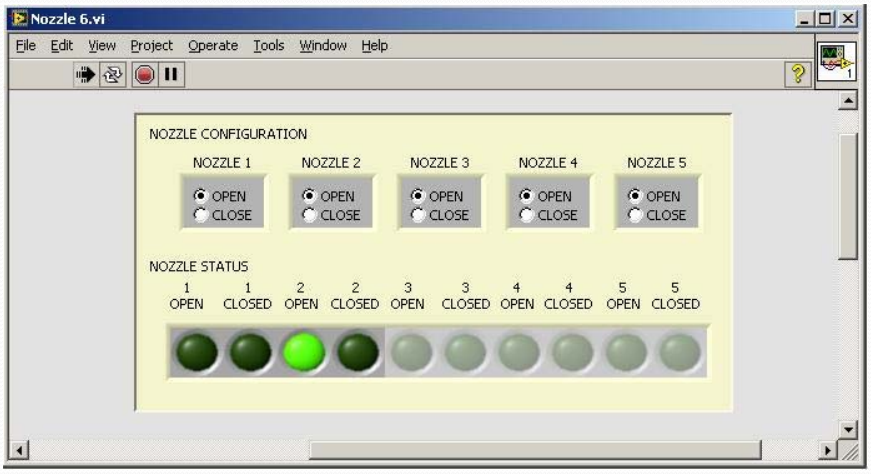
Open Nozzle 2 - LabVIEW



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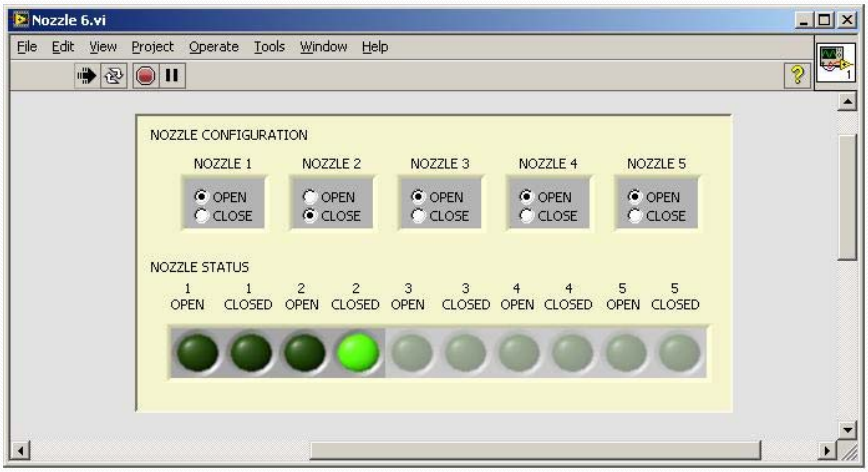
Close Nozzle 2 - LabVIEW



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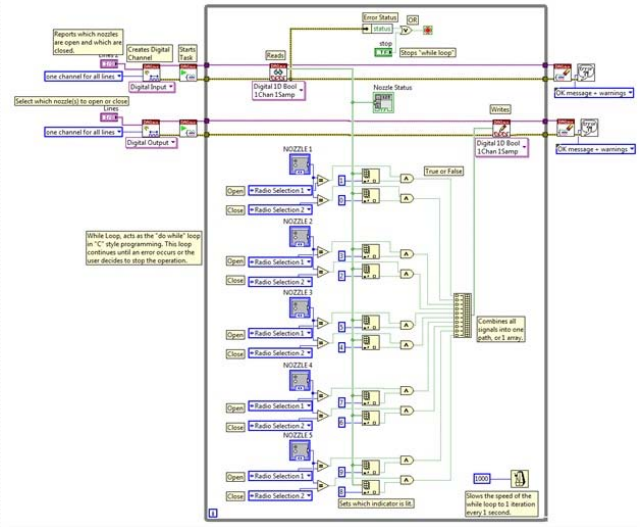
Block Diagram - LabVIEW



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Testing – New Design - Open

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Testing – New Design - Closed

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Validation – New Design

- Pressure Difference – Inlet to Outlet – P1 (in wc)
  - Inches to Water Column
- P1 – Chamber Pressure at the Nozzle Plate
  - Old Sealing Method
  - 1-4 Closed ,Nozzle 5 Open

  P1 = 1.2125 (in wc)
  - Nozzle 2 and 5 Open

  P1 = 0.7447 (in wc)
  - New Method
  - 1-4 Closed, Nozzle 5 Open

  P1 = 1.2153 (in wc)

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Lessons Learned

- What Worked, What Did Not
  - The switch circuit performed as expected
  - LabVIEW preformed as expected
  - New lid seals as good as the old duct tape and cap method
  - The New Nozzle lid, Weight reduction and air flow control
  - Bigger Cylinder, Added last minute
  - Full Pressure on and off

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Acknowledgements

- Support Team
  - Marshall Miers – Regal Beloit Project Advisor
  - Dr. David Momoh – IPFW Project Advisor
  - Professor Paul Lin - Senior Design Phase 2 (The Gate Keeper)
  - Professors Paul De Mond and Dennis Mull – Senior Design Phase 1 (The Planners)

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Time for Questions

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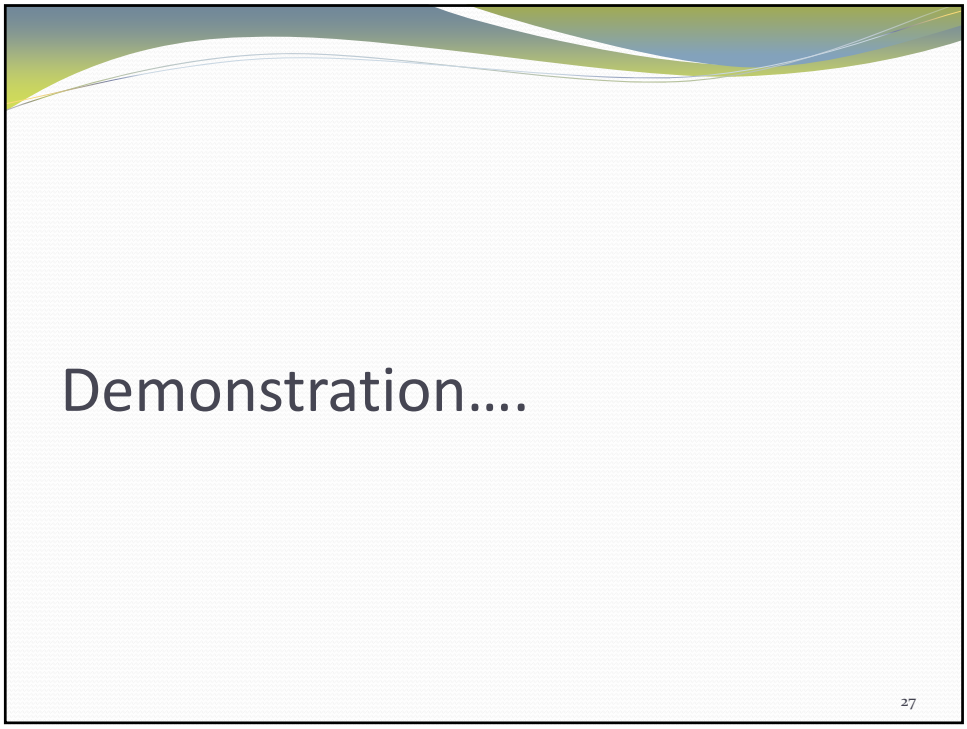
Demonstration….
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