Autonomous Control of a Thermal Distortion Tester

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Electrical and Computer Engineering

Presentation Agenda

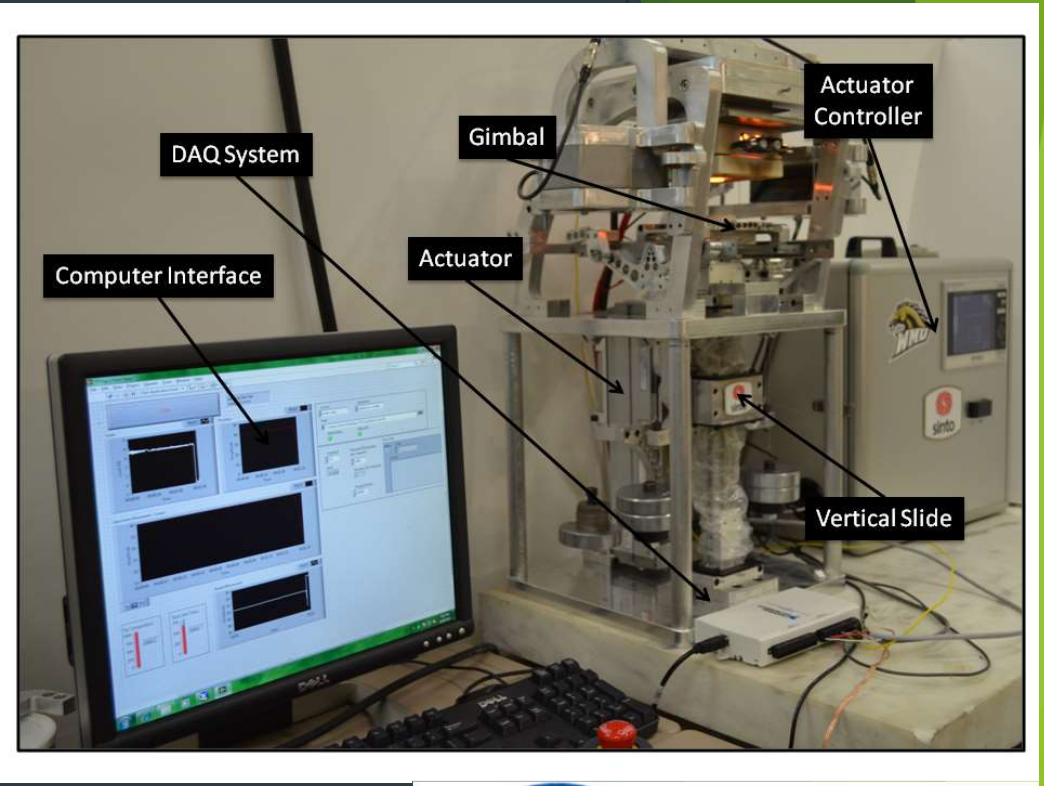
- Introduction and purpose
  - Kevin
- Design
  - Michael
- Results, conclusions and recommendations
  - Zach

Introduction

- Metal casting industry - 6th largest US
  - $40 billion
- Most industries utilize metal casting
- Cast iron and aluminum alloys - most common

Background

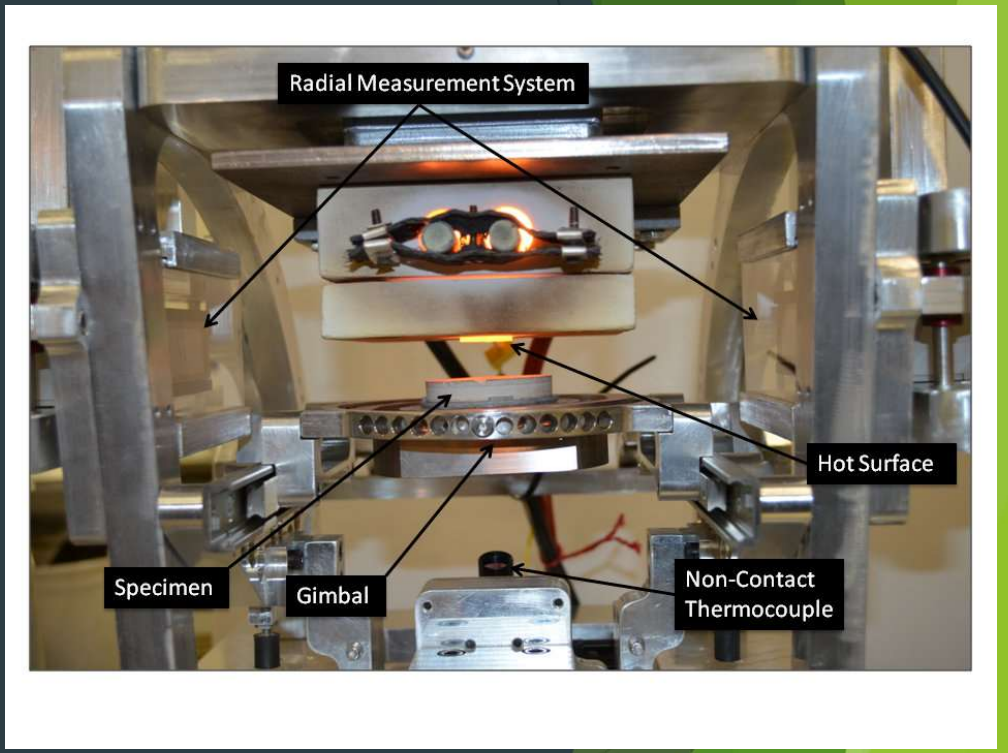
- WMU has close ties to metal casting industry
- Thermal Distortion Tester (TDT) tests metal casting molds
- Invented by Dr. Sam Ramrattan of WMU



AFS American Foundry Society

TDT Operation

- Heating element connected to power supply
- Actuator motor pushes mold into heating element to establish operating temperature
- Thermocouple measures temperature
- Micrometer measures sand mold distortion



Problems Associated with TDT

- Old power supply – welder
  - No control
  - Limited temperature (only 1000°C)
- Not automated

Project Purpose

- To improve control of temperature and position of the mold (‘cookie’)
- Achieve higher testing temperatures
- Automate testing cycle

Example Project Specifications

- Obtain a suitable controllable power supply (At least 5kW)
- Program a software to control temperature and integrate with the system (must reach 1200°C)
- Test the TDT (must meet specifications)

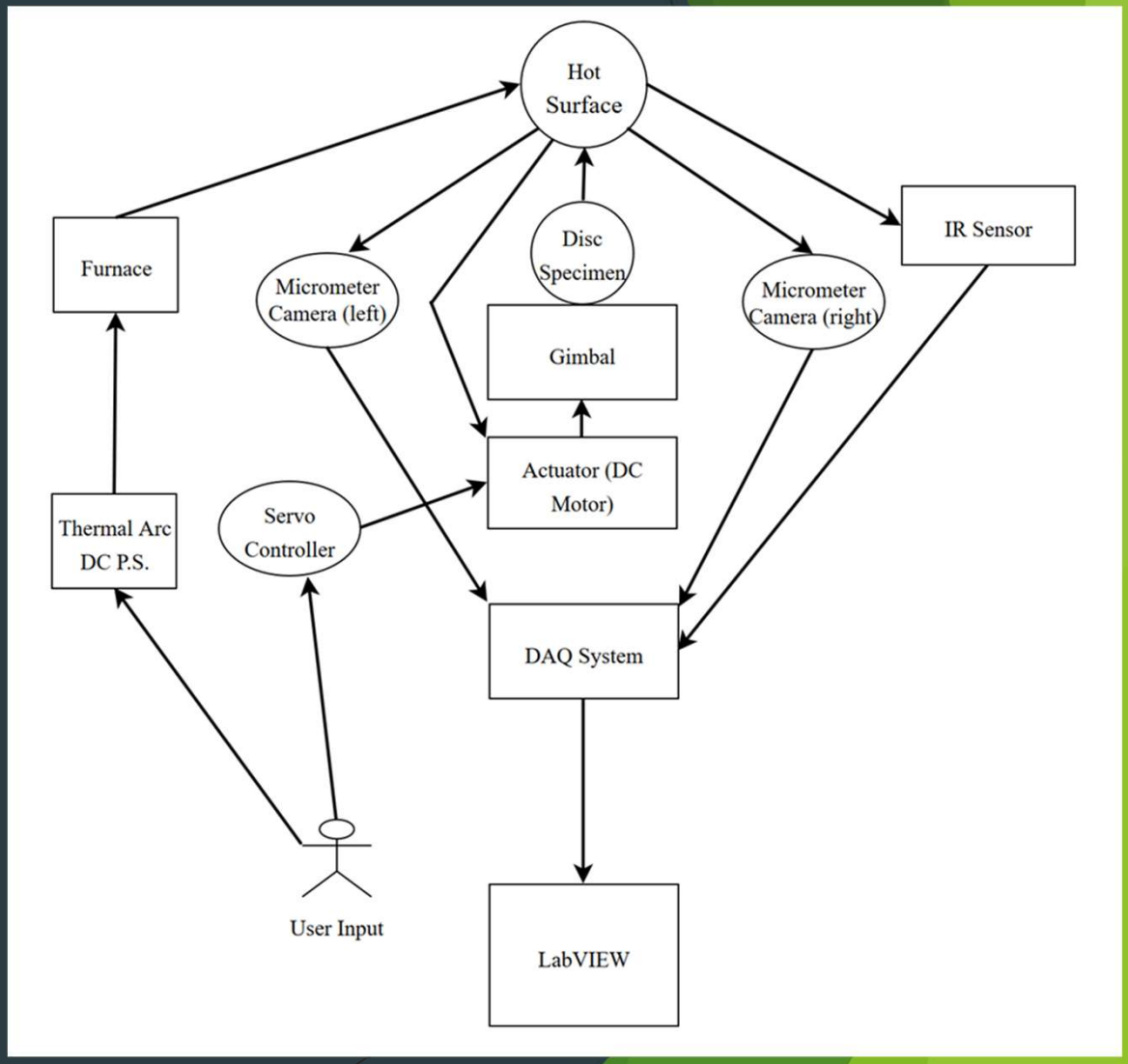
Design Steps

I. Automate control of the power supply in LabVIEW using temperature feedback system in LabVIEW

II. Add actuator control in LabVIEW

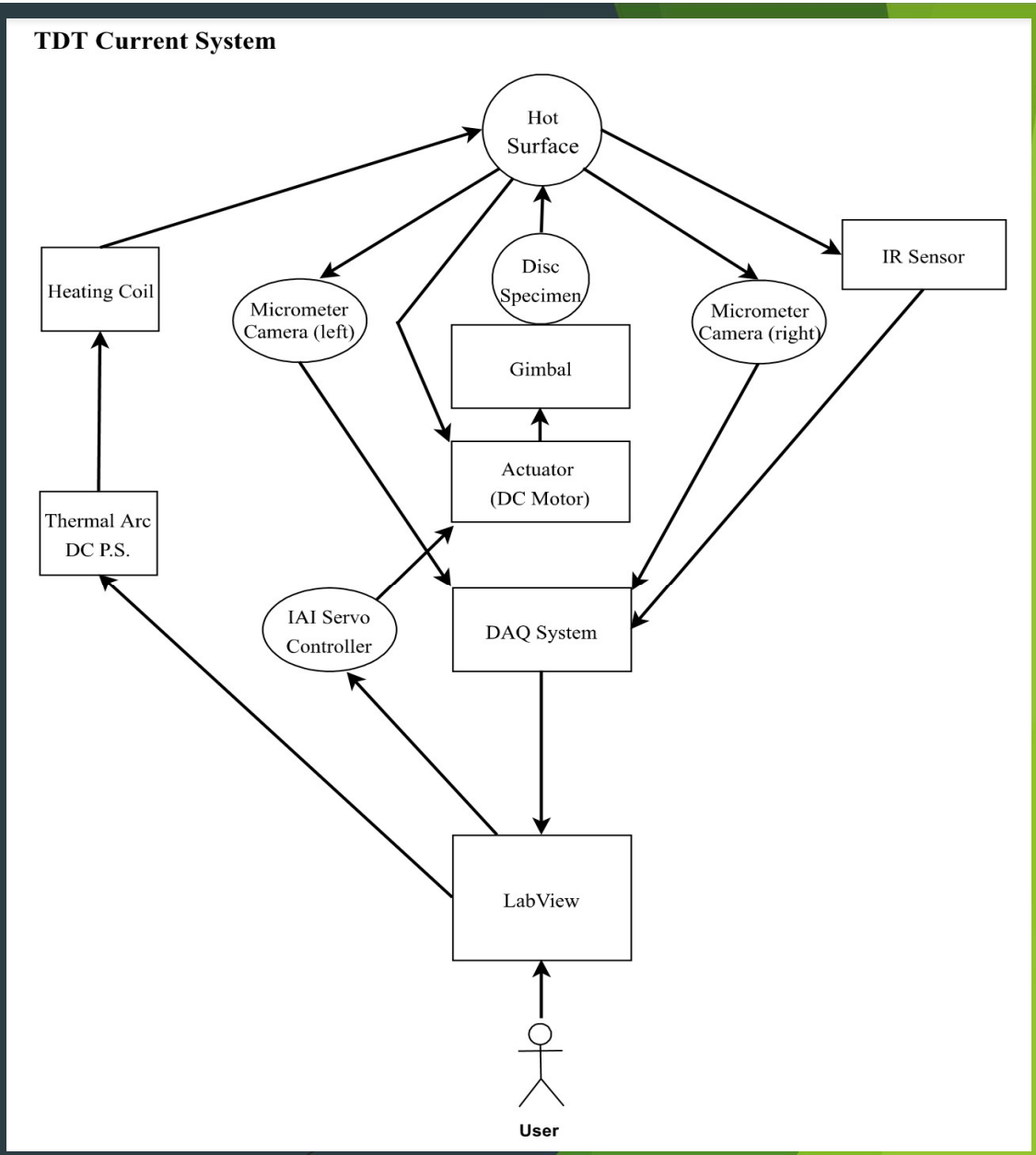
III. Improve User Interface (UI) on LabVIEW

Block Diagram of the Previous System



Block Diagram of the Improved TDT

- User can automate control of power supply and actuator during the testing process
- Real-time testing has been improved



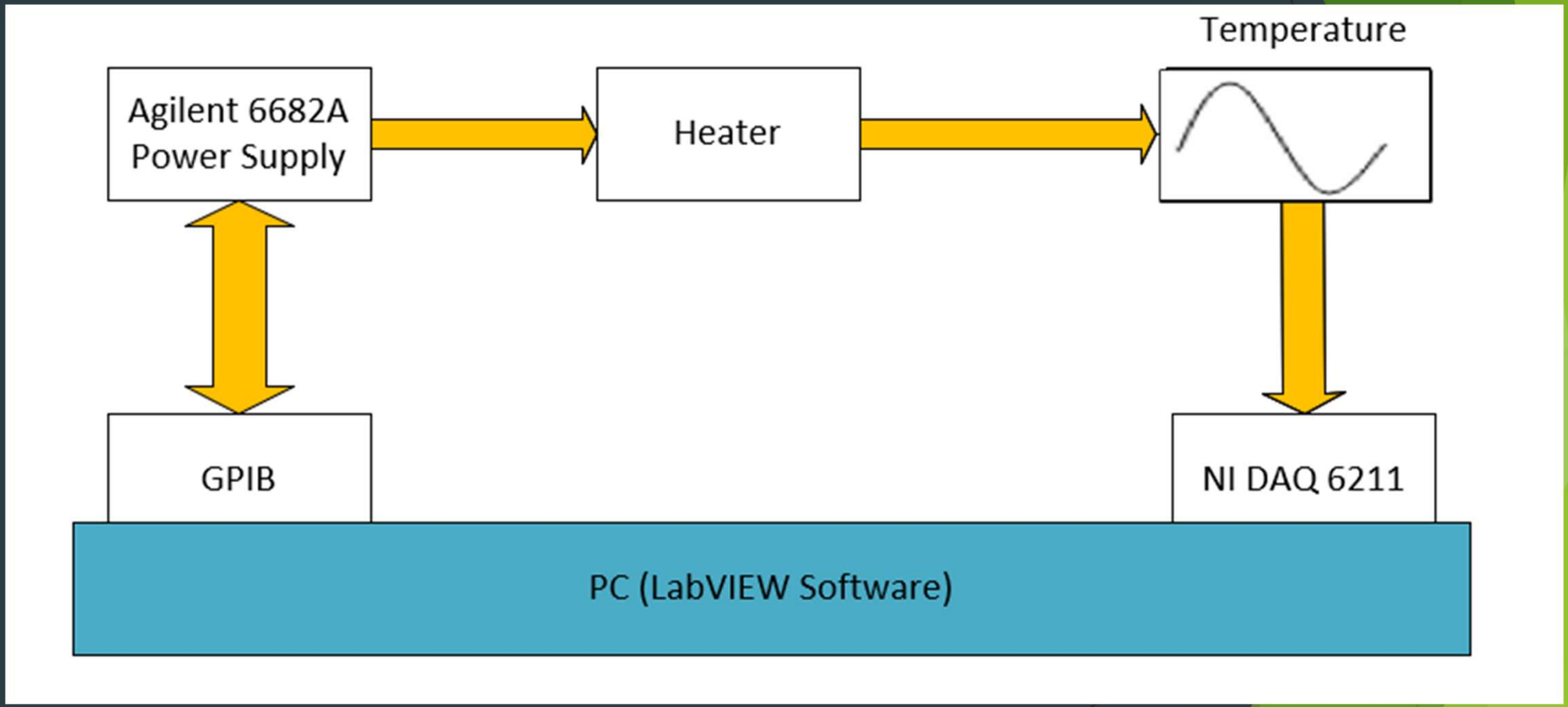
LabVIEW

- Popular control software used in industry
- LabVIEW is used for
  - Instrument control
  - Data acquisition
  - Industrial automation
- Provides a friendly user interface for testing and developing production test systems.
- Virtual Instruments (VI) are created in LabVIEW for programming

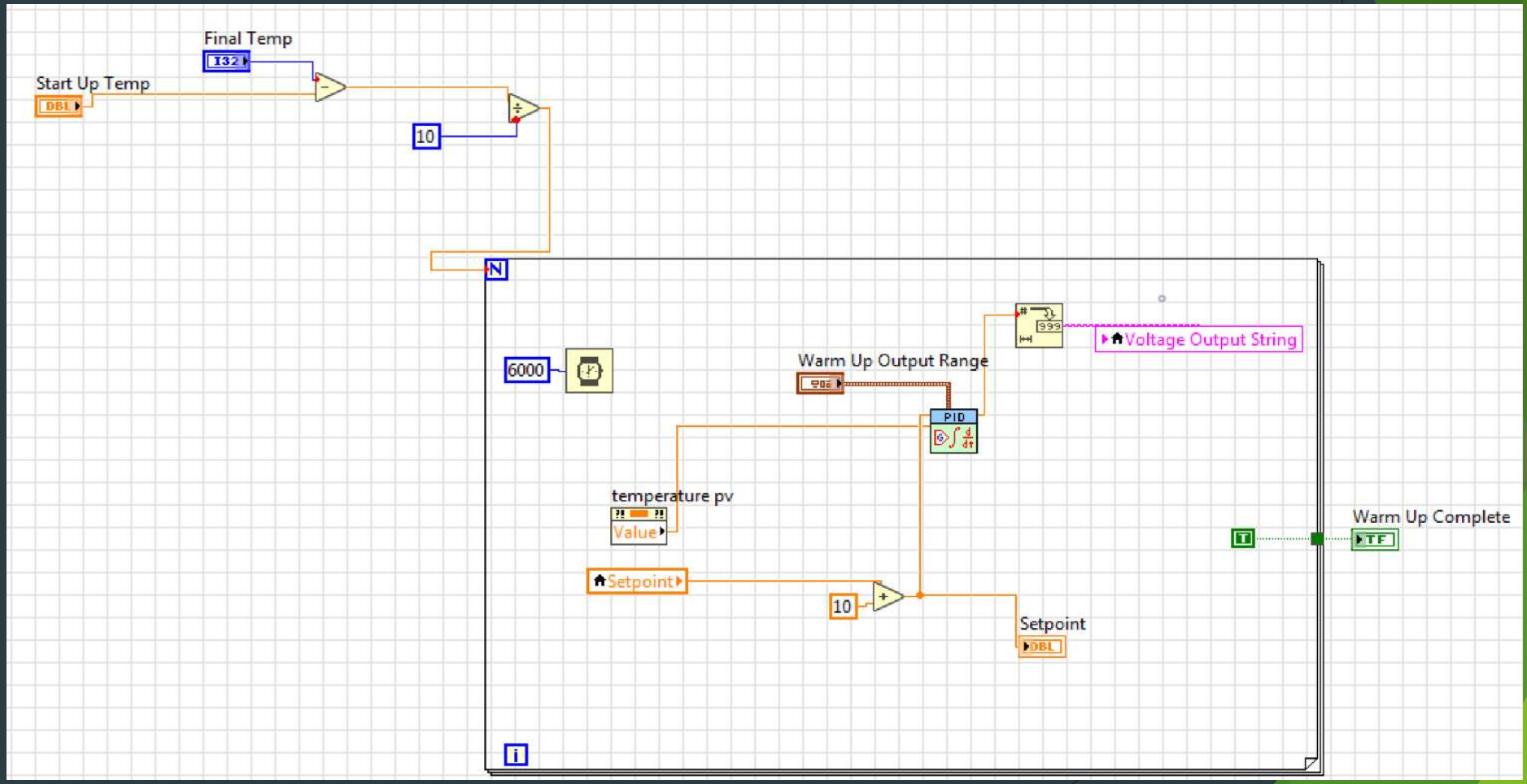
Temperature Control Feedback System

- Thermocouple measures the temperature
- Thermocouple sends data to the data acquisition device (DAQ)
- Controls power delivered to the heating element based on temperature measurements
- Uses PID control algorithm to

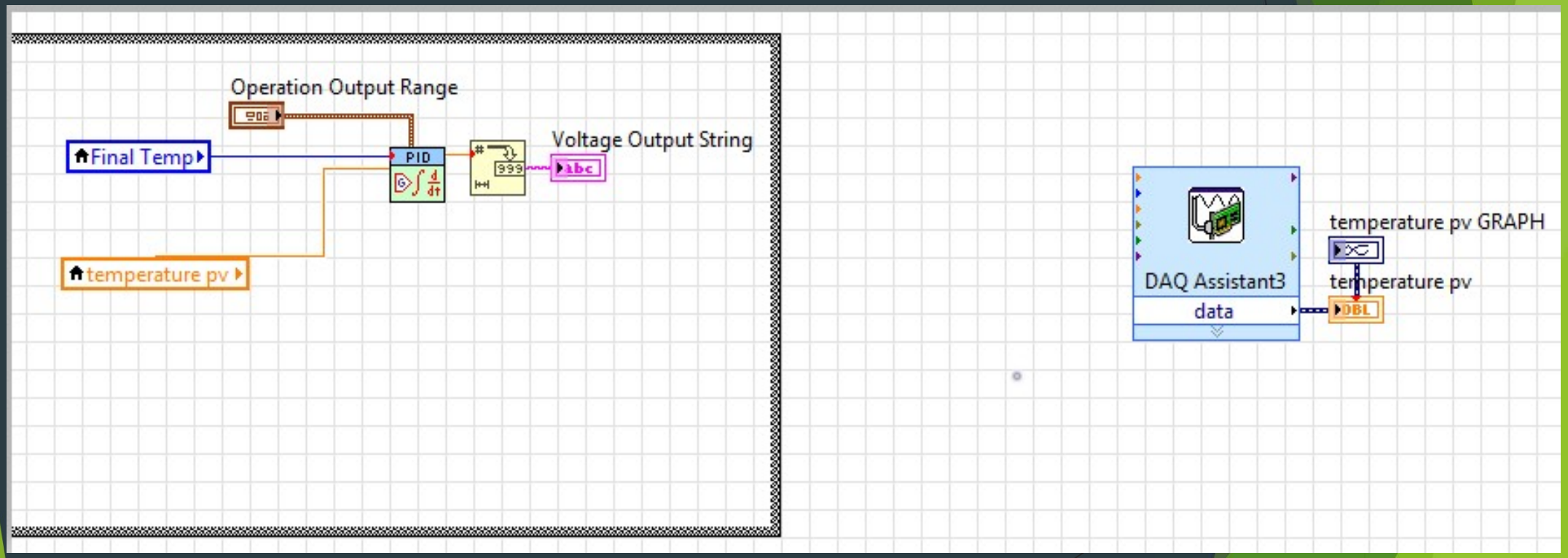
Power Supply Control



Power Supply Virtual Instrument (VI)



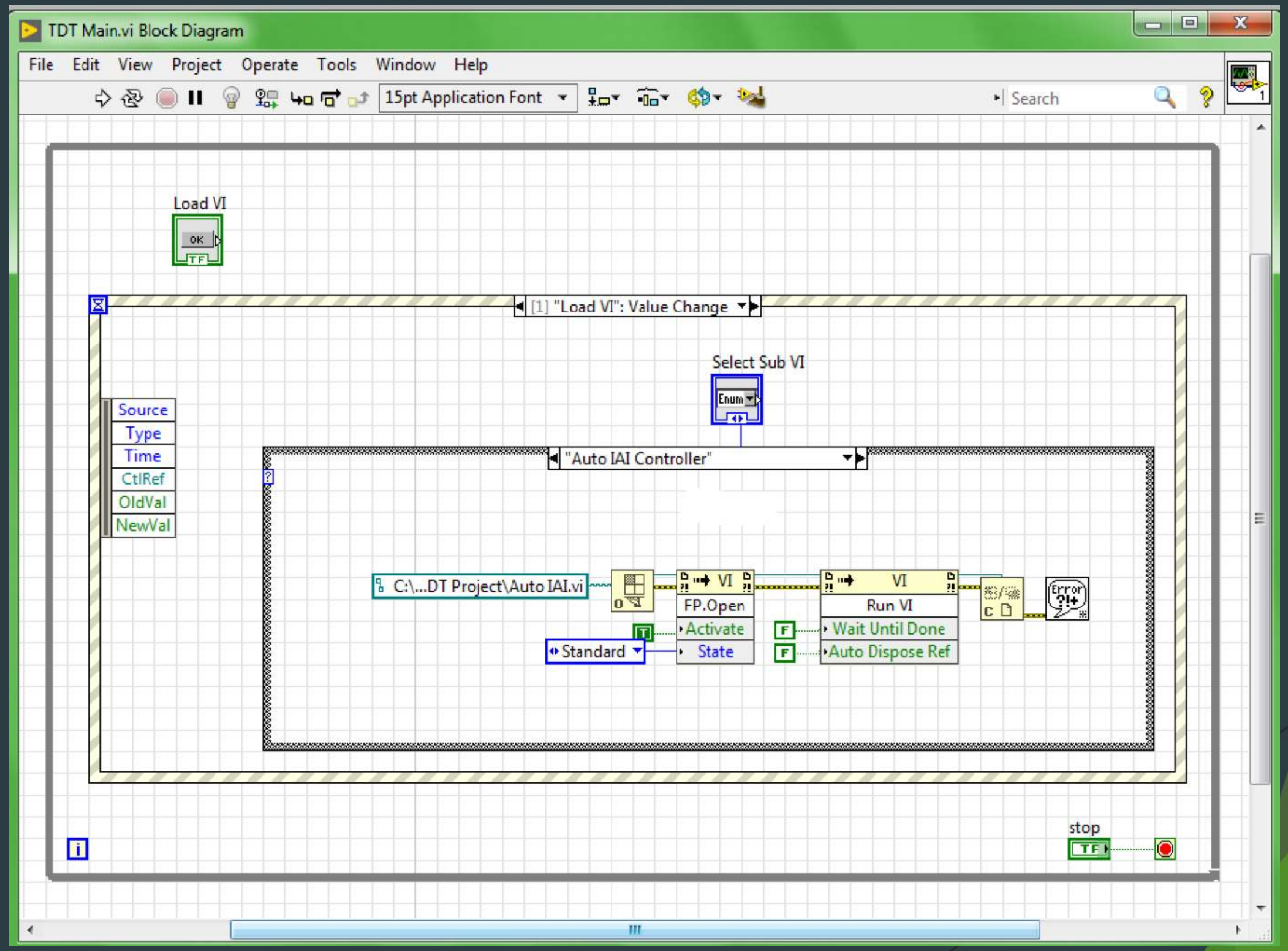
Power Supply Virtual Instrument (VI)



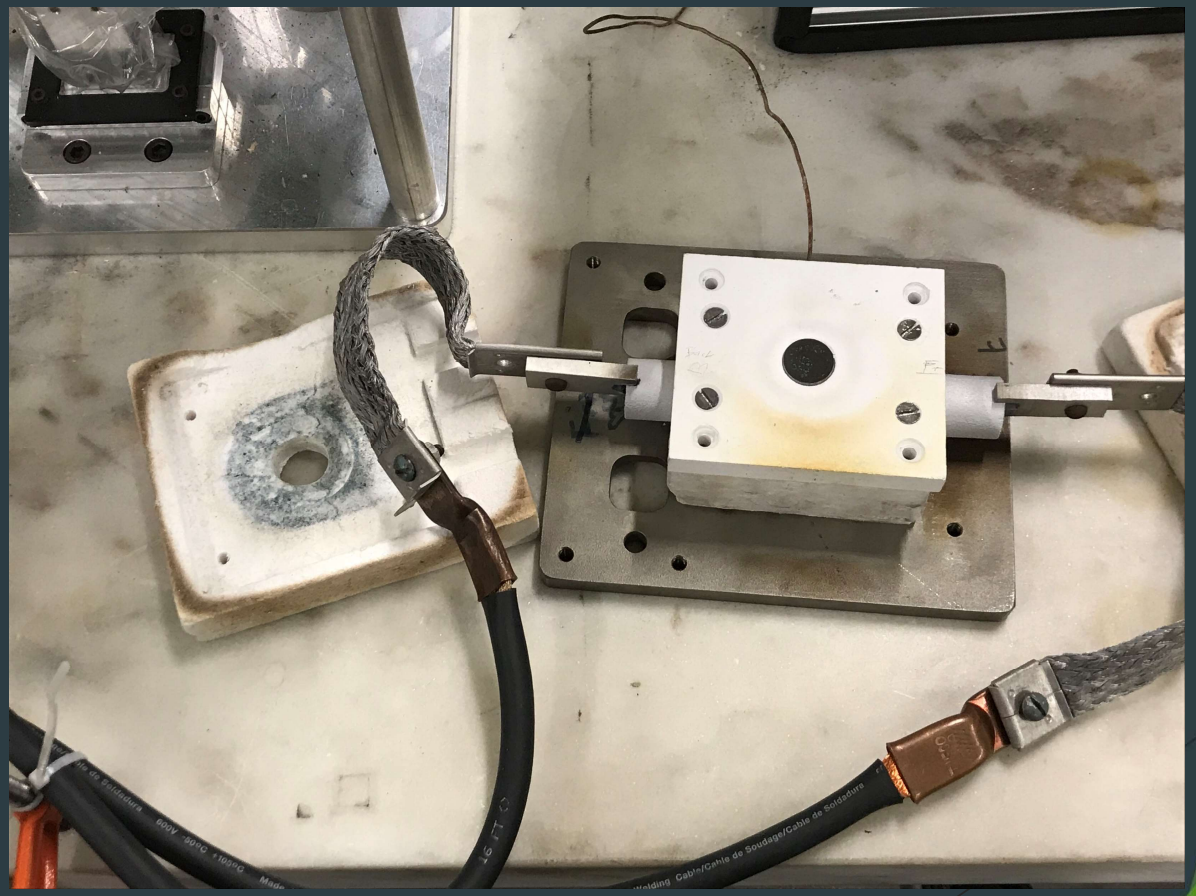
Controlling the Actuator

- Uses an IAI controller to move actuator motor
- Uses commands to turn on, reset, move up, and turn off
- Removes need of original controller

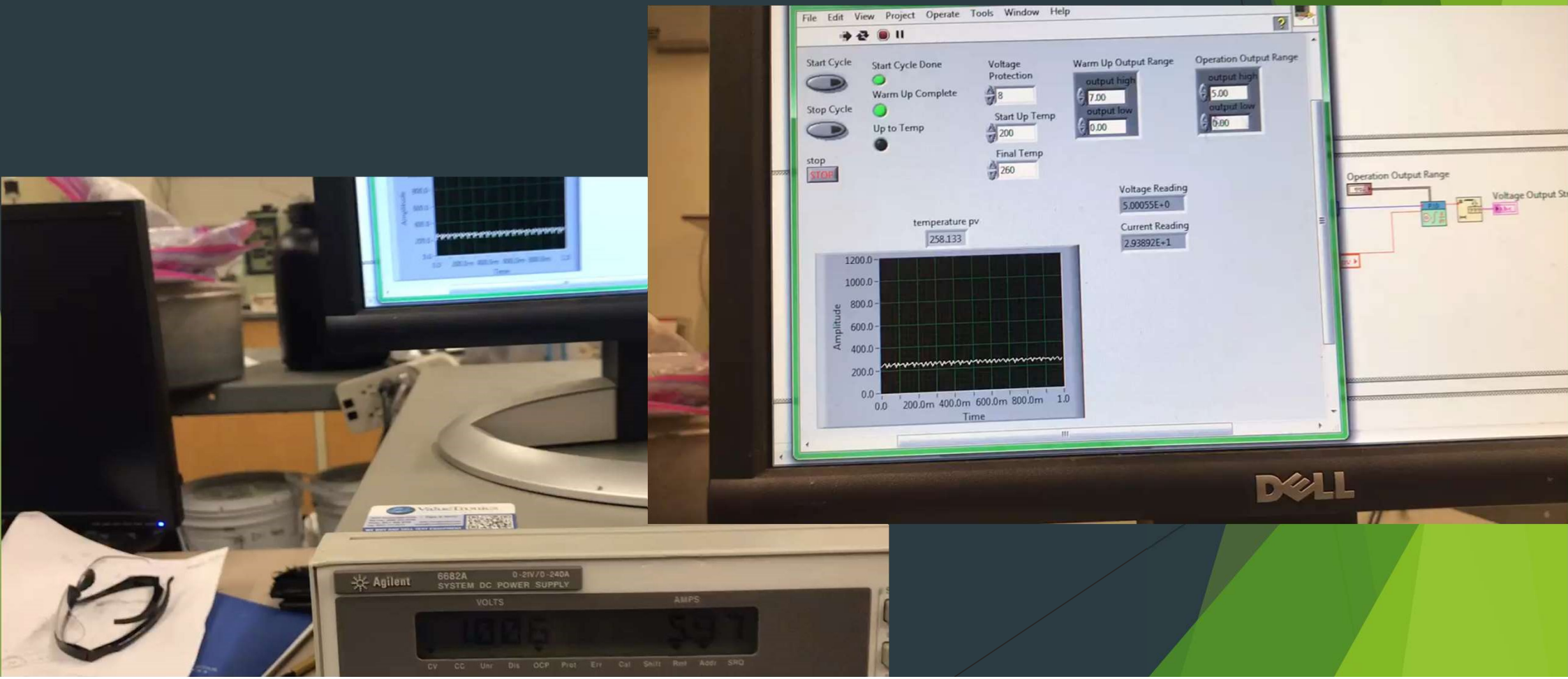
LabVIEW Main Driver VI



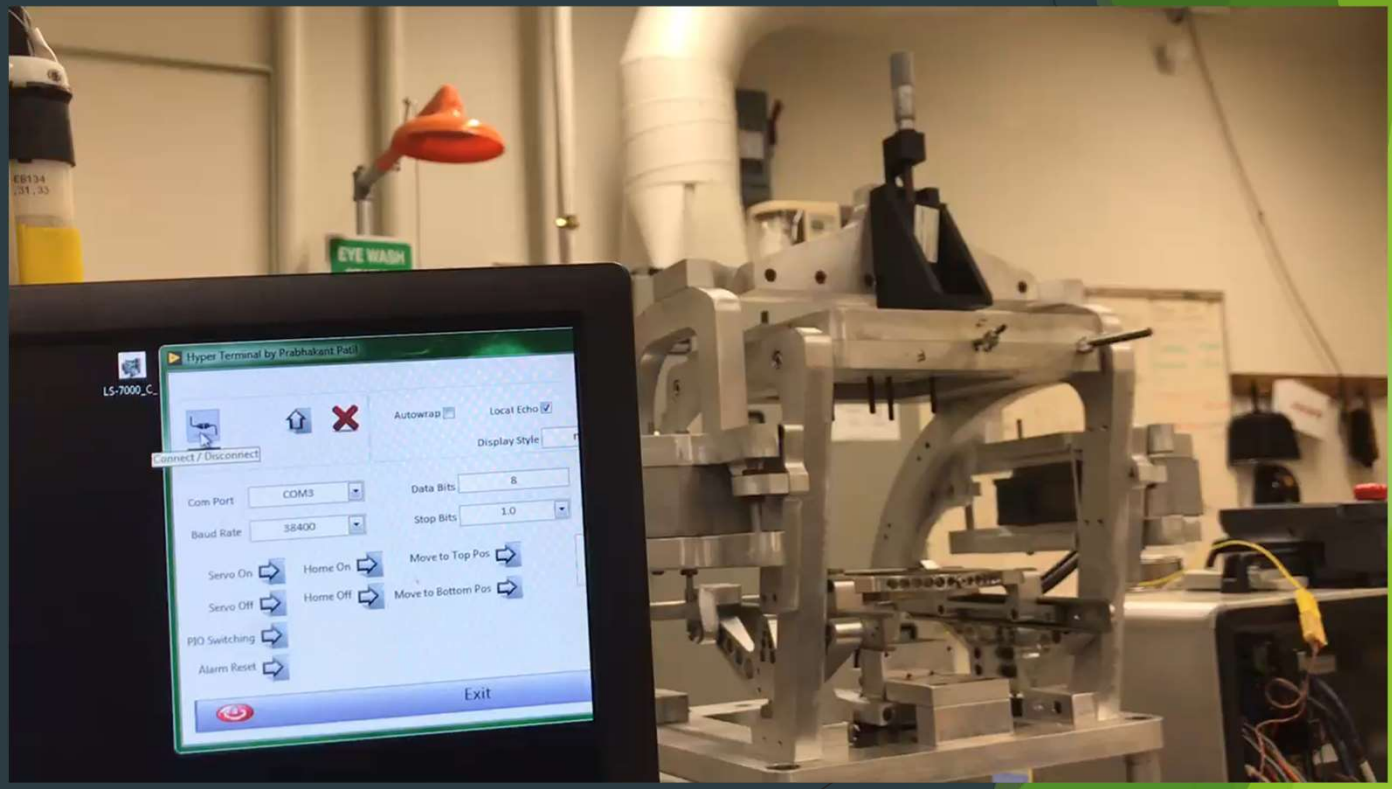
System Validation



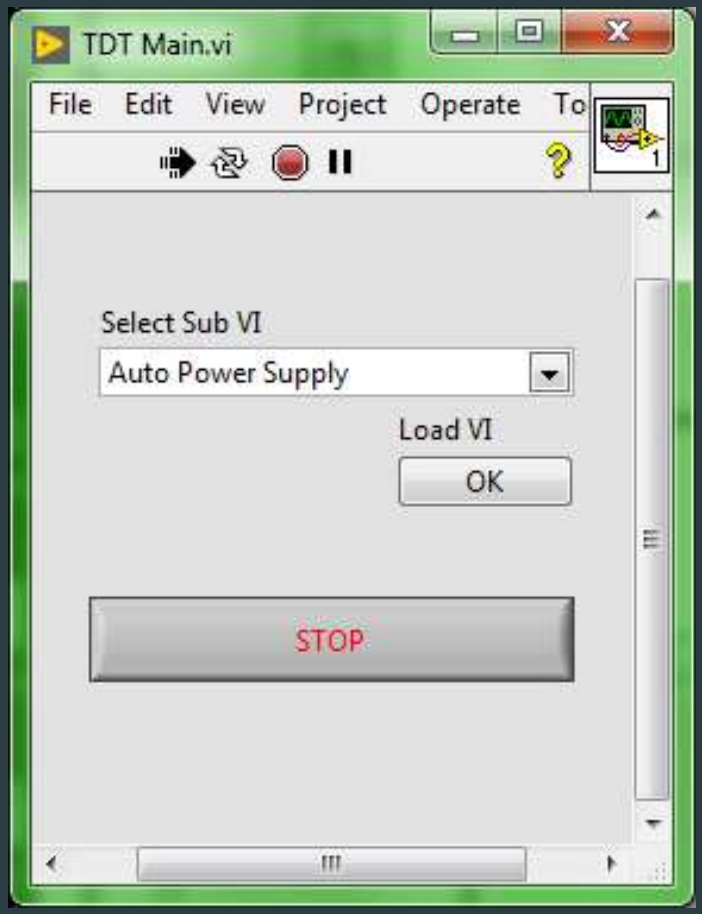
PID Loop Executing



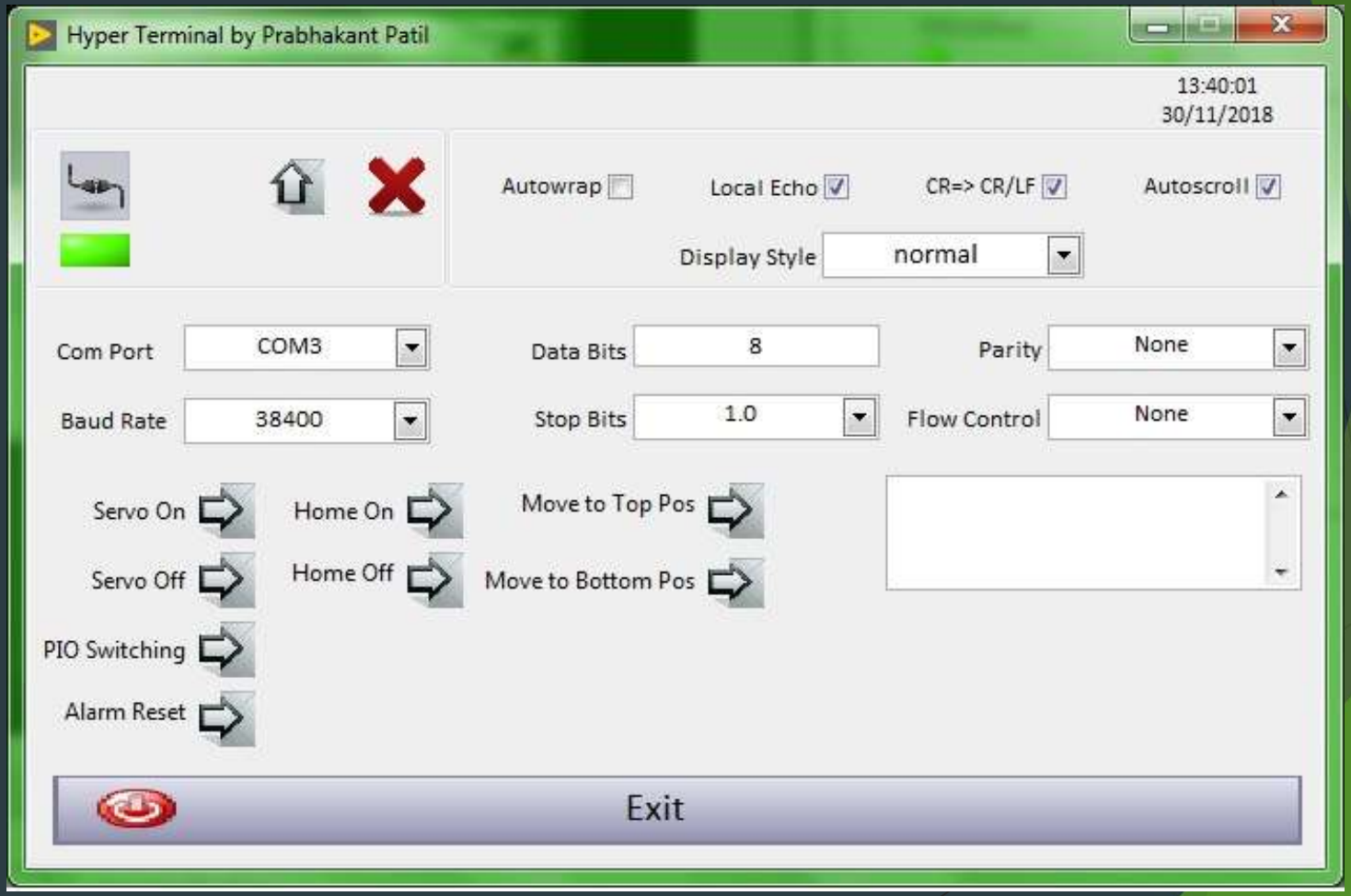
Video of Temperature Results, End of Cycle



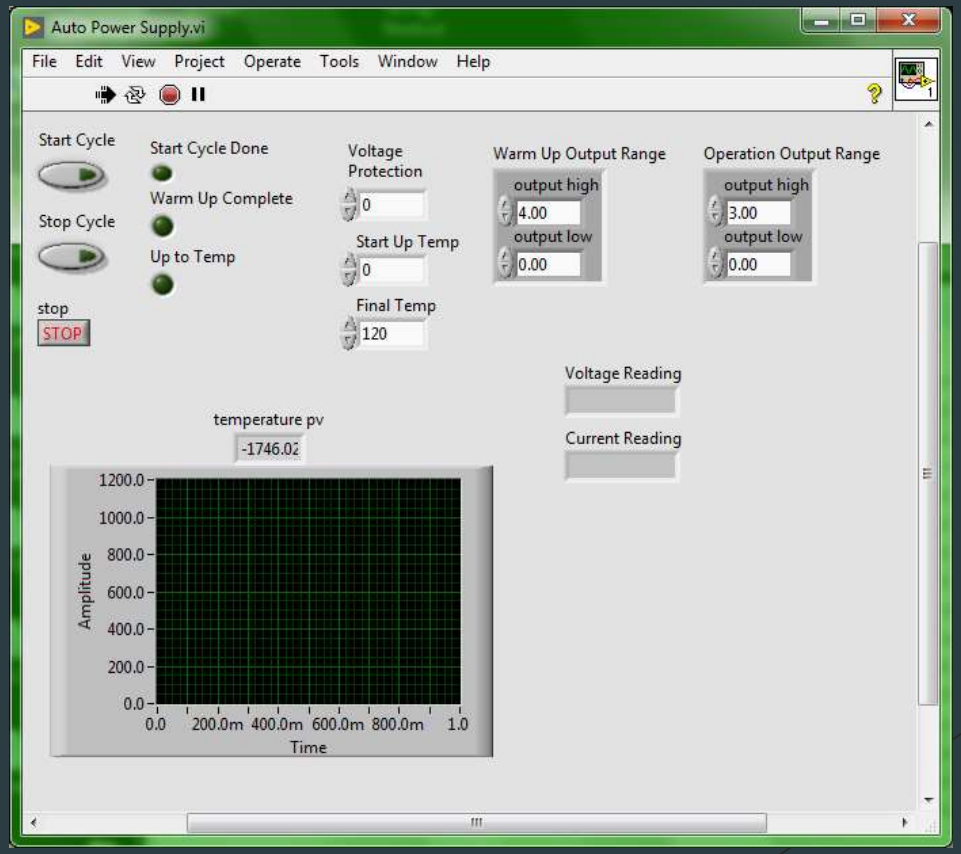
Main Thermal Distortion Tester



IAI Actuator Controls



Power Supply Controller Program



Does Design Meet Specifications?

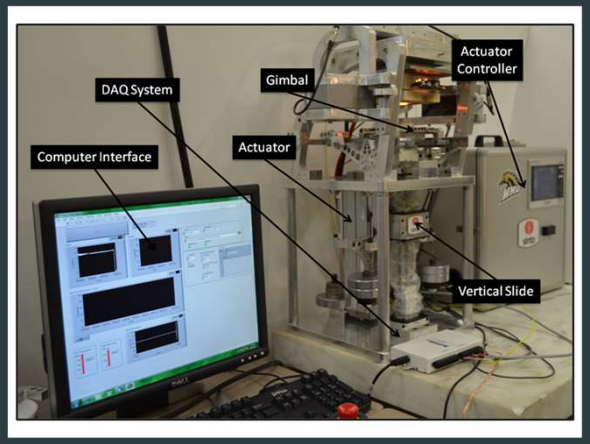
- Obtain a suitable controllable power supply (At least 5kW)
  - Agilent 6682A Power Supply
- Program a software to control temperature and integrate with the system (must reach 1200°C)
  - Communication and PID temperature control using LabVIEW
- Test the TDT (must meet specifications)
  - Actuation and temperature control

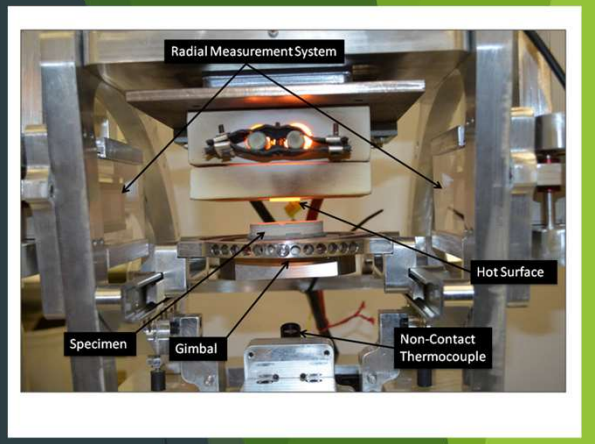
Recommendations for Further Improvements to the TDT

- Infrared Camera
- Automated cookie loading/unloading
- Digital camera snapshot

Acknowledgements

- Dr. Sam Ramrattan – Project Sponsor
- Dr. Damon Miller – Project Advisor
- Pete Thannhauser – LabVIEW Expert





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