James Deromedi
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Computer Science Capstone Project

Mentor

Jonathan Newport

Email

newport@american.edu

Office Location

DMTI 206e

Office Hours

Tuesdays:
10:30am – 12:30pm

Recommended Text

- Maximization of the Thermoelectric Cooling of a Graded Peltier Device by Analytical Heat-Equation Resolution; *E. Thiébaut*
- Cooling, Heating, Generating Power, and Recovering Waste Heat with Thermoelectric Systems; *Lon E. Bell*

Project Summary:

The objective of this embedded engineering design project is to create a system that precisely controls the temperature of a rubidium optical cell for use in quantum optics experiments. A deficiency of commercially available systems for maintaining temperature in these optical cells is that that they heat the entirety of the cell to a single temperature. This configuration allows rubidium to condense on the optical elements, impeding laser light from entering and exiting the optical cell, thereby degrading signal strength. A potential solution to this problem is to preferentially heat the optical windows and create a "cold-finger" on the sides of the cell where rubidium condensation is more likely to occur. The embedded system designed to do this will read the temperature from multiple precision thermistors, use the PID control algorithm to adjust the temperature using either a heating coil or a Peltier device (aka a TEC), and provide a user-interface for the adjustment of setpoint temperatures and PID parameters.

Project Resources:

My mentor will provide most of the required resources that are needed to complete the project. These resources include:

- Pt1000 RTDs
- Peltier TECs
- Arduino-based embedded systems
- UI resources
- Hardware for mounting TEC to Rb Cell

Project Timeline:

Date	Objective #	Deliverable
1/18		
1/25		Block Diagram
2/1	1	
2/8		Rough Schematic
2/15	2	
2/22	3	
3/1		
3/8	4	
3/15	5	
3/22		
3/29	6	Working Temperature Control Device
4/5		
4/12	8	Completed Eagle Diagram
4/19		
4/26	7	Project Complete

Project Objectives:

1. Use the Honeywell 700-102BAA-B00 Class A Pt1000 RTD and a MAX31865 RTD amplifier connected to an embedded system to measure and report the temperature
2. Design a high-current bi-polarity current source to drive a Thermoelectric heat pump (TEC).
3. Use an embedded microcontroller's digital to analog converter to control the TEC.
4. Implement and tune a PID industrial control algorithm to maintain a temperature setpoint.
5. Design and implement a user interface to adjust the temperature setpoint, and optionally the PID control parameters.
6. Add a second identical temperature-control channel.
7. Test and tune with low pressure rubidium optical cell.
8. Design a custom printed circuit board that includes all above functionality.