Temperature Project

Lab: Section K

Masahiro Inano

Christopher Casey

Adam Tigue

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Description:

For our project a container of instant tomato soup was microwaved according to the given instructions. Immediately after removal from the microwave, the thermocouple was placed in the soup to measure its temperature and it was allowed to cool. The temperature was collected every ten seconds for approximately fifteen minutes. After collecting and analyzing the data we were able to establish an average rate of cooling.

Transducer:

We choose to use type T thermocouples to conduct our project. They were chosen because they are able to measure temperatures ranging from -200 to 350 degrees Celsius. The temperatures we will be measuring are well within this range. Also, the limits of error of the type T thermocouple of one degree or .75% will have little impact on our results.

Results:

The circuit shown in Figure 1 was constructed on the solderless breadboard. A photo of the complete circuit can be seen in Figure 2. The long thermocouple was used for the measurement TC and the short one was used for the ice point. Using the program of LabVIEW, the amplifier was calibrated as adjusting R1 and R2 of the potentiometers. To calibrate the amplifier, both TC were placed in the ice bath, and R1 was adjusted for a reading of 0 volts. The measuring TC was placed in the pot of boiling water, and R2 was adjusted for a reading of 0.5 Volts.

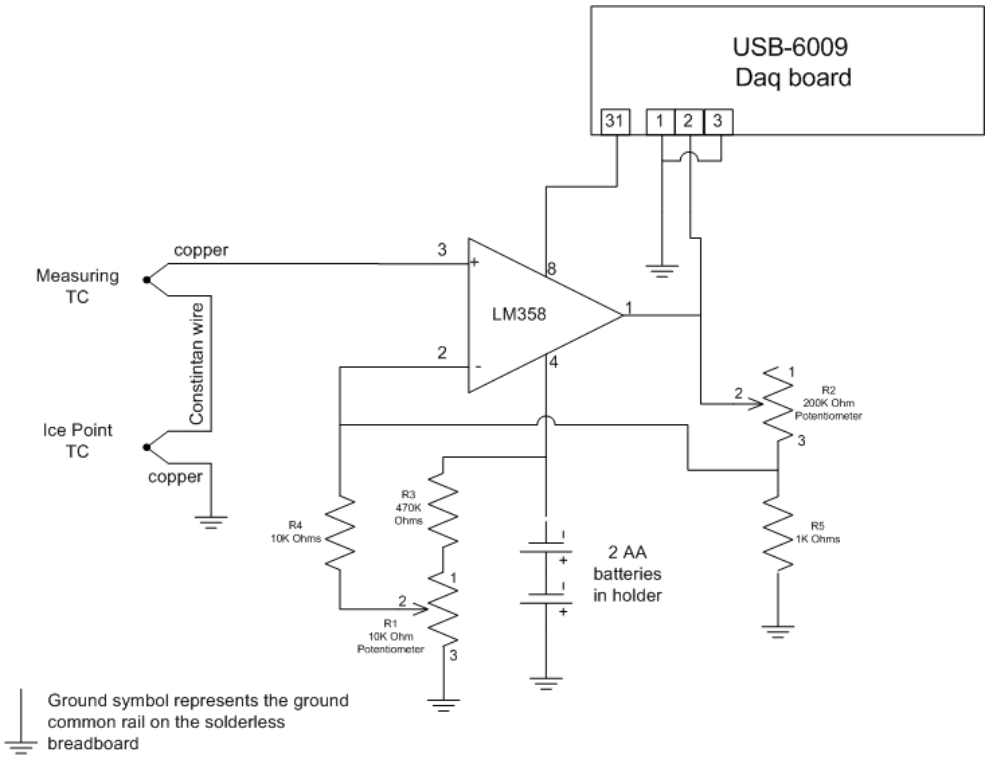


Figure 1: Circuit with USB-6009

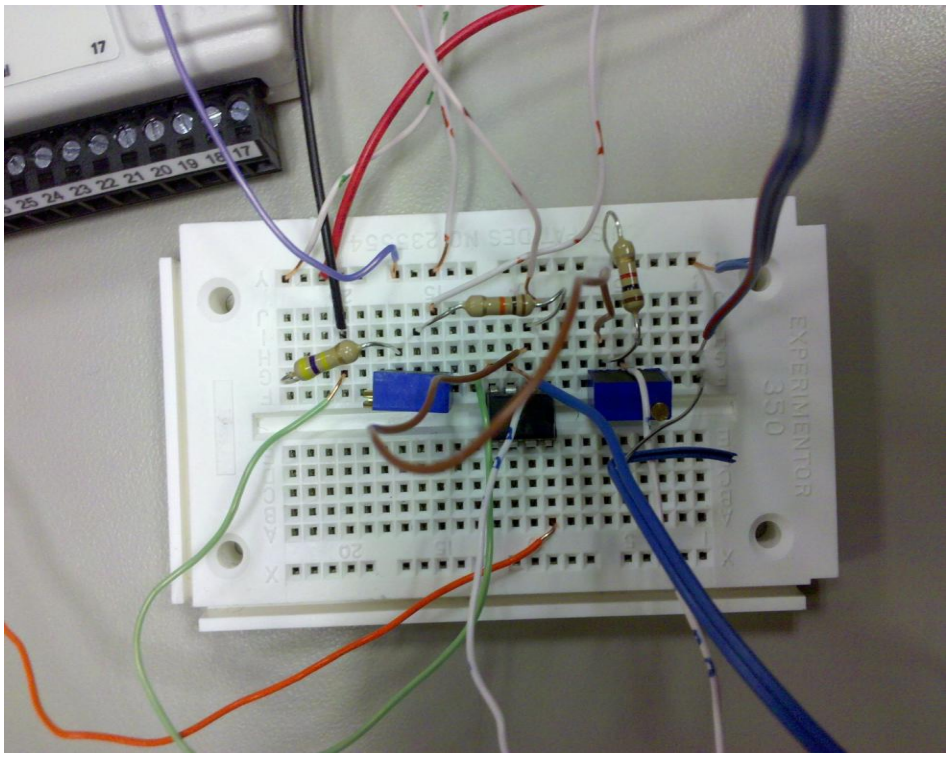
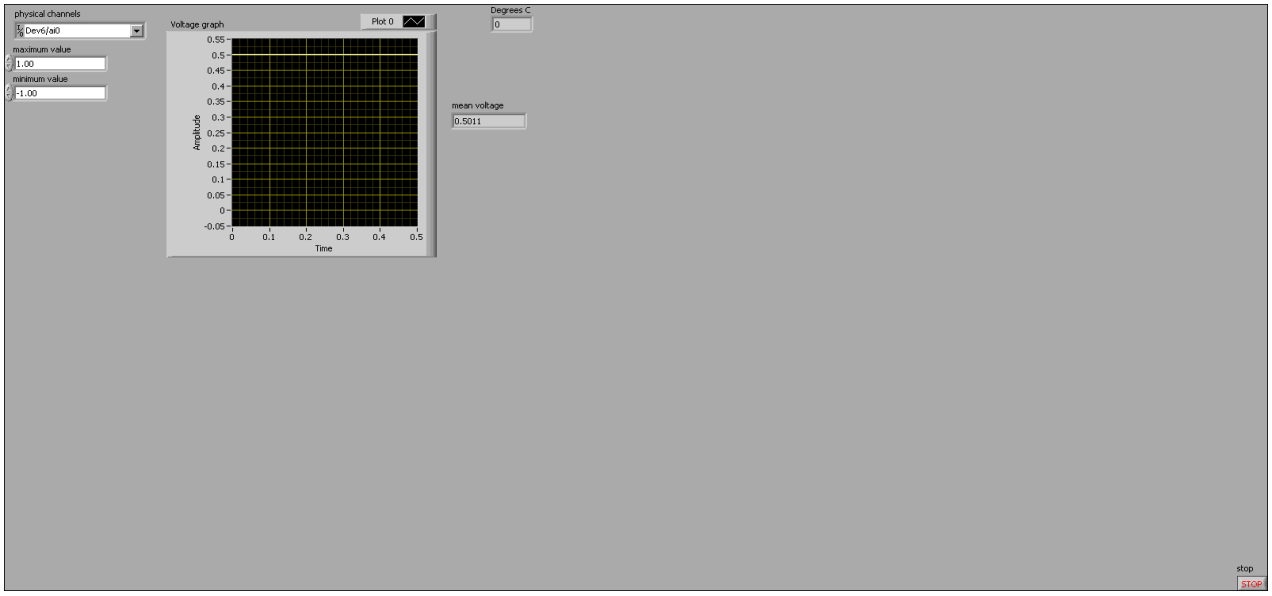
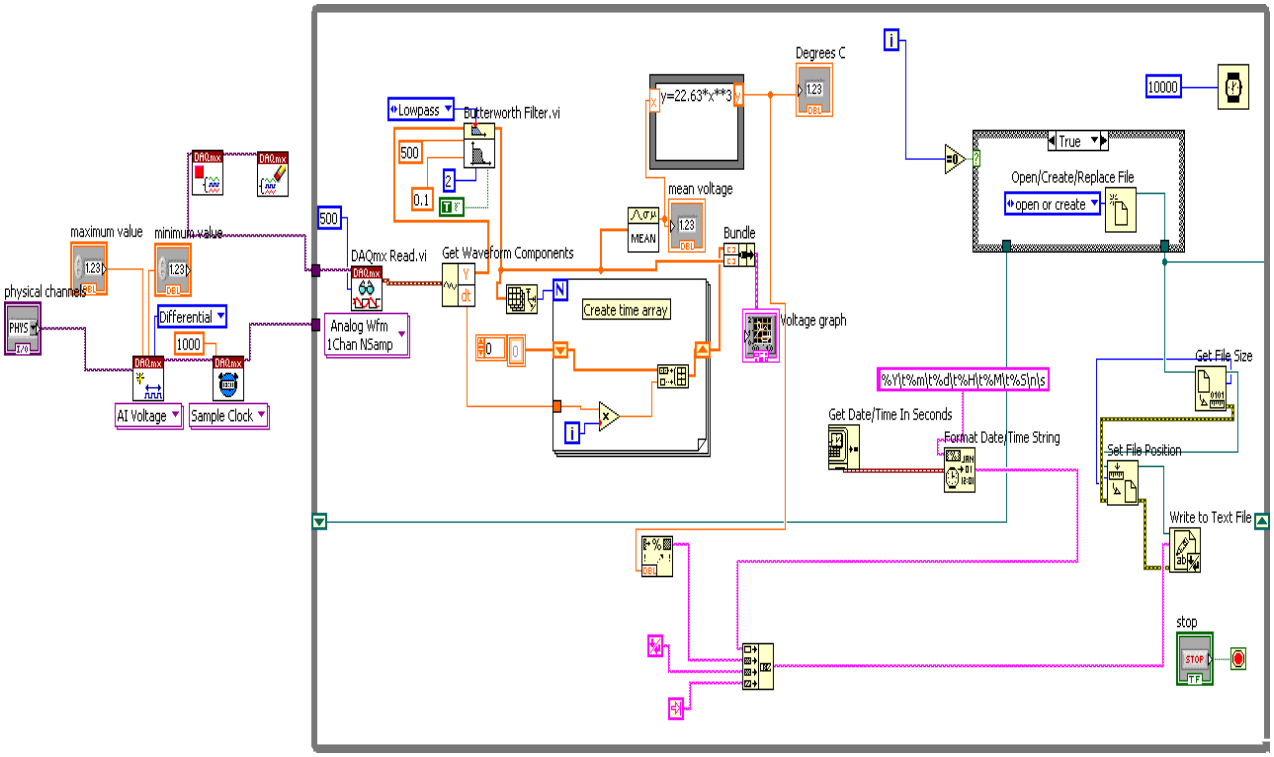
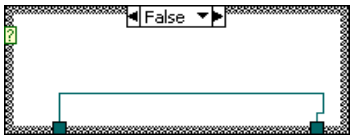


Figure 2 – Photo of completed circuit

The program of LabVIEW was created to display the mean value of temperature in degrees Celsius and create a file and save each sample collected at a 10 second interval. This program can be seen in Figure 3. To accomplish this we used a formula node and entered in the formula y = 22.63x^3 - 55.706x^2 + 221.97x + 0.0184. Within the formula node we specified the input to be the "x" value and the output to be "y". Out of the formula node we wired an indicator to display the temperature on the front panel.







DAQmx Timing.vi

C:\Program Files\National Instruments\LabVIEW 2009\vi.lib\DAQmx\configure\timing.llb\DAQmx Timing.vi

DAQmx Timing (Sample Clock).vi

C:\Program Files\National Instruments\LabVIEW 2009\vi.lib\DAQmx\configure\timing.llb\DAQmx Timing (Sample Clock).vi

DAQmx Create Virtual Channel.vi

C:\Program Files\National Instruments\LabVIEW 2009\vi.lib\DAQmx\create\channels.llb\DAQmx Create Virtual Channel.vi

DAQmx Create Channel (AI-Voltage-Basic).vi

C:\Program Files\National Instruments\LabVIEW 2009\vi.lib\DAQmx\create\channels.llb\DAQmx Create Channel (AI-Voltage-Basic).vi

NI_AALBase.lvlib:Mean.vi

C:\Program Files\National Instruments\LabVIEW 2009\vi.lib\Analysis\baseanly.llb\Mean.vi

NI_AALBase.lvlib:Butterworth Filter.vi

C:\Program Files\National Instruments\LabVIEW 2009\vi.lib\Analysis\3filter.llb\Butterworth Filter.vi

NI_AALBase.lvlib:Butterworth Filter (DBL).vi

C:\Program Files\National Instruments\LabVIEW 2009\vi.lib\Analysis\3filter.llb\Butterworth Filter (DBL).vi

DAQmx Read.vi

C:\Program Files\National Instruments\LabVIEW 2009\vi.lib\DAQmx\read.llb\DAQmx Read.vi

DAQmx Read (Analog Wfm 1Chan NSamp).vi

C:\Program Files\National Instruments\LabVIEW 2009\vi.lib\DAQmx\read.llb\DAQmx Read (Analog Wfm 1Chan NSamp).vi

DAQmx Stop Task.vi

C:\Program Files\National Instruments\LabVIEW 2009\vi.lib\DAQmx\configure\task.llb\DAQmx Stop Task.vi

DAQmx Clear Task.vi

C:\Program Files\National Instruments\LabVIEW 2009\vi.lib\DAQmx\configure\task.llb\DAQmx Clear Task.vi

Figure 3: VI document of LabVIEW

Data shown in Figure 5 was collected while a plastic contaner of hot tomato soup was placed at the room temperature of about 20 degree C and it was getting cooler. The temperature of the tomato soup was recorded for 870 seconds. During this data collection, the reference TC was kept in the ice bath to ensure accurate results, and the measuring TC was in the cup of soup. Plotted in Figure 4, all the collected data is plotted in a temperature vs. time graph. The temperature decrease is almost linear. According to the plot, the slope of this trendline was determined to be -0.0157. It can be seen that the temperature of soup was decreased by 0.942 degree C per min.

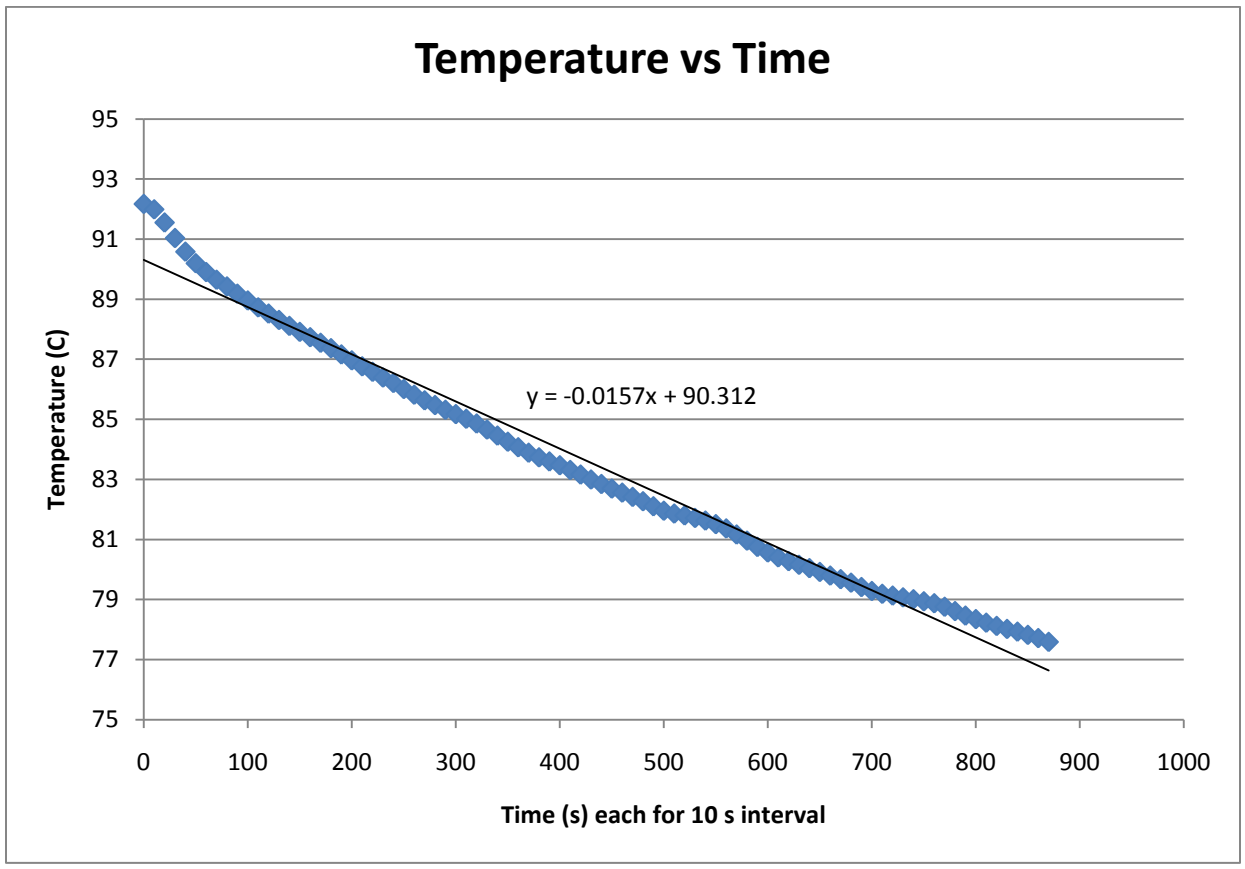


Figure 4 – Data Plot, Temp Vs. Time

92.16898						
	2010	5	5	17	54	59
91.98816						
	2010	5	5	17	55	9
91.54953						
	2010	5	5	17	55	19
91.03334						
	2010	5	5	17	55	29
90.57731						
	2010	5	5	17	55	39
90.19253						
	2010	5	5	17	55	49
89.89836						
	2010	5	5	17	55	59
89.64213						
	2010	5	5	17	56	9
89.42006						
	2010	5	5	17	56	19
89.17795						
	2010	5	5	17	56	29
88.95237						
	2010	5	5	17	56	39

Figure 5 – One page sample of Collected Data