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Date	05/01/2010	Lab	G	Group	1
Exp Title	Grilled Chicken Project				

The purpose of this project was to help the students to show what they learned in the course throughout the semester. The students were to create a hands on project that would use a transducer to measure and record data. The main focus of this project was to determine if a grilled chicken breast would reach 70 degrees Celsius quicker or slower after reheating it several times.

Our project consisted of using grilled chicken breast fillets bought from Walmart and cooking them on a stove. One chicken breast was selected and used throughout the whole experiment. Thermocouples were selected to be the transducer to read the temperature of the chicken. This was selected because it was the most convenient and accurate transducer that was available to us. Also, they are simple to use and can be easily used with the breadboard and Labview.

To start off the experiment the circuit was created. The circuit created was the same circuit used in the Home TC experiment. Using the required items from the parts kit, such as resistors, wires, and thermocouples (TC), the required circuit was constructed. All of the ground wires were connected to one rail of the solderless board. The wires were cut down to a small but appropriate size to help reduce the amount of noise.

The next step of the project was to set up the amplifier using the a Labview code. The code was created to show the voltage and temperature of the system. Part of this code was taken from the snippets in the Home tc experiment. A lowpass filter was set to .1 in the program to help minimize the extra noise. The code was also set up to save the data automatically to a file. The ice point TC was placed in an ice bath while the measurement TC was left in the air. To test everything so far, the measurement TC was dipped in the ice bath and then warmed by placing it in our hand. The voltage decreased to about zero when placed in the ice bath and increased when placed in our hand. Once this was working both TC's were placed in the ice bath and resistor 1 was adjusted to zero volts. Then the measurement TC was placed in a pot of boiling water and resistor 2 was adjusted to 0.5 volts. This took multiple times to get it to set up correctly. This program helped reduce of some of the unwanted noise created in the circuit. The code was modified to display the mean value in degrees Centigrade in addition to the voltage. The formula  $y = 22.63x^3 - 55.706x^2 + 221.97x + 0.0184$ , where y is the temperature out and x is the volts in, was used to do this.

The first thermocouple was place in the ice bath and the other thermocouple was placed inside the chicken breast. The program was started and the chicken breast was place in a pot and the stove top was turned on. Once this started the stopwatch also started.

The program written in Labview recorded the temperature as the time passed. Once the chicken breast reached 70 degrees Celsius the program was stopped along with the stopwatch. The chicken was then placed back in the freezer for about an thirty minutes and then thawed for about thirty minutes. This was to melt any ice that was in the chicken. If the ice would have been left in the chicken, there would have been a phase change and the graph of Temperature vs. Time would not have been linear. This was also done to maintain a constant starting temperature of the chicken as well as the stove and pots. The experiment was repeated five times to ensure that enough data was collected to make educated assumptions.

The temperatures for every 7 seconds of recorded and graphed. This gave an even spread for the data so the graph would show the general temperature change. The graph of the temperature change over time is shown in Appendix A in Figure 1 through Figure 5. These graphs are linear and show a constant rise in temperature. Each time took about seven minutes and forty seconds to complete. The starting temperature of the chicken breast varied between seven to nine degrees Celsius. A condensed version of the data is also attached in Appendix B.

The results of this project show that no matter how many times you cook this certain type of chicken breast, the time to get to a certain temperature does not vary much. A chicken breast of this size will take a little more than seven and a half minutes to reach 75 degrees Celsius. This is the average temperature for chicken to be cooked to. It would be recommended to do this experiment with multiples of different types of chicken. Using just one piece of chicken and not doing this experiment again, due to time constraints, could have shown us just part of the reaction to re-cooking.

The thermocouples were the correct transducers to use. They were very accurate and gave us the data we were seeking. They proved to be the appropriate measuring device by providing an electronic read out of the temperature. One problem with the thermocouples was that they had to be calibrated perfectly or you would get incorrect values. All the error calculations are shown in Appendix C. The theoretical slope was calculated to be the average slope which was .13878. The maximum error was calculated to be 2.2914% for trial 5 and the minimum was trial 1 with an error of .375694%. This shows that the thermocouples had very good precision and accuracy. If this experiment was done with more trials, it would be expected that it would maintain its accuracy with little error.

This project showed our understanding of the breadboard and Labview. We found that the chicken breast would reach 70 degrees Celsius approximately the same each time that it was cooked. We also learned that even though the liquid in the chicken breast was mostly evaporated it had minimal effects. The calibrations of the potentiometers were difficult and took many iterations over a very long time. This was most likely the main cause of the error in the project. The project was a fun way to learn how to use the potentiometers as well as the DAQ equipment.

We encountered some issues while working out this project. One was trying to get the chicken breast to be at a constant starting temperature. Also, the set up and calibration of the circuit took a lot of time and trials. After all the first attempts and fixing of any more minor issues, everything went smoothly. Overall, the project was difficult enough to help refresh and sharpen our skills on using Labview and the breadboard.

Appendix A

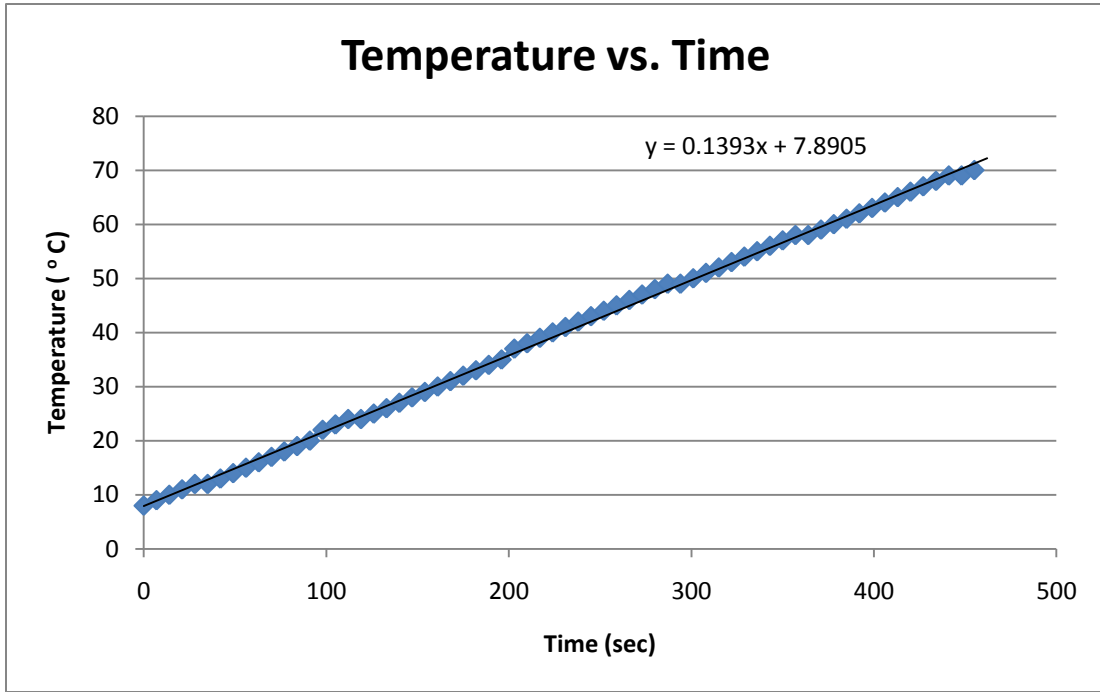


Figure 1: *Temperature vs. Time* graph for Trial 1

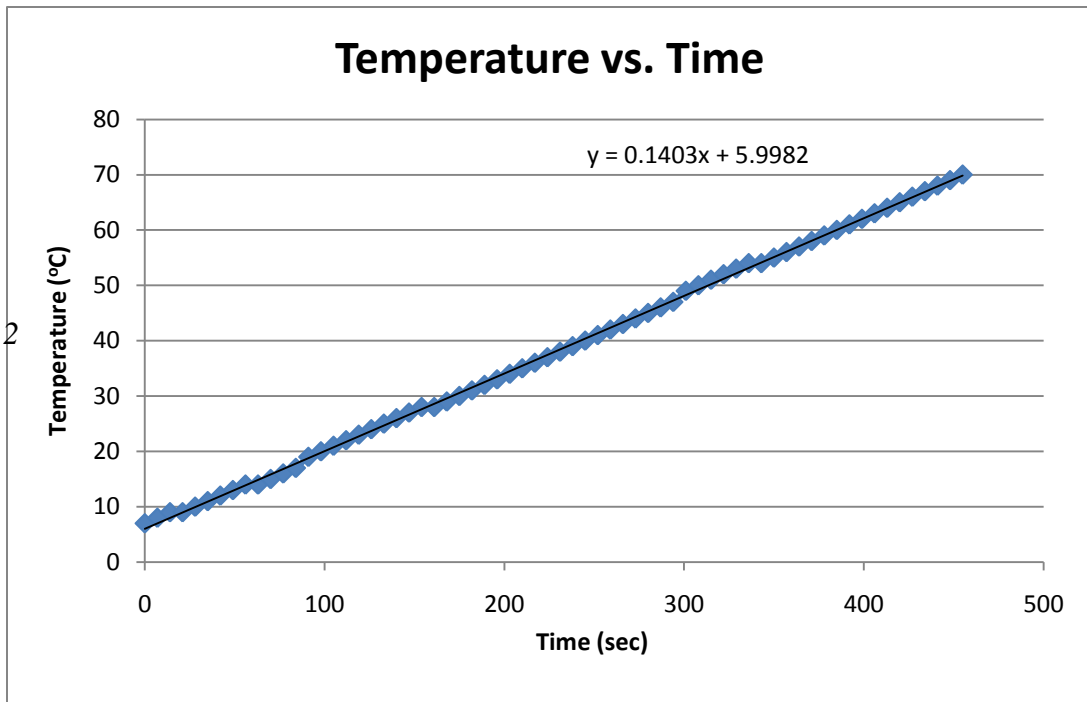
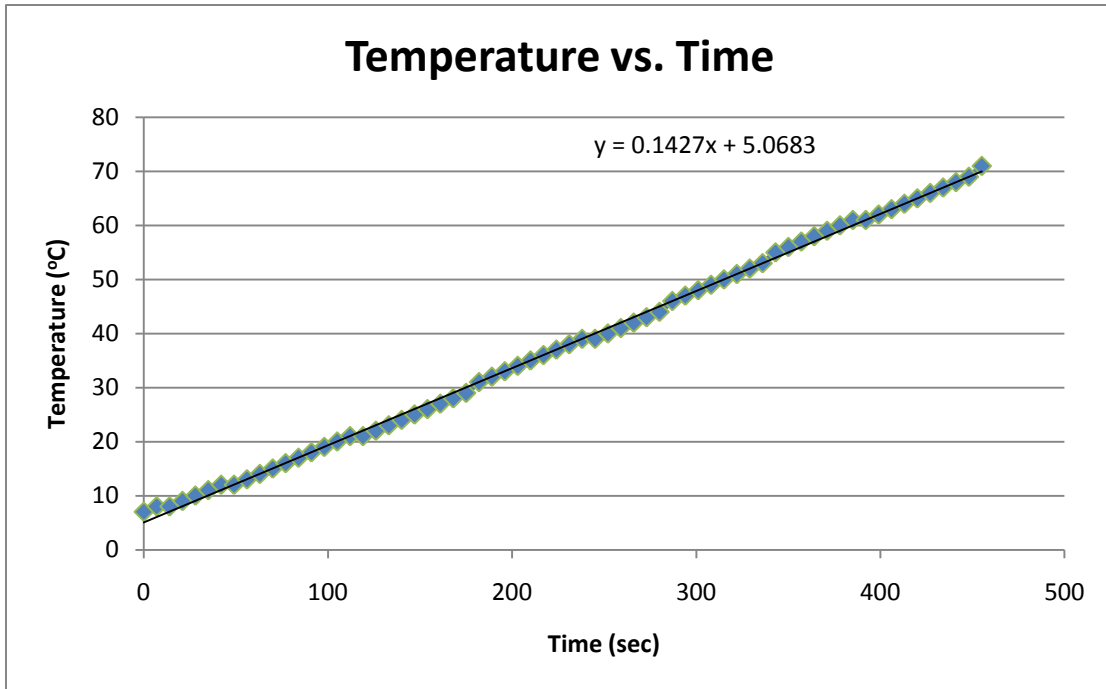


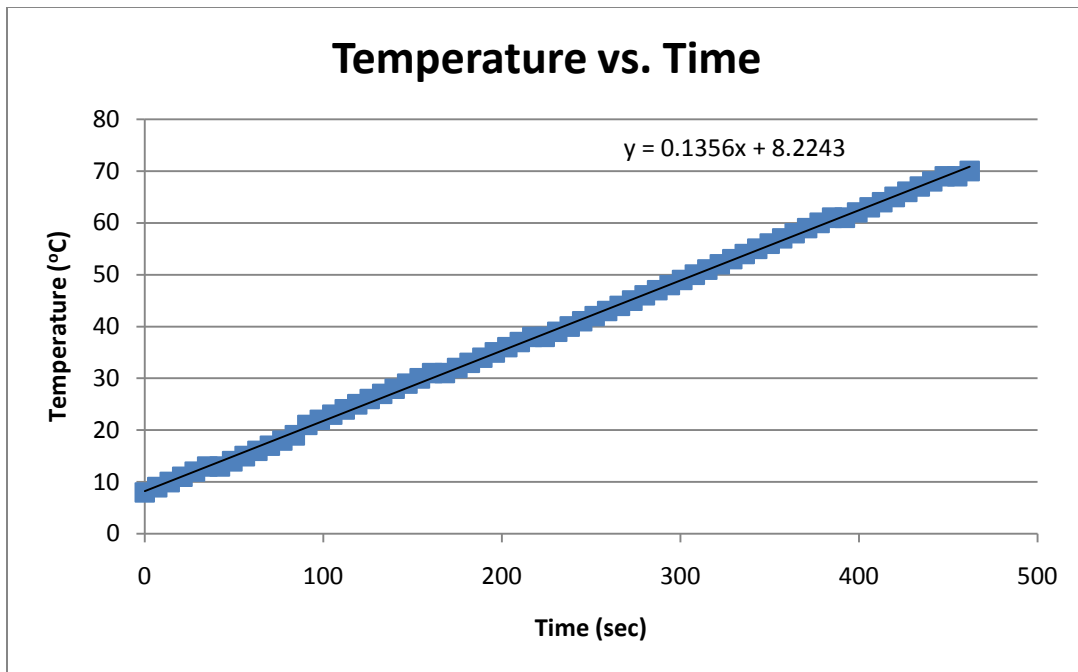
Figure 2: *Temperature vs. Time* graph for Trial 2



**Figure 3:** *Temperature vs. Time graph for Trial 3*



**Figure 4:** *Temperature vs. Time graph for Trial 4*



**Figure 5:** *Temperature vs. Time graph for Trial 5*

## Appendix B

05/01/2010-13:01:44	8degrees Celsius	05/01/2010-13:04:25	30degrees Celsius	05/01/2010-13:07:06	53degrees Celsius
05/01/2010-13:01:51	9degrees Celsius	05/01/2010-13:04:32	31degrees Celsius	05/01/2010-13:07:13	54degrees Celsius
05/01/2010-13:01:58	10degrees Celsius	05/01/2010-13:04:39	32degrees Celsius	05/01/2010-13:07:20	55degrees Celsius
05/01/2010-13:02:05	11degrees Celsius	05/01/2010-13:04:46	33degrees Celsius	05/01/2010-13:07:27	56degrees Celsius
05/01/2010-13:02:12	12degrees Celsius	05/01/2010-13:04:53	34degrees Celsius	05/01/2010-13:07:34	57degrees Celsius
05/01/2010-13:02:19	12degrees Celsius	05/01/2010-13:05:00	35degrees Celsius	05/01/2010-13:07:41	58degrees Celsius
05/01/2010-13:02:26	13degrees Celsius	05/01/2010-13:05:07	37degrees Celsius	05/01/2010-13:07:48	58degrees Celsius
05/01/2010-13:02:33	14degrees Celsius	05/01/2010-13:05:14	38degrees Celsius	05/01/2010-13:07:55	59degrees Celsius
05/01/2010-13:02:40	15degrees Celsius	05/01/2010-13:05:21	39degrees Celsius	05/01/2010-13:08:02	60degrees Celsius
05/01/2010-13:02:47	16degrees Celsius	05/01/2010-13:05:28	40degrees Celsius	05/01/2010-13:08:09	61degrees Celsius
05/01/2010-13:02:54	17degrees Celsius	05/01/2010-13:05:35	41degrees Celsius	05/01/2010-13:08:16	62degrees Celsius
05/01/2010-13:03:01	18degrees Celsius	05/01/2010-13:05:42	42degrees Celsius	05/01/2010-13:08:23	63degrees Celsius
05/01/2010-13:03:08	19degrees Celsius	05/01/2010-13:05:49	43degrees Celsius	05/01/2010-13:08:30	64degrees Celsius
05/01/2010-13:03:15	20degrees Celsius	05/01/2010-13:05:56	44degrees Celsius	05/01/2010-13:08:37	65degrees Celsius
05/01/2010-13:03:22	22degrees Celsius	05/01/2010-13:06:03	45degrees Celsius	05/01/2010-13:08:44	66degrees Celsius
05/01/2010-13:03:29	23degrees Celsius	05/01/2010-13:06:10	46degrees Celsius	05/01/2010-13:08:51	67degrees Celsius
05/01/2010-13:03:36	24degrees Celsius	05/01/2010-13:06:17	47degrees Celsius	05/01/2010-13:08:58	68degrees Celsius
05/01/2010-13:03:43	24degrees Celsius	05/01/2010-13:06:24	48degrees Celsius	05/01/2010-13:09:05	69degrees Celsius
05/01/2010-13:03:50	25degrees Celsius	05/01/2010-13:06:31	49degrees Celsius	05/01/2010-13:09:12	69degrees Celsius
05/01/2010-13:03:57	26degrees Celsius	05/01/2010-13:06:38	49degrees Celsius	05/01/2010-13:09:19	70degrees Celsius
05/01/2010-13:04:04	27degrees Celsius	05/01/2010-13:06:45	50degrees Celsius		
05/01/2010-13:04:11	28degrees Celsius	05/01/2010-13:06:52	51degrees Celsius		
05/01/2010-13:04:18	29degrees Celsius	05/01/2010-13:06:59	52degrees Celsius		

## Appendix C

### Chicken Breast Experiment

Error

$$\text{Theoretical slope} = (.1393 + .1403 + .1427 + .136 + .1356) / 5 = .13878$$

% error

$$\text{Trial 1: } \frac{.1393 - .13878}{.13878} \times 100 = .374694\%$$

$$\text{Trial 2: } \frac{.1403 - .13878}{.13878} \times 100 = 1.09526\%$$

$$\text{Trial 3: } \frac{.1427 - .13878}{.13878} \times 100 = 2.82461\%$$

$$\text{Trial 4: } \frac{.1356 - .13878}{.13878} \times 100 = -2.2914\%$$

$$\text{Trial 5: } \frac{.13878 - .1356}{.13878} \times 100 = 2.2914\%$$

# Appendix D

The screenshot shows a dual-monitor setup. The top monitor displays the National Instruments LabVIEW Student Edition interface. The 'physical channels' panel is visible, showing 'mean voltage' at 0.5011 and 'mean Temp' at 69.0000. A 'STOP' button is also present. The bottom monitor displays a Microsoft Word document titled 'project guideline...'. The document content includes:

developed. This solution requires an in-depth evaluation process and verification procedures. This report should include an error analysis as well as a quantification of:

- Hypothesis
- Reproducibility
- Accuracy

**Example of the deliverable:**

Using a solid programming methodology, the software and systems, create a process for the development of a system design that will ensure accuracy and high-level performance. Additionally, the system design will ensure accuracy and high-level performance. Additionally, the system design will ensure accuracy and high-level performance. Additionally, the system design will ensure accuracy and high-level performance.

**Project deliverables:**

**Deliverable 1:** This is an assignment due by 4:00 PM, April 1<sup>st</sup>. A word document containing a list of all the possible project concepts, score sheets. This should include enough detail that the instructor can evaluate projects for appropriateness. Be sure to include what hardware types you like you will need and what they will be connected. This should be provided in your final deliverable. Each system should include your data, group name and group member names. This will be locked or read-only to the submit group member by April 1<sup>st</sup>.

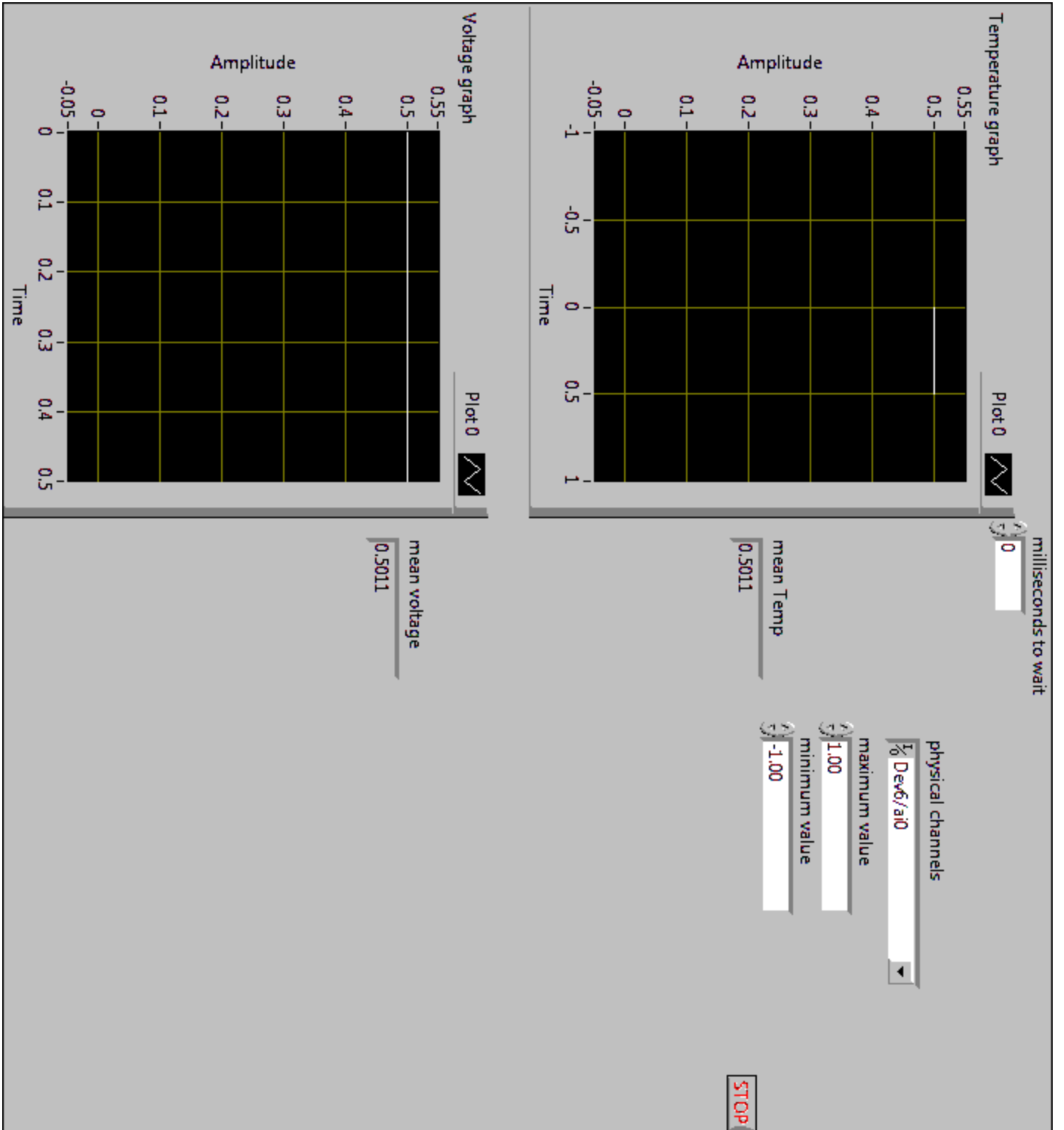
**Deliverable 2:** Due to an assignment due, 4:00 PM, on April 1<sup>st</sup>. A word document containing a list of all the possible project concepts, score sheets. This should include enough detail that the instructor can evaluate projects for appropriateness. Be sure to include what hardware types you like you will need and what they will be connected. This should be provided in your final deliverable. Each system should include your data, group name and group member names. This will be locked or read-only to the submit group member by April 1<sup>st</sup>.

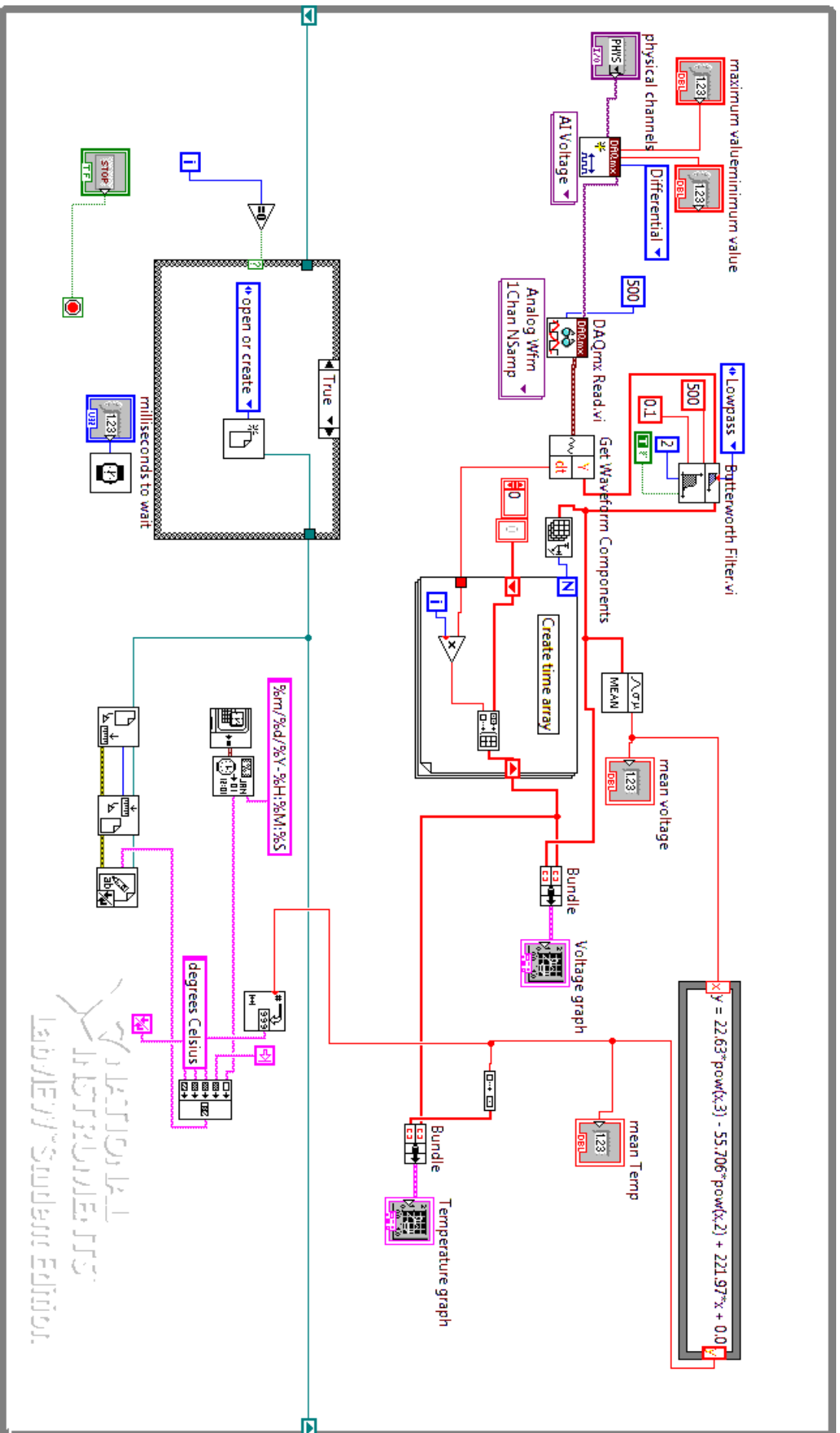
**Deliverable 3:** Due to an assignment due, 4:00 PM, on April 1<sup>st</sup>. A word document containing a list of all the possible project concepts, score sheets. This should include enough detail that the instructor can evaluate projects for appropriateness. Be sure to include what hardware types you like you will need and what they will be connected. This should be provided in your final deliverable. Each system should include your data, group name and group member names. This will be locked or read-only to the submit group member by April 1<sup>st</sup>.

What resources will be used and where they will be obtained from (equipment, shop checkout, purchased, etc.)



# Appendix E





UNIVERSITY OF  
SOUTH ALABAMA  
Library Student Editors

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

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

**DAQmx Create Virtual Channel.vi**

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

**DAQmx Read (Analog Wfm 1Chan NSamp).vi**

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

**DAQmx Read.vi**

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

**NI\_AALBase.lvlib:Butterworth Filter (DBL).vi**

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

**NI\_AALBase.lvlib:Butterworth Filter.vi**

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

**NI\_AALBase.lvlib:Mean.vi**

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