CEG499/699-13: INTELLIGENT SENSOR SYSTEMS
LABORATORY II: DATA ACQUISITION

In this laboratory you will familiarize yourself with the sensor interface board, the plug-in PC board for DAQ (PCI-6024E), NI-DAQ Measurement and Automation software and the LabVIEW programming environment. The exercises in this laboratory will be part of the final virtual instrument that you will integrate in Laboratory III and use in Laboratory IV to collect and analyze data.

SECTION 1: BOARD INTERCONNECTION
In this section you will connect the PC card to your sensor interface board. The instructor should have given you a 68-pin ribbon cable, a 68-pin terminal block and a 20-pin ribbon cable:
1. Connect the 68-pin ribbon cable to the DAQ board on the back of your PC and the terminal block SCSI connector.
2. Connect the 20-pin connector to the ISS sensor interface board
3. Look at Appendices 1 and 2 to determine the appropriate terminal block connection for each of the 20 lines in the ribbon cable
4. Have the instructor check your connections

SECTION 2: DAQ TEST
In this section you will test that your connections and your boards are functioning properly:
1. Start the Measurement and Automation utility
2. Open the Test Panels for the PCI-6024 device
3. Check the digital port by asserting the first four bits. The relay LEDs should light on.
4. Check the analog inputs by connecting the function generator to the S_k channels located to left of the breadboard (do not forget to connect the grounds!)
5. Check the analog outputs by generating a sine wave in the M&A Test Panel and connecting the oscilloscope to the H_k channels to the left of the breadboard (do not forget to connect the grounds!)

SECTION 3: DIGITAL OUTPUTS AND SUB-VIS
In this section you will write a LabVIEW program to control the relay circuits through the digital output lines. These lines will eventually drive the pump and solenoid valves.
1. Write a LabVIEW program that switches the relay lines (D1-D4) with four binary controls (hint: use the 'DIG LINE' output VI).
2. Embed this VI into a sub-VI that accepts four inputs, one per switch.

Note: Using sub-VIs is a good software-engineering practice that will remove clutter from your diagram when you integrate all the components in Laboratory III.

SECTION 4: ANALOG INPUTS, SHIFT REGISTERS AND ARRAY OPERATIONS

In this section you will write a LabVIEW interface to display and store the response of the temperature and gas sensors into a 2D array:

1. Write a LabVIEW program to acquire data from the temperature sensor and the gas sensor at a fixed sampling rate (hint: use the "*Wait (ms)*" and "*AI 1-SCAN*" VIs).
   - The control panel should have two numeric controls to select sampling rate and total sampling time, both in seconds.
   - Sensor readings should be stored into a 2D array (hint: use shift registers in the flow control structure)
   - The control panel should have a Graph to display the array of sensor responses in real time.
2. Build a sub-VI that samples the six analog inputs and returns the results in an array. Update the previous program to make use of this sub-VI.

SECTION 5: FILE I/O

In this part you will write a LabVIEW program to save the sensor response into an ASCII file. The data should be saved in tabular form: one column per sensor, and one row per sample. (hint: use the "*Array To Spreadsheet String*" and "*Write Characters To File*" VIs)

Store all your files in a safe place (You may want to FTP them to your college account). We will use all these VIs in Laboratory III.

APPENDIX 1
PINOUT OF THE 20-LINE RIBBON CABLE

LINE NUMBER	SIGNAL CODE
1	D1
2	H1
3	D2
4	H2
5	D3
6	H3
7	D4
8	H4
9	GND
10	S1
11	GND
12	S2
13	GND
14	S3
15	GND
16	S4
17	GND
18	S5
19	GND
20	S6

LEGEND:

D: Digital output for relay switches
H: Analog output line for heater voltage set-points
S: Analog input line with sensor signals

APPENDIX 2
PINOUT OF THE 68-PIN TERMINAL BLOCK

Left	Pin	Pin	Right
ACH8	34	68	ACH0
ACH1	33	67	AIGND
AIGND	32	66	ACH9
ACH10	31	65	ACH2
ACH3	30	64	AIGND
AIGND	29	63	ACH11
ACH4	28	62	AISENSE
AIGND	27	61	ACH12
ACH13	26	60	ACH5
ACH6	25	59	AIGND
AIGND	24	58	ACH14
ACH15	23	57	ACH7
DAC0OUT[1]	22	56	AIGND
DAC1OUT[1]	21	55	AOGND[1]
RESERVED	20	54	AOGND[1]
DIO4	19	53	DGND
DGND	18	52	DIO0
DIO1	17	51	DIO5
DIO6	16	50	DGND
DGND	15	49	DIO2
5 V	14	48	DIO7
DGND	13	47	DIO3
DGND	12	46	SCANCLK
PFI0/TRIG1	11	45	EXTSTROBE*
PFI1/TRIG2	10	44	DGND
DGND	9	43	PFI2/CONVERT*
5 V	8	42	PFI3/GPCTR1_SOURCE
DGND	7	41	PFI4/GPCTR1_GATE
PFI5/UPDATE*	6	40	GPCTR1_OUT
PFI6/WFTRIG	5	39	DGND
DGND	4	38	PFI7/STARTSCAN
PFI9/GPCTR0_GATE	3	37	PFI8/GPCTR0_SOURCE
GPCTR0_OUT	2	36	DGND
FREQ_OUT	1	35	DGND

[1] Not Available on 6023E