Lab(2)

Faculty of Engineering,
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Design of Measurement Systems, Sp. 2015

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NATIONAL INSTRUMENTS
LabVIEW

LAB Goals:

- Learning how to perform basic statistical analysis of measured data.
- Learning how to perform logical operations
- Getting an idea of a whole measurement system

Labview Datatypes

Data Type	Scalar	1D Array	2D Array	Color
Numeric - Floating Point				Orange
Numeric - Integer				Blue
Boolean				Green
String				Pink

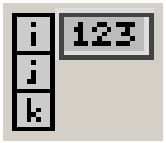
Building Arrays

What is an array?

- An array can either resemble a vector or a matrix. As does a vector and a matrix, an array groups similar pieces of data.
- Arrays may contain numeric, Boolean, string, and cluster data types. They may be used as an indicator (output) or a control (input).

Creating a One-Dimension Array.

In the Front-Panel:

- Controls Palette → Modern → Array, Matrix & Cluster → Array 

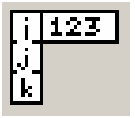
- Notice when you first put the array on the front panel that it is empty. You can determine your array type by inserting either a control or indicator inside the array.
- For example, for a numerical indicator array:

  Controls Palette → Num Inds → Num Ind → Place inside Array.

Creating a One-Dimension Array.

In the Block-Diagram (Creating Constant Array):

- Functions Palette → Programming → Array → Array Constant
- To make the array a numerical constant array:
  - Functions Palette → Mathematics → Numeric → Numeric Constant
  - Drag and drop it to the Array constant box



OR:

- Functions Palette → Programming → Array → Build Array
- Functions Palette → Mathematics → Numeric → Numeric Constant. And connect the numerical constant to the build Array box.

Exercise (1)

- For the given data, implement a VI that calculates:
  - Mean,
  - Standard deviation

And Plot the measurements data.

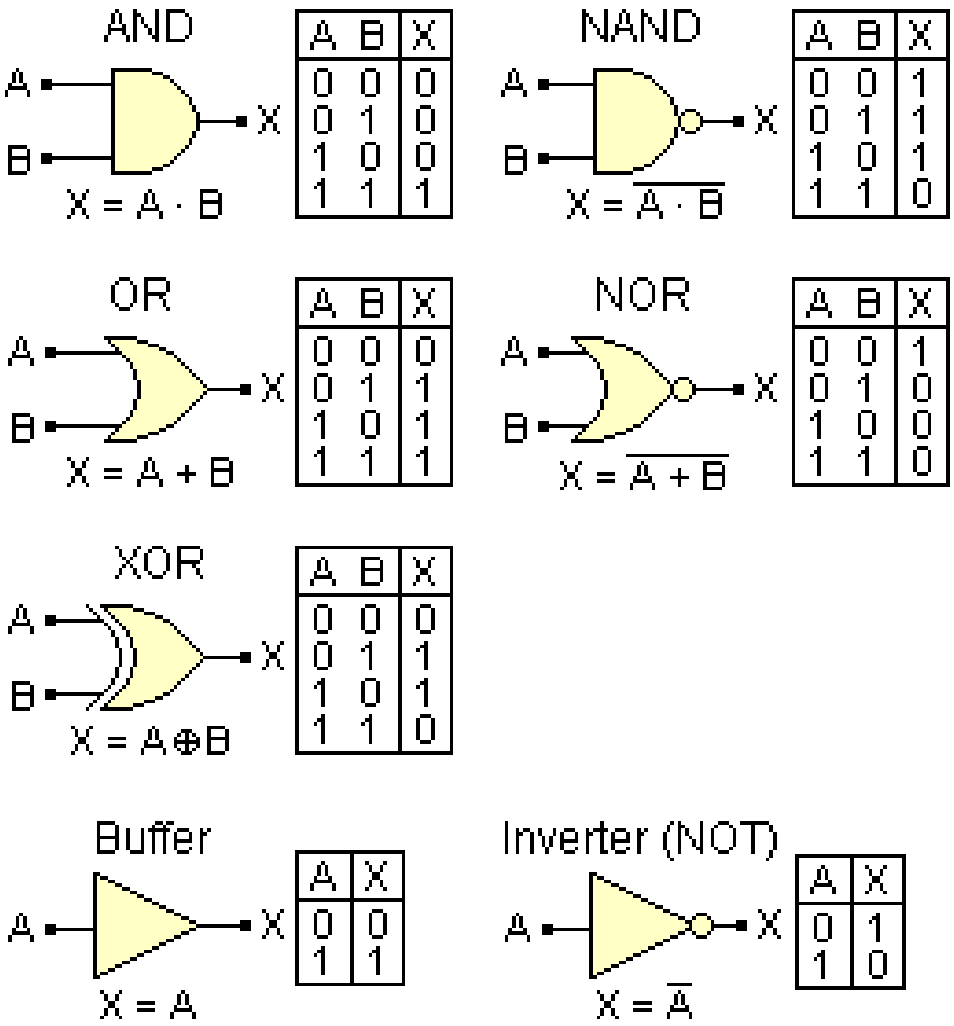
Trial	1	2	3	4	5	6	7	8	9	10
Current (mA)	21.5	22.1	21.3	21.7	22	22.2	21.8	21.4	21.9	22.1

Exercise (2)

- Implement a VI that finds the best-fit straight line for the given calibration data.
- Put indicators for the slope and intercept.

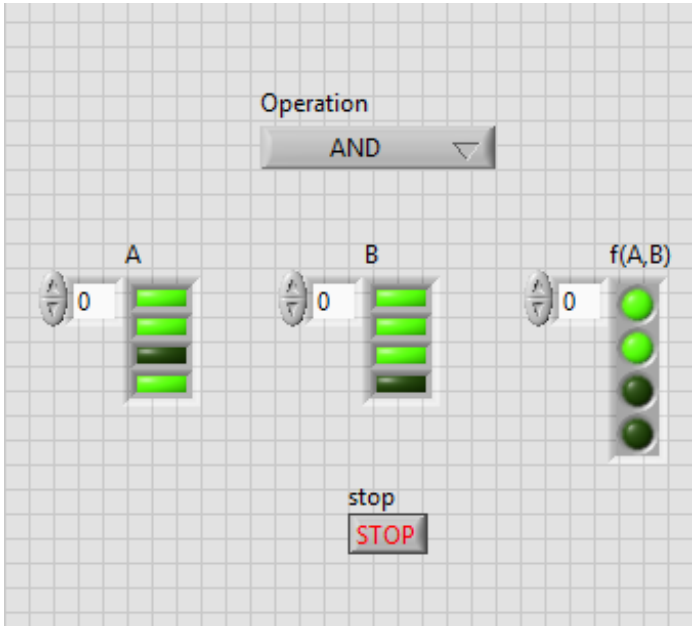
Input (x)	Output (y) (decreasing direction)
0	0
5	1.2
10	3.5
15	3
20	5
25	5.5
30	7
35	7.7
40	9

Remember


AND
A
B
X
X = A · B
A B X
0 0 0
0 1 0
1 0 0
1 1 1
NAND
X = $\overline{A \cdot B}$
A B X
0 0 1
0 1 1
1 0 1
1 1 0
OR
X = A + B
A B X
0 0 0
0 1 1
1 0 1
1 1 1
NOR
X = $\overline{A + B}$
A B X
0 0 1
0 1 0
1 0 0
1 1 0
XOR
X = A⊕B
A B X
0 0 0
0 1 1
1 0 1
1 1 0
Buffer
X = A
A X
0 0
1 1
Inverter (NOT)
X = $\overline{A}$
A X
0 1
1 0

Exercise (3)

- Implement a VI that consists of two arrays of led controls (Every array consists of 4 leds). This VI is intended to calculate the appropriate Boolean operation based on the user input, and display the result in an array of led indicators. The required operations are:
  - AND
  - OR
  - XOR
  - NAND
  - NOR

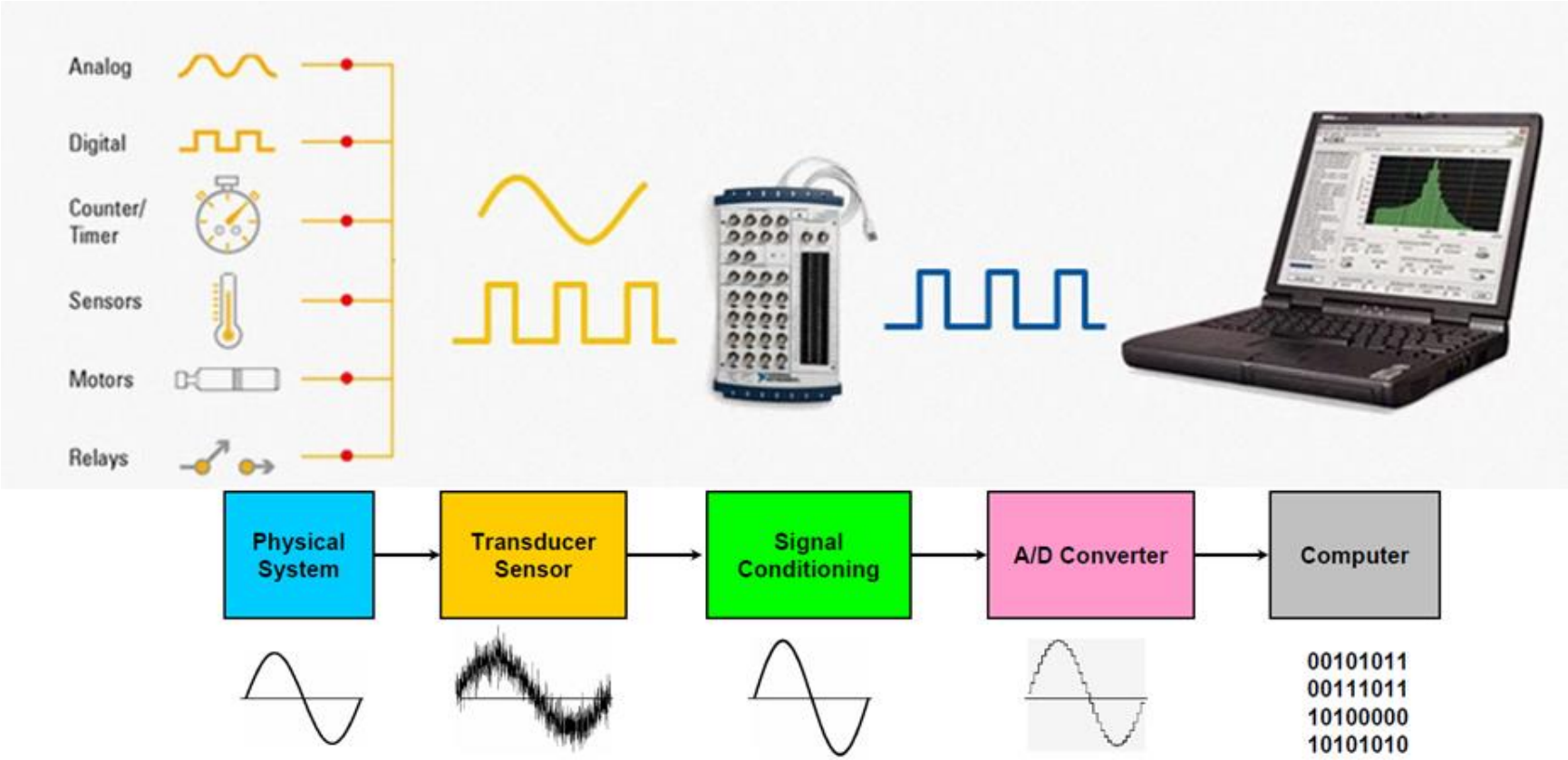


What is Measurement?

- Measurement is the process of quantifying physical variables such as temperature, gas pressure, force or velocity by means of sensors and data acquisition systems.

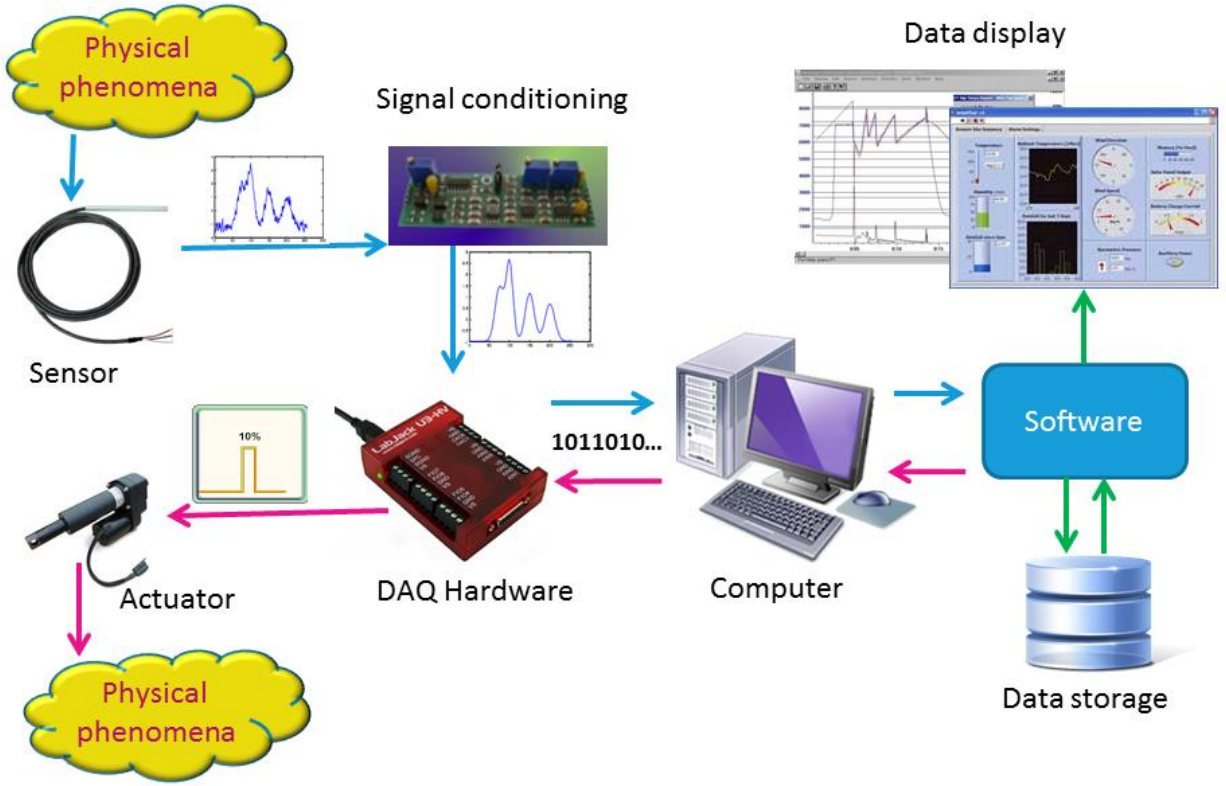
- Measurement signals can either be used for analyzing data and storage, for monitoring different process variables in a process control system, or to understand a system performance and consequently in the next step to generate signals to the actuators to act in a desired manner.

What is Measurement?

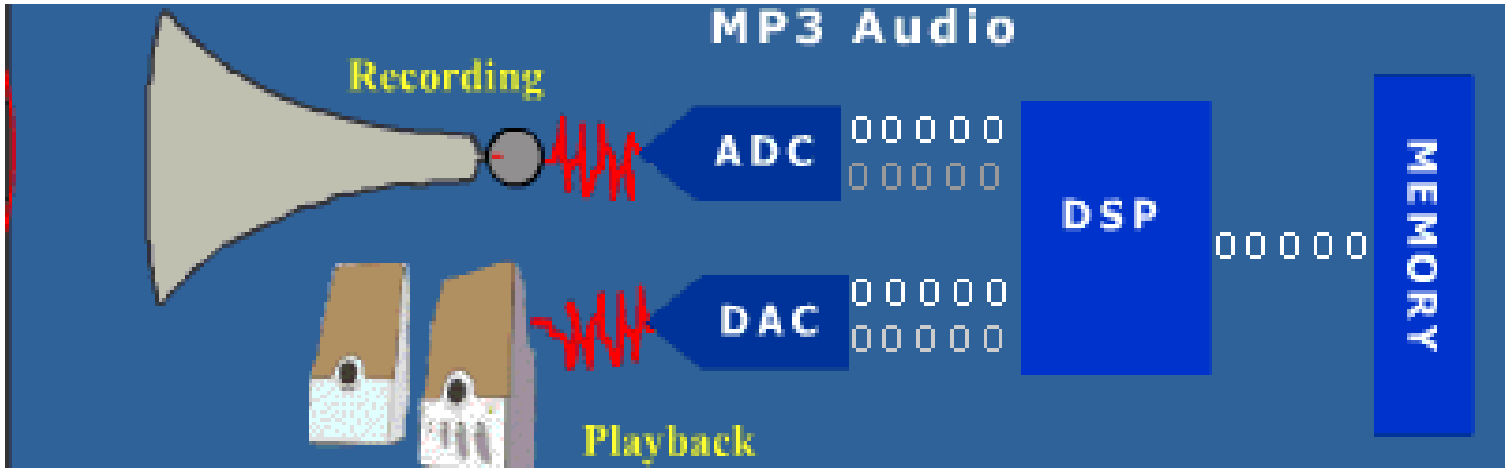


Data Acquisition

- Data Acquisition (DAQ) is the process that involves receiving signals from the real world to analyze, understand and process them.

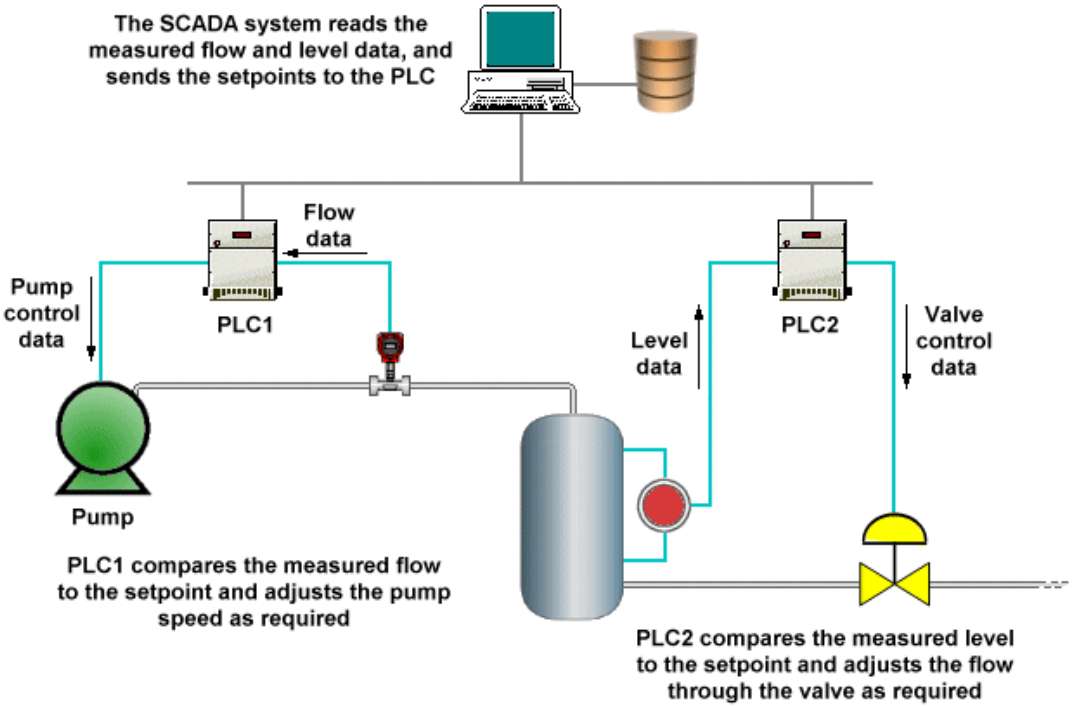


Data Acquisition



SCADA

Industrial systems known as SCADA (Supervisory Control and Data Acquisition) combine data acquisition with process control and supervision.



DAQ Card Selection

- Sampling rate
- Resolution
- No. of channels
- Communication Bus
- Portability

Example: NI (National Instruments) USB-6008 DAQ

- Specs:
  - 8 analog inputs (12-bit, 10,000 Sample/sec)
  - 2 analog outputs (12-bit, 150 Sample/sec)
  - 12 digital I/O (Bi-directional)
  - Successive Approximation ADC
  - Communication Bus: USB
  - NI-DAQmx driver software