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## 17/ENG04/057

# ELECTRICAL ELECTRONICS ENGINEERING

# EEE 471: ELECTRONIC INSTRUMENTATION (DIGITAL)

## QUESTION:

1. Explain briefly the signal processing and interfacing techniques in measuring instruments

2. Explain briefly the expert system instrumentation

### SOLUTION:

### 1) Explain briefly the signal processing

A signal is any time-varying quantity. A system is any process that produces an output signal in response to an input signal.

Signal processing is an emerging technology that incorporates the fundamental theory, algorithms, processing, and transferring information in different patterns, which is broadly designated as signals. Transmission of information, or signals, is done through a channel. Signals are processed for a variety of reasons, such as to remove unwanted noise, to correct distortion, to make them suitable for transmission or to extract certain meaningful information.

Signal processing can be in various areas which includes: audio and speech processing, sonar, radar and other sensor array processing, spectral density estimation, statistical signal processing, digital image processing, data compression, video coding, audio coding, image compression, signal processing for telecommunications, control systems, biomedical engineering, and seismology.

Signal processing can either be Analogous or Digital;

- The term Analog Signal Processing describes a body of techniques that can be implemented to process analog (or real-world) signals. This includes the theory and application of filtering, coding, transmitting, estimating, detecting, analyzing and reproducing analog signals.
- The term Digital Signal Processing describes the taking of real-world signals like voice, audio, video, temperature, pressure, or position that have been digitized and then mathematically manipulating them. This includes wide variety of goals such as: enhancement of visual images, recognition and generation of speech, compression of data for storage and transmission. A DSP is designed for performing mathematical functions like "add", "subtract", "multiply" and "divide" very quickly.

DSP system performs the following operations:

- Accepts an analog signal as an input.
- Converts this analog signal to numbers
- Performs computations using the numbers.
- Converts the results of the computations back into an analog signal.



Figure 1: Representing the digital signal process

### 2) Signal processing Interfacing techniques in measuring instruments.

One of the key ways to add efficiency and accuracy to laboratory is by interfacing the instruments. The instruments that are used within laboratories range from simplistic 'dumb' instruments that simply output a number to instruments that include data management software that can communicate with external systems (such as WinLIMS.NET) in a bidirectional manner System integration with interfaced instruments offer high accuracy over result, Interfaced systems allow effective utilization of instruments to improve sample analysis.

Interfacing of measuring instruments is the method of connecting or linking together one instruments, especially a Optocoupler with another enabling the design or adaption of the output and input configurations of the two electronic devices so that they can work together.

#### Interfacing techniques in Measuring Instruments:

Interfacing is more than just using the software program of computers and processors to control something. While computer interfacing uses the unidirectional and bidirectional input and output ports to drive various peripheral devices, many simple electronic circuits can be used to interface to the real world either using mechanical switches as inputs, or individual LEDs as outputs.

Computer Interfacing using LIMS:

There are two types of instrument interfaces:

- 1) Uni-directional Interface
- 2) Bi-directional Interface

Uni-directional interfaces: are the simplest form of data transfer, typically defined as acquiring data from the instrument and reporting it to LIMS. This type of interface usually requires additional information (such as the sample identifiers) to be entered at the instrument or interface level, before committing the results to LIMS. Uni-directional interfaces are the easiest to implement.

Bi-directional interfaces: are more intricate, as they involve the movement of information back and forth between LIMS, the interface and the instrument. A typical bi-directional interface would involve querying LIMS for a list of pending samples for a certain test. After collecting this list of samples, the interface would deliver the work list to the instrument. After analysis, the data is collected by the interface and reported back to LIMS.

### > Interfacing using Mechanical input Switching:

The simplest and most common type of input interfacing device is the push button switch. Mechanical ON-OFF toggle switches, push-button switches, rocker switches, key switches and reed switches, etc. are all popular as input devices because of their low cost and easy of input interfacing to any circuit. Some of these switches are as explained below:

Input Interfacing a Single Switch: Switches and push-buttons are mechanical devices that have two or more sets of electrical contacts. When the switch is open or disconnected, the contacts are open circuited and when the switch is closed or operated these contacts are shorted together. The most common way of input interfacing a switch (or push button) to an electronic circuit is via a pull-up resistor to the supply voltage as shown. When the switch is open, 5 volts, or a logic "1" is given as the output signal. When the switch is closed the output is grounded and 0v, or a logic "0" is given as the output.



DIP Switch Input Interfacing: As well as input interfacing individual push-buttons and rocker switches to circuits, several switches can also be interfaced together in the form of keypads and DIP switches.

DIP or Dual-in-line Package switches are individual switches that are grouped together as four or eight switches within a single package. This allows DIP switches to be inserted into standard IC sockets or wired directly onto a circuit or breadboard.



#### Interfacing with Opto Devices

An Optocoupler (or opt isolator) is an electronic component with an LED and photo-sensitive device, such as a photodiode or phototransistor encased in the same package. The Opto-coupler interconnects two separate electrical circuits by means of a light sensitive optical interface. This means that we can effectively interface two circuits of different voltage or power ratings together without one electrically affecting the other.

Optical Switches (or opto-switches) are another type of optical (photo) switching devices which can be used for input interfacing. The advantage here is that the optical switch can be used for input interfacing harmful voltage levels onto the input pins of microcontrollers, PICs and other such digital circuits or for detecting objects using light as the two components are electrically separate but optically coupled providing a high degree of isolation (typically 2-5kV).

#### 3) Explain briefly the expert system instrumentation:

Expert system is a part of the artificial intelligence, a solution software for complicated problems, which solving the problems need experiences and knowledge. The design of expert system can be used to help instrumentation maintenance system. By using application of expert system, the system can do health monitoring, automatic trouble tracing ang gives advise toward the trouble. this instrumentation's maintenance system is a tool which has an analytic and inference ability toward the trouble.

This smart system is a very useful tool to get a good data acquisition system quality. the model system also can be developed to be a specific application as a remote instrumentation's management system. This smart measuring instrumentation maintenance system program will be very helpful for system management process and ultimately will support the quality of the data acquisition system. Model of this system can be developed for other applications, for example a management system remote instrumentation (remote system).