



SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

COURSE NAME : 23EET206 CONTROL SYSTEMS AND INSTRUMENTATION

II YEAR ECE /III SEMESTER

Unit 5-Oscilloscope, Signal Generator, Analyzer and Data
Acquisition System

Topic 6 : Data Acquisition System



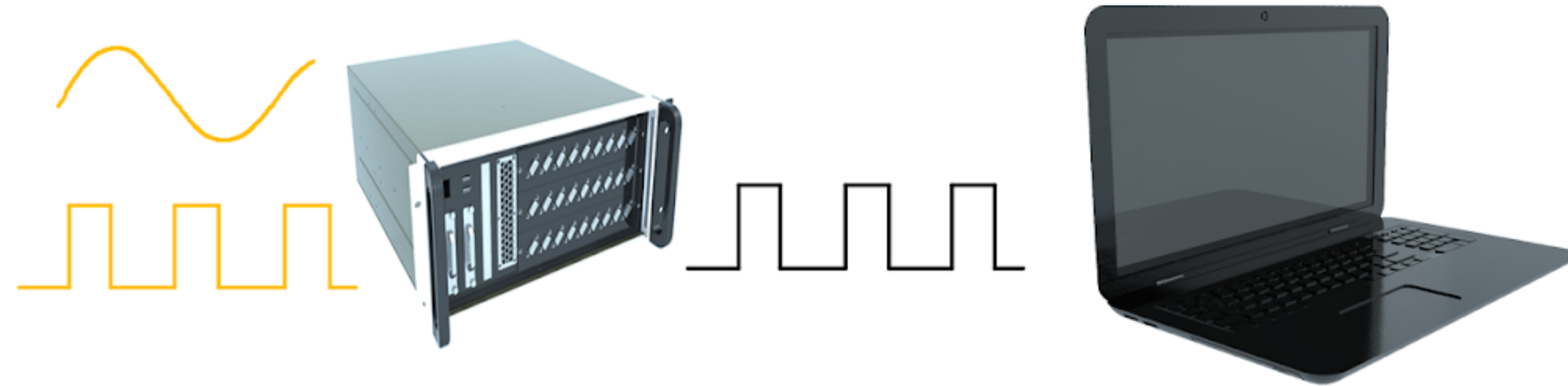
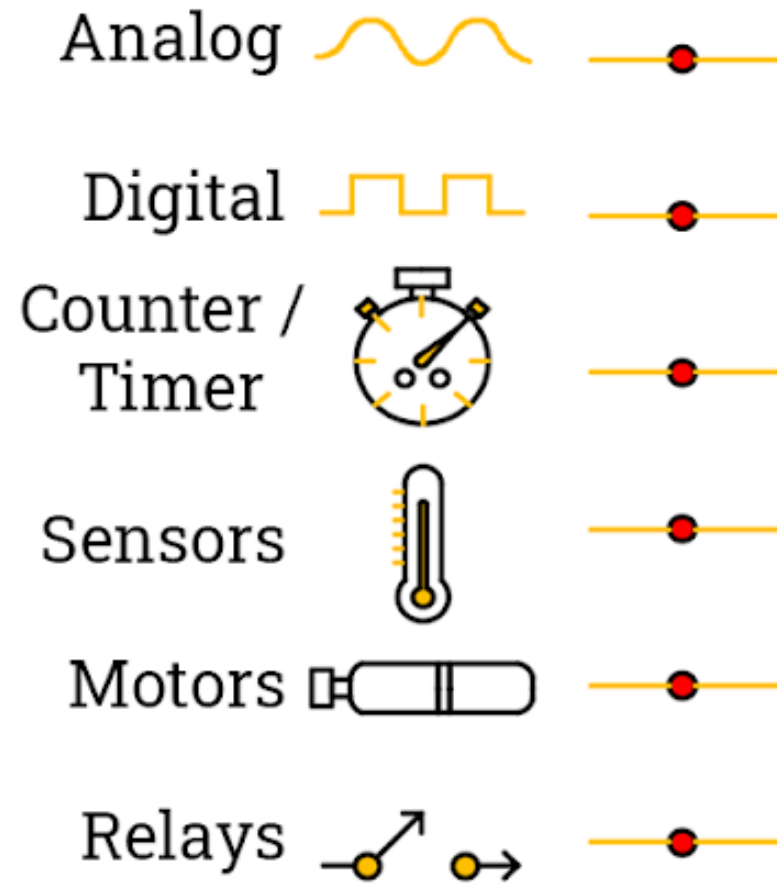


DATA ACQUISITION SYSTEM

- A data acquisition system is an integrated setup consisting of sensors, measurement devices, and a computer.
- It is utilized for gathering and processing data to analyze electrical or physical phenomena, enabling a comprehensive understanding of the collected information.
- Data acquisition systems utilize software to perform their tasks and can quickly process and store data in various formats.
- These systems capture data from real-world systems and store it in a format that is readily accessible for further engineering or scientific analysis.
- Data acquisition systems can be either handheld or remotely operated.
- Handheld systems are used when direct physical interaction with the specimen is possible. In contrast, remote data acquisition systems are employed when direct human interaction with the object is impractical or unnecessary, allowing for measurements to be taken from a distance.



BASIC COMPONENTS



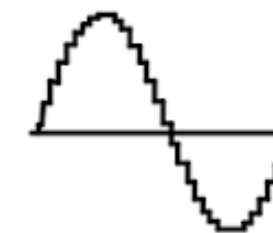
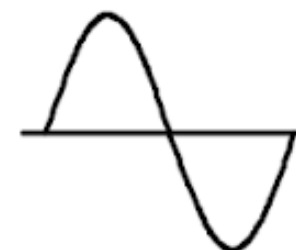
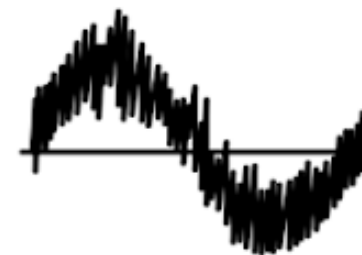
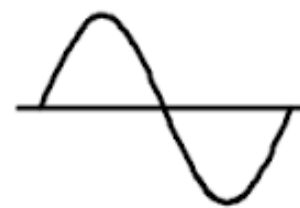
Physical System

Transducer Sensor

Signal Conditioning

A / D Converter

Computer



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BASIC COMPONENTS

- A data acquisition system, comprising both software and hardware, is designed to measure or control physical properties in the real world.
- A complete data acquisition system typically includes DAQ hardware, sensors, actuators, signal conditioning equipment, and a computer running DAQ software. Additionally, if precise timing is crucial, an independent timing system may be required, especially in event-mode DAQ systems.



TRANSDUCER

- Sensors or transducers serve the purpose of interacting with the subject measured.
- They interact with the subject either directly or indirectly, or as defined in other words, contact or non-contact.
- These tools convert the physical values to produce an output of electrical signals.
- There are many different types of sensors that are utilized in data acquisition systems depending on the nature of their application.



SIGNAL CONDITIONING

- The electrical signals obtained from sensors often contain noise or interference and may require modification before they can be used. Additionally, these signals might be too weak for the data acquisition system to measure accurately.
- To address these issues, additional circuitry, known as a signal conditioner, is employed.
- Signal conditioning is the process of enhancing and optimizing these signals to ensure accurate measurement and reliable data acquisition.



SIGNAL CONDITIONING

- The signal conditioner employs filter circuits to separate noise from the actual signal and amplification circuits to boost weak signals. These are among the primary functions performed by signal conditioners.
- Additionally, a well-designed signal conditioning circuit can handle other processes such as linearization, calibration, and excitation.
- The choice of signal conditioning circuit depends significantly on the characteristics of the sensors used in the DAQ system.



DATA ACQUISITION HARDWARE

- Data acquisition hardware acts as an intermediary between sensors and the computer.
- It connects to the computer via USB ports or PCI-express slots on the motherboard.
- This hardware is responsible for receiving signals from the sensors and converting them into digital signals that the computer can interpret.
- Essentially, this hardware enables the computer to process and analyze the data collected by the sensors.



ANALOG TO DIGITAL CONVERTER(ADC)

- This component of a DAQ system, known as the Analog-to-Digital Converter (ADC), is crucial for converting analog signals into digital data.
- At the heart of every data acquisition system, the ADC transforms environmental data into discrete levels that a processor can interpret.
- These discrete levels correspond to the smallest detectable changes in the measured signal. The resolution of an ADC is determined by its bit depth.
- A higher number of bits allows for more discrete levels, which improves the resolution of the analog-to-digital conversion.
- Essentially, the resolution of an ADC is similar to the precision marks on a measuring stick.



DIGITAL TO ANALOG CONVERTER

- This component of a DAQ system is responsible for facilitating the input and output of binary signals.
- It ensures that digital data can be effectively transferred between the system and external devices or components.



SINGLE ENDED INPUT CONVERTERS

- This component is designed to support the input from single-ended wires, facilitating the connection and measurement of signals.
- Some DAQ hardware operates independently of a computer.
- These standalone systems include an embedded processor and computing unit within the hardware itself.
- Such standalone data acquisition systems can provide real-time data representation without needing to connect to a computer.



COMPUTER

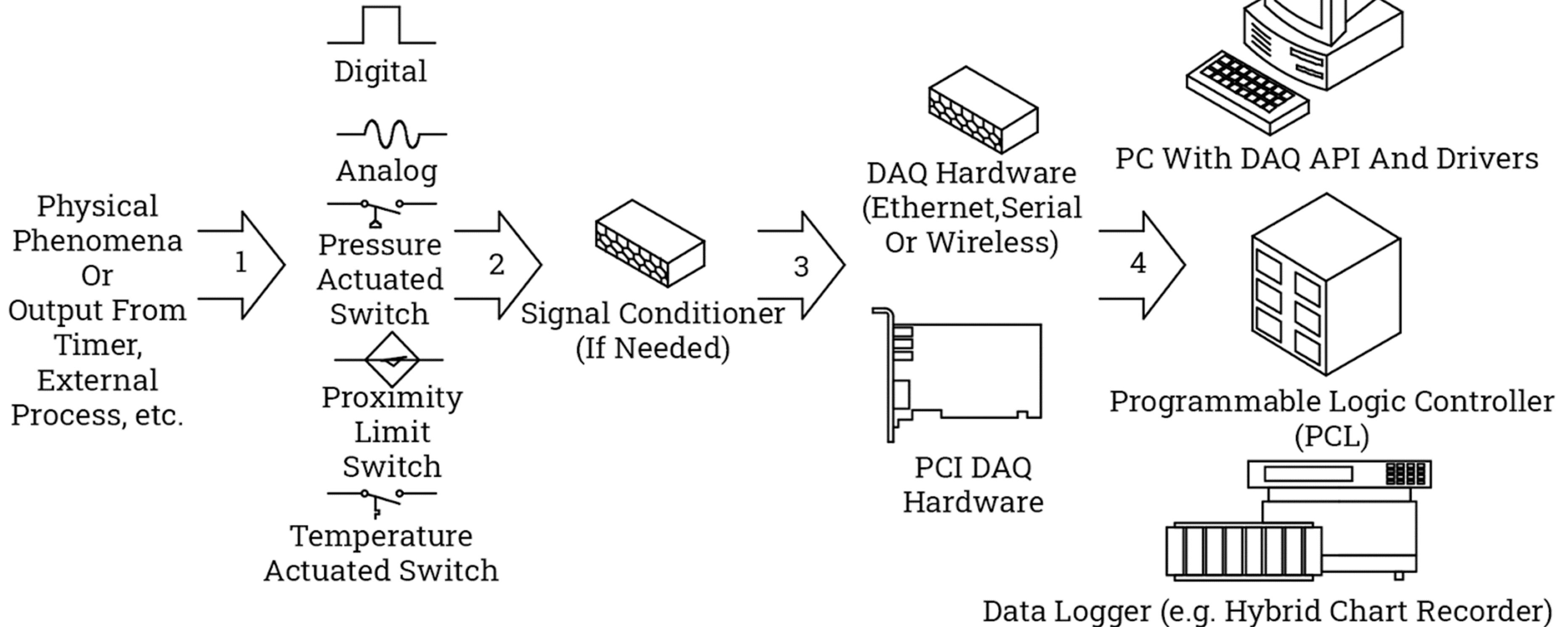
- The computer serves as the final component in a data acquisition (DAQ) system.
- Its primary role is to collect and process the data received from the DAQ hardware for further analysis.
- Simply connecting the DAQ hardware to a computer is not sufficient to interpret the collected data. Specialized DAQ software is necessary to convert the raw data into readable and meaningful results.
- This software acts as an intermediary layer between the DAQ hardware and the user, enabling the computer to perform advanced computations and analyses based on the collected data.



DATA ACQUISITION CARDS AND MODULES

- Many data acquisition systems utilize rack-mounted modules filled with various cards to provide the necessary measurement functions.
- These cards must conform to the system's electrical and mechanical interfaces.
- Rack systems are often standardized, and the modules are commonly available from multiple manufacturers, making the selection process more convenient.

DATA ACQUISITION EQUIPMENT





DATA ACQUISITION SOFTWARE

- Specialized data acquisition software is essential for acquiring, storing, and processing data in a logical format. This software can be developed in various programming languages and tailored for specific applications. Alternatively, many pre-existing data acquisition software packages are available for use.
- Proprietary data acquisition software packages offer the advantage of pre-existing development and deployment, meaning most common issues have already been addressed. Although there may be costs associated with software maintenance, these are generally lower than the costs of maintaining a custom-built system.



DATA ACQUISITION METHODS

Various methods are employed in data acquisition systems to gather and process data.

These techniques include:

- Bit Stream Disk – to – Image file
- Bit Stream Disk – to – Disk
- Logical Acquisition
- Sparse Acquisition



BIT STREAM DISK – TO – IMAGE FILE

- This data acquisition approach is employed in specialized systems, particularly by forensic experts. It is a versatile technique that enables the duplication of an original drive, creating one or more exact copies.
- Crucially, it captures all data from the original drive, including connected sectors or clusters, which helps recover files that may have been deleted or altered.
- Common tools used for this process include EnCase, X-Ways, FTK, and ILook Investigator, among others.



BIT STREAM DISK – TO – DISK FILE

- In cases where generating a bit-stream disk-to-image file is not feasible due to software or hardware problems or compatibility issues, a bit-stream disk-to-disk method is utilized as an alternative.
- When forensic investigators encounter difficulties with older drives, they opt to produce a bit-stream disk-to-disk replica of the original drive.
- Tools such as EnCase, SafeBack, and Norton Ghost are commonly used for this purpose.
- These tools can adjust the geometry of the target disk to align with the data copied from the original drive.



LOGICAL ACQUISITION

- This approach is employed to collect only the files pertinent to a specific case investigation. For instance, it is used to gather Outlook .ost or .pst files in email investigations or to retrieve particular records from a large RAID server.



SPARSE ACQUISITION

- This technique is akin to logical acquisition. It allows investigators to gather fragments of unallocated data. This approach is typically used when a full drive examination is not required.



DATA SAMPLING RATE

- The sampling rate, also known as frequency (F), is influenced by the characteristics of the process being monitored and practical considerations.
- In digital data acquisition, transducers convert continuous analog signals into digital form for computer processing. Since computers cannot store continuous analog waveforms, they divide the signals into discrete samples.
- The sampling rate, measured in hertz, refers to the number of samples taken per unit of time from a continuous signal.



DATA SAMPLING RATE

- The sampling rate is a crucial factor in interpreting trends accurately. If the sampling rate is too low, significant trends might be overlooked or obscured.
- In the past, limitations in computer storage and memory were a common concern, but modern computers typically have ample resources to handle high sampling rates.



BENEFITS OF DATA ACQUISITION SYSTEMS

Reshaping Common Mind & Business Towards Excellence



Build an Entrepreneurial Mindset Through Our Design Thinking FrameWork

Benefits of data acquisition systems include:

- Accuracy
- Flexibility
- Scalable
- High Efficiency and Reliability of Processes
- Faster Analysis and Resolution of Problems
- Reduced Data Redundancy
- Decrease in Update Errors
- Improved Integration of Data Through Less Reliance on Other Programs
- Improved Access to Data for Users



BENEFITS OF DATA ACQUISITION SYSTEMS

Reshaping Common Mind & Business Towards Excellence



Build an Entrepreneurial Mindset Through Our Design Thinking FrameWork

- Supervision of Processes without Human Interaction
- Improved Data Security
- Cost-Effectiveness
- Quality Control
- Data Acquisition Systems are Highly Versatile
- Better File Processing and Transfer Capabilities



APPLICATION OF DATA ACQUISITION SYSTEMS

- Electronics
- Automotive Industry
- Imaging
- Laser Technology
- Sonar-Radar
- Industrial Machines
- Non-destructive Testing
- Gas Detection

Redesigning Common Mind & Business Towards Excellence



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References

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Thank You