



Al-Mustaqbal University
College of Engineering & Technology
Biomedical Engineering Department



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Lecture No.:-3

Lecture Title: [[Bioinstrumentation](#)]

• **Bio-instrumentation or Biomedical Instrumentation**

Is an application of biomedical engineering, which focuses on the devices and mechanics used to measure, evaluate, and treat biological systems human

- It focuses on the use of multiple sensors to monitor the physiological characteristics of living organisms
- Bioinstrumentation is a new and upcoming field, concentrating on treating diseases and bridging together the engineering and medical worlds.
- The quantity, property, or condition that is measured by an instrumentation system is called the **measurand**).
- **measurand** can be :a bioelectric signal, such as those generated by muscles or the brain, or a chemical signal or mechanical signal that is converted to an electrical signal.,

Basics of bioinstrumentation system

Sensors and biosensors: used to convert physical (**measurands**) into electric outputs.

The outputs from these biosensors are **analog signals—that is, continuous signals**—that are sent to the analog processing and digital conversion block.

In the digital conversion block, the signals are **amplified, filtered, conditioned, and converted to digital form.**

Once the analog signals have been digitized and **converted to a form that can be stored and processed by digital computers**, many more methods of signal conditioning can be applied.

Basic instrumentation systems also include **output display** devices that enable human operators to view the signal in a format that is easy to understand. These displays may be numerical or graphical, discrete or continuous, and permanent or temporary. Most output display devices are intended to be observed visually, but some also provide audible output—for example, a beeping sound with each heartbeat.

- **In addition to displaying data**, many instrumentation systems have the capability of storing data.
- In some devices, the signal is stored briefly so further processing can take place or so an operator can examine the data.
- In other cases, the signals are stored permanently so different signal processing schemes can be applied at a later time.
- **Holter monitors**, for example, acquire 24 hours of ECG data that is later processed to determine arrhythmic activity and other important diagnostic characteristics.



With the invention of the telephone and now with the Internet, signals can be acquired with a device in **one location, perhaps in a patient's home, and transmitted to another device for processing and/or storage.**

- This has made it possible, for example, to provide quick diagnostic feedback if a patient has **an unusual heart rhythm while at home.**
- It has also allowed medical facilities in rural areas to transmit diagnostic images to **tertiary care hospitals so that specialized physicians can help general practitioners arrive at more accurate diagnoses.**

Two other components play important roles in instrumentation systems. The first is the **calibration signal**.

A signal with known amplitude and frequency content is applied to the instrumentation system at the sensor's input.

The calibration signal allows the components of the system to be adjusted so that the output and input have a known, measured relationship.

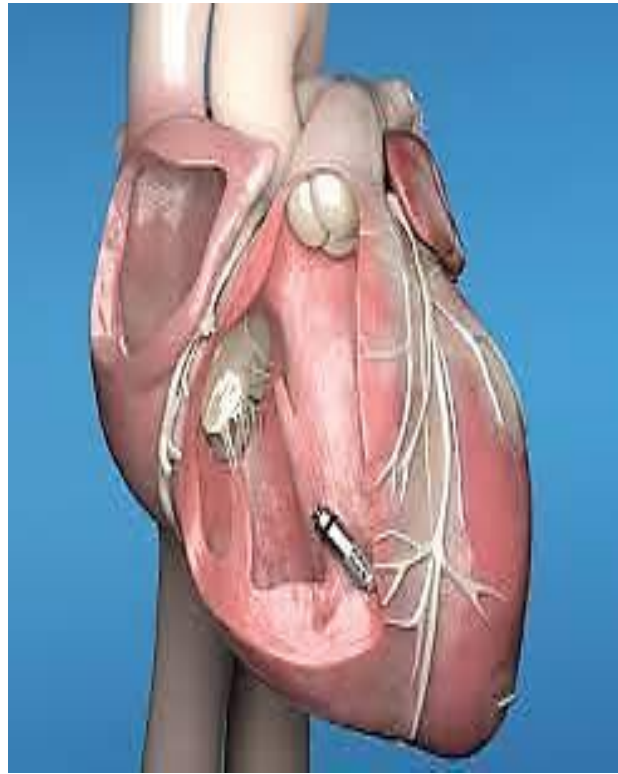
Without this information, it is impossible to convert the output of an instrument system into a meaningful representation of the measurand.

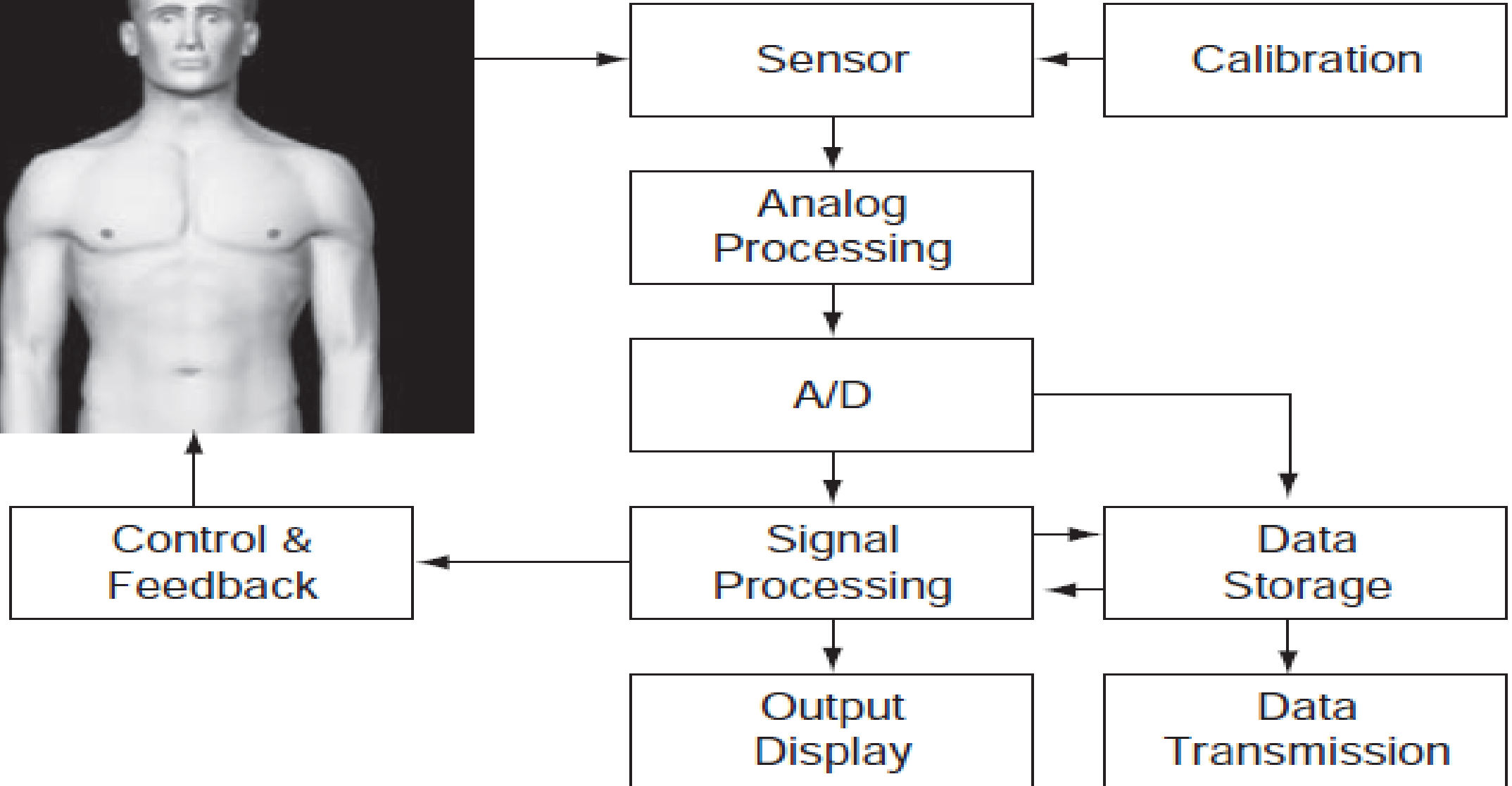
Another important component, **a feedback element**, is not a part of all instrumentation systems.

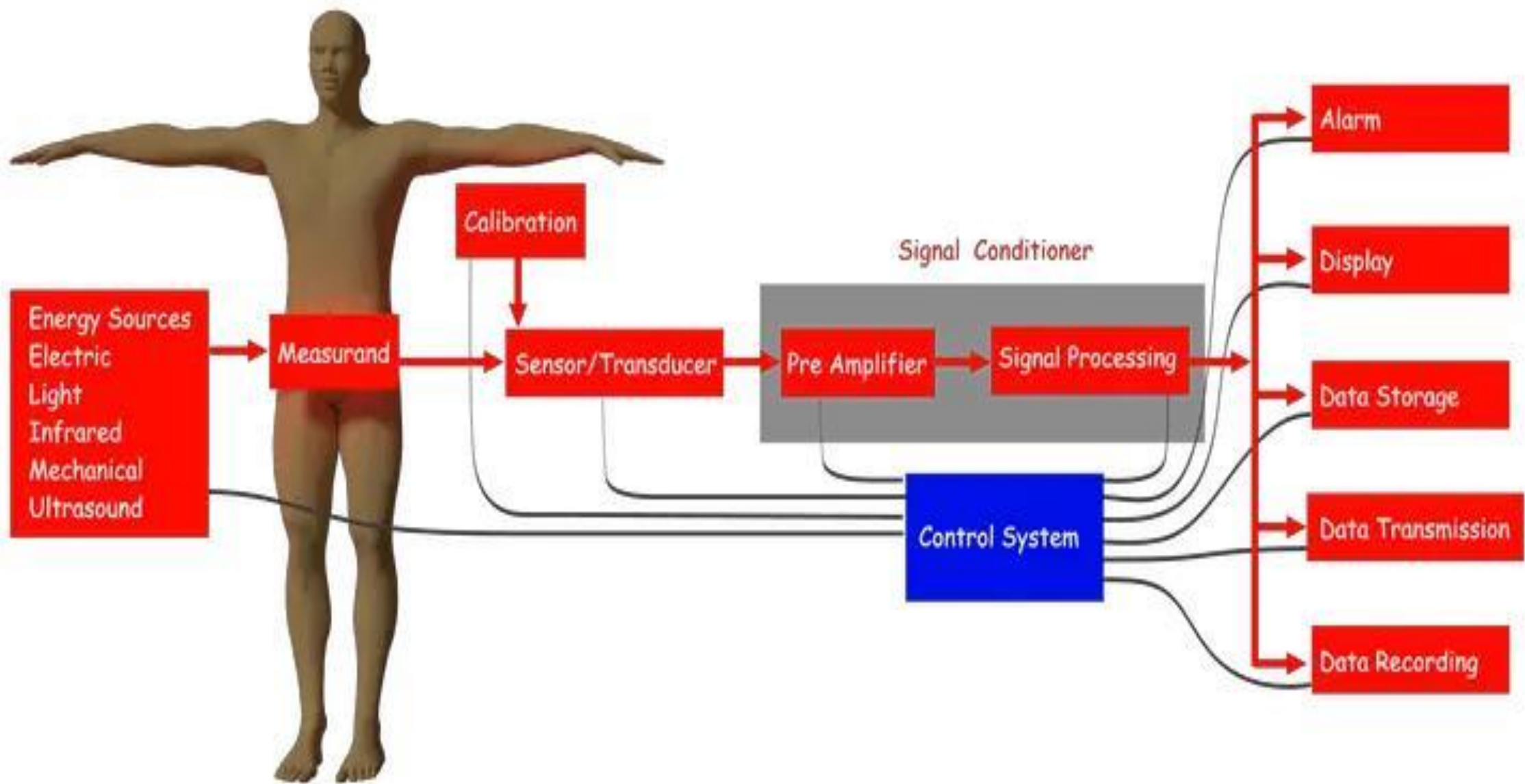
These devices include **pacemakers and ventilators that stimulate the heart or the lungs**.

Some feedback devices collect physiological data and stimulate

- response—a heartbeat or breath—when needed or are part of biofeedback systems in which the patient is made aware of a physiological measurement, such as blood pressure, and uses conscious control to change the physiological response.









- Instruments in an operating room. Modern surgical suites are filled with instruments that provide continuous monitoring of a patient's vital signs and that aid in the surgical procedures. These instruments make surgery safer for the patient, and enable surgeons to perform operations with speed and precision that would be otherwise unattainable.

Medical Device Classification

Medical Device Examples

Anesthesia workstation



Infusion pump



Hemodialysis machine



Defibrillator

