



Al-Mustaqbal University College  
Department of Medical Instrumentation Techniques Engineering  
Class:Third  
Subject: Medical Instrumentation (II)  
Lecturer: Forqan Ali Wahhab  
Lecture: Introduction to Medical Instrumentation

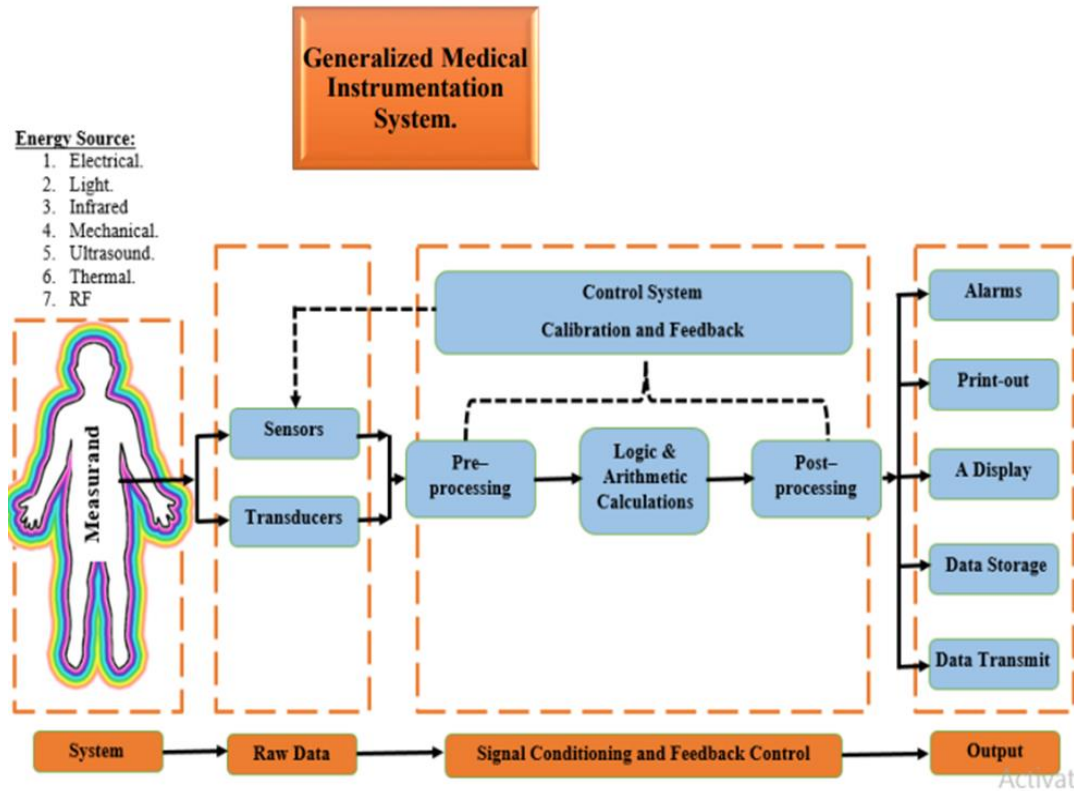
### ✓ WHAT IS MEDICAL DEVICE?

ACCORDING TO WHO: **MEDICAL DEVICE** MEANS ANY INSTRUMENT, APPARATUS, IMPLEMENT, MACHINE, APPLIANCE, IMPLANT, REAGENT FOR IN VITRO USE, SOFTWARE, MATERIAL OR OTHER SIMILAR OR RELATED ARTICLE, INTENDED BY THE MANUFACTURER TO BE USED, ALONE OR IN COMBINATION, FOR HUMAN BEINGS, FOR ONE OR MORE OF THE SPECIFIC MEDICAL PURPOSE(S) OF:

- DIAGNOSIS, PREVENTION, MONITORING, TREATMENT OR ALLEVIATION OF DISEASE,
- DIAGNOSIS, MONITORING, TREATMENT, ALLEVIATION OF OR COMPENSATION FOR AN INJURY,
- INVESTIGATION, REPLACEMENT, MODIFICATION, OR SUPPORT OF THE ANATOMY OR OF A PHYSIOLOGICAL PROCESS,
- SUPPORTING OR SUSTAINING LIFE,
- CONTROL OF CONCEPTION,
- DISINFECTION OF MEDICAL DEVICES
- PROVIDING INFORMATION BY MEANS OF IN VITRO EXAMINATION OF SPECIMENS DERIVED FROM THE HUMAN BODY



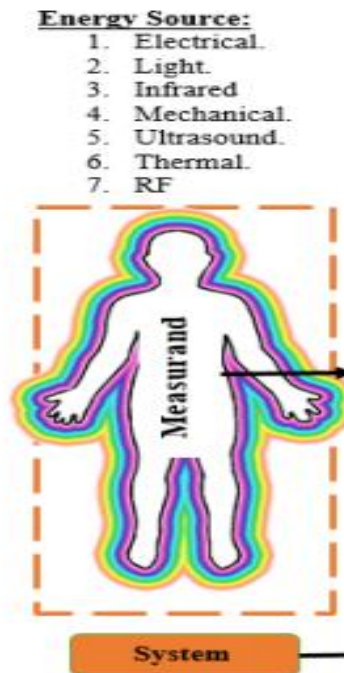
### ✓ Generalized Medical Instrumentation System





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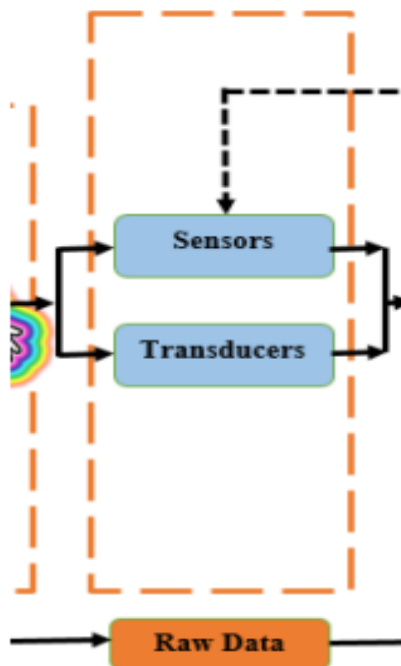
The **physical** amount, property, or state what the system measures is called the Measurand. The availability of the Measurand is significant because it may be internal (blood pressure), it may be on the body surface (electrocardiogram potential), it may originate from the body (infrared radiation), or it may be derived from a tissue sample (such as blood or a biopsy) that is removed from the body. Most medically essential Measurand can be grouped in the following classes: biopotential, pressure, flow, dimensions (imaging), displacement (velocity, acceleration, and force), impedance, temperature, and chemical concentrations. The Measurand may be restricted to an exact organ or anatomical structure.





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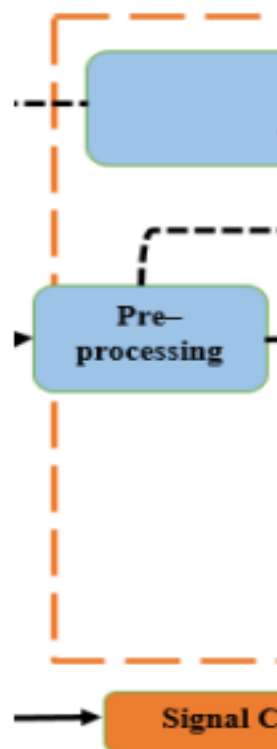
Commonly the term transducer is defined as a device that convert one form of energy to another. A sensor converts a physical Measurand to an electric output. The sensor should respond only to the form of energy present in the Measurand, to the elimination of all others. The sensor should interface with the living system in a method that reduces the energy extracted, while being minimally invasive. Many sensors have a primary sensing element such as a diaphragm, which converts pressure to displacement. A variable conversion element, such as a strain gage, then converts displacement to an electrical voltage. Sometimes the sensitivity of the sensor can be adjusted over a wide range by altering the primary sensing element. Many variable conversion elements need external electric power to obtain a sensor output.





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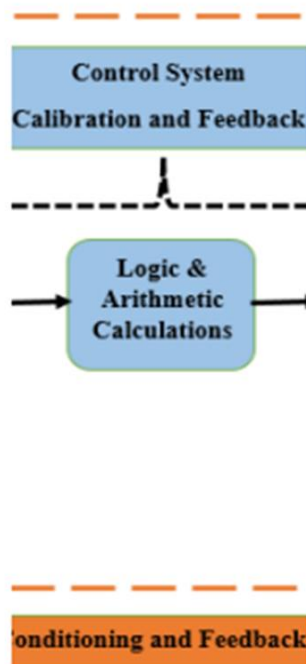
Usually the sensor / transducer output had a range of millivolts, which needs to be amplified initially and processed finally. The gain of the amplifier on this stage depends strongly on the next stage requirements, often the output are converted to digital form and then processed by specialized digital circuits or a microcomputer as there will be logic and arithmetic units.





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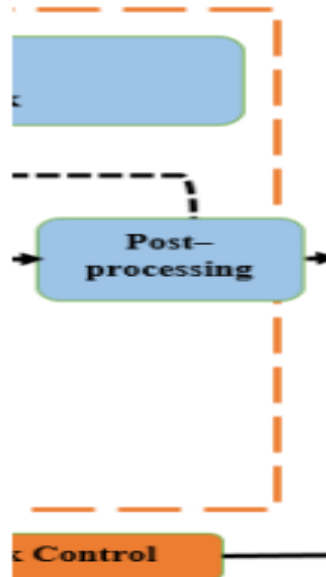
Basic and complicated modes of calculations for the raw amplified data gathered from the patient's body through the sensor / transducer are done on this element . For example, signal filtering adjustment, based on operator selection mode, mathematical manipulation between inputs to calculate required parameter and so on .



Processing here to final output elements, either based on manipulating the signal to match the requirement of the output elements or to adjust the scale of time, frequency and signal level for the real shape mode. Specialized digital circuits or a microcomputer is example, to average repetitive signal to reduce noise, or it may convert information from the time domain to the frequency domain, is a good example of it.



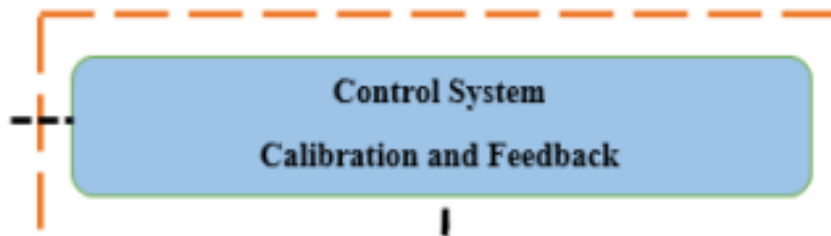
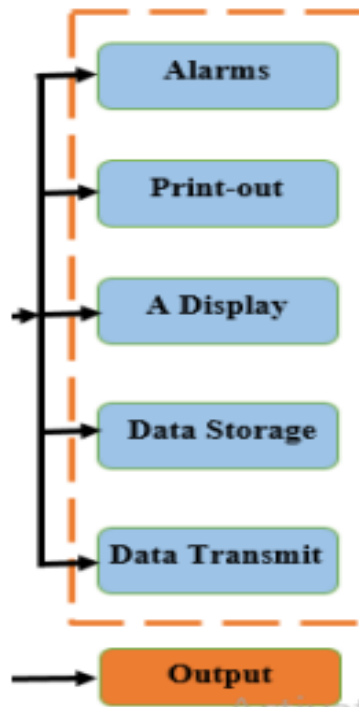
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The results of the measurement procedure must be demonstrated to an arrangement that the human operator can identify. The finest form of the display may be arithmetical or graphical, discrete or continuous, long-lasting or brief, depending on the specific Measurand and how the operator will use the evidence. Although most displays depend on our past experience, some information (Doppler ultrasound signals, for example) is best perceived by the other senses (here, the auditory sense). The different modes suggested in Figure (2) are almost used in most of the medical devices, either alone or by matching number of them according to the device design criteria.



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A calibration signals with the properties of the Measurand should be applied to the sensor / transducer input or as early in the signal – processing series as possible. Many form into control and feedback may be requisite to elicit the Measurand, to fine-tune the sensor and signal conditioner, and to direct the flow of output for display, storage, or transmission. Control or feedback may be automatic or manual. Data may be stored concisely to meet the requirements of the signal





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conditioning or to allow the operator to examine data that precede alarm conditions. Otherwise, data may be stored before the signal conditioning, so that different processing arrangements can be used. Conventional principles of communications can often be used to transmit data onto remote displays at nurses' stations, medical centers, or medical data – processing facilities.