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Computer Engineering
Measurement and Instrumentation.
EEE 319

1. Describe briefly (with examples) Sensors and Actuators for Biomedical Applications.

Actuators for biomedical applications

In the biomedical field when preforming a surgery on very small parts of the human body. The doctor in the past would have followed an habitual process of which the accuracy of the results could be very low. Periodic advancements have brought increased accuracy with the help of small actuators & sensors.

Actuators are output transducers that control systems use to affect the environment that it (the system) controls. Actuators are considered output devices as they provide an outward relationship from the computer to the environment. In biomedicine blood pumps and pacemakers are common actuators

A blood pump adds pressure to the blood flow in the circulatory system. It is used to either pump blood through a dialysis machine to or to pump blood through the circulatory system when the heart is unable to do so. On type of blood is the Centrifugal blood pump, which pumps by the use of a spinning rotor to pump blood through centrifugal action through an outlets at the circumference of the pump. The artifical pacemaker regulates the heart pumping dynamics through a series of output electric signals that stimulates the cardiac muscles of the heart.

Examples of biomedical inclined actuators

- Actinol
- Laser techniques to remove stenoses
- Small pill.
- Dialysis machines
- Ventilators.

Sensors for Biomed

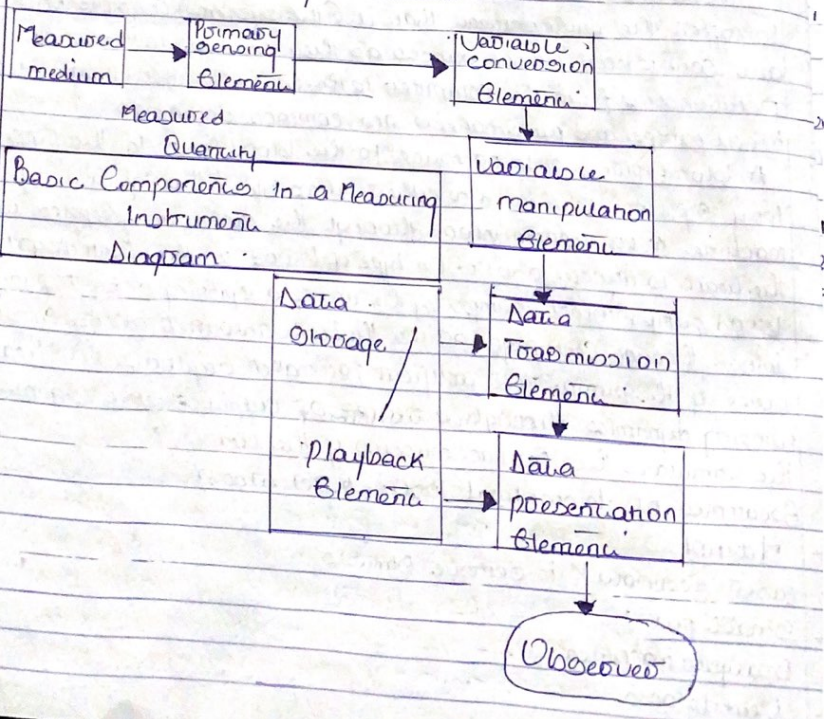
Sensors are critical components in all devices and measurement system. Defining the term sensors is tough so instead we use the definition of an electrical transducer. A device which provides a usable output in response to a specified measured. Sensors consist of sensing components, converting devices & electronic circuits.

Sensor characteristics include: measurement range, sensitivity, accuracy, precision, resolution, reproducibility, offset, linearity etc.

Examples

- Heart sound sensor
- Blood flow sensor
- Electrochemical electrode
- Oxygen & CO_2 sensor for blood
- Respiratory sensor

2 Describe with sketches and examples, of the components of a basic measuring instrument



The measured medium: This is the medium that is being measured.

Primary Sensing element: This first receives energy from what is being measured and produces an output depending on the measurement. The output is usually a physical variable eg displacement or voltage.

Variable Conversion element: The output signal of the primary sensing element needs to be converted to a more suitable variable while preserving the information content of the original signal this component is used

Variable manipulation Element: If an instrument needs a signal represented by a physical variable to be manipulated, manipulation meaning specifically a change in numerical value according to a definite rule but a preservation of the physical nature of the variable. This component performs that function.

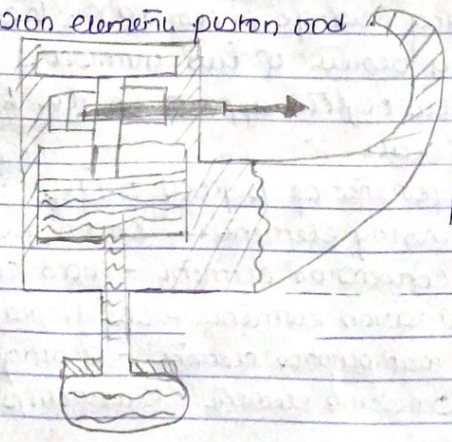
Data Transmission Element: This components transmits data from one component to another in a measuring instrument.

Data Presentation Element: This component is what displays the information gotten from the measured in a way recognizable.

Data storage/playback Element: Some instruments have distinct data storage which an easily accessible data stored on demand

Examples in a pressure guage.

1 Variable transmission element linkage.
2 primary Sensing element piston
3 Variable Conversion element piston
4 Measurement fluid
5 Variable transmission element piston rod



pressure guage.

3. Describe briefly case studies of two medical measurement instruments.

1. Electronic Thermometers : are based on the idea that the resistance of a piece of metal changes as the temperature changes. As metals get hotter atoms ~~vibrate~~ vibrate more inside them, this loaders for electricity to flow and the resistance increases and vice versa. It works by putting a voltage across the metal probe and measuring how much current flows through it. If the probe is put in boiling water the water's heat makes electricity flow through the probe easily so the resistance goes up by a precisely measurable amount. A microchip inside the thermometer measures the resistance and converts it into a measurement of temperature.

Basic components of Electronic thermometer

- primary sensing element - probe
- Variable conversion element - microchip
- Data Transmission element - microchip
- Variable manipulation element - microchip.

Digital scale : works with the use of strain guage load cell then converts the force of a weight to an electric signal. The key components are the strain guage used to measure the strain of an object, a loaded sensor used to convert a force into an electric signal. The load cell is also known as a force transducer. The load cell sensor then converts the deformation to an electric sign Because the load cell has an electric charge as it moves downwards, the electrical resistance changes. The resulting change in resistance becomes an electric signal. As a result of this numbers indicating the weight of the object appear on the LCD display of the digital scale.

Basic component of Digital scale

- Primary Sensing element - Strain guage
- Variable conversion element - load cell sensor
- Data presentation element - LCD display
- Variable manipulation element - analog to digital converte
- Data transmission element - Microchip.