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18/ENG02/042
EEE 319 – Measurement and Instrumentation.
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1. Describe briefly (with examples) sensors and actuators for biomedical Applications.

A sensor tends to convert a physical attribute to an electrical signal. An actuator does the opposite. It changes an electrical signal to a physical action. This is a very critical components in all devices and measurement system. They are widely used in fields of medicine, science, environmental monitoring, etc.

Biomedical sensors are used in medicine and biotechnology. They are tools that detect specific biological, chemical or physical processes and then transmit or report this data. They can be classified into chemical sensors, physical sensor and biosensor.

Applications of sensors include:

i They produce data in a raw format. From the data integration and usability perspective, this raw data may not be acceptable to other heterogeneous systems.

ii The MIP sensor can be used for defence and security: The rapid detection of chemical and biological agents can be used ~~for~~

iii Portable multiparameter bedside monitoring appliances are available for intensive care.

iv Sensor based systems can replace the function of human sensing organs like hearing aids, tactile sensing in artificial limbs.

v Referral for recommendations for initiating exercise program for dialysis.

vi Diabetes medication

vii Handy ~~applications~~ appliances are available on the market for personal and home monitoring or diagnostics.

An actuator is a component of a machine that is responsible for moving and controlling a mechanism. It turns a control signal into mechanical action such as an electric motor. Actuators may be based on hydraulic, pneumatic, etc means but are driven by software. Actuators and sensors often work together in maintainance applications, either the sensor sends the signal and the actuator performs the action or an actuator movement triggers a sensor to send an alert or vice versa.

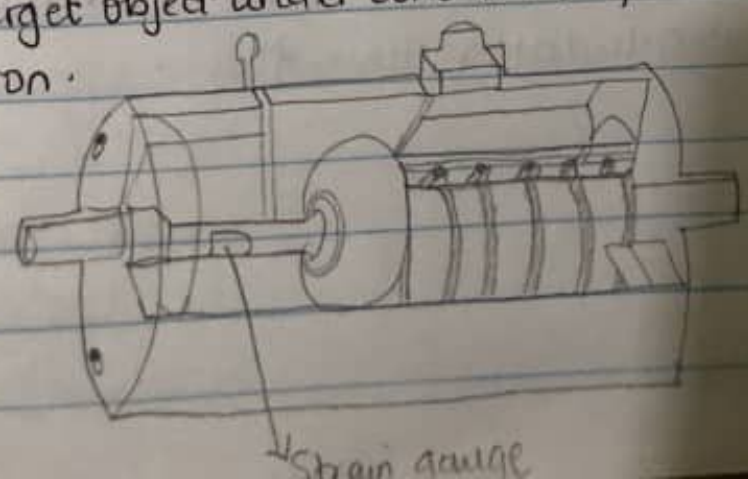
Examples of sensors and actuators are:

- Electric actuators
- Blood pressure sensor
- Respiration sensor
- Solenoids
- Comb drives
- Hard drive stepper motors
- Electric motors

2 Describe with sketches and examples of the components of a basic measuring instruments.

i Torque Transducers:

The torque transducer convert torsion corresponding to a torque of the shaft to an electric quantity and then output signals through slip ring, brush and photo transmittance. They ensure accurate and easy measurement of the torque transmitted from the target object under conditions of standstill to high speed rotation.



ii Digital indicator

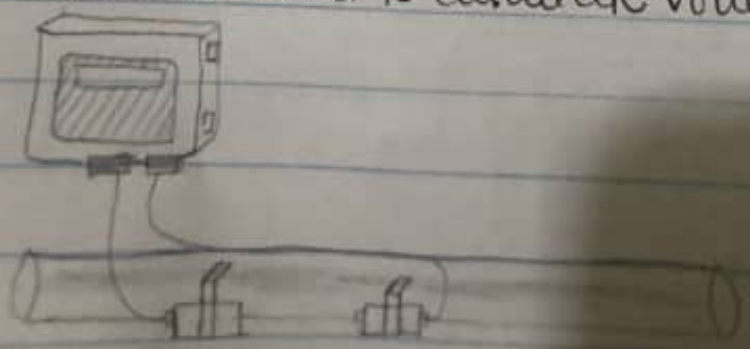
These are flexible devices which can be used in many different fields such as industry and research as well as for a wide variety of measurement work. They allow the user to view diverse parameters such as temperature, vibration, etc. Electric digital indicators switch from inch to mm and include a hold feature to lock peak readings on the display

iii Force sensor

Force sensors use load cells to weigh objects and prevent machinery from overloading. At the core of force sensors are load cells, transducers that convert force into measurable electrical output.

iv Ultrasonic flow meter.

This is a type of flow meter that measures the velocity of a fluid with ultrasound to calculate volume flow.



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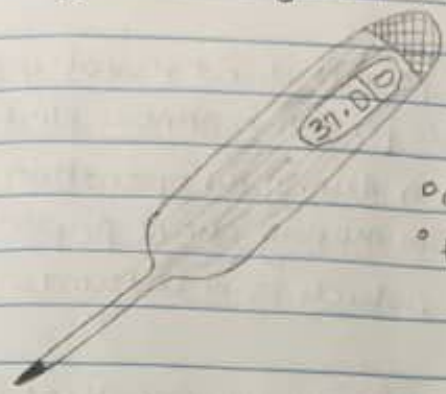
1/ Thermometer: This is a device that measures temperature or a temperature gradient. It has two important elements: A temperature sensor in which some change occurs and some means of converting this change into a numerical value.



°CELSIUS
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3/ Describe briefly case studies of two medical measurement instruments

Endoscope:

This is an instrument (a nonsurgical one) used to examine a person's digestive tract. Using an endoscope, a flexible tube with a light and camera, pictures of a digestive tract can be displayed on a color TV monitor. There is no standardised method for the evacuation of gastric phytobezoars.

* Three consecutive patients with large gastric bezoars were examined. Phytobezoar removal using a standard endoscope was attempted but unsuccessful. Each phytobezoar was successfully evacuated by directed suction through an endoscope with a large diameter accessory channel.

Result:

Complete and rapid bezoar evacuation was achieved at one session in all patients. Aspirated volumes were 500 and 1000 ml. There was no procedure-related complications involved.

Conclusion:

The endoscopic suction removal of gastric phytobezoars using

a large-channel endoscope compiling directed endoscopic suction with other endoscopic techniques might be effective in the removal of more complex bezoars.

* Cardioscope

This is an instrument that permits direct visual inspection of the interior of the heart. This permits continous electrocardiographic observation of the heart's action during an operation. The recording is monitored by a tracing on slow moving chart paper or by observing it on a cardioscope, which is a cathode ray tube display.

* Two patients with heart problem were examined. The main cause of the problem was not known fully using But successfully, it was known using the cardioscope which displayed the heart on a monitor

Result:

A complete scan and detection of the heart and its problem was carried out and achieved as no procedure related problems were involved.

Conclusion:

The use of a cardioscope in detecting and seeing through the heart might be very effective.