RAJI UMMU-SALMA ONIZE
18/ENG08/020
BIOMEDICAL ENGINEERING
BME 311 ASSIGNMENT
QUESTION

1. Describe briefly (with examples) Sensors and Actuators for biomedical applications.

Sensors are very critical components in all devices and measurements systems. They have been widely used in a lot of fields such as science, medicine, automated manufacturing, environmental monitoring and so on.

Biomedical sensors enable the detection of biologic events and their conversion to signals. Sensors convert one type of quantity, such as temperature, into an equivalent signal of another type of quantity. It also takes biomedical variables and usually convert them into an electrical or optical sign. As such, the biomedical sensor serves as an interface between a biological and information system. Applications of sensors includes/

- Sensors have enabled us to develop computer based medical imaging tools that could not be available without them, such as computer tomography, ultrasound echography and many others.
- Sensors may also bring a great development in conventional imaging tools, like x-ray photography, by getting more information with smaller radiation doses.
- Portable multiparameter bedside monitoring appliances are available for intensive care.
- Handy appliances are available on the market for personal and home monitoring or diagnostics
- Sensor based systems can replace the function of human sensing organs, like artificial retina, hearing aids, tactile sensing in artificial limbs. etc
- Rapid diagnostic tool have emerged recently based on immunosensors

and DNA-chips.

An actuator drives the events within the equipments. It takes an electrical signal and combines it with an energy source to create physical motion. An actuator may be pneumatic, hydraulic, electric, thermal, or magnetic. For example, an electrical pulse may drive the functioning of a motor within an asset.

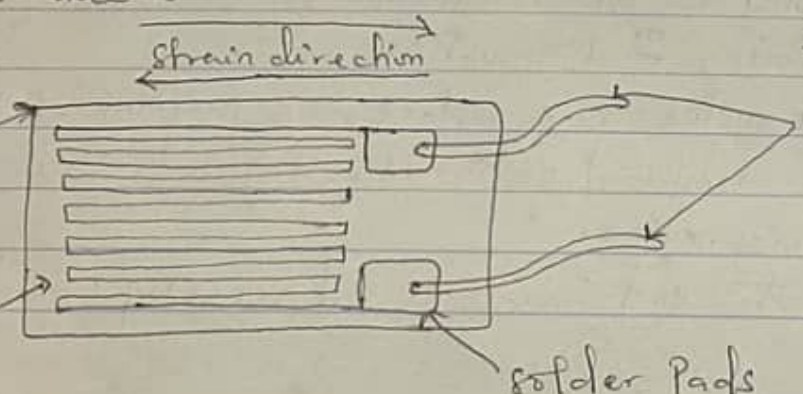
Actuators and sensors often work together in maintenance applications; either the sensor sends the signal and the actuator performs the action, or an actuator movement triggers a sensor to send an alert. Examples of sensors and actuators include:-

a. Respiration sensor
b. Blood pressure sensor
c. Heart sound sensor
d. Oxygen and carbondioxide sensor for blood
e. Spring actuators
f. Hydraulic actuators
g. Electric actuators
h. Biosensor
i. Scanners:- CT, MRI and PT scanning instruments are used in the hospitals, clinics and palliative care units for examination and diagnosis purposes. These scanners are powered with linear actuators which allow easy movement and direction
j. Linear actuators help control the accuracy and positioning of the beam in the laser positioning equipment.

~~2. Describe, with sketches and examples of the basic measuring instrument~~

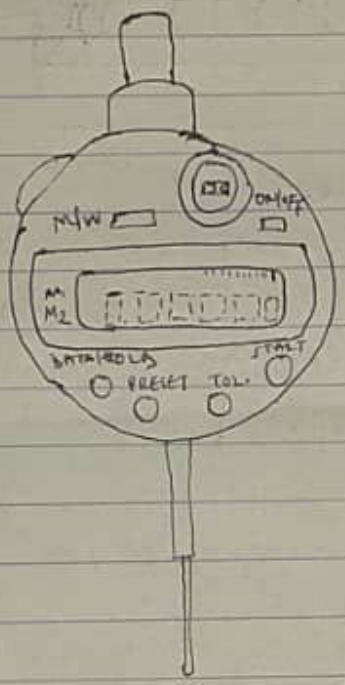
2. Describe with sketches and examples of the components of a basic measuring instrument.

a. Strain guages



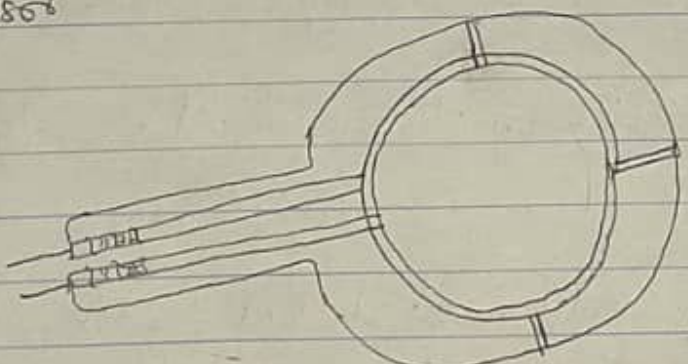
A strain guage is a sensor whose resistance varies with applied force. It converts force, pressure, tension, weight into a change in electrical resistance which can then be measured. A typical example of a strain gauge is the type used for measuring force in industrial environments is 15 mV/V at 1000 pounds. That is, at exactly 1000 pounds applied force, the bridge will be unbalanced by 15 millivolts for every volt of the excitation voltage.

b. Digital indicator



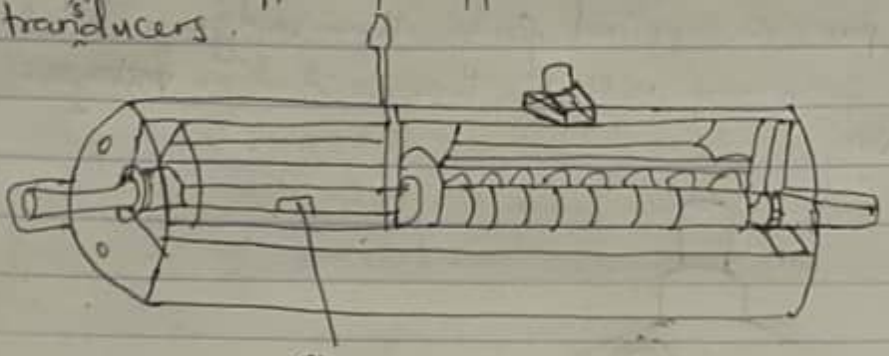
Digital indicators are flexible devices which can be used in many different fields such as industry and research, as well as for a wide variety of measurement works. This devices allow the user to view diverse parameters such as temperature, humidity, normalized signals, vibrations

c. Force sensor



A force sensor measures the tension and compression forces which act on the sensor and is also referred to as a force transducer. Some examples of force sensors are load cells, pneumatic load cells, hydraulic load cells. There are many types of force sensors available for different types of applications.

d. Torque transducers.



The sensor for torque measurement in various driving parts like the engine and the transmission. This sensors measures the twist with a strain guage, and transmits the output signals by using a transformer, or by using an optical sensor.

e. Load cells.

A load ~~sensor~~ cell is a transducer which converts force into a measureable electrical output. A load cell measures mechanical force, mainly the weight of objects. Examples of load cells include :- Tension load cells, compression load cells, beam load cells.

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

a. Dialyser.

A case study on 67-year old male diabetic with end-stage renal disease receiving dialysis. The objective was to provide physical therapy

intervention to a patient receiving dialysis. The patient's chief complaints included decreased balance, loss of sensation, fear of falling, and decreased endurance during activities of daily living due to the effects of dialysis treatment. The dialyser is going to remove impurities from the blood of ~~patients in~~ the patient.

Medical diagnosis

- ESRD on dialysis
- GRF (glomerular filtration rate) - 13mL/min
- Referral for recommendations for initiating exercise program for dialysis

Medications:-

- Diabetes medication
- Hypertension medication
- Depression medication

Conclusion

Using the dialyser for dialysis treatment, the patient are at a high risk of impaired physical function and mobility which are strong predictors of disability, hospitalization, falls and death and are often associated with poor outcomes.

b. Endoscope

There is no standardized method for the evacuation of gastric phytobezoars. Prior endoscopic attempts have used injected cellulase and various devices to disrupt bezoars.

Methods

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. Each patient was followed up for bezoar recurrence.

Results:-

Rapid, complete bezoar evacuation was achieved at one session in all patients. Aspirated volumes were 500, 700 and 1000 mL. There were no procedure-related complications.

Conclusion:-

Endoscopic suction removal of gastric phytobezoars using a large-channel endoscope is efficacious and safe. Coupling directed endoscopic suction with other endoscopic techniques might be efficacious of removal of more complex bezoars.