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18/ENG02/031
COMPUTER ENGINEERING
EEE 319 ASSIGNMENT

1 Biomedical Sensors

These are special electronic devices that are capable of ~~trad~~ transducing biomedical signals into easily measurable electric signals. They also act as key components in various medical diagnostic instruments.

Sensor Classification

These biomedical sensors can be classified into four types which are physical, chemical, electrical (biopotential electrodes) and bioanalytic (aka biosensors). Biosensors is considered as a special subclassification of biomedical sensor they are a group of sensors that have 2 distinct components: a "biological recognition element" and "a supporting structure" which also acts as a transducer. Look at the classification below.

	Class of Sensor	Biomedical Sensors involved
1.	Physical Sensors	Geometric, Mechanical, Thermal, Hydraulic etc
2.	Chemical Sensors	Gas, Photometric, Electrochemical etc
3.	Biopotential Electrodes	Microelectrode, metal plate, etc
4.	Biosensors	Enzymes, proteins, Cells, Antibodies, etc

Examples of Sensors for Biomedical Application

Here are some examples of sensors used to perform some of the major biomedical operations today:-

i) **Oxygen and Carbon dioxide sensors for blood:-** These are non-invasive sensors for measuring O_2 and CO_2 in arterial blood

ii) **Heart Sound Sensor:-** Expansion and shrinkage of heart results in vibration of artery that is formed by blood turbulence in the vein. When that vibration is transpired to the surface of thoracic cavity, the heart sound is discovered by the heart sensor. It helps doctors diagnose many kinds of diseases in the body

iii) **Blood flow Sensor:-** There are two methods in which the blood flow sensors operates: One method is direct measurement, where this sensor is inserted into the blood pipe to sense transient blood flow. The indirect method places the blood flow sensor outside the vein and senses blood flow by the parameter related to blood flow.

iv) **Respiration Sensors:-** It is used in sensing and monitoring respiration of a patient and is also critical as it is an important basis of clinic diagnosis and necessary for patients in the field of surgery. The respiration system can be classified into 3 parameters which are respiration frequency, respiration flow and lung respiration volume.

v) Blood Pressure Sensor:- Doctors that use equipment to check blood pressure are helped with the use of this sensor since it is able to sense blood pressure.

1b Biomedical Actuators

These are smart actuators utilized as a part of biomedical field which are useful in biomedical applications when biological objects or their environment need to be controlled on the microscopic scale. Furthermore, the ability to integrate many microactuators as easily as only one makes it feasible to produce complex microsystems capable of controlling many parameters

Examples of Actuators for Biomedical Application

i) Micromanipulators:- To manipulate cells, and other biological objects, micromanipulators must be driven by a micro-actuation mechanism capable of ~~condu~~ operating in a conductive solution.

ii) Surgical Microinstruments:- A scapel driven by a piezoelectric microactuator is an innovative example of using MEMS (Micro-Electro-Mechanical Systems) Technology in surgical tools. By integrating an ability to measure the stresses experienced by the scapel during cutting, the actual cutting force can be quantified and controlled

iii) Microfilters:- MEMS technology has been used to realize filters that are precisely and uniformly machined, which

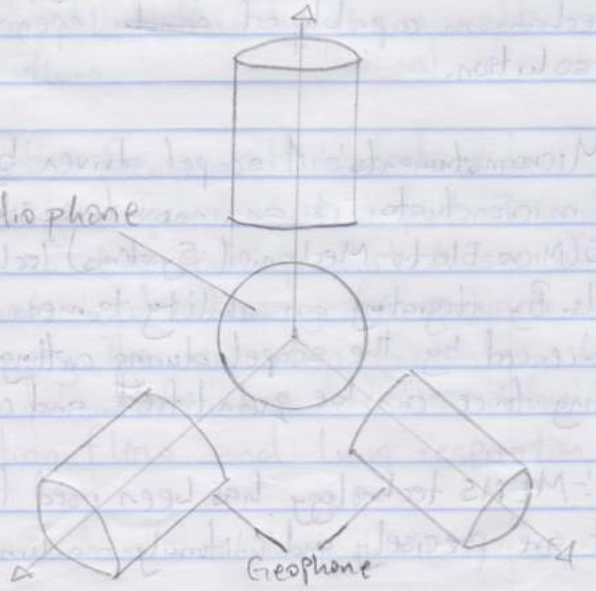
greatly reduces statistical variation in objects that pass through

iv) Microneedles:- The reduction in pain caused by needle insertion is important for patient satisfaction and health and so Micromaching MEMS has been used to produce silicon microneedles that are much sharper than existing needles.

2 Components of a Measuring Instrument:-

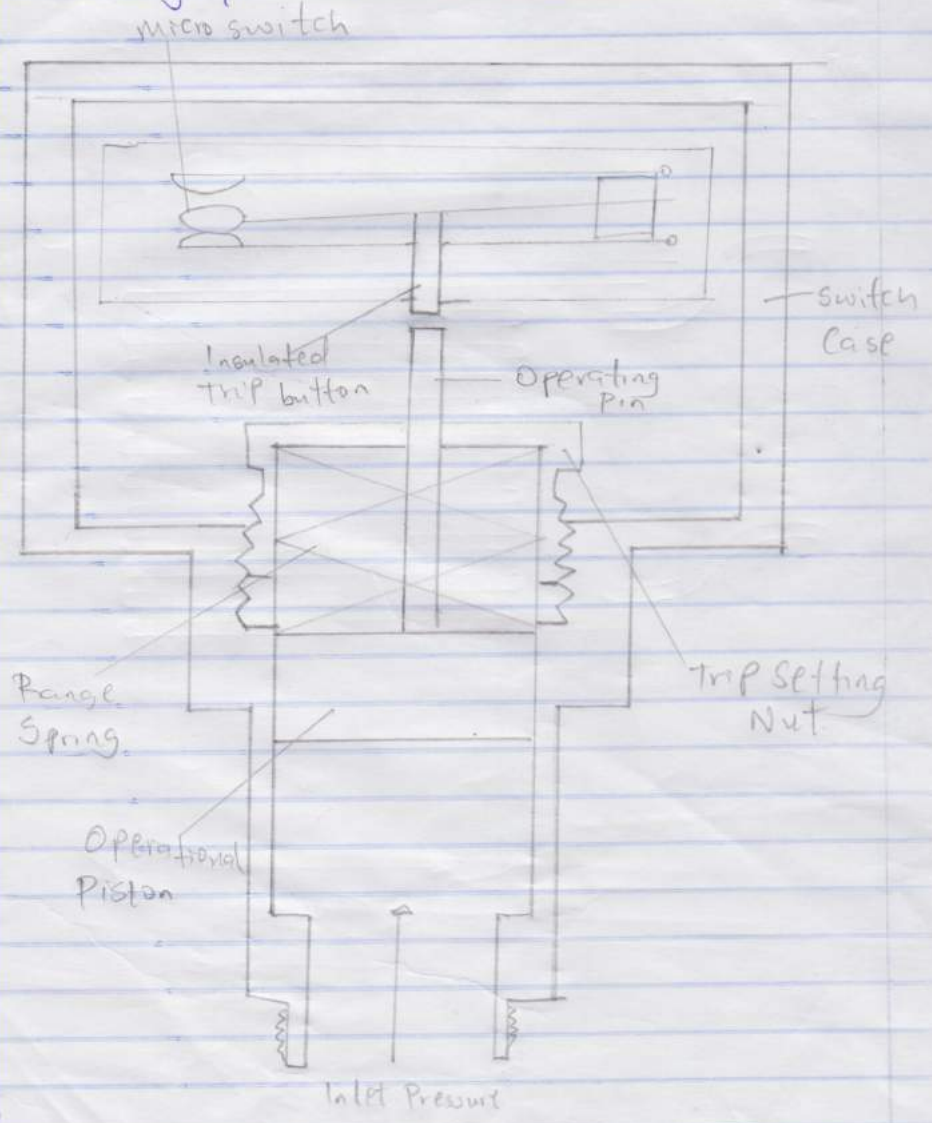
2.1 Vector Sensors

The vector sensor is a sensor that detects the translation power in three directions. The sensor can miniaturize because of a simple structure and is the best for the usage of the gripping force detection, etc. The direction of power can be detected by using the vector sensor. The output to the control machine can easily be connected by using a special transmitter



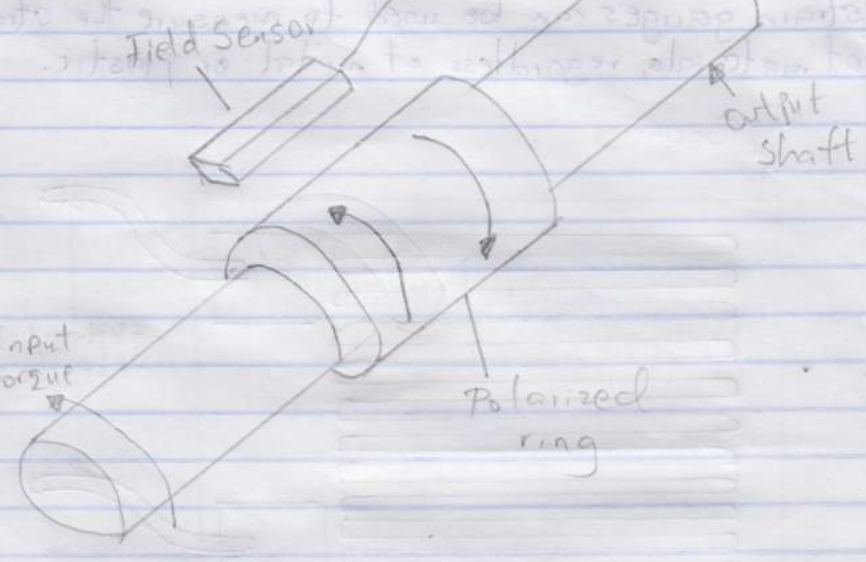
ii Pressure Sensors:-

It is a device for pressure measurement of gases or liquids. Using Silicon On Sapphire technology or strain gage, these high-accurate and prolonged stability-type pressures sensors are sensors that measure pressure as electric signals. Connecting them to various devices for measurement, the sensors can perform, displaying, recording, monitoring pressure, etc.



iii) Torque Transducers

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

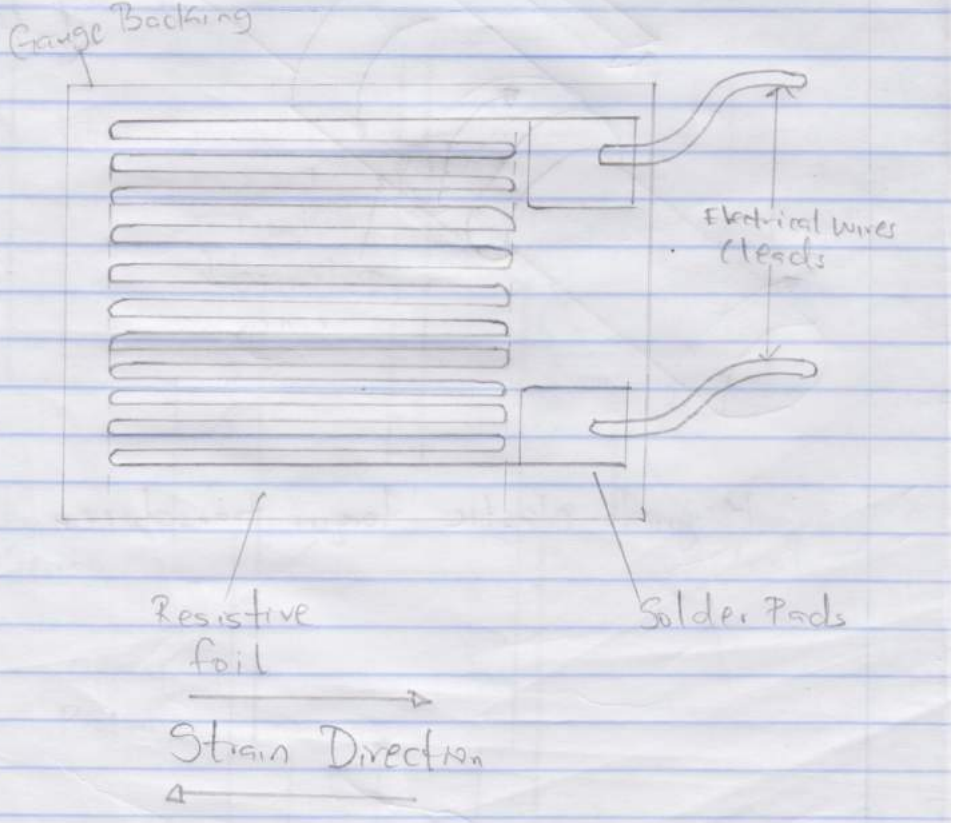


Magneto-elastic torque transducer

iv) Strain Gauge

They consist of a very fine and thin metallic foil etched in a grid pattern, which is bonded to a device and used to measure the strain, or amount of deformation of the device when load or pressure is applied. The resulting ~~elect~~ electrical output is proportional to the strain.

Because these strain gauges are so small that they are negligible in mass, they excel in sensitivity, stability and fatigue with no inertial effect. The strain gauges can be used to measure the strain of materials, regardless of metal or plastic.



3i

Case Study of Medical Thermometer

A medical thermometer (also known as clinical thermometer) is used for measuring human or animal body temperature. The tip of the thermometer is inserted into the mouth under the tongue, or armpit, etc

History

The medical thermometer began as an instrument more appropriately called a water thermoscope, constructed by Galileo Galilei circa 1592-1593. It lacked an accurate scale with which to measure temperature and could be affected by changes in atmospheric pressure Italian ~~Sant~~ physician Santorio Santorio is the first known individual to have put a measurable scale on the thermoscope and wrote of it in 1625, though he possibly invented one as early as 1612.

Later on, two individuals switched from water to alcohol in the thermometer.

i) The earliest is Ferdinando II de' Medici, Grand Duke of Tuscany (1610-1670), who created an enclosed thermometer that used alcohol circa 1654.

ii) Daniel Gabriel Fahrenheit (1686-1736), a Polish-born Dutch physicist, engineer, and glass blower, made contributions to thermometers as well. He created an alcohol thermometer in 1709 and later innovated the mercury thermometer in 1714. Mercury, he found, responded more quickly to temperature changes than the previously used water.

Farenheit also created the temperature scale which is named after him, having recorded the system in 1724 The scale is still only mainly used for everyday applications in the United States, its territories and

associated states as well other places.

Classification by location

a) Oral :- Taken by ~~taking~~ putting the thermometer securely under the tongue. ~~which~~

b) Armpit :- ~~Take~~ Done by putting thermometer tightly under the armpit

c) Rectal :- The use of rectal thermometer is used in taking temperature from the rectum

d) Ear :- The use of ear thermometer is used to take temperature reading as close to the brain's temperature.

e) Forehead :- Temporal artery thermometers and plastic strip thermometers are used here.

ii) Case Study of Sphygmomanometer

A sphygmomanometer (a.k.a. blood pressure gauge) is a device used to measure blood pressure, composed of an inflatable cuff to collapse and then release the artery under the cuff in a controlled manner, and a mercury or aneroid manometer to measure the pressure. Manual sphygmomanometers are used with a stethoscope when using the auscultatory technique It consists of an inflatable cuff, a measuring unit and a mechanism for inflation which may be a manually operated bulb and valve or a pump operated electrically

History

The sphygmomanometer was invented by Samuel Siegfried Karl Ritter von Basch in the year 1881. It was later that a new version was introduced in Scipione Riva-Rocci in 1896. In 1901, a pioneering neurosurgeon Dr. Harvey Cushing brought an example of the device to US, modernized it and popularized it within the medical ~~comput~~ community. Further improvement came in 1905 when Russian physician Nikolai Korotkov included diastolic blood pressure measurement following his discovery of "Korotkoff Sound".

Operation

With a manual instrument, listening with a stethoscope to the brachial artery, the examiner slowly releases the pressure in the cuff at a rate of approximately 2 mm per heart beat. As the pressure in the cuff falls, a "whooshing" or pounding sound is heard, when blood flow first starts again in the artery. The pressure at which this sound began is noted and recorded as the systolic blood pressure. The cuff pressure is further released until the sound can no longer be heard. This is recorded as diastolic blood pressure. In noisy environments where auscultation is impossible (such as the scenes often encountered in emergency medicine), systolic blood pressure alone may alone ~~may~~ be read by releasing the pressure until a radial pulse is palpated (felt). In veterinary medicine, auscultation is rarely used, and palpation or ~~ultra~~ visualization of pulse distal to the sphygmomanometer is used to detect systolic pressure.

Digital instruments use a cuff which may be placed, according to the instrument, around the upper arm, wrist, or a finger, in all cases elevated to the same height as

the heart. They inflate cuff and gradually reduce the pressure in the same way as a manual meter and measure blood pressures by oscillometric method.

Types

There are two types namely; Manual and Digital Sphygmomanometers. The manual sphygmomanometer uses auscultation while that of digital meters employ oscillometric measurements rather than auscultation