SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
An Autonomous Institution

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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

19EET304/ IOT for Electrical Sciences

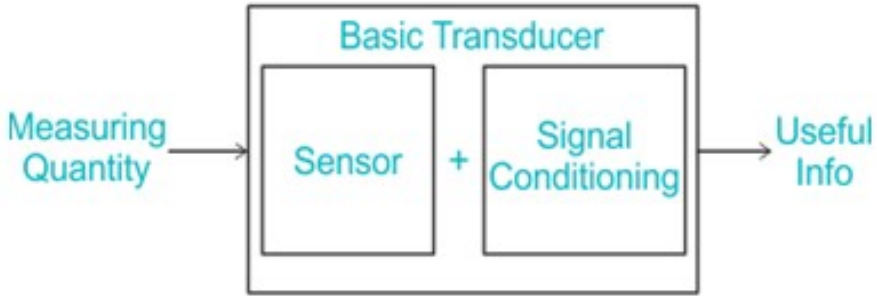
III YEAR VI SEM

UNIT 2 – SENSORS

TOPIC 5 – ELECTROSTATIC TRANSDUCER

TRANSDUCER

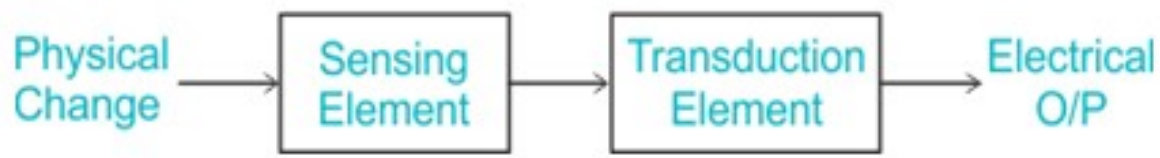
A transducer is defined as any electronic device that helps energy conversion from one form to the energy of another form. The energy is generally a signal of some form, it can be both an input or an output signal.



TRANSDUCER

•The Sensor part senses a particular type of energy. It gives a response according to the physical phenomenon that it senses. The response serves as the input for the transducing element.

•The Transducing part converts the energy sensed by the sensor into some other form of energy.



CHARACTERISTICS OF TRANSDUCER

- **Sensitivity:** This is a measure of **how much output** signal is produced for a given input signal.
- **Accuracy:** This is a measure of **how closely** the output signal matches the input signal.
- **Linearity:** This is a measure of **how well** the output signal **is proportional** to the input signal.
- **Frequency response:** This is a measure of the range of frequencies that the transducer can accurately reproduce.
- **Dynamic range:** This is a measure of the **difference between** the **largest** and **smallest** signals that the transducer can **accurately reproduce**.
- **Noise level:** This is a measure of the **amount of unwanted electrical** noise generated by the transducer.

CLASSIFICATION OF TRANSDUCERS

- Based on operating principle
- Based on the role of the trasnducing element
- Based on output signals
- Based on applications

Sensors and Actuators

Based on their applications, transducers are classified into:

Sensors: These transducers are used to **measure physical quantities**, such as temperature, pressure, and flow. Examples include **thermocouples**, strain gauges, and flow meters.

Actuators: These transducers are used to control physical systems, such as motors and valves. Examples include electric motors, solenoids, and piezoelectric actuators.

Transducer and Sensor

Transducers	Sensors
Transducers are devices that convert the energy of one form into another.	Sensors are devices that convert physical quantities into either a readable form or into electrical signals which are then used with transducers in tandem.
Examples are microphones, LVDT, LED, loudspeakers, etc.	Examples are pressure sensors, motion sensors, etc.

Transducer and Sensor

•In ultrasound machines convert the variations of sound energy into electrical output which can be read on a display.

•Microphones convert sound energy into electrical energy.

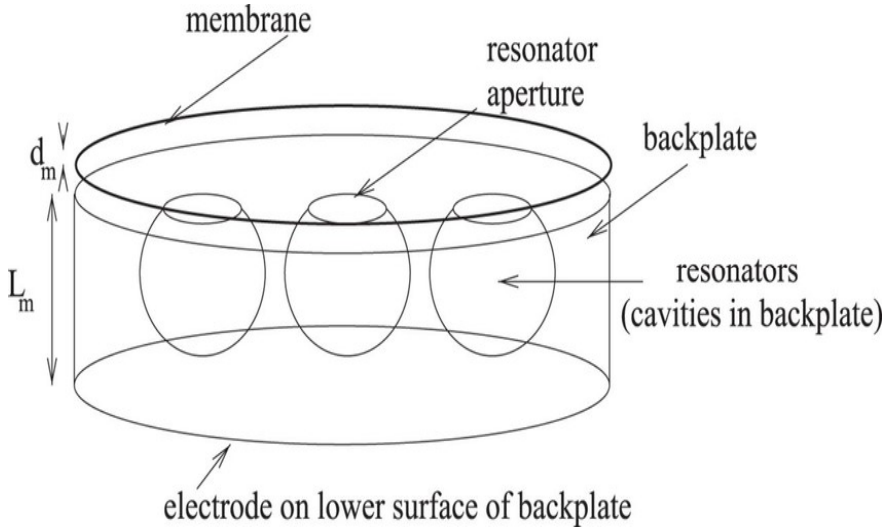
•Antennas where converts electromagnetic signals into electrical signals.

•In a digital RPM meter of a vehicle where transducers convert the torque produced by the engines into electrical signals which is further converted into readable data on the display.

ELECTROSTATIC TRANSDUCER

An electrostatic transducer comprising a vibrating plate or electret diaphragm which has a monocharge on its surface and including a pair of back electrodes clamping the electret there between and including an electrically conductive electrostatic shield covering the back electrodes so as to increase the fidelity and life of the transducer.

ELECTROSTATIC TRANSDUCER



ELECTROSTATIC TRANSDUCER

The stronger the charges on the stators, the greater the diaphragm displacement. This is how an electrostatic transducer translates an electrical audio signal into diaphragm motion to produce sound waves in the room.

WHAT IS THE DIFFERENCE BETWEEN PIEZOELECTRIC AND ELECTROSTATIC TRANSDUCER?

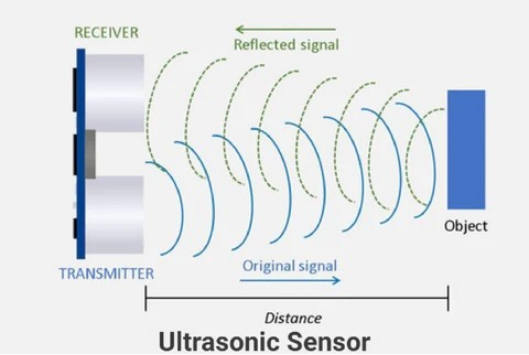
The main difference between the two is that piezoelectric transducers use a ceramic material whereas electrostatic transducers contain a thin metal membrane. While their materials differ, they both rely on the piezoelectric effect in order to function.

WHAT IS ULTRASONIC SENSOR?

Ultrasonic sensors are electronic devices that calculate the target's distance by emission of ultrasonic sound waves and convert those waves into electrical signals. The speed of emitted ultrasonic waves traveling speed is faster than the audible sound.

WORKING PRINCIPLE

Ultrasonic sensor working principle is either similar to sonar or radar which evaluates the target/object attributes by understanding the received echoes from sound/radio waves correspondingly. These sensors produce high-frequency sound waves and analyze the echo which is received from the sensor. The sensors measure the time interval between transmitted and received echoes so that the distance to the target is known.



Ultrasonic sensors

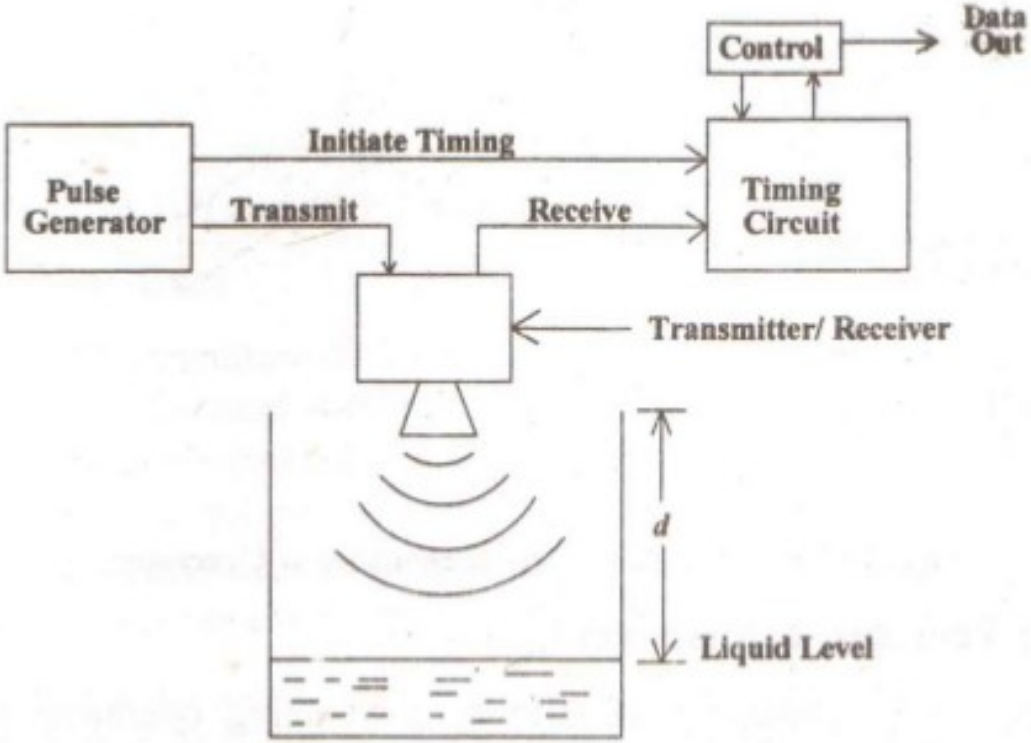


Figure 10.9 : Principle of an Ultrasonic Range Sensor

Ultrasonic sensor

- For continuous measurement of a level in a tank, floats are being replaced by ultrasonic range sensors,
- Ultrasonic sensors use pulses of sound to measure distance.
- A transmitter sends out a pulse, which is reflected against the fluid whose level is being measured.
- When the transmitter sends out the pulse, it simultaneously initiates a timer circuit that counts clock cycles.

Ultrasonic sensor

- A receiver, housed with the transmitter, receives the reflection of sound.
- The received signal terminates the timer and initiates the computation of distance.
- A microprocessor computes distance based on the speed of sound through the medium, typically air.
- The microprocessor may take several samples and compute and average to obtain a more accurate measurement.

Ultrasonic sensor

- The reflected signal will travel 2d during the period that the timer is on, del t.
- If v is the velocity of sound in the medium, the distance between transducer and liquid level is

$$d = v(2\Delta t)$$

ADVANTAGES

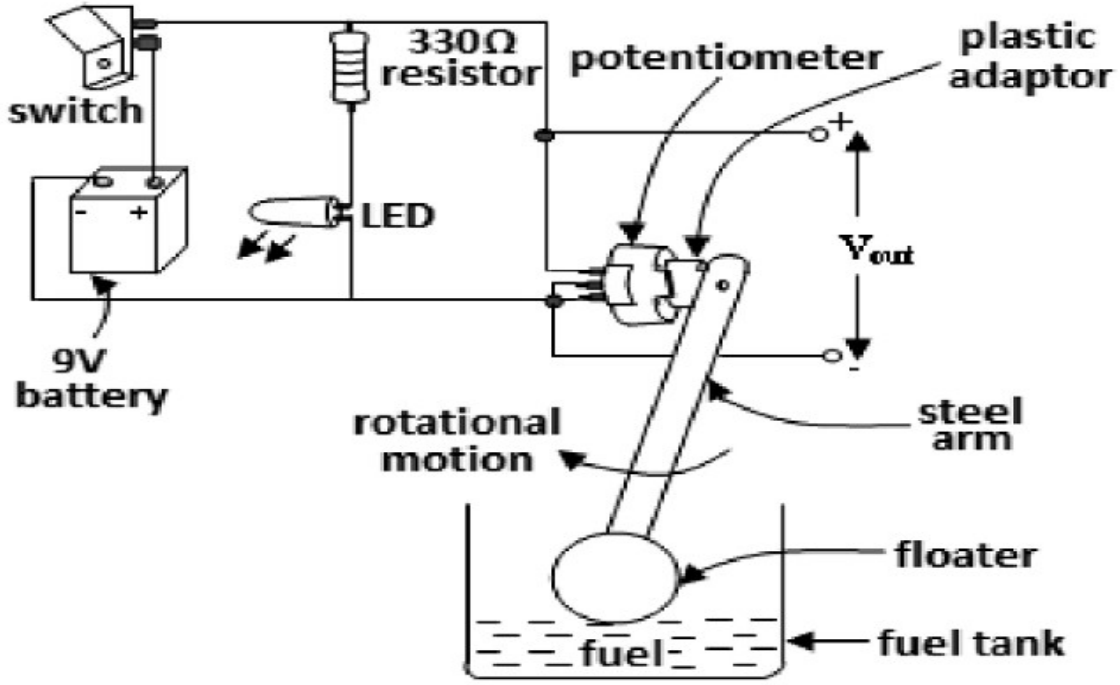
1. Capacitive sensing can sense diverse kinds of materials like metal, liquid, skin and plastic.
2. Capacitive sensing is wear-free and contactless.
3. With small sensor sizes, capacitive sensing has the capability to sense up to a large distance.
4. Capacitive sensing is a low power solution.

ASSESSMENT – 1

CAN YOU IDENTIFY THIS SENSOR?

ASSESSMENT – 2

Can you explain the circuit?



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Thank You