SNS COLLEGE OF TECHNOLOGY

Coimbatore-35

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

23ECE304-SMART SENSORS AND DEVICES

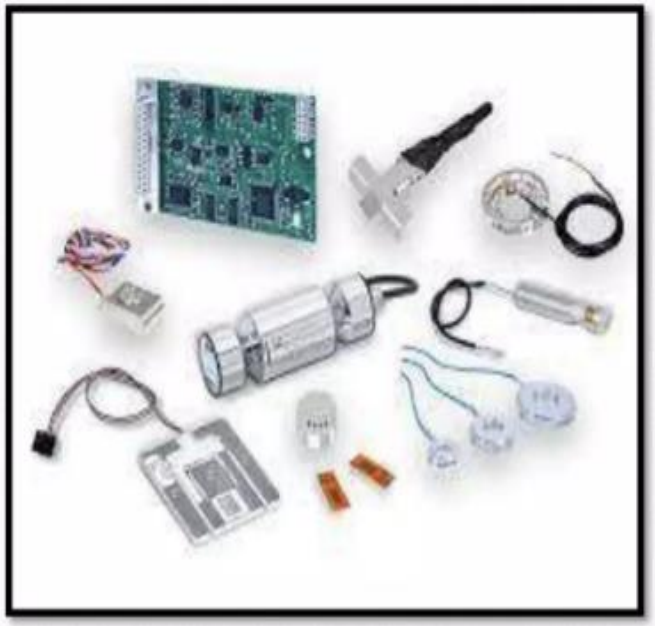
III ECE / V SEMESTER

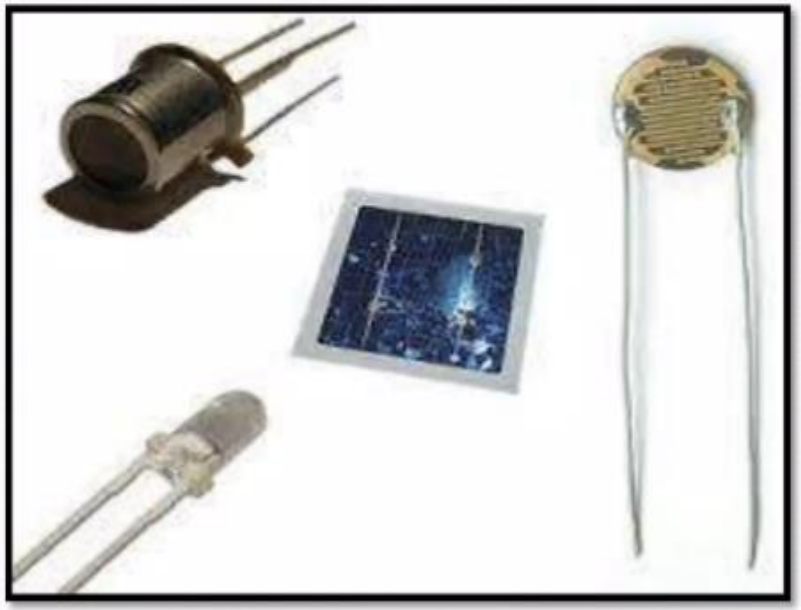
UNIT 1 – OVERVIEW OF MEASUREMENTS AND SENSORS

TOPIC –SENSOR FUNCTIONS AND CLASSIFICATION

What is a Sensor?

A device which detects or measures a physical property and records, indicates, or otherwise responds to it is called sensor





What is a Sensor?

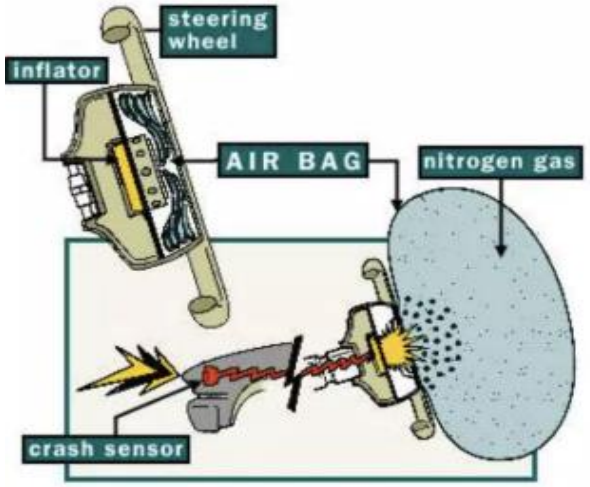
Touch Sensor

Ultrasonic Sensor

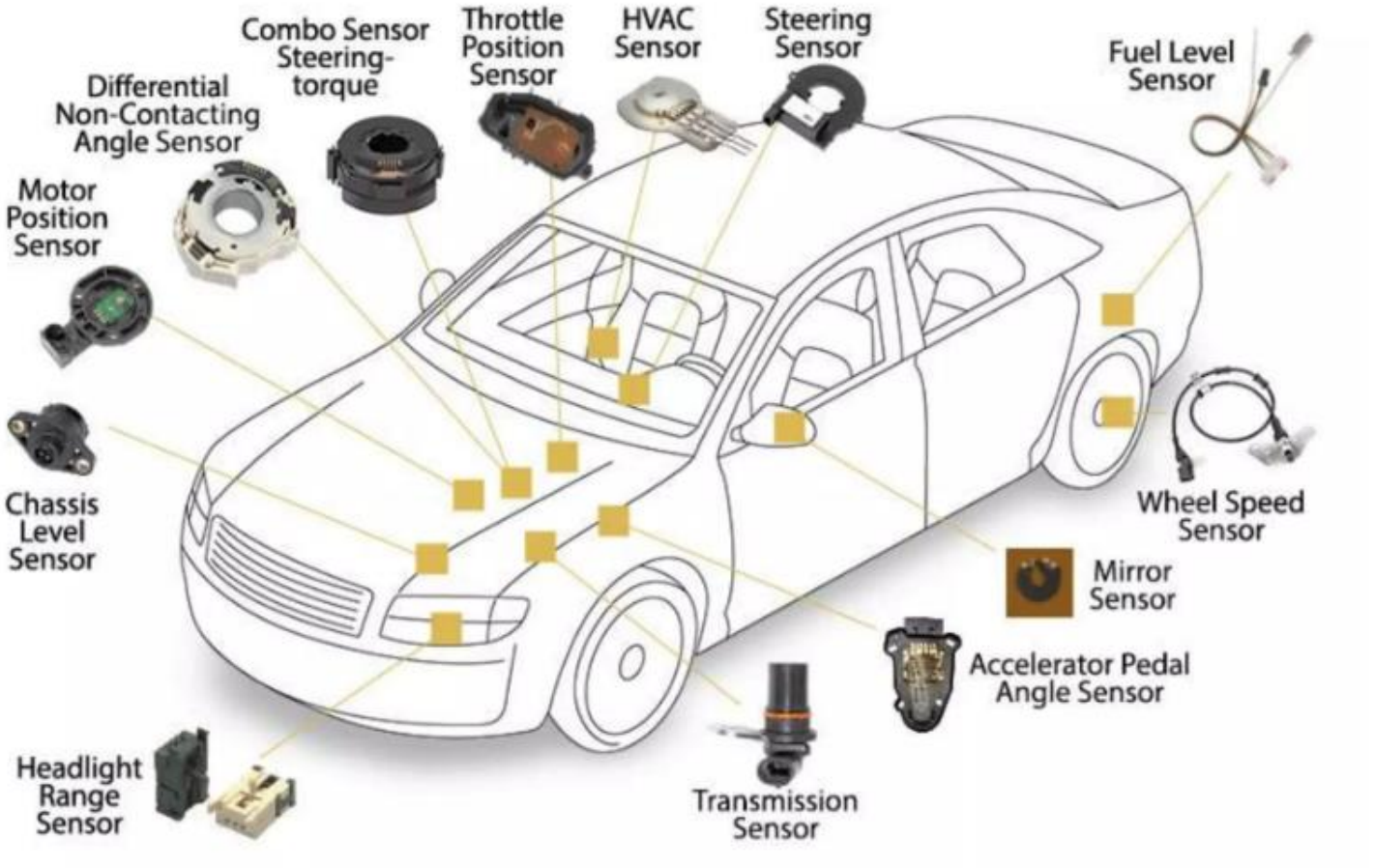
Speed Sensor

Temperature Sensor

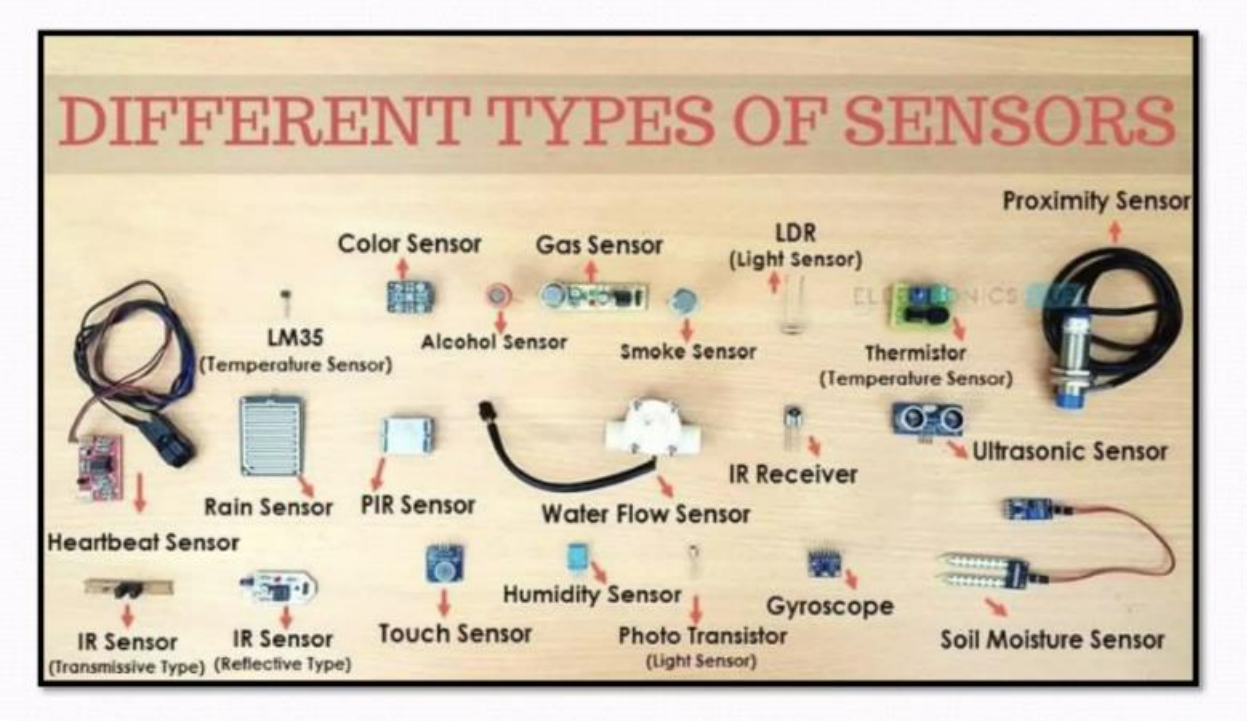
Different Types of Sensors and Their Applications



Examples of Sensors in Car



Types of sensor

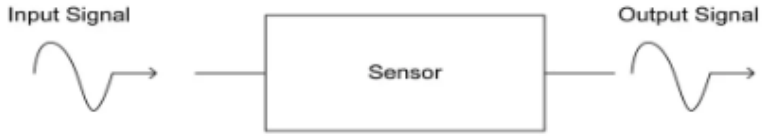


Some general statements

- Sensors/actuators are common
- Usually integrated in a system (never alone)
- A system of any complexity cannot be designed without them
- Very difficult to classify
- Difficult to get good data on them
- Definitions and terms are confusing

Sensor Definition

- American National Standards Institute (ANSI) Definition
  - A device which provides a usable output in response to a specified measurand



- A sensor acquires a physical parameter and converts it into a signal suitable for processing (e.g. optical, electrical, mechanical)

- A transducer
  - Microphone, Loud Speaker, Biological Senses (e.g. touch, sight,…ect)

Sensor Definition

- Also called: transducer, probe, gauge, detector, pick-up etc.
- Start with the dictionary:

- A device that responds to a physical stimulus and transmits a resulting impulse. (New Collegiate Dictionary)
- A device, such as a photoelectric cell, that receives and responds to a signal or stimulus. (American Heritage Dictionary, 3rd ed., 1996)
- A device that responds to a physical stimulus (as heat, light, sound, pressure, magnetism, or a particular motion) and transmits a resulting impulse (as for measurement or operating a control) . (Webster, 3rd ed., 1999)

Transducer Definition

- A device that is actuated by power from one system and supplies power usually in another form to a second system. (New Collegiate Dictionary)
- A substance or device, such as a piezoelectric crystal, that converts input energy of one form into output energy of another. (from: Trans-ducere – to transfer, to lead) (American Heritage Dictionary, 3rd ed., 1996)
- A device that is actuated by power from one system and supplies power usually in another form to a second system (a loudspeaker is a transducer that transforms electrical signals to sound energy) . (Webster, 3rd ed., 1999)

Actuator Definition

- A mechanism for moving or controlling something indirectly instead of by hand. (New Collegiate Dictionary)
- One that activates, especially a device responsible for actuating a mechanical device such as one connected to a computer by a sensor link (American Heritage Dictionary, 3rd ed., 1996)
- One that actuates; a mechanical device for moving or controlling something. (Webster, 3rd ed., 1999)

More Confusion

- Transducer can mean:
  - sensor
  - actuator
  - transducer can be part of a sensor
  - sensor can be part of a transducer
- Many sensors can work as actuators (duality)
- Many actuators can work as sensors
- What is it then? - All of the above!

Definitions

Stimulus

- The quantity that is sensed.
- Sometimes called the measurand.

Sensor

- A device that responds to a physical stimulus.

Transducer

- A device that converts energy of one form into energy of another form.

Actuator

- A device or mechanism capable of performing a physical action

Detectable Phenomenon

Stimulus	Quantity
Acoustic	Wave (amplitude, phase, polarization), Spectrum, Wave Velocity
Biological & Chemical	Fluid Concentrations (Gas or Liquid)
Electric	Charge, Voltage, Current, Electric Field (amplitude, phase, polarization), Conductivity, Permittivity
Magnetic	Magnetic Field (amplitude, phase, polarization), Flux, Permeability
Optical	Refractive Index, Reflectivity, Absorption
Thermal	Temperature, Flux, Specific Heat, Thermal Conductivity
Mechanical	Position, Velocity, Acceleration, Force, Strain, Stress, Pressure, Torque

Physical Principles

- Amperes's Law
  - A current carrying conductor in a magnetic field experiences a force (e.g. galvanometer)
- Curie-Weiss Law
  - There is a transition temperature at which ferromagnetic materials exhibit paramagnetic behavior
- Faraday's Law of Induction
  - A coil resist a change in magnetic field by generating an opposing voltage/current (e.g. transformer)
- Photoconductive Effect
  - When light strikes certain semiconductor materials, the resistance of the material decreases (e.g. photoresistor)

Need For Sensors

- Sensors are omnipresent. They embedded in our bodies, automobiles, airplanes, cellular telephones radios, chemical plants, industrial plants and countless other applications.

- Without the use of sensors, there would be no automation !!
  - Imagine having to manually fill mineral water bottles

Choosing a Sensor

Environmental Factors	Economic Factors	Sensor Characteristics
Temperature range	Cost	Sensitivity
Humidity effects	Availability	Range
Corrosion	Lifetime	Stability
Size		Repeatability
Overrange protection		Linearity
Susceptibility to EM interferences		Error
Ruggedness		Response time
Power consumption		Frequency response
Self-test capability		