

* Smart Sensors

- Smart Sensors are advanced sensors.
- It is not just a sensor.
- It has microcontroller (brain) inside it.
- It can:
 - Sense
 - Process
 - correct errors
 - communicate

Ex: ~~Remote~~ ~~Pass by~~ Your phone's Proximity Sensor

- when you make call & bring the mbl near your ear, the screen turns off.

- It has built-in microcontroller.

Features

- Communication
 - Error correction
 - high accuracy
- Traditional Sensors give raw data
- Smart Sensors give meaningful data.
- used in IoT
- Ex: automatic brightness control in mbl.

Smart Sensor is like a Smart Student

- Normal Student → only listens
- Smart Student → listens + understands + explains to others

* Primary Sensors

- These are the first sensors.
- It detects physical quantity.
- Detects changes in environment.
- Converts physical quantity into electrical signal.
 - Physical → electrical.

ex: • Gas Sensor

- Strain Gauge

• Light Sensor

- Thermistor

• Temperature Sensor

* Excitation

- Excitation as the energy
 - supplied to sensor to activate.
- Some sensors require an external power supply for proper operation.

Types

• Voltage excitation

DC excitation

• Current excitation

AC excitation

→ To make sensor active.

→ Improves performances

ex: Battery in Smartwatch

• Excitation is like charging your phone.

* Amplification

- Sensors produce very small signals (mV)
- Amplification increases very small sensor signal
- Sensor O/P is very small
- To make it usable, readable we amplify it.

ex: Amplifier is like a mic

- Your voice is slow → mic makes loud

- It res the low-level sensor output signal to a suitable level

ex: ECG machine

* Filters

- used to remove noise & unwanted signal, unwanted frequencies from sensor.

→ It cleans the signal.

→ So, we get accurate result.

ex: email - Spam

① Noise filtering in mobile during call.

Converters

- Smart Sensors Convert analog into digital
- Microcontroller only understand digital

ADC Types ADC (e.g. thermometer) body temp → digital values

①. Analog Digital Converter (ADC)

Analog Signal → Digital Signal

②. Digital Analog Converter (DAC)

Digital → Analog.

ADC

Ex:

① Speed measurement in vehicle

② meter

③ weighting machine

* Compensation

- It corrects errors in sensor output.
 - errors caused by temperature, humidity, pressure, aging.
 - To improve accuracy
- ex: Weight machines
even if machine gets old, still shows correct weight.

* Data Communication

- Smart sensors send data through communication protocols.
- transmission of data to other systems.

Wired communication

- I²C
- SPI

Wireless communication

- WiFi
- Bluetooth

ex: Smartwatch sends calls to smartwatch

* Information Coding & Processing

- Converts raw sensor data into meaningful data
- Convert to usable info

Operations

- Error correction
- Data normalization

⇒ Sensor data is processed into meaningful

info

Processing Units

- microcontrollers
- DSP

- ex:
- Step counting in smartwatch
 - Heart rate calculation

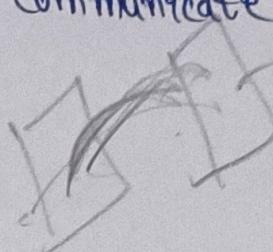
* Standards for Smart Sensors Interface

- Standards are rules / principles.
- like languages help people talk,
 - standards help sensors communicate.

Standards

①. I²C

- two wires
- one wire for data, one for clock
- simple
- low power
- multiple sensors can connect
 - Sensors on washing m/c



②. SPI

- uses four wires
- faster than I²C
- high speed
- sensors on TVs

③. VART

- uses two wires
- no clock
- easy to use
- low cost
- simple

④. Modbus

- in industries

⑤. CAN

(Sensors on cars)

- specially designed for vehicles
- reliable
- Airbag & Speed Sensors