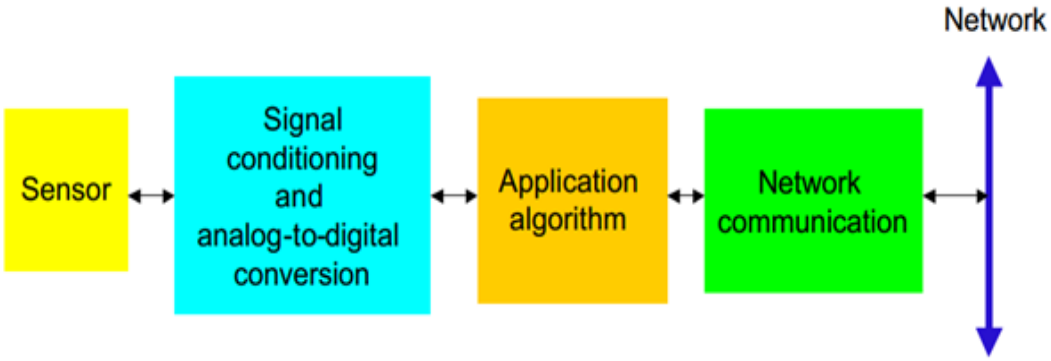
SMART SENSORS:

Smart sensors is a device that takes input from the physical environment and uses built-in compute resources to perform predefined functions upon detection of specific input and then process data before passing it on.

Example: A fingerprint sensor reads your finger, checks the pattern inside the device, and then sends whether it matches or not.

Smart sensors = **sense + process + send output**.



The sensor collects raw data from the environment. The raw signal from the sensor is often weak or analog. Cleans and strengthens the signal (signal conditioning) Converts analog signal to digital (ADC) so that electronics can understand it Application algorithm processes the digital data and makes decisions. After processing, the information is sent to another device or system through a network.

FUNCTIONAL CAPABILITY OF A SMART SENSOR:

Smart sensors have small computers built inside them. This means they can think and process data right where the measurement happens, instead of sending raw data far away.

They can do:

- Basic calculations
- Send data in standard digital formats

➢ Because of this, smart sensors can collect environmental data more accurately, with less noise and fewer mistakes.

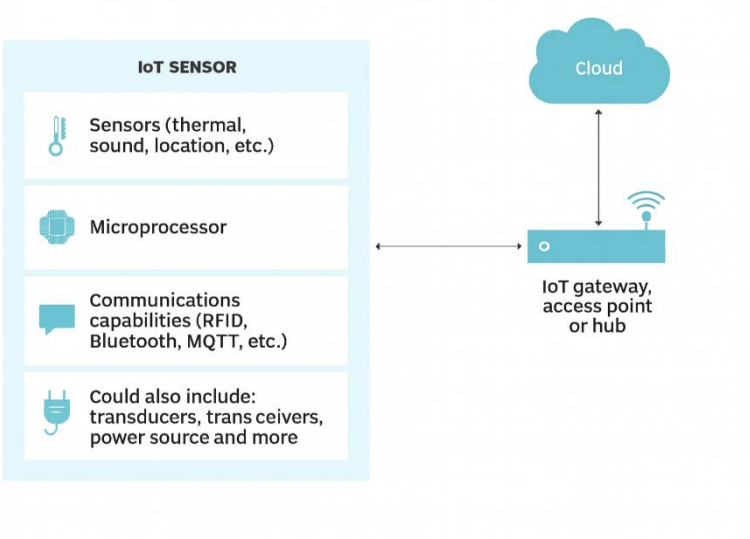
They are used in many areas like:

- Smart electricity grids
- Military monitoring
- Space/earth exploration
- Scientific research

COMPONENTS OF A SMART SENSOR:

A smart sensor has three components:

- A sensor that captures data.
- A Microprocessor that computes on the output of the sensor via programming.
- Communications capabilities.



Inside a smart sensor, there are four main parts:

1. Sensors (thermal, sound, location, etc.)

These parts sense or detect things from the environment.

2. Microprocessor:

- This is a small computer inside the sensor.
- It processes the data collected by the sensor.

- It can also perform calculations, filtering, or basic decision-making.

3. Communication Capabilities:

This allows the sensor to send data wirelessly. It can use technologies like:

- RFID
- Bluetooth
- MQTT protocol (Message Queuing Telemetry Transport)
- Wi-Fi
- Zigbee

This ensures the sensor can communicate with other devices.

4. Additional Components:

Some IoT sensors may also include:

- **Transducers** (convert one form of energy to another)
- **Transceivers** (send and receive wireless signals)
- **Power source** (battery or wired power)

These parts help the sensor work continuously and communicate properly.

5. IoT Gateway:

- The sensor sends the processed data wirelessly to an IoT gateway / access point / hub.
- The gateway acts as a middle device between the sensor and the cloud. It collects data from many sensors and sends it to the internet.

6. Cloud:

Finally, the gateway sends the data to the cloud. In the cloud, data can be:

- Stored
- Analyzed
- Processed

This is where IoT systems make smart decisions.

TYPES OF SMART SENSORS:

- **Analog Sensors:** They give a continuous (smooth) output signal. The signal changes gradually, like how temperature goes up or down slowly.
- **Digital Sensors:** They give binary outputs (0s and 1s). They convert the measured value directly into digital form inside the sensor.
- **Infrared Sensors:** These detect heat or infrared light.
- **Proximity Sensors:** They detect how close an object or person is.
- **Contact Sensors:** They need physical contact to sense something.
- **Non-Contact Sensors:** They do not need physical contact.

ADVANTAGES OF A SMART SYSTEM:

- Energy Efficiency and Sustainability.
- Access to Data in Hard or Dangerous Places
- High Performance
- Built-in Analytics and Processing

DISADVANTAGES OF SMART SYSTEM:

- Can be hacked or tampered with
- High cost
- Maintenance problems
- Requires skilled people
- Challenges in IoT deployment