PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY

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TYPES OF SENSORS USED IN IOT

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Sensors:

Sensors are used for sensing things and devices etc.
A device that provides a usable output in response to a specified measurement.
The sensor attains a physical parameter and converts it into a signal suitable for processing (e.g. electrical, mechanical, optical) the characteristics of any device or material to detect the presence of a particular physical quantity.

TYPES OF SENSORS:

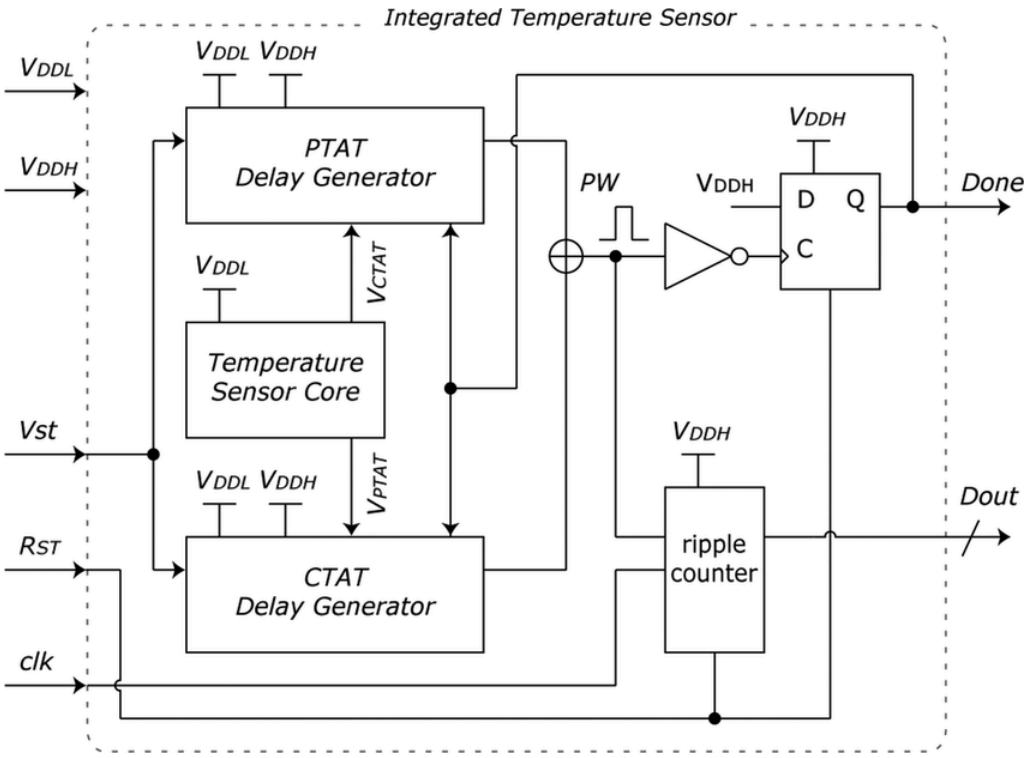
1. Temperature sensors
2. Proximity sensors
3. Pressure sensors
4. Motion sensors
5. Infrared sensors

1. Temperature sensors:

Temperature sensor is a device, used to measure the temperature using an electrical signal.

It requires a thermocouple or RTD(Resistance temperature Detector). It is the most common and most popular sensor.

Temperature sensor, the change in the temperature correspond to change in its physical property like resistance or voltage



Working Principle:

Different types of temperature sensors work on different principles:

1. Thermocouples:

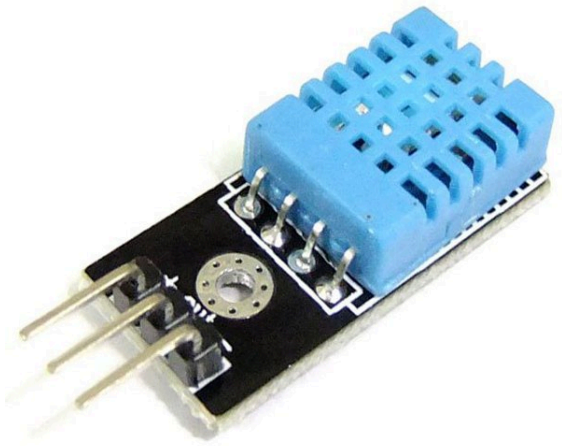
- Made of two dissimilar metal wires joined at one end.
- When the junction experiences a temperature change, a voltage (Seebeck effect) is generated, which is proportional to the temperature difference.
- **Used in industrial furnaces, engines, and high-temperature applications.**

2. Resistance Temperature Detectors (RTDs):

- Made of a metal (typically platinum) that changes resistance with temperature.
- Higher temperatures increase electrical resistance.
- **Used in scientific research, medical equipment, and HVAC systems.**

3. Thermistors:

- Made of ceramic or polymer materials that change resistance with temperature.
- Two types: **NTC (Negative Temperature Coefficient)** and **PTC (Positive Temperature Coefficient)**.
- **Used in home appliances, automotive temperature monitoring, and medical devices.**



4. Infrared (IR) Temperature Sensors:

- Detect infrared radiation emitted by an object to measure temperature without

contact.

- **Used in medical thermometers, fire detection, and industrial quality control.**

5. Semiconductor Temperature Sensors:

- Use voltage or current changes across a semiconductor junction to measure temperature.
- Used in microcontrollers, laptops, and smartphones for thermal management.

Applications of Temperature Sensors:

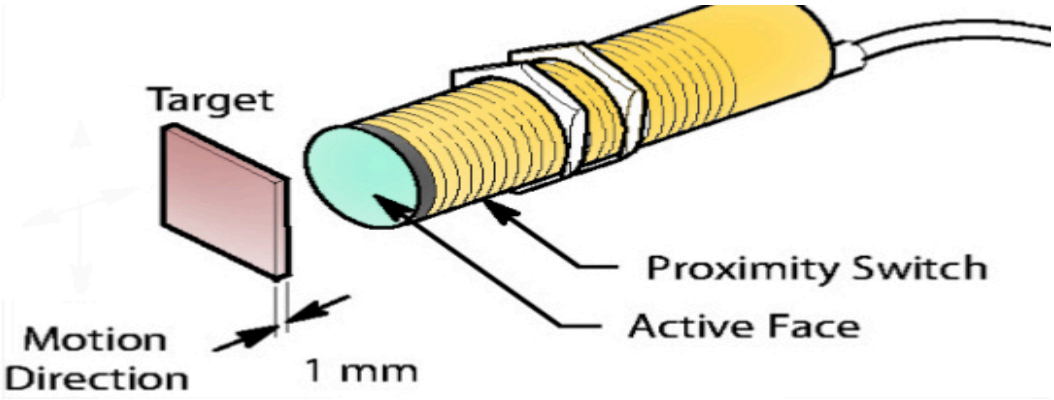
🔹 **Industrial Automation** – Monitoring temperature in manufacturing and processing industries.
🔹 **HVAC Systems** – Regulating heating and cooling in buildings.
🔹 **Medical Equipment** – Measuring body temperature in digital thermometers.
🔹 **Automotive Industry** – Engine temperature monitoring and climate control.
🔹 **Smart Homes** – Used in smart thermostats like Nest and Ecobee.
🔹 **Food & Agriculture** – Cold storage monitoring and greenhouse temperature control.
🔹 **Aerospace & Defense** – Used in jet engines and spacecraft.

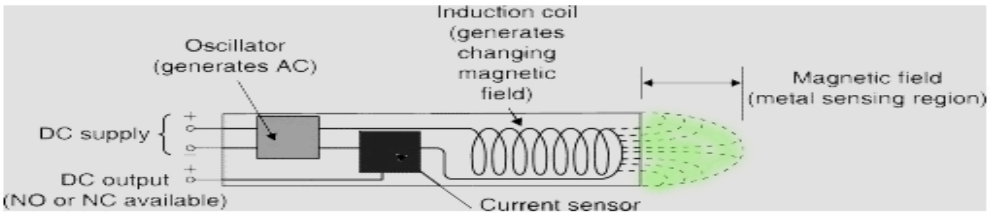
2. Proximity sensors:

Proximity actually meaning is nearness, so the proximity sensor is a sensor able to detect the presence of nearby objects by generating frequency without any contact with the object.

Electromagnetic radiation is emitted by proximity sensor for instance and looks for changes in the field or return signal.

The object being sensed is often referred to as proximity sensors target depending on the proximity sensor target.





Types of Proximity Sensors:

1. **Inductive Sensors –**

   Detects metallic objects using electromagnetic fields.

2. **Capacitive Sensors –**

   Detects both metallic and non-metallic objects based on changes in capacitance.

3. **Ultrasonic Sensors –**

   Uses sound waves to detect objects.

4. **Infrared (IR) Sensors –**

   Detects objects using infrared light.

5. **Hall Effect Sensors –**

   Detects magnetic fields.

Working Principle:

Different proximity sensors operate on various principles:

1. Inductive Proximity Sensors:

- Generate an electromagnetic field using a coil.
- When a metallic object enters the field, it induces eddy currents, which change the sensor's output signal.
- **Used in industrial automation, conveyor belt systems, and automotive applications.**

2. Capacitive Proximity Sensors:

- Consist of two plates forming a capacitor.
- When an object (metallic or non-metallic) comes near, the capacitance changes, triggering a response.
- Used in touch screens, liquid level detection, and material handling.

3. Ultrasonic Proximity Sensors:

- Emit high-frequency sound waves and measure the time taken for the echo to return.
- The distance is calculated based on the time delay.
- Used in parking sensors, robotics, and smart toilets.

4. Infrared (IR) Proximity Sensors:

- Emit infrared light and detect reflections from nearby objects.
- The sensor determines the presence of an object based on the reflected light intensity.
- Used in mobile phones (screen auto-off), security systems, and touchless

controls.

5. Hall Effect Sensors:

- Detect magnetic fields using semiconductor material.
- When a magnetic field is present, the sensor generates a voltage signal.
- Used in motor speed detection, contactless switches, and automotive ignition systems.

Applications of Proximity Sensors:

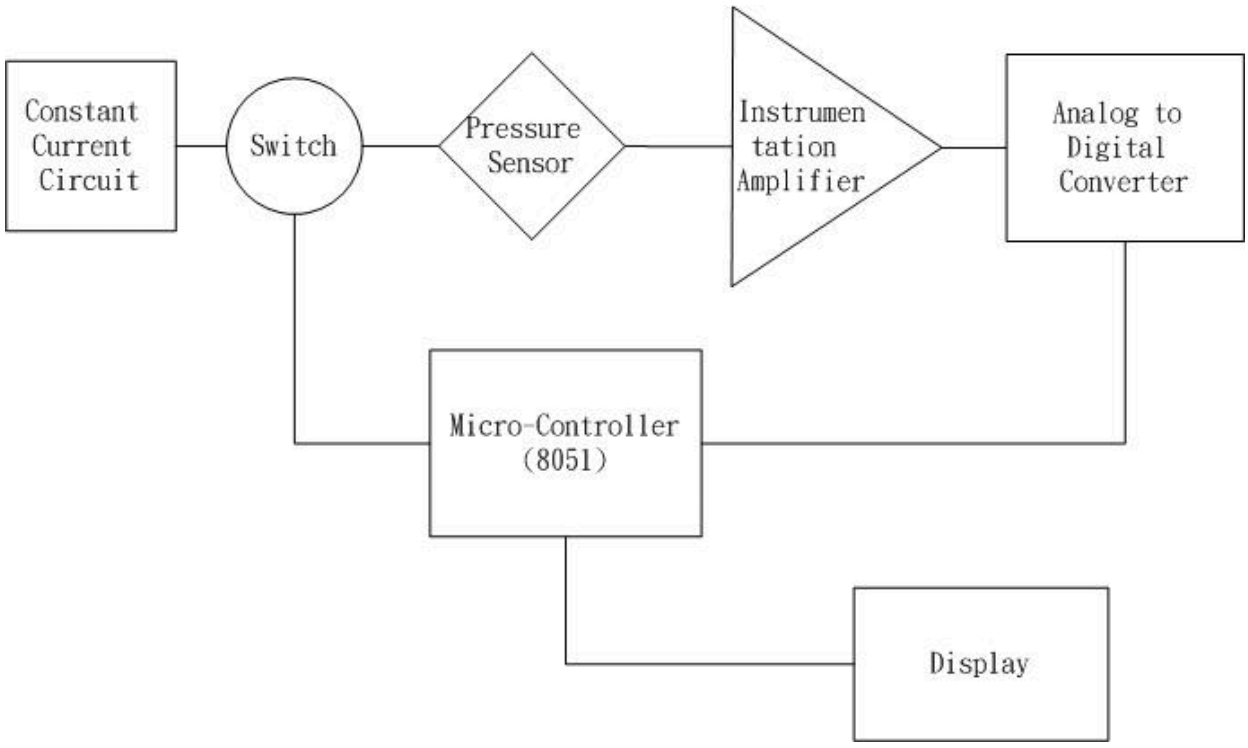
- **Automotive Industry** – Parking sensors, collision avoidance systems.
- **Industrial Automation** – Object detection on conveyor belts.
- **Smartphones & Tablets** – Proximity sensing for screen auto-off.
- **Security Systems** – Motion detection for alarms and automatic doors.
- **Robotics** – Object detection and obstacle avoidance.
- **Medical Devices** – Non-contact detection in surgical tools and monitoring systems.

3. Pressure sensors:

An IoT pressure sensor is any device that senses pressure and converts it into an electric signal.

The level of voltage given out by the sensor depends on the level of pressure applied.

These sensors enable IoT systems that monitor systems and devices that are pressure propelled.



Types of Pressure Sensors:

- **Absolute Pressure Sensors** – Measure pressure relative to a vacuum (zero pressure).

- **Gauge Pressure Sensors** – Measure pressure relative to atmospheric pressure.

- **Differential Pressure Sensors** – Measure the difference between two pressure points.

- **Sealed Pressure Sensors** – Measure pressure relative to a fixed reference point.

Working Principle:

Different types of pressure sensors work based on various principles:

1. Strain Gauge Pressure Sensors:

- Use a strain gauge (a small resistive element) attached to a diaphragm.
- When pressure is applied, the diaphragm deforms, changing the resistance.
- This change is converted into an electrical signal.
- Used in industrial machinery and hydraulic systems.

2. Capacitive Pressure Sensors:

- Consist of two plates forming a capacitor, separated by a diaphragm.
- When pressure is applied, the diaphragm moves, changing the capacitance.
- The change in capacitance is measured and converted into pressure data.
- Used in HVAC systems, barometers, and weather stations.

3. Piezoelectric Pressure Sensors:

- Use piezoelectric materials that generate an electric charge when deformed by pressure.
- The generated voltage is proportional to the applied pressure.
- Used in medical devices, aerospace, and dynamic pressure monitoring.

4. Optical Pressure Sensors:

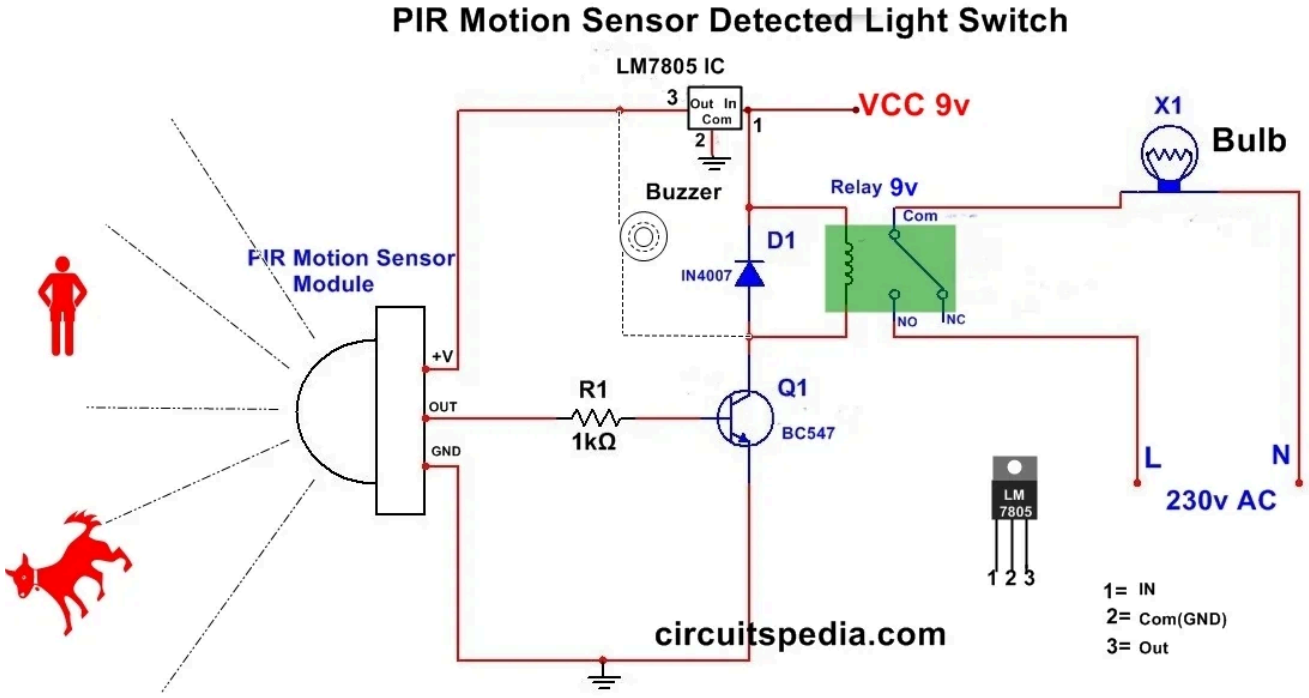
- Use fiber optics to detect pressure-induced changes in light transmission.
- Highly sensitive and used in extreme conditions.
- Used in oil and gas exploration, biomedical applications.

Applications of Pressure Sensors:

- **Automotive Industry —** Tire pressure monitoring systems (TPMS), fuel injection systems.
- **Industrial Automation —** Hydraulic and pneumatic pressure monitoring.
- **Medical Devices —** Blood pressure monitors, ventilators, and infusion pumps.
- **Aerospace & Aviation —** Cabin pressure monitoring, altitude measurement.
- **Weather & Environmental Monitoring** – Barometric pressure measurement for weather forecasting.
- **Oil & Gas Industry —** Pipeline pressure monitoring and leak detection.

4.Motion sensors:

A motion sensor is a device that detects movement in a given area and converts it into an electrical signal. It is commonly used in security systems, automation, robotics, and smart devices to trigger alarms, activate lighting, or track movement.



Types of Motion Sensors:

- **Passive Infrared (PIR) Sensors** – Detect body heat (infrared radiation).
- **Ultrasonic Sensors** – Use sound waves to detect movement.
- **Microwave Sensors** – Emit microwaves and measure reflection changes.
- **Accelerometers & Gyroscopes** – Detect changes in speed and orientation.
- **Tomographic Sensors** – Use radio waves for motion detection.

Working Principle:

Different motion sensors operate on various principles:

1. Passive Infrared (PIR) Sensors:

- Detect infrared radiation emitted by warm objects (humans, animals).
- When a heat source moves, it causes a change in detected infrared radiation, triggering an alert.
- Used in home security, automatic lighting, and smart home devices.

2. Ultrasonic Motion Sensors:

- Emit high-frequency sound waves and detect changes in reflected waves when an object moves.
- Can detect motion even in complete darkness.
- Used in parking sensors, automatic doors, and robotic navigation.

3. Microwave Motion Sensors:

- Emit microwave pulses and measure changes in the reflected signal.
- Can detect movement through walls but may be affected by interference.
- Used in security systems and industrial automation.

4. Accelerometers & Gyroscopes:

- Measure changes in acceleration, tilt, and orientation.
- Used in mobile phones to detect screen rotation, step counting, and fall detection.
- Used in smartphones, fitness trackers, and automotive safety systems.

5. Tomographic Motion Sensors:

- Emit low-power radio waves that form a mesh network.

- Detect movement when objects disturb the wave pattern.
- Used in high-security areas and large spaces like warehouses.

Applications of Motion Sensors:

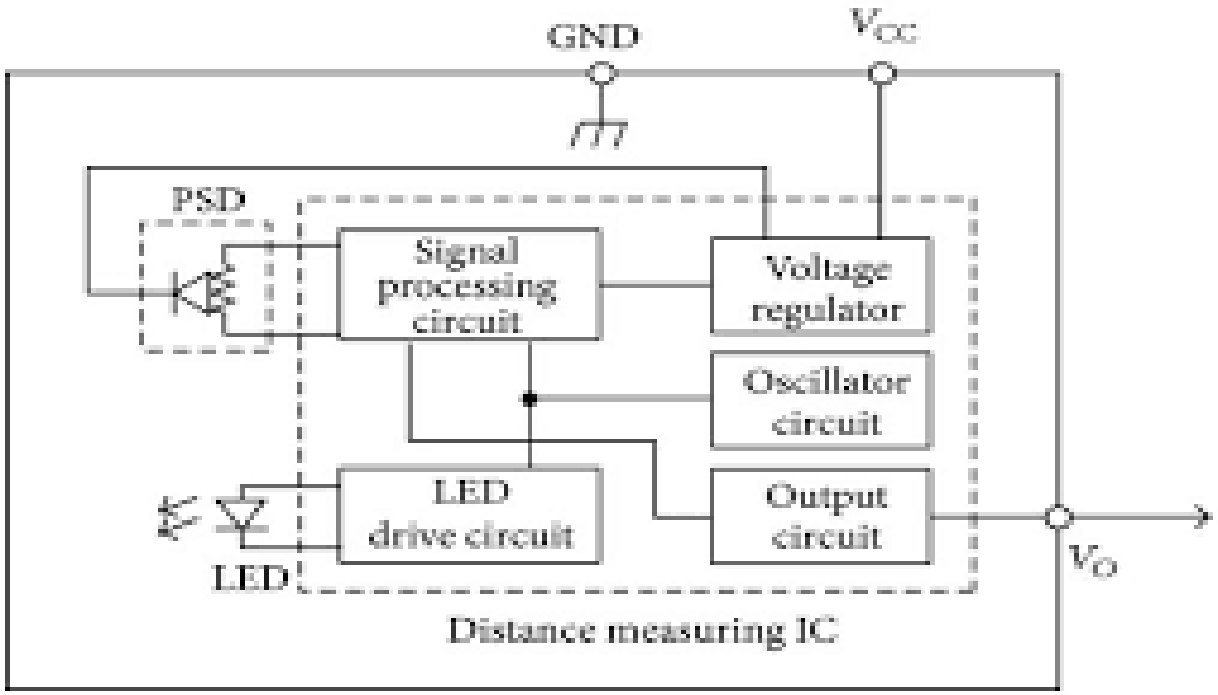
- **Home Security Systems** – Intruder detection, alarm activation.
- **Smart Lighting** – Automatic lights in rooms and streets.
- **Automotive Industry** – Airbag deployment, collision detection.
- **Robotics & Automation** – Object detection and movement tracking.
- **Wearable Devices** – Fitness tracking, step counting, posture monitoring.
- **Gaming & Virtual Reality** – Motion detection for interactive gaming

5. Infrared sensors:

Active infrared sensors work with radar technology and they both emit and receive infrared radiation.

This radiation hits the objects nearby and bounces back to the receiver of the device.

Through this technology, the sensor can not only detect movement in an environment but also how far the object is from the device.



Types of Infrared Sensors:

1. **Active IR Sensors** – Emit and detect IR radiation (e.g., IR LEDs, photodiodes).
2. **Passive IR Sensors (PIR)** – Detect infrared radiation from objects (mainly body heat).
3. **Thermal IR Sensors** – Measure temperature variations based on infrared radiation.

Working Principle:

1. Active Infrared Sensors:

- Emit infrared radiation using an IR LED and detect the reflected or interrupted signal using a photodiode.
- If an object passes between the emitter and receiver, it causes a change in the received signal, triggering a response.
- Used in object detection, proximity sensors, and communication systems.

2. Passive Infrared (PIR) Sensors:

- Do not emit IR radiation but detect infrared radiation emitted by warm objects (e.g., humans, animals).
- When a heat source moves within the sensor's field of view, it causes a change in detected infrared levels, activating the sensor.
- Used in motion detectors, security systems, and automatic lighting.

3. Thermal Infrared Sensors:

- Detect temperature differences by measuring IR radiation intensity from an object.
- Work based on the Stefan-Boltzmann Law, where objects emit IR radiation proportional to their temperature.
- Used in thermal cameras, fire detection, and temperature sensing.

Applications of Infrared Sensors:

🔹 **Motion Detection** – Used in PIR-based security systems and automatic lighting.

🔹 **Temperature Sensing** – Thermal IR sensors are used in medical **thermometers, industrial temperature monitoring, and firefighting**.

🔹 **Proximity Sensing** – IR sensors in touchless taps, automatic doors, and mobile phones (screen auto-off feature).

🔹 **Remote Controls & Communication** – Used in TV remotes, IR-based data transmission, and Li-Fi communication.

🔹 **Industrial & Robotics** – Object detection and automation in conveyor belts, robotics, and smart manufacturing.

🔹 **Agriculture** – Soil moisture detection and precision farming using thermal IR sensors.