What is Sensors?

Temperature

Accelerometer

Infrared

Humidity

Ultrasonic

Smoke

Color

Touch

WHAT IS A SENSOR?

- Sensors are an integral part of modern living. If you are reading this article on a computer, you are most likely using a mouse, which contains an optical sensor. If you are on a smartphone, you are using touch sensors every time you touch the screen. But what exactly is a sensor?
- A sensor is a device that measures physical input from its environment and converts it into data that can be interpreted by either a human or a machine. Most sensors are electronic (the data is converted into electronic data), but some are more simple, such as a glass thermometer, which presents visual data. People use sensors to measure temperature, gauge distance, detect smoke, regulate pressure and a myriad of other uses.

CLASSIFICATION OF SENSORS

- There are several classifications of sensors made by different authors and experts. Some are very simple and some are very complex.
- The following classification of sensors may already be used by an expert in the subject but this is a very simple classification of sensors.
- In the first classification of the sensors, they are divided in to Active and Passive. Active Sensors are those which require an external excitation signal or a power signal.
- Passive Sensors, on the other hand, do not require any external power signal and directly generates output response.

CLASSIFICATION OF SENSORS

- Active and passive sensors are two different types of sensors used to measure physical quantities or environmental conditions. Here are some examples of each type:
- Active Sensors:

1. RADAR (Radio Detection and Ranging): This sensor emits radio waves that are reflected back by an object, allowing it to determine the distance, speed, and direction of the object.
2. Lidar (Light Detection and Ranging): This sensor emits pulses of laser light and measures the time it takes for the light to reflect back from an object. This allows it to determine the object's distance and shape.
3. Ultrasonic Sensor: This sensor emits high-frequency sound waves that bounce off an object and return to the sensor. By measuring the time it takes for the sound waves to return, the sensor can determine the object's distance and position.
4. Infrared Sensor: This sensor emits infrared radiation and measures the reflection or absorption of the radiation by an object. It is often used in temperature sensors and motion detectors.

- Passive Sensors:

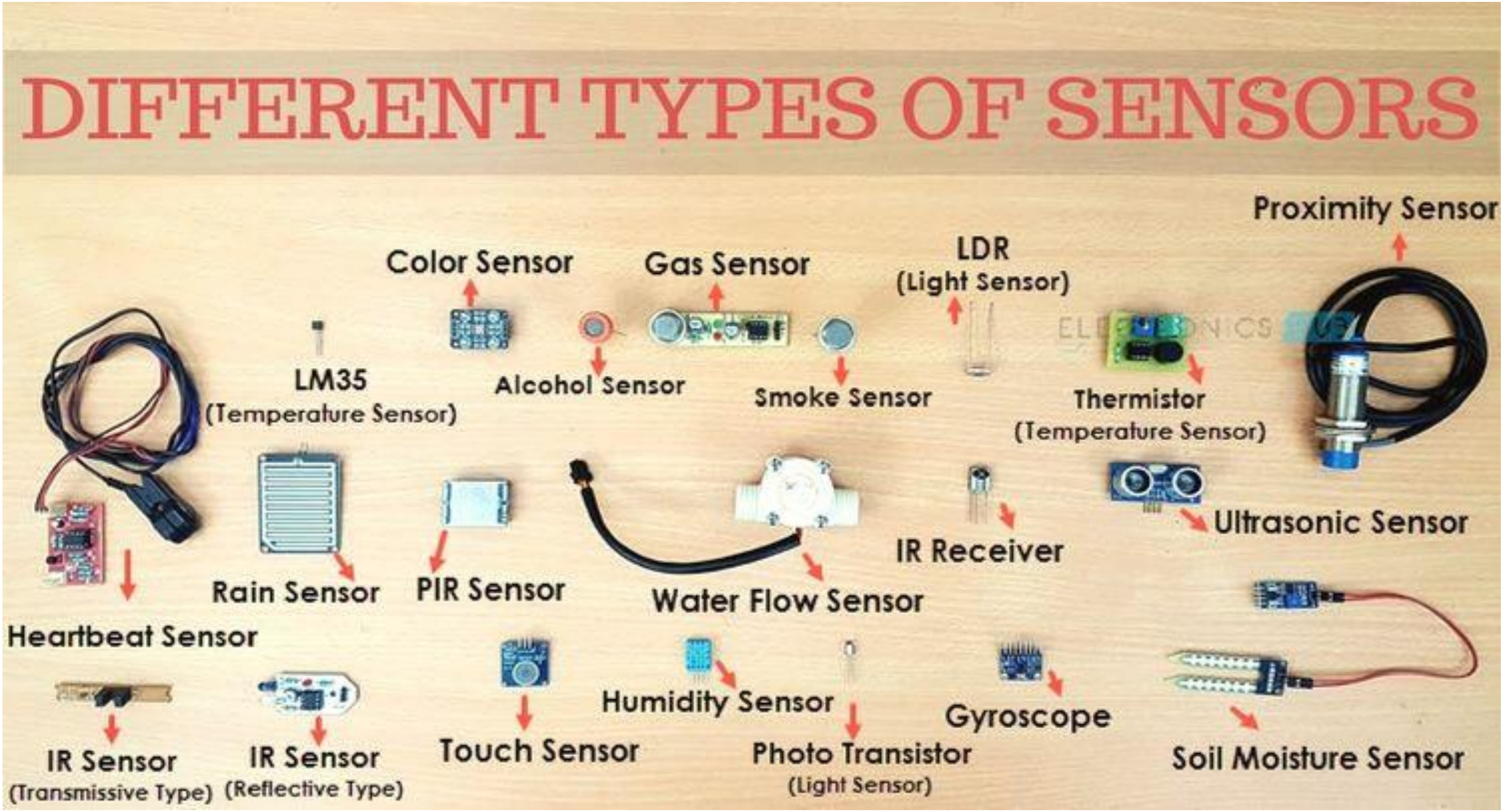
1. Temperature Sensor: This sensor measures the temperature of its surroundings without emitting any energy. Examples include a thermometer or a thermocouple.
2. Light Sensor: This sensor measures the amount of light in its surroundings without emitting any light of its own. Examples include a photodiode or a photoresistor.
3. Strain Gauge: This sensor measures the amount of strain or deformation in an object without applying any external force.
4. Humidity Sensor: This sensor measures the amount of water vapor in the air without emitting any energy.

- In general, active sensors require a power source to operate and emit some form of energy to measure the environment, while passive sensors do not emit energy and simply detect and measure existing physical quantities or environmental conditions

CLASSIFICATION OF SENSORS

- The other type of classification is based on the means of detection used in the sensor. Some of the means of detection are Electric, Biological, Chemical, Radioactive etc.
- The next classification is based on conversion phenomenon i.e., the input and the output. Some of the common conversion phenomena are Photoelectric, Thermoelectric, Electrochemical, Electromagnetic, Thermooptic, etc.
- The final classification of the sensors are Analog and Digital Sensors. Analog Sensors produce an analog output i.e., a continuous output signal (usually voltage but sometimes other quantities like Resistance etc.) with respect to the quantity being measured.
- Digital Sensors, in contrast to Analog Sensors, work with discrete or digital data. The data in digital sensors, which is used for conversion and transmission, is digital in nature.

DIFFERENT TYPES OF SENSORS



DIFFERENT TYPES OF SENSORS WITH THEIR APPLICATIONS

- In daily life, it has become our habit to implement various types of sensors frequently in the power systems comprising of load control systems, electrical and electronics appliances, and industrial and home automation. All types of sensors are further divided into analog and digital sensors.
- However, there are few **types of sensors** that are used in electronic applications such as pressure sensors, touch sensors, IR sensors, ultrasonic sensors, temperature sensors, proximity sensors, and so on

1. Temperature Sensor
2. Proximity Sensor
3. Accelerometer
4. IR Sensor (Infrared Sensor)
5. Pressure Sensor
6. Light Sensor
7. Ultrasonic Sensor
8. Smoke, Gas and Alcohol Sensor
9. Touch Sensor

DIFFERENT TYPES OF SENSORS WITH THEIR APPLICATIONS

10. Color Sensor
11. Humidity Sensor
12. Position Sensor
13. Magnetic Sensor (Hall Effect Sensor)
14. Microphone (Sound Sensor)
15. Tilt Sensor
16. Flow and Level Sensor
17. PIR Sensor
18. Touch Sensor
19. Strain and Weight Sensor

TEMPERATURE SENSORS:

- **1.Temperature Sensors:**
- Temperature is the commonly measured environmental quantity for various reasons. There are different types of temperature sensors that are used for measuring temperature such as thermistors, resistance temperature detectors, thermocouples, semiconductor temperature sensors, and so on.
- On the basis of requirements, various types of sensors are used for the purpose of measuring temperature in different applications. A simple temperature sensor with a circuit may be used for switching the load on and off at a specific temperature.
- This temperature is detected by the temperature sensor, in these cases, a thermistor is put to use. The temperature sensor circuit comprises a thermistor, transistor, relay, and battery. The temperature sensor activates the relay by detecting the required temperature.
- The relay switches on the load that is connected to it which can be AC or DC. This circuit may be further utilized for the purpose of controlling the fan on the basis of temperature. Primarily, this type of sensor may be further classified into various other types such as digital temperature sensors, thermistors, and so on.

TEMPERATURE SENSORS:

- **Function**: Temperature sensors measure the ambient temperature of the environment.
- **Use Cases**:
  - **Climate Control Systems**: In HVAC (Heating, Ventilation, and Air Conditioning) systems, temperature sensors help maintain the desired room temperature.
  - **Weather Stations**: They provide accurate temperature readings for weather forecasting and climate monitoring.
  - **Smart Thermostats**: These sensors enable precise temperature control and energy efficiency in smart homes.
  - **Food Storage Management**: Temperature sensors monitor refrigerators and freezers to ensure safe food storage.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PROXIMITY SENSOR

2. Proximity sensor :

- The proximity sensor is a type of IoT sensor in which the existence and non-existence of the surrounding objects are identified. After this, the detected signal is converted into a form that the user understands.
- This type of sensor is mainly applied in the retail domain where any movement is found out and an association is present between the consumer and product. The users are provided with quick notifications related to exclusive offers and discount updates of the products in which they are interested.

PROXIMITY SENSOR:

- **Function**: Proximity sensors detect the presence or absence of objects in close proximity without physical contact.
- **Use Cases**:
  - **Touchless Switches**: Proximity sensors are used in touchless interfaces, such as automatic door openers and touchless faucets.
  - **Obstacle Detection in Robotics**: Robots equipped with proximity sensors can avoid collisions with objects.
  - **Automatic Hand Sanitizer Dispensers**: Proximity sensors trigger sanitizer dispensing when a hand is nearby, promoting hygiene

PROXIMITY SENSOR:

- They can also be used in environments where oil or water is used, giving them a firm advantage over alternative methods of detection. Capacitive proximity sensors can detect media such as water, resin, and metal, dependent on the dielectric constant of the object. Different types of sensor are best suited to detecting different objects, as explored below:
- **Capacitive proximity sensors** – metals, liquids, water, resin, powders
- **Inductive proximity sensors** – metals including aluminium, copper, brass, and iron
- **Magnetic proximity sensors** – magnets

ACCELEROMETER:

- **3. Accelerometer:**
- **Function**: Accelerometers measure acceleration in multiple directions, allowing devices to detect motion and orientation.
- **Use Cases**:
  - **Smartphones**: Accelerometers enable screen rotation, motion-based gaming, and step counting in fitness apps.
  - **Fitness Trackers**: These sensors monitor user movements and provide data for activity tracking.
  - **Automotive Airbag Systems**: Accelerometers detect sudden deceleration during collisions, triggering airbag deployment for passenger safety.


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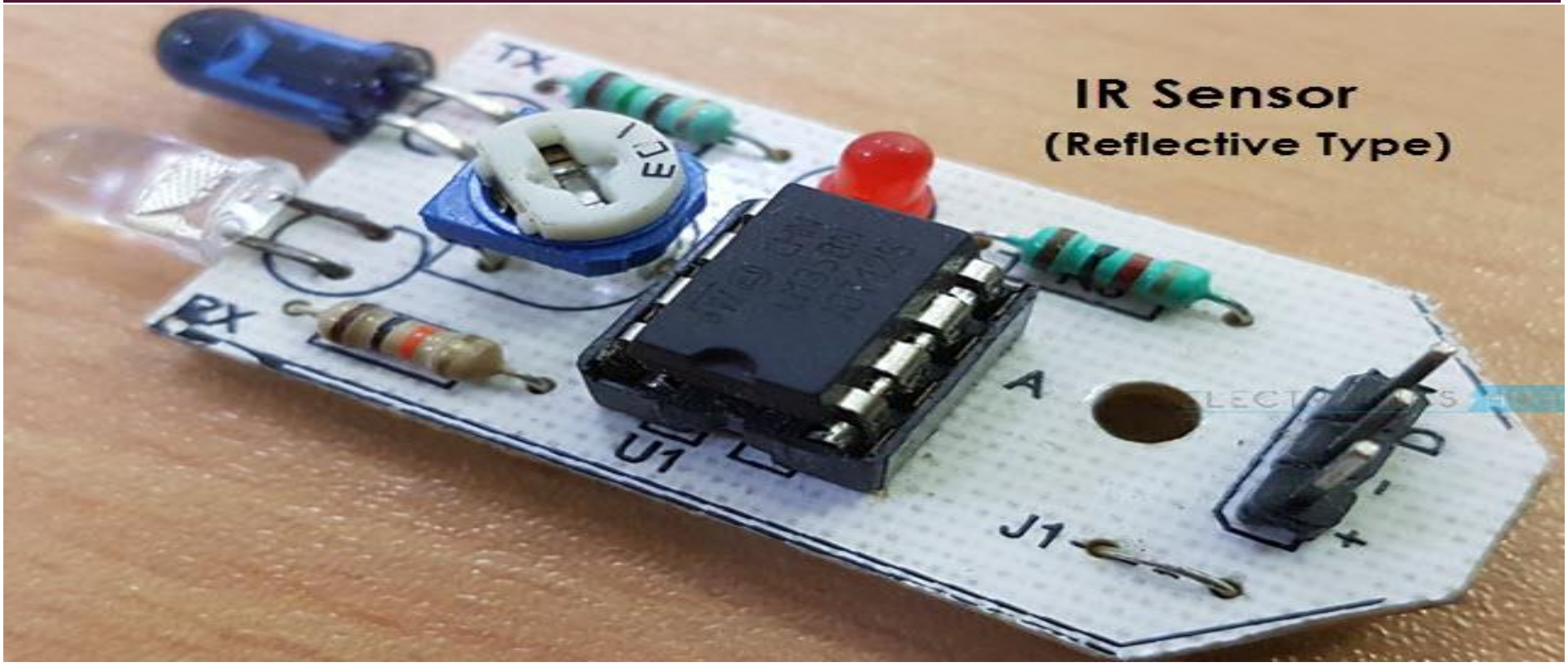
IR SENSORS:

- **4. IR Sensor (Infrared Sensor):**
- The small photo chips comprising of photocells that are used for detecting and emitting infrared light are termed IR sensors. These sensors are most commonly used for the purpose of designing remote-control technology.
- These sensors may be used for detecting various obstacles of the robotic vehicle and controlling the direction of the same. There are different types of sensors that might be used for the detection of infrared lights.
- A simple example of an IR sensor circuit that we use in our day-to-day life is a TV remote control. It comprises IR receiver circuits and IR emitter circuits that may be designed. The IR emitter circuit is used as a remote by the user for the purpose of emitting infrared light.
- This infrared light is transmitted or sent to the IR receiver circuit which interfaces to the devices such as IR remote-controlled robots or a TV. These sensors are further used for designing television remote controls.
- A TV remote is an example of a simple IR sensor-based electronics project which is used for the purpose of controlling a robotic vehicle in remote areas by using IR or TV remote. This type of TV remote is being utilized for sending commands to the robotic vehicle.

IR SENSORS:

- **IR Sensor (Infrared Sensor):**
- **Function**: IR sensors detect the presence of infrared radiation, which is often used to detect motion or proximity.
- **Use Cases**:
  - **Remote Controls**: IR sensors receive signals from remote controls to operate devices like TVs and home theater systems.
  - **Intruder Detection Systems**: IR sensors can trigger alarms or security cameras when motion is detected in a secure area.
  - **Proximity Sensing**: Automated faucets and toilets use IR sensors to activate water flow when hands are nearby, promoting touchless operation

IR SENSORS:



PRESSURE SENSOR:

- **5. Pressure Sensor:**
- **Function**: Pressure sensors measure the pressure of gases or liquids.
- **Use Cases**:
  - **Barometric Pressure Measurement**: Pressure sensors are essential in weather forecasting, helping determine changes in atmospheric pressure.
  - **Aviation**: Pressure sensors assist in altitude measurement and cabin pressure control in aircraft.
  - **Automotive Tire Pressure Monitoring**: These sensors monitor tire pressure, ensuring safe driving and fuel efficiency.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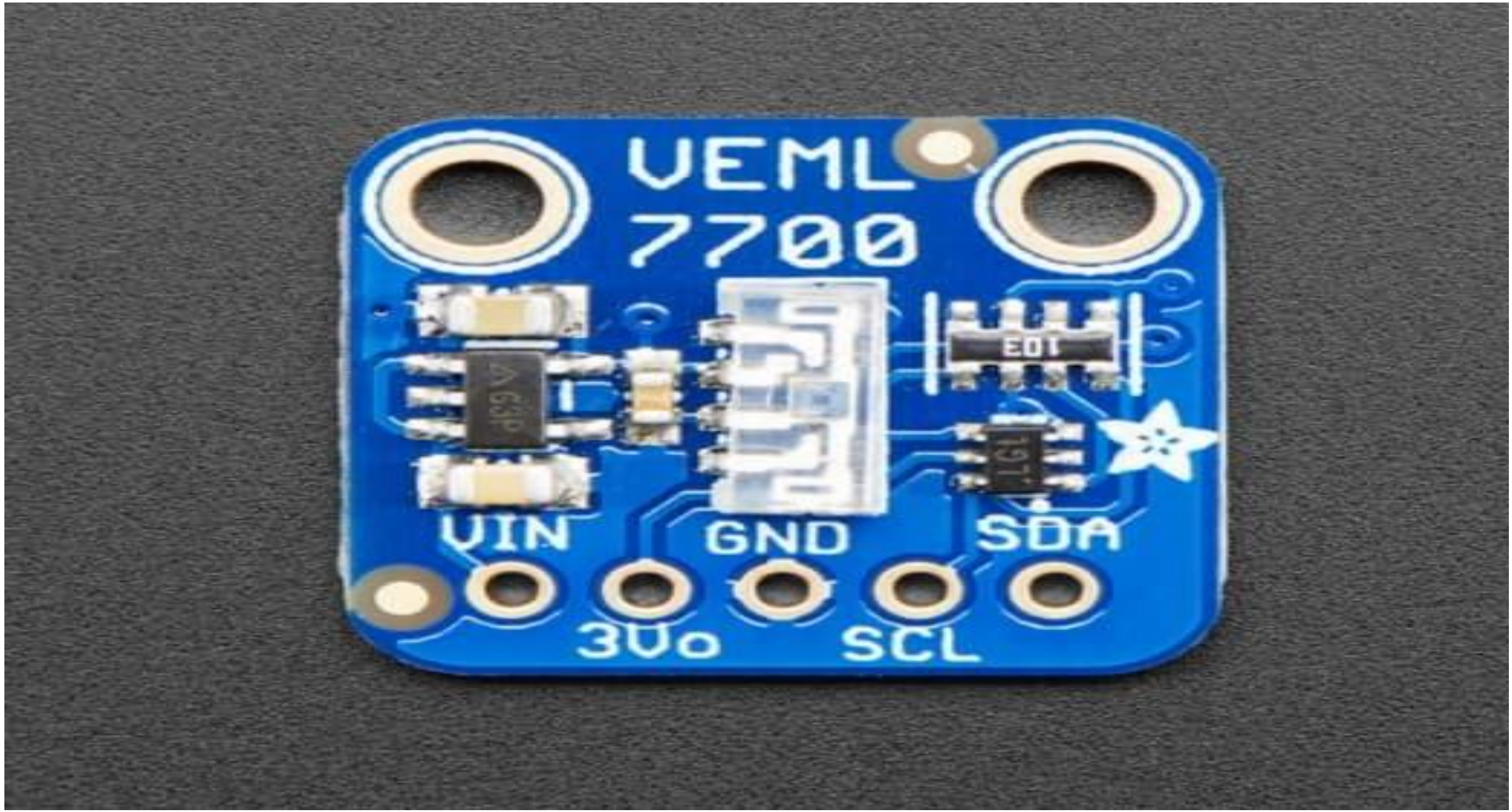
LIGHT SENSOR:

- **6. Light Sensor:**
- **Function**: Light sensors measure ambient light levels.
- **Use Cases**:
  - **Automatic Brightness Adjustment**: Light sensors in smartphones adjust screen brightness based on the surrounding light conditions to save energy and enhance user experience.
  - **Outdoor Lighting**: Light-sensitive outdoor lighting systems turn on at dusk and off at dawn.
  - **Energy-Saving Features in Smart Homes**: Smart homes use light sensors to control lighting and optimize energy usage.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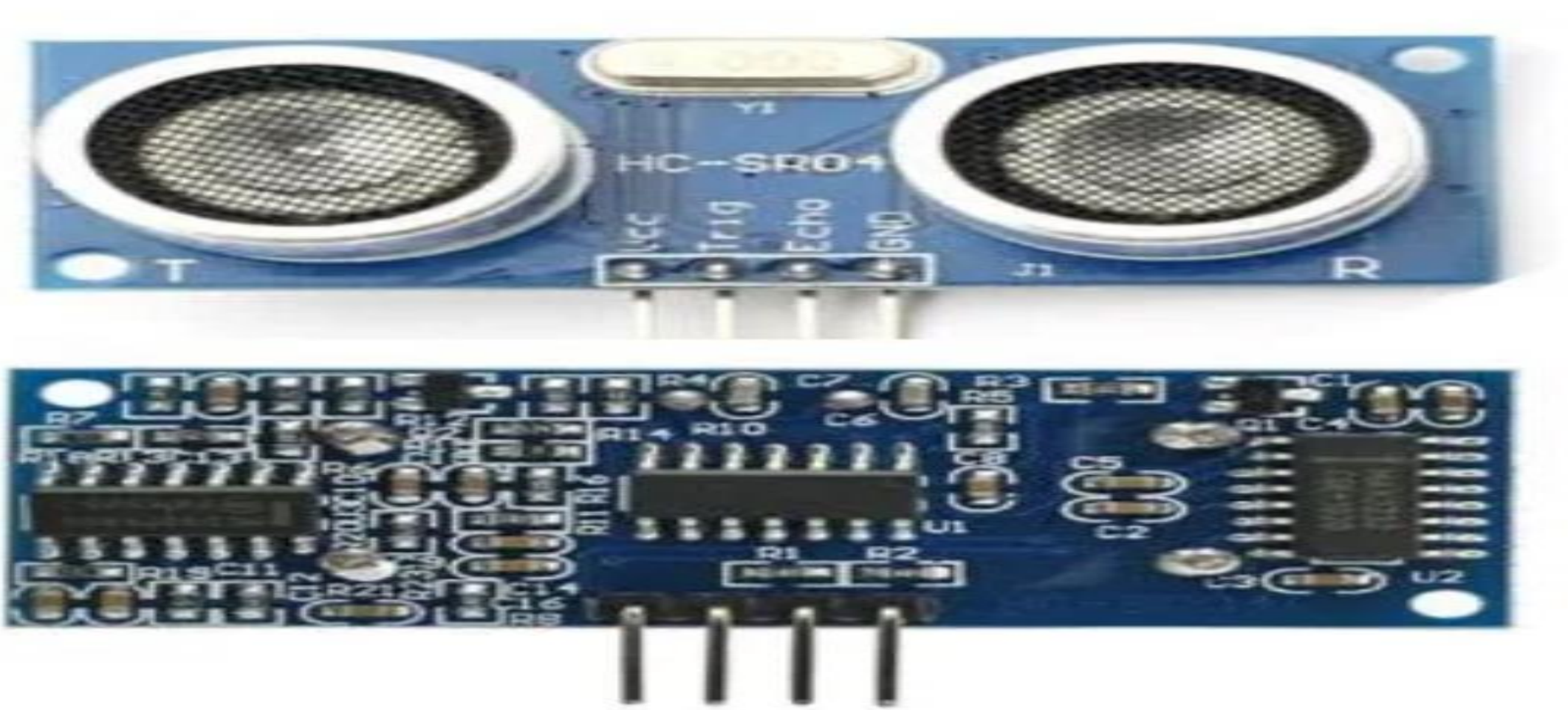
ULTRASONIC SENSOR:

- **7. Ultrasonic Sensor:**
- An ultrasonic sensor or transceiver is a transducer that works on the principle alike radar or sonar and is known for estimating the attributes of the target by interpreting. These sensors are classified as active and passive ultrasonic sensors and maybe differentiated on their working.
- The active ultrasonic sensors are known for generating high-frequency sound waves that are received back by the ultrasonic sensor for the evaluation of echo. The time interval taken for receiving and transmitting the echo helps in the determination of the distance to an object.
- However, the passive ultrasonic sensors are merely used for the detection of ultrasonic noise whose presence can be found in specific conditions. When it comes to the practical application of an ultrasonic sensor with a circuit, it may also be used as an ultrasonic distance sensor circuit.

ULTRASONIC SENSOR:

- **Function**: Ultrasonic sensors use ultrasonic waves to measure the distance to an object.
- **Use Cases**:
  - **Object Detection in Robotics**: Ultrasonic sensors help robots avoid obstacles by detecting their proximity.
  - **Parking Assistance in Automobiles**: Ultrasonic sensors assist drivers in parking by measuring the distance to nearby objects and providing feedback.
  - **Water Level Measurement in Tanks**: These sensors gauge water levels in tanks and containers, enabling efficient resource management..

ULTRASONIC SENSOR



SMOKE, GAS, AND ALCOHOL SENSOR:

- **8. Smoke, Gas, and Alcohol Sensor:**
- **Function**: These sensors detect the presence of specific gases, smoke, or alcohol vapor.
- **Use Cases**:
  - **Fire Alarms (Smoke Detection)**: Smoke sensors are essential for early fire detection and safety in homes and commercial buildings.
  - **Gas Leakage Detection**: Gas sensors identify gas leaks in homes, ensuring safety by triggering alarms and shutting off gas supplies.
  - **Breathalyzer Tests (Alcohol Detection)**: Alcohol sensors are used in breathalyzer devices to measure blood alcohol content for law enforcement and personal use.

GAS SENSOR:

- **Gas Sensor:**
- Gas sensors are similar to chemical sensors but are specially implemented for observing modifications in the quality of air. This is done to find out which types of gases are present in it. This sensor is being used in multiple domains such as health, manufacturing, agriculture, for supervision of gas in coal industries, chemical laboratory investigations, etc.
- Some of the gas sensors that have been put to use include hydrogen type, hygrometer, carbon-dioxide sensor, ozone monitoring type, air pollution type, gas detection type, etc.

MQ-2 Combustible Gas, Smoke Sensor

Features of MQ2

Operating Voltage is +5V

Can Measure or detect LPG, Alcohol, Propane, Hydrogen, CO and even methane

Analog output voltage: 0V to 5V

Digital Output Voltage: 0V or 5V (TTL Logic)

TOUCH SENSOR:

- **9. Touch Sensor:**
- **Function**: Touch sensors detect touch or contact with a surface, allowing users to interact with devices through touch.
- **Use Cases**:
  - **Capacitive Touchscreens**: Smartphones and tablets use capacitive touch sensors for user input, enabling touch gestures, multi-touch, and virtual keyboards.
  - **Touch-Sensitive Buttons in Appliances**: Appliances like microwave ovens use touch sensors for button-free operation and easy cleaning.
  - **Interactive Kiosks**: Touch sensors provide intuitive interaction in self-service kiosks, ATMs, and information terminals.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COLOR SENSOR :

10. **Color Sensor**:

- **Function**: A color sensor detects and measures the color of an object by analyzing the light reflected off or transmitted through the object. It can provide data on the color's specific parameters like RGB values or color temperature.
- **Use Cases**: Color sensors are used in applications like color sorting machines (sorting items by color), color matching (ensuring products meet color quality standards), and color recognition in industrial automation.


Color Sense

HUMIDITY SENSORS:

11.Humidity Sensor:

- *Function*: A humidity sensor measures the water vapor content in the air. It typically consists of a humidity-sensitive element that changes its electrical resistance with humidity levels.
- *Example*: In a greenhouse, the humidity sensor constantly measures the humidity. When the humidity decreases, the sensor detects the change and triggers a water misting system to increase humidity, maintaining an ideal environment for plant growth.

POSITION SENSOR :

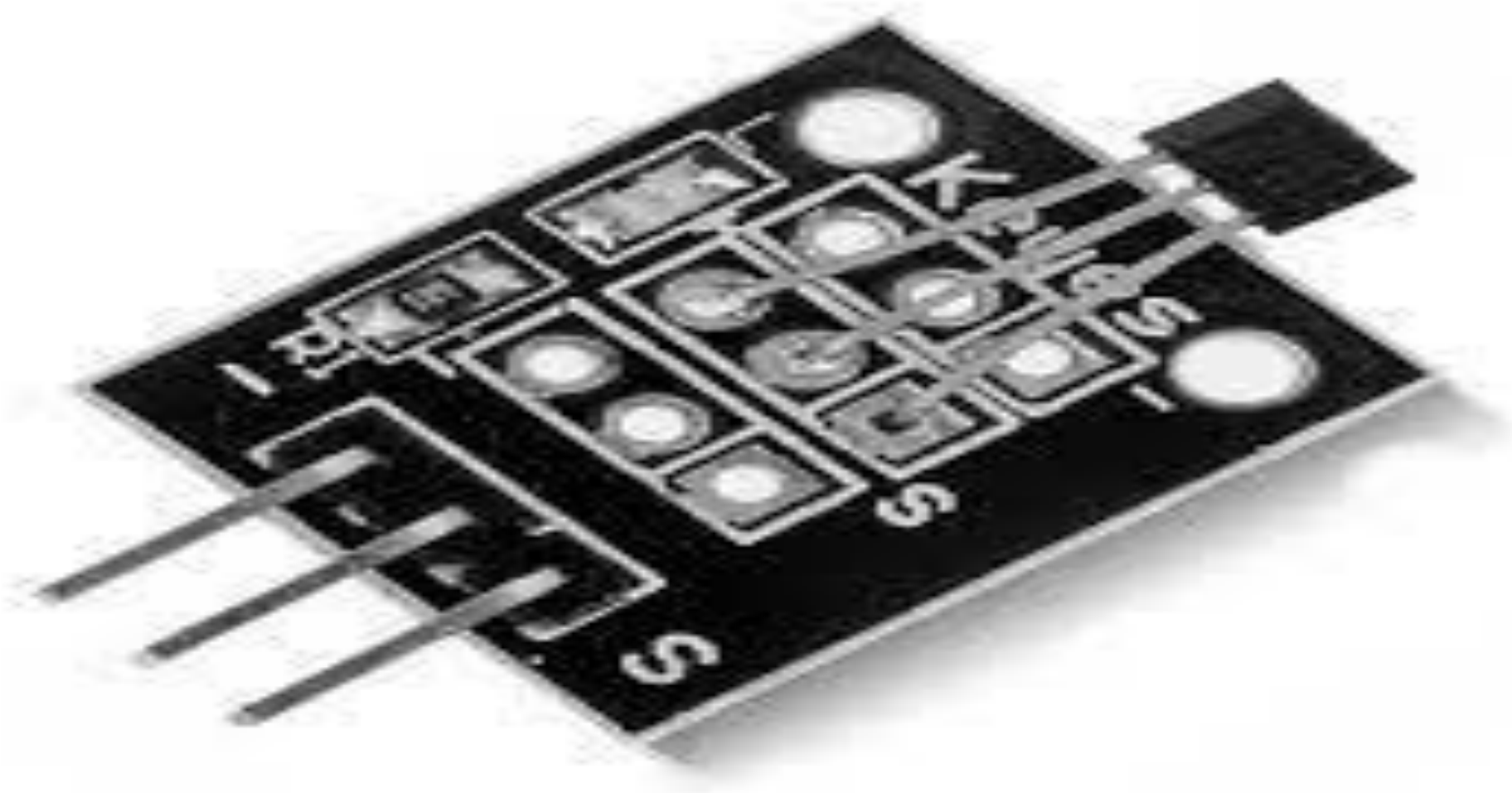
12.Position Sensor:

- *Function*: A position sensor determines the position or displacement of an object, usually by detecting changes in magnetic or electrical fields.
- *Example*: In an automobile, the position sensor in the throttle body uses a potentiometer to measure the throttle's position. This data is sent to the ECU, which adjusts fuel and air intake accordingly.

MAGNETIC SENSOR (HALL EFFECT SENSOR):

13.Magnetic Sensor (Hall Effect Sensor):

- *Function*: A Hall Effect sensor detects the presence and strength of magnetic fields by measuring the Hall voltage created when a magnetic field interacts with a semiconductor.
- *Example*: In a laptop, a Hall Effect sensor in the lid detects the presence of a magnetic field when the lid is closed, allowing the laptop to enter sleep mode or hibernate.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MICROPHONE (SOUND SENSOR):

14.Microphone (Sound Sensor):

- *Function*: A microphone converts sound waves, which are variations in air pressure, into electrical signals through a diaphragm and a transducer like a condenser or dynamic microphone element.
- *Example*: In a smartphone, the microphone serves as a sound sensor, converting spoken words into electrical signals for voice calls and voice recognition.

TILT SENSOR:

15.Tilt Sensor:

- *Function*: A tilt sensor measures the orientation of an object relative to gravity by detecting changes in capacitance or resistance as the sensor tilts.
- *Example*: In a gaming controller, tilt sensors detect the orientation of the controller, allowing players to steer or control in-game actions by tilting the controller.


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FLOW AND LEVEL SENSOR:

16.Flow and Level Sensor:

- *Function*: Flow sensors monitor the rate of liquid or gas flow, while level sensors detect the height or volume of a liquid in a container.
- *Example*: In a water treatment plant, flow sensors monitor the flow rate of water in pipes, ensuring the correct amount of chemicals is dosed to maintain water quality.

PIR SENSOR (PASSIVE INFRARED SENSOR):

17.PIR Sensor (Passive Infrared Sensor):

- *Function*: PIR sensors detect changes in infrared radiation, usually emitted by warm objects. They work by comparing two pyroelectric sensors.
- *Example*: In a security system, a PIR sensor detects motion in a room by sensing changes in the heat signature. When an intruder enters, the sensor triggers an alarm or activates security measures.


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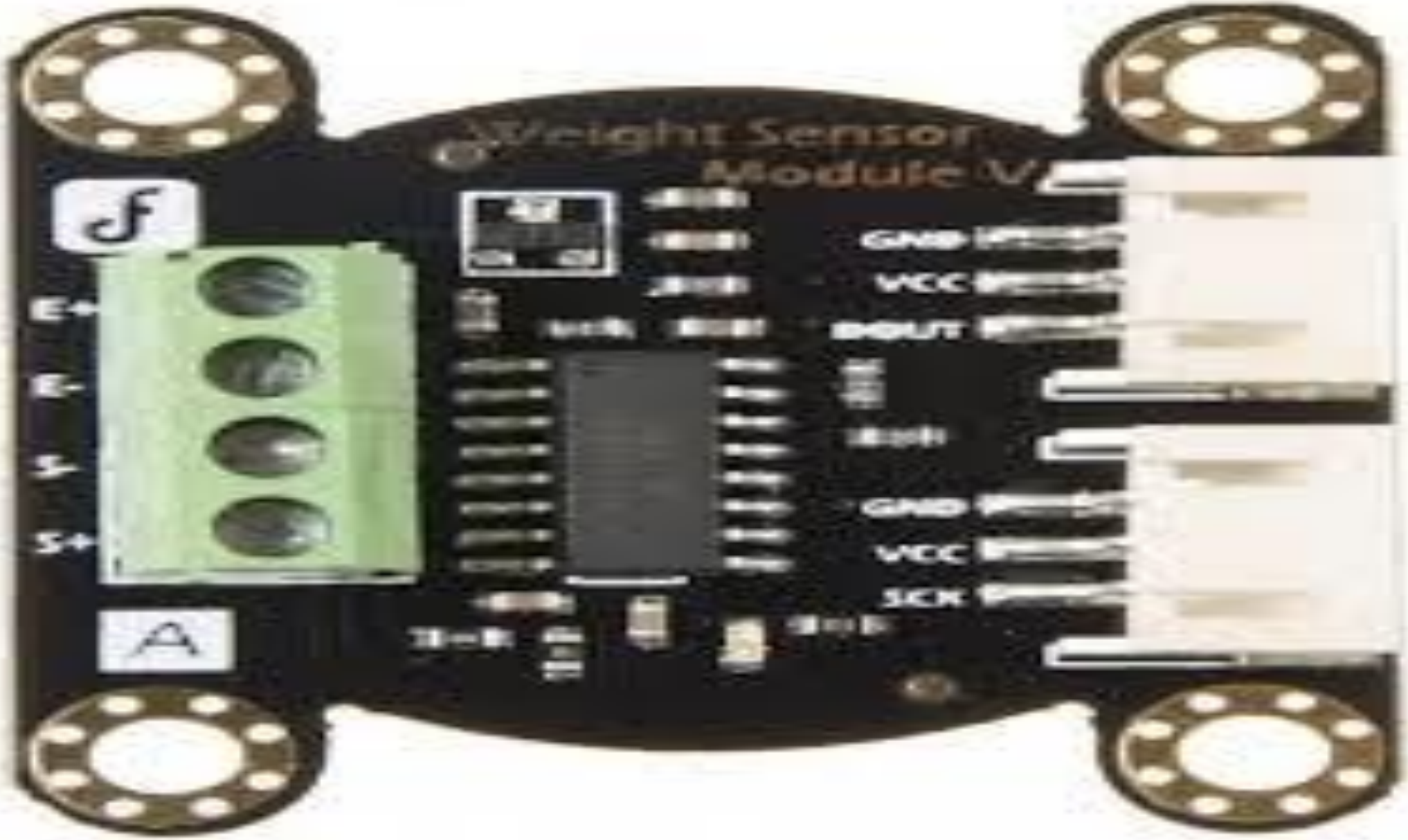
STRAIN AND WEIGHT SENSOR:

19.Strain and Weight Sensor:

- *Function*: Strain and weight sensors measure the deformation or strain in a material when a force is applied, and this information is used to determine weight or load.
- *Example*: In a grocery store checkout scale, a strain gauge-based weight sensor measures the weight of items placed on it, enabling the calculation of the total cost of groceries.


Weight Sensor
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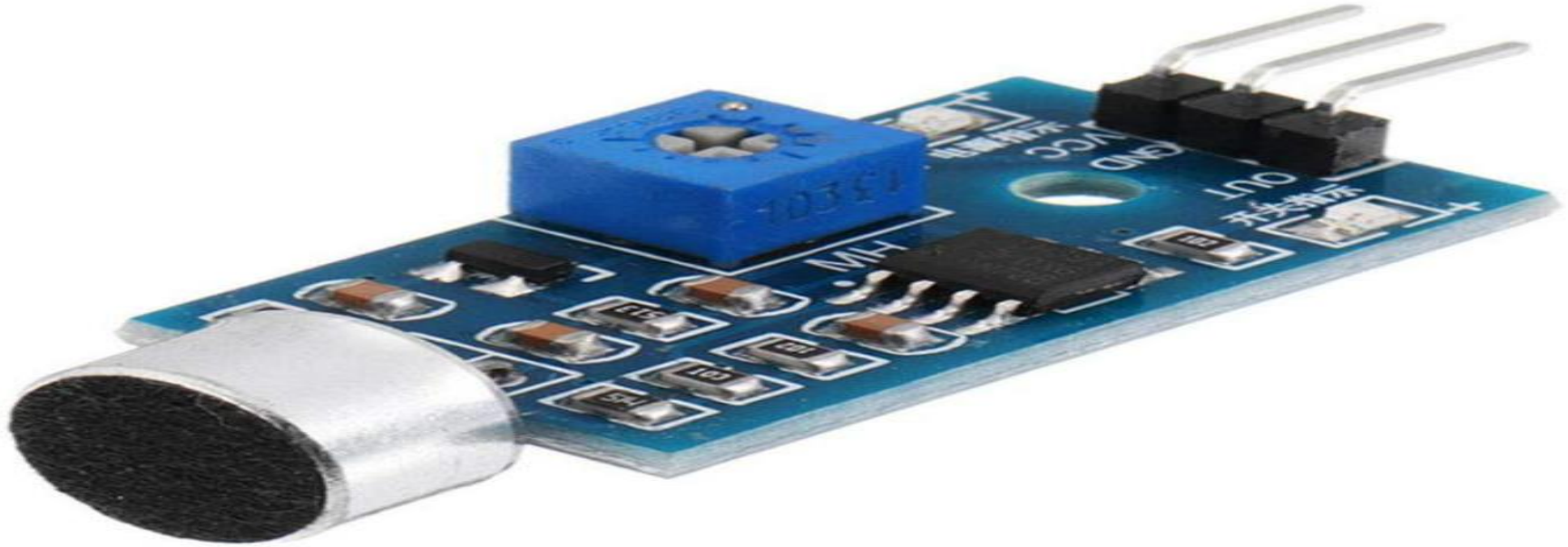
SOUND SENSOR:

- **Sound Sensor:**
- Sound sensors can generally be identified as the microphone devices that are used for delivering the corresponding level of voltage and sound on the basis of the sound level detection. By implementing the sound sensor, a small robot may be manufactured for navigation on the basis of sound received.
- In comparison to light sensors, the design process of sound sensors is complicated. The reason being the delivery of minimal voltage difference by them. This is further to be amplified for providing voltage variation that is measurable.
- Various other **sensors** include a light sensor, tactile sensors, force sensors, etc. The types of sensors used in building include motion detection sensors, camera sensors, gas sensors, smoke and fire detection sensors, electric voltage and current sensors, and temperature sensors.

SOUND SENSOR



CHEMICAL SENSOR:

- **Chemical Sensor:**
- A chemical sensor helps in determining various kinds of changes in liquid and for detecting the air chemical variations. These are mainly put to use in bigger cities and towns as it is important to look after the changes for providing safety to the people.
- This type of sensor is essentially implemented in commercially atmospheric observation. It is used for processing management which may comprise of fortuitously or intentionally evolved chemicals, radioactive exposure, pharmaceutical industries, and reusable operations in space stations.
- The most commonly used chemical sensors include chemical FET, electrochemical gas type, chemi resistor, non-dispersive IR, zinc oxide nanorod, and fluorescent chloride type.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USES OF SENSORS

- **Uses of Sensors**
- If we look around carefully, sensors are used in many products that we use in our day-to-day life. Sensors are used in various industries comprising automotive, medical, aerospace, defense, and agriculture.