Optical Sensor

- An optical sensor converts light rays into an electronic signal.
- The purpose of an optical sensor is to measure a physical quantity of light and, depending on the type of sensor, then translates it into a form that is readable by an integrated measuring device.
- Optical Sensors are used for contact-less detection, counting or positioning of parts.
- Optical sensors can be either internal or external.
- External sensors gather and transmit a required quantity of light, while internal sensors are most often used to measure the bends and other small changes in direction.
- The measurands possible by different optical sensors are Temperature, Velocity Liquid level, Pressure, Displacement (position), Vibrations, Chemical species, Force radiation, pH- value, Strain, Acoustic field and Electric field.

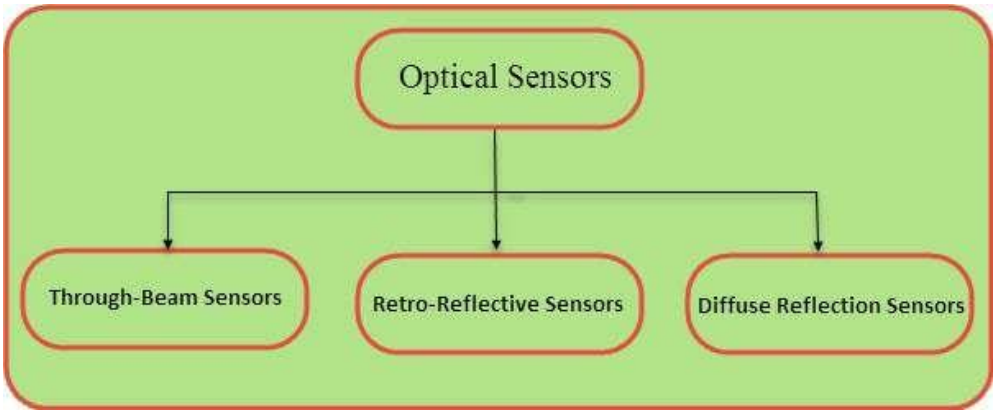
Types of Optical Sensors

- There are different kinds of optical sensors, the most common types which we have been using in our real world applications as given below.
- Photoconductive devices used to measure the resistance by converting a change of incident light into a change of resistance.
- The photovoltaic cell (solar cell) converts an amount of incident light into an output voltage.
- The Photodiodes convert an amount of incident light into an output current.
- Phototransistors are a type of bipolar transistor where the base-collector junction is exposed to light. This results in the same behavior of a photodiode, but with an internal gain.

- The operating principle is the transmitting and receiving of light in an optical sensor, the object to be detected reflects or interrupts a light beam sent out by an emitting diode.

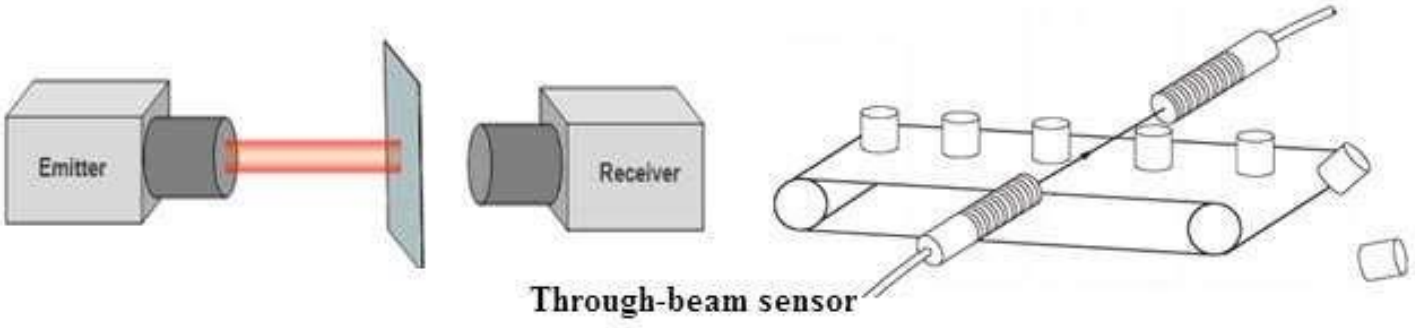
- Depending on the type of device, the interruption or reflection of the light beam is evaluated.
- This makes it possible to detect objects independently of the material they are constructed from (wood, metal, plastic or other).

- Special devices even allow for a detection of transparent objects or those with different colors or variations in contrast.
- Different types of optical sensors as explained below.



Beam Sensors

- The system consists of two separate components the transmitter and the receiver are placed opposite to each other.
- The transmitter projects a light beam onto the receiver.
- An interruption of the light beam is interpreted as a switch signal by the receiver.
- It is irrelevant where the interruption occurs.



Through-beam sensor

Advantage:

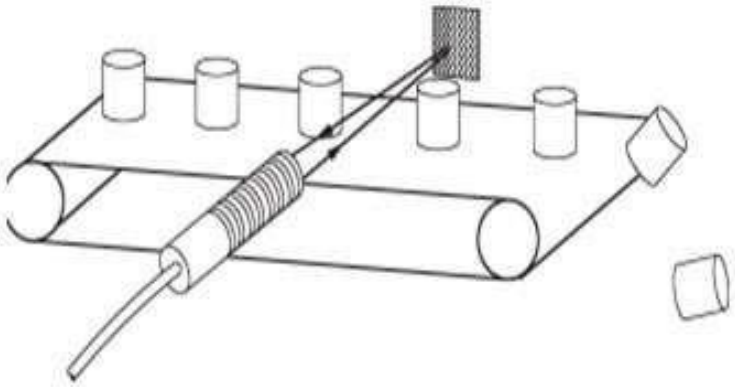
- Large operating distances can be achieved and the recognition is independent of the object's surface structure, color or reflectivity.

- To guarantee a high operational dependability it must be assured that the object is sufficiently large to interrupt the light beam completely.

Retro-Reflective Sensors

- Transmitter and receiver are both in the same house, through a reflector the emitted light beam is directed back to the receiver.

- An interruption of the light beam initiates a switching operation. Where the interruption occurs is of no importance.



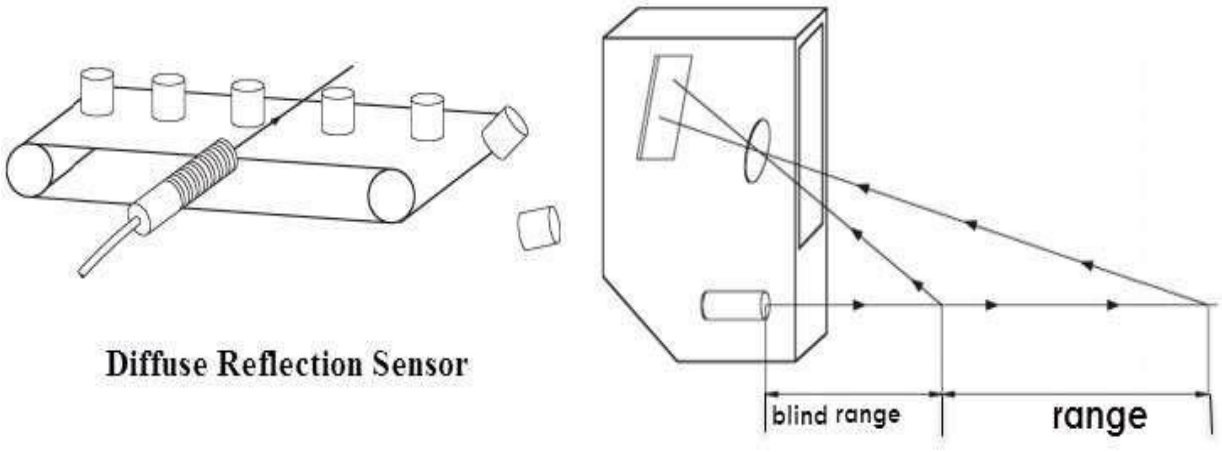
Retro-Reflective Sensors

Advantage:

- Retro-reflective sensors enable large operating distances with switching points, which are exactly reproducible requiring little mounting effort.
- All objects interrupting the light beam are accurately detected independently of their surface structure or color.

Diffuse Reflection Sensors

- Both transmitter and receiver are in one housing.
- The transmitted light is reflected by the object to be detected.



Diffuse Reflection Sensor

Advantage:

- The diffused light intensity at the receiver serves as the switching condition.
- Regardless of the sensitivity setting the rear part always reflects better than the front part.
- This leads to the consequence to erroneous switching operations.

Different Light Sources for Optical Sensors

- There are many types of light sources.

- The sun and light from burning torch flames were the first light sources used to study optics.
- As a matter of fact, light coming from certain (exited) matter (e.g., iodine, chlorine, and mercury ions) still provides the reference points in the optical spectrum.
- One of the key components in optical communication is the monochromatic light source.
- In optical communications, light sources must be monochromatic, compact, and long lasting.
- Here are two different types of light source.

1. LED
2. LASER

LED (Light Emitting Diode)

- During the recombination process of electrons with holes at the junctions of n-doped and p-doped semiconductors, energy is released in the form of light.
- The excitation takes place by applying an external voltage and the recombination may be taking place, or it may be stimulated as another photon.
- This facilitates coupling the LED light with an optical device.

A LED is a p-n semiconductor device that emits light when a voltage is applied across its two terminals

LASER (Light Amplification by Stimulated Emission Radiation)

- A laser is created, when the electrons in the atoms in special glasses, crystals, or gasses absorb energy from an electrical current they become excited.
- The excited electrons move from a lower-energy orbit to a higher-energy orbit around the atom's nucleus. When they return to their normal or ground state this leads to the electrons emit photons (particles of light).
- These photons are all at the same wavelength and coherent.
- The ordinary visible light comprises multiple wavelengths and is not coherent.