Optical Sensor Research

Optical sensors are used to convert light rays into an electronic signal, measuring the amount of light energy received by the sensor and converting this into “a form that is readable by an integrated measuring device” (ElProCus, 2020). There are many different ways in which they can achieve this and many different applications for this type of sensor.

What Types of Optical Sensors are There?

The most common kinds of optical sensor, used in real world applications, are:

* Photoconductive devices, converting a change in light into a change in resistance (ElProCus, 2020).
* Photovoltaic cell (solar cell), converting a change in light into an output voltage (ElProCus, 2020).
* Photodiodes, converting a measure of light into an output current (ElProCus, 2020).

The different types of optical sensor are:

* Through-beam sensors

This system uses a transmitter (projects a beam of light) and receiver (senses the beam of light) placed opposite from each other. If an object breaks the beam then the receiver reads this as a switch signal (ElProCus, 2020). An advantage of this type of sensor is that “large operating distances can be achieved” (ElProCus, 2020), and an interruption in the beam will be sensed regardless of the size, shape, reflectivity or colour (ElProCus, 2020).

* Retro-reflective sensors

This type of sensor uses a transmitter and receiver built within the same casing, with a reflector placed opposite the casing. The transmitter emits a beam of light which is reflected back to the receiver. As with the through-beam sensor, an interruption in the beam is read as a switch signal by the receiver (ElProCus, 2020). This sensor is advantageous due to its ability to “enable large operating distances” (ElProCus, 2020) and object detection, with the size, shape, colour and reflectivity of the object having no effect on its detection (ElProCus, 2020).

* Diffuse reflection sensors

This system uses a transmitter and receiver built into the same casing, with the transmitter emitting a beam of light and an object (to be detected) acting as the reflective surface for the light to be returned to the receiver (ElProCus, 2020). In this system, the light intensity detected by the receiver causes a switch to occur. This system can incur error during the switching process, due to “the rear part reflecting better than the front part” (ElProCus, 2020), no matter what sensitivity the receiver is set to.

What are Typical Applications of Optical Sensors?

There are a wide range of applications for optical sensors. Some of these include:

* Ambient light sensors for mobile devices

These types of sensors are usually used in mobile devices such as phones and tablets. They are used to allow for the adjustment of the device’s display, correcting for the background lighting experienced by the user. This optimises the screen brightness for the user’s vision and also allows for as little battery life consumption as possible (ElProCus, 2020).

* Heart rate monitors in the biomedical sector

Optical heart rate monitors transmit LED light through a subject’s skin, reading the amount of light reflected back to determine their heart rate. “Fluctuations in heart rate can be translated into heart rate” (ElProCus, 2020) because blood absorbs more light than the skin. When the heart beats and the heart is filled with more blood, less light is reflected than when the heart has less blood inside. “This process is called photoplethysmography” (ElProCus, 2020).

* Liquid level sensors in multiple sectors

This system is used to measure the amount of liquid within a given container. It works by using a diffuse reflection type sensor, sending out a beam of light from a transmitter and reading the amount of light that is reflected using a receiver. If there is no liquid at the level of the sensor then the full amount of light will be reflected, but if the liquid is at the same height as the sensor then it will cause the emitted light to “disperse” (ElProCus, 2020) and less light will be reflected back to the receiver.

How Can Control be Achieved by a Microprocessor, Sensors and Motors?

* Discuss closed-loop control

A control system is “when a number of elements are combined together to form a system to produce desired output” (Electrical4U, 2019). The difference between open-loop and closed-loop system is that open-loop systems require manual input to function, whereas closed-loop systems allow for autonomous function (Electrical4U, 2019). Closed-loop control systems have many applications in industries including agriculture, chemical plants, quality control, nuclear power plants, water treatment plants and environmental control (WhatIs, 2020).

Other Useful Links

Robot Platform (2020) *Wireless Communication.* Available at: http://www.robotplatform.com/knowledge/communication/wireless\_communication.html (Accessed 14/02/2020)

C. Benson RobotShop (2018) *How to Make a Robot – Lesson 4: Understanding Microcontrollers.* Available at: https://www.robotshop.com/community/tutorials/show/how-to-make-a-robot-lesson-4-understanding-microcontrollers (Accessed 14/02/2020)

RoboticLab (2020) *Microcontrollers and Robotics.* Available at: https://home.roboticlab.eu/en/microcontrollers (Accessed 14/02/2020)

SparkFun (2020) *Analog to Digital Conversion.* Available at: https://learn.sparkfun.com/tutorials/analog-to-digital-conversion/all (Accessed 14/02/2020)

References

Electrical4U (2019) *Control System | Closed-Loop Open-Loop Control System.* Available at: https://www.electrical4u.com/control-system-closed-loop-open-loop-control-system/ (Accessed 19/02/2020)

ElProCus (2020) *Optical Sensor Basics and Applications.* Available at: https://www.elprocus.com/optical-sensors-types-basics-and-applications/ (Accessed 14/02/2020)

WhatIs (2020) *Closed Loop Control System.* Available at: https://whatis.techtarget.com/definition/closed-loop-control-system (Accessed 14/02/2020)