Analog Sensors

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What are sensors?

Sensors are devices that can detect measurements from external sources and can send this signal to another device, usually a microprocessor. There are two types of sensors: digital and analog. Digital sensors give a binary output, 0 or 1, while analog sensors can output any range of numbers. An analog sensor works by converting a physical quantity into an electrical signal that can be processed by an electronic system. The analog signal is continuous, meaning it can take on any value within a range.

Analog sensors are essential for many electronic systems. They are easy to use, cost-effective, and easy to get which is great for preventative measures. There are several types of analog sensors, including resistive, capacitive, inductive, and piezoelectric sensors. Each type of analog sensor is designed to measure a specific physical quantity and works differently. The sensors that I would like to explore can have multiple types:

Types of analog sensors

- Light
- Sound
- Pressure
- Temperature

Light Sensors

Light sensors have a photoelectric effect. The electrons moving after a light effect happens. This creates an electric charge that can be called current. There are subtypes of light sensors:

- **Photovoltaic** – Solar cells. The light levels generate voltage or current and store it in silicon cells for future use. These are usually panels.
- **Light-dependent** – Gauges for light levels. They operate as automatic switches for various devices. These devices come under the classification of photoresistors as the reason their resistance value enhances as the light levels go up.
- **Photo Diode** – Remote controls, cameras, and video recorders.
- **Proximity** – Detects either the closeness of another item or motion. These are helpful in robotic machines to pass through obstacles and keep away from object bumpings.

Figure 1. Photo Diode

Sound Sensors

Sound sensors can usually detect sound ambient wavelengths in the environment. They can also measure intensity and convert the wavelength to an electrical signal that can be read. There are five subtypes of sound sensors:

- **Dynamic Microphone** - Usually used in theater or stage performance. A fixed coil vibrates back and forth. Low distortions and induces electrical current.
- **Carbon Microphone** - Detects resistance change in carbon granules. Provides good contact when the wavelength pressure goes up or down to increase or decrease resistance. Used in telephones or amplifiers.
- **Ribbon Microphone** - Used in high quality audio devices. The ribbons vibrate through magnetism.
- **Condenser Microphone** - The microphone is a thin membrane near a metal plate that acts like a metal diaphragm. Requires a constant power supply (DC) and a buffer amplifier due to its high impedance. Can be overloaded with loud sounds.
- **Sound Sensor Module** - A device that consists of multiple sound sensors to combine into one. Used for in-home applications, security systems, and monitoring systems.

Pressure Sensors

Pressure Sensors detect pressure changes. Pressure is the amount of force over an area. These sensors are usually applied to tanks for preventative measures. They can alert team members when the pressure falls out of a specified level. Here are a few types of pressure sensors:

- **Strain Gauge** - Most common. Measures expansion and contractions to calibrate pressure. Then turns it into an electronic signal

- **Variable Capacitance** - Uses two plates to measure capacitance. The capacitance changes with the different pressure in the environment.
- **Solid State** - The fluid pressure in the surrounding area can detect force applied which activates an internal diaphragm that measures and produces an electrical output.
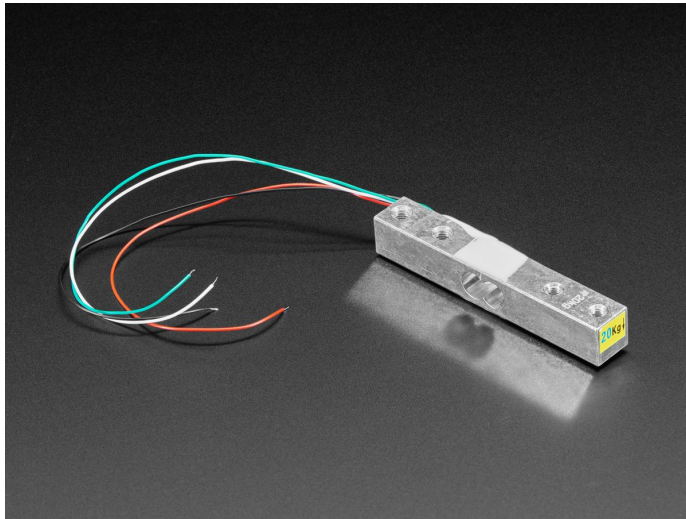

Figure 2. Strain Gauge Load Cell

Temperature Sensors

Temperature Sensors are responsive to temperature changes. Some applications need accuracy like life-saving machinery and some do not, such as the thermometer in your house. Here are four types of temperature sensors:

- **Negative Temperature Coefficient (NTC) Thermistors** - Changes in resistance are correlated with temperature change. Resistance goes up as temperature goes down.
- **Resistance Temperature Detectors (RTDs)** - Uses an element like copper, nickel or platinum that changes in resistance based on temperature.
- **Thermocouples** - Two wires at two points. Two metals that are different, form a voltage differential.
- **Semiconductor-Based Sensors** - Usually in integrated circuits (ICs). It has two diodes with voltage and current sensitive changes that monitor temperature.

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