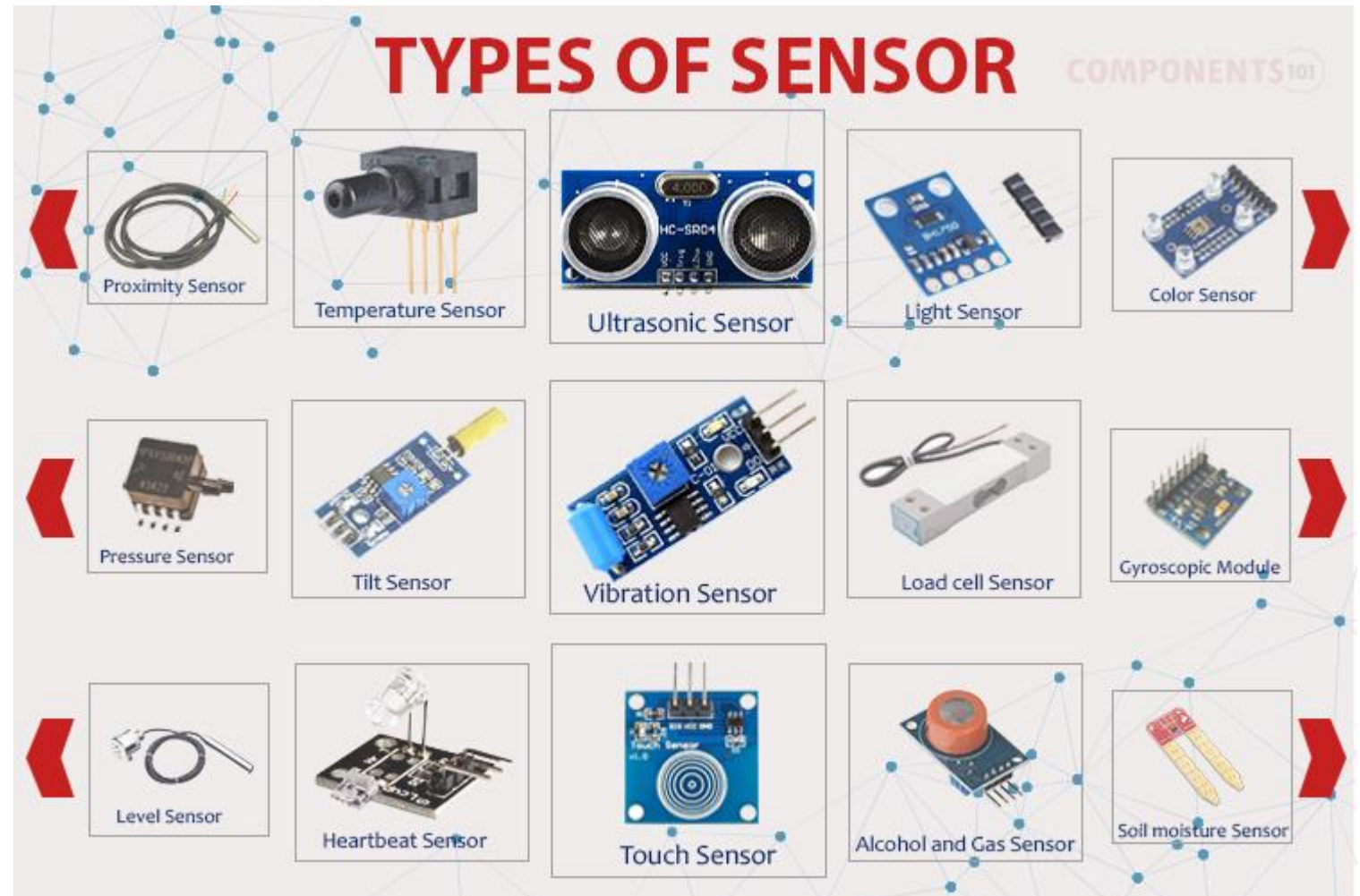


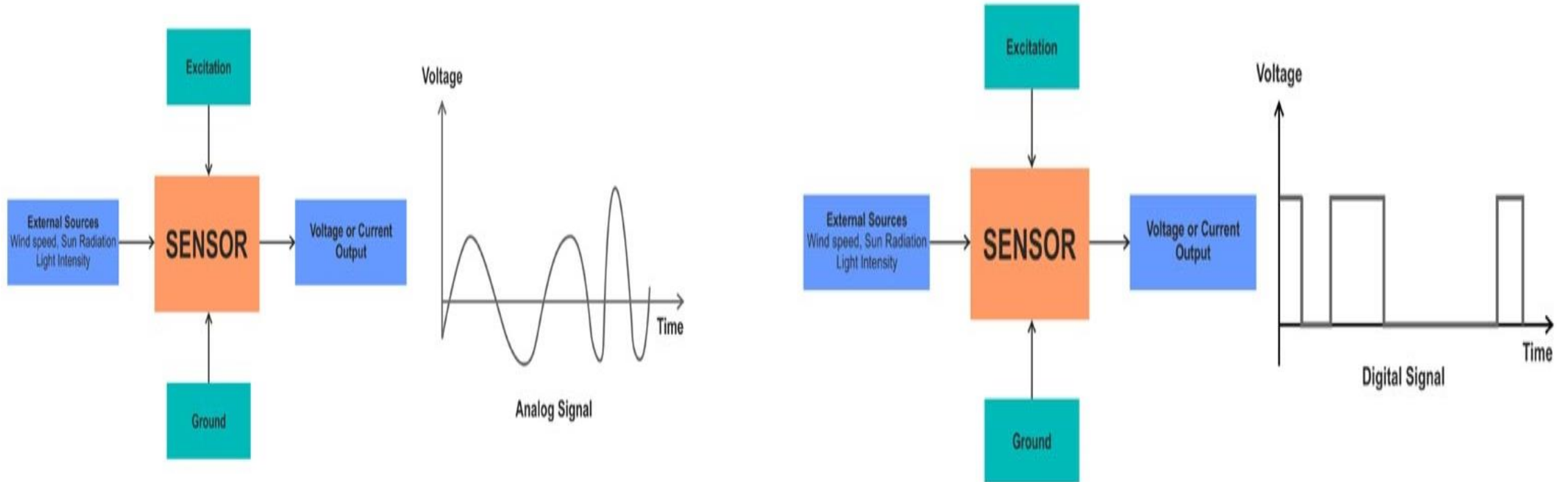
Other sensors

Sensors are used extensively in consumer electronics for monitoring, measuring, data logging and control. Common sensors are pressure, proximity, motion, temperature, radio frequency (RF), ultrasonic, flow, level, acoustic, touch and optical.

- Fingerprint scanners
- Proximity sensors
- Barometers
- Heart rate monitors

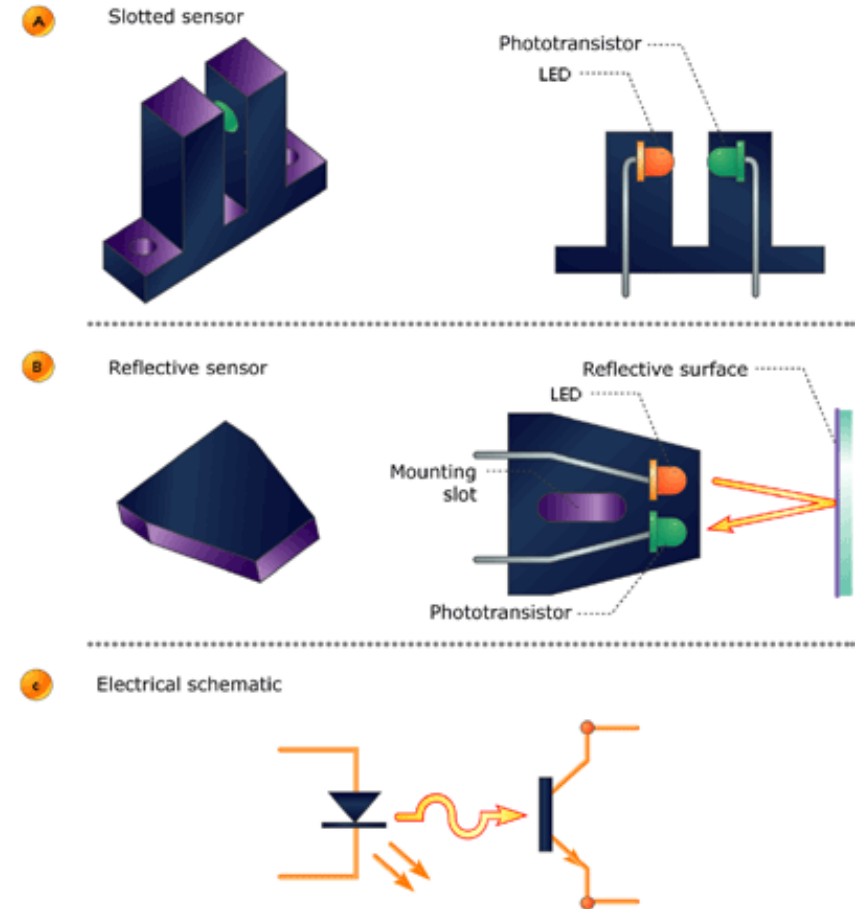
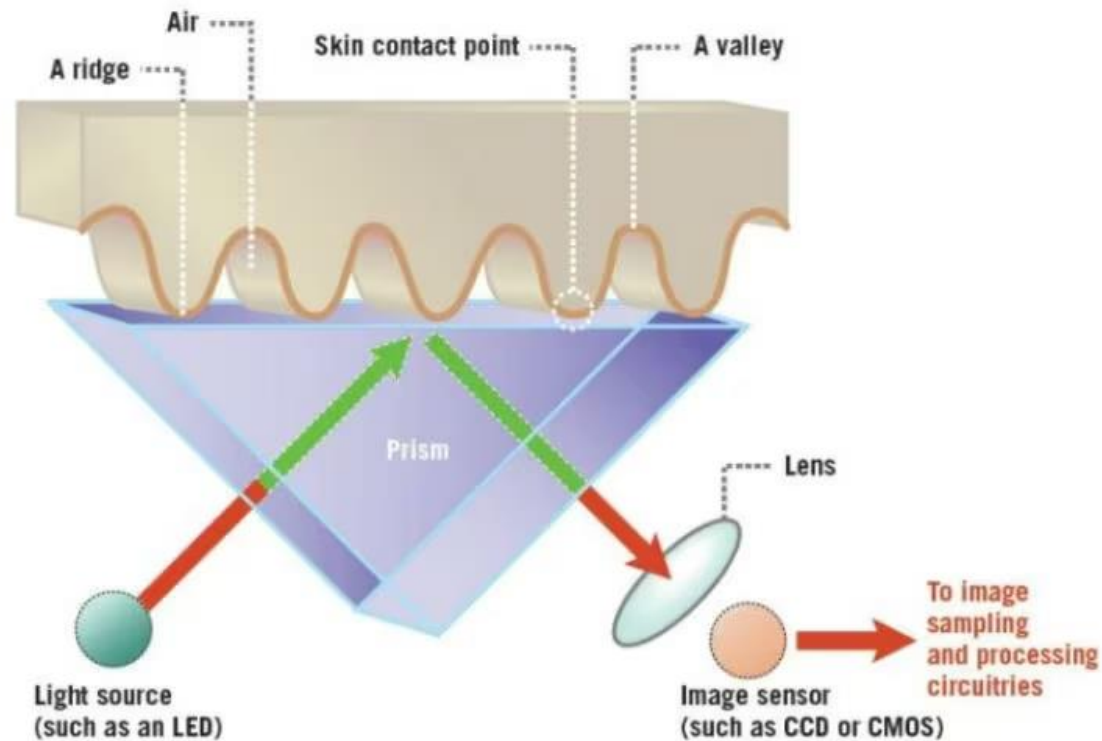


Analog versus Digital Sensors

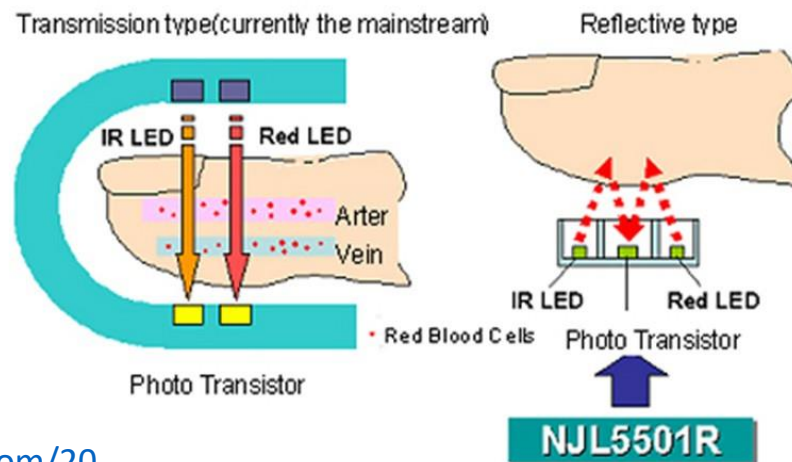
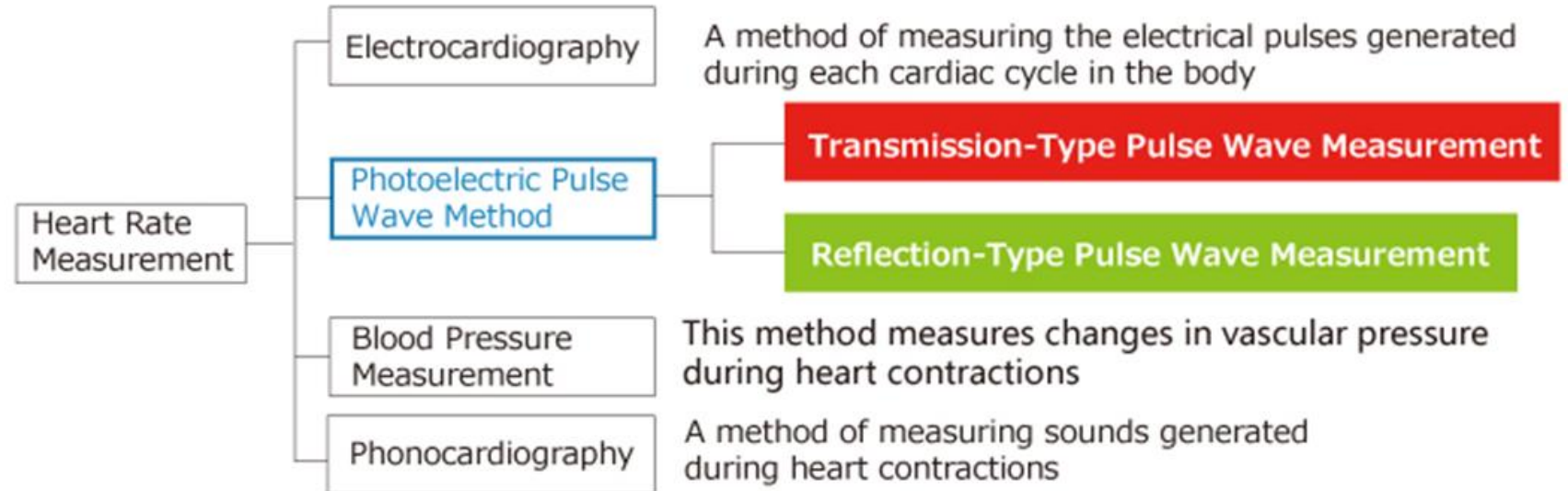


Optical Sensor: Fingerprint Scanner

An optical sensor.

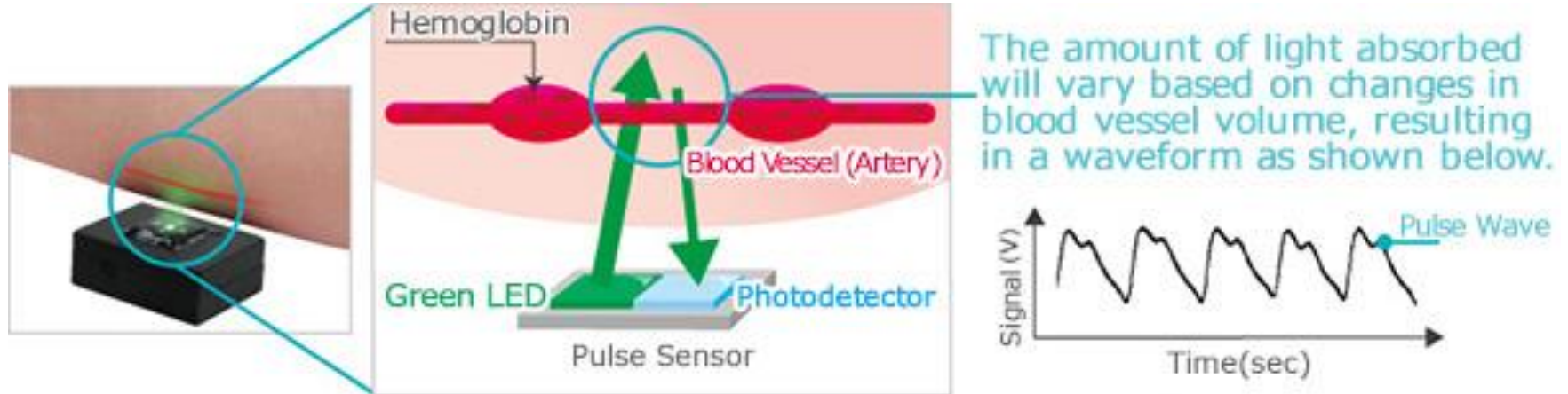


Optical sensor: Heart rate monitor



- Pulse sensors using the photoelectric pulse wave method are classified into 2 types depending on the measurement method: transmission and reflection.
- Transmission types measure pulse waves by shining red or infrared light on the body surface and detecting the change in blood flow during heart beats as a change in the amount of light transmitted through the body.
- This method is limited to areas where light can easily penetrate, such as the fingertip or earlobe.

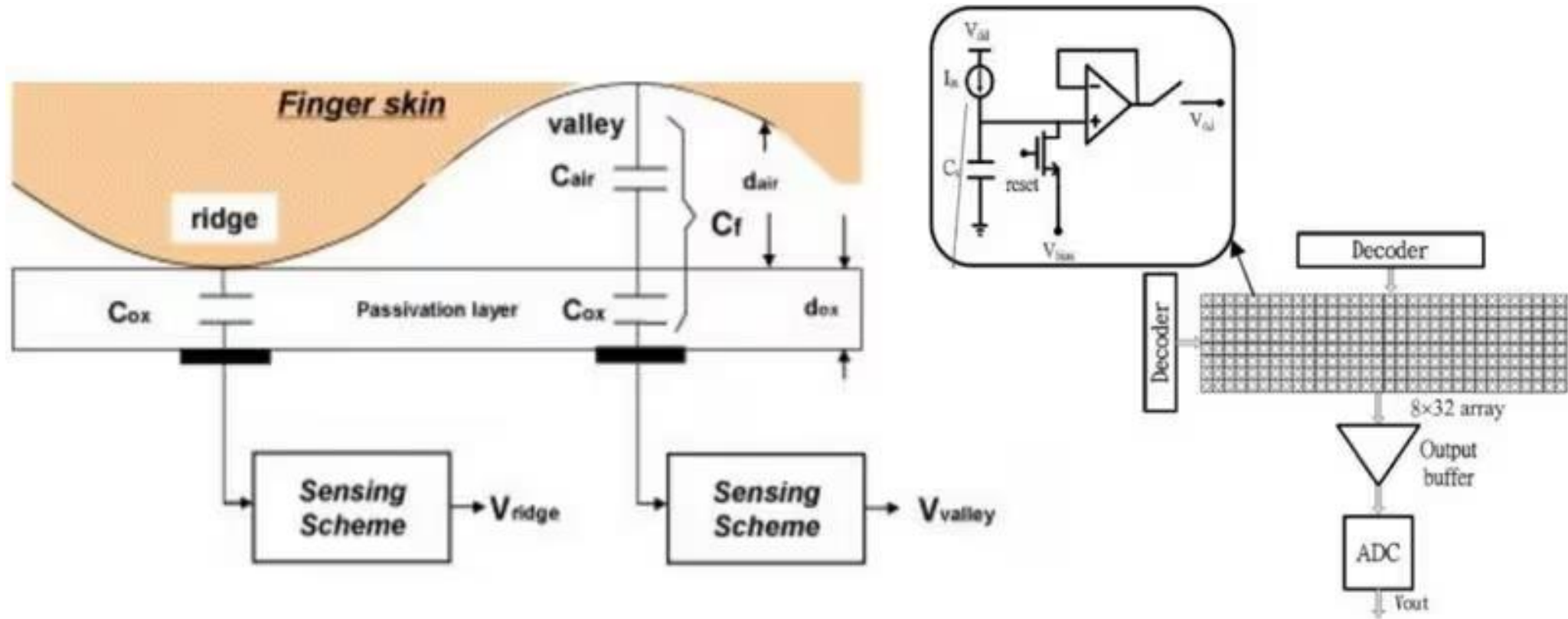
Optical sensor: Heart rate monitor



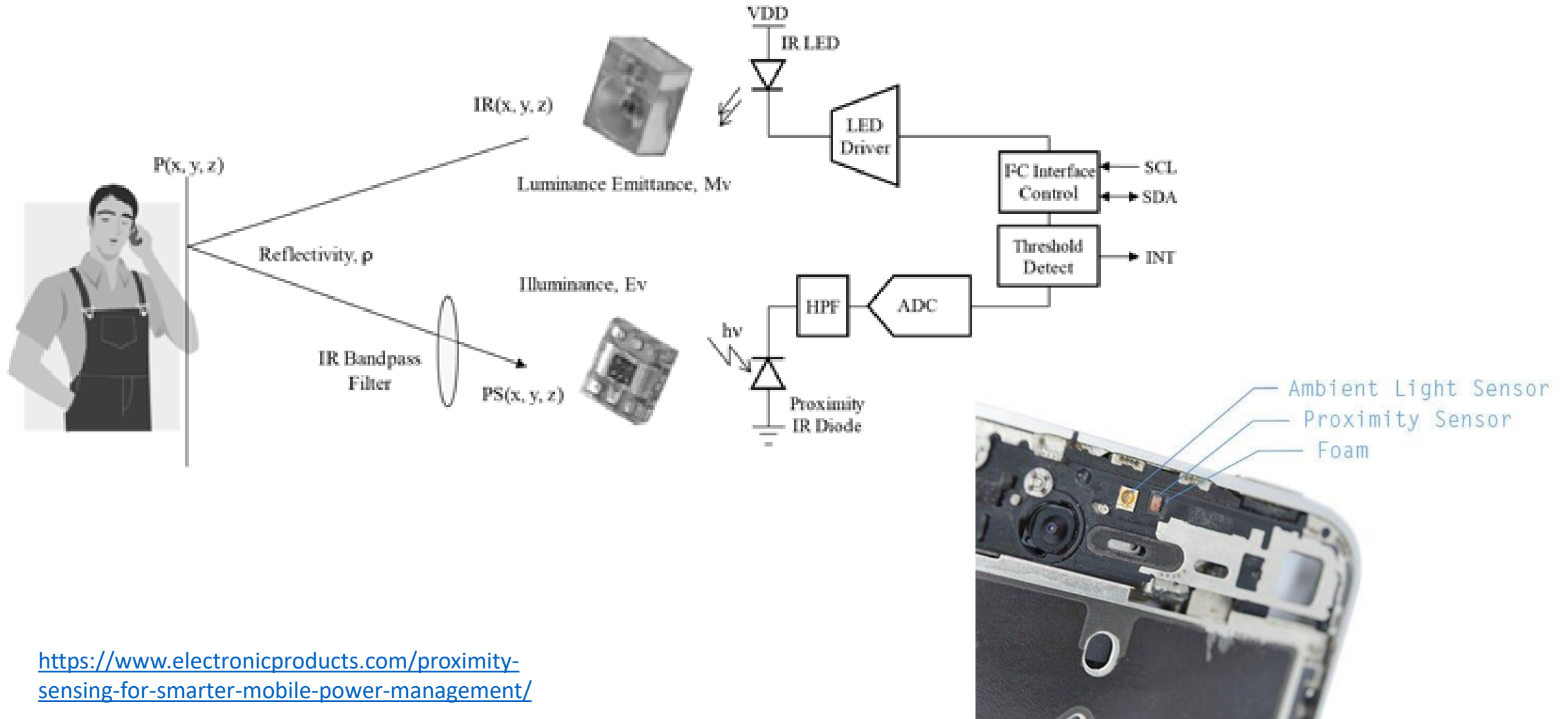
- Reflection-type pulse sensors (Optical Sensors for Heart Rate Monitor) emit infrared, red, or green light (~550nm) towards the body and measure the amount of light reflected using a photodiode or phototransistor.
- Oxygenated hemoglobin present in the blood of the arteries has the characteristic of absorbing incident light, so by sensing the blood flow rate (change in blood vessel volume) that changes following heart contractions over time we are able to measure the pulse wave signal.
- Since reflected light is measured, the range of suitable areas is not limited as with transmission types.



Fingerprint Scanner: Capacitive Sensor

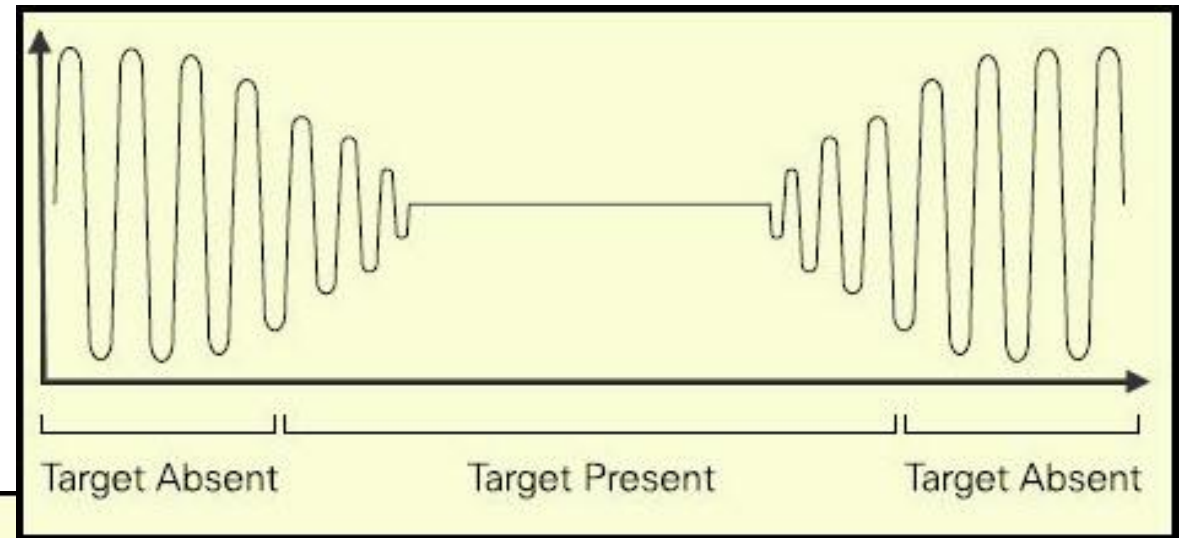
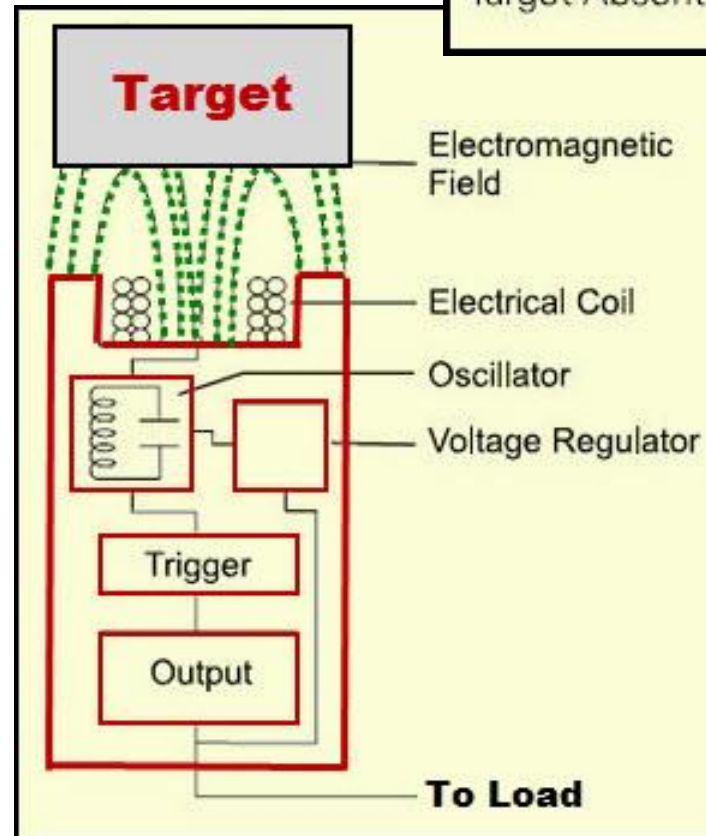
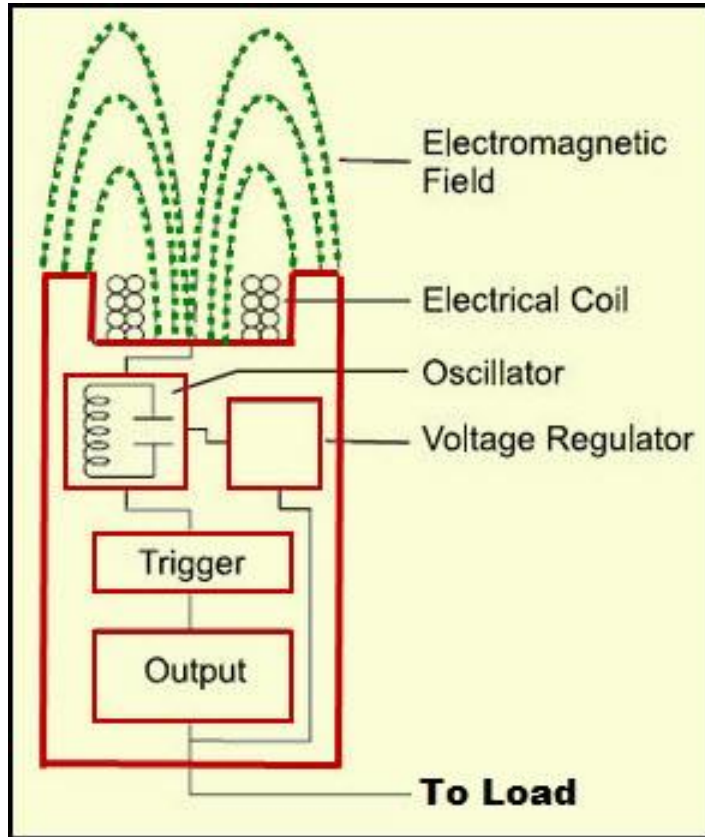


Proximity Sensor



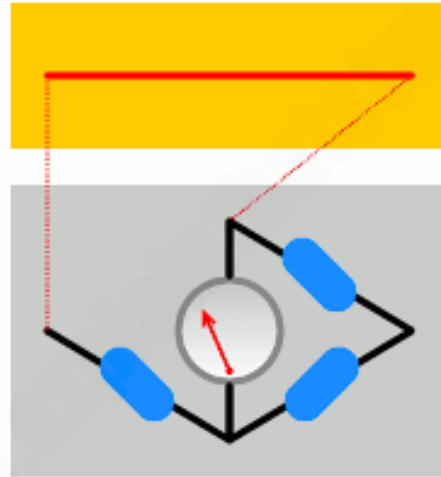
<https://www.electronicproducts.com/proximity-sensing-for-smarter-mobile-power-management/>

Proximity Sensor



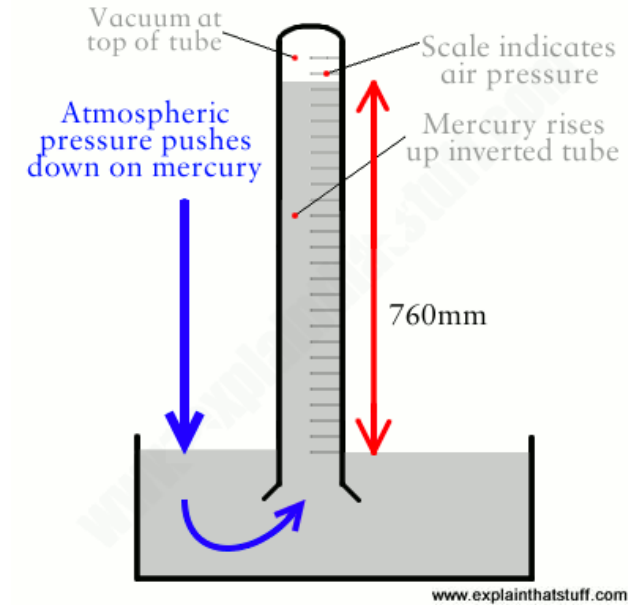
<https://www.elprocus.com/simple-proximity-sensor-circuit-and-working/>

Barometers

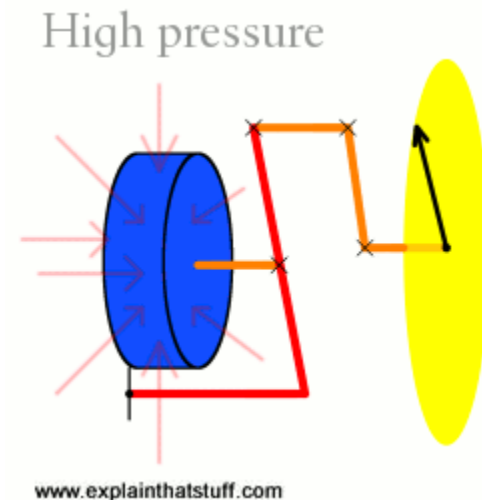


www.explainthatstuff.com

As the pressure changes, a rubber membrane (top, red) flexes back and forth. As it stretches, its resistance increases. A Wheatstone-bridge type of electric circuit connected to the membrane (gray/blue, bottom) measures the resistance and a chip converts it into a pressure measurement.



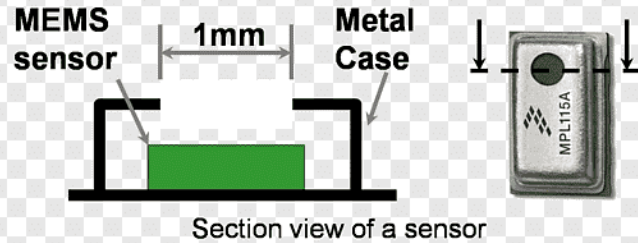
www.explainthatstuff.com



www.explainthatstuff.com

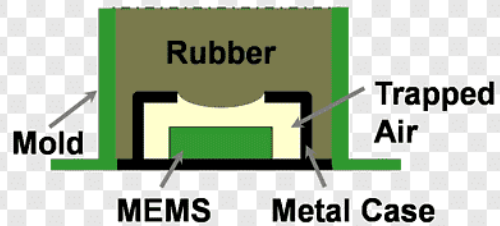
Barometers MEMS

Rubber Casting Process



1) Rubber is poured into the mold

- Rubber does not fill the sensor area



2) Use a vacuum chamber

- Degassing removes air bubbles
- Rubber fills the sensor

