

# Sensors

{ ELTN 130  
Tom Thoen  
Teacher / Student / Hobbyist / Inventor

*A sensor* is a device that converts the measurement of a natural phenomenon into an electronic signal.

What can be measured? Some examples:

- Physical contact / distance
- Light
- Sound
- Temperature
- Humidity
- Acceleration
- Velocity
- Force / Strain

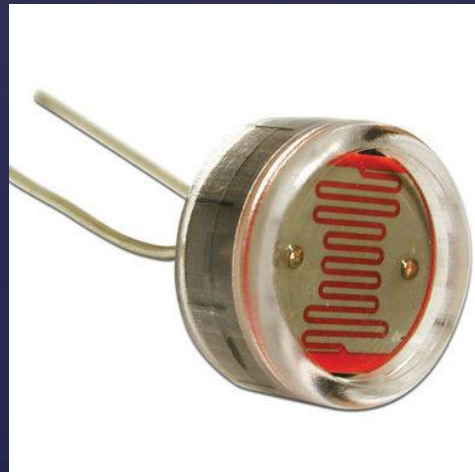
# Categories of sensors

Sensors can be *passive* or *active*

Passive: Produce a signal without an external supply voltage

Examples:

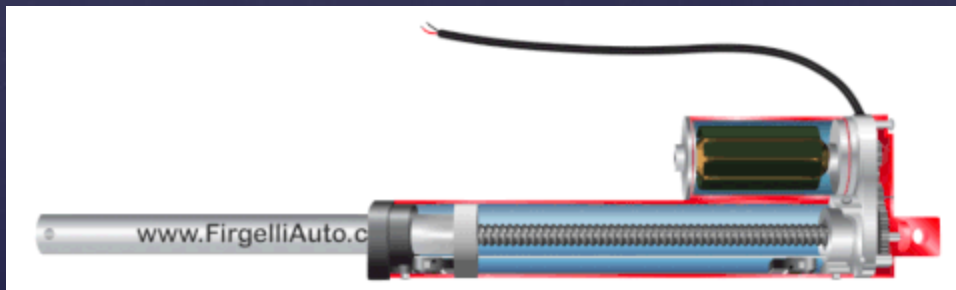
- Mechanical Switches – detect contact or relative distance
- Light-dependent resistors (LDR's) - change resistance based on light
- Thermistors – change resistance based on temperature



# Switches as sensors:

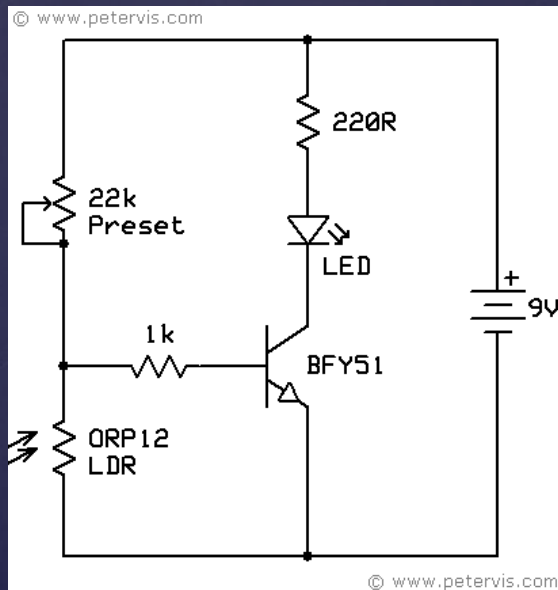
Mechanical switches are often used as contact sensors in a variety of applications

In robotics or motion control, switches are used to sense physical objects or end of travel:

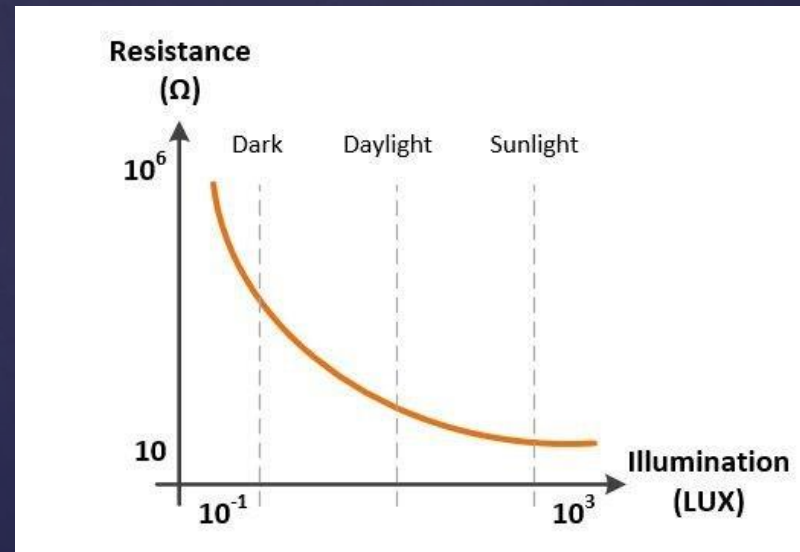


# LDRs – Light Dependent Resistors

LDR's are made of semiconductors (like diodes), but are sensitive to light. When photons strike the surface, it changes the resistance between the pins



Transistor switch circuit



Output – resistance vs. intensity

# LDRs – Applications

Since the output is often *non-linear* they are often used to sense a light threshold



Photo-sensor



Streetlight control

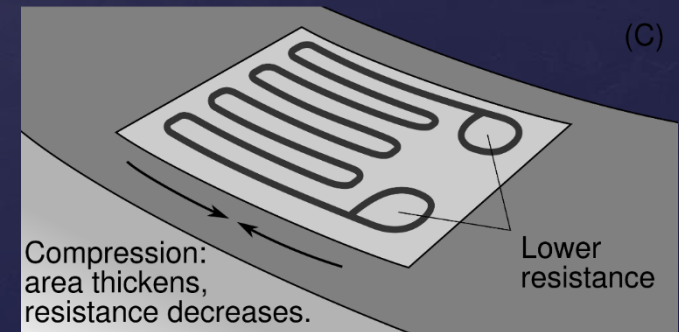
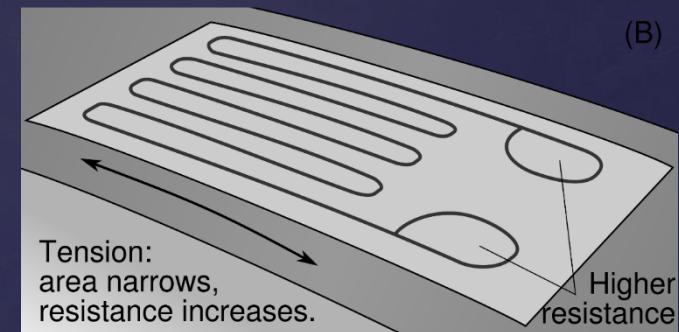
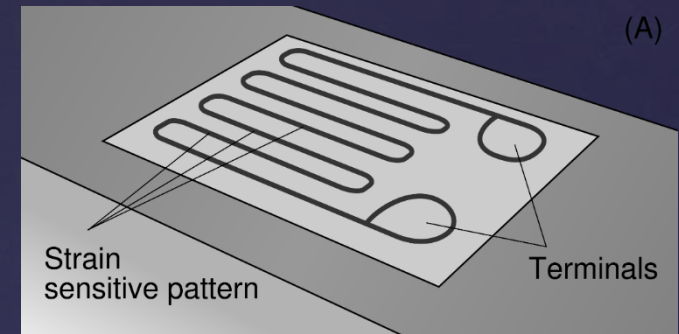
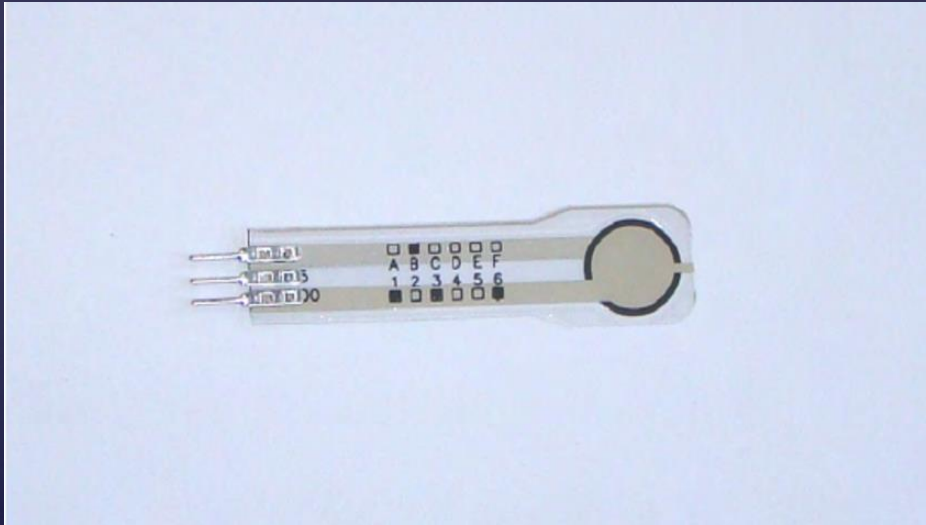
Photo-sensor



Control of clock display brightness

# Strain Gauges:

- Sense displacement caused by force
- Output level is so low that it needs to be amplified to be useful



# Strain Gauges:

- Applications: VR gloves

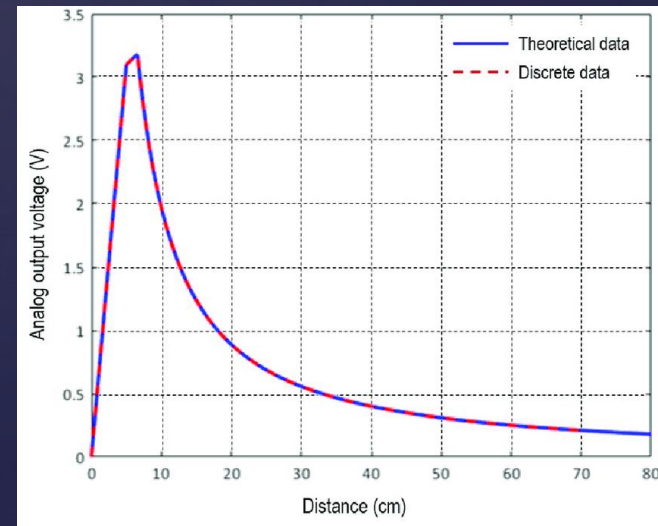
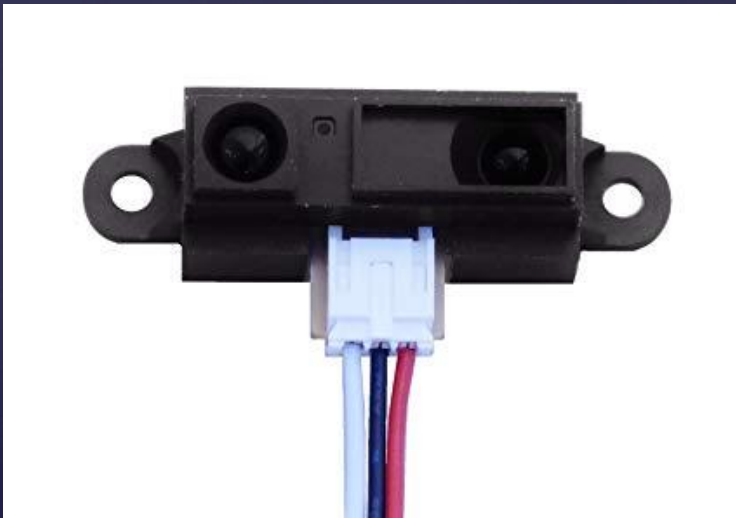




# Active Sensors:

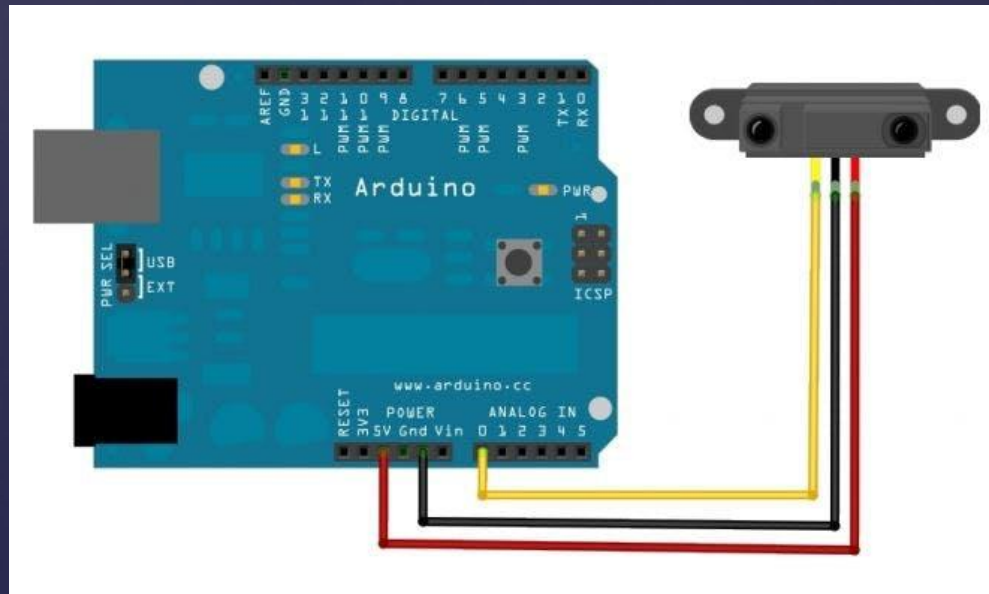
- Provide an analog voltage or digital output
- Require a power source

Example: Distance sensor



# Proximity / Distance sensors:

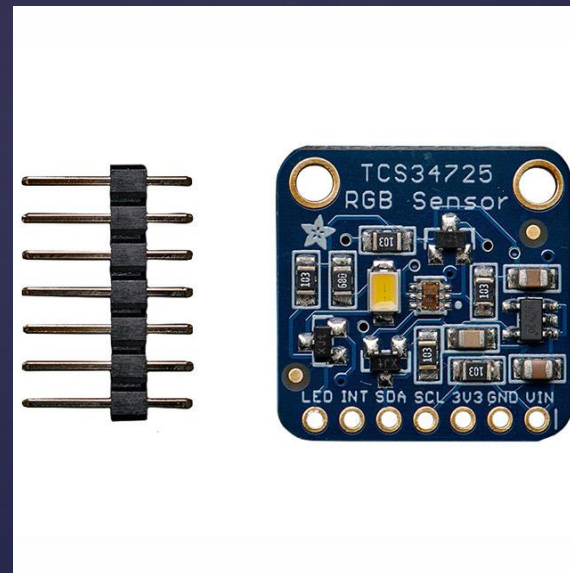
- Typically connected to a microcontroller to process the data
- Example: MIT 101 robot



# Active Sensors: Color sensor

- Digital output: Can either provide a simple “on” or “off” output
- Can also output a stream of data to be processed

Example: Color detector



# Active Sensors: Color sensor

- ↳ [25C1E85A-D1E1-4D28-BB8B-A61F7FDCDF3F.MOV](#)
- ↳ [5F7D4DCD-95F2-47C0-8EA2-70D291693C29.MOV](#)
- ↳ [5CC24EEF-97CD-4237-A68C-2FAD7401C065.MOV](#)
- ↳ [42F3A72C-4116-4A4B-A6F5-AD6ADAC70ECD.MOV](#)

# Sensor Applications

- Alarms – over temperature, light detection
- Datalogging – tracking specific data over time
- Feedback control systems (gyros / accelerometers for drones)
- Biomedical / Bio-feedback