

Control Interfaces

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Master en Música para Experiencias del Entretenimiento
ENTI-UB

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Outline

Control Interfaces

- Definition

- Taxonomy

Electronics

- Sensors

- Basics

Outline

Control Interfaces

Definition

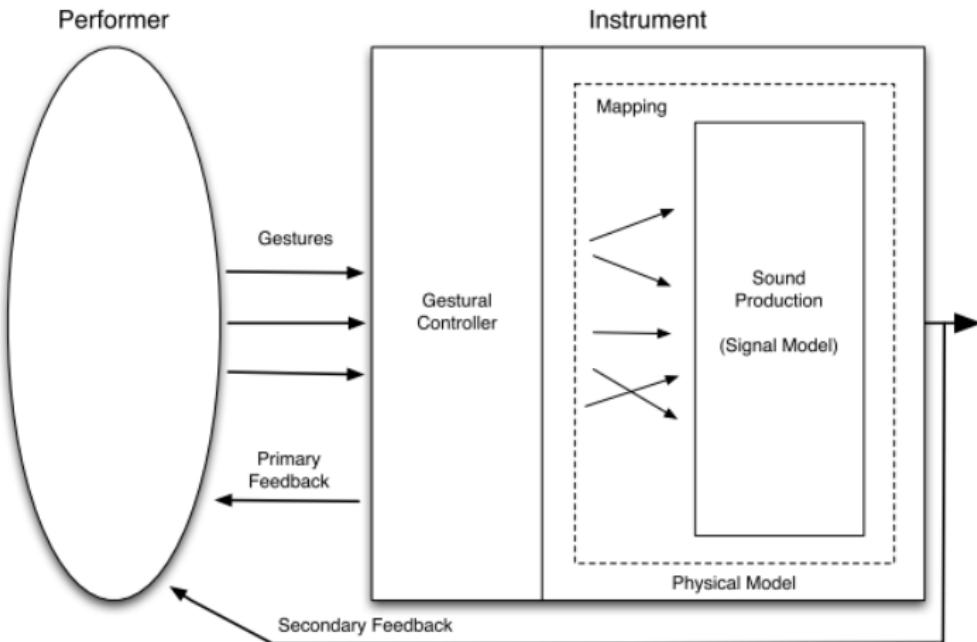
Taxonomy

Electronics

Sensors

Basics

Control Interfaces



Wanderley, M. M. (2001). Performer-Instrument Interaction: Applications to Gestural Control of Sound Synthesis. PhD thesis, University Paris 6.

Control Interfaces - Definition

(Tentative definition)

The *Control Interface* (also called *Gestural Controller*, *Instrument Body*, *Input Device*, *Physical Interface*, or just *Interface* or *Controller*) is the part of the instrument with which the performer interacts through gestures.

Control Interfaces - Definition

In the case of DMIs, the control interface can be **anything** that provides the user a way to interact, and it is capable to quantify this interaction in a digital way, to be understood by a microprocessor.

Control Interfaces - Definition

*"The controller component can typically be a simple computer mouse, a computer keyboard, a MIDI keyboard or a MIDI fader box, but with the use of sensors and appropriate analogue to digital converters, any control signal coming from the outside (i.e. the performer, but also the audience or the environment – as in the case of interactive installations) can be converted into control messages understandable by the digital system. Changes in motion, pressure, velocity, light, gravity, skin conductivity or muscle tension, almost anything, can now become a 'music controller'."*¹

¹Jordà, S. (2007). Interactivity and live computer music. Computer Music Journal.

Control Interfaces - Definition

(Anticipated conclusion)

"Any input device can become a good or a bad choice depending on the context, the parameter to control, or the performer who will be using it"²

²Jordà, S. (2007). Interactivity and live computer music. Computer Music Journal.

Control Interfaces - Taxonomy

Wanderley's classification:³

- ▶ Instrument-like Controllers
- ▶ Augmented Controllers
- ▶ Alternate Controllers

³Wanderley, M. M. (2001). Gestural Control of Music. International Workshop Human Supervision and Control in Engineering and Music.

Control Interfaces - Taxonomy

Instrument-like Controllers

- ▶ The controller design tries to faithfully replicate an existing acoustic instrument.
- ▶ Electronic versions of traditional instruments.
- ▶ Subcategory: Instrument-inspired controllers

Control Interfaces - Taxonomy



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<https://commons.wikimedia.org/w/index.php?curid=46988058>

Control Interfaces - Taxonomy



Control Interfaces - Taxonomy



Control Interfaces - Taxonomy



GameReactor,

<https://www.gamereactor.eu/images/?productid=200&id=97749>

Control Interfaces - Taxonomy



By Keytar.jpg:

[https://www.flickr.com/photos/tommygunnphotography/derivative work: Clusternote \(talk\) - Keytar.jpg, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=12470544](https://www.flickr.com/photos/tommygunnphotography/derivative work: Clusternote (talk) - Keytar.jpg, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=12470544)

Control Interfaces - Taxonomy



Control Interfaces - Taxonomy



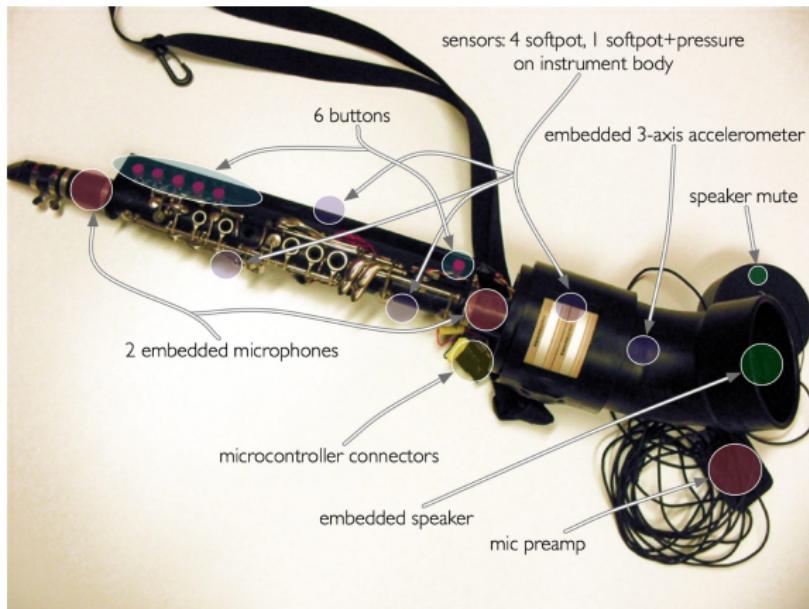
Control Interfaces - Taxonomy

Augmented Controllers

- ▶ Acoustic instruments with enhanced gesture possibilities due to sensors

Control Interfaces - Taxonomy

Augmented Clarinet by Stelios Manousakis



<http://modularbrains.net/portfolio/feedback-augmented-sopranino-clarinet/>

Control Interfaces - Taxonomy

Seaboard by ROLI



Control Interfaces - Taxonomy

Augmented Piano by A. Veinberg



Control Interfaces - Taxonomy

Augmented Violin by M. Kimura



Control Interfaces - Taxonomy

Does augmented reality produces augmented instruments...?

Control Interfaces - Taxonomy

Alternate Controllers

- ▶ Controllers which are not inspired by existing acoustic instruments

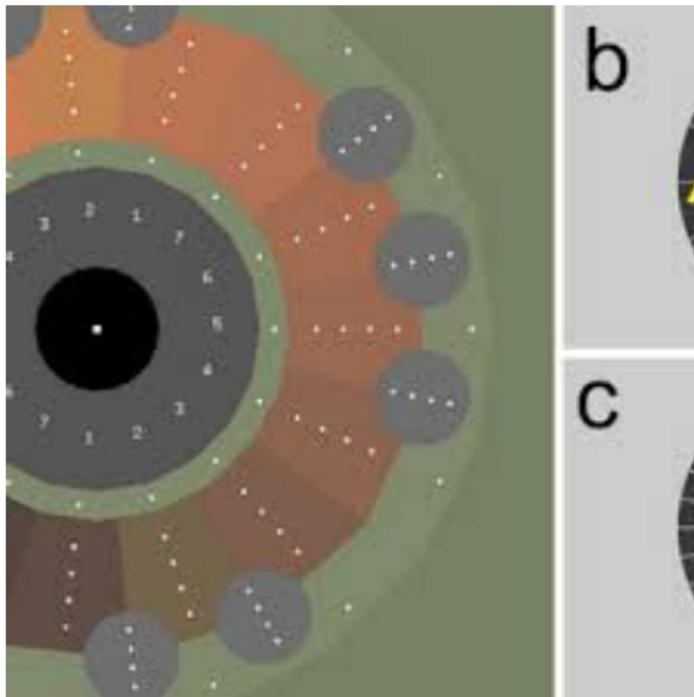
Control Interfaces - Taxonomy

Otamaton



Control Interfaces - Taxonomy

Eyeharp



Control Interfaces - Taxonomy

Myo



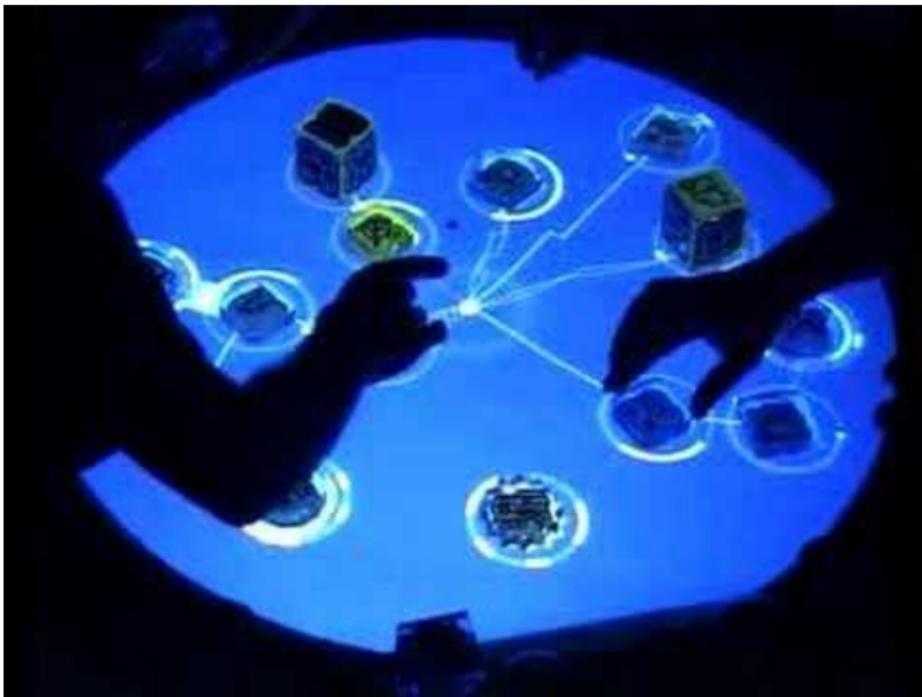
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EEG



Control Interfaces - Taxonomy

Reactable



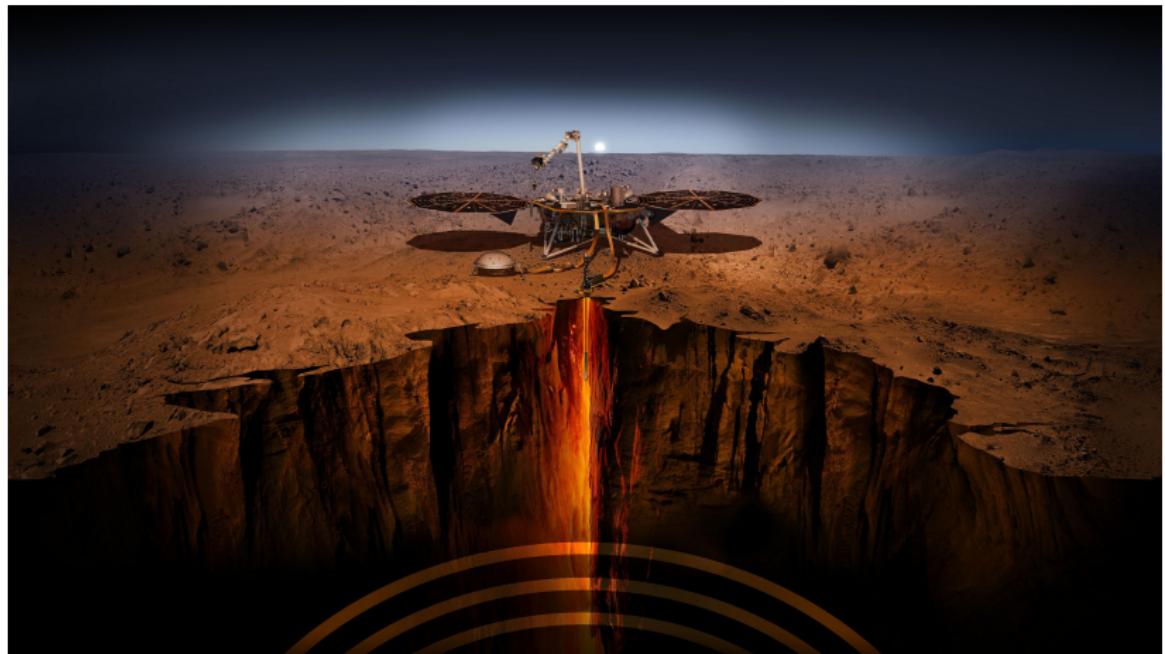
Control Interfaces - Taxonomy

Computers as DMI interfaces?

- ▶ Live Coding
- ▶ Mierdofón

Control Interfaces - Taxonomy

Mars InSight?



Outline

Control Interfaces

 Definition

 Taxonomy

Electronics

 Sensors

 Basics

Electronics - Sensors

"In the broadest definition, a sensor is a device, module, or subsystem whose purpose is to detect events or changes in its environment and send the information to other electronics, frequently a computer processor. A sensor is always used with other electronics."⁴

⁴Wikipedia, Sensors. <https://en.wikipedia.org/wiki/Sensor>

Electronics - Sensors

"Sensors are the 'sense organs of the machine'."⁵

⁵Bongers, A. J. "Interaction in multimedia art." Knowledge-Based Systems 13.7-8 (2000): 479-485.

Electronics - Sensors

Sensors provide the way to convert measurable physical magnitudes "from our world" into quantified data understandable by a computer.

Electronics - Sensors

DMI context: Vertegaal's sensor classification:⁶

- ▶ Physical property sensed
- ▶ Resolution of sensing
- ▶ Direction of sensing
- ▶ Type and amount of feedback provided

⁶Vertegaal, Roel, Tamas Ungvary, and Michael Kieslinger. "Towards a musician's cockpit: Transducers, feedback and musical function." ICMC. Vol. 96. 1996.

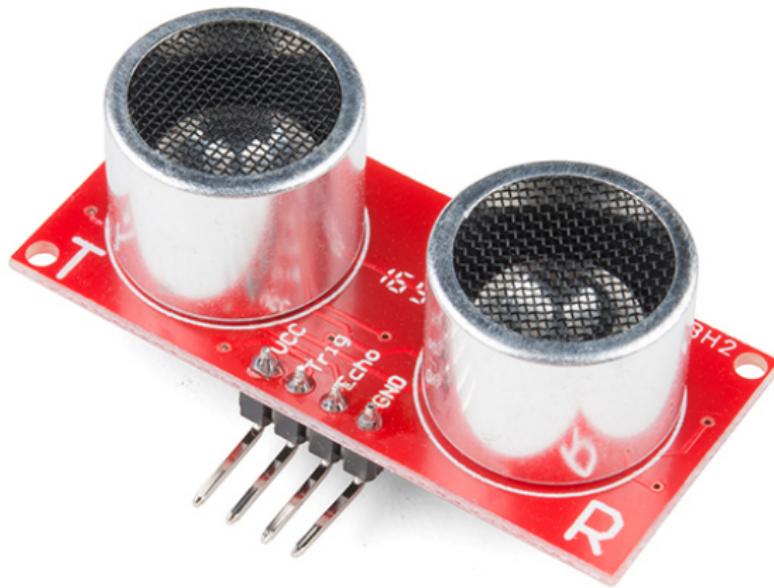
Electronics - Sensors

Resolution	Physical Property	position	rotary position	velocity	rotary velocity	isometric force	isotonic force	isometric rotary force	isotonic rotary force
	<i>discrete</i>	key button fader tablet	rotary switch bend sensor rotary pot abs. joystick mod. wheel	mouse trackpad	dial trackball	aftertouch pressure pad	accelero-meter	isometric joystick	pitch-bend wheel spring-mounted joystick
	<i>infinite</i>	tracker							

from Vertegaal, Roel, Tamas Ungvary, and Michael Kieslinger. "Towards a musician's cockpit: Transducers, feedback and musical function." ICMC. Vol. 96. 1996.

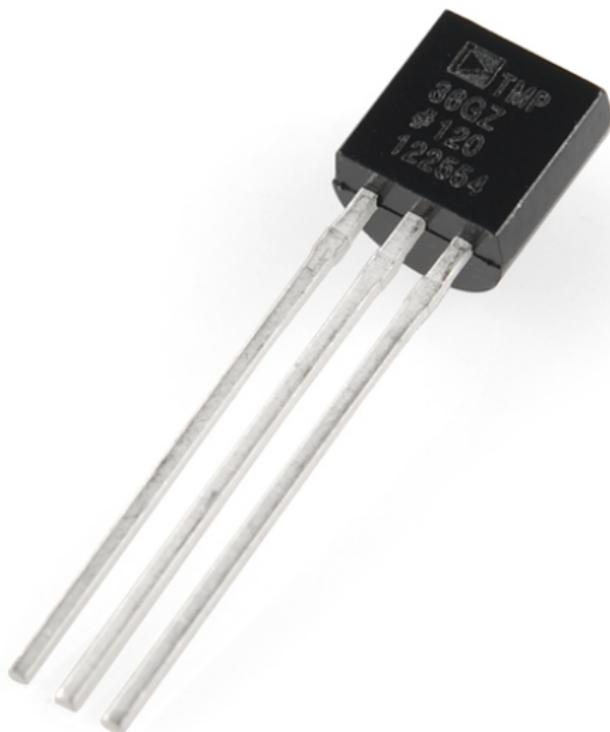
Electronics - Sensors

Ultrasonic Distance Sensor HC-SR04



Electronics - Sensors

Temperature Sensor TMP36



Electronics - Sensors

Photocell GL5528



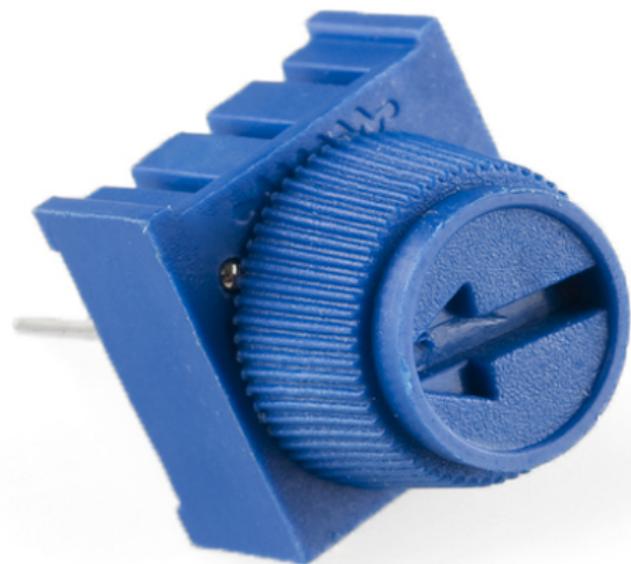
Electronics - Sensors

Button



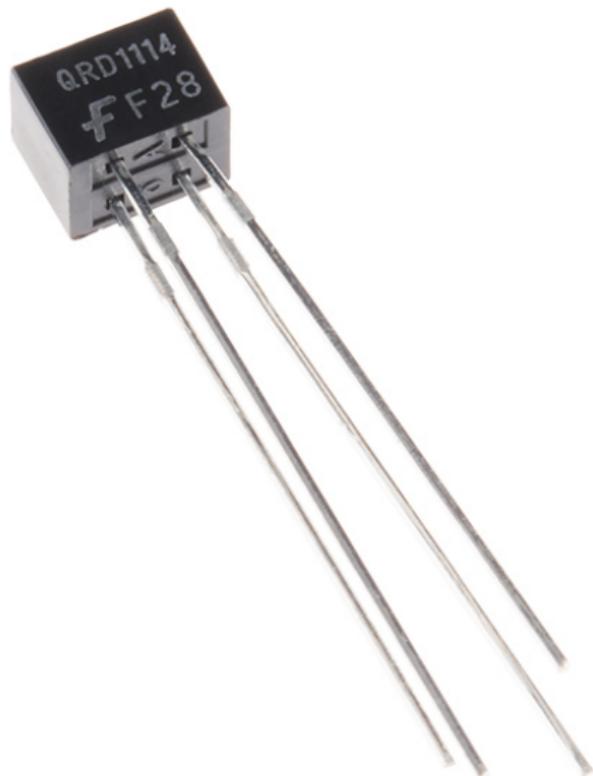
Electronics - Sensors

Trimpot



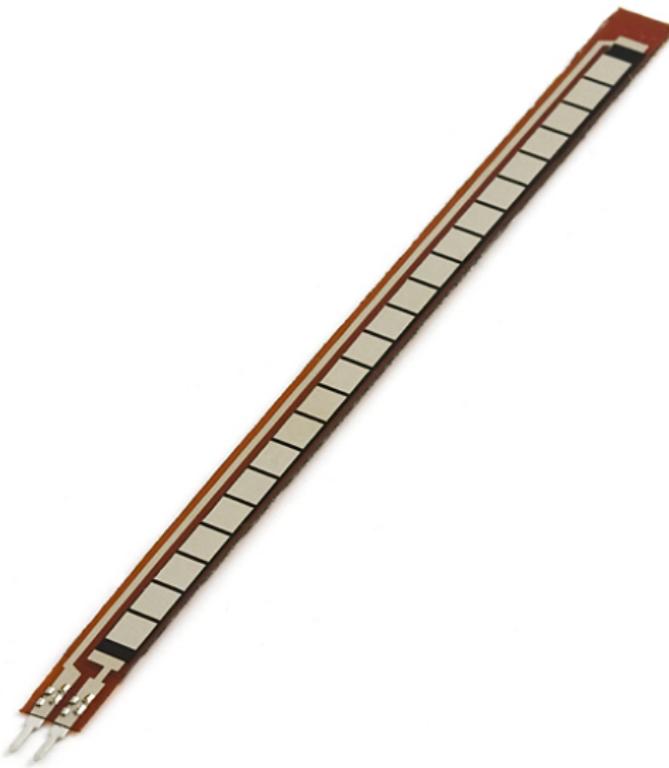
Electronics - Sensors

Optical Detector / Phototransistor QRD1114



Electronics - Sensors

Flex Sensor FS7548



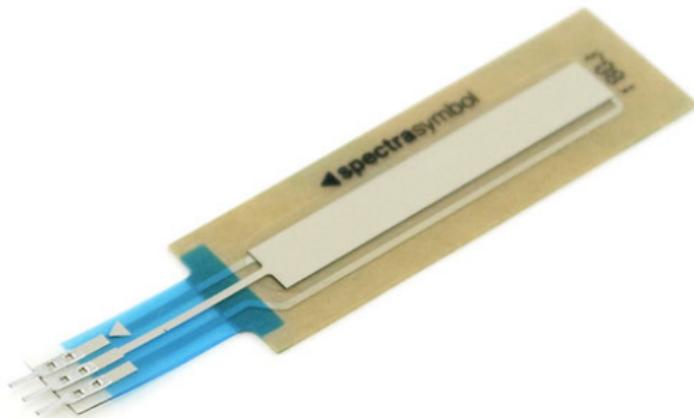
Electronics - Sensors

Reed Switch



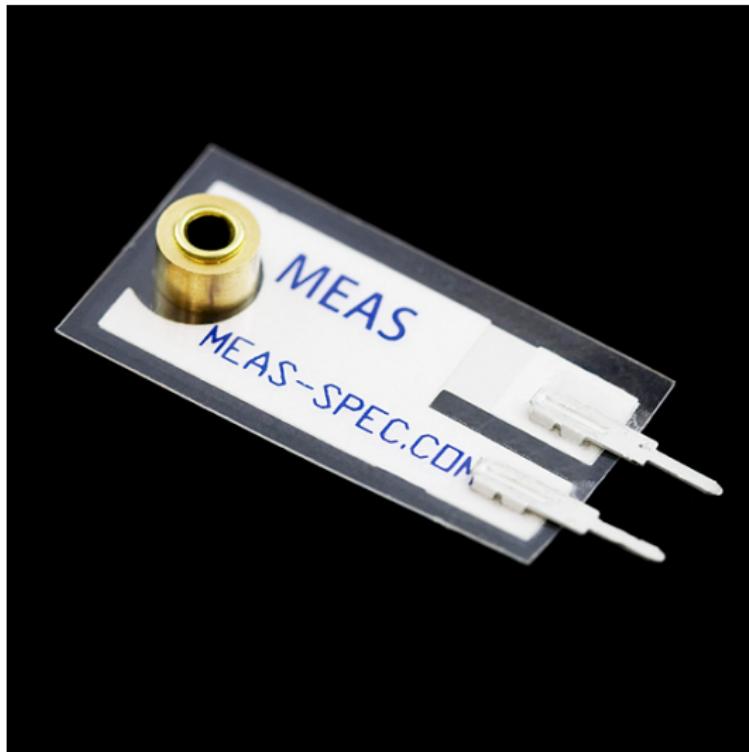
Electronics - Sensors

Softpot Membrane Potentiometer



Electronics - Sensors

Piezo Vibration Sensor



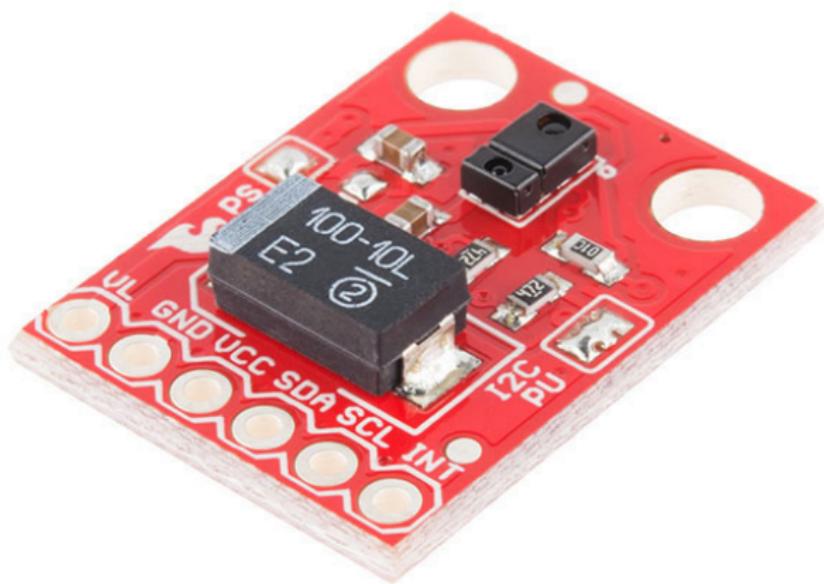
Electronics - Sensors

RGB and Gesture Sensor - APDS-9960



Electronics - Sensors

9DoF IMU Breakout - LSM9DS1



Electronics - Sensors

Thumb Joystick



Electronics - Basics

"Electronics, branch of physics and electrical engineering that deals with the emission, behaviour, and effects of electrons and with electronic devices."⁷

⁷" electronics — Devices, Facts, & History". Encyclopedia Britannica.
Accessed on 19/02/2019.

Electronics - Basics

Three fundamental physical magnitudes:

- ▶ Voltage (V)
Electric potential difference. Measured in *Volts (V)*.
- ▶ Current (I)
Amount of transmitted charge per surface and time unit.
Measured in *Amperes (A)*.
- ▶ Resistance (R) / Impedance (Z)
Opposition to the electrical flow. Measured in *Ohms (Ω)*.

Electronics - Basics

Hydraulic analogy⁸:

- ▶ Voltage / Gravitational Potential
- ▶ Current / Flow Rate
- ▶ Resistance / Pipe constriction

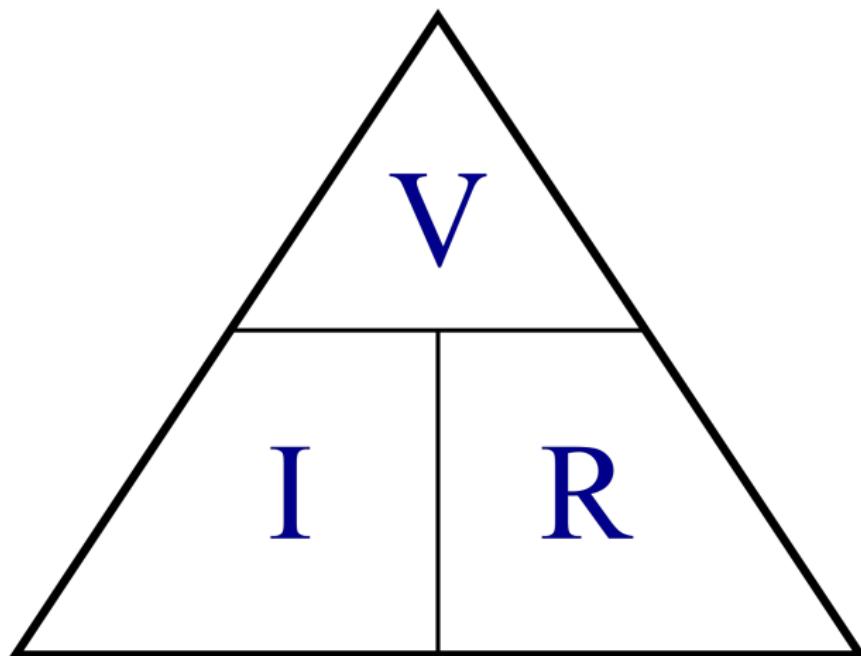
⁸Wikipedia. Hydraulic analogy.

https://en.wikipedia.org/wiki/Hydraulic_analogy. Accessed 19/02/2019

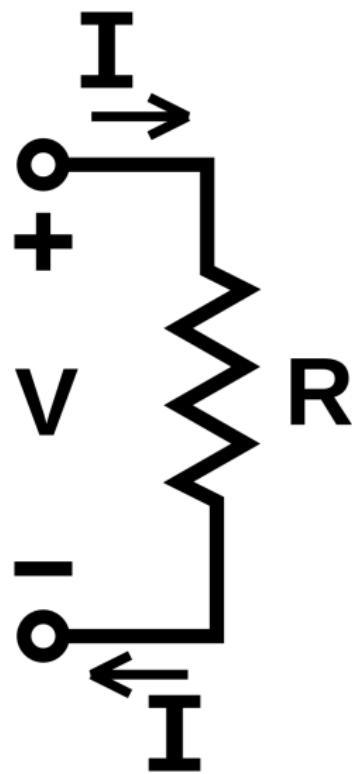
Electronics - Basics

Ohm's Law

$$V = IR$$



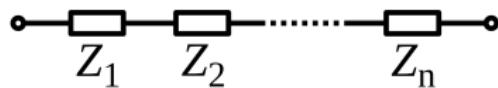
Electronics - Basics



Electronics - Basics

Combining impedances

Series:

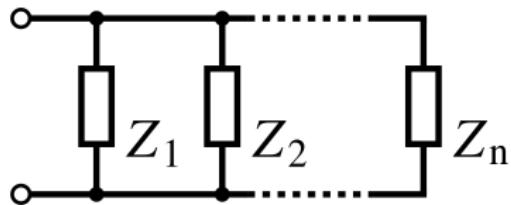


$$Z_{eq} = Z_1 + Z_2 + \dots + Z_N$$

Electronics - Basics

Combining impedances

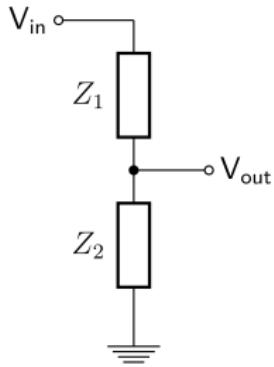
Parallel:



$$\frac{1}{Z_{eq}} = \frac{1}{Z_1} + \frac{1}{Z_2} + \dots + \frac{1}{Z_N}$$

Electronics - Basics

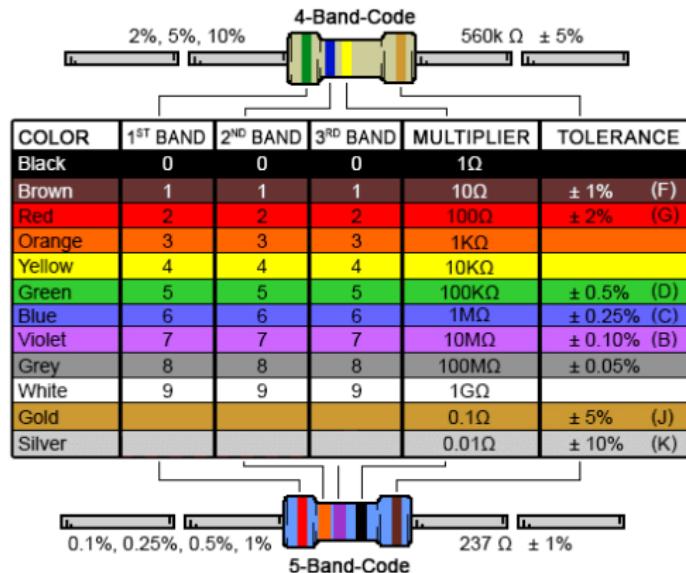
Voltage Divider



$$V_{out} = \frac{Z_2}{Z_1 + Z_2} V_{in}$$

Electronics - Basics

Resistor Color Chart



Digi-Key, 4 Band Resistor Color Code Calculator.

<https://www.digikey.com/en/resources/conversion-calculators/conversion-calculator-resistor-color-code-4-band>.

Electronics - Basics

"Arduino is an open-source electronics platform based on easy-to-use hardware and software. It's intended for anyone making interactive projects."⁹



⁹<https://www.arduino.cc/>