Electronic and electromechanical prototyping

Introduction - Sensors

Corso LM 'Materiali Intelligenti e Biomimetici' – Prof. A. Ahluwalia

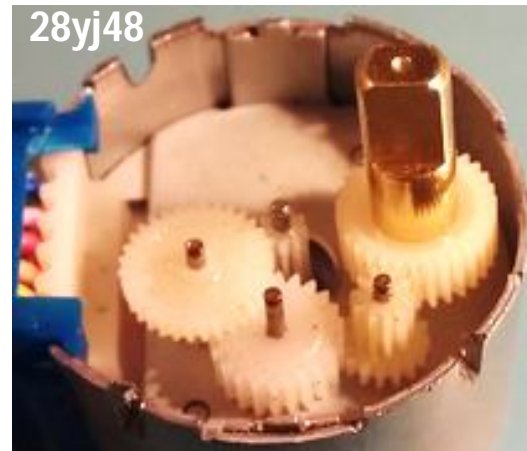11/05/2017

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Stepper Again

- **steps= n° steps per revolution * gear ratio**= $(360°/5.625°) * 64 = 64*64 = $ 4096 (half step mode)
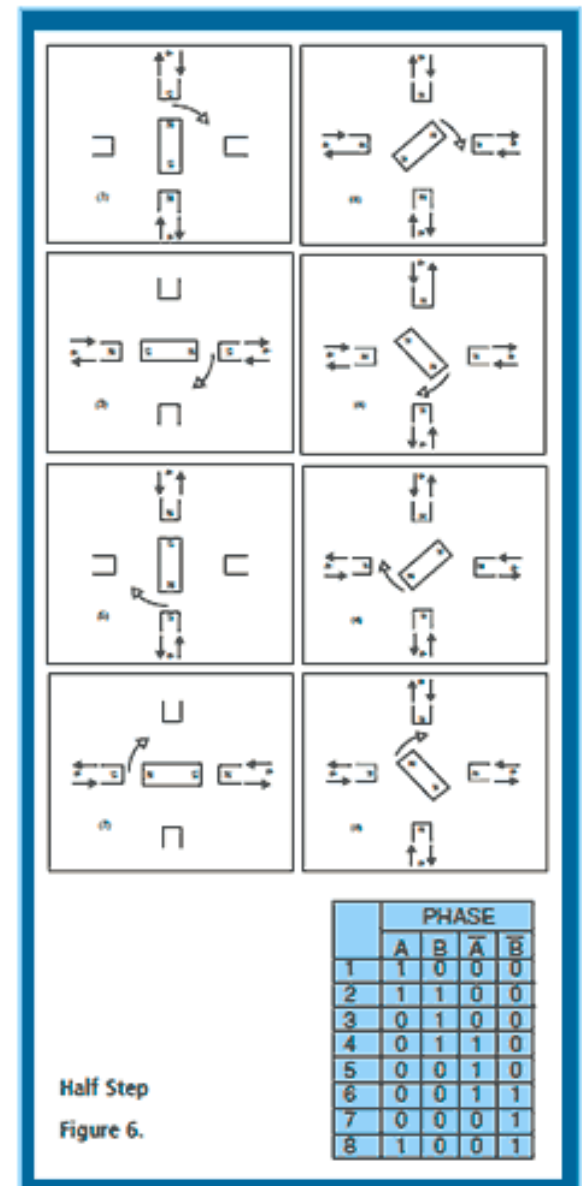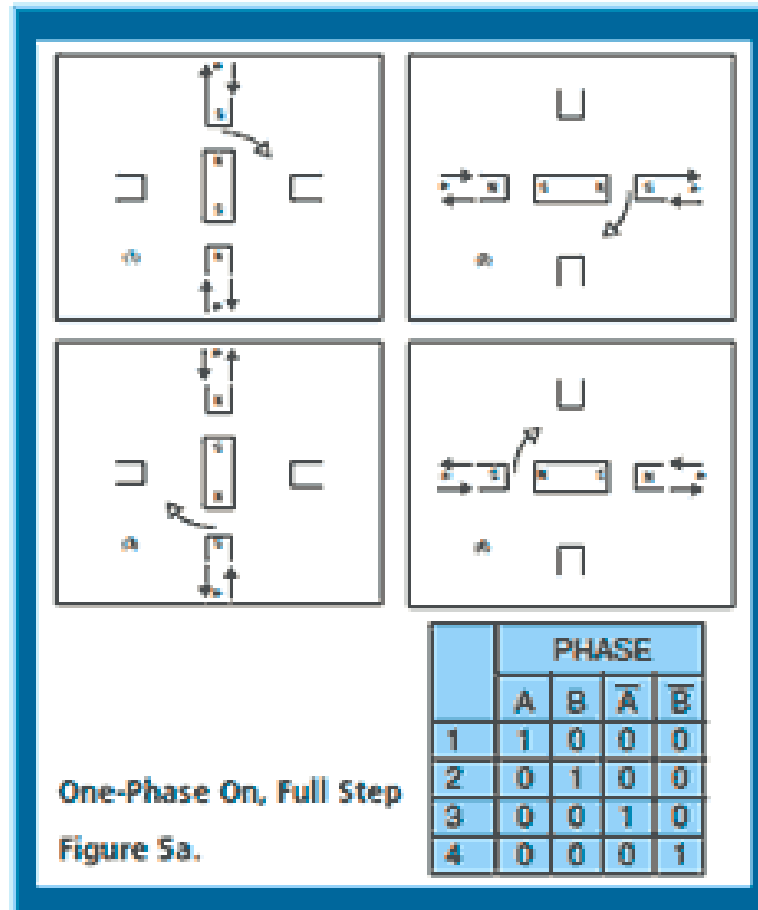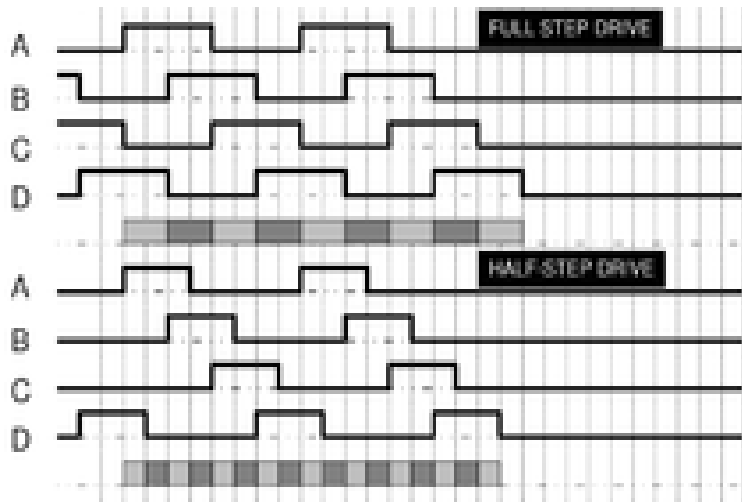
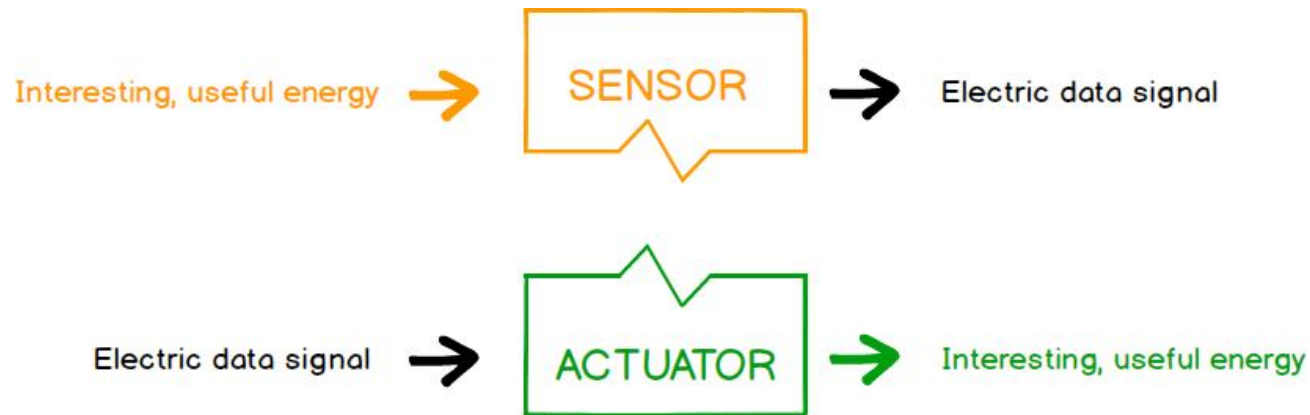passi del motore per un giro complete del rotore;

Dipende da Arduino la modalità:

- **Half step mode** (default):
  5.625°/step, 64 steps/revolution

- **Full step mode:**
  11.25°/step, 32 steps/revolution

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Stepper Again (2)

FULL STEP DRIVE

HALF-STEP DRIVE

One-Phase On, Full Step

Figure 5a.

	PHASE			
	A	B	$\overline{A}$	$\overline{B}$
1	1	0	0	0
2	0	1	0	0
3	0	0	1	0
4	0	0	0	1

Half Step

Figure 6.

	PHASE			
	A	B	$\overline{A}$	$\overline{B}$
1	1	0	0	0
2	1	1	0	0
3	0	1	0	0
4	0	1	1	0
5	0	0	1	0
6	0	0	1	1
7	0	0	0	1
8	1	0	0	1

Sensors vs. Actuators

The word "**Transducer**" is the collective term used for both Sensors and Actuators.
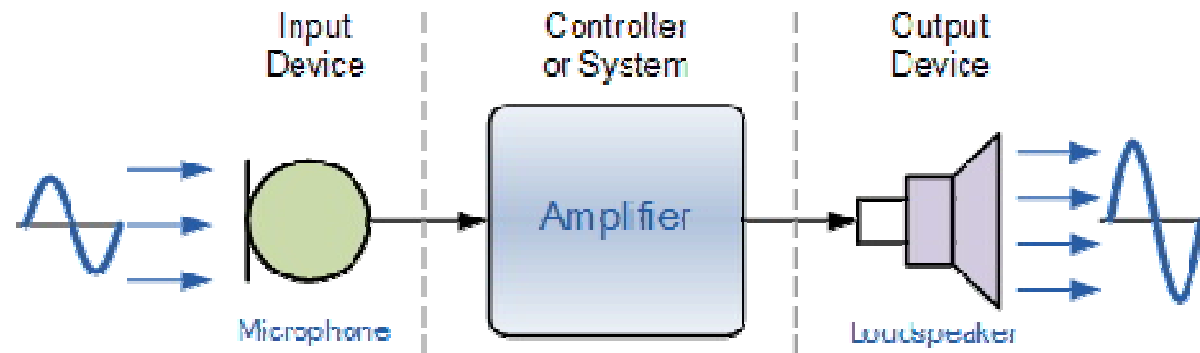
Devices which perform an **"Input" function** are commonly called **Sensors** because they "*sense*" *a physical change* in some characteristic and covert that into an electrical signal.

Devices which perform an **"Output" function** are generally called **Actuators** and are used to *control some external device,* for example movement or sound.
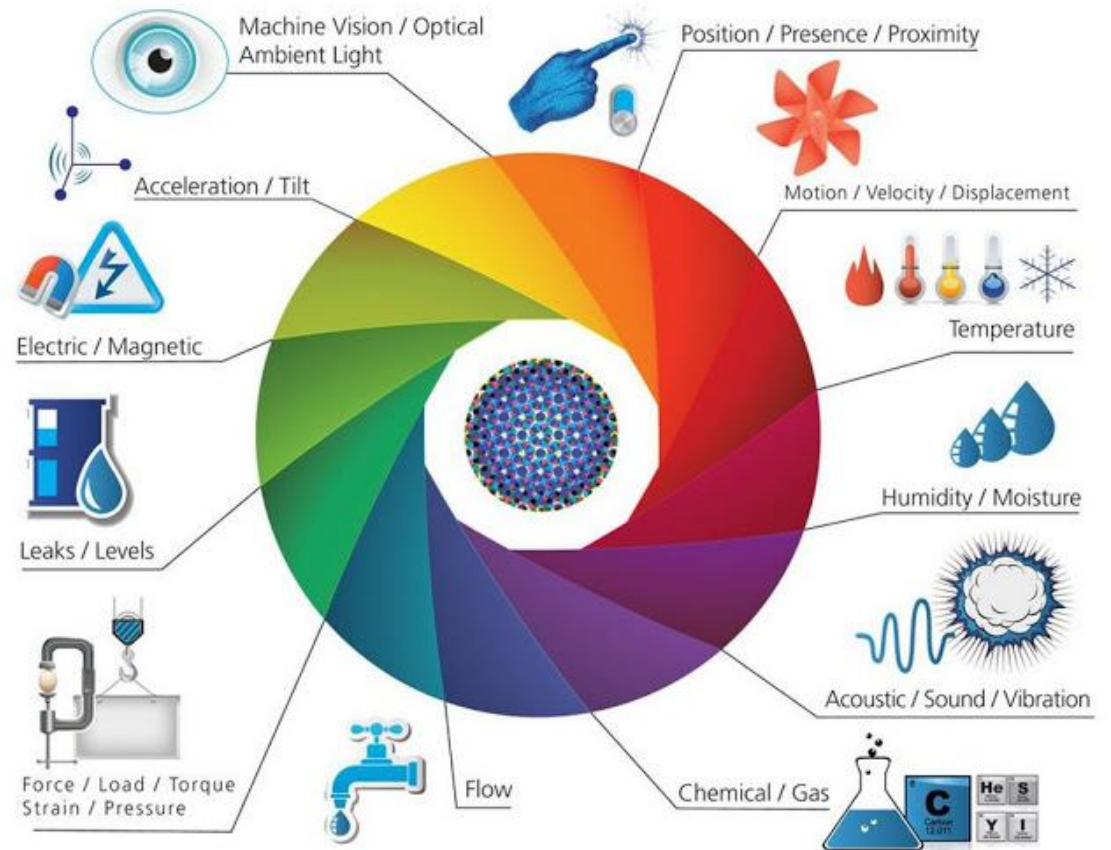
Transducers

Electrical Transducers are used to **convert energy of one kind into energy of another kind.**

For example, *a microphone (input device) converts sound waves into electrical signals* for the amplifier to amplify (a process), and *a loudspeaker (output device) converts these electrical signals* back into sound waves and an example of this type of simple Input/Output (I/O) system is given below

Transducer – types

Quantity being Measured	Input Device (Sensor)	Output Device (Actuator)
Light Level	Light Dependant Resistor (LDR) Photodiode Photo-transistor Solar Cell	Lights & Lamps LED's & Displays Fibre Optics
Temperature	Thermocouple Thermistor Thermostat Resistive Temperature Detectors	Heater Fan
Force/Pressure	Strain Gauge Pressure Switch Load Cells	Lifts & Jacks Electromagnet Vibration
Position	Potentiometer Encoders Reflective/Slotted Opto-switch LVDT	Motor Solenoid Panel Meters
Speed	Tacho-generator Reflective/Slotted Opto-coupler Doppler Effect Sensors	AC and DC Motors Stepper Motor Brake
Sound	Carbon Microphone Piezo-electric Crystal	Bell Buzzer Loudspeaker

Sensors

Input type transducers or sensors, produce a **voltage or signal output response which is proportional to the change in the quantity that they are measuring** (the stimulus). The type or amount of the output signal depends upon the type of sensor being used. But generally, all types of sensors can be classed as two kinds: Passive Sensors or Active Sensors.

Generally, **active sensors** require an **external power supply to operate**, called an excitation signal which is used by the sensor to produce the output signal. Active sensors can also produce signal amplification.
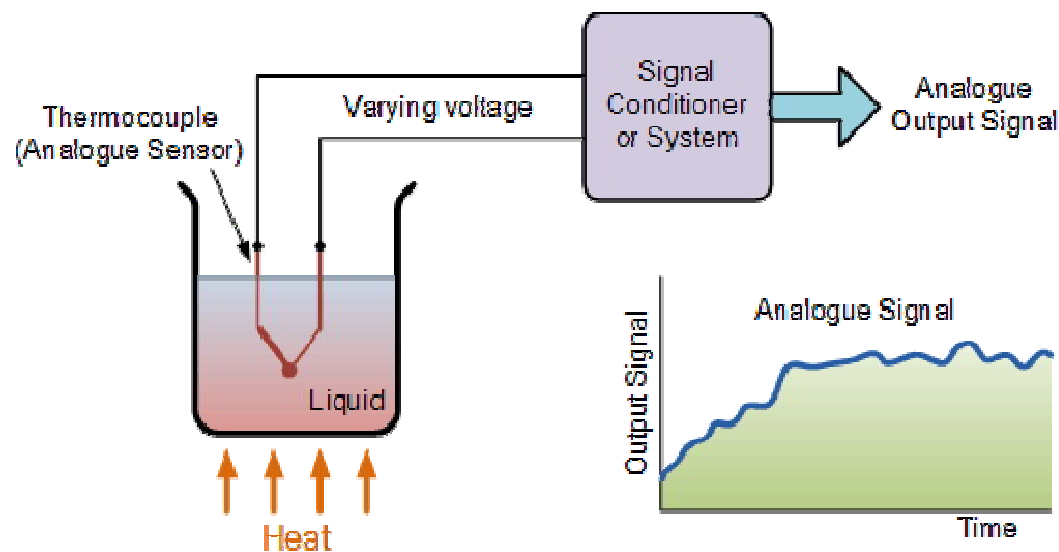A good example of an active sensor is an LVDT sensor or a strain gauge. Strain gauges are pressure-sensitive resistive bridge networks that are external biased (excitation signal) in such a way as to produce an output voltage in proportion to the amount of force and/or strain being applied to the sensor.

A **passive sensor** does **not need any additional power source** or excitation voltage. Instead a passive sensor generates an output signal in response to some external stimulus. For example, a thermocouple which generates its own voltage output when exposed to heat.

Analogue Sensors

Analogue Sensors produce a **continuous output signal** or voltage which is generally *proportional to the quantity being measured.*

Physical quantities such as Temperature, Speed, Pressure, Displacement, Strain etc are all analogue quantities as they tend to be continuous in nature. For example, the temperature of a liquid can be measured using a thermometer or thermocouple which continuously responds to temperature changes as the liquid is heated up or cooled down.
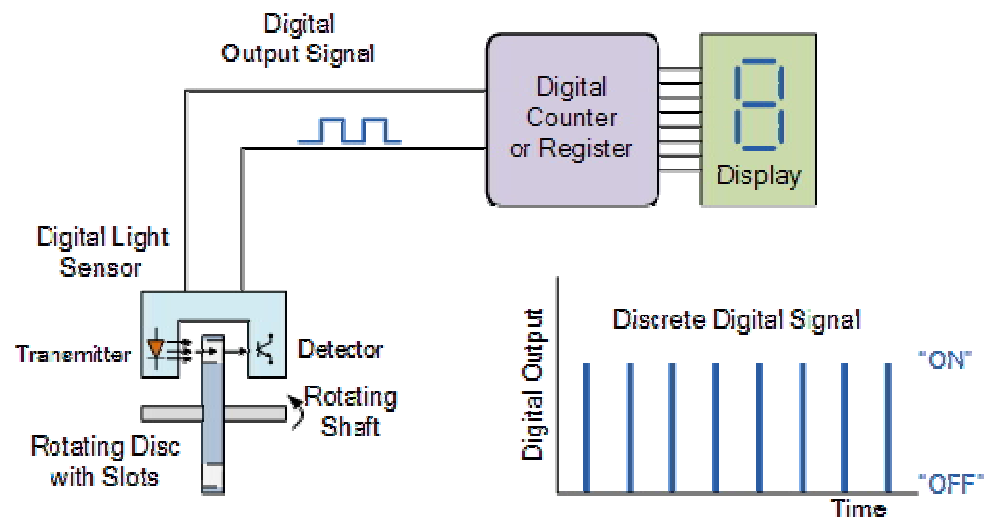

Also **analogue signals can be easily converted into digital type** signals for use in micro-controller systems by the use of **analogue-to-digital converters** (ADC).

Digital Sensors

Digital Sensors produce a **discrete digital output signals** or voltages that are a *digital representation of the quantity being measured*.

Digital sensors produce a **Binary output signal** in the form of a logic "1" or a logic "0", ("ON" or "OFF"). This means then that a digital signal *only produces discrete (non-continuous) values* which may be outputted as a single "bit", (serial transmission) or by combining the bits to produce a single "byte" output (parallel transmission).

For example, the speed of the rotating shaft can measured by using a digital LED/Opto-detector sensor.

The disc which is fixed to a rotating shaft has a number of transparent slots within its design. As the disc rotates with the speed of the shaft, each slot passes by the sensor in turn producing an output pulse representing a logic "1" or logic "0" level.

These pulses are sent to a register of counter and finally to an output display to show the speed or revolutions of the shaft. By increasing the number of slots or "windows" within the disc more output pulses can be produced for each revolution of the shaft

References

http://www.electronics-tutorials.ws/io/io_1.html