

Electrical and Electronic Measurements, Part 2

Lecture 6: Sensors and Transducers

Liquid Flow and Light Sensors

Dr. Haitham El-Hussieny

Electronics and Communications Engineering
Faculty of Engineering (Shoubra)
Benha University



November 2016

Table of Contents

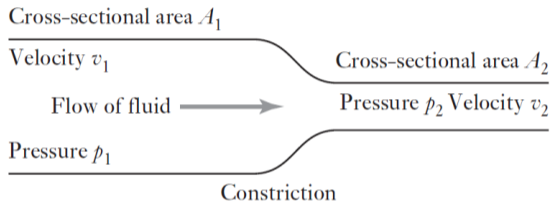
1 Liquid Flow Sensors.

2 Light sensors.

Liquid Flow Sensors:

Basic Principle:

- The principle of measuring the flow rate Q of liquids is to measure the pressure drop occurring when the fluid flows through a constriction.

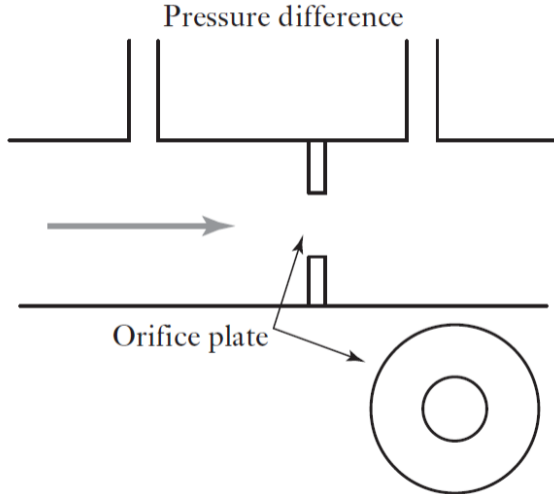


- By Bernoulli's equation:

$$Q = \frac{A}{\sqrt{1 - (A_2/A_1)^2}} \sqrt{\frac{2(P_1 - P_2)}{\rho}}$$

Velocity Sensors:

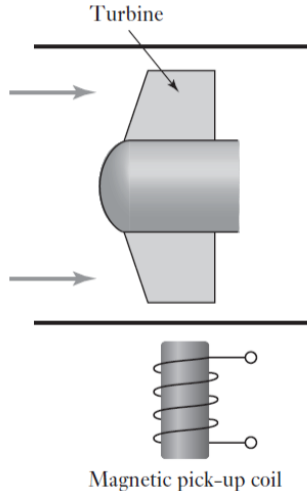
[1] Orifice plate:



- The orifice plate is simply a disc, with a central hole, which is placed in the tube through which the fluid is flowing.
- The pressure difference is measured between a point equal to the diameter of the tube upstream and a point equal to half the diameter downstream.
- The orifice plate is simple, cheap, with no moving parts, and is widely used.
- However, it does not work well with slurries (a thin mixture of an insoluble substance, as cement).

Velocity Sensors:

[2] Turbine meter:



- The turbine flow-meter consists of a multi-bladed rotor that is supported centrally in the pipe along which the flow occurs.
- The fluid flow results in rotation of the rotor, the angular velocity being approximately proportional to the flow rate.
- The rate of revolution of the rotor can be determined using a magnetic pick-up. The pulses are counted and so the number of revolutions of the rotor can be determined.

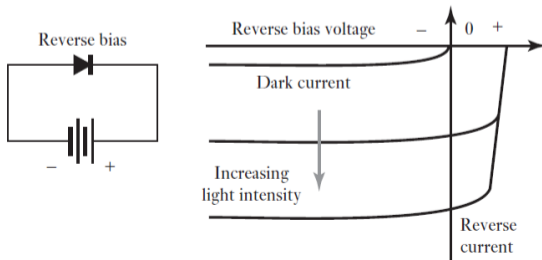
Table of Contents

1 Liquid Flow Sensors.

2 Light sensors.

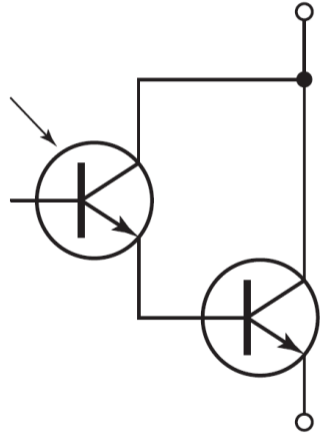
Light sensors:

- Photodiodes are semiconductor junction diodes which are connected into a circuit in reverse bias. With no incident light, the reverse current is almost negligible and is termed the dark current.
- When light falls on the junction, extra hole–electron pairs are produced and there is an increase in the reverse current and the diode resistance drops.
- The reverse current is very nearly proportional to the intensity of the light.
- A photodiode can thus be used as a variable resistance device controlled by the light incident on it.



Light sensors:

- The phototransistors have a light-sensitive collector–base p–n junction.
- When there is no incident light there is a very small collector-to-emitter current.
- When light is incident, a base current is produced that is directly proportional to the light intensity.
- The production of a collector current is then a measure of the light intensity.
- Phototransistors are often available as integrated packages with the phototransistor connected in a Darlington arrangement with a conventional transistor to give a much greater collector current for a given light intensity.



Course Project:

[1] Inmoov Robotic Finger:



Inmoov

Open source 3D printed Robot

Project Capacity: 3 to 5 Students.



[Build yours](#) - Blog

🔑 Finger Starter Assembly of the "Finger Starter"

Here is the list of parts and the number of prints

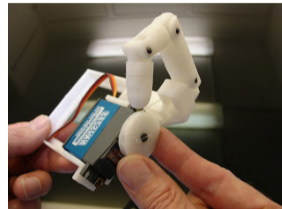
- 1x FingerIndex
- 1x FingerTester
- 1x RobRing
- 1x Servo-Pulley

This is going to be interesting!!

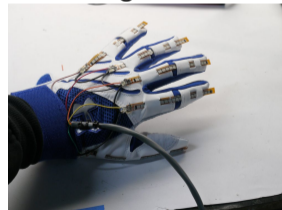
We are going to assemble a finger to a small se the pictures is a digital HK15298 but you can u and if the size specifications are the same.

BUILD YOURS INDEX
FINGER STARTER
HAND AND FOREARM
BICEP
SHOULDER AND TORSO
BACK
NECK AND JAW
EYE MECHANISM
TOP STOMACH
MID STOMACH
LOW STOMACH
NERVO BOARD TUTORIAL
HARDWARE MAP + BOM
HOW TO START (MYROBOTLAB)
HOW TO CREATE GESTURES
INMOOV PARTS AND DERIVATIVES

<https://inmoov.fr>



Robot Finger Starter Kit

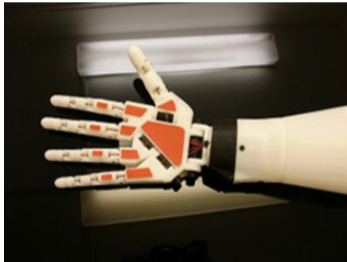


One Flex Sensor

Course Project:

[2] Inmoov Robotic Hand and Forarm:

Project Capacity: 10 to 15 Students.



[Build yours >](#)

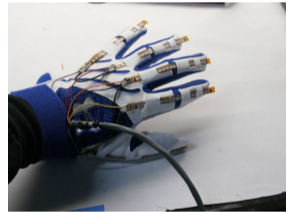
Hand and Forarm

Download STL files from the Galery.

Here is the list of parts and the number of prints

- 1x Thumb
- 1x Index
- 1x Majeure
- 1x Auriculaire
- 1x Pinky
- 1x Bolt_entretoise
- 1x Wristlarge
- 1x Wristsmall

BUILD YOURS INDEX
FINGER STARTER
HAND AND FORARM
BICEP
SHOULDER AND TORSO
BACK
NECK AND JAW
EYE (MECHANISM)
TOP STOMACH
MID STOMACH
LOW STOMACH
NERVO BOARD TUTORIAL
HARDWARE (MAP + BOIT)
HOW TO START MYROBO
HOW TO CREATE GESTUR
INMOOV PARTS AND DIR



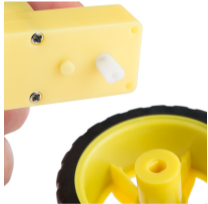
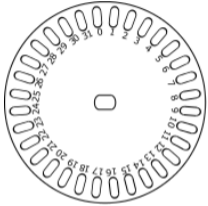
Five Flex Sensor

<https://inmoov.fr>

Course Project:

[3] Incremental Encoder:

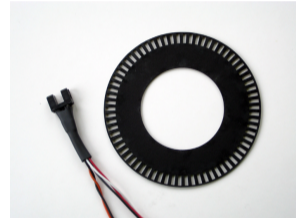
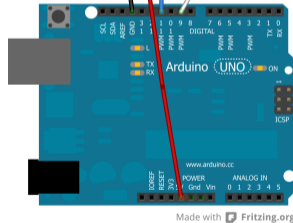
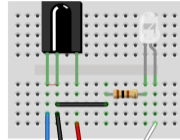
Project Capacity: 3 to 5 Students.



IR Receiver



IR Transmitter



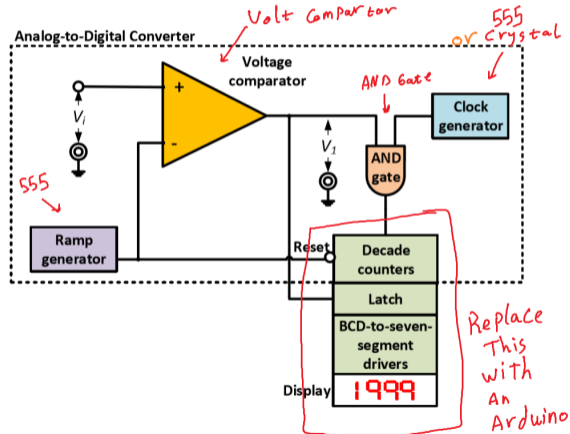
Encoder +
Opto-coupler

Course Project:

[4] Ramp-type Digital Voltmeter:

Project Capacity: 3 to 5 Students.

Ramp Type Digital Voltmeters:



Ramp type DVM block

End of Lecture

Best Wishes