HACKTEX VIRTUAL TRAINING MATERIALS
ADVANCED TEXTILES MANUFACTURING INDUSTRY
Learning unit 2 Raw materials and components for functional and smart textiles
Lesson 3

Raw materials and components for e-textiles

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RAW MATERIALS AND COMPONENTS FOR E-TEXTILES

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Contents

- Summary of electrically conductive raw materials
- Sensors, actuators and energy supply
- Microcontrollers
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SUMMARY OF ELECTRICALLY CONDUCTIVE RAW MATERIALS

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Conducting fibers:

- Metal coated fibers
- Intrinsically conductive polymeric yarns
- Optical fibers

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Metal coated fibers

- Coating is a process in which one or several layers of material are deposited on the surface of a substrate.
- Several methods are being developed for conductive coating and other thin film coating applications.
- Metal coated fiber combines, at part, the flexibility of traditional fiber with the mechanical properties of the using metal.
- The metals mostly used are the silver, copper, aluminum, nickel, tin, steel and gold. Metal-coated textiles can be applied for the antistatic properties, electromagnetic shielding and heating textiles (only for silver).

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Intrinsically conductive polymeric yarns

- Conductive fibers and yarns can be divided into mono and multifilament completely made of metal (alloys) such as copper, stainless steel, etc.
- Intrinsically conducting polymers (ICPs) such as polypyrrole (PPy), polyaniline, and polythiophene are conjugated polymers with alternating double and single bonds along their polymer chain that result in a wide range of electrical conductivity.
- Conductive surfaces for anti-static or electromagnetic shielding applications are difficult to achieve with metals but can be realised by coating with conductive polymers. Conducting polymer-coated textiles, also, offer the possibility of heating without placing wiring across the fabric.

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Optical fibers

- An optical fibre is a cylindrical light waveguide that exploits the property of light being refractive.
- Optical fibres manufacturing consists of two major processes; by preform making influencing the attenuation and the dispersion characteristics of optical fibres and by drawing influencing glass geometry characteristics and strength.
- The materials used to produce an optical fiber can be glass, plastic and polymer clad silica.
- Optical fibres can be applied for data transmission, sensors (strain, compression, temperature and chemical substances) and for illumination.

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SENSORS ACTUATORS AND ENERGY SUPPLY

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Sensors

Sensor is the device that has the function to receive a specific parameter from the environment, to create a signal, to transform that signal into another analogue or digital signal and then to transmit it, with the purpose to be recognized, redden and understood from another device or person.

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Types of Sensors

- The ECG electrode or the electrocardiogram can conduct electric current.
- The EMG electrode or electromyogram can measures the electrical activity of skeletal muscles.
- The strain sensor is a device to measure the strain of an object.
- The temperature sensor is a sensor that measures the temperature of the environment and/or the body temperature.
- The pressure sensor is a device that senses pressure and converts it into an electric signal where the amount depends upon the pressure applied.

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Types of Sensors

- The gas sensor measures the presence and/or the concentration of combustible or toxic gases in the atmosphere.
- The humidity sensor is the sensor that can measure the humidity, the moisture and the solvent based on the principles of the resistive resistance and the capacitance.
- The pH sensor is a sensor that uses halo chromic materials, which are changing colors respect the varying pH environment.
- The optical textile sensors work with the variation of the light intensity or the amplitude that can be sensed by a fiber Bragg grating (FBG) sensor.

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Actuators

Actuator is the device that has the function to react under a specific parameter, which works like a trigger. The way that works an actuator to have the reaction, determines the type of the actuator, who can be mechanical, chemical, thermal, optical or electrical.

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Types of Actuators

- Mechanical actuator.
- Thermal actuator.
- Chemical actuator.
- Optical or visual actuator.
- Electrical actuator.

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Energy harvesting and storage

The sensors and the actuators, that do not use passive smart materials, need energy to work. This energy should be able at any moment that the user needs the properties of the garment, so storage systems are necessary in the development of an e-textile.

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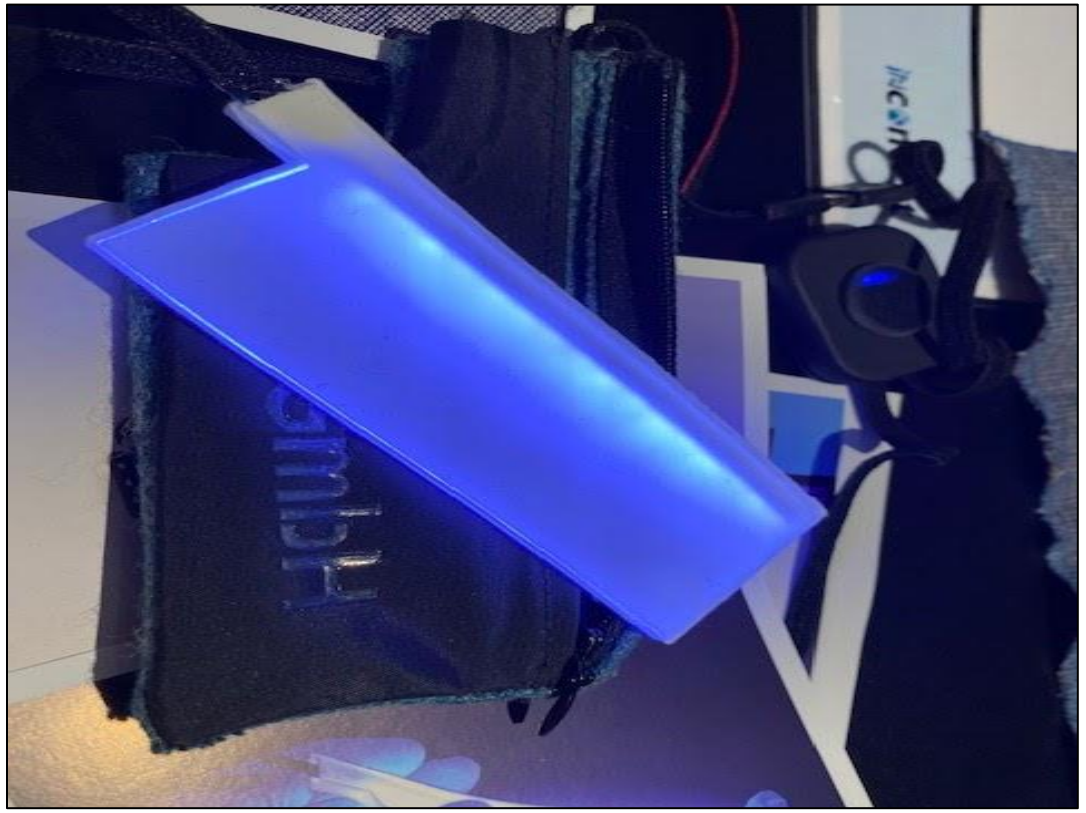
Output devices (LED's, passive displays)

The output devices, used in the textiles sector, are Light Emission Diode (LED) arrays, thermo-chromic ink, vibration, and shape memory alloys.



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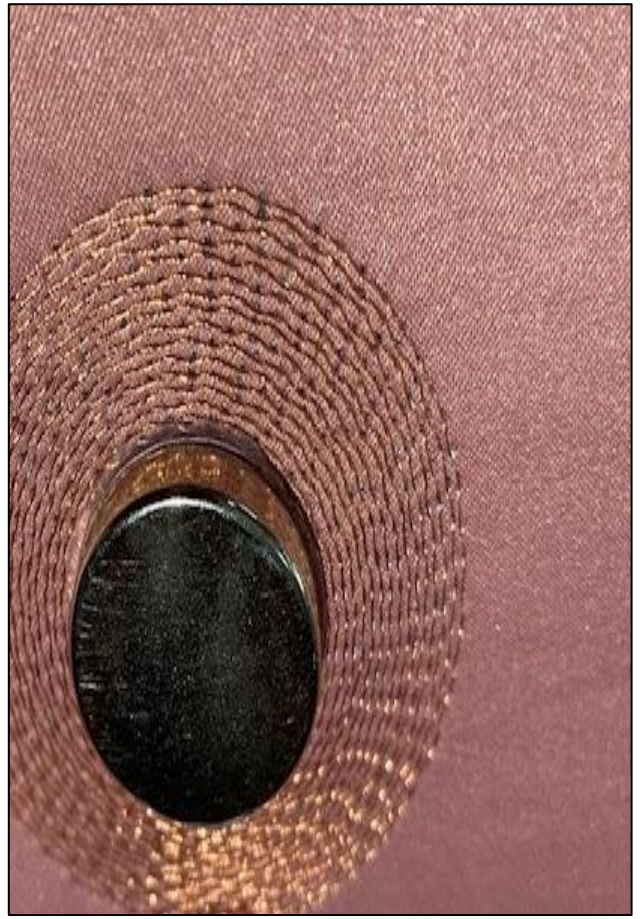
Nano and micro electronics

Nanoelectronics are electronic devices with extremely reduced size based to nanotechnology. They have the mechanical properties of the hybrid material; have semiconductors, single dimensional nanotubes, nanowires, memory chips and displays, but the challenge is to have the same capabilities of the normal-size electronic devices, while their dimensions, weight and power consumption are extremely reduce.



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MICROCONTROLLERS

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Microcontrollers

Microcontrollers is an embedded controller used in automatically controlled electronic devices. Any device that stores, measures, displays or calculates in electronic way, comprises a microcontroller.

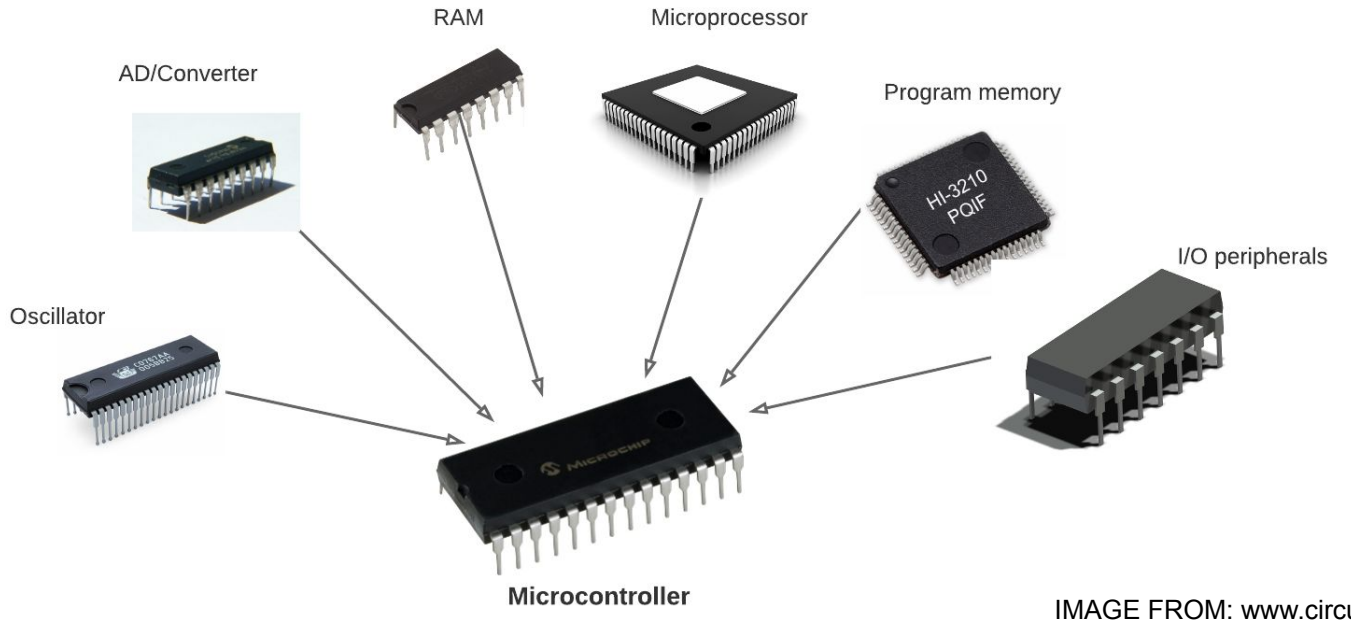

IMAGE FROM: www.circuitbasics.com

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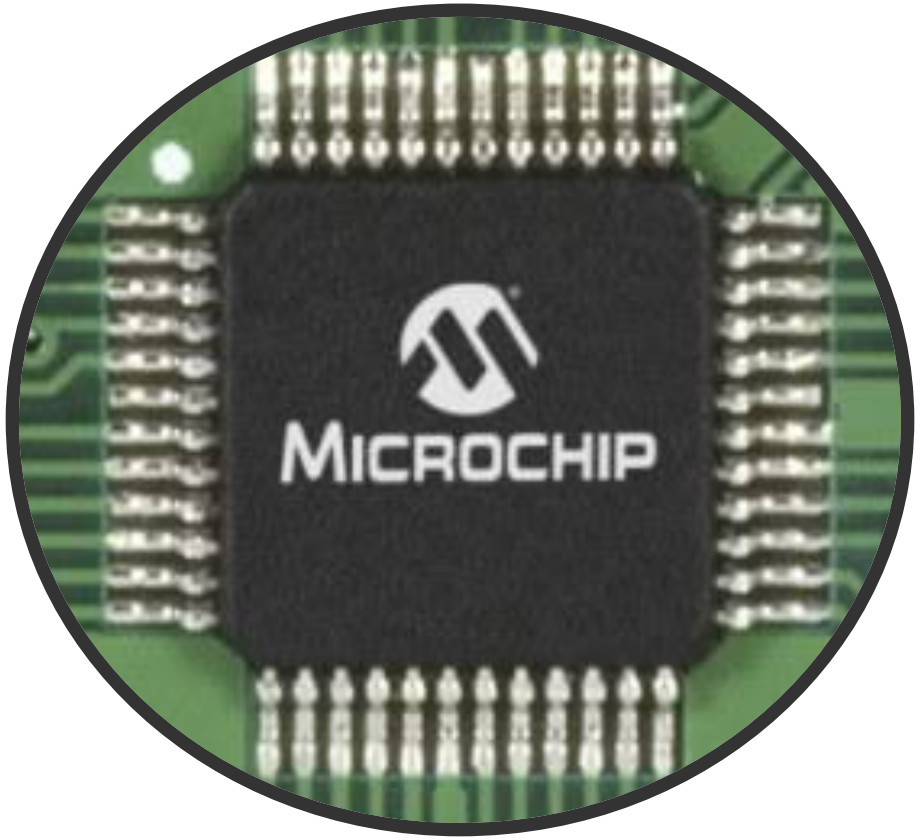
Types of Microcontrollers

Microcontrollers are broadly classified into various categories based on bit configuration, memory, instruction set and architecture memory. The bit configuration is its potential of the its accuracy and performance and is measure in 4bit, 8bit, 64bit and 128bit, the more bits, the more potential the microcontroller is.



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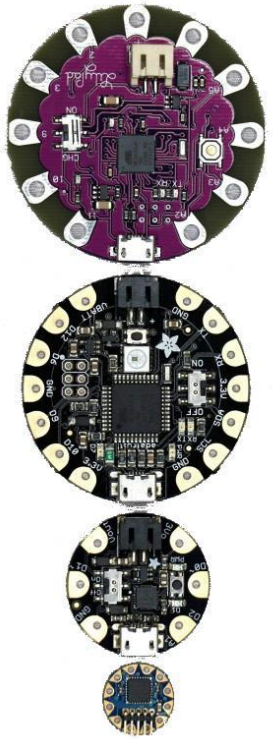
Wearable Microcontrollers

Adafruit designed low-cost microcontroller boards that are small enough to fit into any textile project and be wearable, the GEMMA and the FLORA. This wearable microcontroller is capable of objectifying any wearable project as desired connecting a computer with the USB bootloader.



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WIRELESS COMMUNICATION DEVICES

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Wireless communication devices

- Textile antennas
- Bluetooth
- Zigbee transmitter and receiver modules

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Textile antennas

Antennas are metallic structures that transmit or capture information and data by radio electromagnetic waves. To succeed the transition are able two antennas, so when the one transmit the other can receive the signal and opposite.

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Textile antennas

The integration of Radio Frequency Identification tags into textiles gives interesting perspectives for the clothing industry; a garment could be traced from production stage to recycling, simplicity the logistics and selection in transport and warehouses.

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Bluetooth

The Bluetooth devices are divided into two categories: Basic Rate/Enhanced Data Rate and Bluetooth Low Energy (BLE). In e-textile applications can provide considerably reduced power consumption and cost while maintaining a similar communication range.

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Zigbee transmitter and receiver modules

Zigbee is a low power, low data rate and close proximity, wireless communication technology. In a ZigBee network, there are three kinds of Zigbee devices: Zigbee Coordinator, ZigBee Router and Zigbee end Device. Zigbee End devices do not route traffic. Zigbee Routers are responsible for routing traffic between different nodes and a Zigbee coordinator is a special router responsible for forming the network.

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Summary

- Specific fibres and their used in smart textile systems.
- Functions of various technology components and their applications in textiles.
- The wearable systems with technologies that already existe.

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