# Microcontrollers

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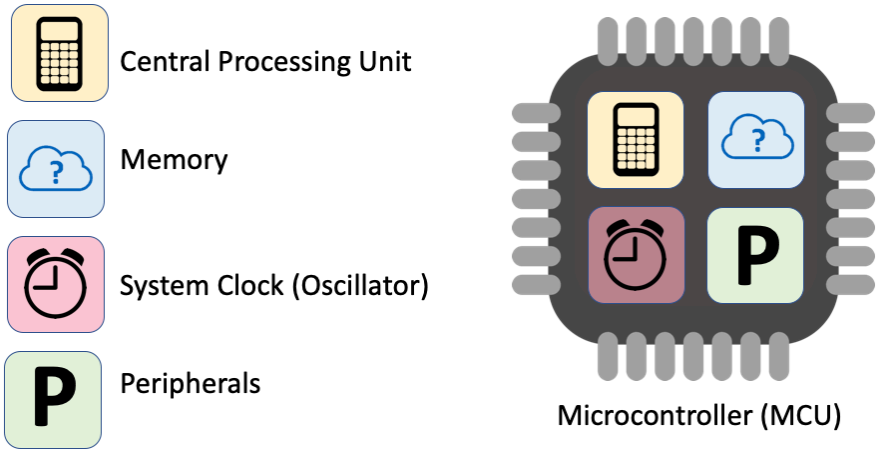
## What is a microcontroller? A microcontroller is a tiny computer on a single metal-oxide semiconductor integrated circuit chip.

Microcontrollers have four fundamental components (similar to a computer).




The majority of microcontrollers are embedded in other machinery, such as automobiles, cell phones, appliances, and peripherals for computer systems. Typical peripherals (input and output devices) include switches, relays, solenoids, LED's, and sensors. Microcontrollers normally control a specific task within the device in which they are embedded.

Microcontrollers must be programmed in order to work. Programmers use different programming languages (ie. BASIC, Assembly, Phyton, C++, etc.) to tell the microcontroller what outputs are desired based on certain inputs. Many engineers use a microcontroller development board (like an Arduino) to design and prototype systems because the boards contain needed circuitry along with the microcontroller for ease of use.

A simple circuit to light an LED is a good example of a system where a microcontroller would be helpful. To light the LED, the button would have to be pushed (see Figure A). To light the LED three times, the button would have to be pushed three times. However, if a microcontroller is added to the circuit, it could be programmed to light the LED three times when the button is pushed one time (see Figure B.)

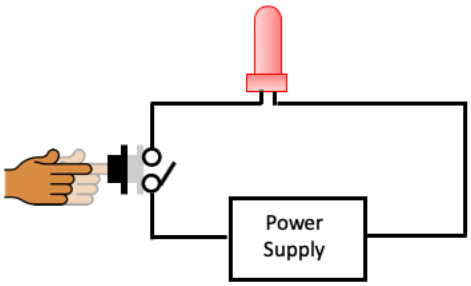



Figure A

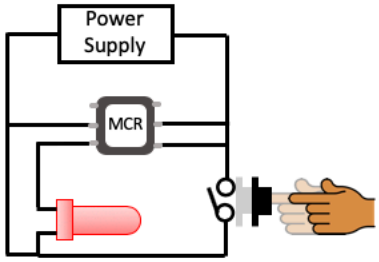



Figure B

Microcontrollers run very simple or more complex tasks depending on the type of CPU and how much memory they have. Microcontrollers can also be combined to run much more complex tasks.

## Vocabulary

**Accessory:** An external device that provides input and output for a computer.

**CPU – Central Processing Unit:** The electronic circuitry within a computer that controls and executes operations.

**Chip (Semiconductor Chip):** A device made of interconnected electronic components that are etched or imprinted onto a tiny slice of a semiconducting material, such as silicon or germanium. An integrated circuit smaller than a fingernail can hold millions of circuits.

**Circuit:** An electrical device providing a path for current to flow.

**Conductor:** A device designed to transmit electricity or heat.

**Computer:** A programmable electronic device for storing and processing data.

**Insulator:** A material of such low conductivity that the flow of electric current through it is negligible.

**LED:** Light-emitting diode – a semiconductor device that produces light from electricity.

**Memory:** A device that is used to store information for immediate use by a computer or related computer hardware device.

**Microcontroller:** Refers to a small processor on a single integrated circuit, similar to, but less sophisticated than, a system on chip (SoC). A microcontroller contains one or more processor cores, memory and programmable input/output peripherals.

**Peripheral:** A device that aids the microprocessor in accomplishing a given job. Examples of a peripheral on an MCU: input/output port, timer, analog to digital converter (ADC), digital to analog converter (DAC), or a driver.

**Programming Language:** A type of written language that tells computers what to do in order to work.

**Semiconductor:** A substance, usually a solid chemical element or compound, that can conduct electricity under some conditions but not others, making it a good medium for the control of electrical current. The specific properties of a semiconductor depend on the impurities (or dopants) added to it.

**Sensor:** A device that measures a physical quantity and converts it into a "signal" which can be read by an observer or by an instrument.

**Switch:** A device for making, breaking, or changing the connections in an electrical circuit.

**Solenoid:** A coil of wire that acts like a magnet when a flow of electricity passes through it. Solenoids are most commonly used as electromagnets and can be used to slow the flow of electricity in a circuit.

**System Clock:** A device which regulates the internal components of the computer by issuing a high frequency signal. This signal ensures that all components are synchronized.

## Test Your Knowledge

1. What are the basic parts of a microcontroller?
2. How do microcontrollers affect current technology?

## Resources:

**Videos:**

Microchip Academic Program: https://www.youtube.com/watch?v=jKT4H0bstH8

How Microcontrollers Work: https://www.youtube.com/watch?v=i_g1dD5fFLo

Solid State Workshop: https://www.youtube.com/watch?v=CmvUY4S0UbI

How a Microcontroller is Made: https://www.youtube.com/watch?v=p4vZwycU4Cw

Inside a PCB Factory: https://www.youtube.com/watch?v=ljOoGyCso8s

**Extension Activities:**

IEEE – Try Engineering: Insulators and Conductors: https://tryengineering.org/wp-content/uploads/insandcond.pdf

Beginner's Guide to Microcontrollers: https://www.microcontrollertips.com/a-beginners-guide-to-microcontrollers-faq/

Embedded Systems / Peripherals: https://embeddedinventor.com/9-essential-microcontroller-peripherals-explained/