



COMP140 GAM160: Hacking Hardware / Advanced  
Programming

**Session 2: 12**

# Learning outcomes

- ▶ **Identify** the various parts of the Arduino and their function
- ▶ **Explain** the difference between analog and digital
- ▶ **Follow** the Arduino tutorials to create basic functionality

# Components

Come up and collect your components:

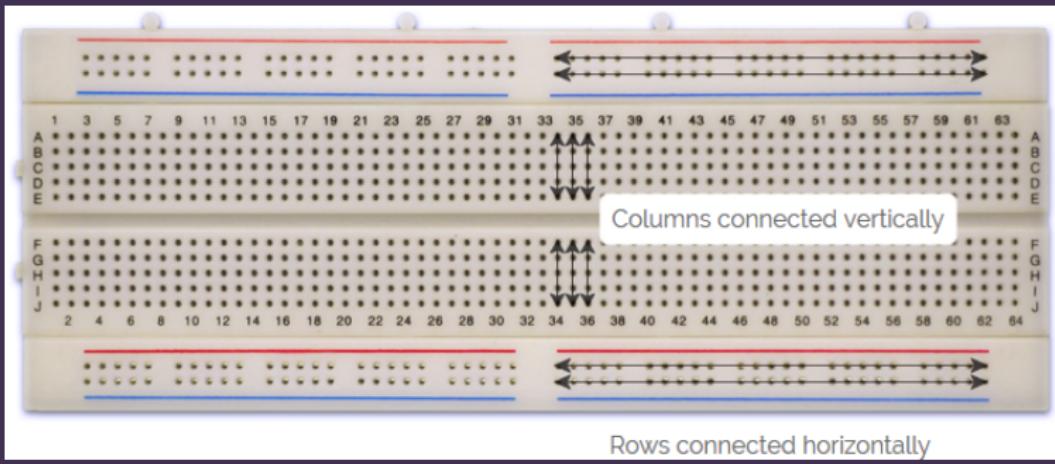


# What's in the Bag?

Come up and collect your components:

- ▶ **3x** 220ohm Resistors (ish)
- ▶ **1x** 10k Resistor
- ▶ **5x** LEDs (red, green, blue, yellow & white)
- ▶ **2x** Potentiometer
- ▶ **1x** Push Button
- ▶ **1x** Bread Board
- ▶ **1x** USB Cable
- ▶ **1x** Arduino
- ▶ **1x** Bunch of hook up wires

# Breadboard



# Resistor



In electronic circuits, resistors are used to reduce current flow, adjust signal levels and divide voltages.

# LED



LEDs, being diodes, will only allow current to flow in one direction. And when there's no current-flow, there's no light. Luckily, this also means that you can't break an LED by plugging it in backwards. Rather, it just won't work.

# Potentiometer



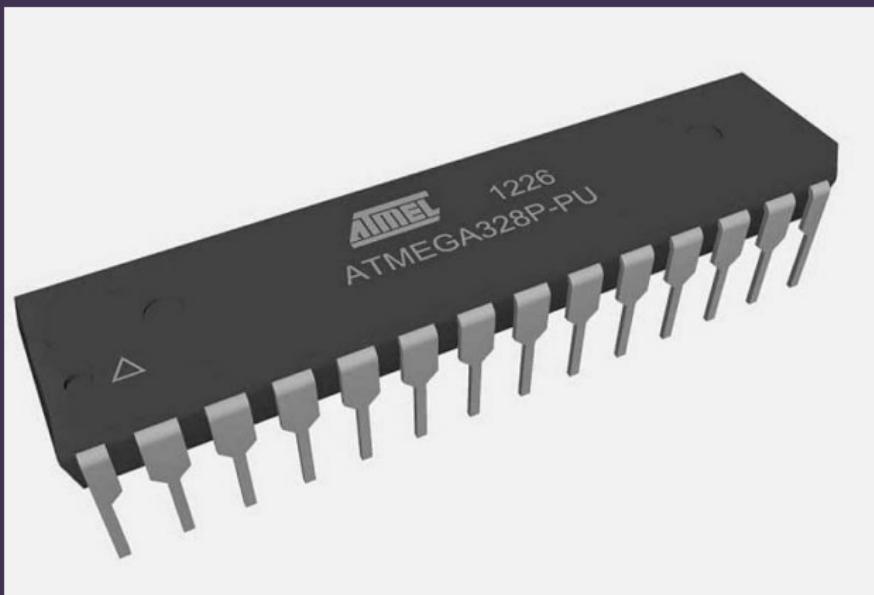
Potentiometer is a small sized electronic component whose resistance can be adjusted manually. Increasing or decreasing the value of resistance controls the amount of current flowing in a circuit.

# Button



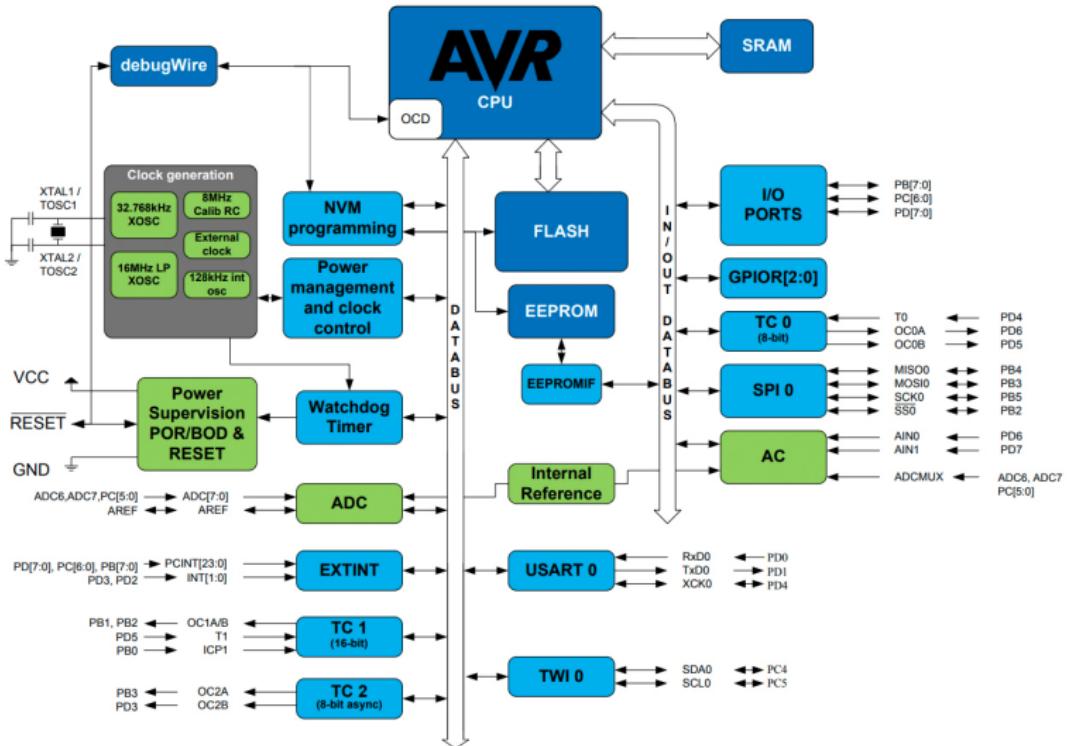
A device for making and breaking the connection in an electric circuit.

# Atmel ATmega328P



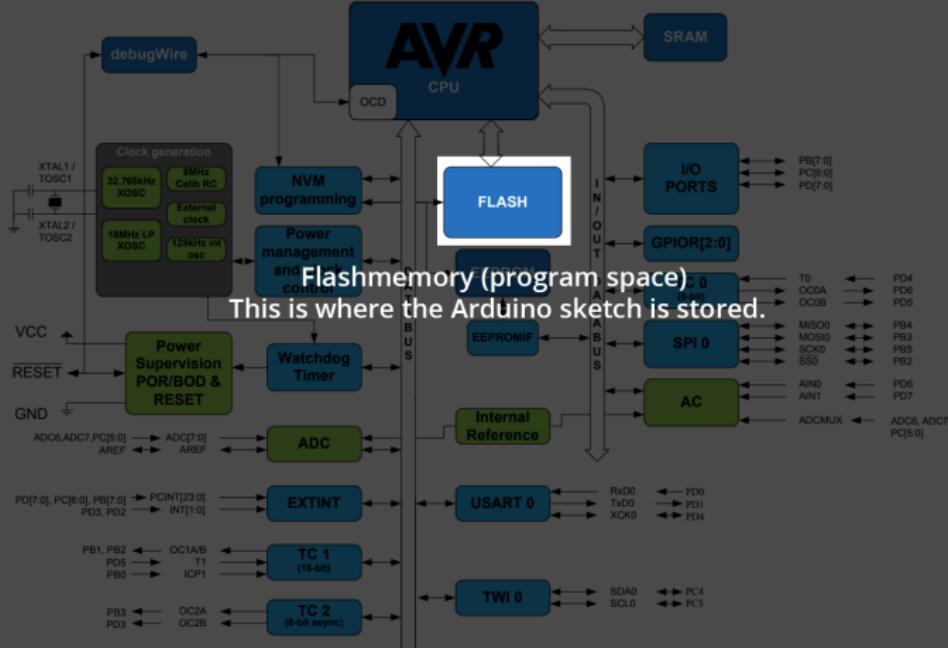
# Block Diagram

Figure 4-1. Block Diagram



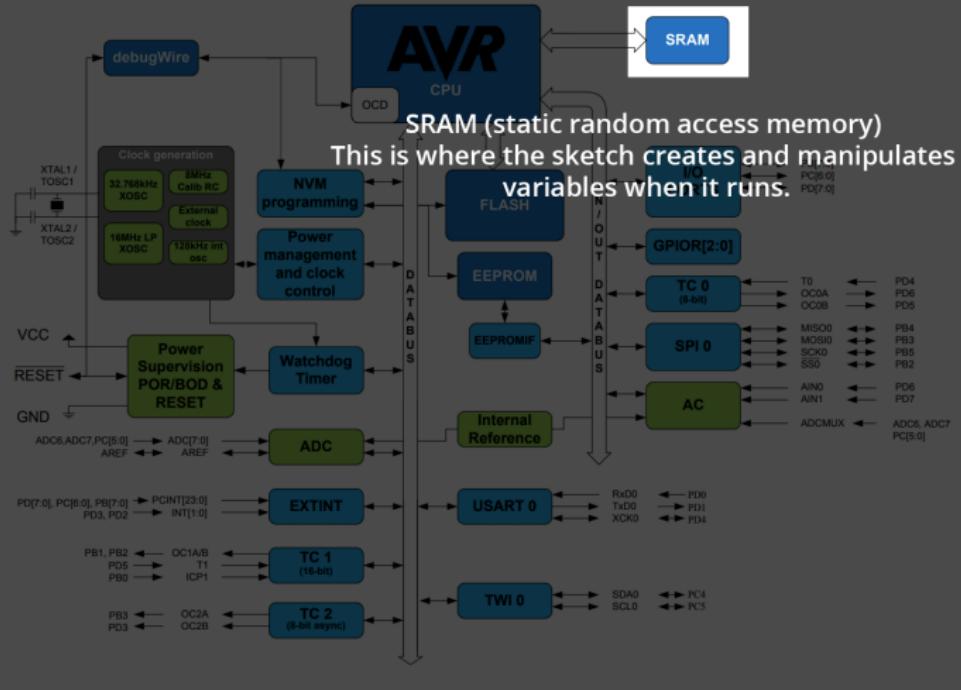
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Figure 4-1. Block Diagram



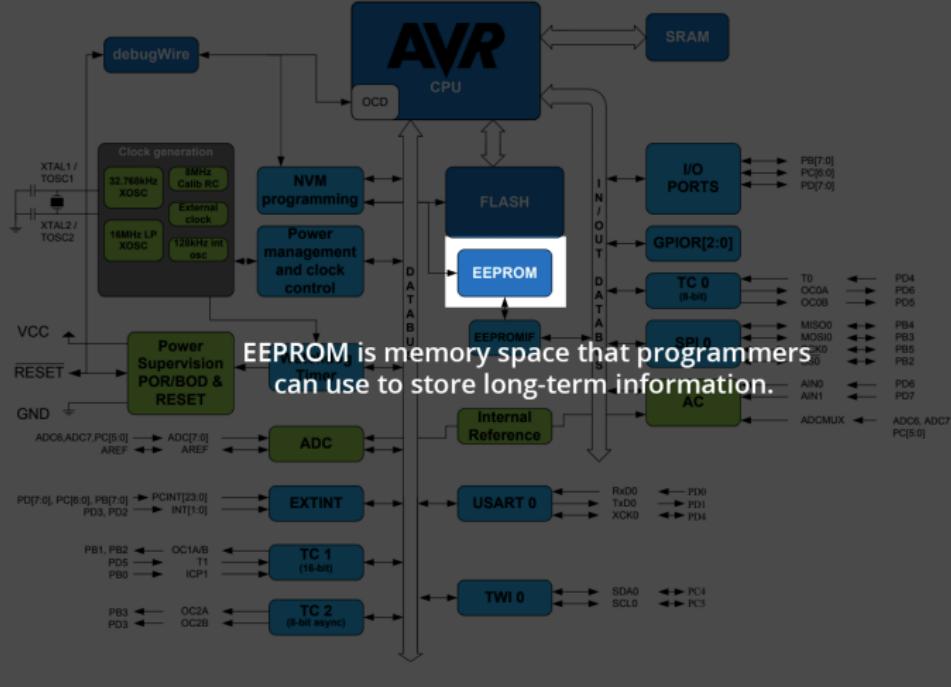
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**Figure 4-1.** Block Diagram



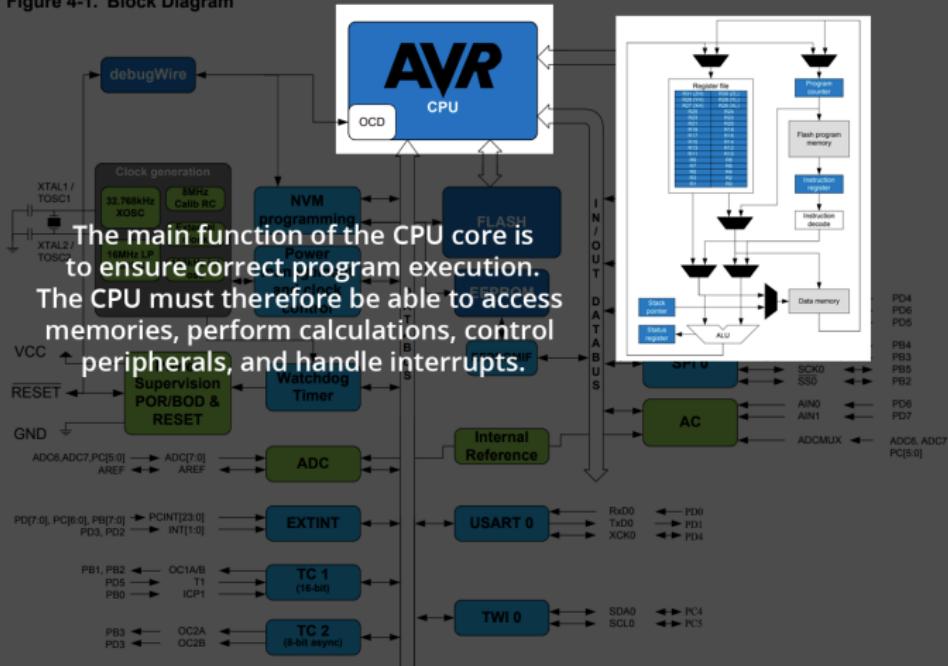
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**Figure 4-1.** Block Diagram



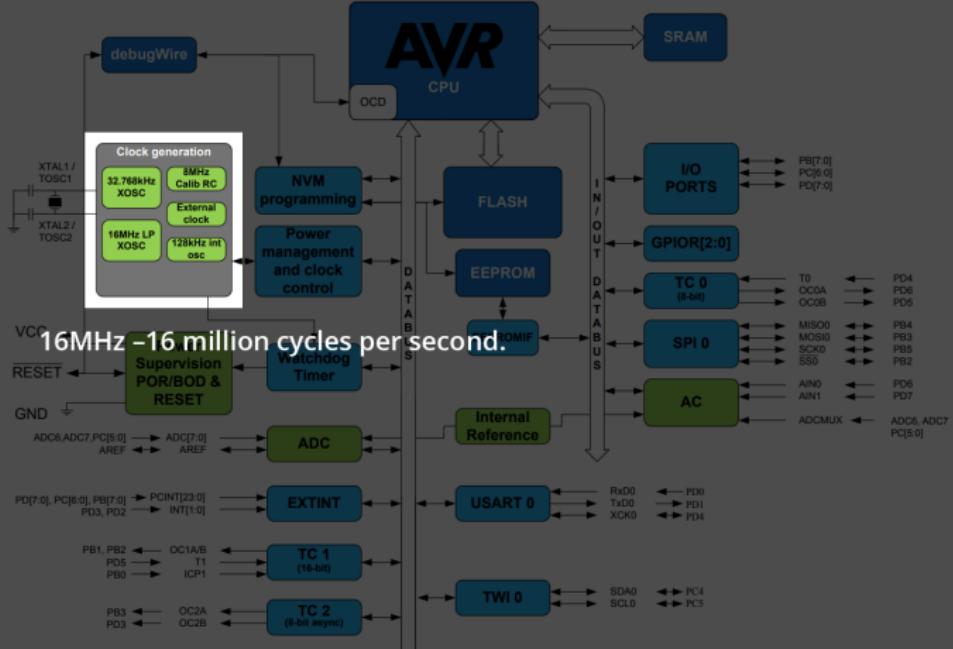
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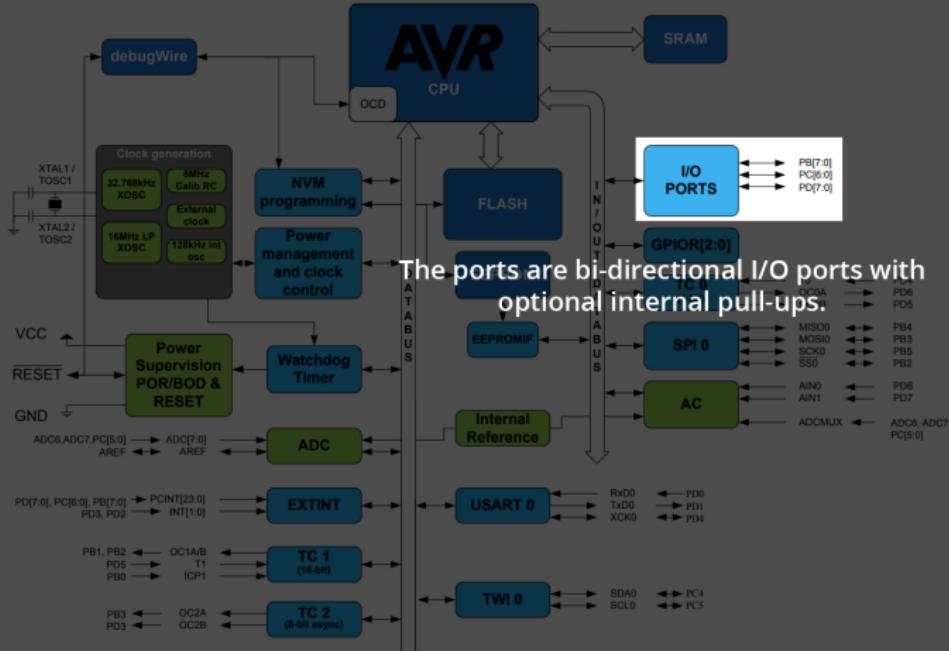
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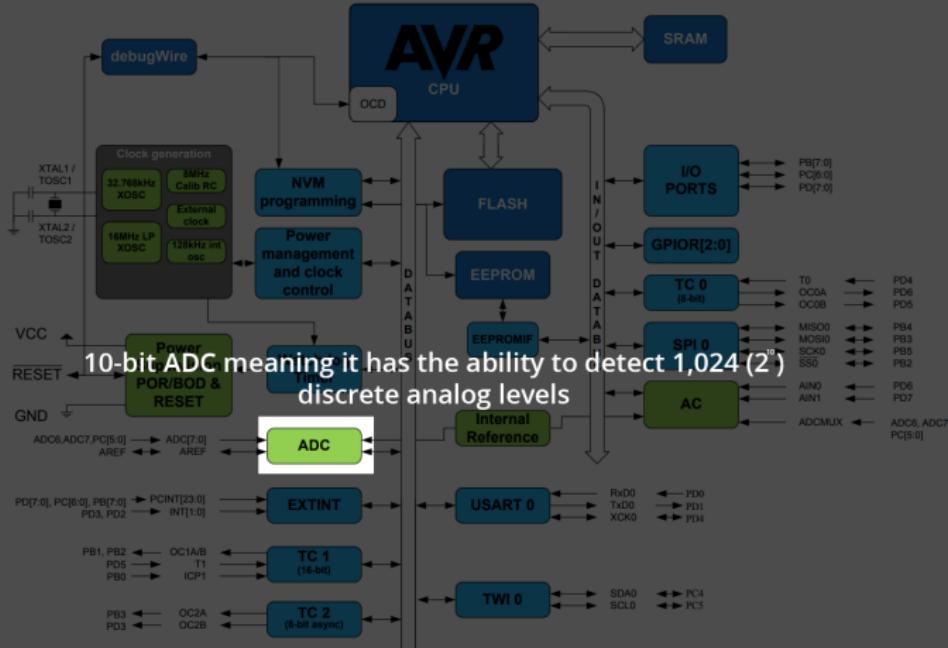
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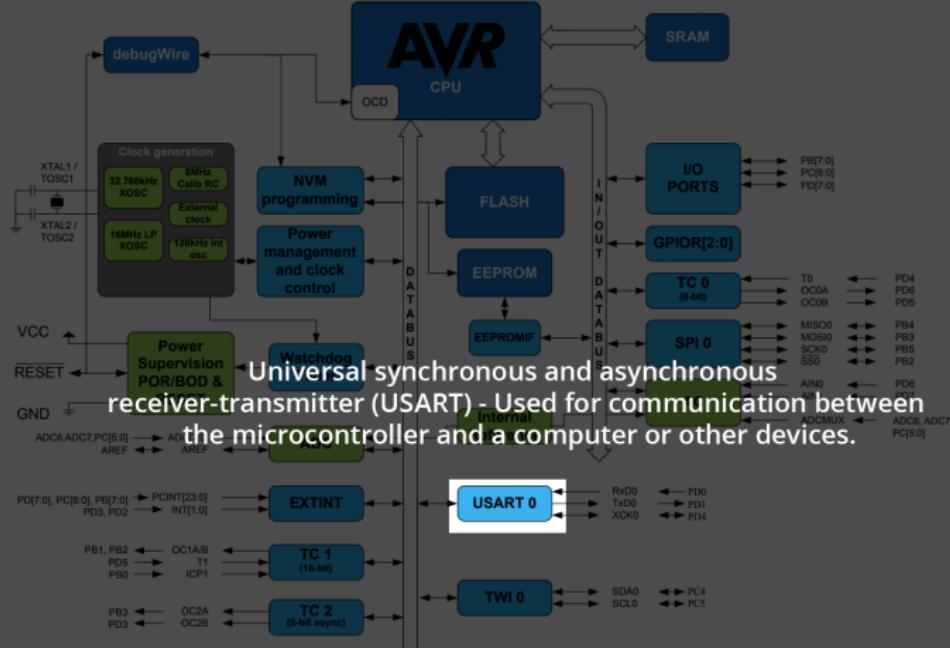
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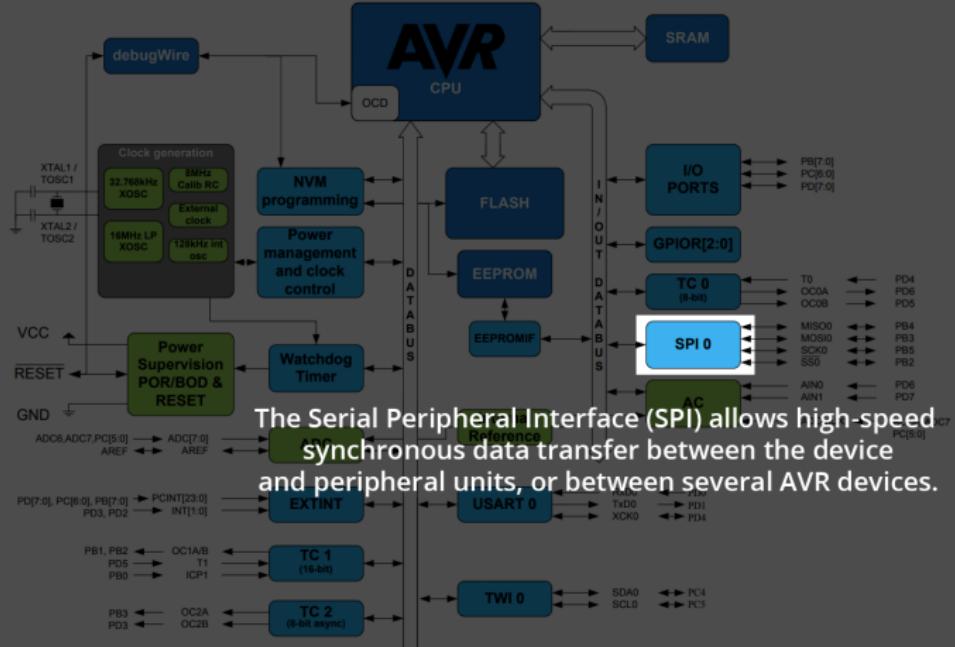
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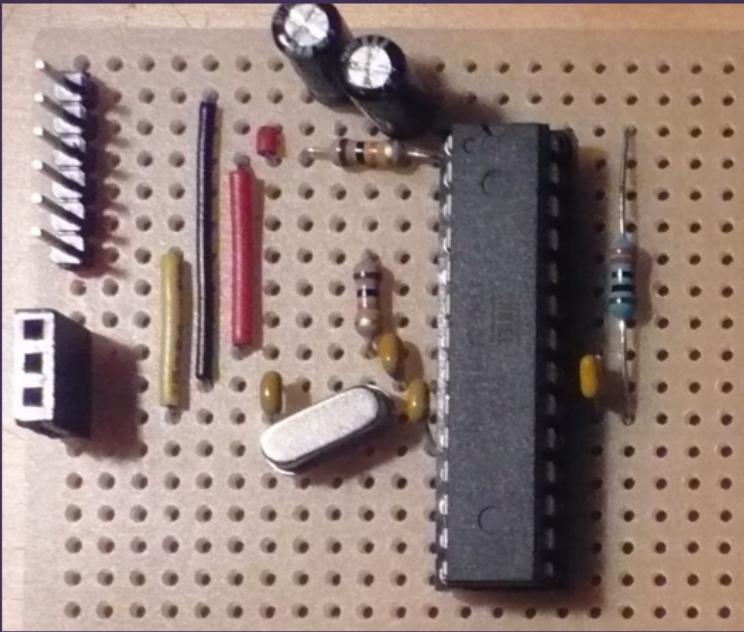


# What is an Arduino?

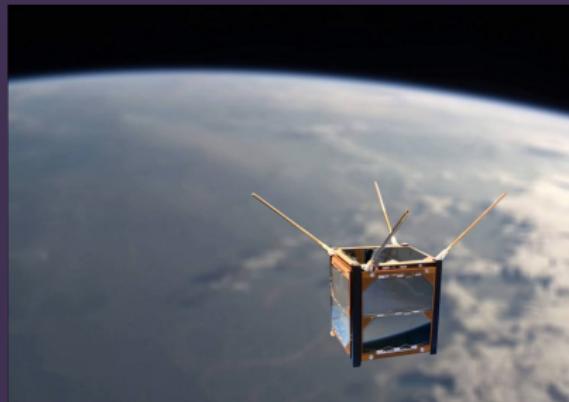


Figure: Rapid Prototyping Board

# Final Form Factor



# Space



The ArduSat satellites are powered by the Arduino Uno. It follows cube satellite (CubeSat) standards to build compact 10 cm cubes that can easily be sent to orbit.

# Sea

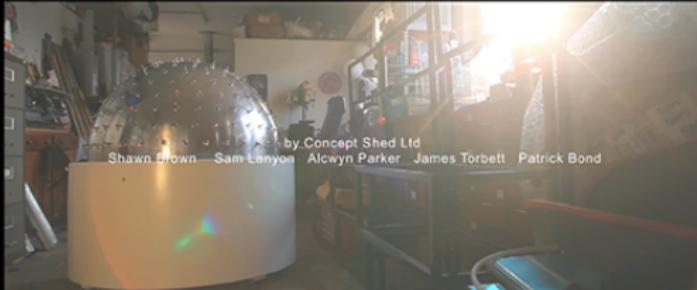


The robotic prototype swimming under water propelled by fins, it was developed at the Control Systems and Robotics Laboratory of the Technological Educational Institute of Crete, in Heraklion (Greece) and it's controlled by an Arduino Mega.

# Institute of Imagination

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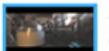
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# Sensors & Actuators



Figure: Just another input / output controller

# What is an Arduino?

- ▶ Open Source
- ▶ The Arduino is a small microcontroller board
- ▶ Basically, a small computer
- ▶ Perfect for rapid prototyping physical computing systems
- ▶ Arduino Uno is based on the Atmel ATmega328P

# The basics

The Arduino can only process electronic signals. This means that stimuli from the physical world need to be transduced to electrical signals before they can be processed from within your code.

- ▶ 14 Digital IO pins (0-14)
- ▶ 6 Analogue in pins(0-5)
- ▶ 6 Analogue out pins(3,5,6,9,10, and 11)

# Technical specs

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g

Figure: A more in depth version of what the Arduino Uno has to offer

# Power

You can power the board using a USB port or DC power supply such as a 9v battery. The Arduino will default to the external power supply if there is one available.



Figure: Arduino can be powered by a DC supply 7-12v but all signals are processed at 5v

# Analogue vs. Digital Signal

What is the difference?

# Analogue vs. Digital Signal

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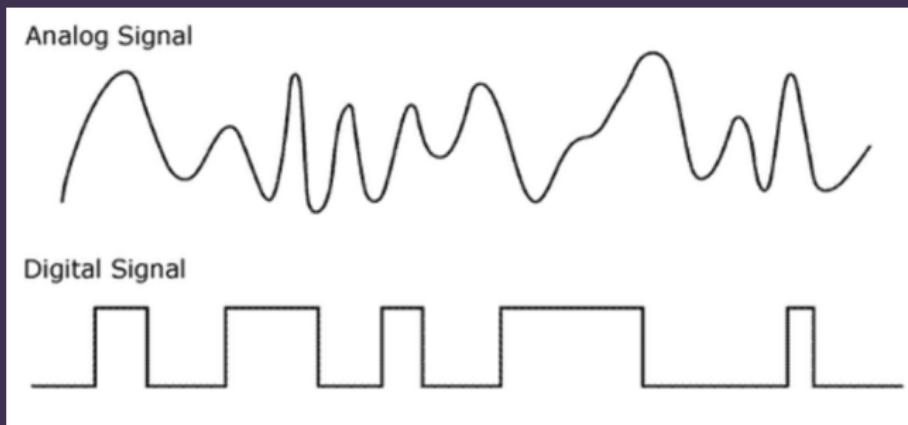
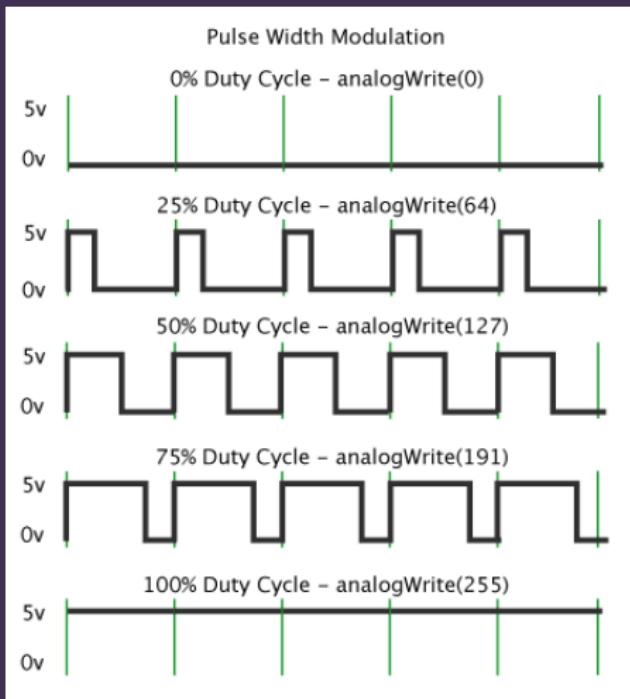


Figure: Arduino can be powered by a DC supply 7-12v

# Analogue Out - PWM



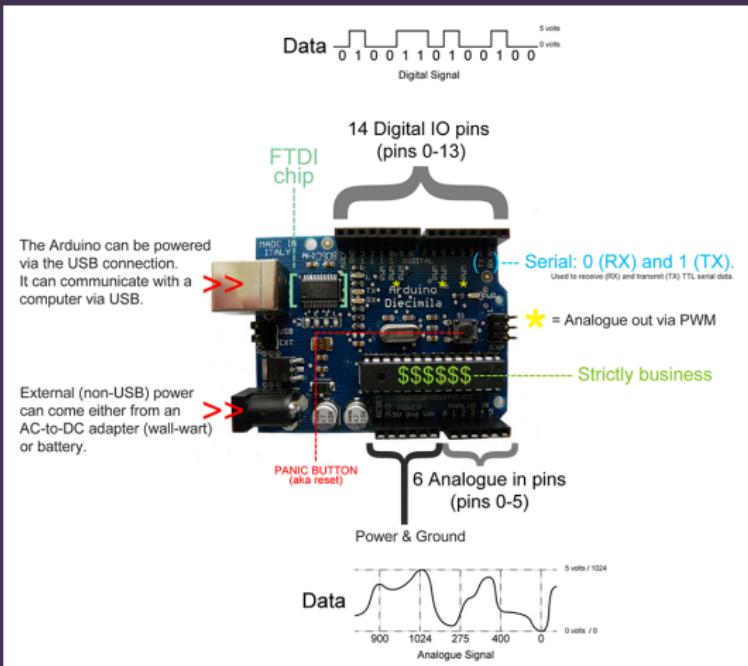
# Serial Communication

Serial communication on pins TX/RX uses TTL logic levels (5V or 3.3V depending on the board).

It communicates on digital pins 0 (RX) and 1 (TX) as well as with the computer via USB. Thus, if you use these functions, you cannot also use

pins 0 and 1 for digital input or output. Serial is used for communication between the Arduino board and a computer or other devices.

# Arduino



# Shields



# Open Source Game Boy Clone



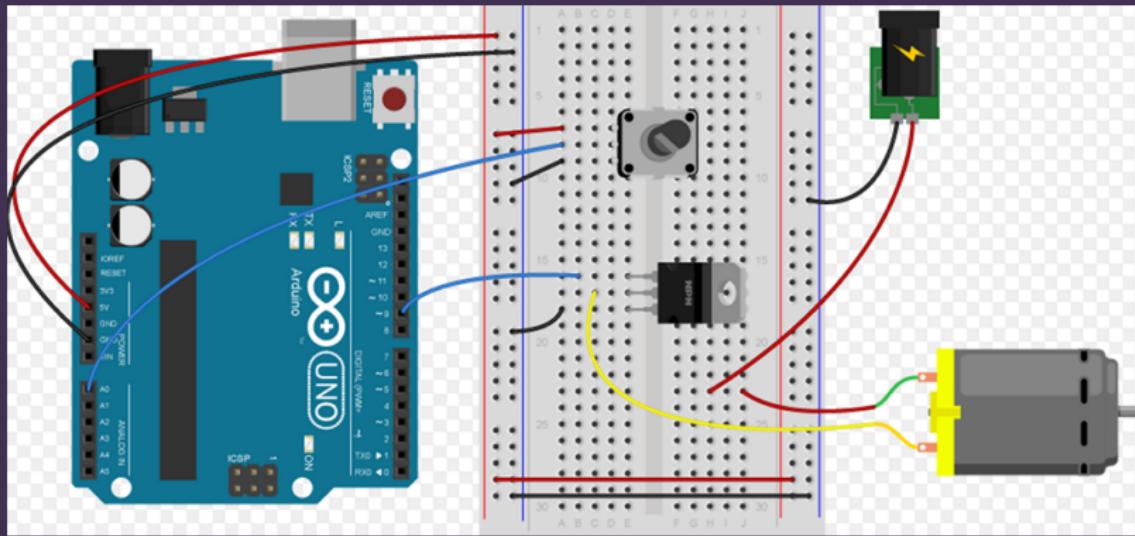
# Places to buy components

The Bitsbox website features a top navigation bar with links for Home, Log In, Search, and a search bar. Below the header are sections for 'CRAZYFLIE 2.0' (ideal for developers and supports Bluetooth LE), 'New Products for February' (including 100W Ceramic WW, 200W Ceramic WW, and 220W Ceramic WW), and 'Arduino Sensors' (with sub-sections for Arduino Sensor Kits, Arduino Sensor Shields, and Arduino Pressure Sensors). The main content area includes a 'Prototyping System for the micro:bit' section with a diagram, a 'Featured Products' section, and a 'Business & Industrial' products section.

Figure: Insure that you buy your components from UK sellers, especially on Ebay

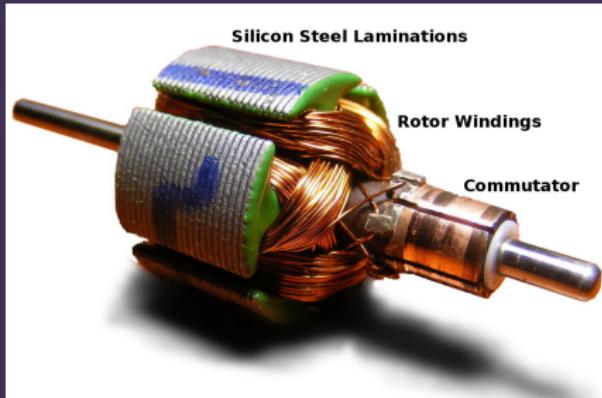
# Driving Large Loads

See spec



# Reverse Voltage

The Arduino should be protected from reverse voltage of solenoids, relays, motors and any other component that use coils. This can be done using a Diode. They act as a one way valve to channel the electric back into the coils.



# Mains Electricity



Figure: There is never any reason why you should be working with mains electricity supply - stay below 12v and even then take care.

# Programming for Arduino

The Arduino language is merely a set of C/C++ functions that can be called from your code. Your sketch undergoes minor changes (e.g. automatic generation of function prototypes) and then is passed directly to a C/C++ compiler (avr-g++).

<https://www.arduino.cc/en/Reference/HomePage>

# HELLO ARDUINO

