



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:

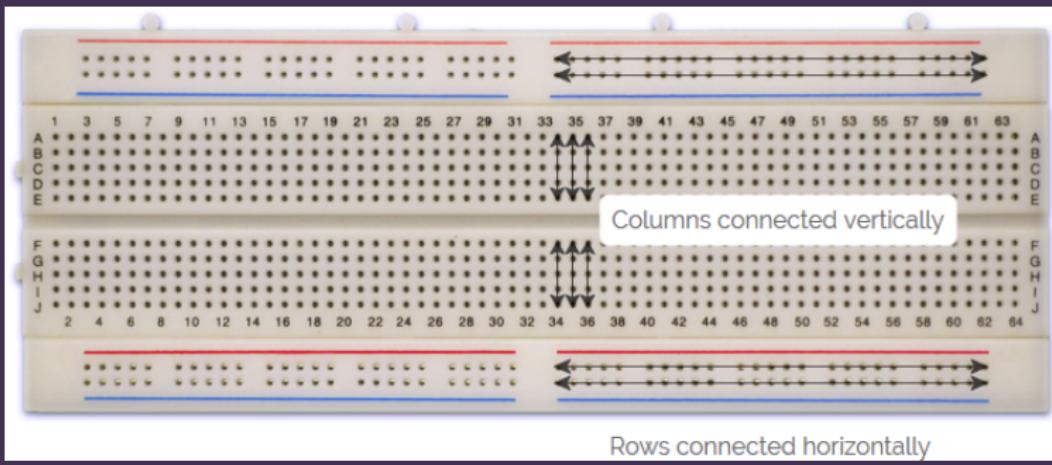


What's in the Bag?

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



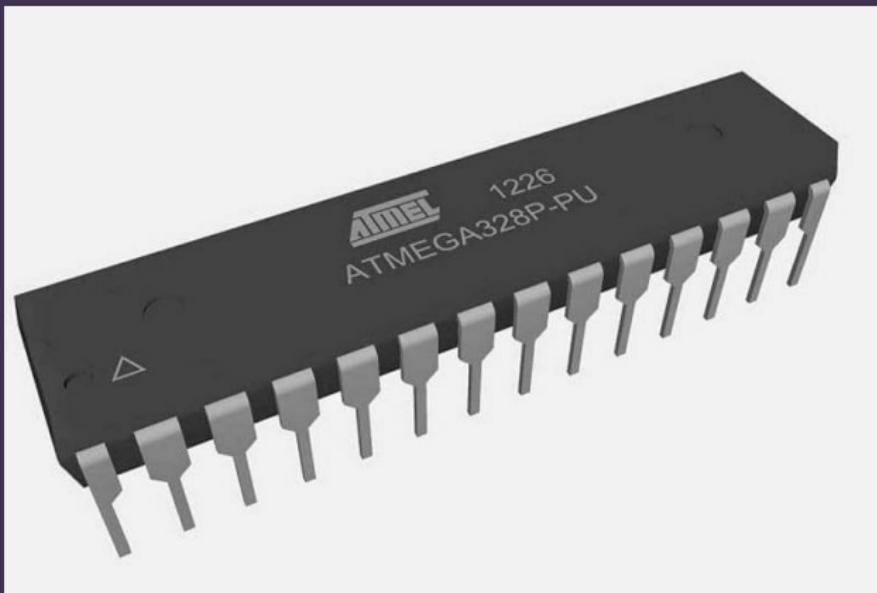
Potentiometer is a small sized electronic component whose resistance can be adjusted manually. Increasing or decreasing the value of resistance controls the amount of current flowing in a circuit.

Button



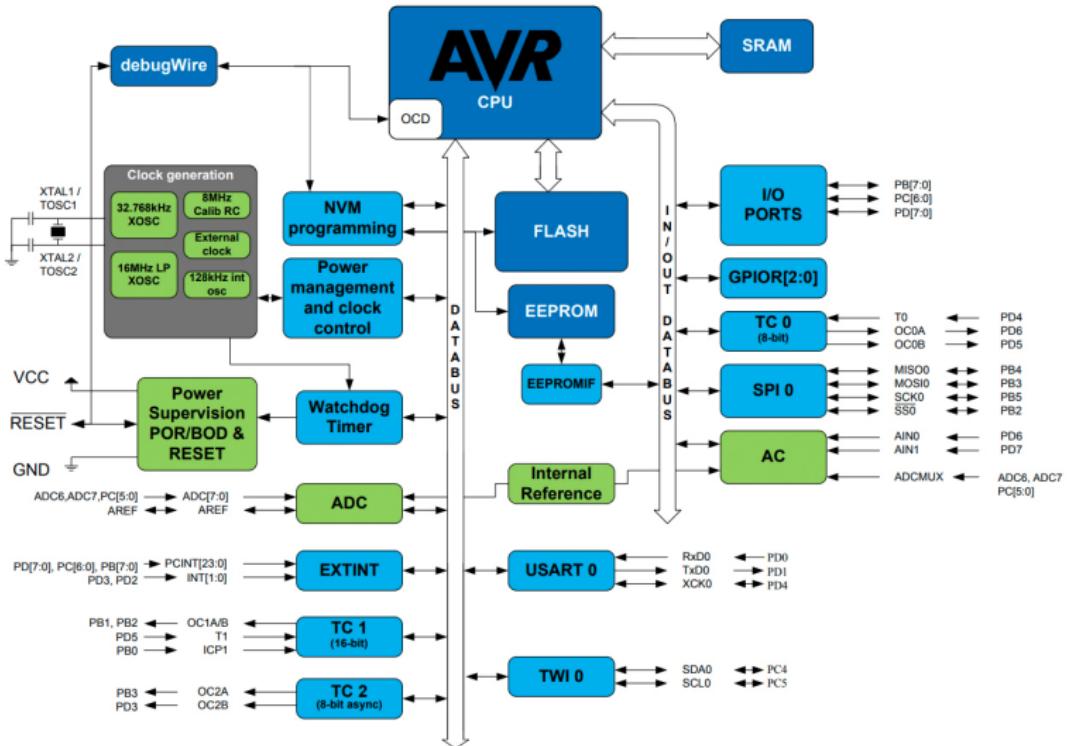
A device for making and breaking the connection in an electric circuit.

Atmel ATmega328P



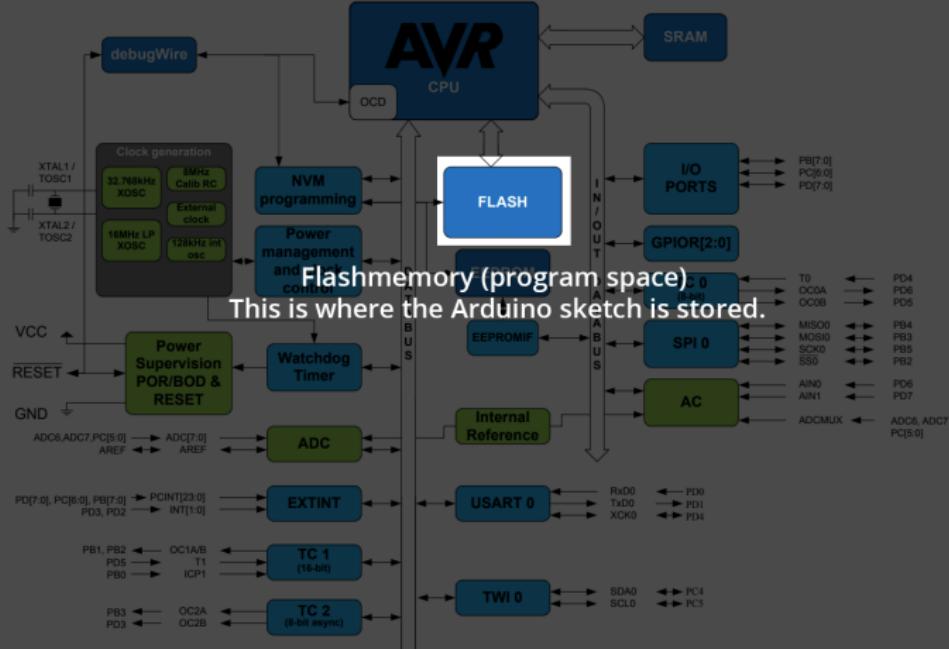
Block Diagram

Figure 4-1. Block Diagram



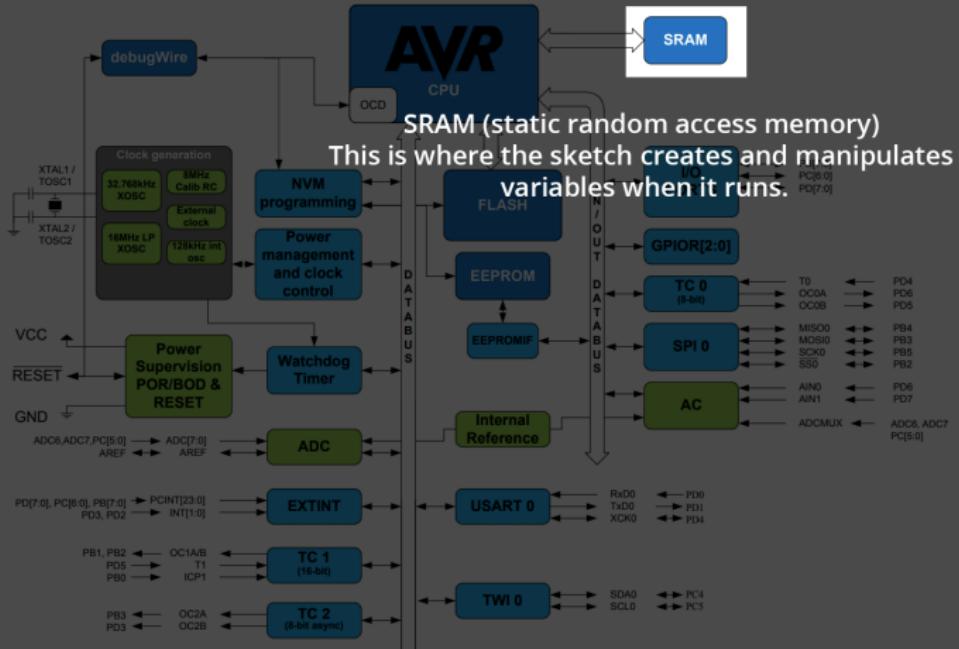
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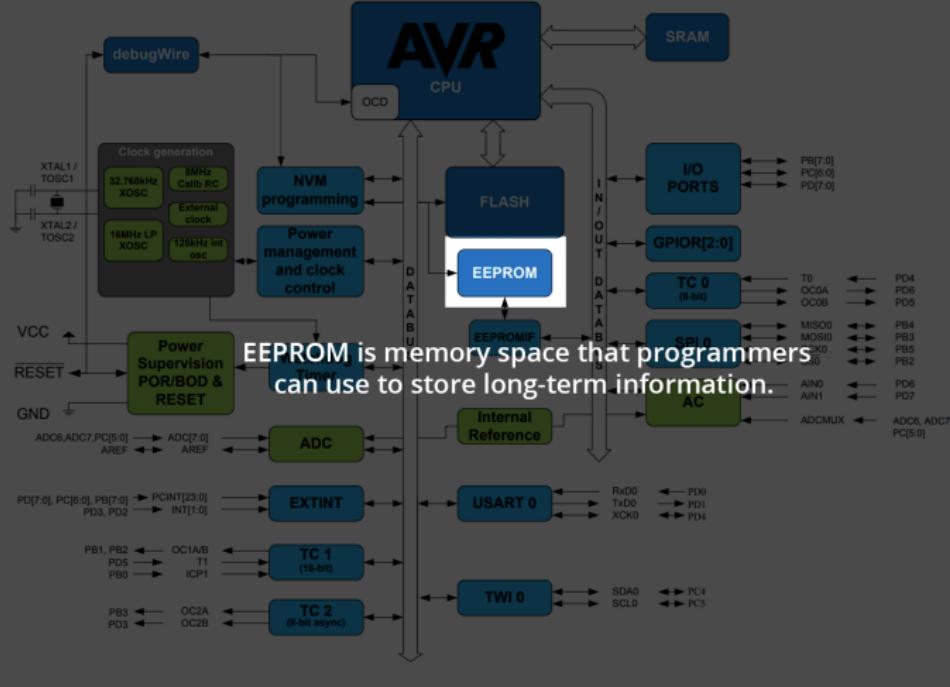
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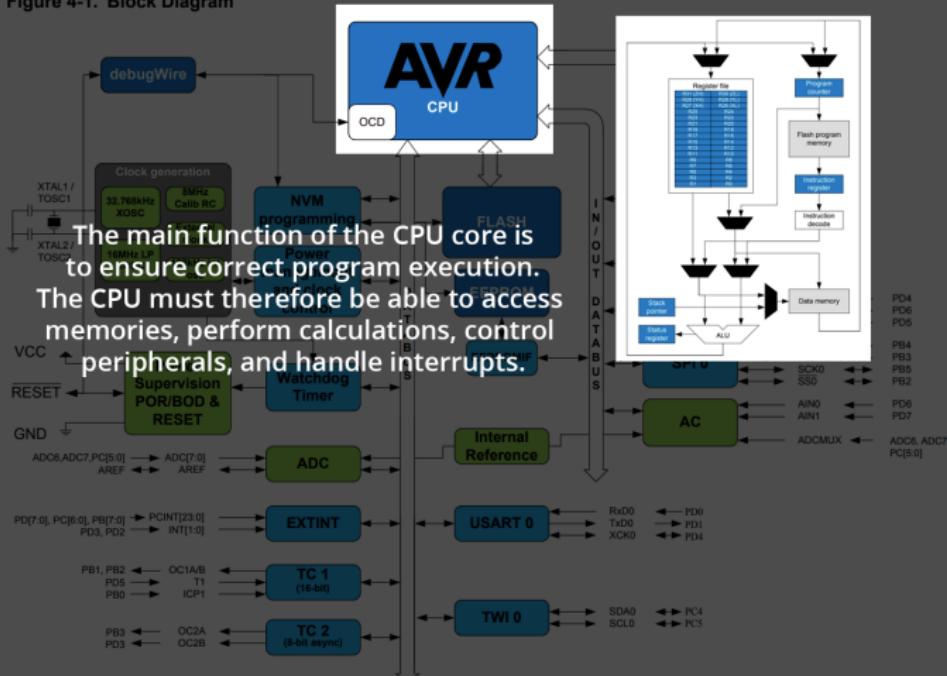
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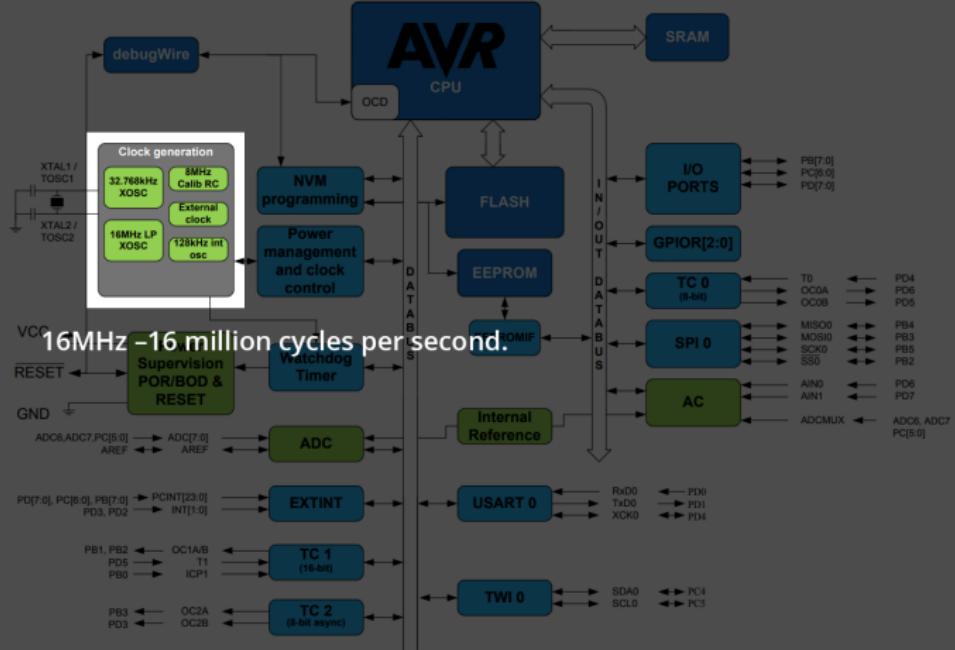
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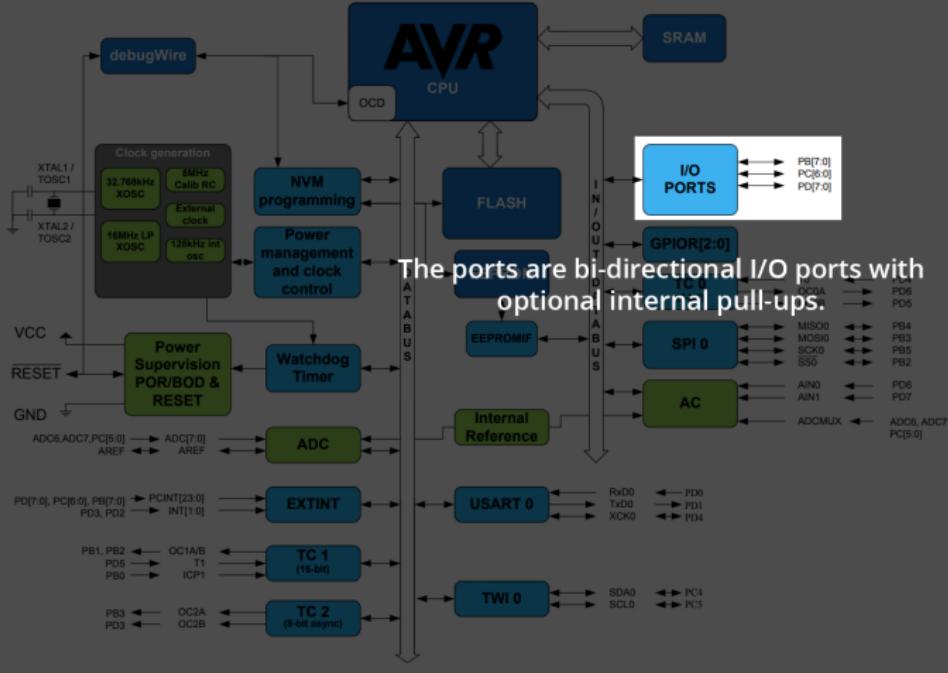
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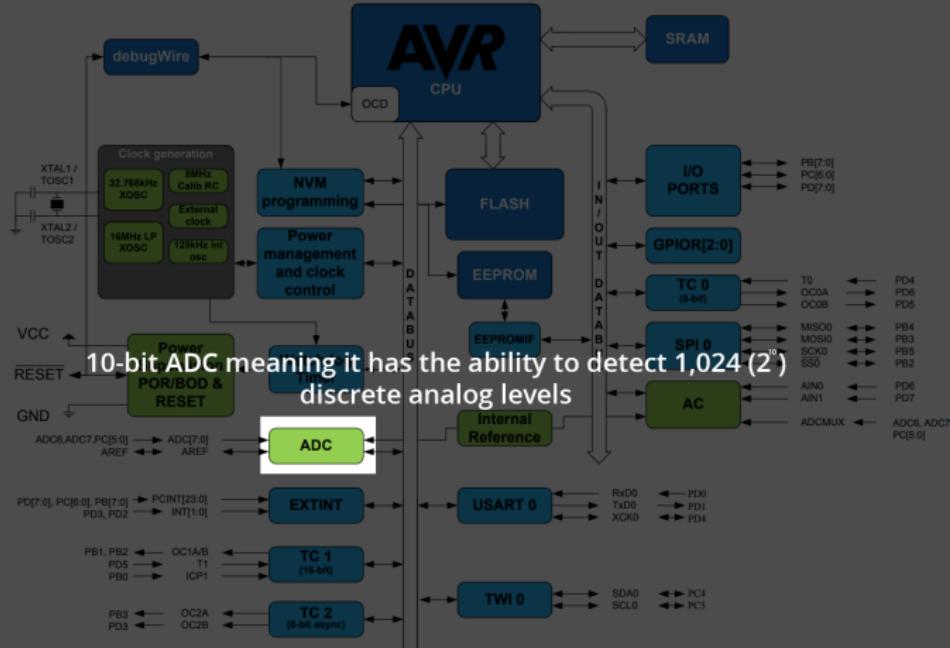
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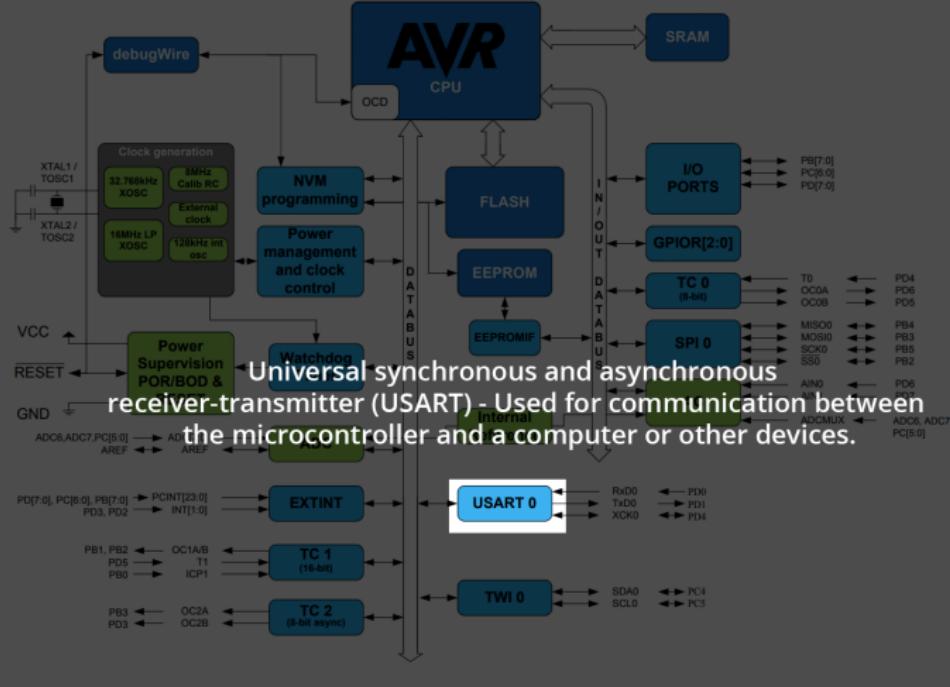
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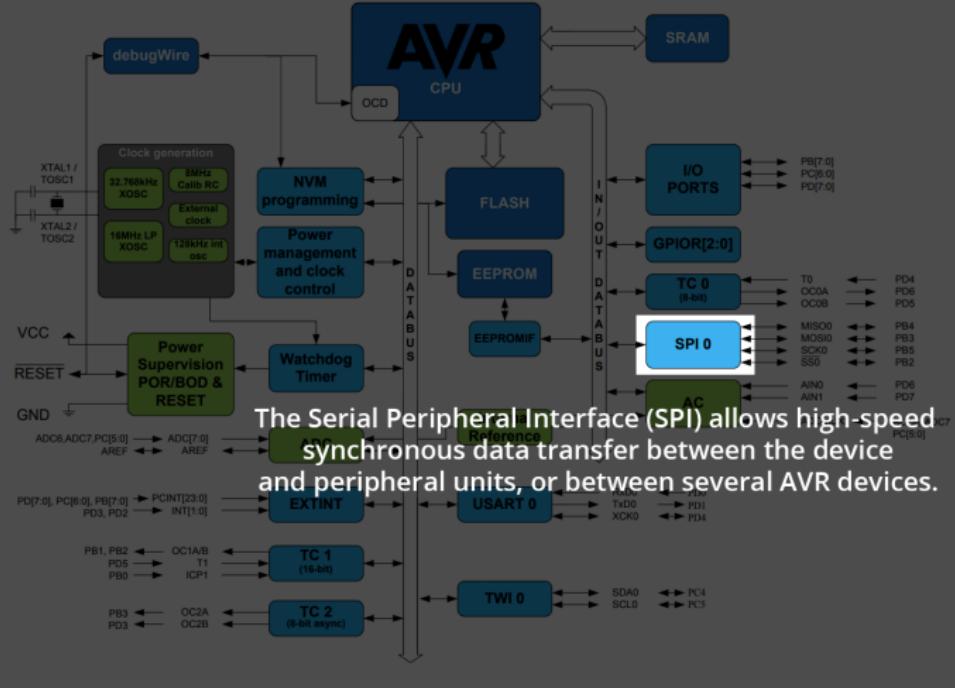
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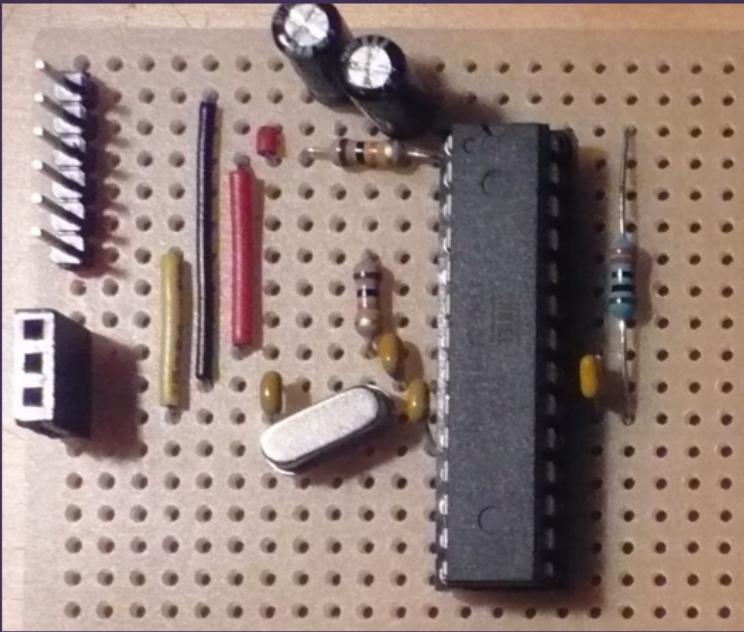
The Serial Peripheral Interface (SPI) allows high-speed synchronous data transfer between the device and peripheral units, or between several AVR devices.

What is an Arduino?

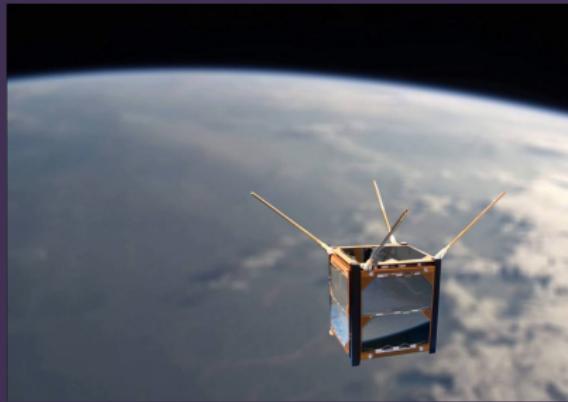


Figure: Rapid Prototyping Board

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

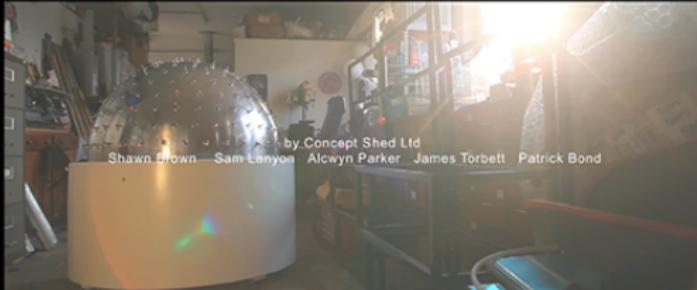


The robotic prototype swimming under water propelled by fins, it was developed at the Control Systems and Robotics Laboratory of the Technological Educational Institute of Crete, in Heraklion (Greece) and it's controlled by an Arduino Mega.

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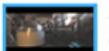
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Sensors & Actuators



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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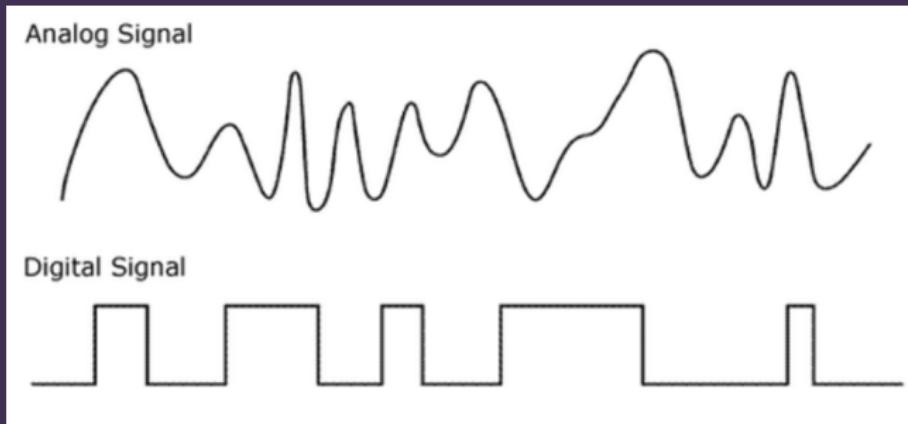
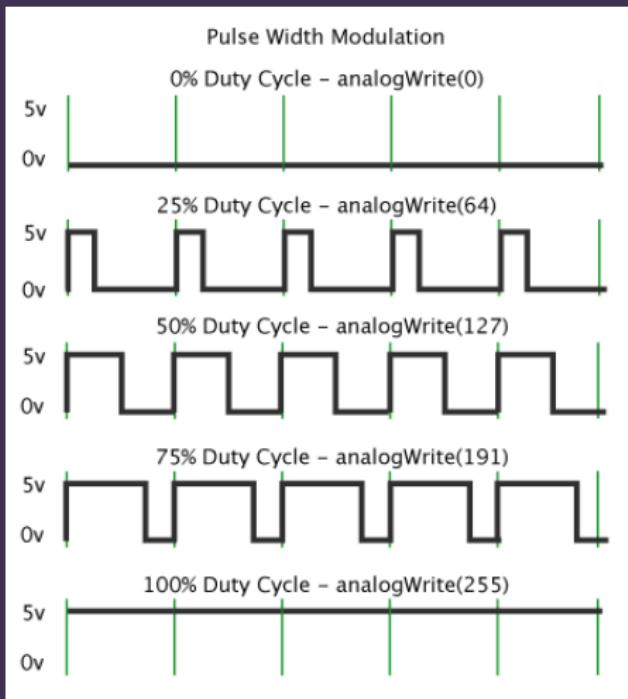


Figure: Arduino can be powered by a DC supply 7-12v

Analogue Out - PWM



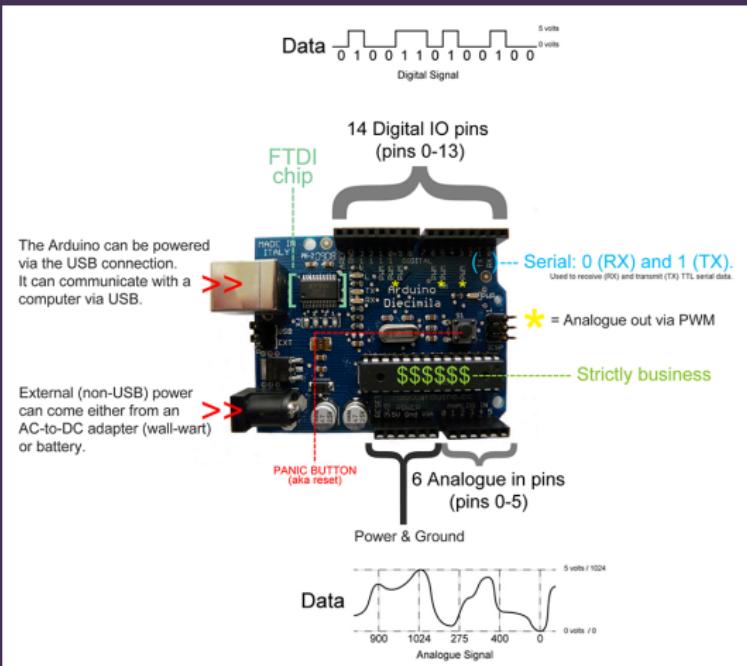
Serial Communication

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



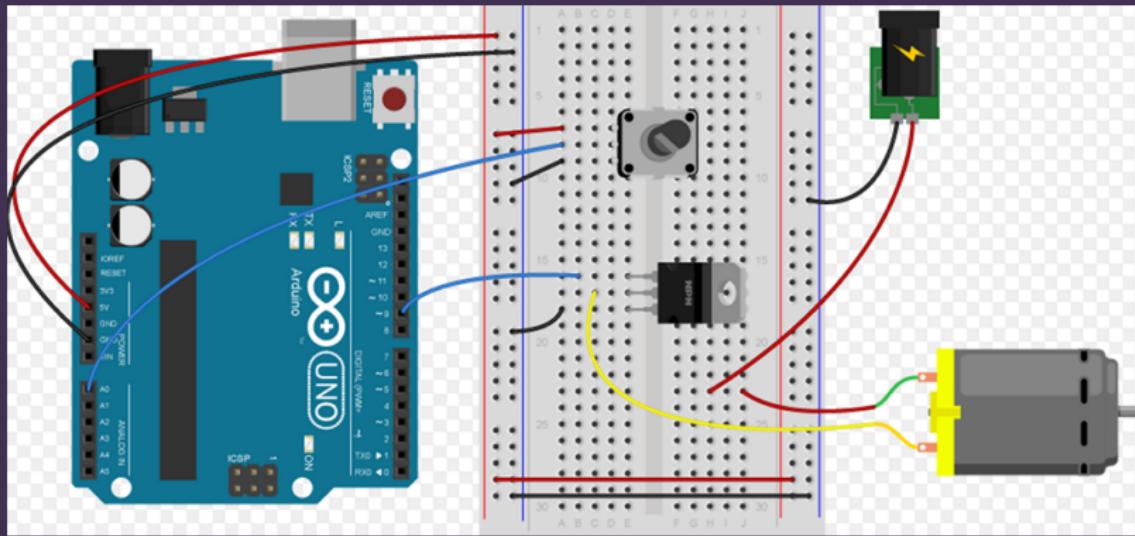
Places to buy components

The screenshot shows the Cool Components website. At the top, there's a search bar with the placeholder "Search cool stuff here..." and a magnifying glass icon. Below the search bar, there are links for "Contact Us", "Community", "Tutorials", and "Cart" (showing "0 items Total £0.00"). The main navigation menu includes "Home", "Log In", "Categories", "3D Printing", "Prototyping", "Inkjet Edition", "Raspberry Pi", "Photos/Electron", "Education", "Sensors", "Wristwatches", "Books", "Power/Chargers", "Measurable", "Prototyping", "Display/Shows", "GPIPS Cellular", "GPS Cellular", "Cables/Adapters", "Kits", "RFID", "Tools", "Audio", "RF/Vouchers", "Prototyping", and "Books". A banner for "CRAZYFLIE 2.0" features a quadcopter and the text "Ideal for developers and supports bluetooth LE". Another banner for "PROTO-PIC" shows a breadboard setup. A central call-to-action button says "Access money off deals". The bottom left has a "BBC micro:bit Shop Now" section with a diagram of the micro:bit board and its connection to a computer via USB. The bottom right shows a "Super Value Ultimate 37 in 1 Sensor Modules Kit for Arduino & Micro:bit" with a price of \$25.99.

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

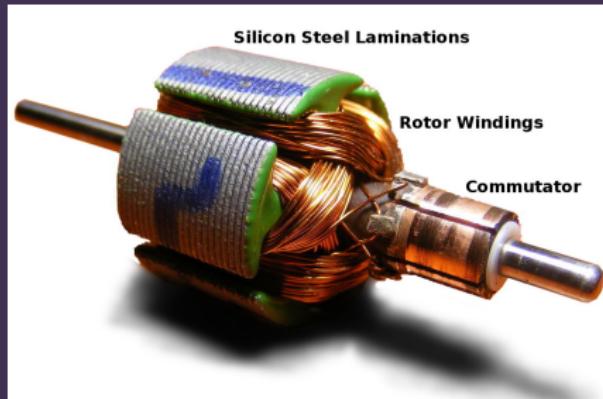
Driving Large Loads

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

