E-FUNDIES

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How to Implement AVR Timer Interrupts in C for Atmel Microcontrollers

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December 01, 2015 (Last Updated: September 13, 2022) | Reading Time: 3 minutes

Timer interrupts are an excellent way of having your AVR do something at a given interval. They can fire off and interrupt what ever else the AVR is doing making for very precise timing. They are one of the best ways to implement custom waveforms for things such as positioning robot servos, dimming LED's, and driving speakers at different frequencies.

Quick Links

E -FUNDIES

STK500 Setup

For this example, make sure that you have your PORTA jumpered to LEDs, as was discussed in our Port Output guide.

The Interrupt Header

In order to use the built in interrupt features in WinAVR you need to include the interrupt header like this:

```
#include <avr/interrupt.h>
```

The ISR keyword

WinAVR uses the keyword **ISR** to denote an **Interrupt Service Routine**. We need to define the **ISR** for **timer1 overflow**. You do it like this:

```
// timer1 overflow
ISR(TIMER1_OVF_vect) {
// process the timer1 overflow here
}
```

Turning on the Timer Interrupt

In order for the interrupt to fire, you must enable it in the **TIMSK** register. To enable both **timer0** and **timer1** interrupts, use the following code in main:

```
// enable timer overflow interrupt for both Timer0 and Timer1
TIMSK=(1<<TOIE0) | (1<<TOIE1);
```

Setup Your Timer

Once you have your **ISR** defined, and you have enabled the interrupt in **TIMSK**, you can setup your timer however you want. When the timer rolls over, the interrupt will be fired. Here is an example of setting up **timer0** to count from 0 to 255, with a divide by 1024 prescaler. This will make the **timer0** interrupt fire 30.63 times every second with a frequency of 8.0MHz (8,000,000 / 255 / 1024 = 30.63).

```
// set timer0 counter initial value to 0
TCNT0=0x00;
// start timer0 with /1024 prescaler
TCCR0 = (1<<CS02) | (1<<CS00);
```

Enable Interrupts

This step is easy, simply call **sei ();** to turn on the global **interrupt enable** flag.

AVR Timer Interrupts Example

Here is a simple example that turns on both **timer0** and **timer1**. It accomplishes the following:

- Sets up **timer0** in divide by 1024 mode, counting from 0 to 255
- Sets up **timer1** in divide by 1024 mode, counting from 0 to 65,535
- On **timer0** interrupt, toggles **PORTA bit 0**.
- On **timer1** interrupt, toggles **PORTA bit 1**.

You will see **PORTA bit 0** blinking on and off 15 times / second, and **PORTA bit 1** blinking on and off every 8.3 seconds.

```
// ***************************************************************************
// Includes
// ***************************************************************************
#include <avr/io.h>
#include
#include <avr/interrupt.h>

// ***************************************************************************
// Interrupt Routines
// ***************************************************************************
// timer1 overflow
ISR(TIMER1_OVF_vect) {
        // XOR PORTA with 0x02 to toggle the LSB
        PORTA=PORTA ^ 0x02;
}

// timer0 overflow
ISR(TIMER0_OVF_vect) {
        // XOR PORTA with 0x01 to toggle the second bit up
        PORTA=PORTA ^ 0x01;
}

// ***************************************************************************
// Main
// ***************************************************************************
int main( void ) {
        // Configure PORTA as output
        DDRA = 0xFF;
        PORTA = 0xFF;
        // enable timer overflow interrupt for both Timer0 and Timer1
        TIMSK=(1<<TOIE0) | (1<<TOIE1);
        // set timer0 counter initial value to 0
        TCNT0=0x00;
        // start timer0 with /1024 prescaler
        TCCR0 = (1<<CS02) | (1<<CS00);
```

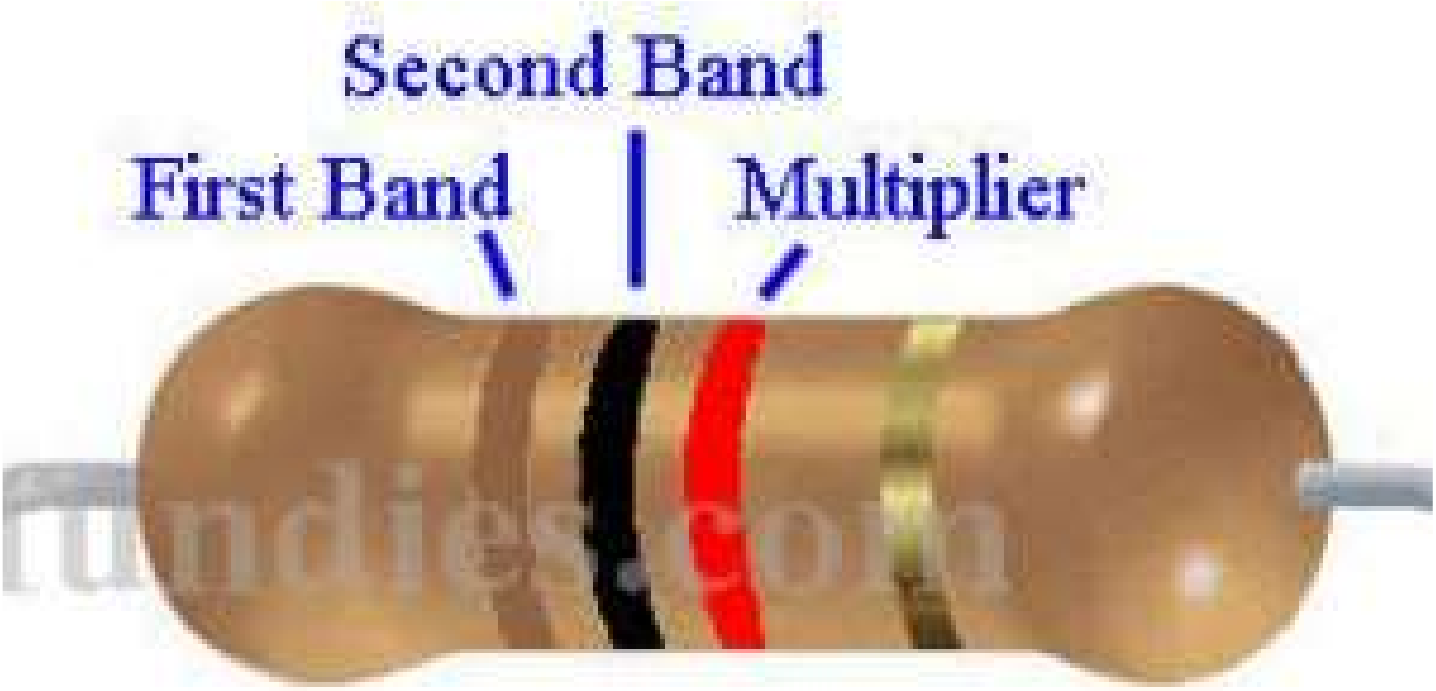
```
        // let's turn on 16 bit timer1 also with /1024
        TCCR1B |= (1 << CS10) | (1 << CS12);
        // enable interrupts
        sei();
        while(true) {
        }
}
```

You can download the complete source code here. This program compiles down to 246 bytes for us.

Next Up, A More Complicated Example

If you want to see some more timer interrupt examples, then check out our More Complex Timer Interrupt Functions guide. Or head back to our index of AVR Guides here.

More from Efundies



How to Select the Right Resistor for Your Circuit: A Fundamentals Guide

The most important component to understand in electronics is the resistor.

More Info

Electricity

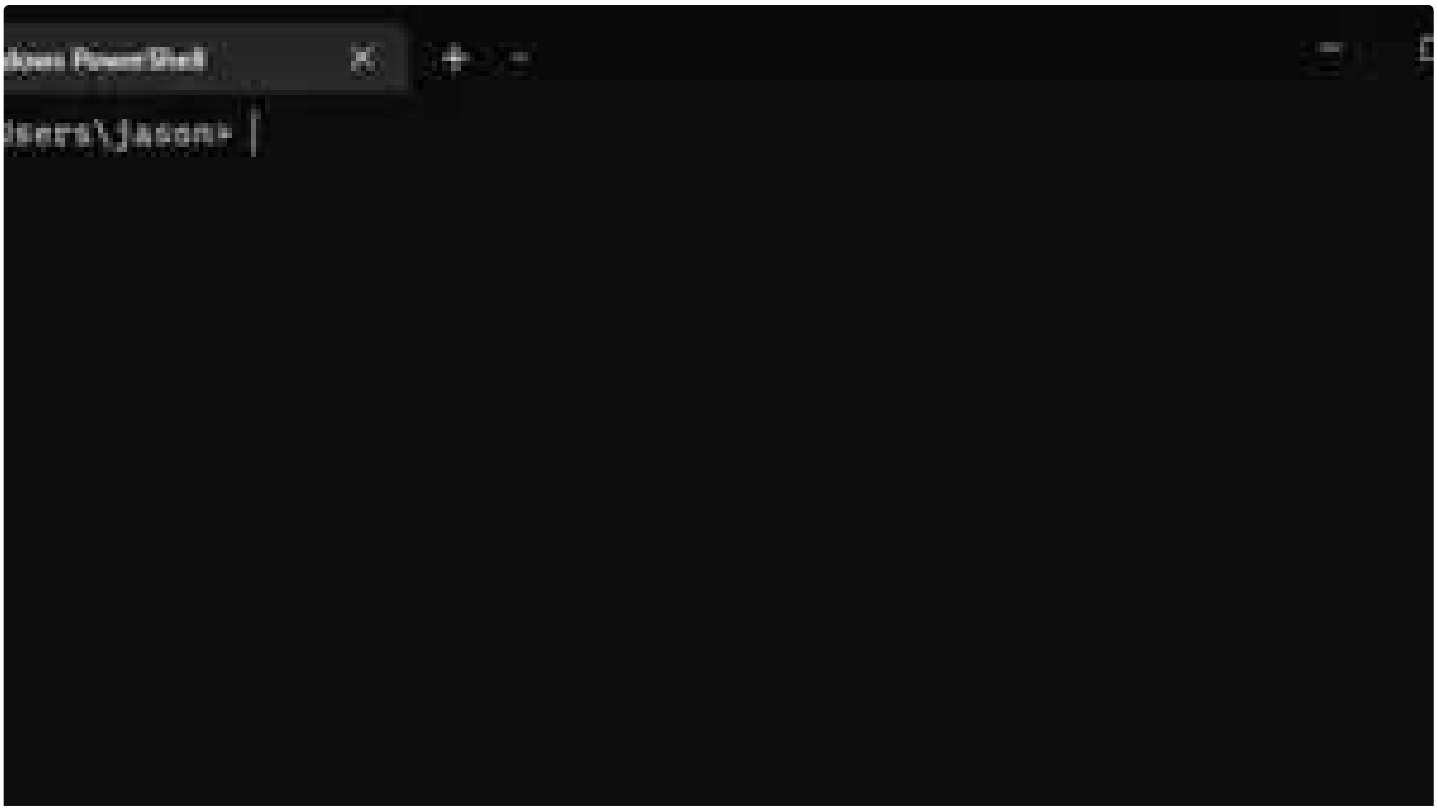
Follow our electricity guides to learn how to read your power meter, save energy, and measure the power usage of various devices in your home.

More Info

How to Set Up STK500 Jumper Settings for AVR Programming

Make sure that you have the STK500 user guide on hand, you are going to need it.

More Info



Windows Command Prompt vs PowerShell

When it comes to comparing Windows Command Prompt and PowerShell, there are a few key differences.

More Info

Command Line Interface

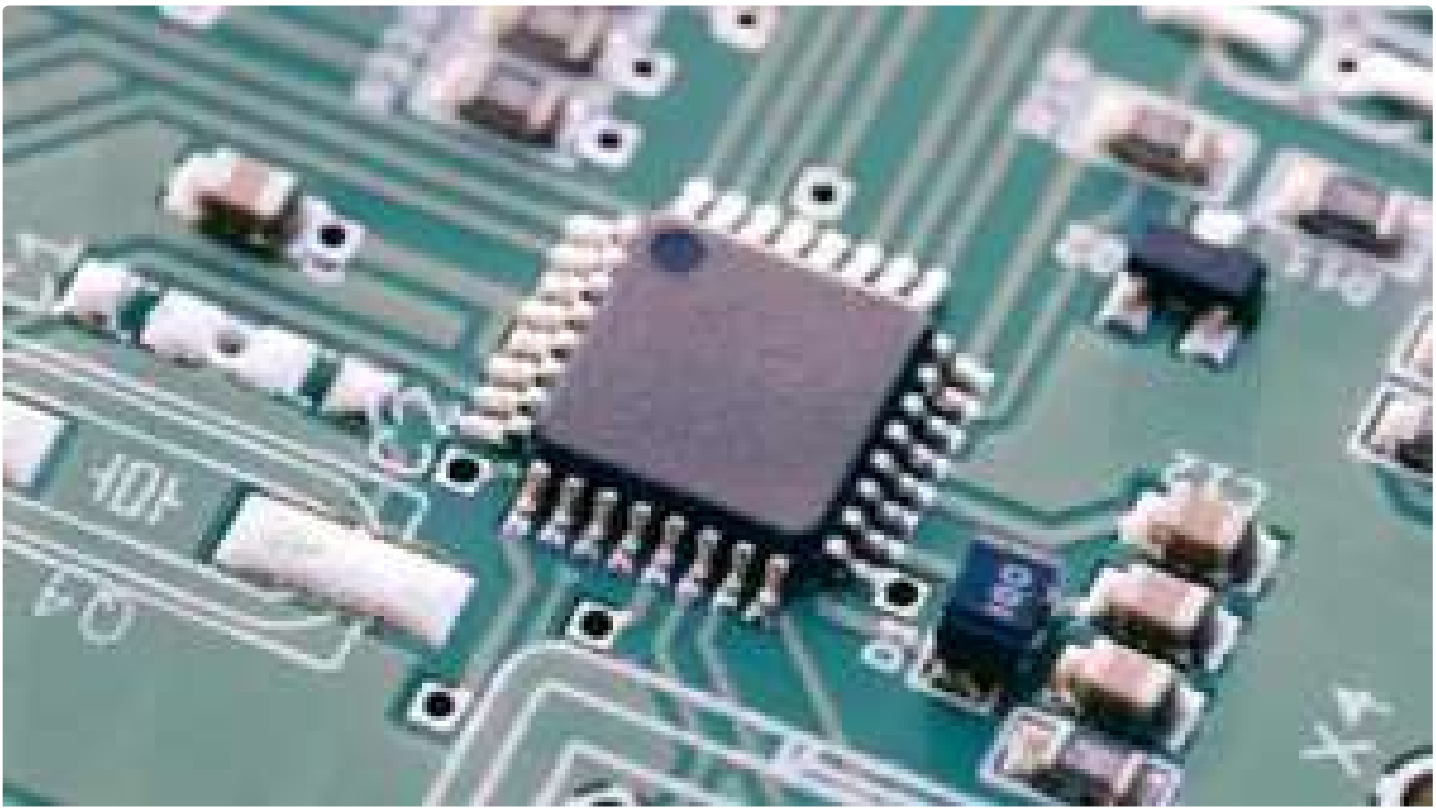
Command line interface (CLI) is a text-based interface that is used to operate computer systems.

More Info

How to Save a PNG File in C#

This guide will walk you through the steps required to save an Image or Bitmap to disc in the PNG format and allow you to specify the compression quality.

More Info



Electronics

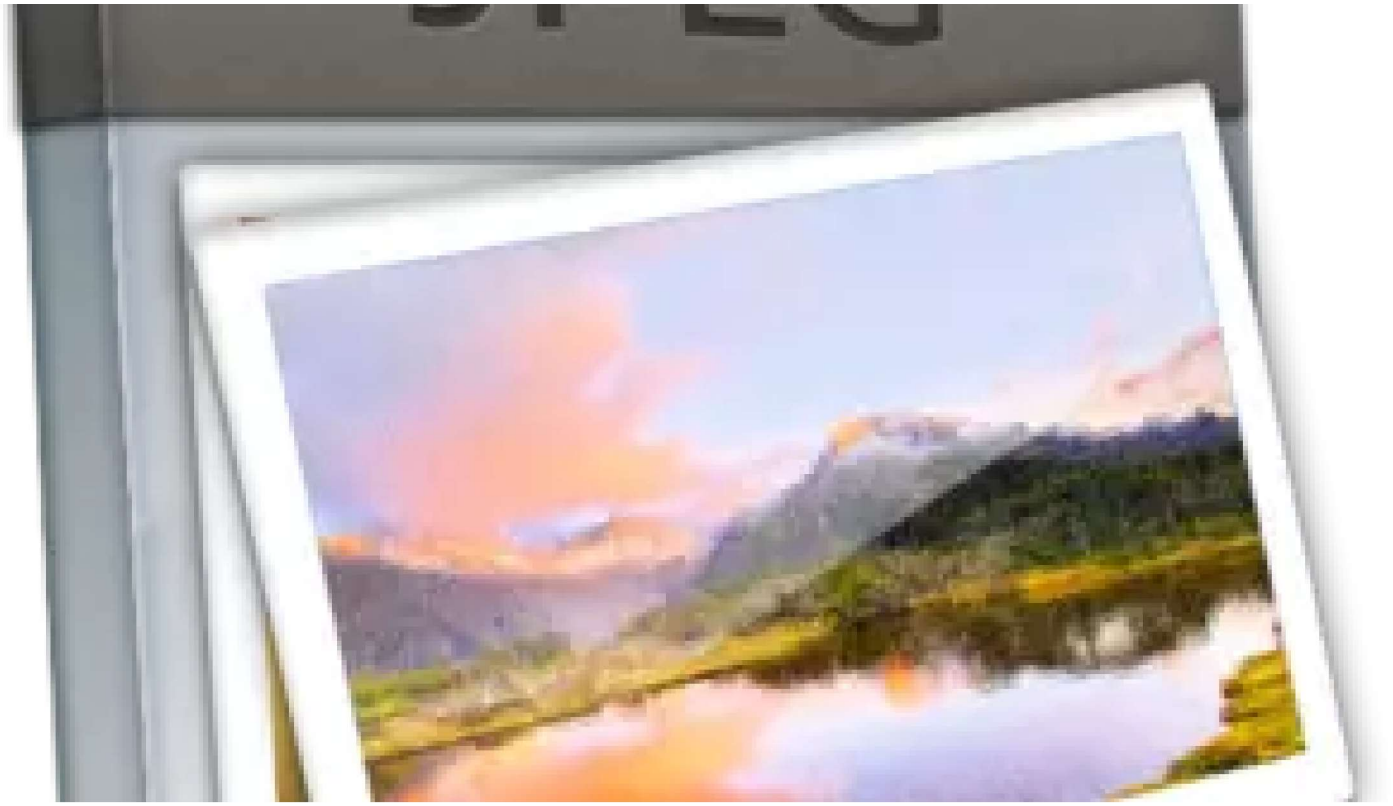
Our collection of electronics articles helps you get started in home automation and circuit building.

More Info

How to Create a WinAVR C Skeleton File

If you are New To C then you can consider this a crash course introduction to the language.

More Info



Load an Image in C#

- Perhaps you want to create an image processing program. - You may need to resize or rescale an image.

More Info

Electronics Fundamentals

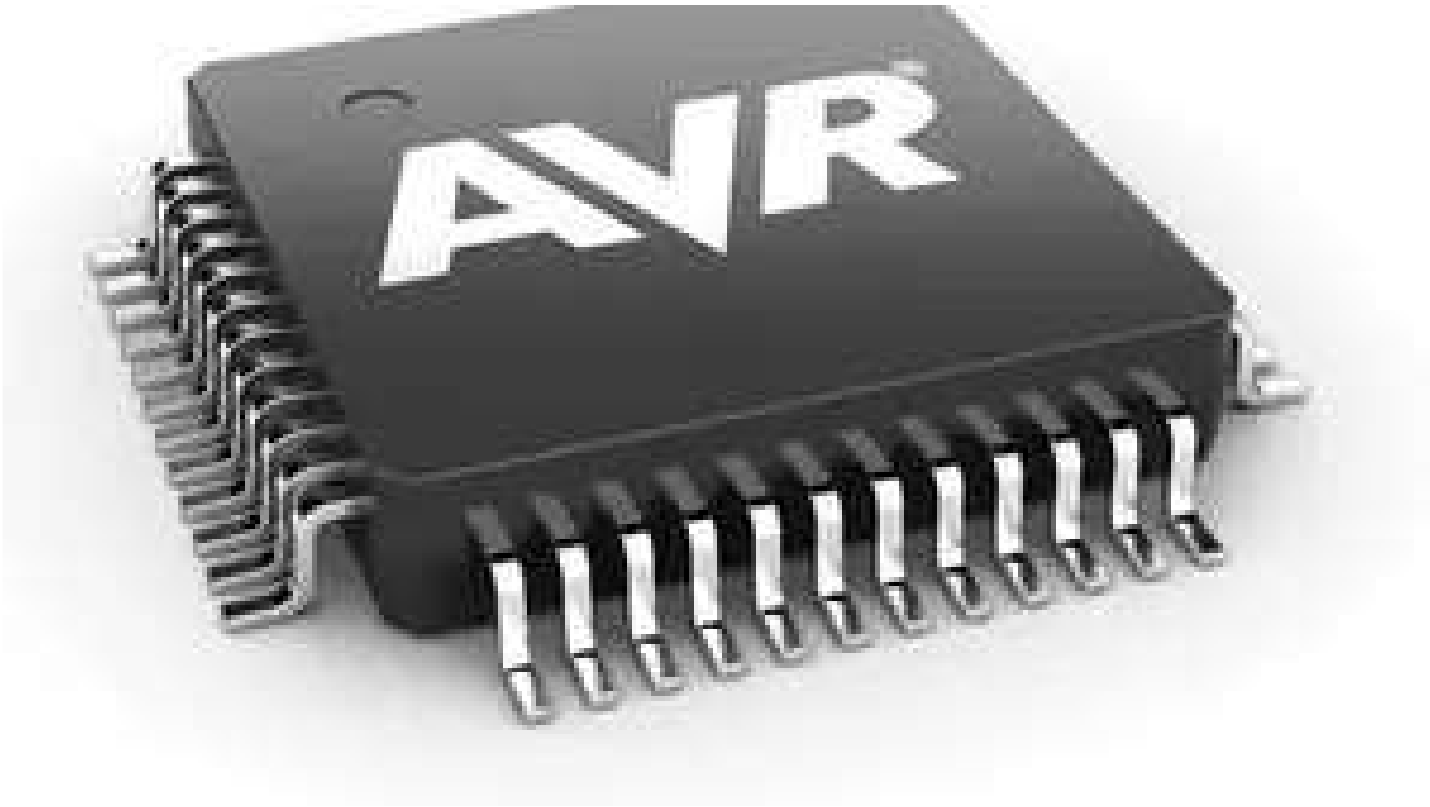
Learn all about resistors, capacitors, and transistors in our collection of Electronics Fundamentals articles.

More Info

AVR Port Input in C

Connect PortB To Switches Remember how we connected **PORTA** to the **LEDS**. Now we are going to connect **PORTB** to the **SWITCHES**.

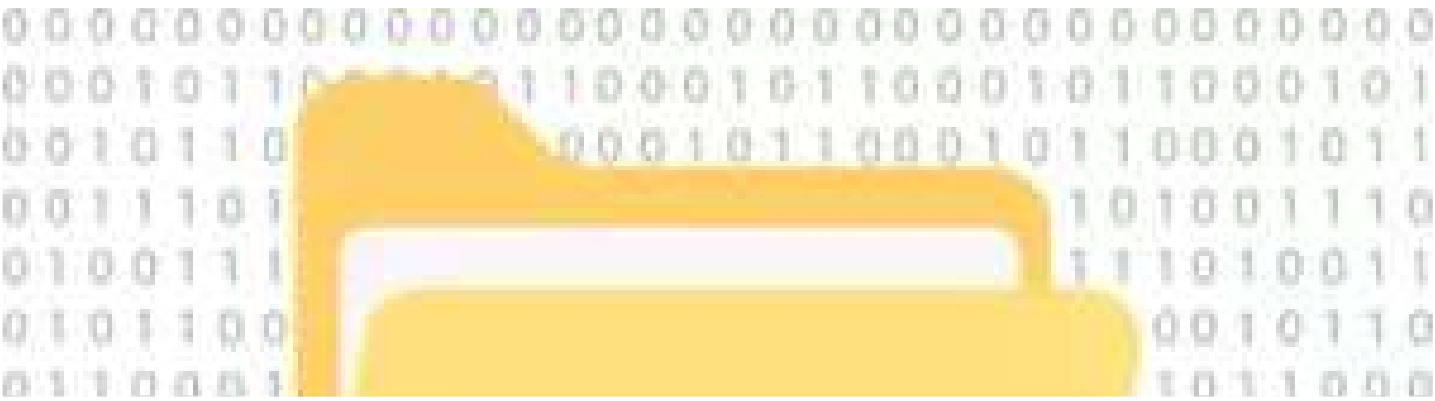
More Info

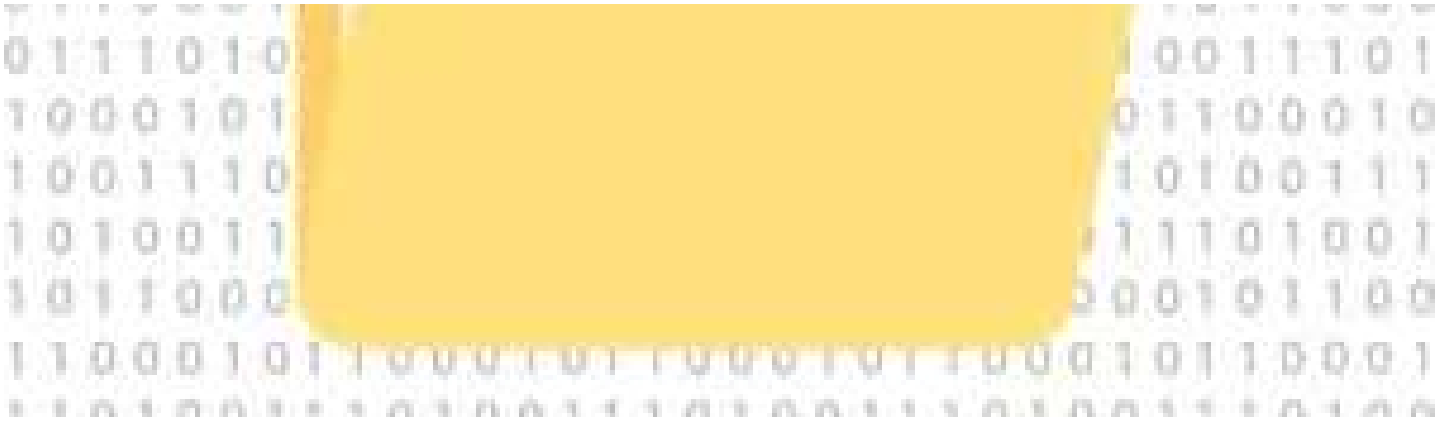


How to Implement AVR Timer Interrupts in C for Atmel Microcontrollers

Timer interrupts are an excellent way of having your AVR do something at a given interval.

More Info

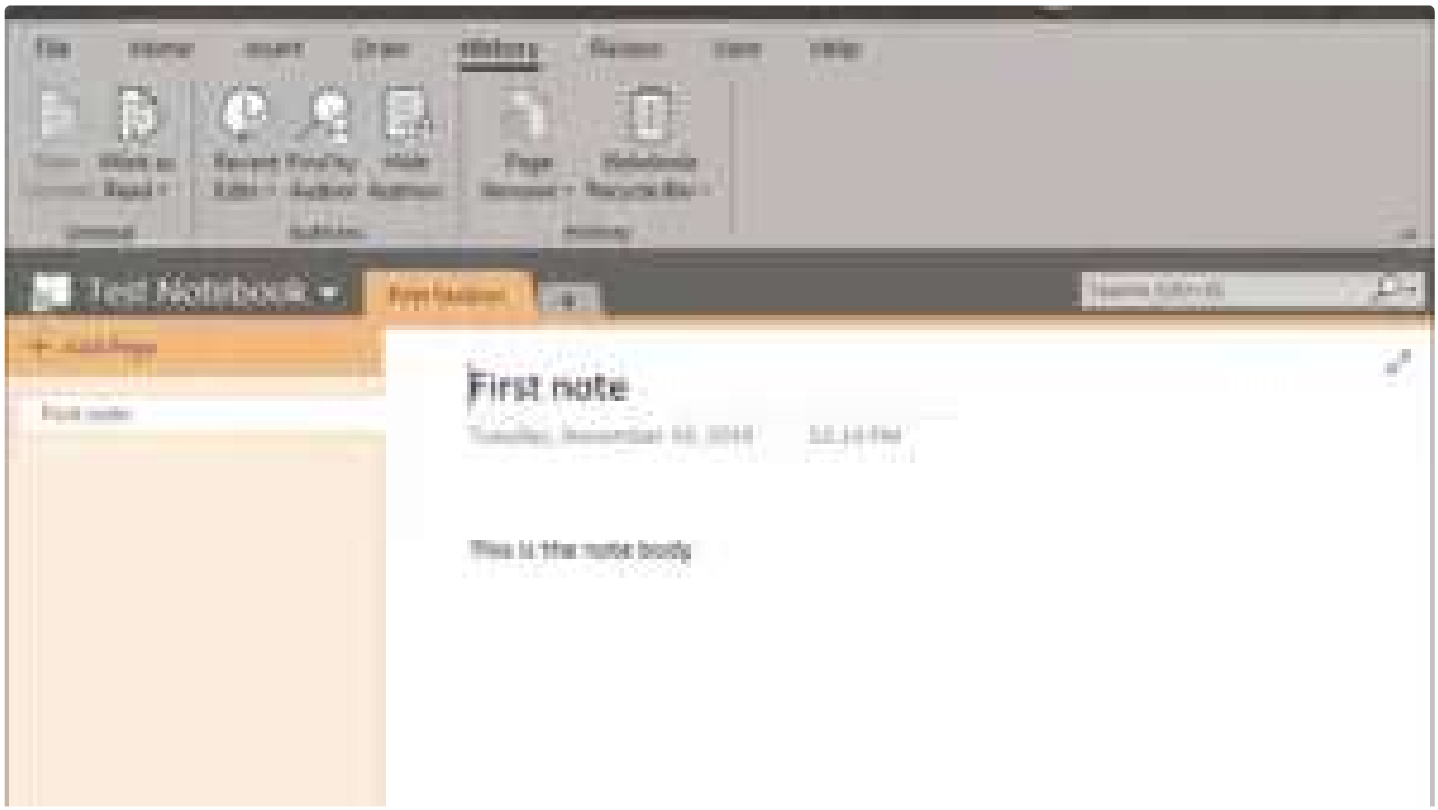




Make a Personal Binary Directory on Your Computer

If you want to keep your computer organized, it's a good idea to create a personal binary directory.

More Info



OneNote Command Line Interface: All You Need to Know

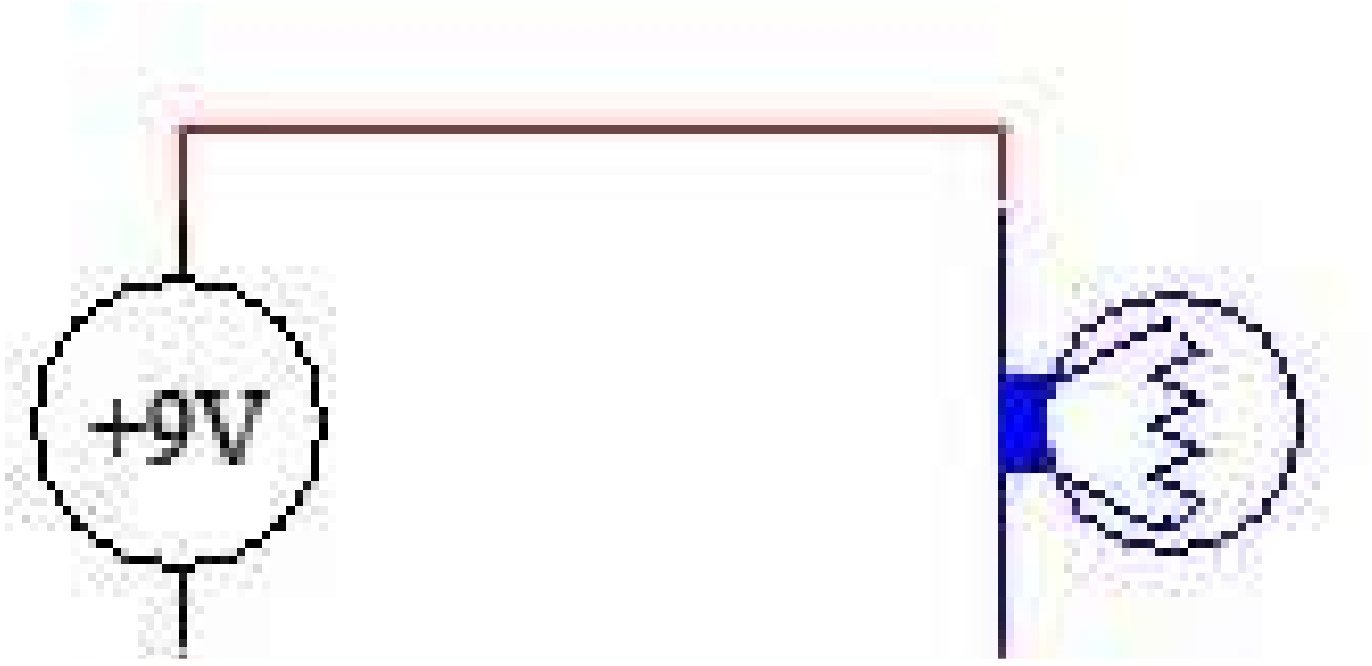
The OneNote Command Line Interface (CLI) is a powerful tool that lets you manage your OneNote notes from the comfort of your command line.

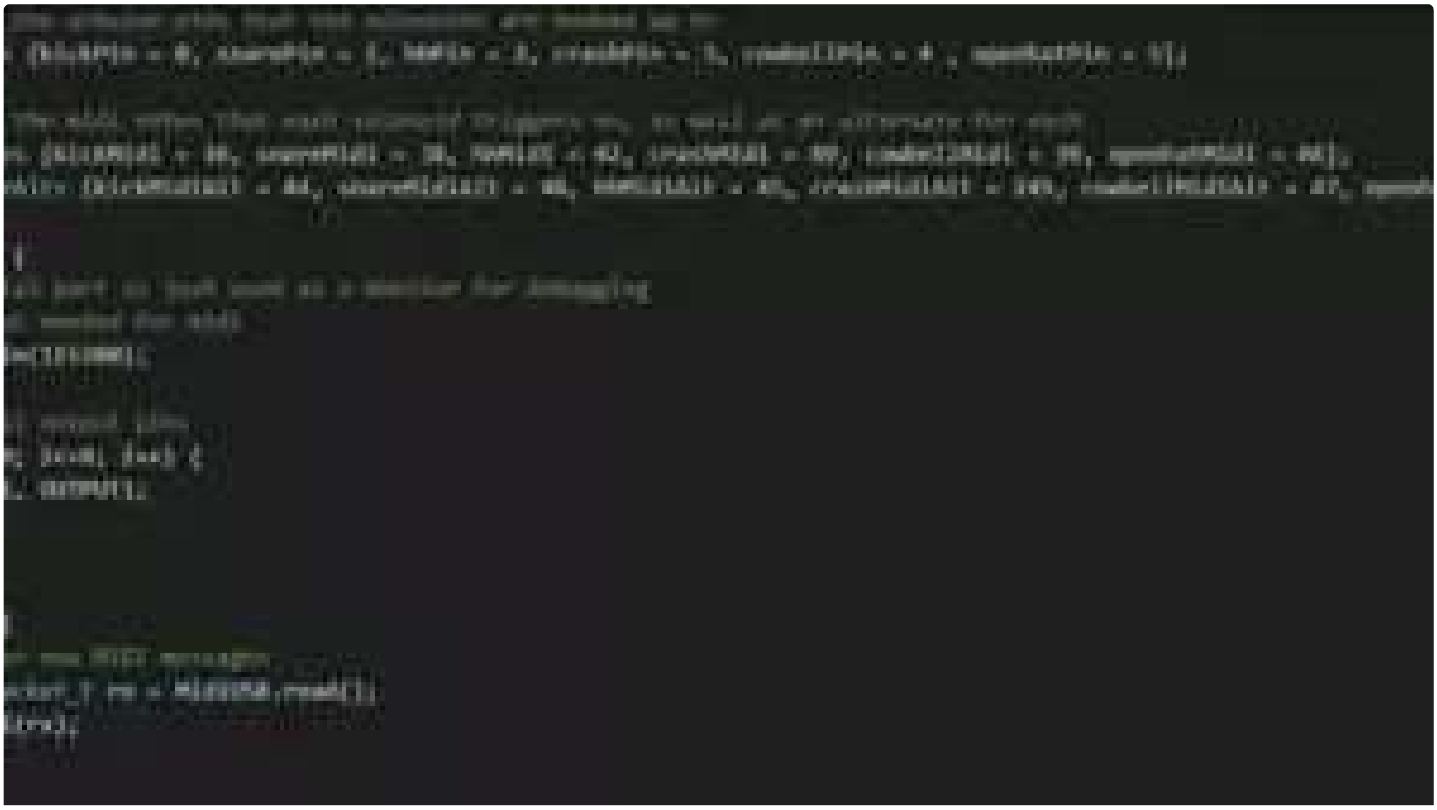
More Info

Programming: Tips and Tricks

A collection of tips, tricks, and snippets of code for a variety of programming languages, including C#, AVR, Arduino, and Perl.

More Info





How To Read Schematics

Those pictures are called a schematic. A schematic is a picture representation of what we are talking about in electronics.

More Info

MIDI Controlled Solenoids with Arduino and Ableton Live - Part 2

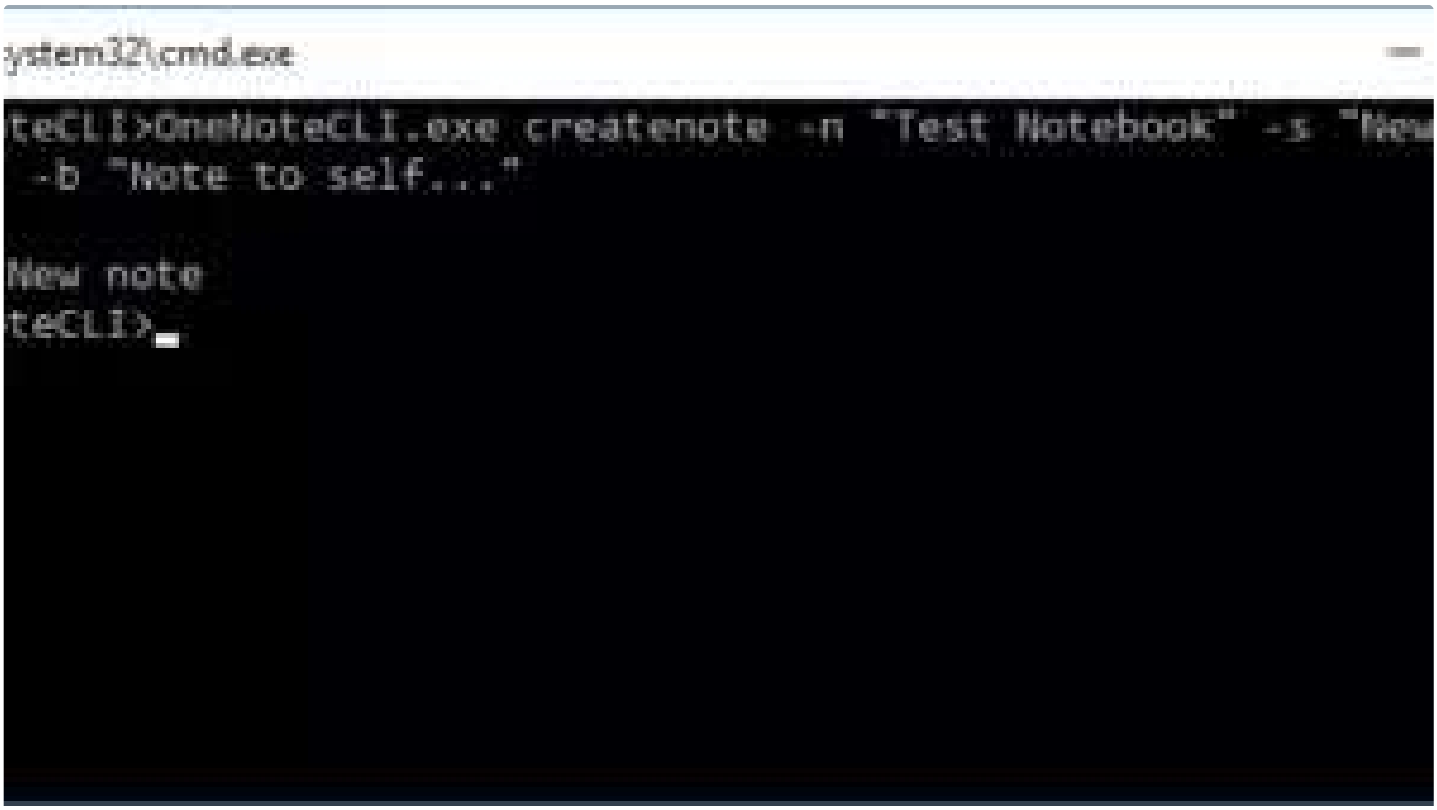
This is part 2 in a 3 part series that shows how to make Ableton Live play music on electric solenoids using an Arduino.

More Info

How to Prototype Electronics Projects

When experimenting with electronics, it is usually best to practice in what is called a Solderless Breadboard.

More Info



How To Quickly Create a OneNote Page from the Command Line

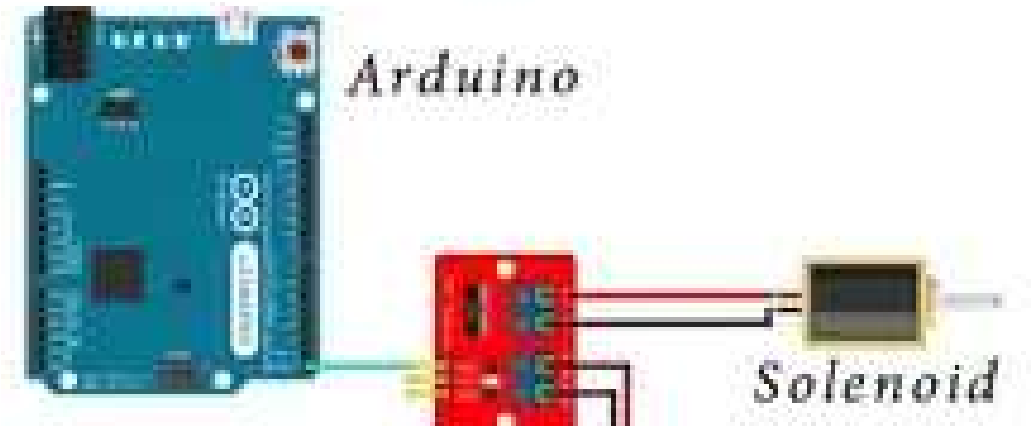
OneNote is a great tool for organizing your thoughts and keeping track of your work, and you can create a OneNote page directly from the command line.

More Info

Image Processing in C#: A Comprehensive Guide

C# is a great language to do image processing in. It's fast and easy to handle complex image manipulations with it.

More Info



MIDI Controlled Solenoids with Arduino and Ableton Live - Part 3

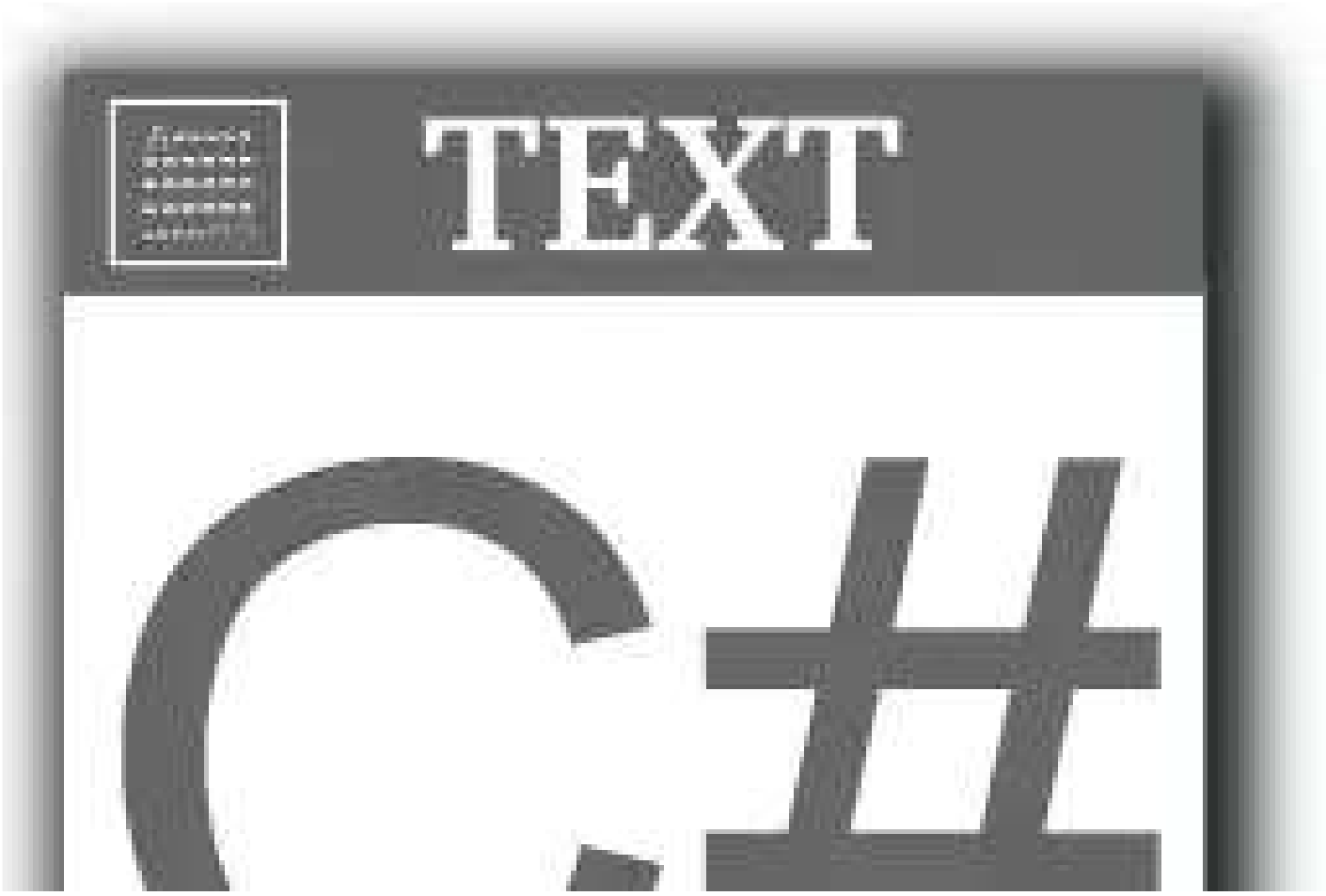
This is the 3rd and final part in a 3 part series about how to control solenoids using Ableton Live and an Arduino.

More Info

NodeMCU

We use NodeMCU boards for almost every aspect of home automation. These inexpensive little power-houses can solve many home automation problems.

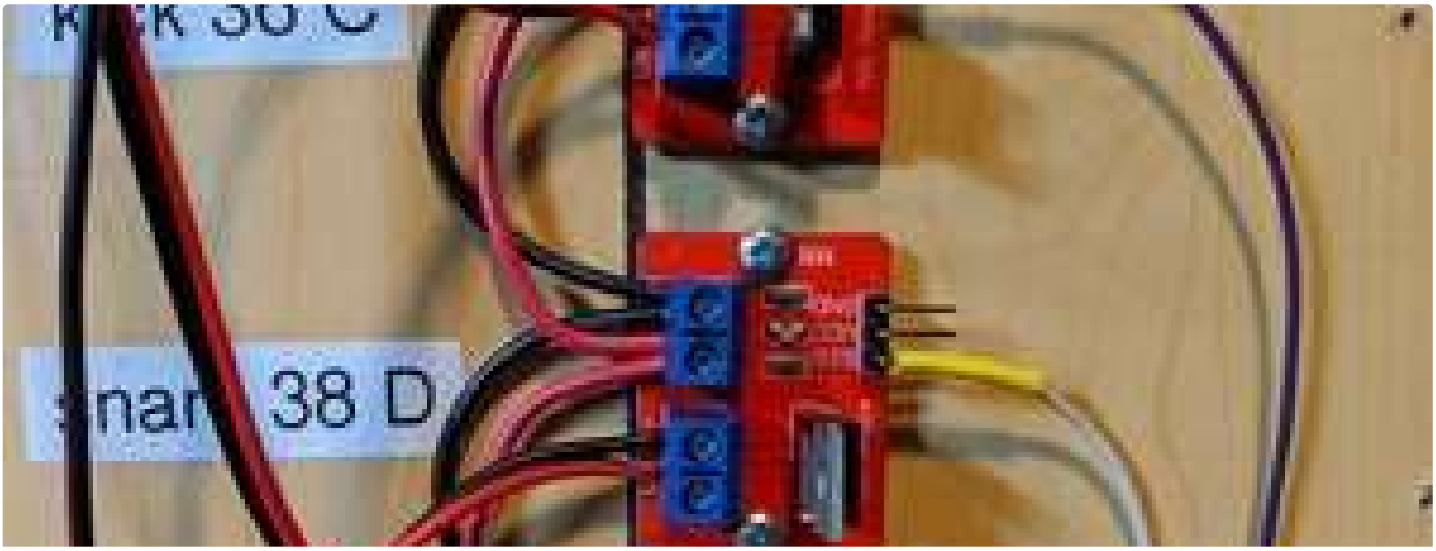
More Info

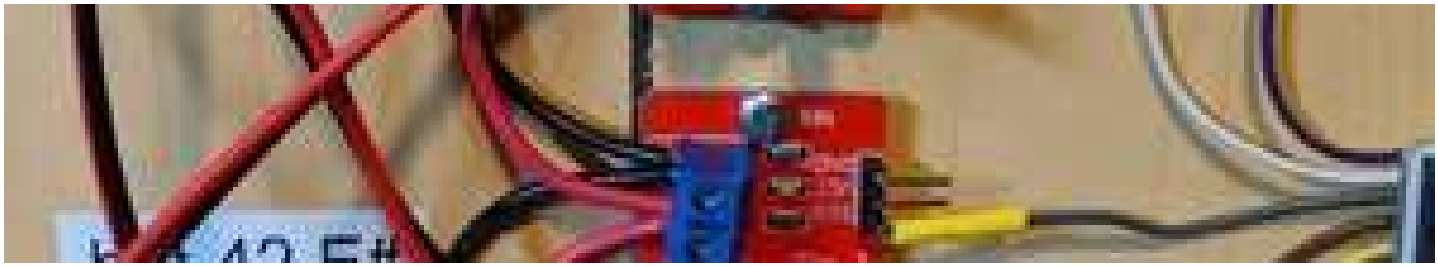


C# Text File

There is a static object called "File" (located in System. IO) that does all the hard work for you.

More Info

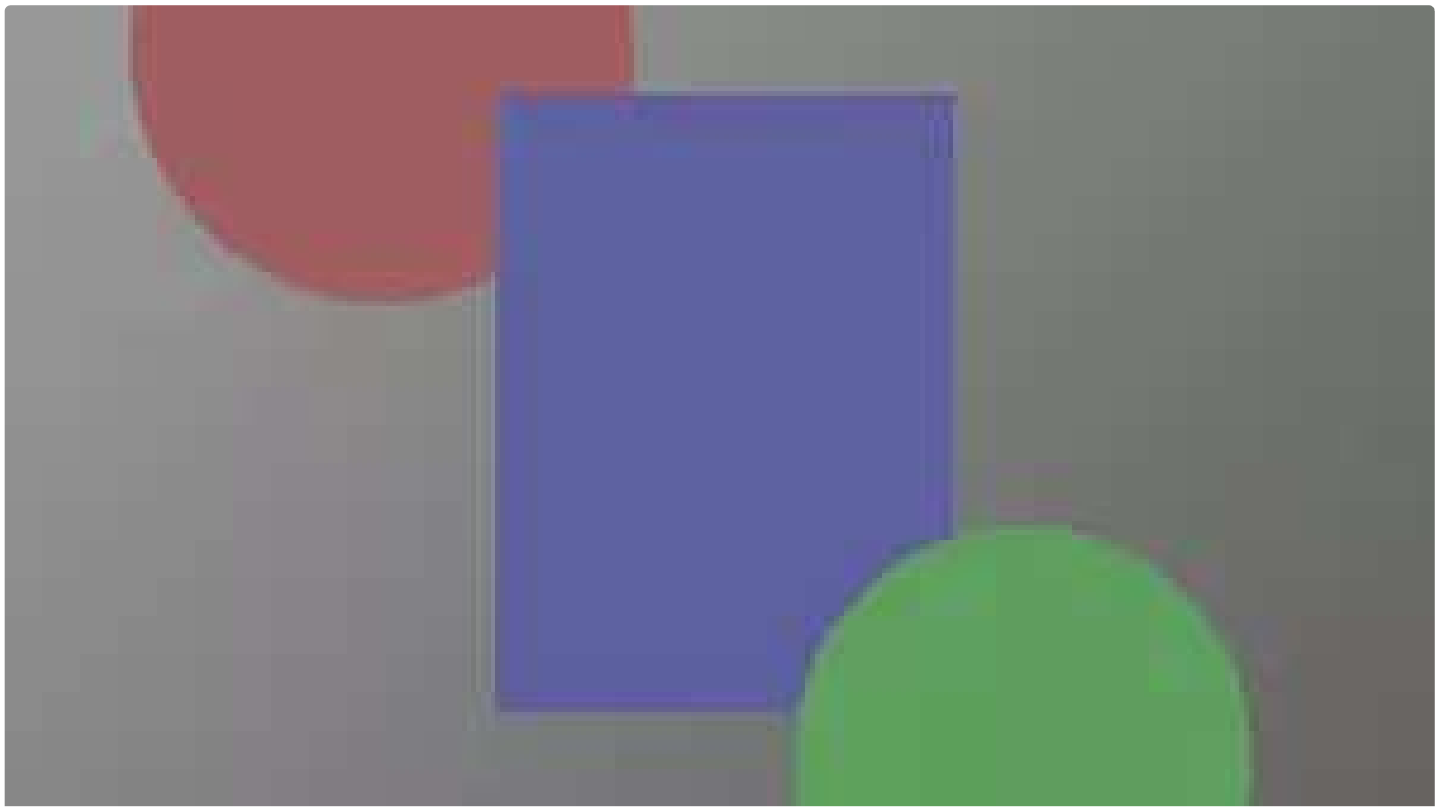




MIDI Controlled Solenoids with Arduino and Ableton Live - Part 1

At the end of the series you will have a setup that is capable doing this. This is a pretty complex topic so it is split into 3 parts to make it easier to follow.

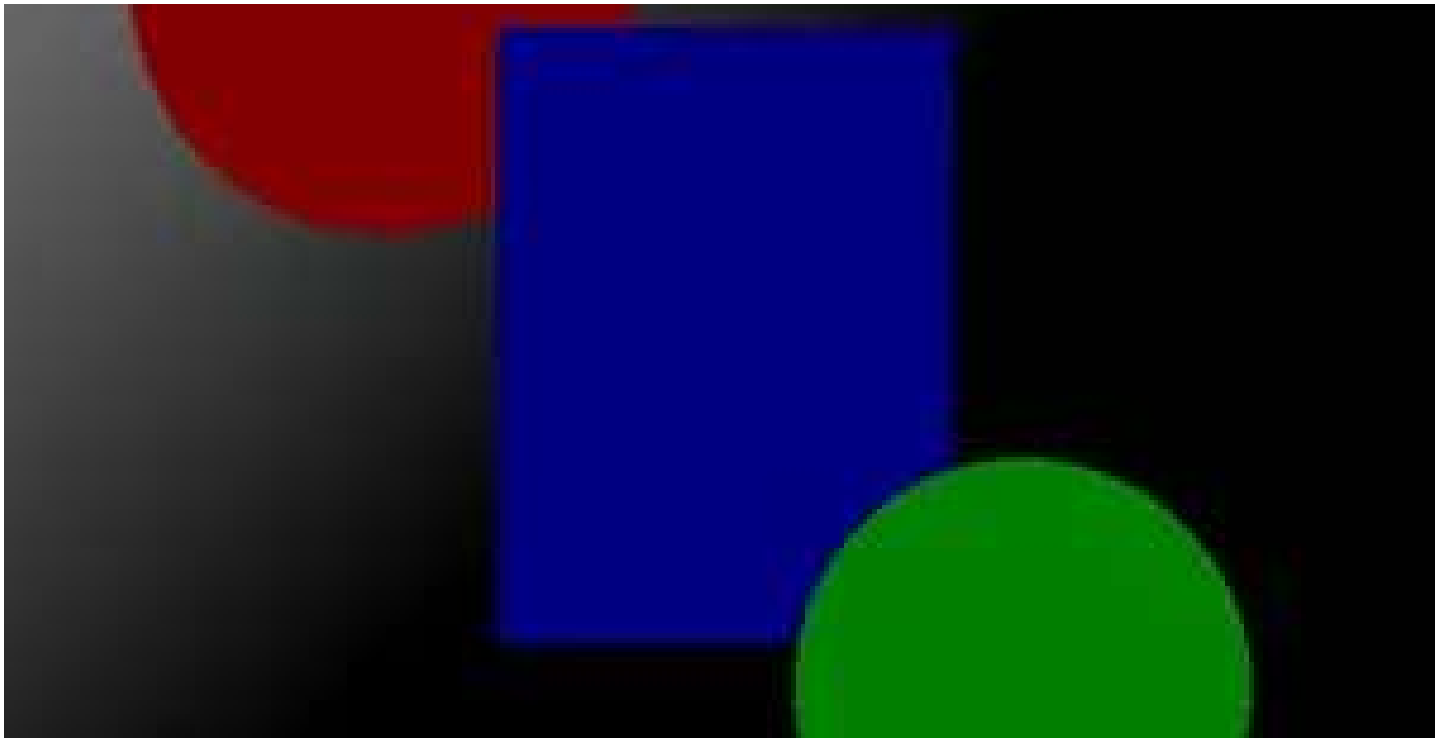
More Info



How to Adjust the Contrast of an Image in C#

Adjusting the contrast of an image in C# is an easy operation because it can be done on a single pixel at a time.

More Info



How to Darken an Image in C#

In order to darken an image in C# you need to look at each pixel one at a time and decrease it's red, green, and blue values.

More Info

Home Automation

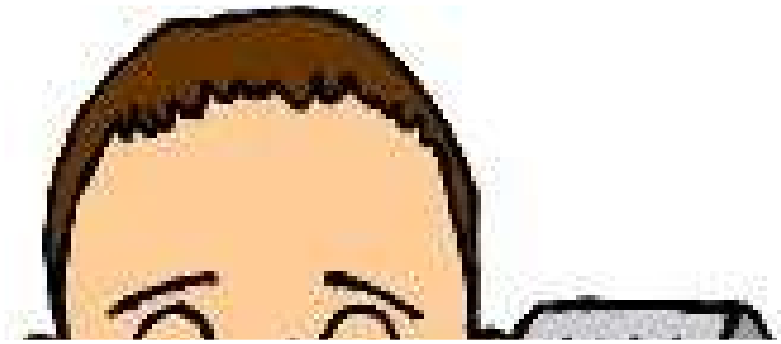
You can use home automation to control almost anything that you can think of. Let's design your system from the ground up.

More Info

How to Move Massive Amounts of Data Safely and Efficiently

If you're dealing with a large amount of data, you need to make sure you're moving it safely and efficiently. Here are some tips on how to do just that.

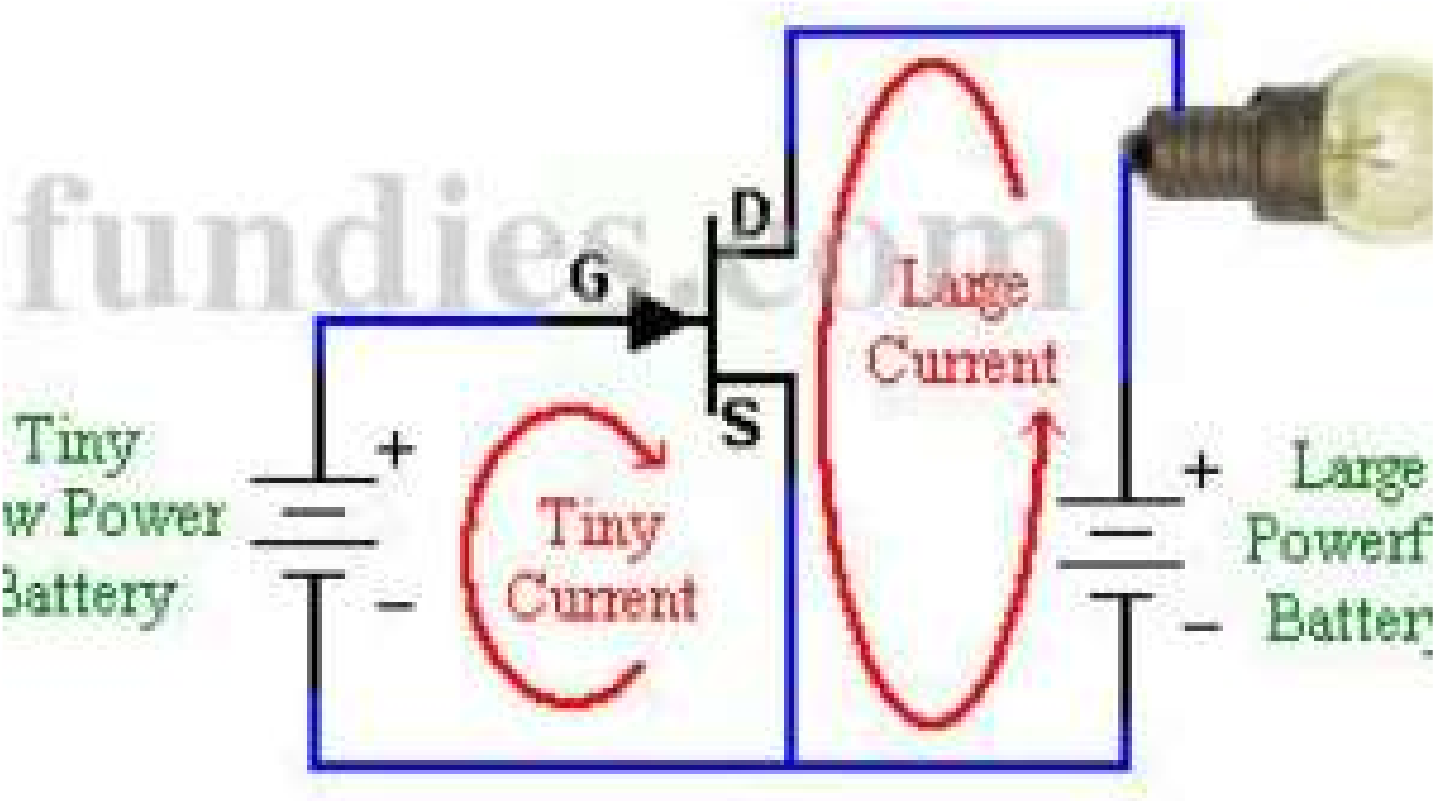
More Info



How to Understand Electronics Signals and Flow for Beginners

Signals and Systems is a common term that is used to refer to system design.

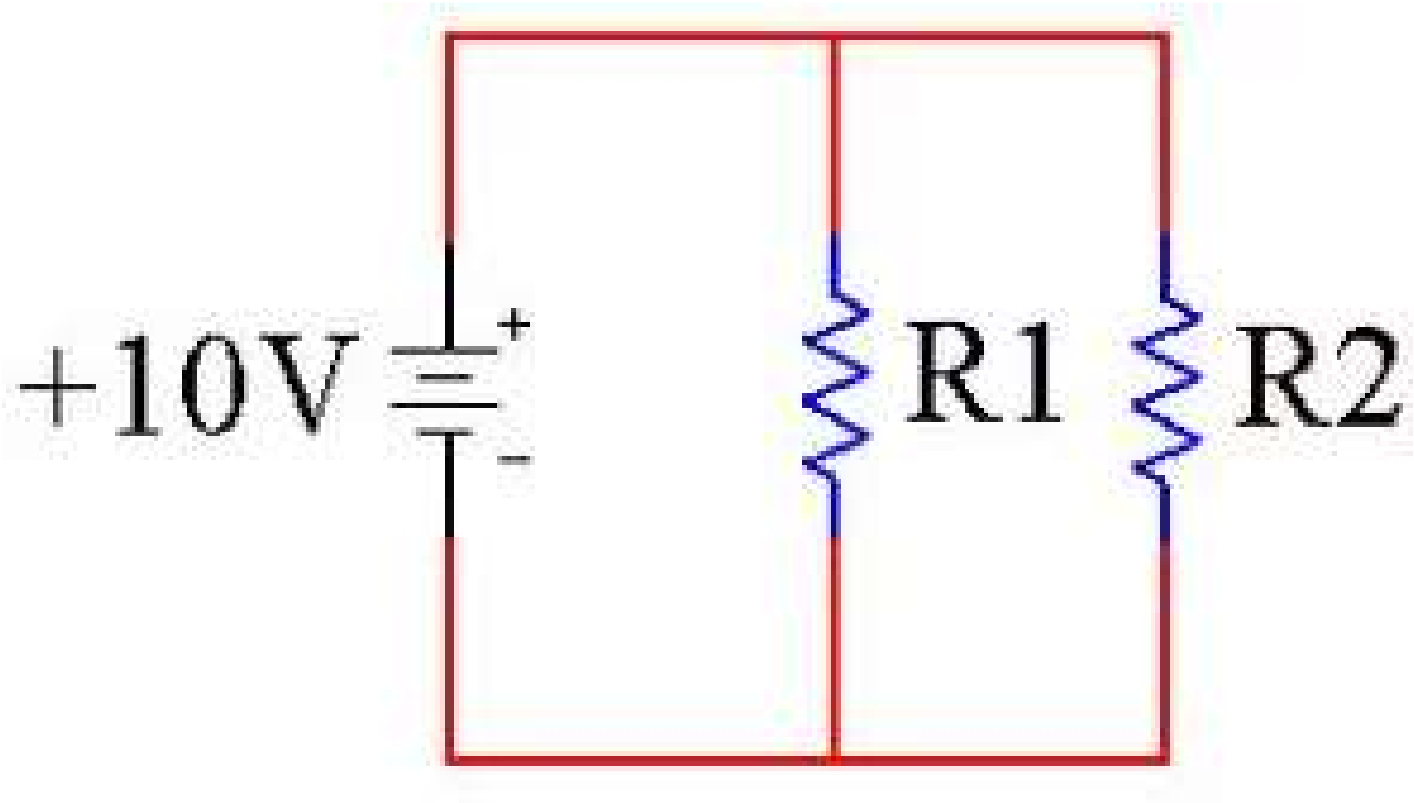
More Info



What are Transistors and How do They Work?

With the transistor we introduce the first 3 legged device. Transistors come in many varieties, shapes and sizes.

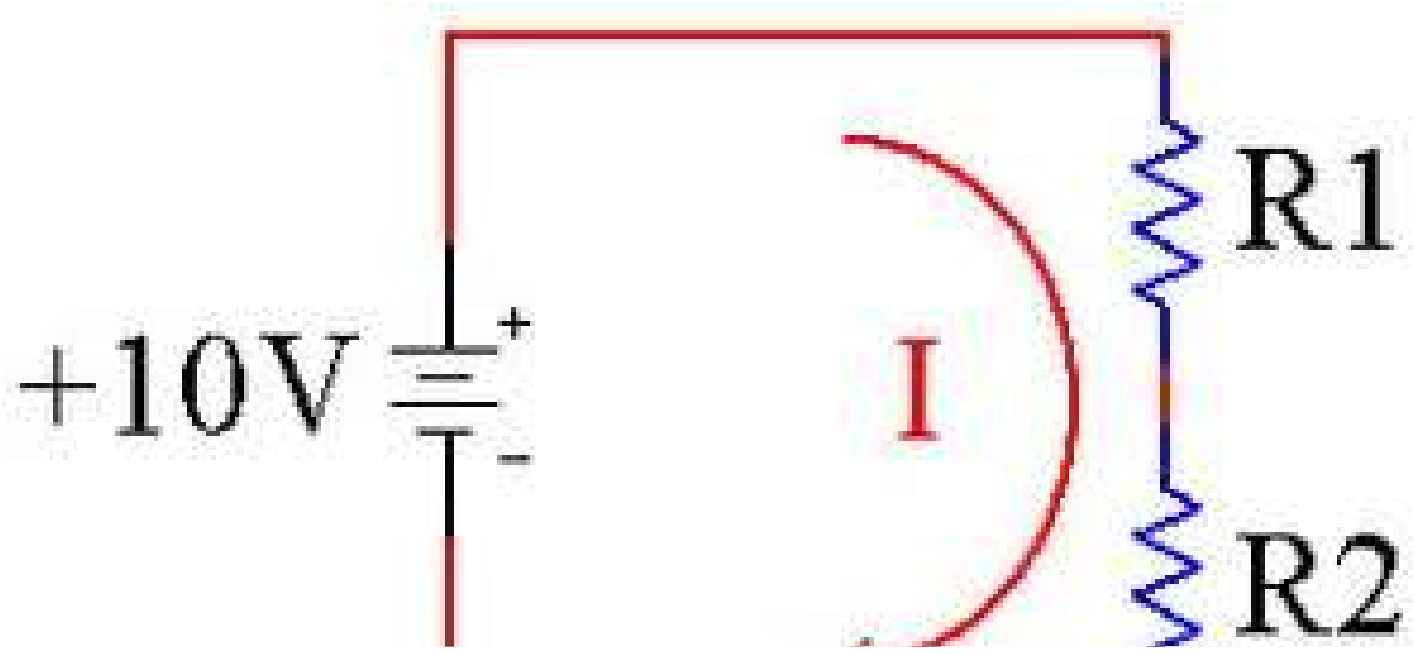
More Info



Resistors in Parallel

Learn how to calculate the equivalent resistance of two resistors when they are wired in parallel.

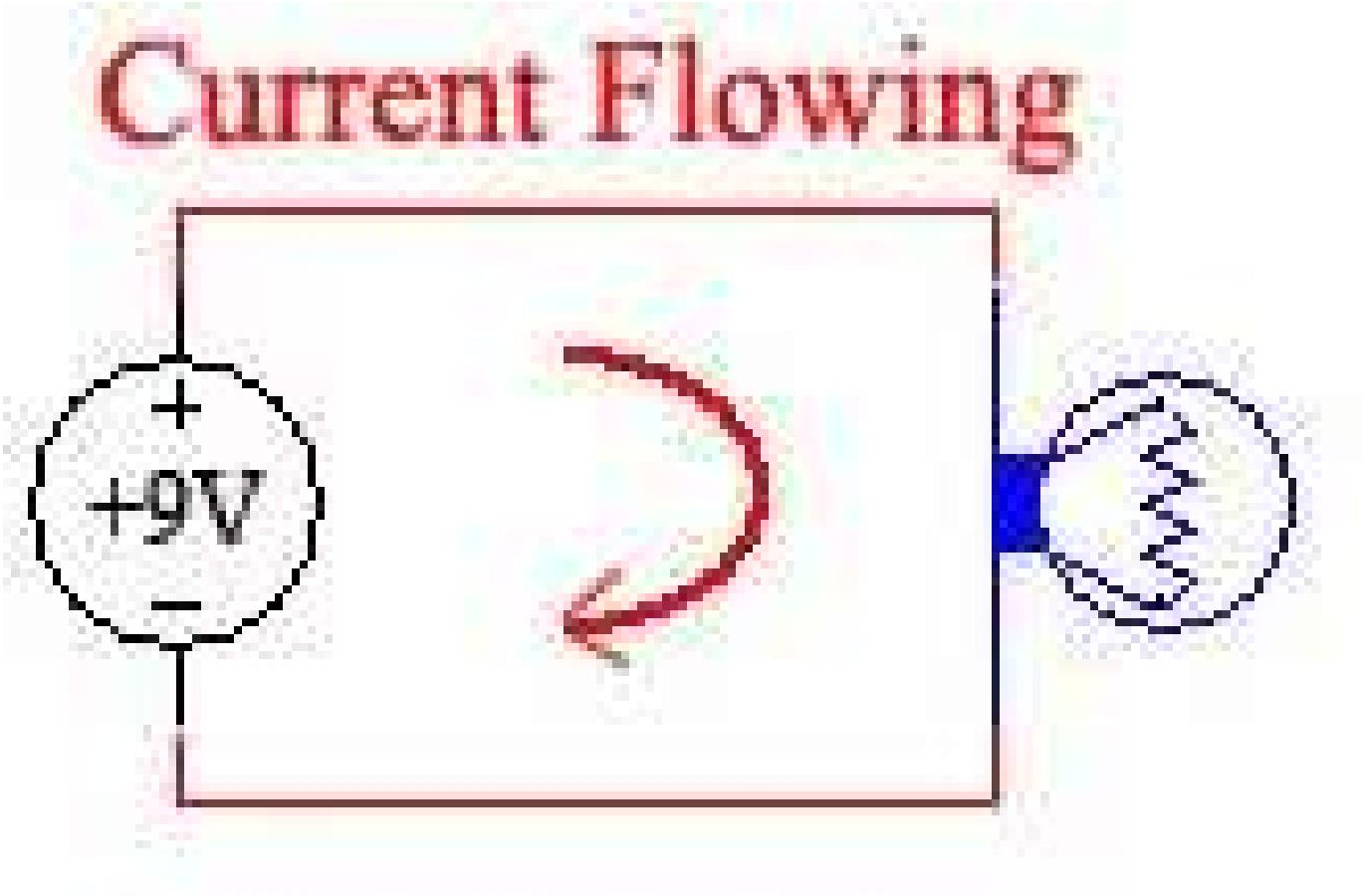
More Info



Resistors in Series

When you wire resistors in series, you can simply add their values together to get the new equivalent reistance.

More Info



Begining Circuit Analysis and Ohms Law

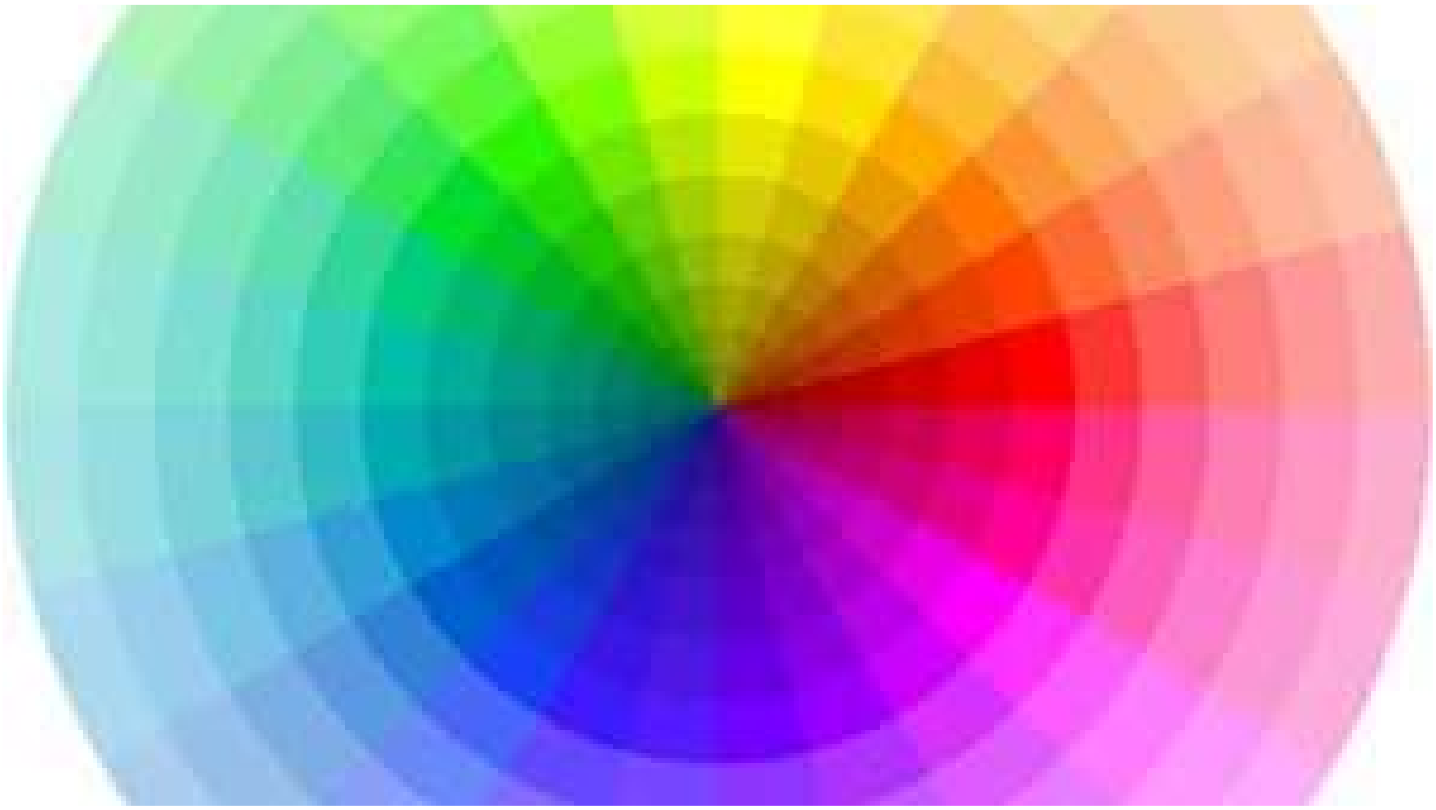
For simple circuits this is pretty easy. For complex circuits it can be amazingly hard, even for pros.

More Info

C#: How to Use HTML Colors in Your Code

The .Net framework has a great object for dealing with colors called Color that we use to deal with HTML color codes.

More Info



C# Color Object

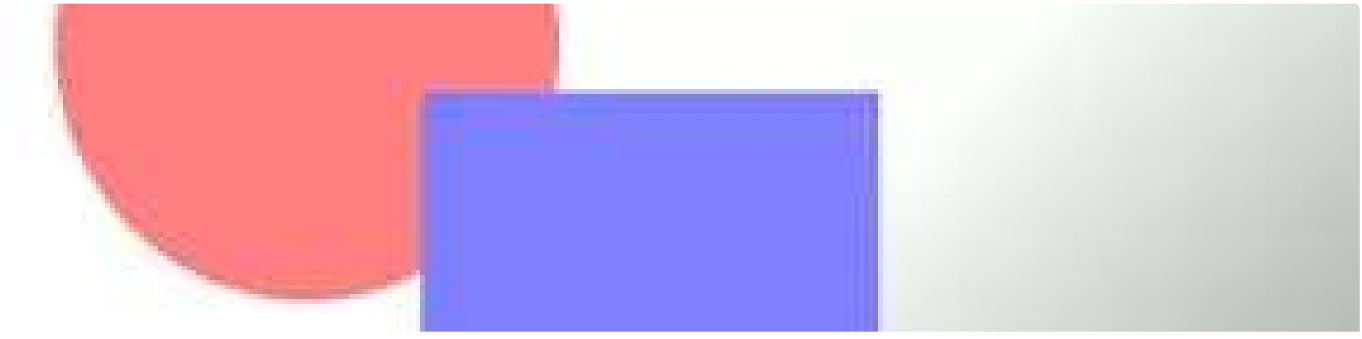
Once you have a Color object you can easily get the RGB and HSB values out of it.

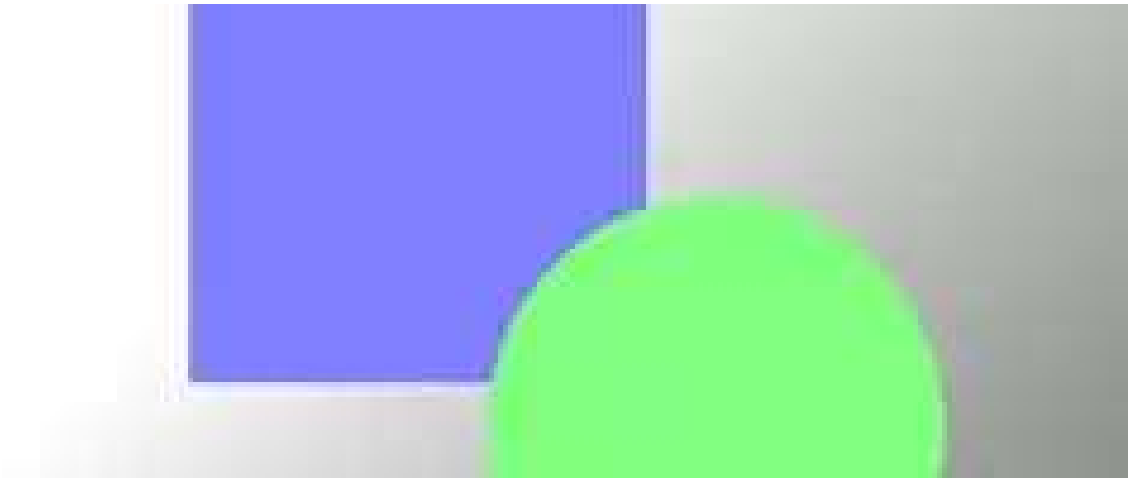
More Info

How to Read a Schematic - Common Schematic Symbols

There are about 10 that you should memorize, and the rest you can look up. Here we will show you some common schematic symbols and give a brief description of them.

More Info





How to Lighten an Image in C#

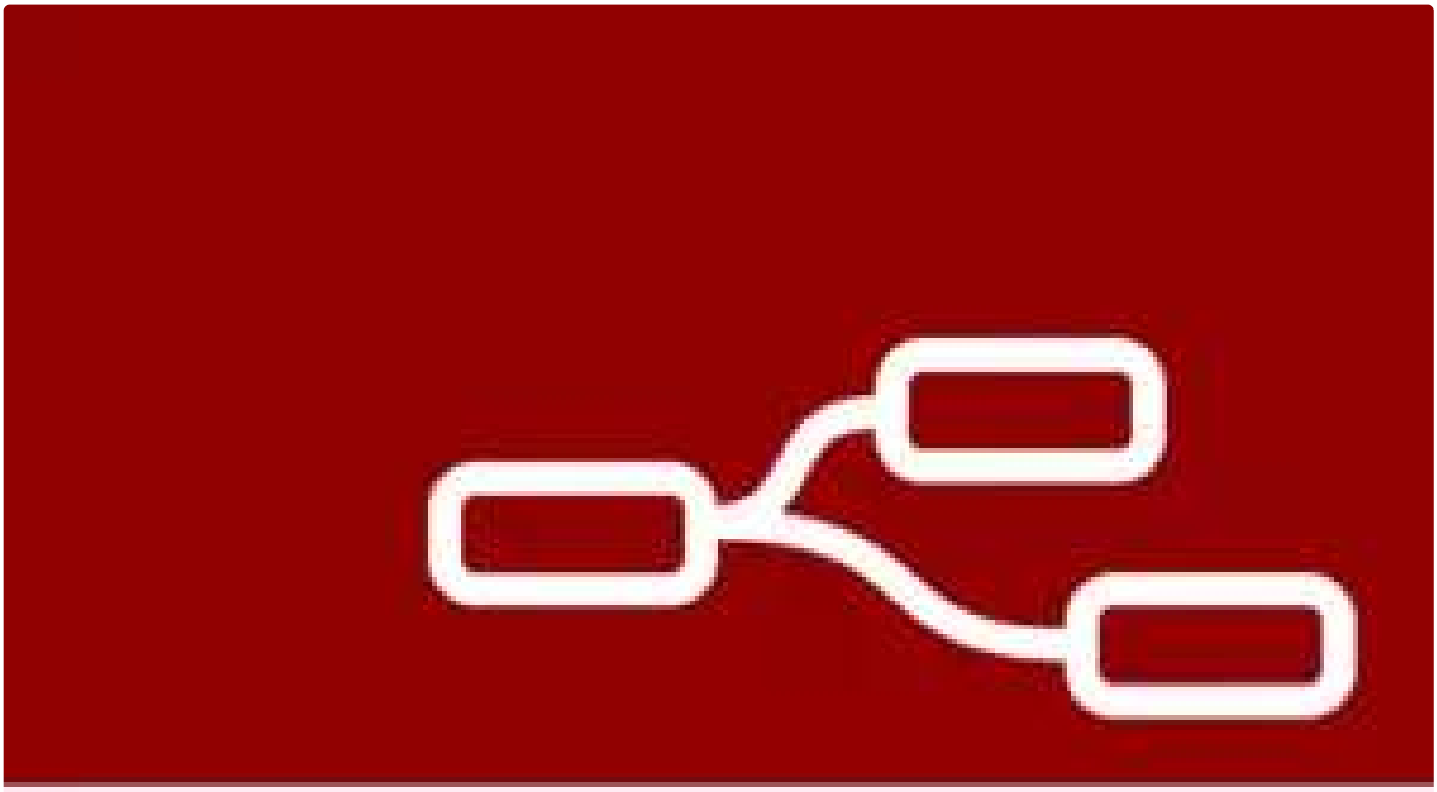
In order to lighten an image in C# you need to look at each pixel one at a time and increase it's red, green, and blue values.

More Info

Linux

When you get interested in home automation, you are eventually going to want to learn Linux.

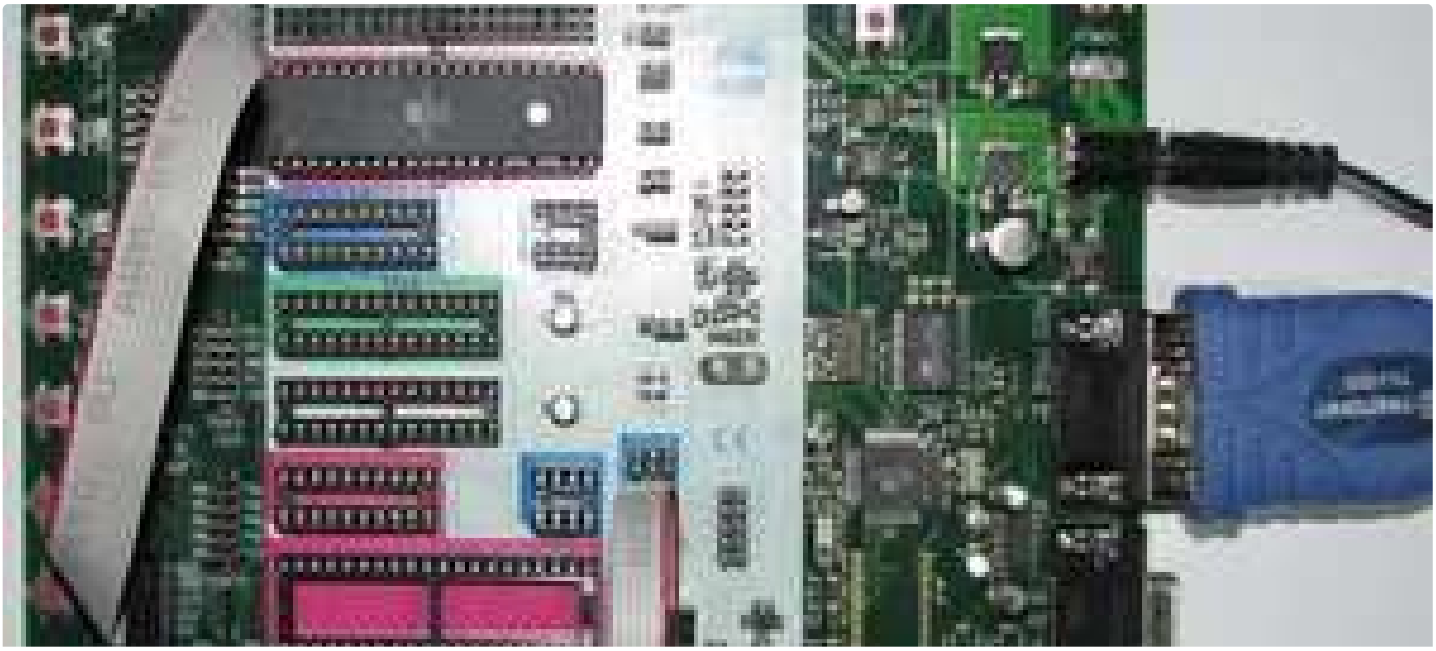
More Info

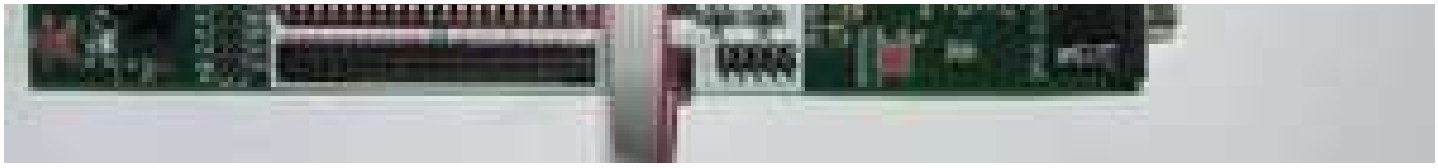


Node-RED

Node-RED is the easiest way to manage your home automation rules. It couples well with Home Assistant and is much easier to program.

More Info





AVR Port Output in C

Port output on an AVR microcontroller is very flexible. We show you how to configure each register.

More Info

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