Use a $1 ATTiny to drive addressable RGB LEDs

by danasf on May 25, 2013

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Intro: Use a $1 ATTiny to drive addressable RGB LEDs

Arduinos are wonderful and easy to work with, but there are some projects where you need a microcontroller, or want to add some interactivity but don't really want to dedicate a $20-30 board!

At a little over $1/each (less in bulk) the ATTiny85 is a great chip for the job: it has 6 I/O pins and is capable of 16Mhz with minimal external components, is enough to work with many sensors, even drive popular addressable LEDs like Adafruit's NeoPixels, WS2811 strips.

The setup process is a little technical, but not too scary I promise, and you can use the familiar Arduino programming environment.

What you'll need:

* An ATTiny (this tutorial uses the ATTiny85-20PU)
* a USB ISP AVR Programmer (My tutorial uses this one)
* a breadboard
* some jumpers or wires (color coded wires are really helpful)
* a computer with the latest Arduino software installed (if you don't already have it, download here)
* a 5V wall wart (Old cell phone power suppliers work wonderfully, double check them for a 5V output. If you need one, these are plentiful at thrift shops!)
* 5V Addressable LEDs (this tutorial assumes use of 3-wire WS2811/WS2812)

Very helpful:

* 10 uF capacitor
* 1 low value resistor (ex 47, 100, 220 Ohm)
* A plain 1-color LED for testing

If you're looking for addressable RGB LEDs try Adafruit's Neopixel line or search ebay for WS2811 . They come in strips, pixels, segments, modules of many varieties. Working with 5V (as opposed to 12V) will be easier for this tutorial, so that's what I recommend!

Image Notes
1. 143 pixels on 1 ATTiny!

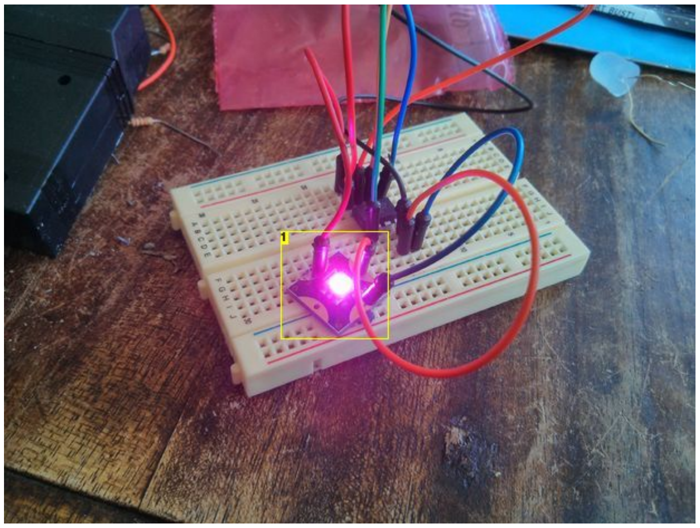
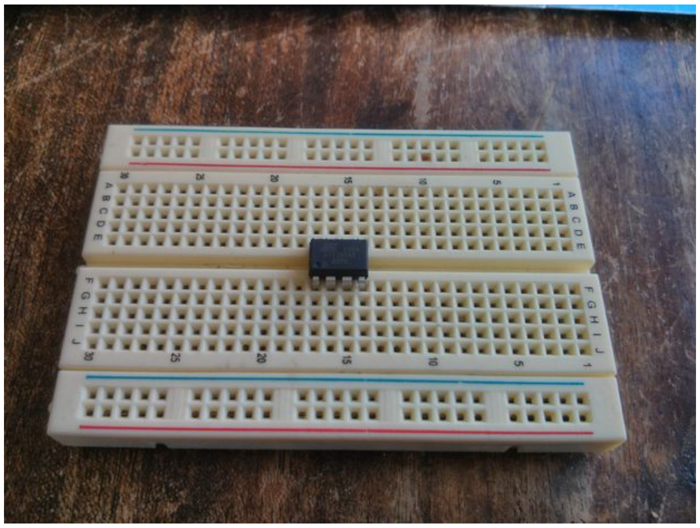


Image Notes
1. LED pixel



Step 1: Download & Install ATTiny core

After you've installed Arduino you'll need to add support for the ATTiny. You can do this with the ATTiny core for Arduino. Installing this is a lot like installing a software library.

Download it here

Make sure Arduino is not running and follow the instructions in the ReadMe:

* Ensure the "hardware" folder exists under the Arduino Sketch folder. For
example, if the Arduino Sketch folder is...

C:\Projects\Arduino\

Ensure this folder exists...

C:\Projects\Arduino\hardware\

* Extract the contents of the archive into the "hardware" folder, so you have something like:

C:\Projects\Arduino\hardware\tiny\

Create a new file in this folder called boards.txt.

Open the Prospective Boards.txt file that came with your ATTiny archive. We'll need to copy the configurations we want to use in Arduino. The ones we need are for ATTiny85, specifically ATTiny85 @ 16 MHz (internal PLL; 4.3 V BOD) but feel welcome to add others if you think they'll be useful.

Save the boards.txt file and try starting Arduino. If you don't see ATTinys as an option in the Tools -> Board menu you may have to place the files in the Arduino program folder. I have some weird old machines and here are my workarounds:

On my very old Mac

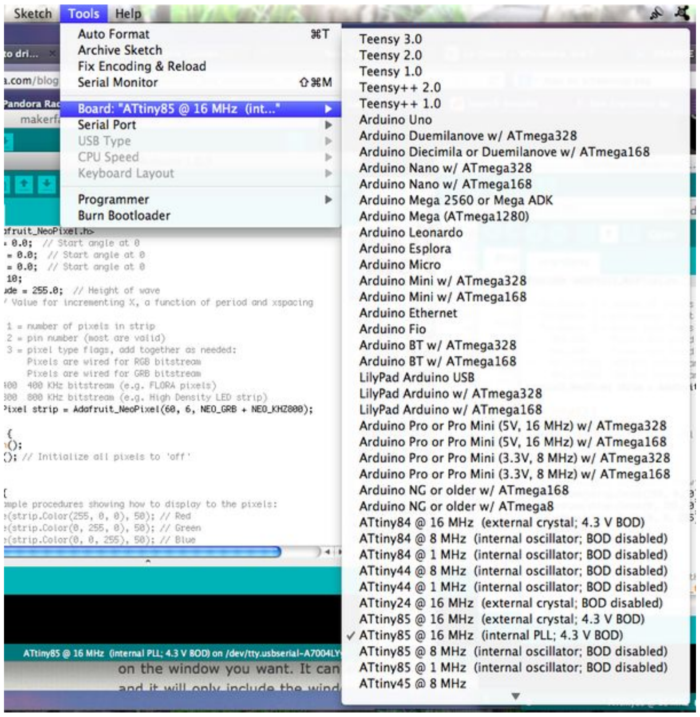
Browse to Applications -> Arduino, (right click), choose Show Package Contents. It should look like you're browsing a folder, navigate to Contents -> Resources -> Java -> hardware

Copy the tiny folder, boards.txt here!

On Ubuntu

Put your tiny folder and boards.txt in /usr/share/arduino/hardware

```
sudo cp -R /path/to/your/tiny/folder /usr/share/arduino/hardware
```

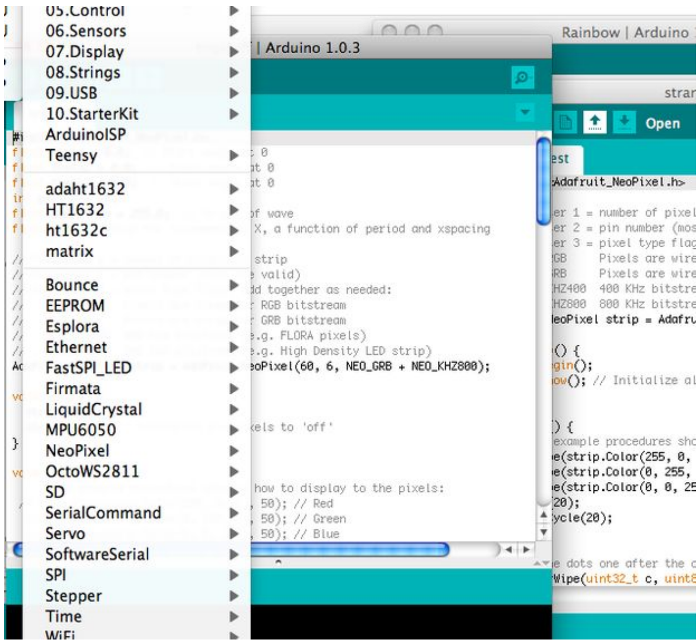

Sketch
Tools
Help
Auto Format
Archive Sketch
Fix Encoding & Reload
Serial Monitor
Board: "ATtiny85 @ 16 MHz (int..."
Serial Port
USB Type
CPU Speed
Keyboard Layout
Programmer
Burn Bootloader
Teensy 3.0
Teensy 2.0
Teensy 1.0
Teensy++ 2.0
Teensy++ 1.0
Arduino Uno
Arduino Duemilanove w/ ATmega328
Arduino Diecimila or Duemilanove w/ ATmega168
Arduino Nano w/ ATmega328
Arduino Nano w/ ATmega168
Arduino Mega 2560 or Mega ADK
Arduino Mega (ATmega1280)
Arduino Leonardo
Arduino Esplora
Arduino Micro
Arduino Mini w/ ATmega328
Arduino Mini w/ ATmega168
Arduino Ethernet
Arduino Fio
Arduino BT w/ ATmega328
Arduino BT w/ ATmega168
LilyPad Arduino USB
LilyPad Arduino w/ ATmega328
LilyPad Arduino w/ ATmega168
Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega328
Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega168
Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega328
Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega168
Arduino NG or older w/ ATmega168
Arduino NG or older w/ ATmega8
ATtiny84 @ 16 MHz (external crystal; 4.3 V BOD)
ATtiny84 @ 8 MHz (internal oscillator; BOD disabled)
ATtiny84 @ 1 MHz (internal oscillator; BOD disabled)
ATtiny44 @ 8 MHz (internal oscillator; BOD disabled)
ATtiny44 @ 1 MHz (internal oscillator; BOD disabled)
ATtiny24 @ 16 MHz (external crystal; BOD disabled)
ATtiny85 @ 16 MHz (external crystal; 4.3 V BOD)
✓ ATtiny85 @ 16 MHz (internal PLL; 4.3 V BOD)
ATtiny85 @ 8 MHz (internal oscillator; BOD disabled)
ATtiny85 @ 1 MHz (internal oscillator; BOD disabled)
ATtiny45 @ 8 MHz
ATtiny85 @ 16 MHz (internal PLL; 4.3 V BOD) on /dev/tty.usbserial-A7004LY

Step 2: Download & Install Neopixel Library

Again make sure Arduino is closed.

Download Bluebie's fork of Adafruit's Neopixel library, which includes support for the ATTiny! Direct download link

Unzip, place it in your Arduino libraries folder and start Arduino! In **File -> Examples** , you should see NeoPixel and a 'standtest' example sketch!



Step 3: Connect your ATTiny and Programmer

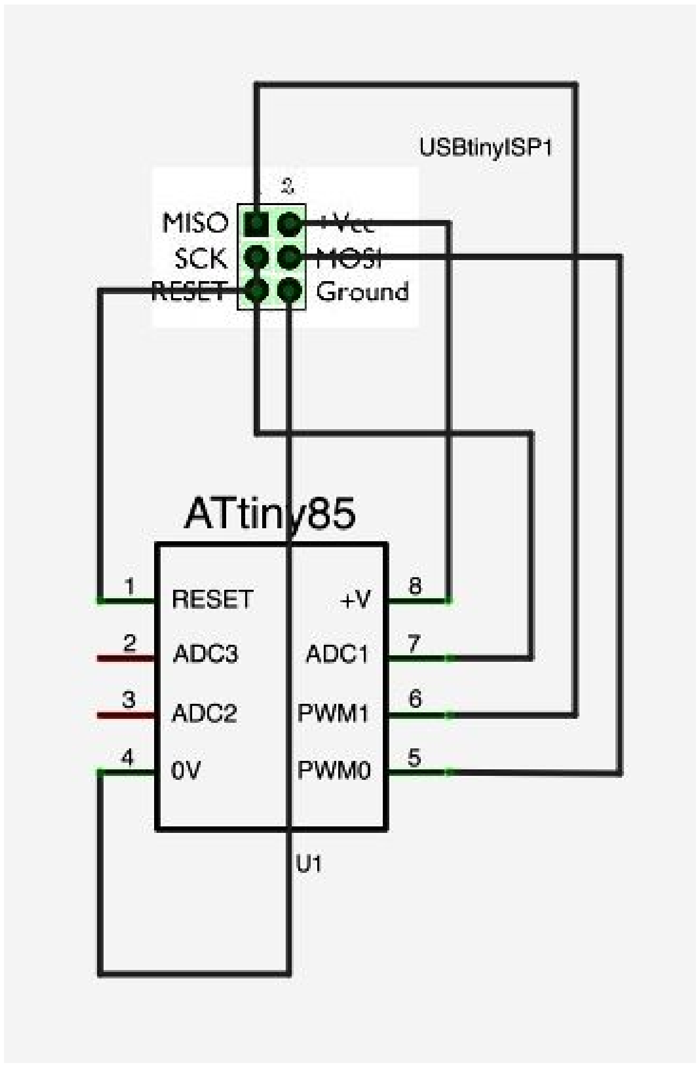
Following this schematic connect the pins from your programmer to the ATTiny on the breadboard.

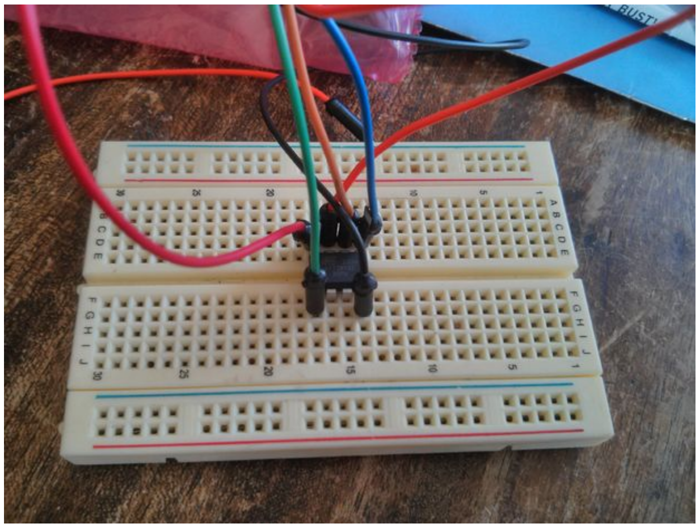
If you get confused about orientation of your programming cable or microcontroller (like I do), some hints:

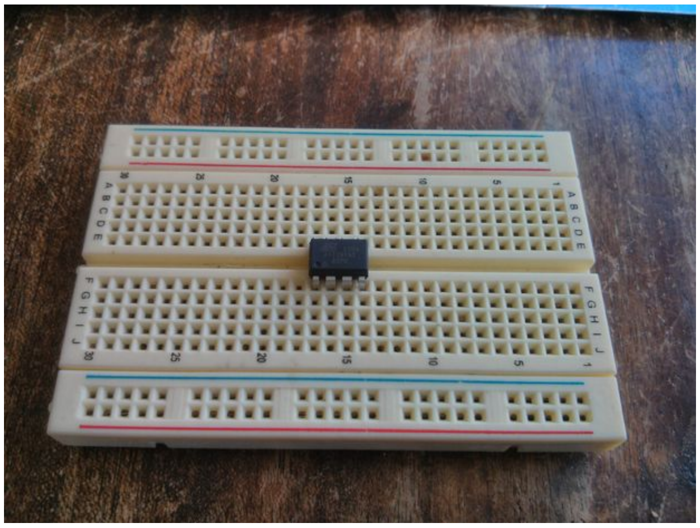
ATTiny: look for a dot or bubble, this should be over the RESET pin (1)

Programmer cable: look for an arrow on the side of the ribbon cable, this is pin 1. Or you can find VCC and Ground via attaching wires and testing with a multimeter.

Schematic CC-BY-SA aurelient / Fritzing


USBtinyISP1
1
2
MISO
SCK
RESET
+Vcc
MOSI
Ground
ATtiny85
1
RESET
2
ADC3
3
ADC2
4
0V
8
+V
7
ADC1
6
PWM1
5
PWM0
U1





Step 4: Test the Blink sketch

Connect your programmer and start Arduino.

We'll need to set our ATTiny to 16Mhz to use our addressable lights so in **Tools -> Board** , select **ATTiny85 16MHz (Internal PLL)** , then in Tools choose **Burn Bootloader** (you'll only have to do this once per chip).

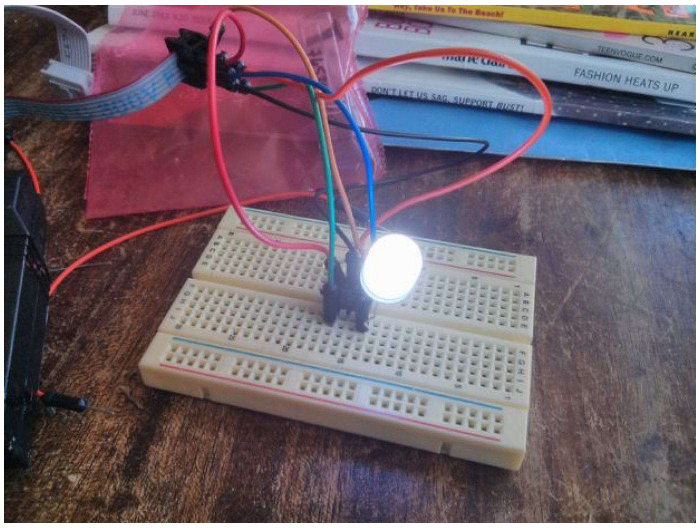
Once this is done you can try uploading a sketch to make sure everything works correctly.

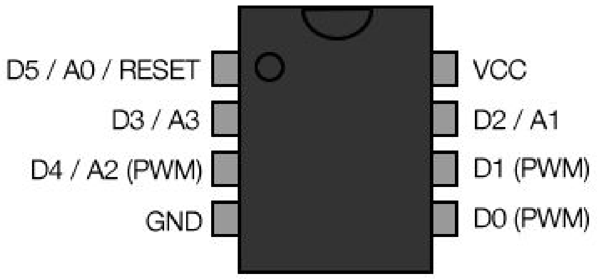
Choose **Examples -> Basics -> Blink**

Change the LED pin from 13 to 4.

Connect a simple LED, the positive end to digital pin 4 on the ATTiny and the negative to ground.

Upload and you should have a blinky LED!





Step 5: Setup your WS2811 LEDs and try your sketch

Upload your sketch

Connect your programmer and start Arduino

Open **Examples -> NeoPixel -> standtest**

Change the first parameter to the number of LEDs you have and the second (pin number) to pin 4.

The example below drives 10 LEDs on pin 4, though I was able to drive over 2 meters of high density strip (143 pixels) on one chip :-)

Adafruit_NeoPixel strip = Adafruit_NeoPixel(10, 4, NEO_GRB + NEO_KHZ800);

Setting up your LEDs

If you're using one or two LEDs you probably can test them directly without an external power supply. Connect your LED's GND, 5V pins to 5V, GND on your breadboard.

Place a low value resistor between ATTiny pin 4 and your LED DATA/DIN Pin, this will help with signal integrity (if you want to a more thorough explanation, this post is really informative).

If you're using a strip or more pixels you'll need external power. As above connect ATTiny pin 4 to your strip with a low value resistor.
Connect your power supply's 5V, GND to the LED strip. You'll also need to tie the power supply GND to the GND pin of your ATTiny. See the schematic image for an example setup.

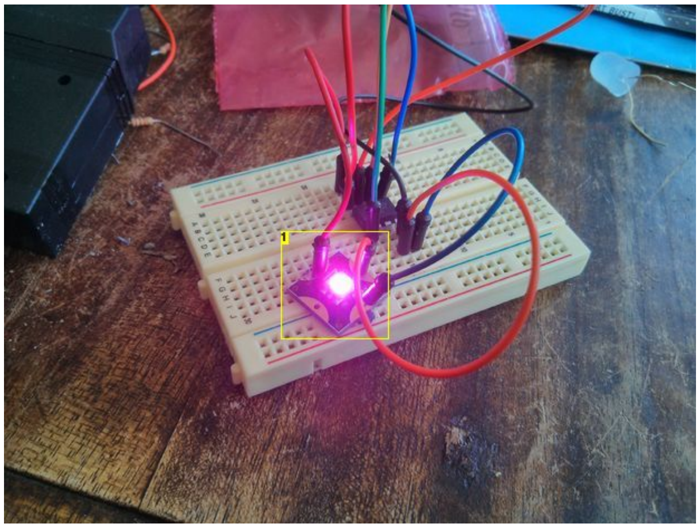


Image Notes
1. LED pixel

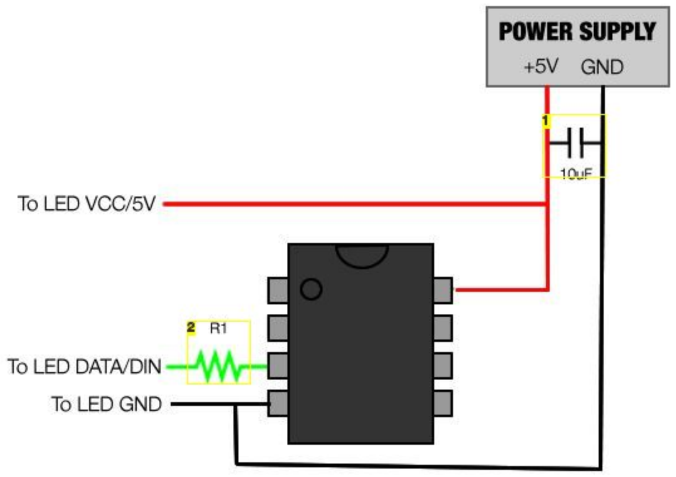


Image Notes
1. decoupling capacitor
2. low value resistor

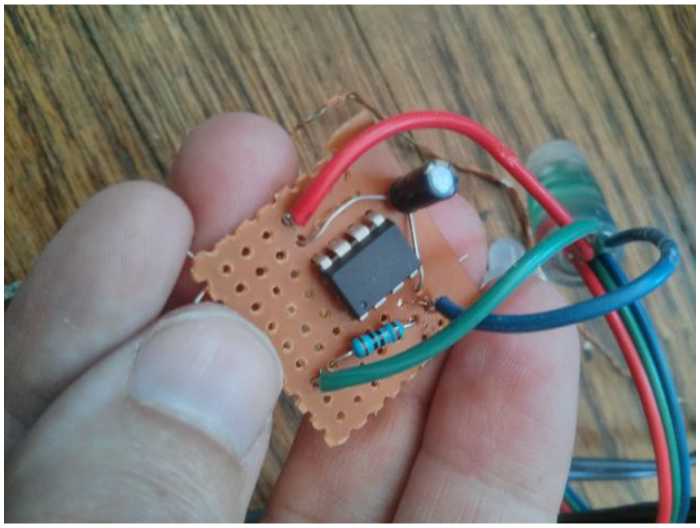
Step 6: Sit back and enjoy

Fingers crossed all of these steps worked and you're watching a light show right now! Look for some new Instructables soon with additional projects.

If you have improvements for this tutorial please let me know, I'm sure there are a few things I've missed!

Enjoy your light up creations and happy hacking :-)

Image Notes
1. 143 pixels on 1 ATTiny!

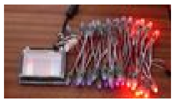


Related Instructables

My response to the WS2811 with an AVR thing by cunning_fellow

LED Flipbookit: full color and brightness control with an Arduino by spacehippy

Light Sensing Fairy Lights (video) by gfwilliams



Touchscreen RGB Light Controller (video) by gfwilliams

Colour Addressable LED Dsiplay by jimeer01

Telnet to your Arduino/AVR! by nevdull