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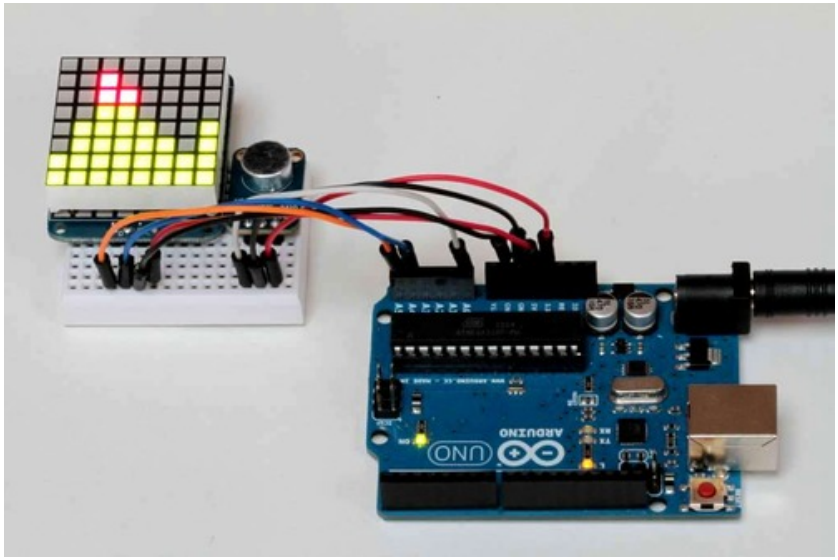
Adafruit Microphone Amplifier Breakout

Created by Bill Earl



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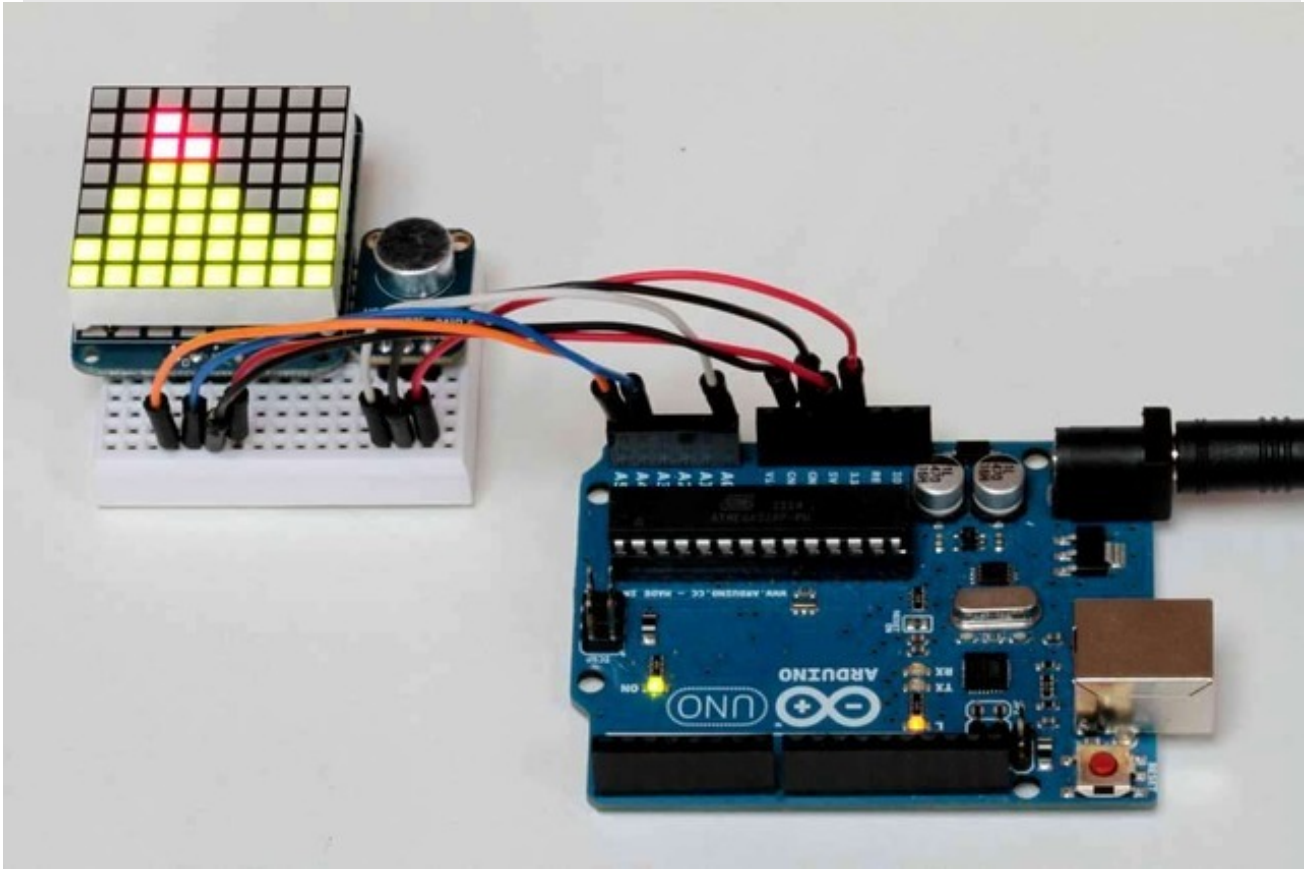
Guide Contents

Overview



This guide shows how to connect the Adafruit Electret Microphone Amplifier to measure sound levels with your Arduino.

The Microphone Amplifier mates an Electret Capsule Microphone (http://adafru.it/aW6) with a MAX4466 Operational Amplifier (http://adafru.it/aW7) optimized for use in microphone pre-amplifier applications. The flexible supply voltage and and adjustable gain make this module adaptable to a wide variety of audio applications.

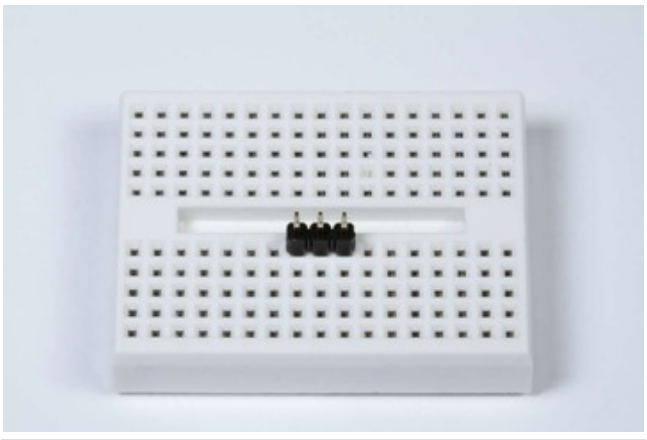
Specifications:

- Supply Voltage: 2.4v-5v
- Output: Rail-to-Rail - up to to 5vp-p
- Frequency Response: 20Hz - 20 KHz
- Adjustable Gain 25x-125x
- Available From: Adafruit of course! (http://adafru.it/1063)

Assembly and Wiring

Assembly:

The board comes with all surface-mount components pre-soldered. The included header strip can be soldered on for convenient use on a breadboard or with 0.1" connectors.



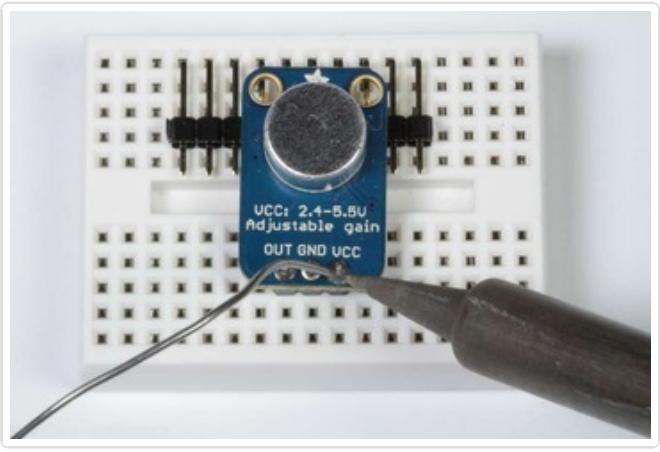
Prepare the header strip:

Cut the strip to length if necessary. It will be easier to solder if you insert it into a breadboard - long pins down.

Add the breakout board:

Place the breakout board over the pins.

(You can prop up the free edge of the board with some extra pins to better align it for soldering.)



And Solder!

Be sure to solder all pins for reliable electrical contact.

(For tips on soldering, be sure to check out our Guide to Excellent Soldering (http://adafru.it/aTk).

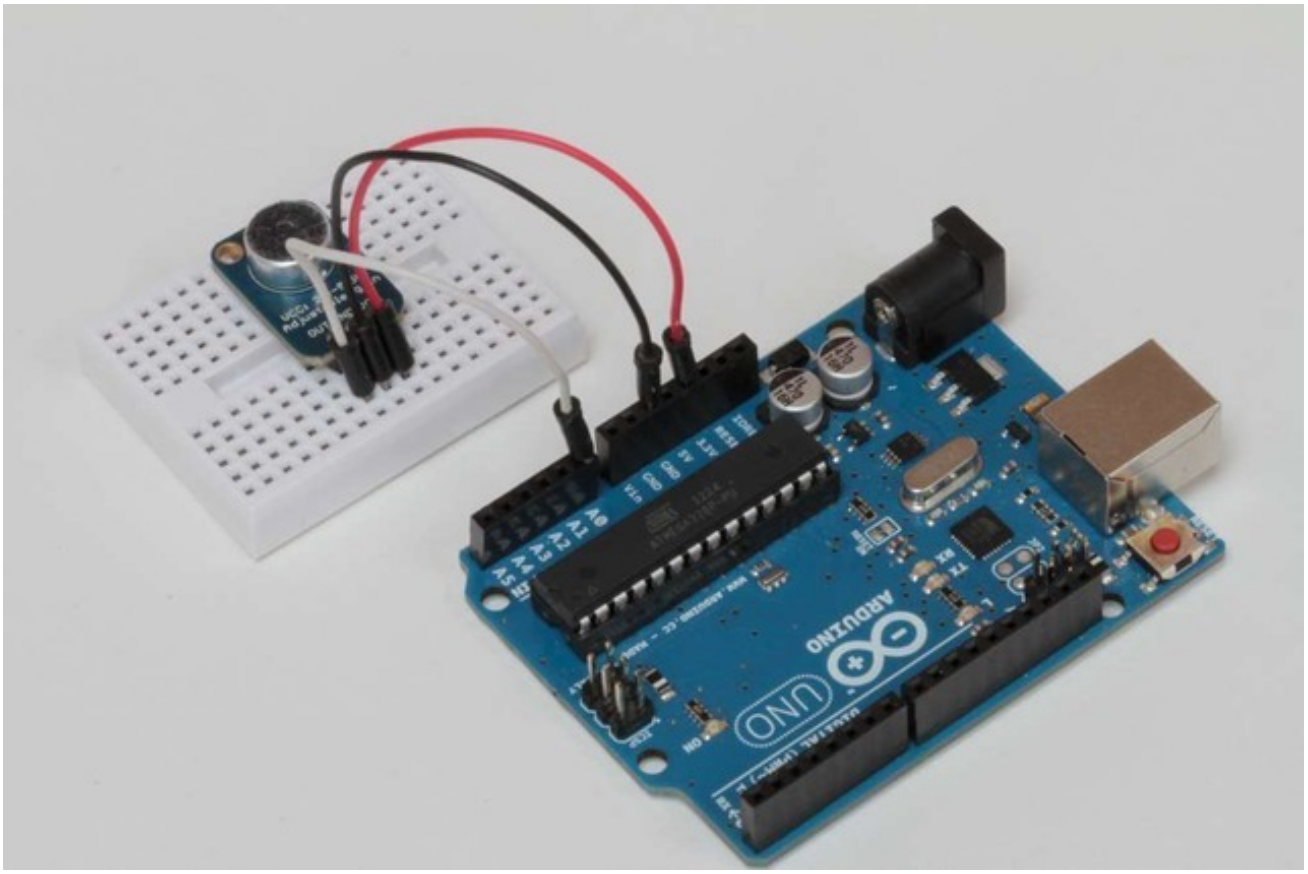
Wiring:

The amplifier has only 3 connections, so wiring is simple:

- GND -> GND
- VCC -> 3.3V
- OUT -> AIN0

VCC can be anywhere from 2.4-5VDC. For the best performance, we use the 3.3v pin because it is the "quietest" supply on the Arduino.

The output will have a DC bias of VCC/2 so when its perfectly quiet, the voltage will be a steady VCC/2 (1.65v).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Measuring Sound Levels

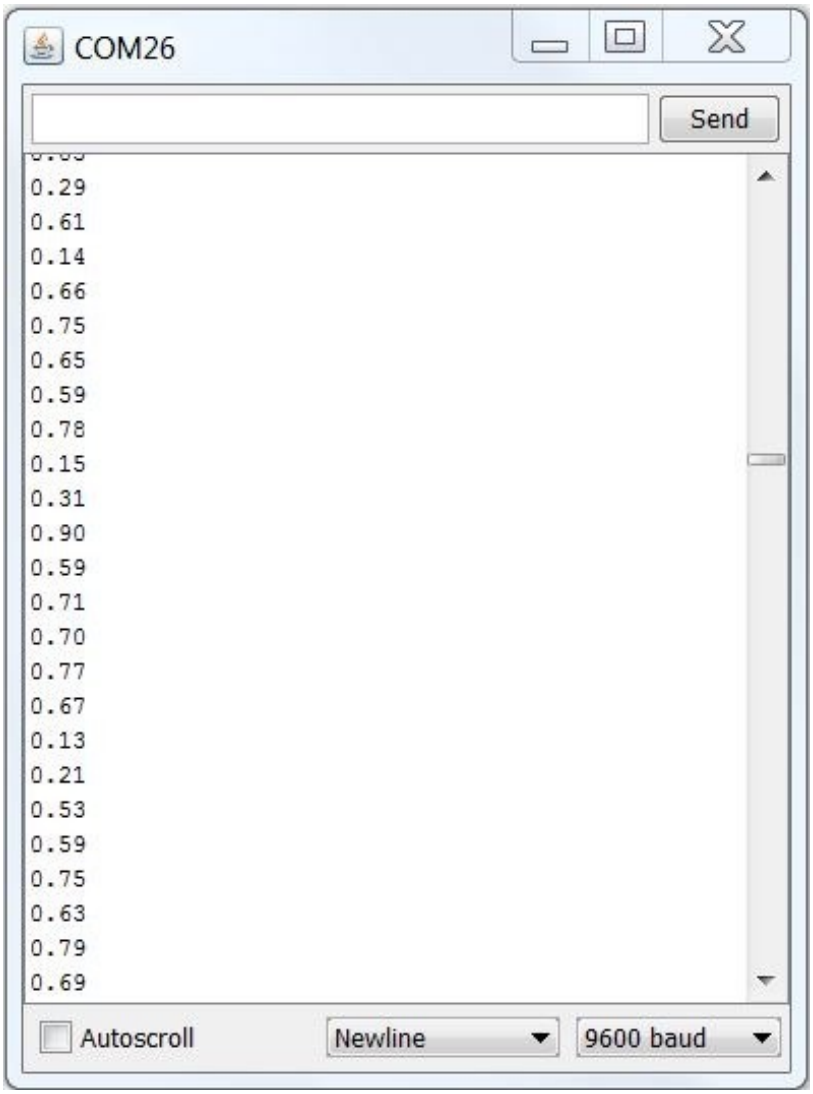
The Audio signal from the output of the amplifier is a varying voltage. To measure the sound level, we need to take multiple measurements to find the minimum and maximum extents or "peak to peak amplitude" of the signal.

In the example below, we choose a sample window of 50 milliseconds. That is sufficient to measure sound levels of frequencies as low as 20 Hz - the lower limit of human hearing.

After finding the minimum and maximum samples, we compute the difference and convert it to volts and the output is printed to the serial monitor.

```
/*****************************************
Example Sound Level Sketch for the
Adafruit Microphone Amplifier
*****************************************/

const int sampleWindow = 50; // Sample window width in mS (50 mS = 20Hz)
unsigned int sample;

void setup()
{
  Serial.begin(9600);
}


void loop()
{
  unsigned long startMillis= millis();  // Start of sample window
  unsigned int peakToPeak = 0;   // peak-to-peak level

  unsigned int signalMax = 0;
  unsigned int signalMin = 1024;

  // collect data for 50 mS
  while (millis() - startMillis < sampleWindow)
  {
    sample = analogRead(0);
    if (sample < 1024)  // toss out spurious readings
    {
      if (sample > signalMax)
      {
        signalMax = sample;  // save just the max levels
      }
      else if (sample < signalMin)
      {
```

```
          signalMin = sample;  // save just the min levels
        }
      }
    }
    peakToPeak = signalMax - signalMin;  // max - min = peak-peak amplitude
    double volts = (peakToPeak * 3.3) / 1024;  // convert to volts

    Serial.println(volts);
}
```

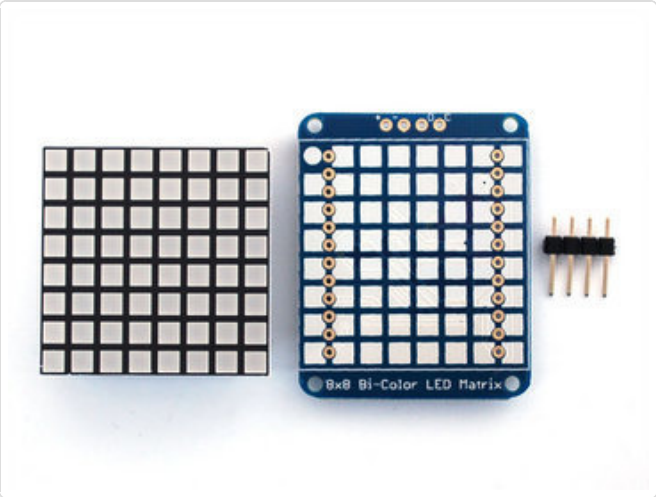


OK, so that's not very exciting. What else can you do with it?

Scrolling Sound Level Meter

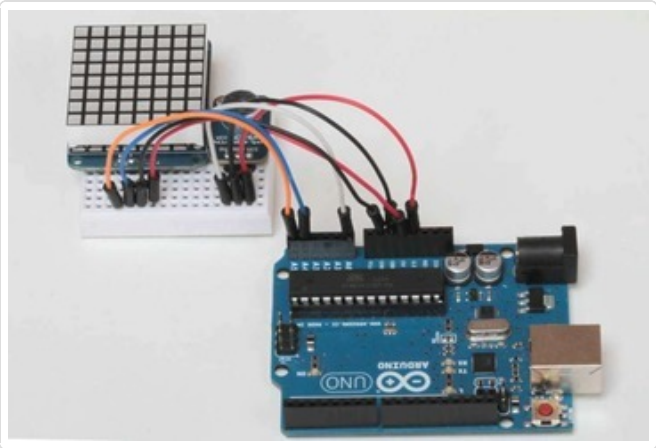
So now we will take the peak-to-peak measurement and use it to drive a Bicolor LED Matrix (http://adafru.it/902) to display the sound level. To make it more interesting, we will scroll the display so that the last 8 measurements are graphed in real-time.

To do this you will need to download the Adafruit GFX Library (http://adafru.it/aJa)and LED Backpack Library (http://adafru.it/aLI). The Wire Library is included in the Arduino IDE installation.



Assemble the Matrix

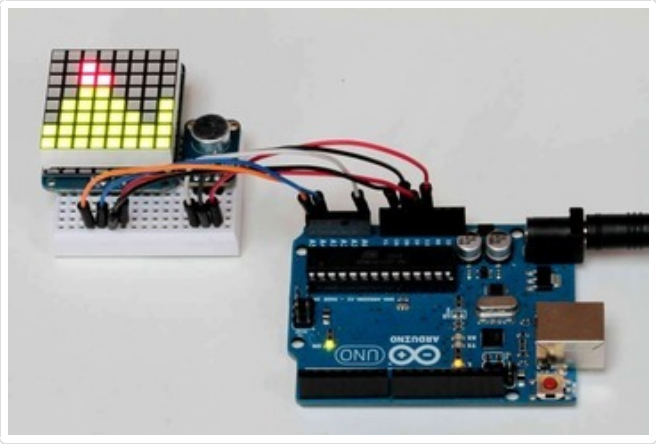
Follow the tutorial here (http://adafru.it/aW8):



Connect the Matrix

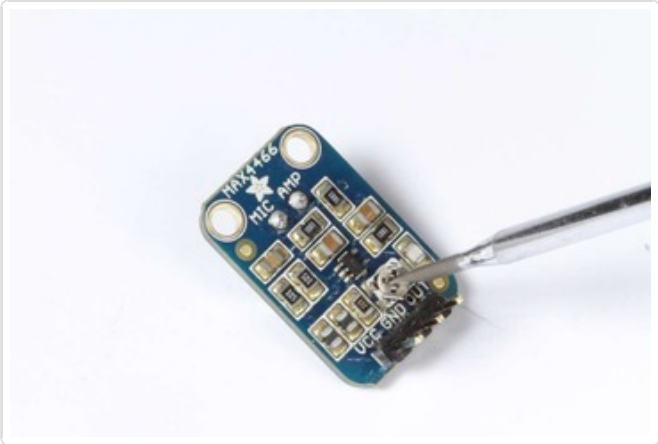
The Matrix backpack has 4 pins, connected as follows:

1. '+' -> 5v
2. '-' -> GND
3. D -> SDA (Analog Pin 4)
4. C -> SCL (Analog Pin 5)



Upload the Code

Paste the code below into the Arduino IDE and upload it. Speak in a normal voice about 6-8 inches from the microphone and the sound level meter matrix display should start scrolling.



Adjust the Gain

Although the amplifier is capable of a rail-to-rail signal (3.3v in this case), the code maps a 1v peak-to-peak signal to the full scale of the display.

This can be changed in the code. Or you can adjust the gain trimmer-pot of the amplifier with a small straight-bladed screwdriver. The amplifier gain is adjustable from 25x to 125x.

Make all gain adjustments gently. If you feel resistance, stop. The tiny trim pot is delicate and it is easy to damage by turning past the stop.

```
/*****************************************
Scrolling Sound Meter Sketch for the
Adafruit Microphone Amplifier
*****************************************/

#include <Wire.h>
#include "Adafruit_LEDBackpack.h"
#include "Adafruit_GFX.h"

// Include the Matrix code for display
Adafruit_BicolorMatrix matrix = Adafruit_BicolorMatrix();

const int maxScale = 8;
const int redZone = 5;

const int sampleWindow = 50; // Sample window width in mS (50 mS = 20Hz)
unsigned int sample;

void setup()
{
  Serial.begin(9600);

  matrix.begin(0x70);  // pass in the address
}
```

```
void loop()
{
  unsigned long startMillis= millis();  // Start of sample window
  unsigned int peakToPeak = 0;   // peak-to-peak level

  unsigned int signalMax = 0;
  unsigned int signalMin = 1024;

  while (millis() - startMillis < sampleWindow)
  {
    sample = analogRead(0);
    if (sample < 1024)  // toss out spurious readings
    {
      if (sample > signalMax)
      {
        signalMax = sample;  // save just the max levels
      }
      else if (sample < signalMin)
      {
        signalMin = sample;  // save just the min levels
      }
    }
  }
  peakToPeak = signalMax - signalMin;

  // map 1v p-p level to the max scale of the display
  int displayPeak = map(peakToPeak, 0, 1023, 0, maxScale);

  // Update the display:
  for (int i = 0; i < 7; i++)  // shift the display left
  {
    matrix.displaybuffer[i] = matrix.displaybuffer[i+1];
  }

  // draw the new sample
  for (int i = 0; i <= maxScale; i++)
  {
    if (i >= displayPeak)  // blank these pixels
    {
      matrix.drawPixel(i, 7, 0);
    }
    else if (i < redZone) // draw in green
    {
      matrix.drawPixel(i, 7, LED_GREEN);
    }
    else // Red Alert!  Red Alert!
```

```
    {
      matrix.drawPixel(i, 7, LED_RED);
    }
  }
  matrix.writeDisplay();  // write the changes we just made to the display
}
```

More Cool Projects!

For more fun with the Adafruit Microphone Amplifier, check out the outstanding Wave Shield Voice Changer (http://adafru.it/aW9) project:

And the Tiny Arduino Music Visualizer (http://adafru.it/aWa)!

Downloads

Datasheets

- Link to the MAX4466 datasheet (http://adafru.it/aW7) (the main amplifier chip)
- The electret microphone used (http://adafru.it/aW6)

Schematic:

Click to embiggen