MODEL RAILROADING WITH ARDUINO

Dave Falkenburg & John Plocher
Silicon Valley Lines Model Railroad Club
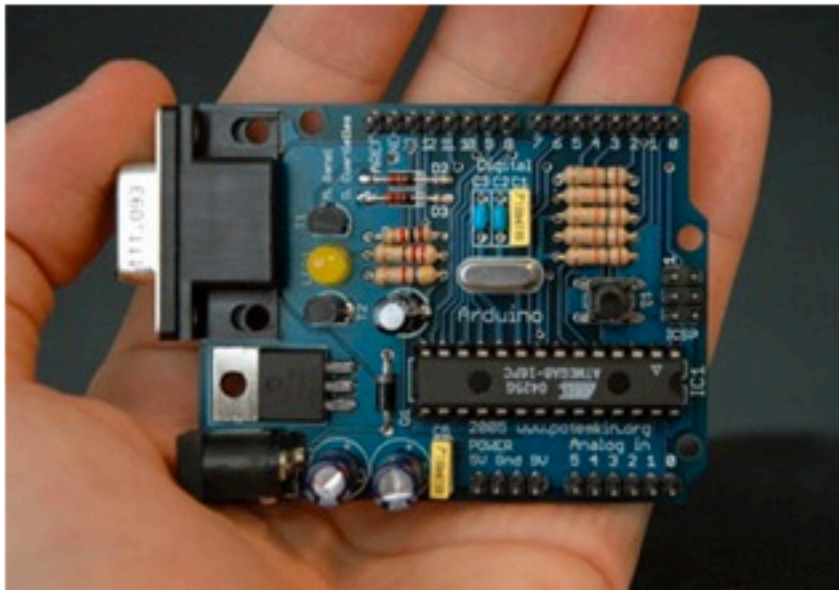
WHAT IS AN ARDUINO?

WHAT IS AN ARDUINO?

- Arduino is an *open-source* electronics prototyping platform based on flexible, easy-to-use hardware and software.

- It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments.

- A little programmable computer platform designed help people "make things go."

http://www.arduino.cc/

Arduino

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Buy | Download | Getting Started | Learning | Reference | Hardware | FAQ   Blog » | Forum » | Playground »

Photo by Nicholas Zambetti

Arduino is an open-source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments.

Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling lights, motors, and other actuators. The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software on running on a computer (e.g. Flash, Processing, MaxMSP).

The boards can be built by hand or purchased preassembled; the software can be downloaded for free. The hardware reference designs (CAD files) are available under an open-source license, you are free to adapt them to your needs.

Arduino received an Honorary Mention in the Digital Communities section of the 2006 Ars Electronica Prix. The Arduino team is: Massimo Banzi, David Cuartielles, Tom Igoe, Gianluca Martino, and David Mellis. Credits

Buy an Arduino Board

Download the Arduino Software

Development: For information on the development of Arduino, see the Arduino project on Google Code. Changes to

Arduino on Twitter (more)

3 days ago, @sypie the Arduino Duemilanove is ready to go, you just need a usb cable. we don't do kits

3 days ago, @fpsrandy Yes they are copies made in china who are violating our trademark

33 days ago, @pieterfloris we wrote to them already and they acted

34 days ago, @pieterfloris they made their own compatible board

34 days ago, @ahosgood yes! sdcard and arduino mega will be supported soon

Arduino News (archive)

HARDWARE

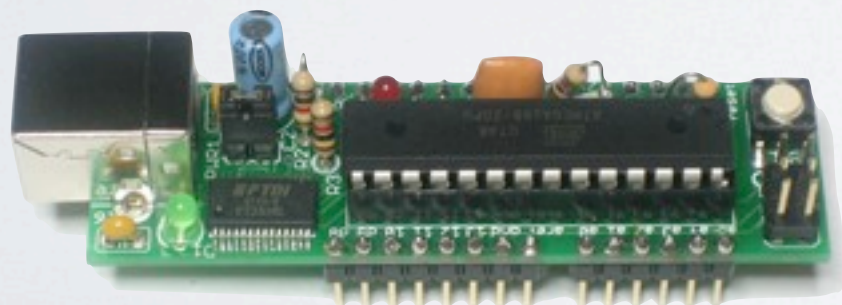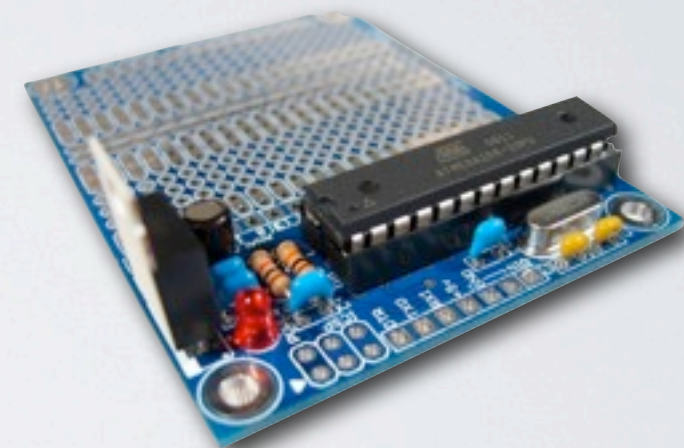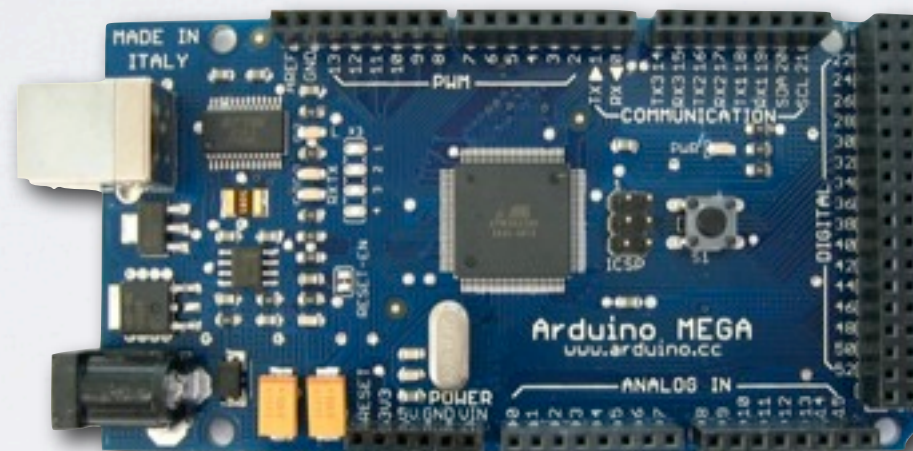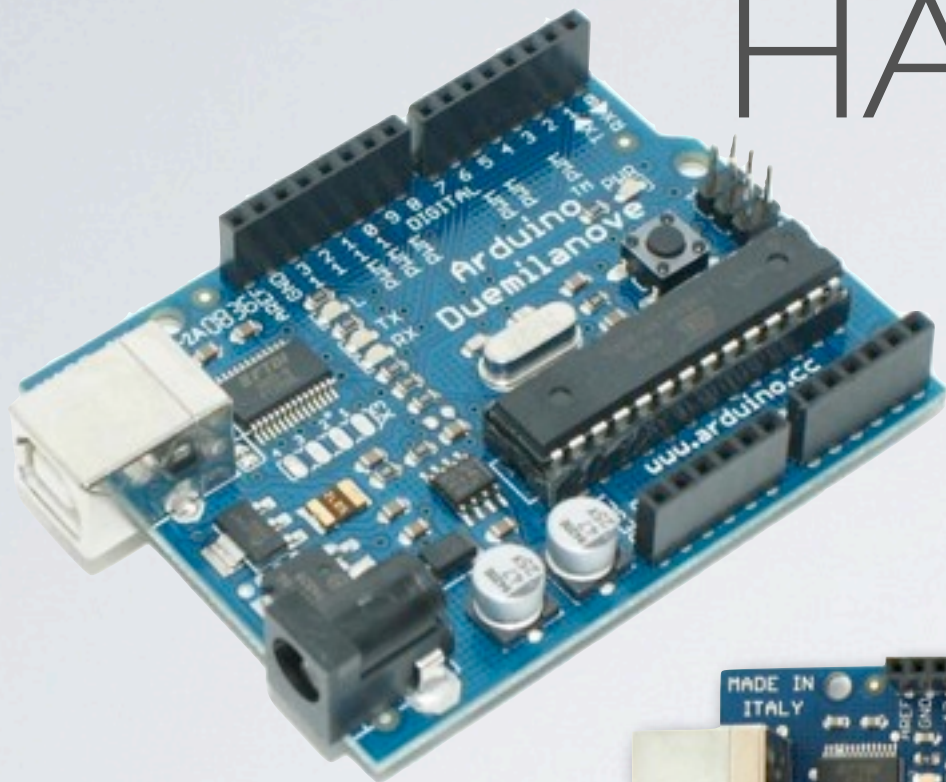- Based upon widely available 8-bit Micro-controllers

    - Single-chip Computers as powerful as the early PCs

    ...but cost much less

- *Open Hardware*

    - Schematics and board designs freely available

- Kits and Built-up Boards from $15 to $80

HARDWARE
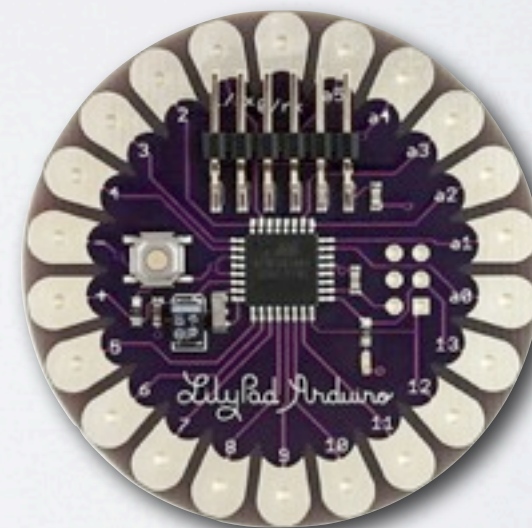
HARDWARE

- 19 pins, each can be either Input or Output

  - 6 can be PWMed (digital dimmer)

  - 6 Analog pins

  - 13 Digital pins

- 6V-12V external Power Supply or from USB

- Easily Expandable & Customizable to add features

- Think "C/MRI on a chip" with extras

SOFTWARE

- Works with Windows, Mac OS X, and Linux

- *Open Source*

  - Free to Download & Use

  - Easy and fast to use

- Program via USB

SOFTWARE

- C-like Language

- Programs are called "Sketches"

  - Rapid Prototyping of small projects

  - Can do useful things in 1 or 2 pages of code

- Easy to use "Libraries" developed by others

  - DCC, Communications, motor control, LED dimming etc.

SOFTWARE

- All the "grunt work" is done for you by Arduino, which hides most of the complexity (remember, it was designed for artists!)

- Only two functions to worry about

  - `setup` : initialize inputs & outputs

  - `loop` : run over and over again until power is removed

```
/*   Blink: Turns on an LED on for one second, then off for one second, repeatedly.

  * LED connected from digital pin 13 to ground.
  * Note: On most Arduino boards, there is already an LED on the board connected to
    pin 13, so you don't need any extra components for this example.
   Created 1 June 2005
   By David Cuartielles
   http://arduino.cc/en/Tutorial/Blink
   based on an orginal by H. Barragan for the Wiring i/o board
 */

int ledPin =  13;     // LED connected to digital pin 13

// The setup() method runs once, when the sketch starts

void setup()
{
  pinMode(ledPin, OUTPUT);     // initialize the digital pin as an output:
}


// the loop() method runs over and over again, as long as the Arduino has power

void loop()
{
  digitalWrite(ledPin, HIGH);   // turn the LED on
  delay(100);
  digitalWrite(ledPin, LOW);    // turn the LED off
  delay(100);
}
```

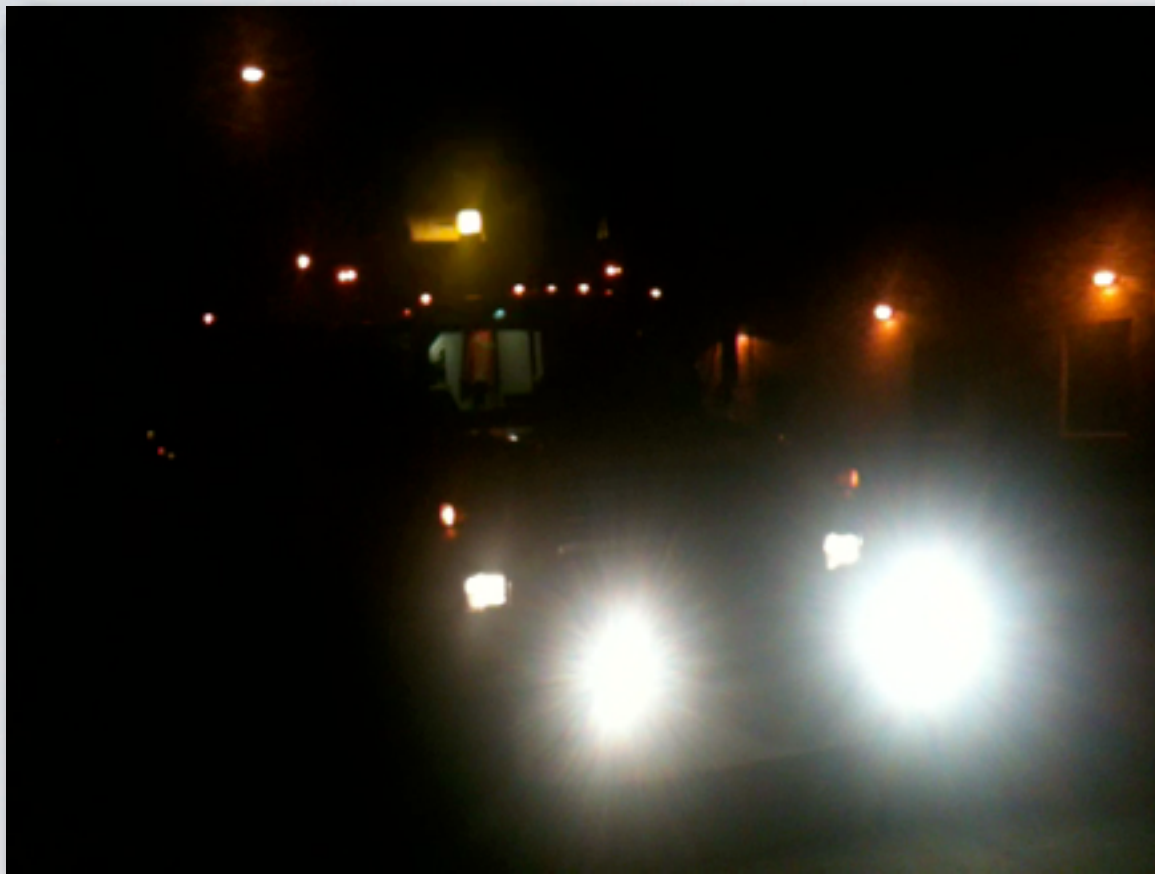# WHAT CAN YOU DO?

SPECIAL EFFECTS

SPECIAL EFFECTS
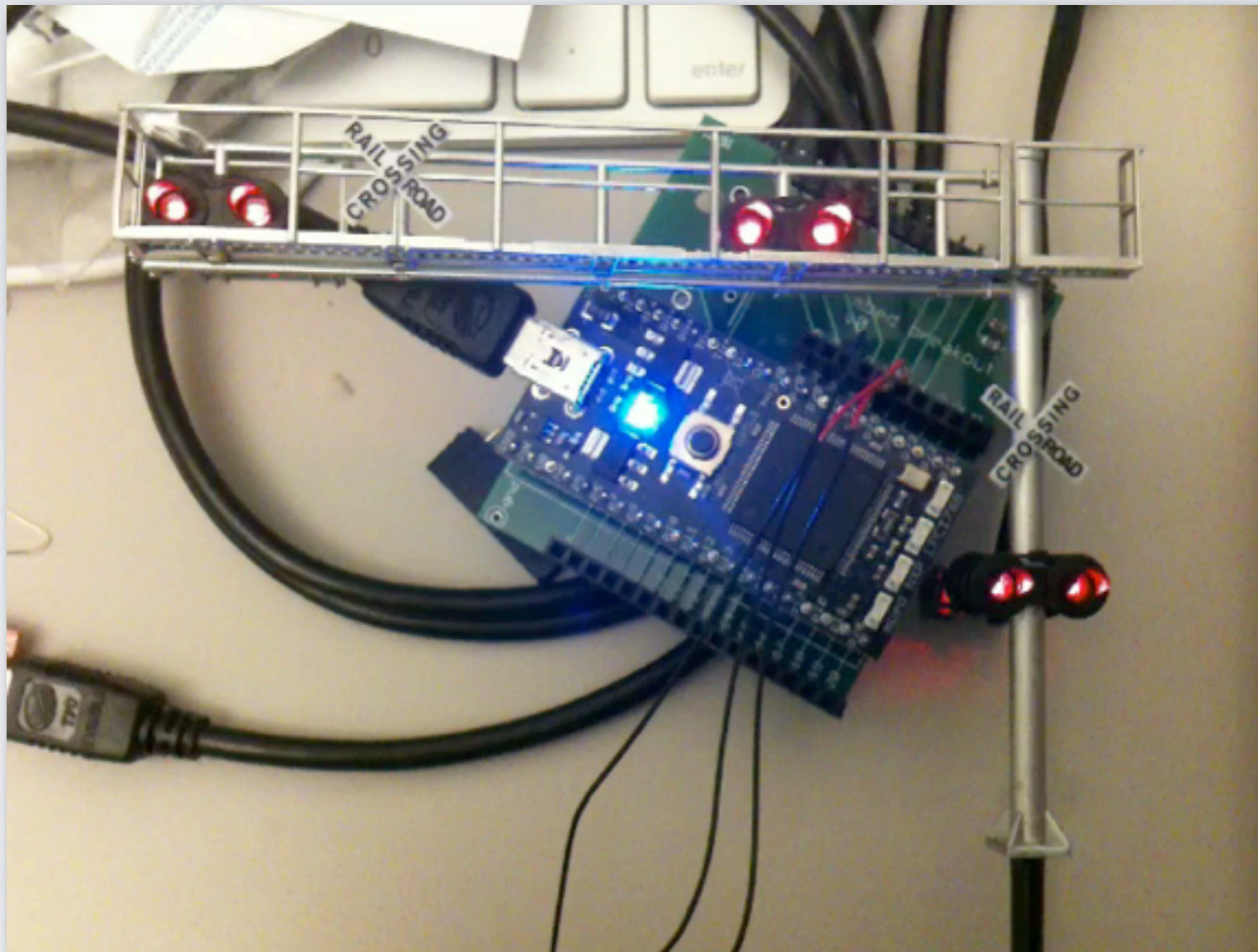
NOTE: This is an mbed, not an Arduino; probably should re-shoot the video.

EFFECTS YOU CANNOT BUY
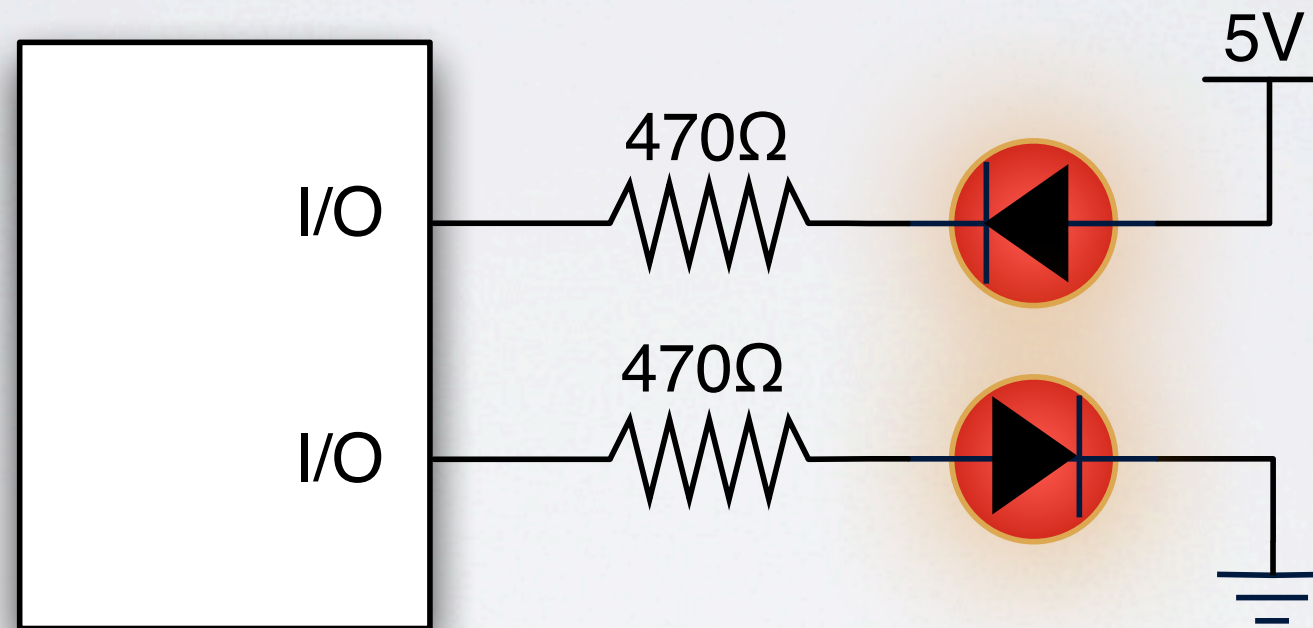

Sperry Rail Service Inspection Vehicle

SIGNALS

CONNECTING LEDS

- **Anode** (+, *long leg*) of LED to +5V (or 3.3V)

- **Cathode** (-, *short leg, flat side*) of LED to DIGITAL I/O Pin through a 470Ω resistor (330Ω for 3.3V)

- **Anode** (+, *long leg*) to DIGITAL I/O Pin through a 470Ω resistor (330Ω for 3.3V)

- **Cathode** (-, short leg, flat side) to Ground

MAKING FIRE

```
int ledPin =  13;  // LED connected to digital pin 13

void setup()   {
  pinMode(ledPin, OUTPUT);
}

void loop()
{
  int dark;
  for (dark=0;dark<1000;dark++) {
    if (dark<500) {
      digitalWrite(ledPin, HIGH);   // set the LED on
      delay(random(10-10*(dark/500)));
    }
    digitalWrite(ledPin, LOW);    // set the LED off
    delay(random(10+dark,50+dark));
  }
}
```

AN ARC WELDER

```
int ledPin =  13;     // LED connected to digital pin 13

void setup()    {
  pinMode(ledPin, OUTPUT);
}

void loop()
{
  int i,count;

  count=random(10,60);
  for (i=0;i<count;i++) {
    digitalWrite(ledPin, HIGH);    // set the LED on
    delay(random(60));
    digitalWrite(ledPin, LOW);     // set the LED off
    delay(random(200));
  }

  delay(random(800,2000));
}
```
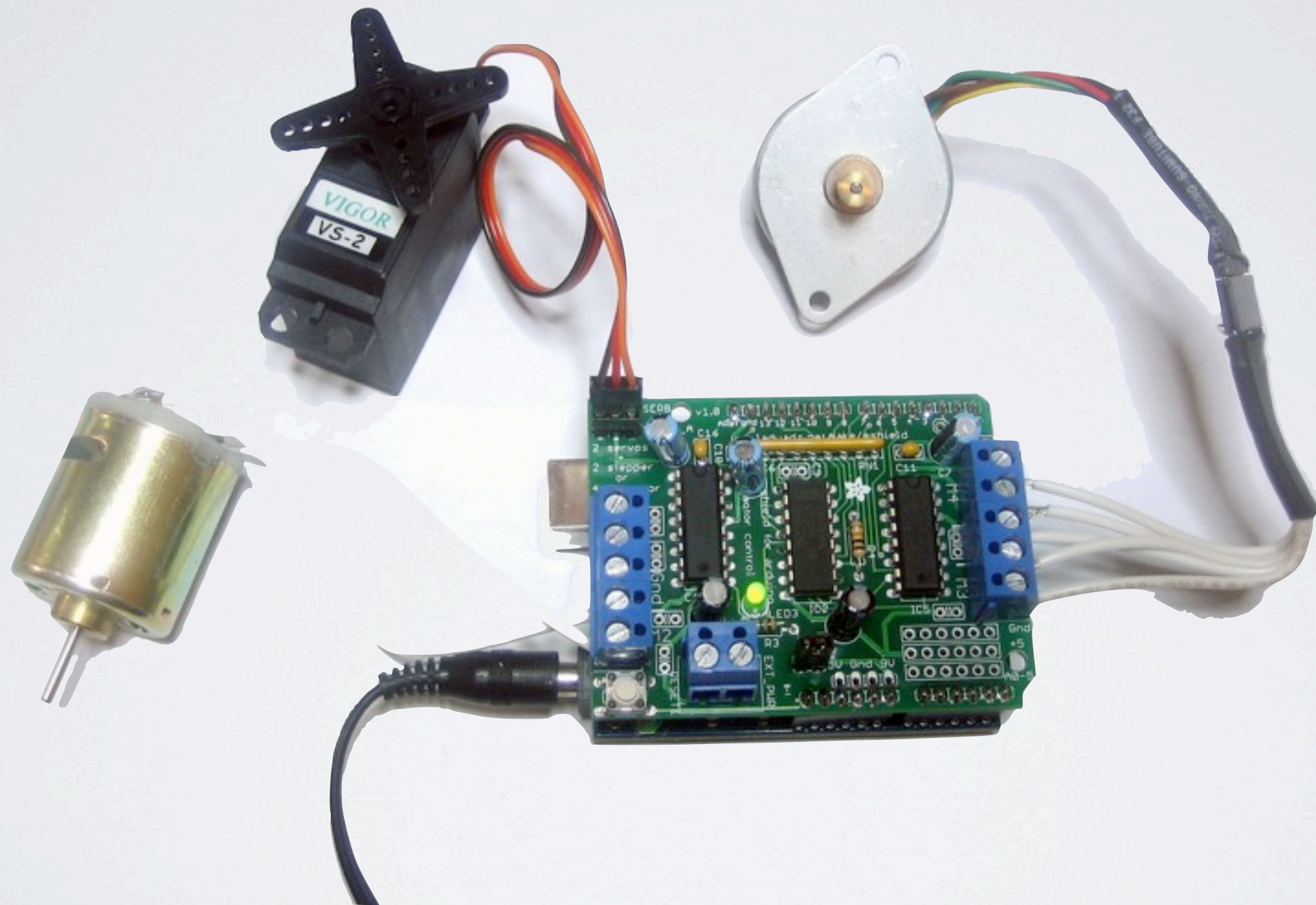
WHAT ELSE?

- Push Buttons

- Photocells

- Current Detectors

- Servo Motors

- Stepper Motors

- MP3 Playback Chips

- RFID Readers

- Other Arduinos

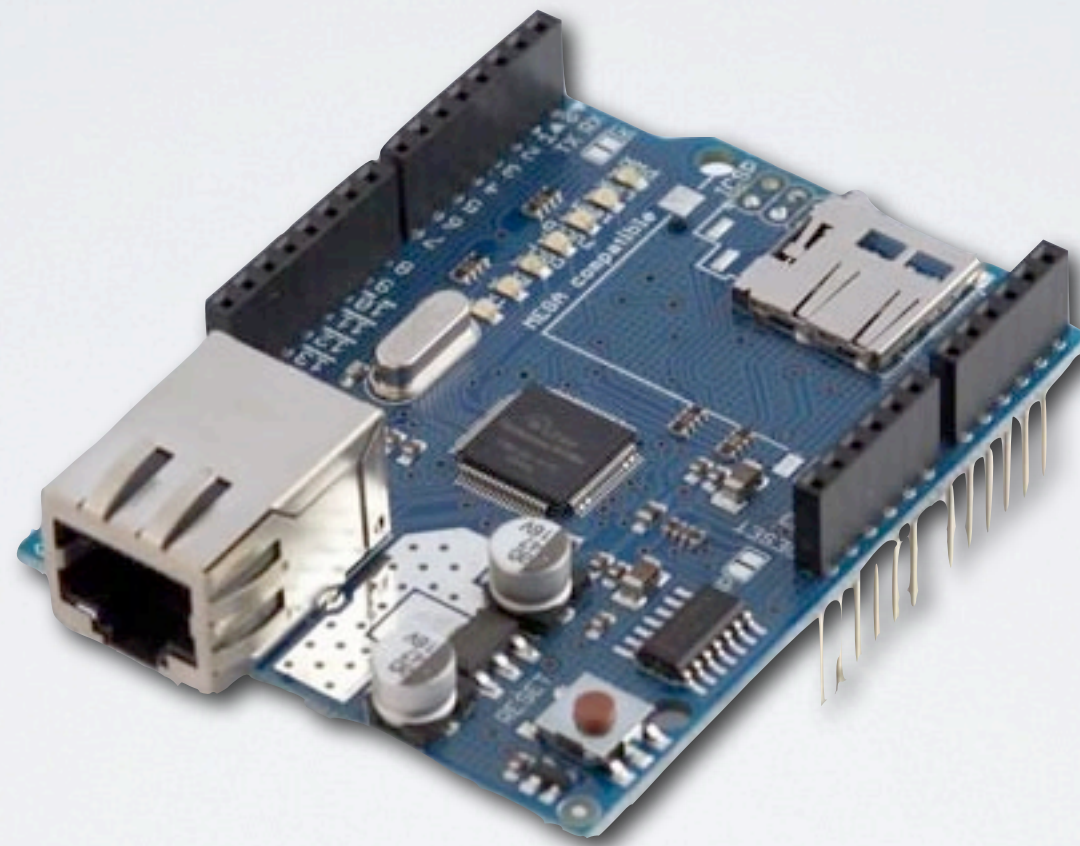- Other Computers

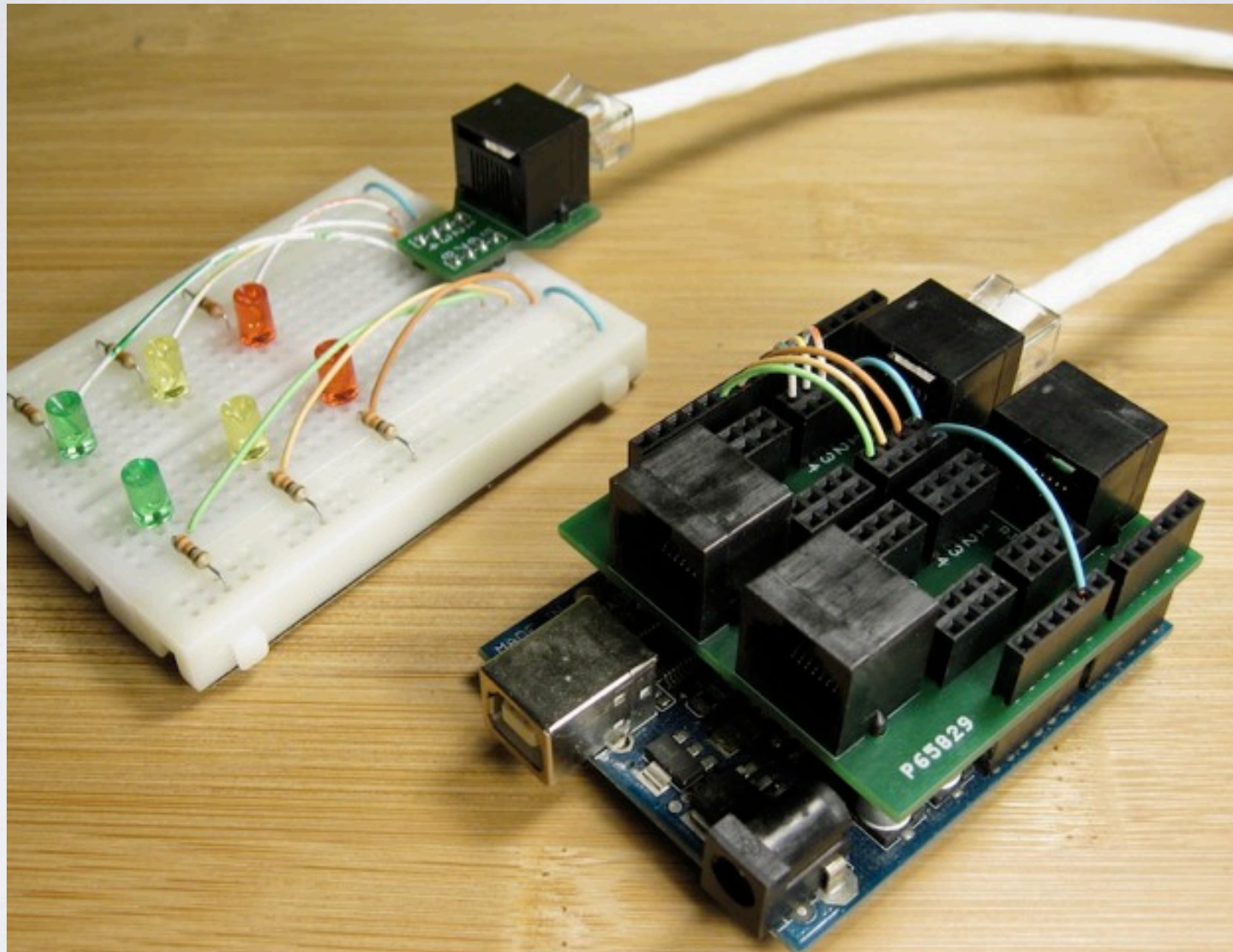 - WiFi

  - Ethernet

  etc., etc., etc.

MOTOR SHIELD

http://www.adafruit.com/

ETHERNET SHIELD

http://www.arduino.cc/

"PATCH SHIELD"

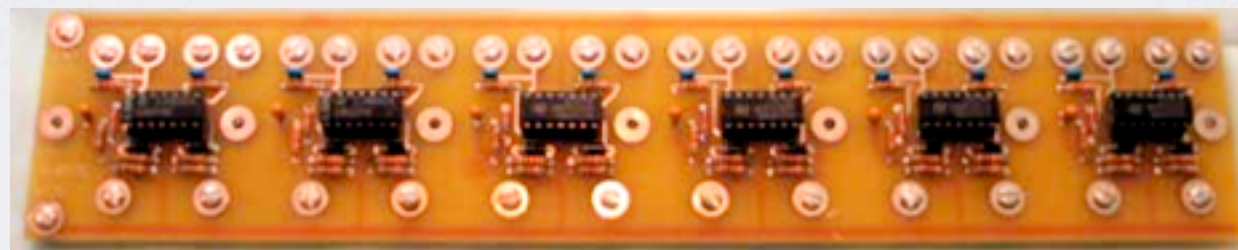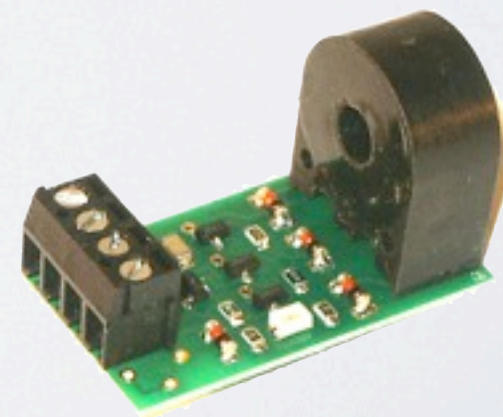http://info.yawp.com/kits/patch-shield-v04/index.html

MIX AND MATCH

- An Arduino can connect to existing Model Railroad Electronics

- Chubb SMC12 for using digital output to control Tortoise

- DCCOD, TeamDigital DBD22, and NCE BD20 Detectors

DEMOS
TO **GET** YOUR **IDEAS**
FLOWING

Hardware & Software by John Plocher

BLINKING LEDS WERE EASY...

- What about something **more** challenging?

- How about doing something with the user's INPUT?

- Can we make noise?

- Maybe even Annoy The Neighbors?
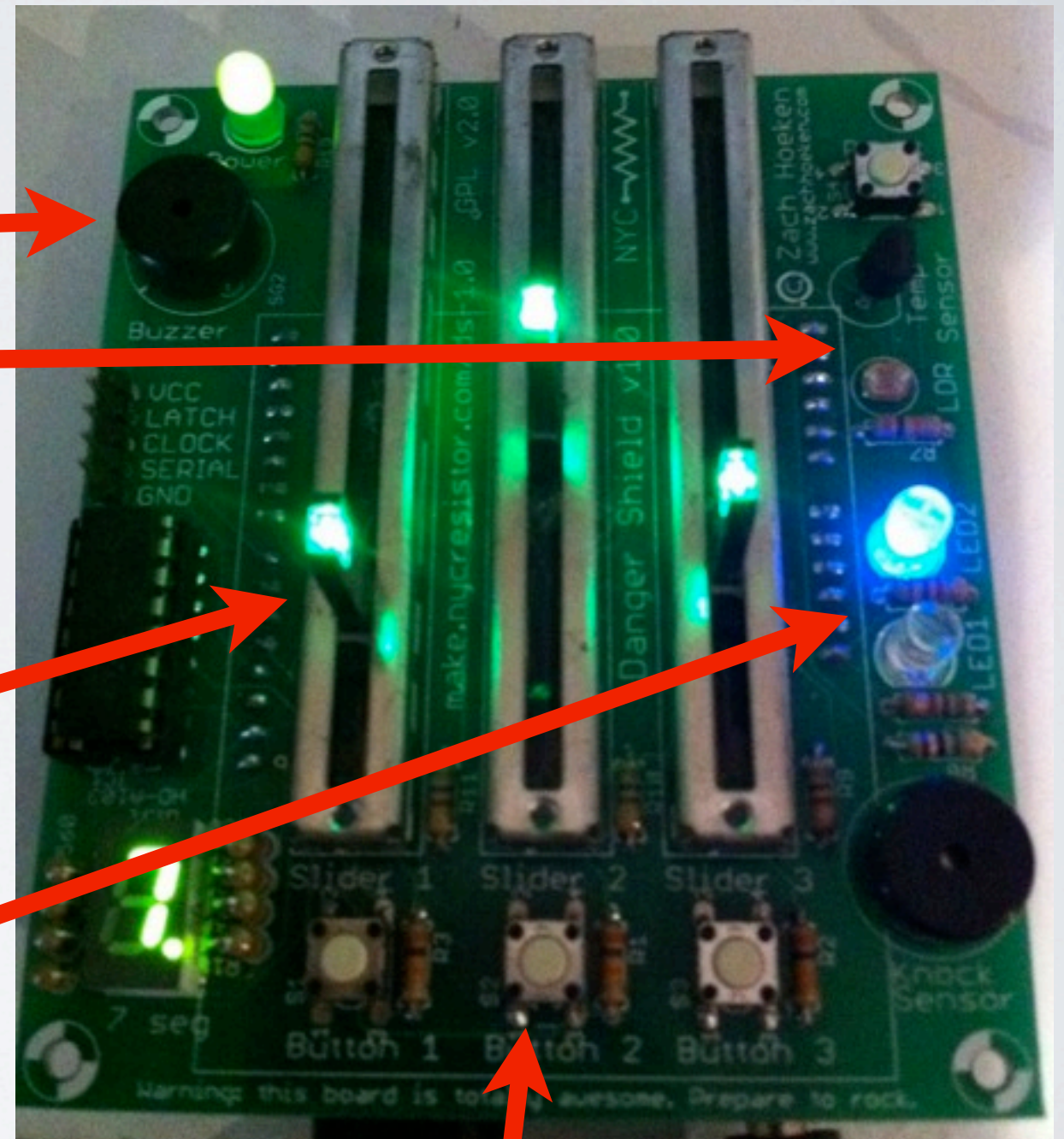
DANGERSHIELD

An Arduino add-on.

buzzer

temperature & light sensors

It's got a variety of electronic components that you can use to do fun and useful things:

linear sliders

LEDs (of course!)

A excuse to learn by playing!

pushbuttons

XYLO -TIGER

Two servos

an LCD display

a xylophone

a few spare parts

and

a couple of hours of tinkering

NEED SOMETHING MORE "RAILROAD RELATED"?

- All these were simply fun ways to learn while playing

- The real fun begins when you apply these lessons to your layout!

CP MICHAEL

- Take the "best of" Loconet, C/MRI and Arduino and try to build a control point for the layout, similar to those used by the "big boys", without having to have a computer running things.

GOALS

- Talk "**Code Line**" to other nodes

  - **Control** packets from dispatcher's cTc machine

  - **Indication** packets from the Control Point field units

- Use **Loconet** to talk to the devices in the interlocking

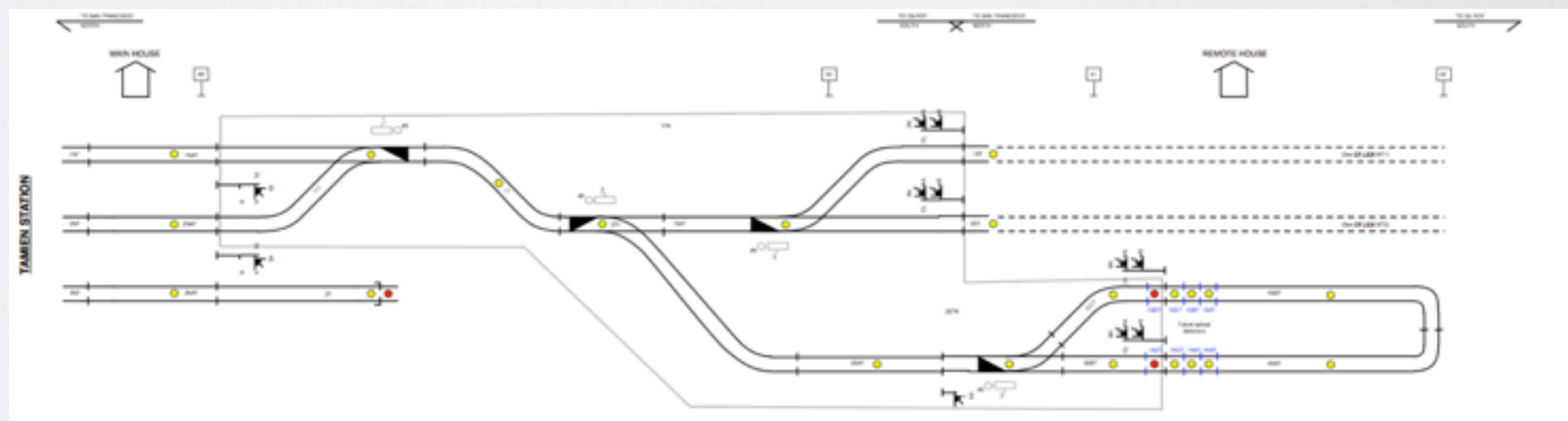- (Future) use NMRAnet as the Code Line...

CP MICHAEL

and a little
imagination
(it **is** a work in progress ;-)

- 16 Track Circuits

- 4 Switches

- 6 Signals

DEMO

- The Panel simulates the Dispatcher's view

  - Track circuits simulated by toggle switches

  - Model Board displays occupancy

- One Arduino pretends to be a (crude!) cTc machine

- The other Arduino simulates a field unit and controls switches

- Boards cost $6-$20 each to design and build myself

LOTS MORE INFO HERE

http://www.arduino.cc/playground/
Main/InterfacingWithHardware

USEFUL LINKS

- http://www.arduino.cc/

- http://www.sparkfun.com/

- http://www.adafruit.com/

or just Google/Bing/Yahoo for "Arduino" in your favorite web browser!

- http://moderndevice.com/

- http://spikenzielabs.com/

- http://techshop.ws/

SOME OTHER COOL LINKS

- DCC Throttle built with an Arduino

  http://www.oscale.net/en/arduino

- DC Control with Arduino:

  http://modelrail.otenko.com/electronics/controlling-your-trains-with-an-arduino

  http://dawson-station.blogspot.com/2010/01/wii-nunchuk-train-control.html

Q&A

EXTRA 2011 WEST

The Unconventional Convention

X2011

2011 NMRA National Convention
July 3 to 9, 2011 - Sacramento, California

DOING THINGS A LITTLE DIFFERENTLY ...

An Advanced Section of layout tours and OP sessions in the San Francisco Bay Area on the weekend at the start of the Convention...

The world-famous California State Railroad Museum and the movie-star Sierra Railroad at Jamestown in the Mother Lode country...

...and a full-blown Railroad Prototype Meet as part of the Convention, OPSIG and LDSIG events, numerous clinic tracks including clinics to teach you entirely new skills, the S scale NASG national convention, Bay Area Garden Railroad clinics...well, this list just goes on and on...