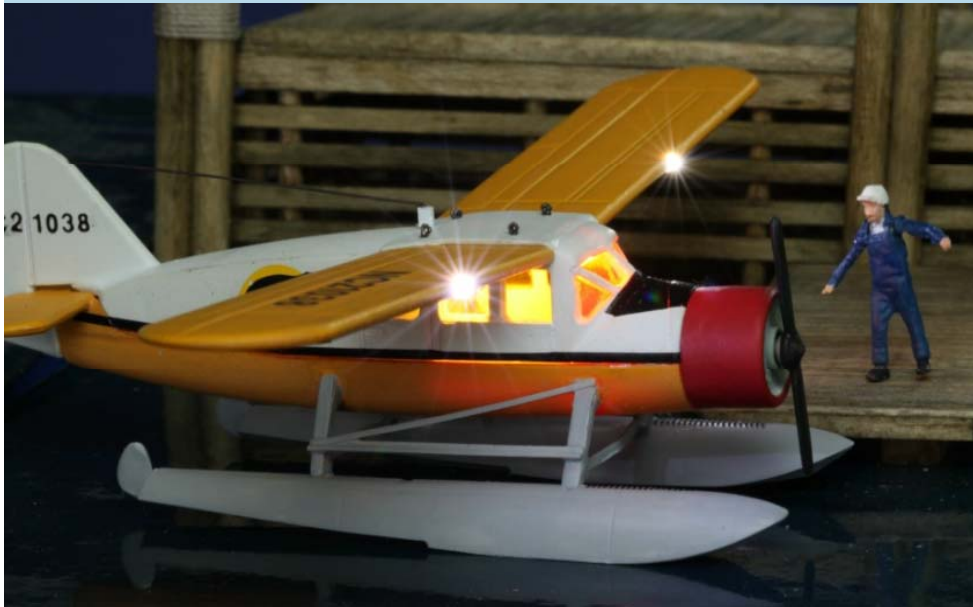


Modeling with Sound Scale Model Animation





My Animation Influences

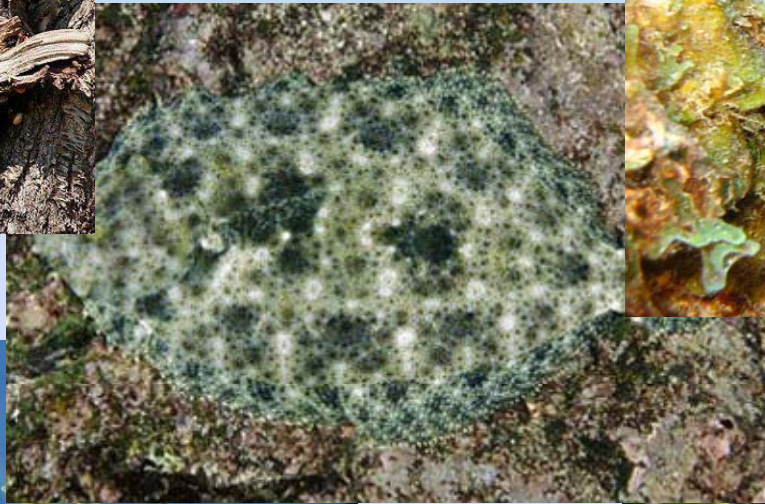
*Disneyland Great Moments with Mr. Lincoln
Grabs and Holds the Imagination*

Pendon Museum (Long Wittenham, Abingdon, Oxfordshire, U.K.) preserves the idyllic rural scene and transport of the 1920's and 30's (pendonmuseum.com)



The Model is the Story

What Makes Something Appear to Be Alive?



Animated versus *Animation*

You can create *animated* features
Blinking lights, Body movements, etc.



When creating an *animation* consider the whole:

- Movement
- Light
- Sound
- Synchronization
- Story



Sound Considerations

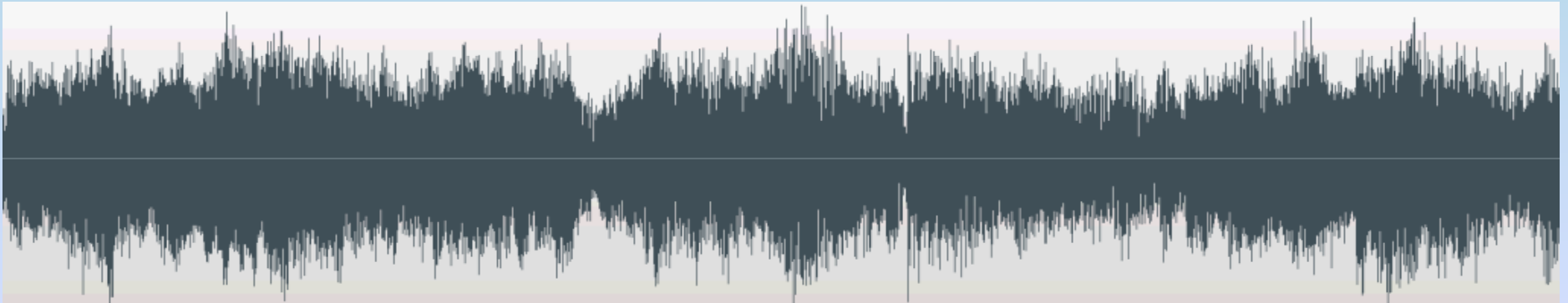
Sound ideas I think about during scene construction

- Background Sound
Unseen sounds obvious and appropriate for the scene like birds, traffic, etc.
I prefer the best quality recordings and players to deliver “subtlety”
- Foreground Sound
Sounds appropriate for a near view not attributed to a single point source like machinery, fans, water flowing, conversations, etc.
- Ambiance
Sound to create a feeling for a scene like rainfall, fog horns, wind, etc. Even though the cause may not be seen (really part of the Background but needs special consideration)
- Spot Sound
Specific sound easily matched to a specific source as in a hammer, saw, crane, etc.– Timing here is almost everything!
- Mobile Sound
Sound generated by a specific source moving through a scene like a locomotive, car, etc.

Sound Advice

The Weakest Link will Change the Experience

Original Sound



Distorted Sound: Attenuated, Frequency Limited & Noise Added

Sound and Noisemakers

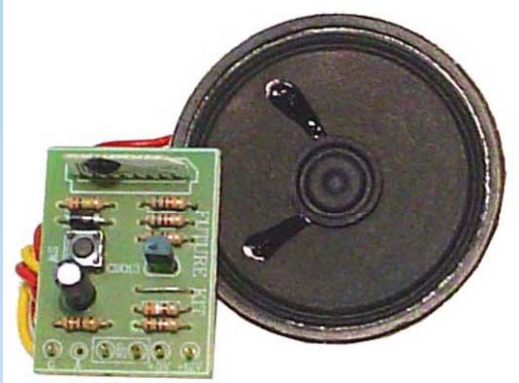
- **DCC Sound Decoders**
 - *Sound clips can be uploaded and replaced, subbing for bells, whistles, etc*
- **Reprogrammable DCC Sound Decoders**
 - *Sounds can be replaced but also the internal sequencing can be reprogrammed (Digitrax, Zimo?)*
- **Commercial Sound Players**
 - *Triggerable, configurable, higher quality sound (Pricom Dream Player)*
- **Sound Modules**
 - *Commercial Sound Modules (ITT Products HQ Series Sound Modules)*
 - *Module sound players: mp3,WAV, & AD4 players (WTV020-SD-16P Module)*
- **Mp3 players**
 - *CD & USB (Thumb) Drive packaged players*
- **Other Issues: Sound Level, Speakers, Enclosures, & Placement**

Sound Players

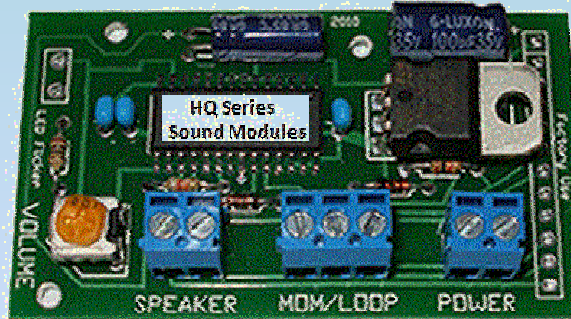
Characteristics to consider:

- 1. Sound source - Built-in, Storage Card, Programmable Memory**
- 2. Quality of reproduction – Sampling rate and bandwidth**
- 3. Output channel – line (needs amplification), speaker**
- 4. Volume control**
- 5. Triggering (Start/Stop, next track, etc) and number of triggers**
- 6. Multiple Voices (Polyphonic)**
- 7. Configurable**
- 8. Synchronization, Cueing and Secondary Control**
- 9. Random play**
- 10. Programmatic interface (accepts commands with communications)**

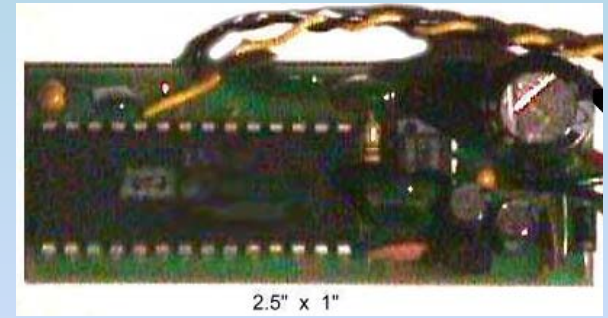
Pre-Loaded Sound Players



BakaTronics FK200 Series



ITT Products HQ Series



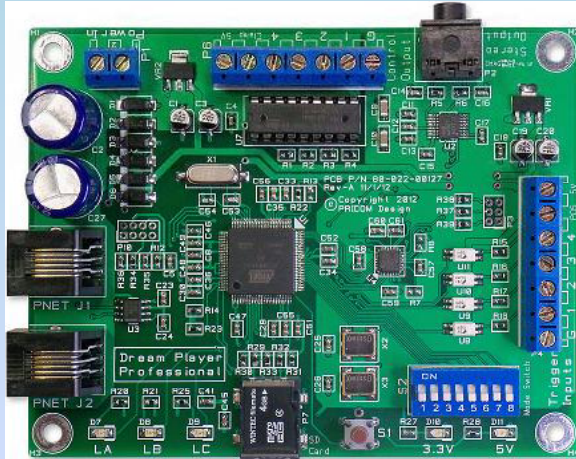
RAM Track Sound Devices

(Trigger-able, Typically Single Sound / Sound Type)

Commercial Sound Players



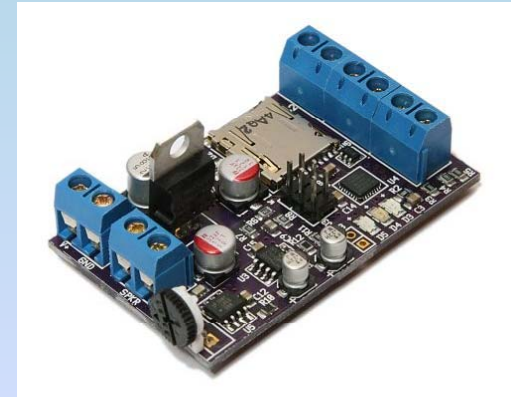
More Sound Players



Pricom Dream Player Pro
6 File Polyphonic
16bit 44.1KHz CD Quality
Control Outputs



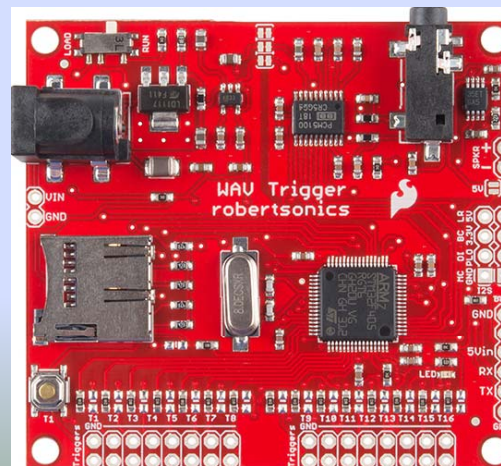
Dream Player Lite
16bit 44.1KHz
Control Outputs



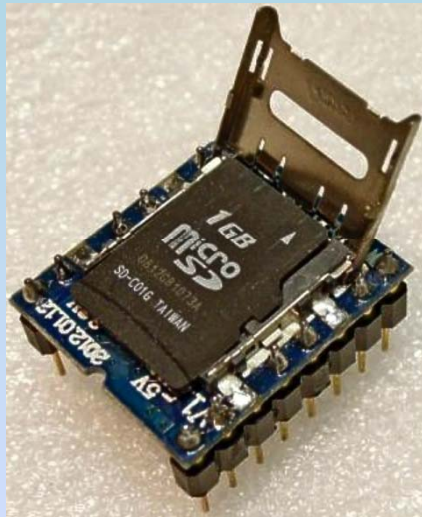
**Iowa Scaled Engineering
CKT-SQUEAL**
16bit 48KHz Mono Only

Sparkfun WAV Trigger

14 File Polyphonic
16bit 44.1KHz
Programmatic Control



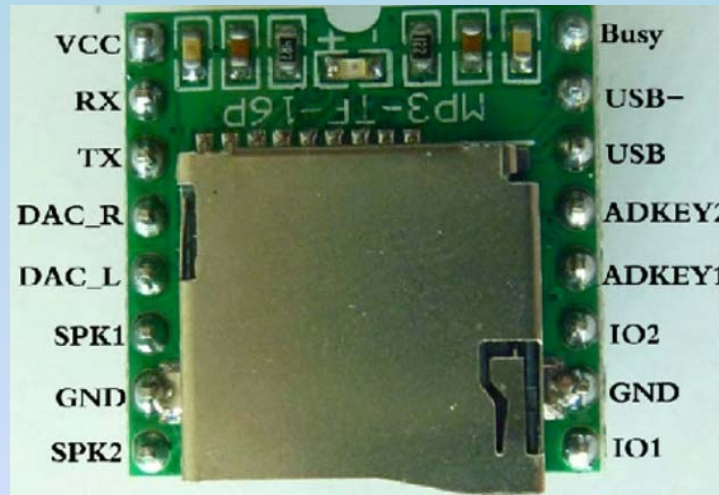
Sound Player Modules



WTV020-SD

4 Bit ADPCM AD4 Files
4bit Delta 32KHz
2W Mono Amp is Weak
1GB Micro SD Card Max
Programmatic & Buttons

1			16
2	RESET	VDD	15
3	AUDIO-L	P06	14
4	NC	NC	13
5	SPK+	P02	12
6	SPK-	P03	11
7	NC	NC	10
8	P04	P05	9
	GND	P07	

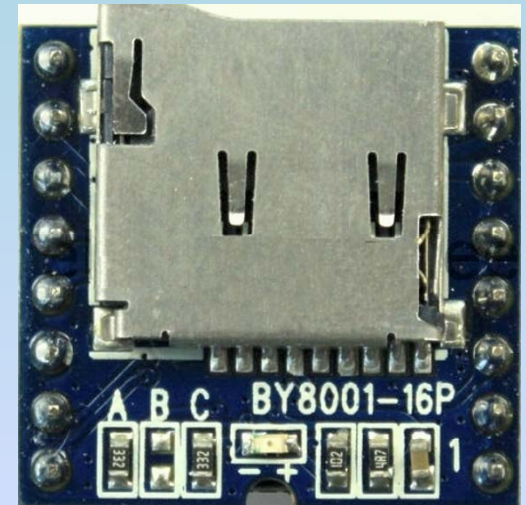


DFPlayer Mini

MP3 & WMV Files
24bit 48KHz
Good 3W Mono Amp
32GB Micro SD Card Max
Programmatic & Buttons

1	VCC	BUSY	16
2	RX	USB-	15
3	TX	USB+	14
4	DAC_R	ADKEY2	13
5	DAC_L	ADKEY1	12
6	SPK1	IO 2	11
7	GND	GND	10
8	SPK2	IO 1	9

DFPLAYER MINI



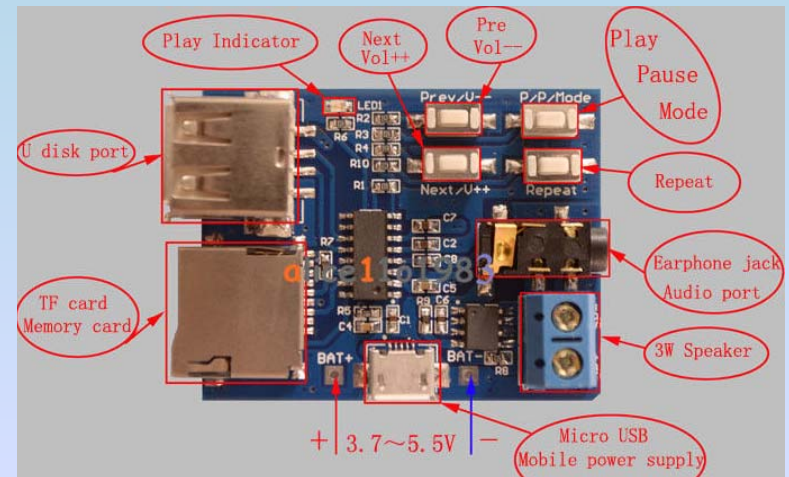
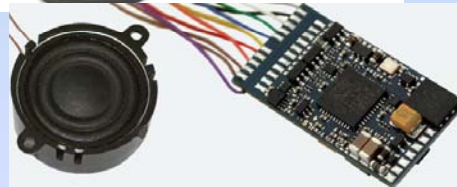
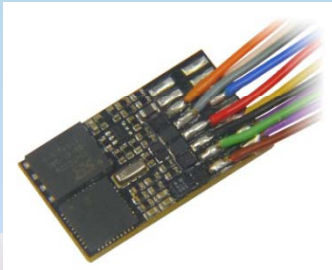
BY8001-16P

WAV & MP3 Files
24bit 48KHz
Good 3W Mono Amp
32GB Micro SD Card Max
Programmatic & Buttons

1			16
2	BUSY	DM	15
3	RX	DP	14
4	TX	GND	13
5	DACR	IO1	12
6	DACL	IO2	11
7	SPK1	IO3	10
8	SPK2	IO4	9
	VCC	IO5	

BY8001-16P

Other Sound Players



Sound Decoders
 Sound Clip Substitution
 DCC Control

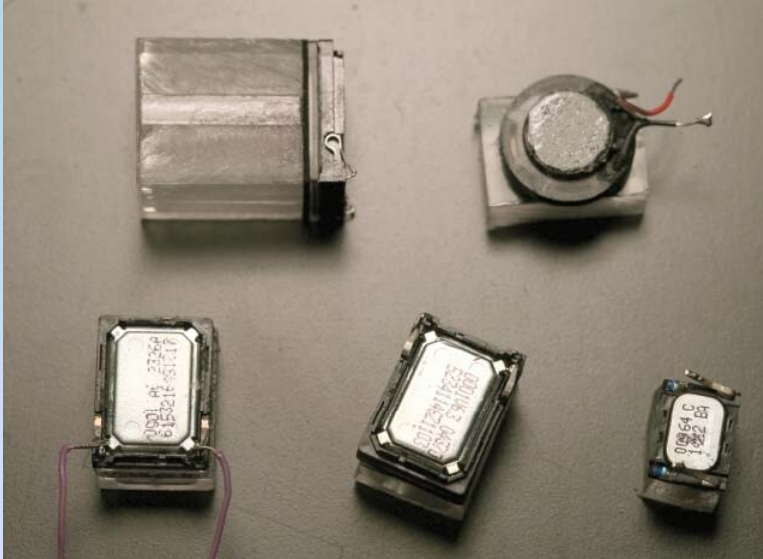
QSI
 Zimo
 ESU LokSound
 Digitrax

Sound Decoders
 Fully Programmable
 DCC Control

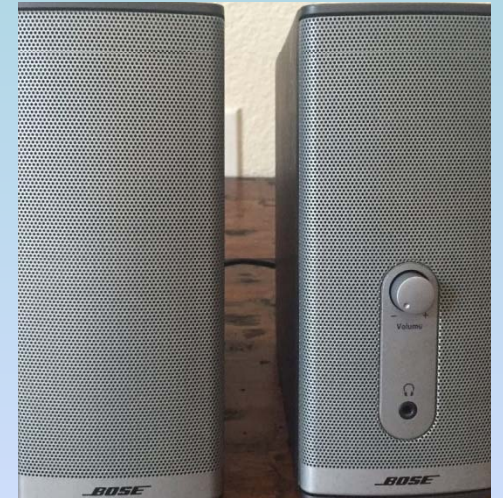
Digitrax
 ESU LokSound

Button Operated Modules
 Switched Control

Speakers



Cell Phone Speakers



Amplified Speakers



High Bass



iPhone 5



Made for DCC Sound (CliffWilliams.co.uk)



Enclosures and Baffles

Source Material: Sounds

Sound Sources:

**FreeSound.org
SoundDogs.com
Soundbible.com
Soundjay.com**



Youtube.com



Fantasonics.com



Personal Recordings

Sound Tools



Sound Recorders

Sound Editors (Free Software)

- **NCH WavePad**
<http://www.nch.com.au/wavepad>
- **(Open Source) Audacity®**
<http://audacityteam.org>
- **Nero Wave Editor**
<http://www.nero.com/enu/downloads>

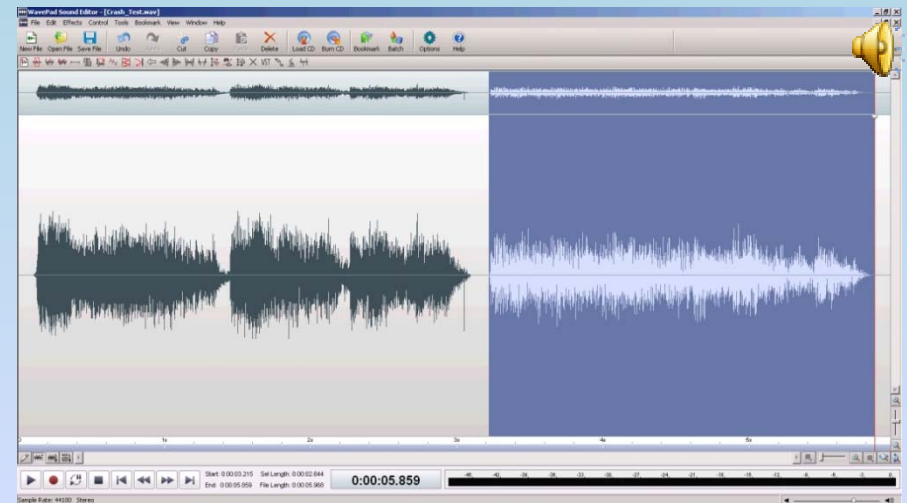
The Sound Editor--Essential in Your Toolbox



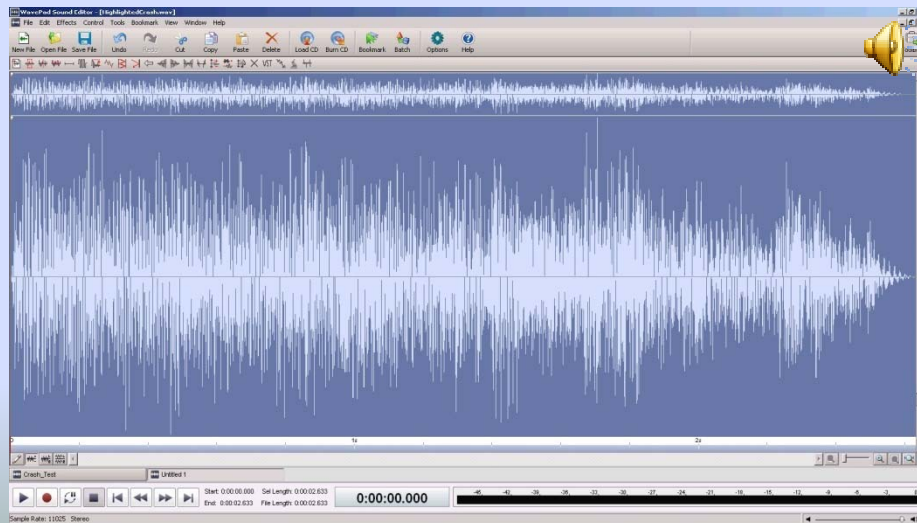
A "Example" Edit for Animation



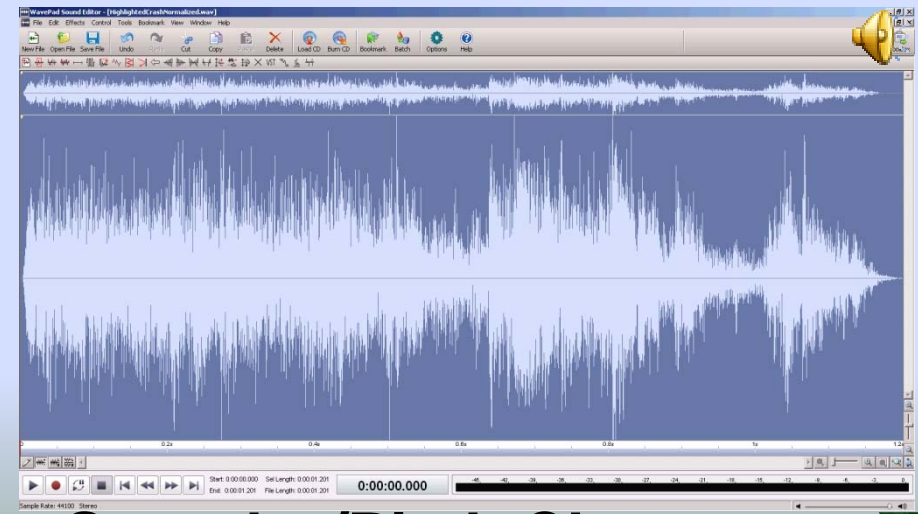
Original Sound



Highlight, Cut, & Paste Sound

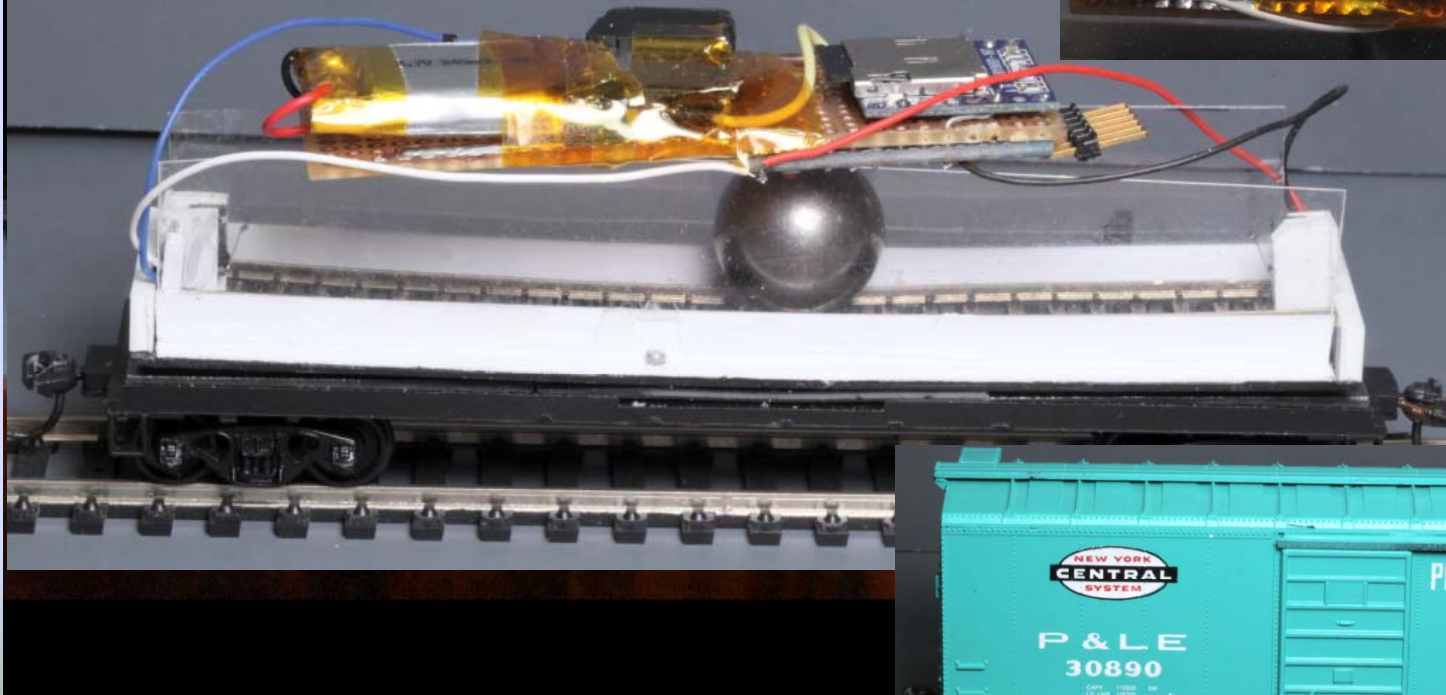
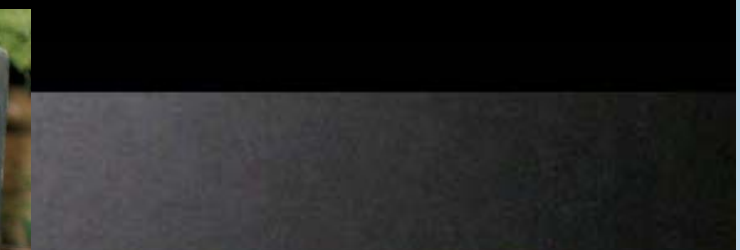


Normalize Sound



Sound w/Pitch Change

John Allen Revisited



Constructing Your Sound

- **Gather your Source Recordings**
- **Highlight, Cut, Paste and Save Clips**
- **Assemble and/or Combine Your Sounds into Playable Segments as Needed**
- **Amplify, Normalize, Attenuate, etc.**
- **Add Effects (Equalization, Reverb, Pitch Change, etc.)**
- **Re-code (re-Format) to Match Your Player**
- **Load and Listen**

But the most Important Tool...

Visual ← — — — — — → Audio



**When all is said and done,
we judge our models by what we see and hear...
So Trust your Ears, and Have a Go!!!**

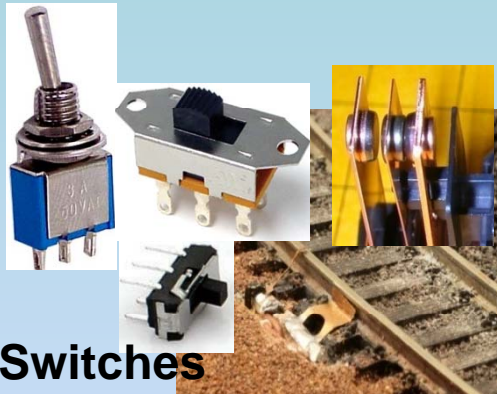
Timing, Cueing, & Synchronization

- **Consider Animation as a sequence of actions**
 - **Move** this...
 - **Play** these **sounds**...
 - **Set** this **speed**...
 - **Turn** this light **on**... **off**... **on**... ..
 - **Wait** so long...
 - **Wait until** something happens...
- **How does an action start ?**
- **What are the delay times among actions ?**
- **How are the actions coordinated ?**
- **How does an action end ?**

Triggers & Cueing

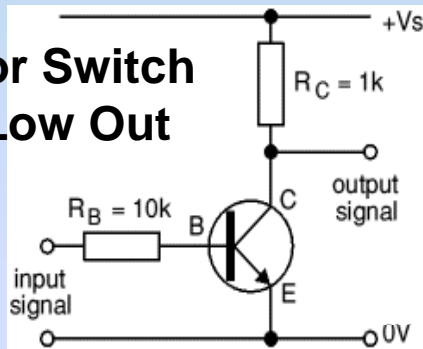
- A **Trigger** is a detectable change
 - Switch closure: **metal contacts, push button, switch...**
 - A sensor change: **optical sensor, magnetic sensor...**
 - The end of a timer: **mechanical or electrical or program**
- A **Timer** is some mechanism that has a known delay
- A **Sequencer** provokes one or more actions at different time intervals
- **Cueing** is the coordinated **start** of multiple actions—like movement start and sound generation
- Action ends with:
 - Completion of sequence
 - End of time period
 - Ending trigger
 - No end – continuous loop

Triggers

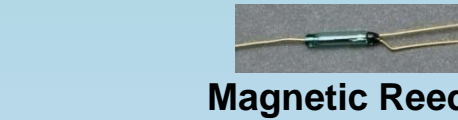


Switches

Transistor Switch
Hi In – Low Out



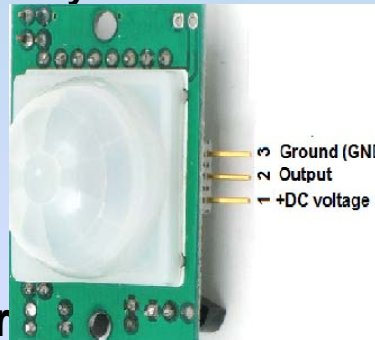
Relays (5V & 12V)
(Switch on a Switch)



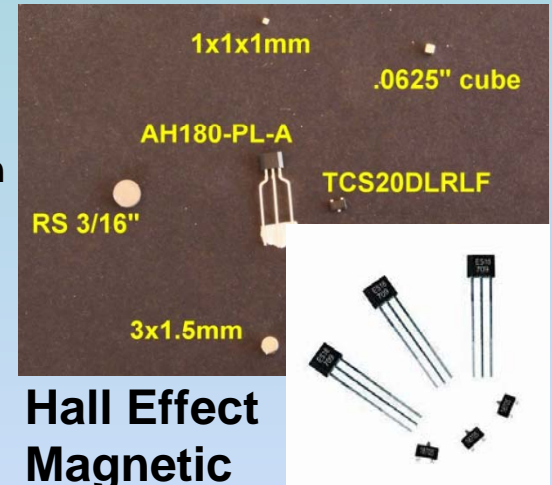
Magnetic Reed Switch



IR Proximity Sensor



Sensor
(Environmental Switches)



Hall Effect
Magnetic
Sensors

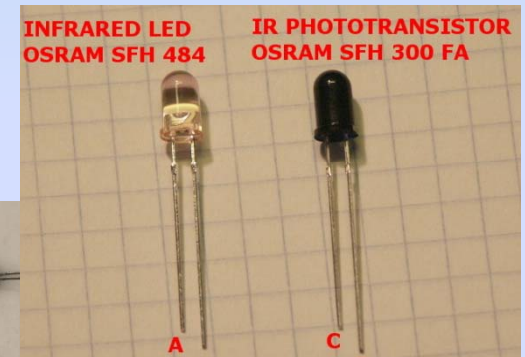


Photo LEDs & Transistors



CAM Input DCC Decoders

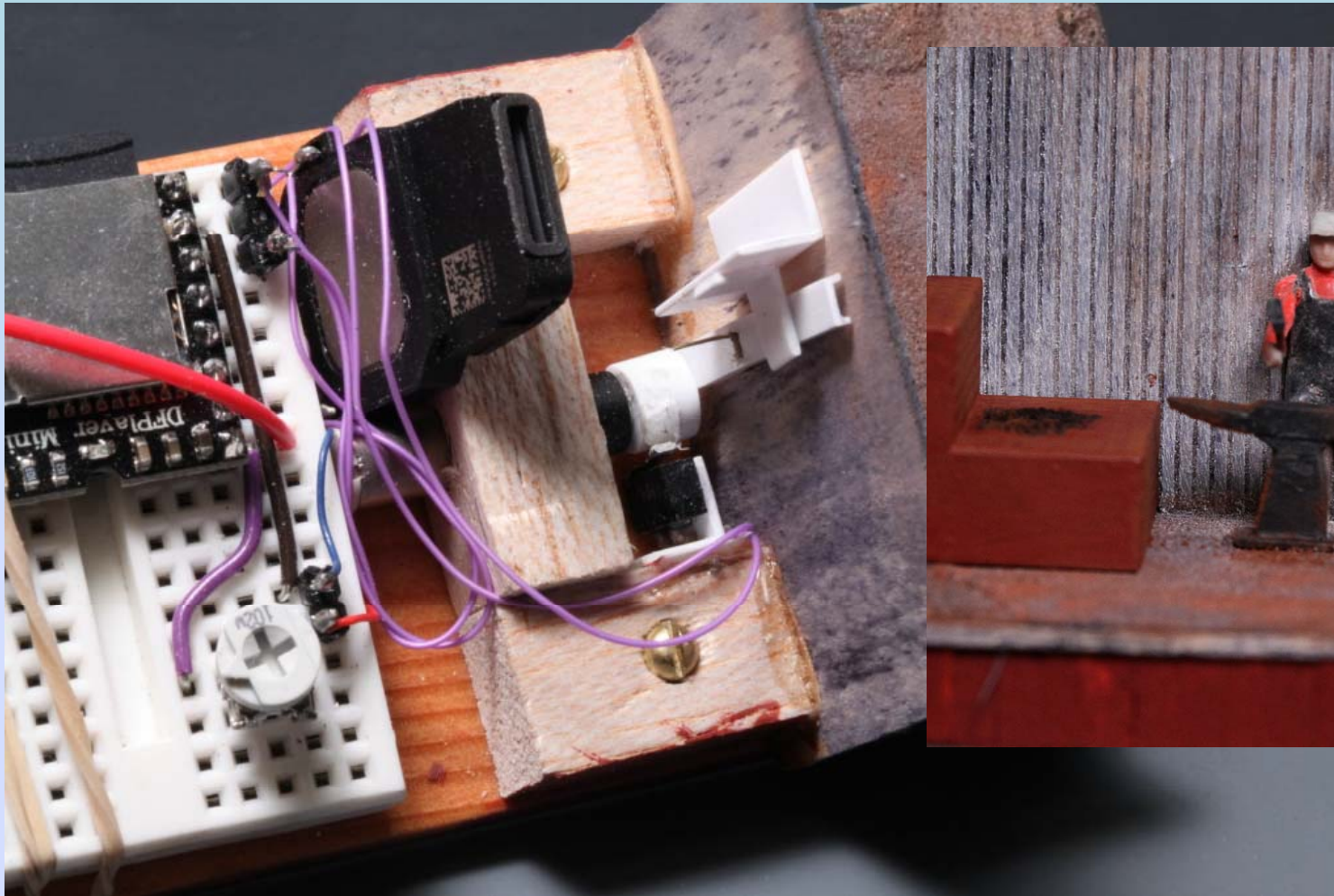
Example: Hammer and Anvil



- **Simple Contact Trigger**
- **Single Sound Played with Sound Module BY8001-16P**
- **Cell Phone Speaker**



Example: Hammer and Anvil



- **Simple Contact Trigger**
- **Single Sound Played with Sound Module BY8001-16P**
- **Cell Phone Speaker**

Programmed Timing & Sequencing

Why Bother?

- **Way More Flexibility Than ANY other Method**
- **Low Cost**
- **Easy to Modify/Change**

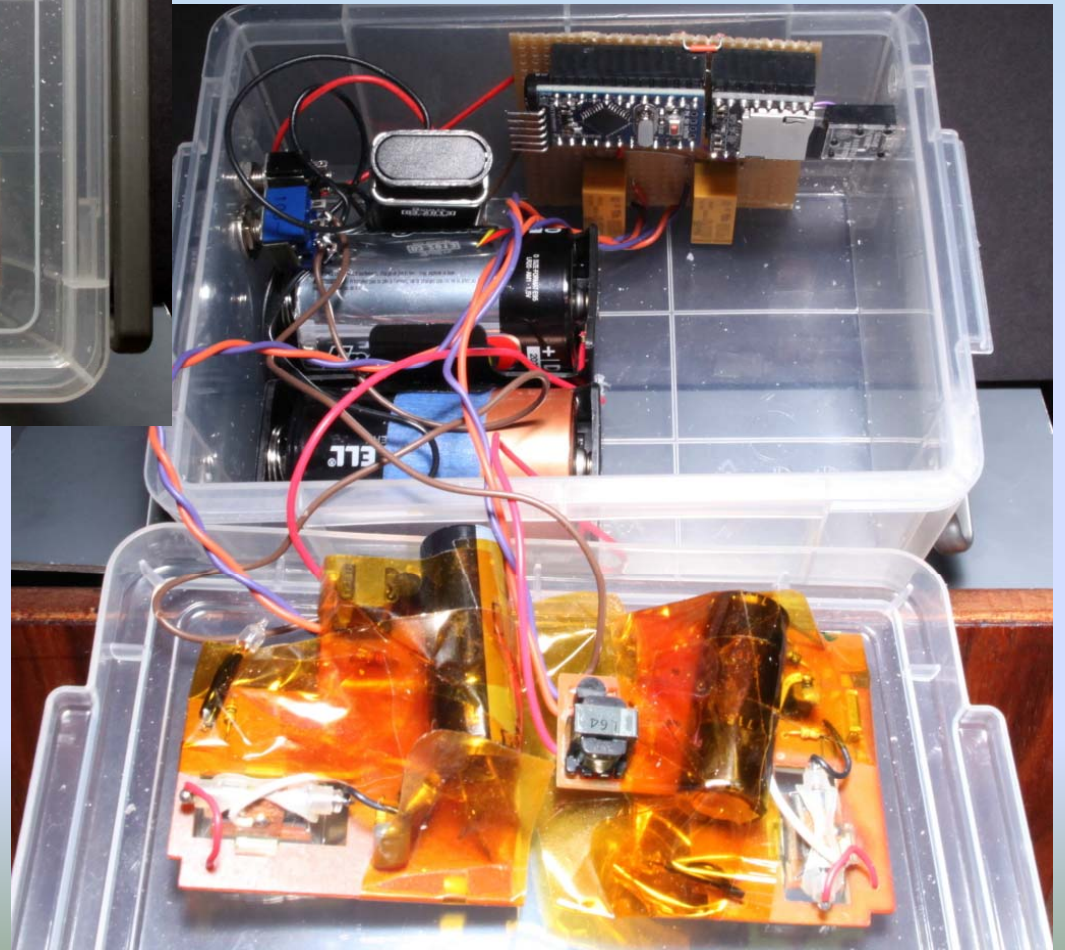
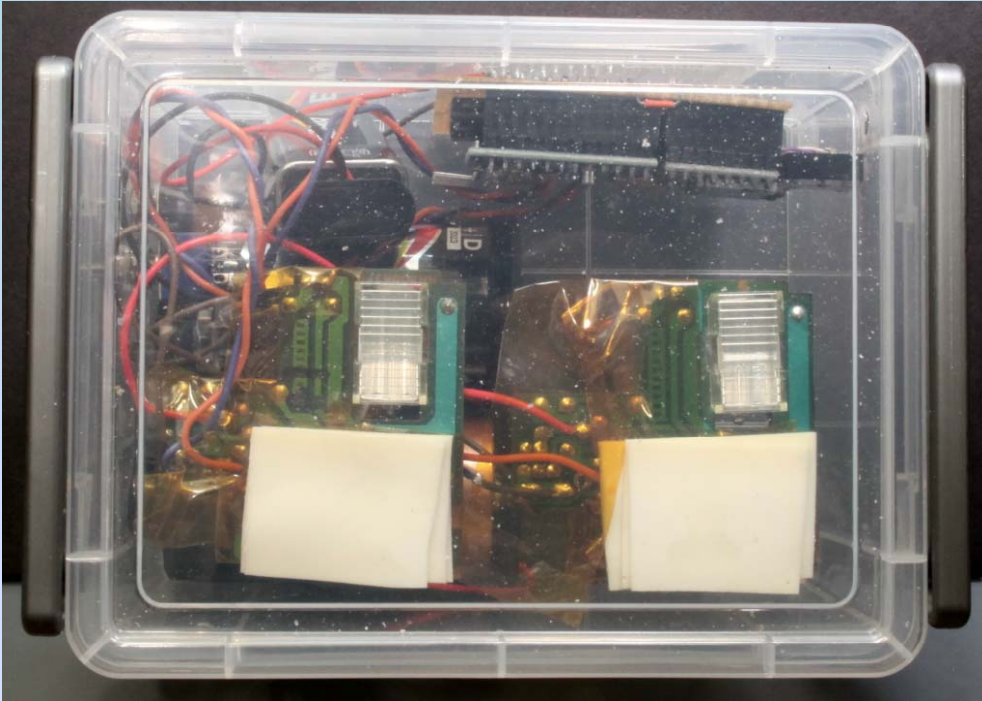
- **Multiple triggers**
- **Multiple Kinds of Triggers**
- **Lights, Motors, Relays, Servos, Sensors**
- **Pseudo Random Sequencing**
- **Different Sequences Can Run Simultaneously**
- **DCC Library Already Written**
- **Support For Sound Generators (MP3, WAV & AD4)**
- **Additional Tutorials, Books, Libraries, Examples**

Thunderstorm in a Box

- Long and short time delays
- Randomized timing
- Easy to Modify/Change
- Coordination of light and sound
 - Multiple thunder sound clips
 - Clips Sequenced with strobe lightning
 - Flash-to-Sound timing shorter as storm nears
- Clips combined to form alternate sequences



Thunderstorm in a Box

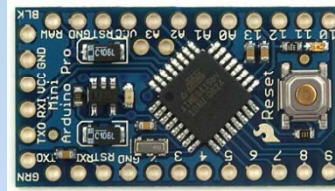


Programmed Timing & Sequencing



Arduino Uno \$11-\$30 Qty1

Arduino Pro Mini

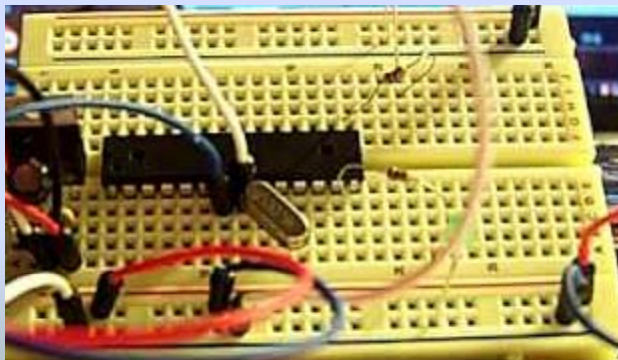


~~\$3.84~~ \$2.25!! Qty 1
ebay.com/itm/221030168024

<http://www.arduino.cc>
<http://sparkfun.com>
<http://www.adafruit.com>



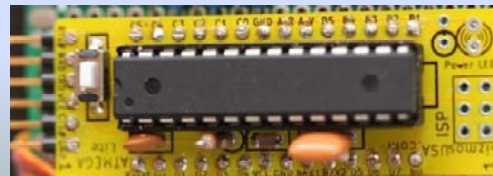
Digispark



Solderless Breadboard



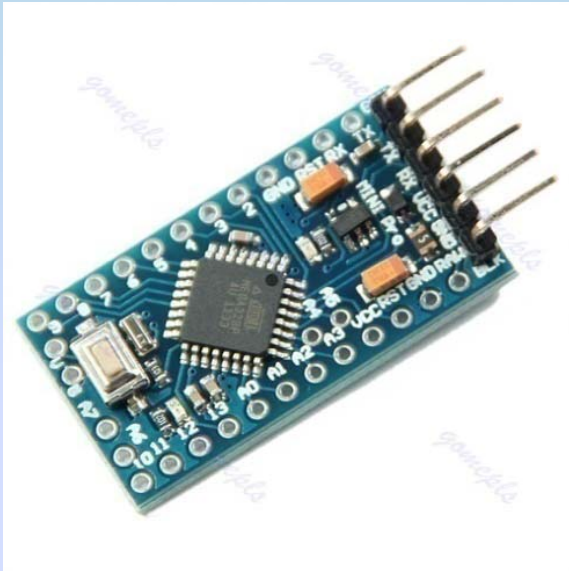
Atmel ATmega328P
Mouser.com \$3.24 Qty1



Atmel 328P on SurplusGizmos.com
Atmel Lite Kit \$6.75 Kit Only

Alternatives:
MC PIC Processor
TI LaunchPad
Many Others

The Essentials for Programmed Sequencing



[ebay.com/itm/221030168024](https://www.ebay.com/itm/221030168024)

Arduino Pro Mini-\$2.25



tinyurl.com/ld6sgy3

USB to Pro Mini Cable-\$8.48 (Need One)

PLUS

arduino.cc/en/Main/Software

arduino.cc

Download Software for FREE

Example: Triggered Crossbucks Flashers

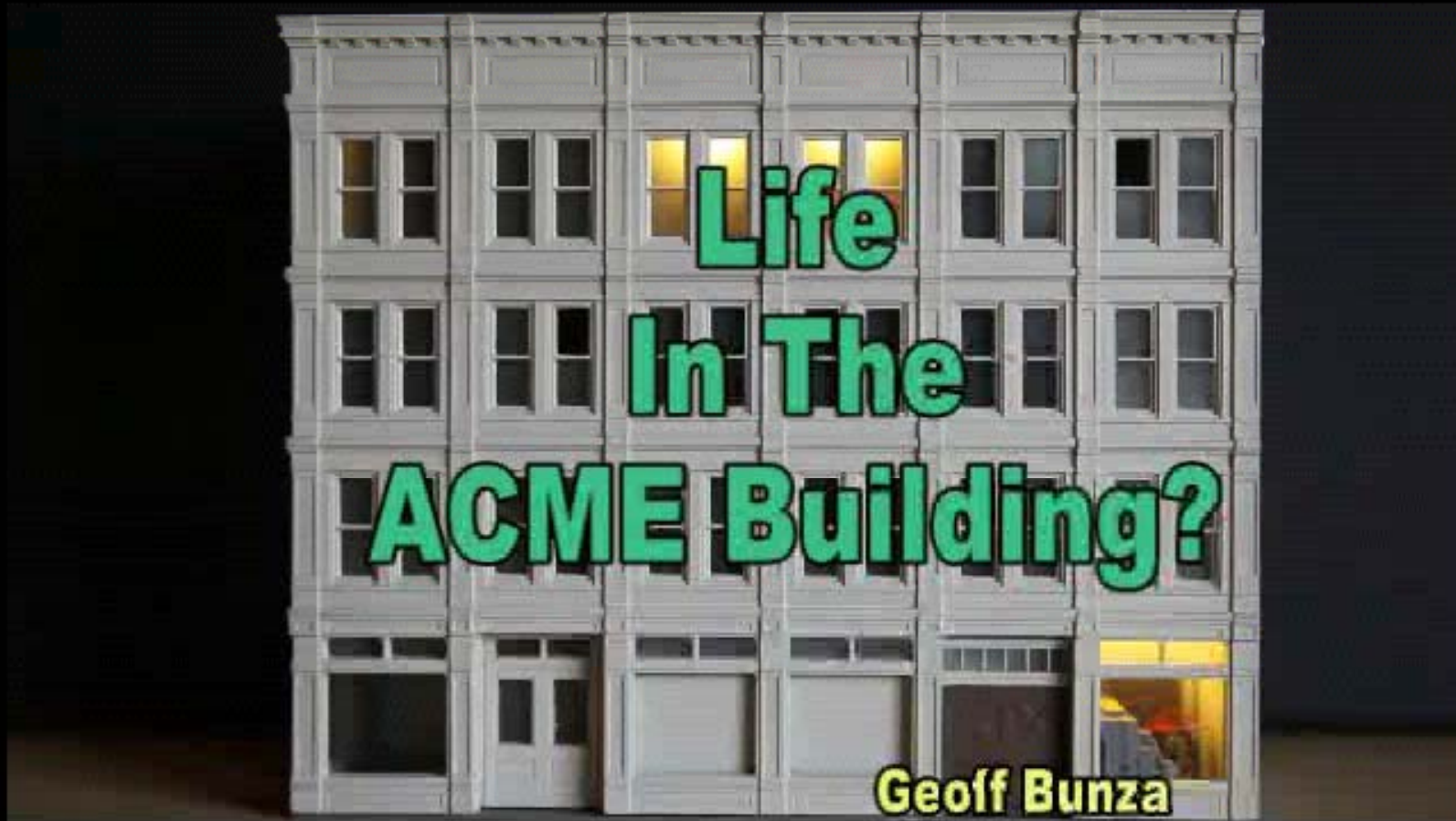
First, Learn to Read, Copy and Edit

// Blink Crossing Signal LEDS

```
void setup() { //This setup section runs ONCE when you press reset or on power up
    pinMode(12, INPUT); // Set up Digital pin 11 as an input
    pinMode(10, OUTPUT); // Set up Digital pin 12 as an output
    pinMode(11, OUTPUT); // Set up Digital pin 13 as an output
}

void loop() // This loop section runs OVER AND OVER again forever
{ if (digitalRead(12)==LOW) //Check if the Pushbutton is pressed (LOW=pressed)
    { // This sequence is run if the button IS pressed
        digitalWrite(10, HIGH); // turn one Flasher on (HIGH is the voltage level)
        digitalWrite(11, LOW); // turn the other Flasher off (LOW is the voltage level)
        delay(1000); // wait for a second – 1000 milliseconds
        digitalWrite(10, LOW); // turn one Flasher off (LOW is the voltage level)
        digitalWrite(11, HIGH); // turn the other Flasher on(HIGH is the voltage level)
        delay(1000); // wait for a second – 1000 milliseconds
    }
    else { // This sequence is run if the button is NOT pressed
        digitalWrite(10, LOW); // turn one Flasher off (LOW is the voltage level)
        digitalWrite(11, LOW); // turn the other Flasher off (LOW is the voltage level)
    }
}
```

Building Lights, Sound, & Motion



Via DCC Control: Animate a Crane



- Prototypical Steam Boiler, Whistle, Bell, and Mechanical sounds
- DCC commands Are Sequenced via JMRI to Provide the Timing



Synchronized Light, Sound, & Motion

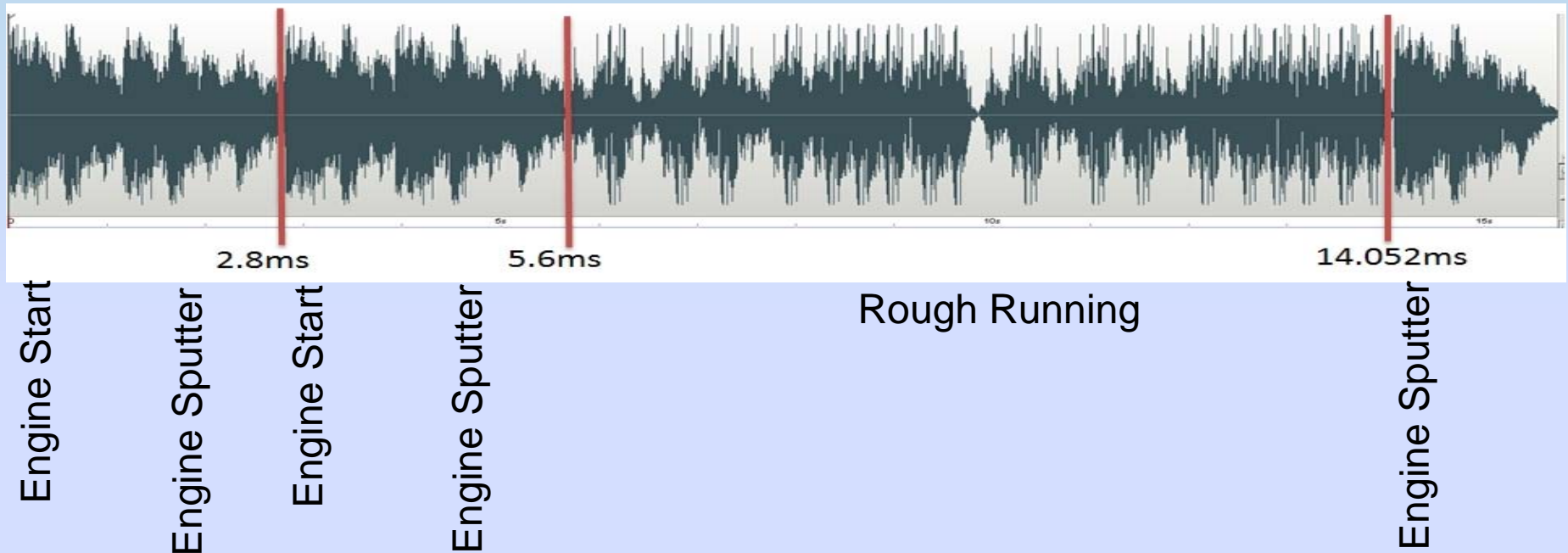


**DCC
&
Direct
Control**



Tying Motion to Sound

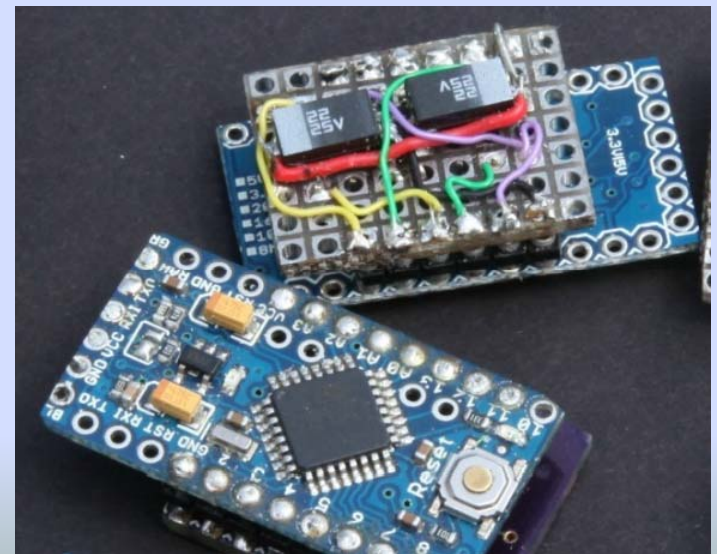
Floatplane Engine Sound Clip as shown in Sound Editor
(Audacity, Nero Wave Editor, WavePad Sound Editor, etc.)



**These events match the delays in the program
Which provides the necessary synchronization
throughout the sound clip**

Programmed Control and DCC

- Adding the figure enhances and complicates the animation
- DCC Software Library (CmdrArduino) for Arduinos
(Downloadable from: www.Railstars.com)
Gives you direct DCC control
- Simultaneous Direct Control of All Pins
- Finer Control of Timing and Functions
- Using Arduino Pro Mini & TI SN754410 Driver



Sequencing Weaves the Animation into a Story

```
functs ^= funct4;
dps.setFunctions0to4(locoAdr,DCC_SHORT_ADDRESS,functs); // F4 rear cabin lights on
wait_dcc(4000); //Wait 4 seconds
functs =functs|funct3;
dps.setFunctions0to4(locoAdr,DCC_SHORT_ADDRESS,functs); // F3 front cabin lights on
wait_dcc(4000); //Wait 4 seconds
functs =functs|funct0;
dps.setFunctions0to4(locoAdr,DCC_SHORT_ADDRESS,functs); // F0 Landing Lights on
wait_dcc(4000); //Wait 4 seconds
functs = functs|funct2;
dps.setFunctions0to4(locoAdr,DCC_SHORT_A
wait_dcc(1); //Wait for the queue
dps.setSpeed128(locoAdr,DCC_SHORT_ADD
wait_dcc(1425); //Wait 1.425 seconds
dps.setSpeed128(locoAdr,DCC_SHORT_ADD
wait_dcc(1400); //Wait 1.4 seconds
dps.setSpeed128(locoAdr,DCC_SHORT_ADD
wait_dcc(1425); //Wait 1.425 seconds
dps.setSpeed128(locoAdr,DCC_SHORT_ADD
wait_dcc(1400); //Wait 1.4 seconds
dps.setFunctions0to4(locoAdr,DCC_SHORT_A
dps.setSpeed128(locoAdr,DCC_SHORT_ADD
wait_dcc(629);
digitalWrite(arm_pin1, 1);
wait_dcc (4940);
digitalWrite(arm_pin1, 0);
wait_dcc(2883);
functs =funct3|funct4|funct0; // Leave only the
dps.setFunctions0to4(locoAdr,DCC_SHORT_A
```



Useful Links and Sources:

Electronics Parts sources:

- <http://www.digikey.com> -- Commercial first quality parts
- <http://www.mouser.com> -- Commercial first quality parts
- <http://www.allelectronics.com> -- Surplus Parts, LEDs, motors
- <http://www.surplusgizmos.com> -- Surplus parts
- <http://www.goldmine-elec-products.com> -- Surplus parts
- <http://stores.ebay.com/ledbaron> -- Wired SMD micro LEDs
- <http://www.ngineering.com> -- Wire LEDs & tools
- <http://stores.ebay.com/tech-fixx> -- 38 Gauge Wire Source:

Arduino parts of all sorts:

- <http://sparkfun.com> -- Stuff for sale & reference material
- <http://www.adafruit.com> -- Stuff for sale & reference material
- <http://ebay.com/> -- Lowest cost Pro Mini boards

Arduino reference material:

- <http://www.arduino.cc> -- Arduino website: libraries, tutorials & reference
- <http://railstars.com/software/cmdrduino> -- Free DCC Software Library for Arduinos
- <http://tinyurl.com/mvqmrly> -- ModelRailroadingWithArduino2.pdf -- John Plocher
Clinic Slides from 2011 NMRA Convention in Sacramento, CA

This Presentation:

home.comcast.net/~gbglacier/Clinics/Modeling_w_Sound_NMRA2015.pdf

Clinic Supplemental Materials:

home.comcast.net/~gbglacier/Clinics/AnimationControl_Clinic_adds.zip

Here are links to some of my animation articles which are all in free online Modeling Magazines:

Using Micro LEDs on Your Layout

MRH model-railroad-hobbyist.com/magazine/mrh-2012-02-feb (Page 74)

Crossbucks and Crossing Gates

NYCSHS nycshs.org/pdf/NYCM_2Q2012.pdf (Page 24)

Bring a Wrecking Crane to Life

MRH tinyurl.com/mjtwdp4 (Cover Article, Page 53)

Teach Your Engineers to Turn Heads

MRH publ.com/5nm2Wxy#/100

Scale Flash Photography

MRH mrhpub.com/2013-07-jul/land/#/51

Scale Model Animation Adding Life to a Layout

Railroad Model Craftsman Magazine, May 2014

Battery Powered Models in HO Scale

MRH mrhpub.com/2014-11-nov/land/#/83

Starting from Scratch with an Arduino Pro Mini (or Moteino)

mrhpub.com/2014-11-nov/land/#99

You can read my Scale Model Animation blog here (Animation & DCC decoders):

<http://model-railroad-hobbyist.com/blog/geoff-bunza>

and you can see additional videos on my YouTube channel on animation:

youtube.com/user/DrGeoffB

I hope you enjoy them too!

A **Step by Step Cookbook for the Modeler Using the Pro Mini** can be found here:
Starting from Scratch with an Arduino Pro Mini (or Moteino):
mrhpub.com/2014-11-nov/land/#99

A good start for the Arduino Learning curve would be the tutorials at:
arduino.cc/en/Tutorial/HomePage

and there are allot of topics there for search for a subject or browse

or

instructables.com/files/orig/F3J/MTJN/FVW22MXN/F3JMTJNFVW22MXN.pdf

or

richardvannoy.info/arduino.php

or

arduino-info.wikispaces.com/TUTORIALS

Now these offer info at different learning levels so pick one you are comfortable with,
or ask a specific question and I will point you in the right direction.

If you are using an Arduino Pro Mini (cheapest full function available) try:

arduino.cc/en/Guide/ArduinoProMini for getting started.

For combining DCC decoder control of Building Lighting animation try:

Scale Model Animation 18: DCC Control for Random Building Lighting

model-railroad-hobbyist.com/node/23026

Modeling with Sound Scale Model Animation



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