

# Donation Box - ZOO

## Electrical Operation

### Introduction

From previous documentation, the electrical circuits were designed in Fall of 2009. The system consisted of two protoboards with a 5 sound chips that played individual sounds through 5 individual speakers. When the box was brought back, many of the wires were deteriorating, solder joints had come loose, and the enclosure was not secure.

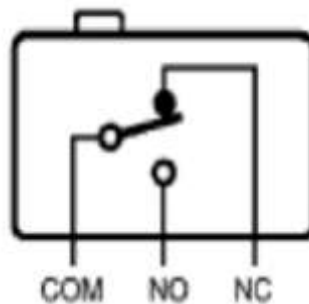
Summer 2018 team re-designed the electrical system, but kept the same functionality of the system. When coins are dropped into the plinko game, the coins will activate 1 of 5 mechanical switches to play a specific sound.

### Typical Operation

1. Coin is dropped into game
2. Coin activates mechanical switch, causing the switch to close and activates the normally open switch
3. Arduino reads 5V into the corresponding input pin
4. Depending on pin, the Arduino will utilize the MP3 shield to play 1 of 5 animal sounds through stereo speakers
5. System is ready to receive next mechanical switch trigger

### Hardware

#### Triggers



The mechanical triggers have 3 pinouts. The COM port is the lone port on the side (1). The normally open port is the first one closest to COM (2). When the switch is depressed, 5v will flow from COM to normally open, sending a signal to the Arduino.

## Wire Harness

The wire harness connects the mechanical switches to the logic board. It consists of a few commercial components that are used in everyday situations.



The circuit board side of the wire harness consolidates five mechanical switch *normally open* lines and a 5v line. This male side only plugs into the female portion one way. The stranded wires are fitted with female crimp pins, that insert into the 6-pin receptacle.



This is the female housing that the male receptacle will plug into on the circuit board. There are two notches that indicate the direction of installation. Be careful in removing the plug, as the crimped wires are delicate and might back out.



This is the spade terminal that the 5v and normally open pins will connect to on the wire harness. The wires are crimped into the insulated spade terminal and secure to the pinouts on the trigger. Be careful in removing the plug, as the crimped wires are delicate and might back out.

## Arduino & MP3 Shield

We utilized the Adafruit MP3 Shield to load and play the animal sounds. The MP3 shield has headers that sit on top of the original Arduino board. There are multiple pins that the MP3 shield requires to operate. See below from the Adafruit website.

There are three 'totally fixed' pins, the hardware SPI pins:

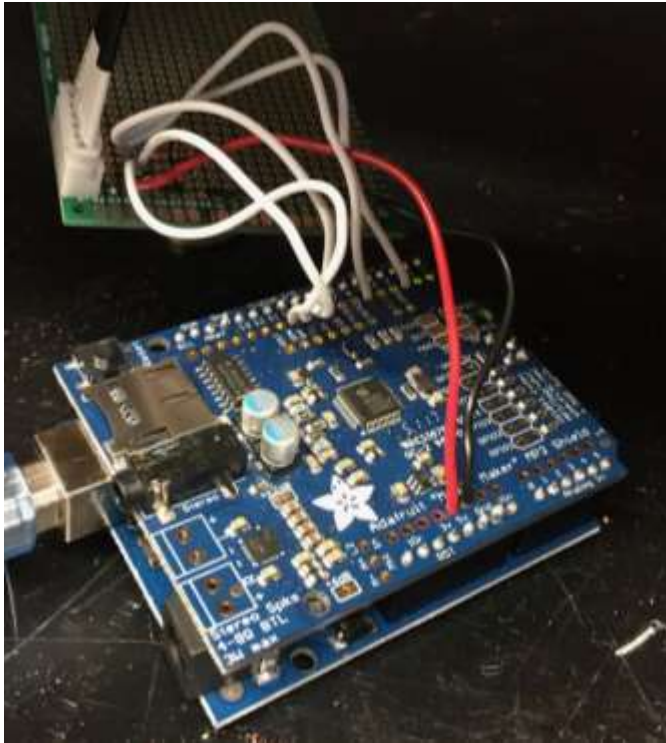
- **SPI SCK** - connected to Digital #13 (but can be connected to the ISP header with a jumper) - used by both the SD card and VS1053
- **SPI MISO** - connected to Digital #12 (but can be connected to the ISP header with a jumper) - used by both the SD card and VS1053
- **SPI MOSI** - connected to Digital #11 (but can be connected to the ISP header with a jumper) - used by both the SD card and VS1053

There are a couple other pins that are required for talking to the VS1053 to play MP3s and such

- **MCS** - this is the VS1053 chip select pin, connected to Digital #7
- **DCS** - this is the VS1053 data select pin, connected to Digital #6

- **CCS** - this is the SD Card chip select pin, connected to Digital #4
- **DREQ** - this is the VS1053 data request interrupt pin - connected to digital #3

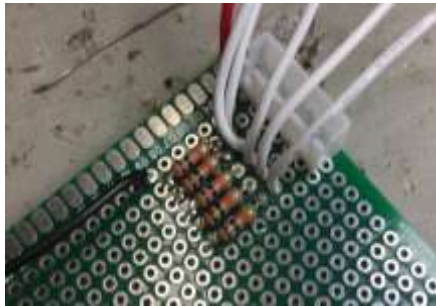
The wires that connect the pins to the protoboard are soldered to parallel pins on the MP3 shield. The pinout is below.



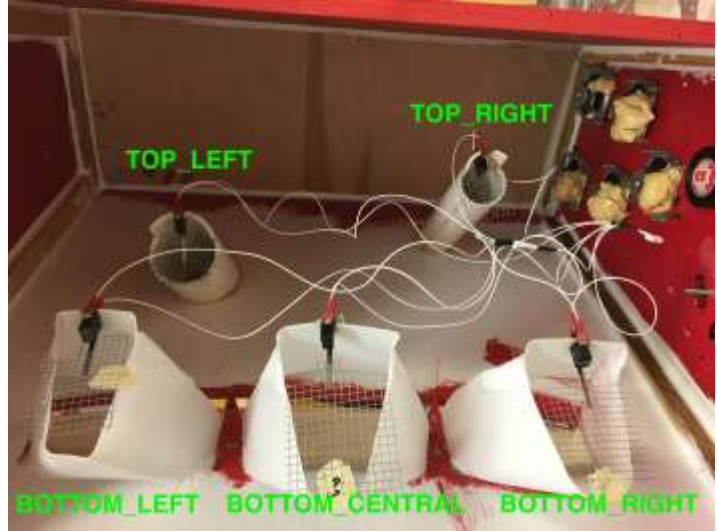
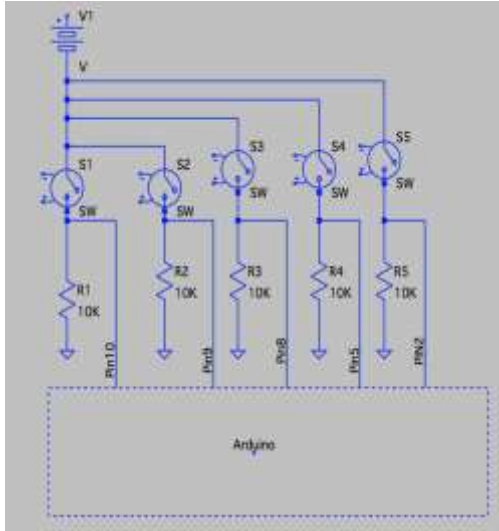
BOTTOM\_RIGHT\_SWITCH 2  
 BOTTOM\_CENTER\_SWITCH 5  
 BOTTOM\_LEFT\_SWITCH 8  
 TOP\_RIGHT\_SWITCH 9  
 TOP\_LEFT\_SWITCH 10

These switches will be defined in the protoboard section. Power is supplied to the Arduino via a battery enclosure. Details will be defined in the battery section.

## Protoboard



The protoboard houses the resistors and female receptacle for the wire harness. All connections are made on the back through solder points and wire.



The switches are labeled as follows to route to the protoboard.

## Battery Housing



The battery housing supports 4 AA rechargeable batteries. Each cell has a voltage of 1.2V, so total voltage provided is 4.8V to the Arduino. Positive and negative leads are wired through the voltage in male plug. Batteries should be recharged using the provided battery charger.

Be sure to switch the housing to OFF when not in use to preserve battery life.

## Software

### Environment setup

Using a USB 2.0 Type A/B cable, you can use the Arduino IDE to modify the program on the chip. Go to Tools and set the following options.

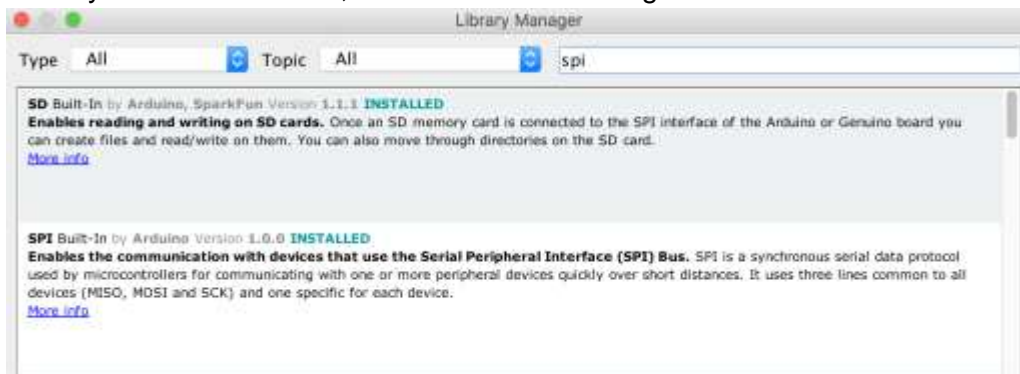
**Board:** "Arduino/Genuino Uno"

**Programmer:** "AVRISP mkII"

The provided program *donation\_box* uses a few third-party modules. Go to Sketch -> Include Libraries -> Manage Libraries...



Search *adafruit\_vs1053* in the search bar and install the library. SPI and SD libraries should already be installed. If not, search for the following libraries and install them.



## MP3 SD Card

The Adafruit MP3 Shield only supports files that are labeled as trackXXX.mp3.

## Arduino code

Please refer to *donation\_box.ino* for comments on functionality.

## Troubleshooting

### Sounds stop playing

Check ON/OFF switch on the battery housing

Check if the lights on the Arduino are ON

Manually check if the switches are actuating

### Wire harness is damaged

Determine which component of the wire harness is damaged

Removed damaged terminal or crimp and re-strip and re-crimp.

Verify functionality by manually actuating the switch.