IG-11 Head NeoPixel Construction

April 2020

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1 DISCLAIMER

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2 Overview

The IG-11 droid .stl files were purchased from the following link: https://www.etsy.com/listing/774617037/spacebobs-nurse-assassin-droid-head?ref=related-6

The intent of this document is to provide information on the methodology I used to enhance the droids head and detonator using NeoPixels.

The project materials utilized are summarized below and a detailed list of the components and associated links for purchasing the materials is listed in section 10 of this document.

- (1) Arduino Nano
- (1) NeoPixel LED Dots Strand – 20 LEDs with 4" pitch
- (1) 3-pin JST SM plug and receptacle
- (1) Panel Mount 2.1mm DC barrel jack
- (1) NeoPixel Mini Button PCB – Pack of 5
- (1) NeoPixel Jewel – 7 x 5050 RGB LED with Integrated Drivers
- (1) 5 VDC Wall Power Adapter (2000mA) – Connector 2.1mm plug

Prior to starting you should have the IG-11 upper body complete. Since each lens is glued in place, I completed the spray-painting process of the head prior to gluing in each lens. This ensures that you do not have to mask off each lens prior to painting.

You should test that you have everything wired correctly by running the NeoPixel code via the Arduino on a test bench prior to installing the NeoPixels on the IG-11. Just hook up everything in a temporary fashion on a test bench to make sure your solder joints are good and everything is functional. This initial troubleshooting step is much easier to do prior to the actual installation.

3 3D Printed Files

3.1 Arduino Head Mounting Bracket

The mounting bracket shown below is glued to the inner portion of the IG-11 Head. The bracket is contoured to provide a gluing surface to the inner portion of the head. There are (2) screw holes on the flat side of the bracket that will be used to affix the Arduino Nano holder.

I used PLA to create the IG-11 Head Mounting Bracket

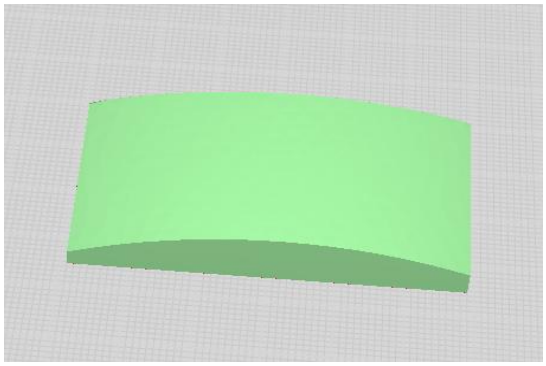

Figure 3-1 Holder Glue Side

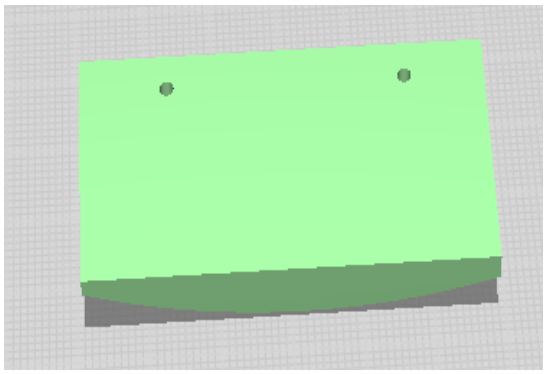

Figure 3-2 Arduino Mount Side

3.1.1 Arduino Head Mounting Bracket Location

The mounting bracket is glued in the position shown below.

Figure 3-4 Arduino Nano Bracket Location

3.2 Arduino Nano Holder

The Arduino Nano Holder is shown below.

I used PLA to create the IG-11 Arduino Nano Holder

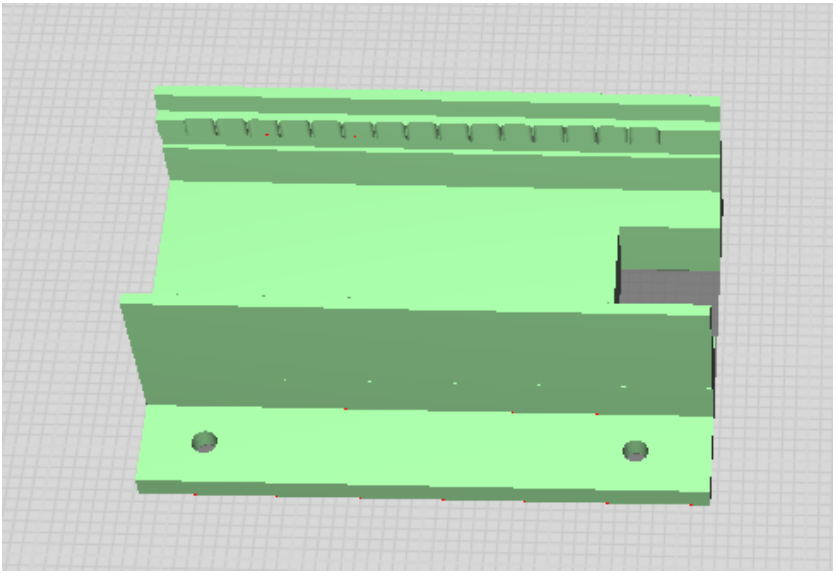

Figure 3-5 Arduino Nano Holder

3.2.1 Placing Arduino Nano in Holder

The Arduino Nano is placed in the holder as shown below.

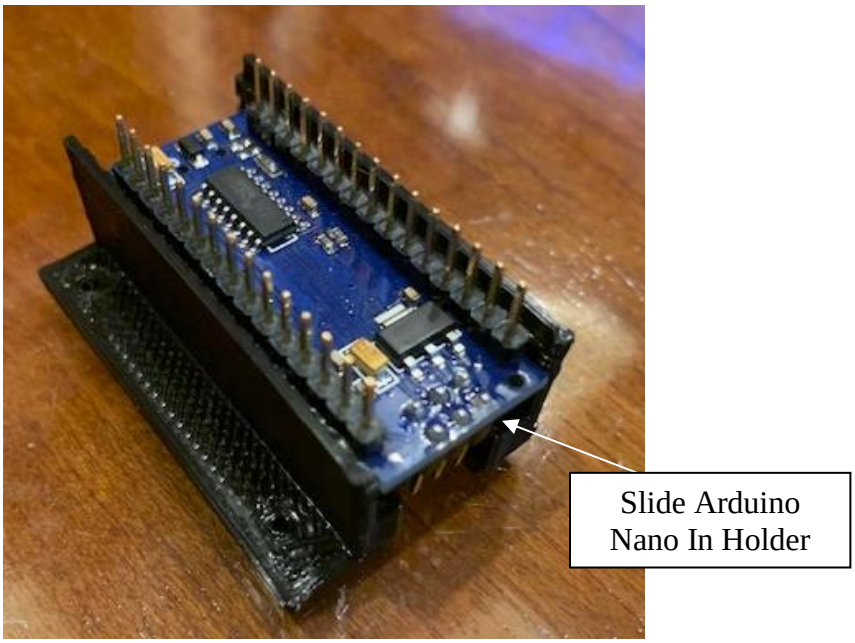

Figure 3-6 Arduino Nano Holder

Figure 3-7 Arduino Nano Holder

3.2.2 Mounting Holder to Bracket

The Arduino Nano with holder is mounted to the head mounting bracket as shown below.

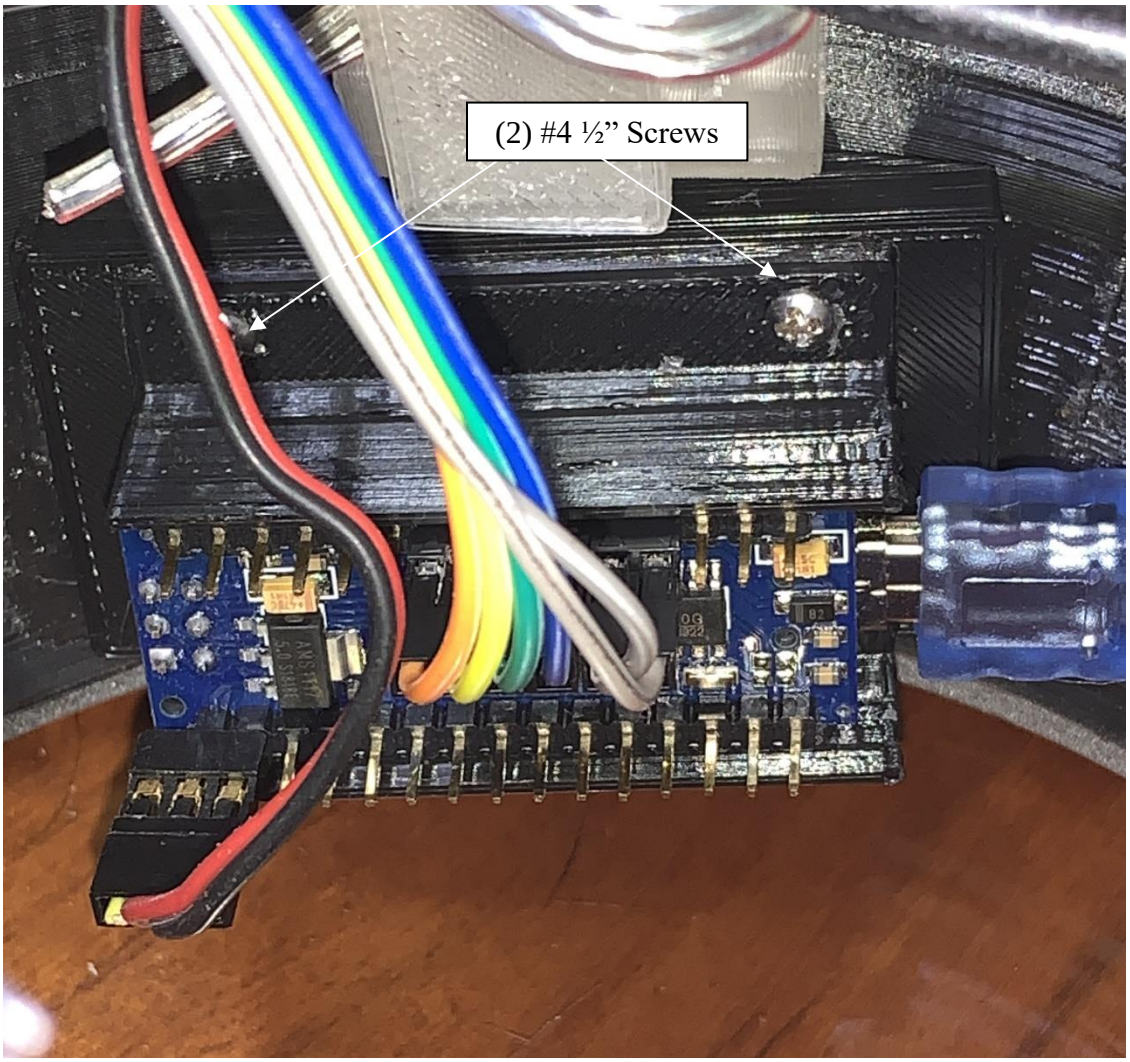

Figure 3-8 Arduino Nano Holder Mounted to Bracket

3.3 Lens and Lens Retainer

Each Lens and Lens Retainer is printed with WYZworks 3D Printer Filament ABS Clear filament. You will need a total of (9) lenses and retainers. Once printed, I sanded the round portion of the lens with 400 grit sandpaper to diffuse the NeoPixel.

Figure 3-9 ABS Filament

The settings to print the Lenses that I used are listed below:

- Layer Height = .25 mm
- Infill Density = 20%
- Printing Temperature = 240 Degrees C
- Bed Plate Temperature = 110 Degrees C
- Supports = Yes
- Support Pattern = Lines
- Support Density = 15%
- Adhesion Type = Skirt

With this support type, they are minimal and can easily be removed with your fingers.

3.4 Head Lens and Lens Retainer Files

The Head lens and retainer .stl files are included in the files section and appear as follows:

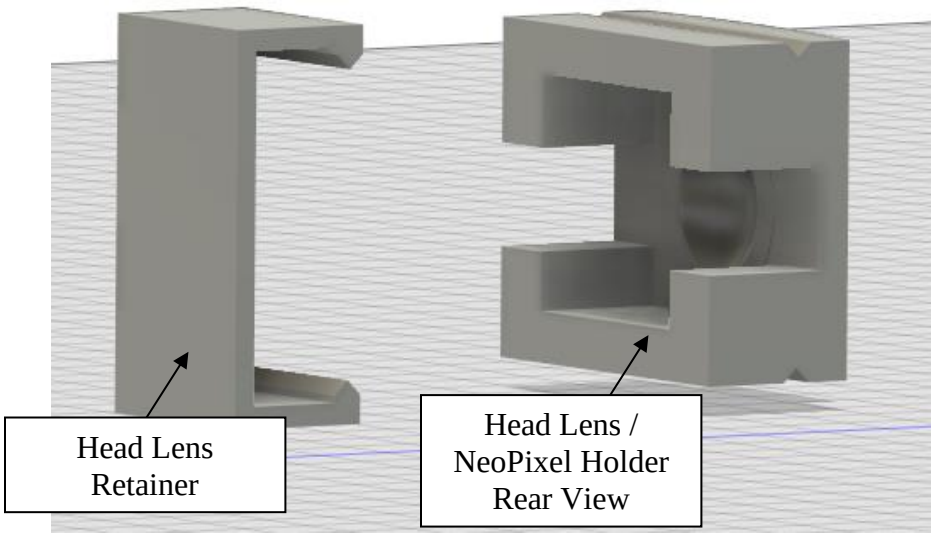

Figure 3-10 Lens and Retainer Rear View

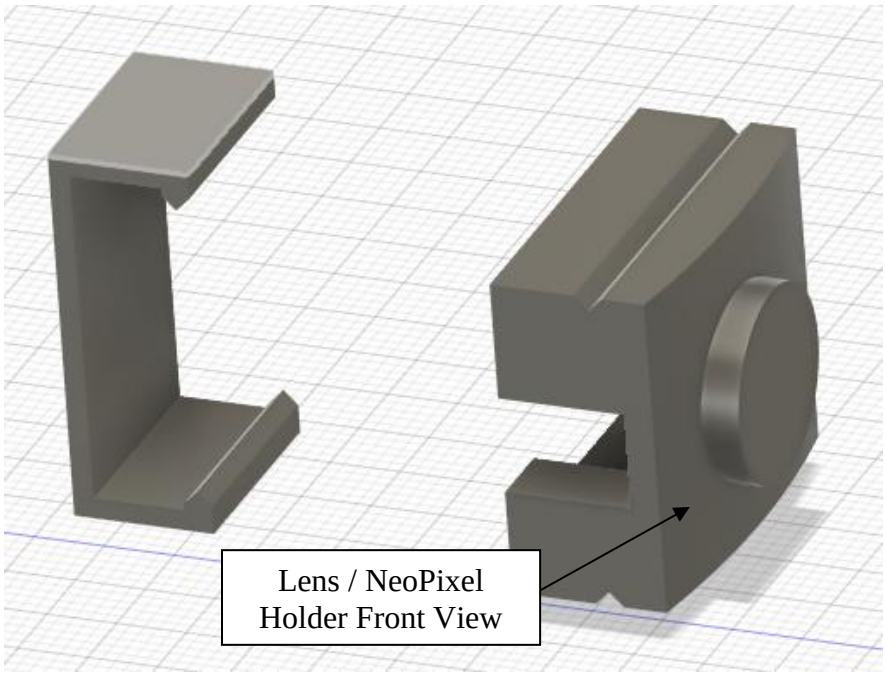

Figure 3-11 Lens and Retainer Front View

3.5 Detonator Holder and Cap

The Detonator NeoPixel Jewel holder and cap is shown below. I used WYZworks 3D Printer Filament ABS Clear filament to print both pieces.

The Detonator holder lens and retainer .stl files are included in the files section and appears as follows:

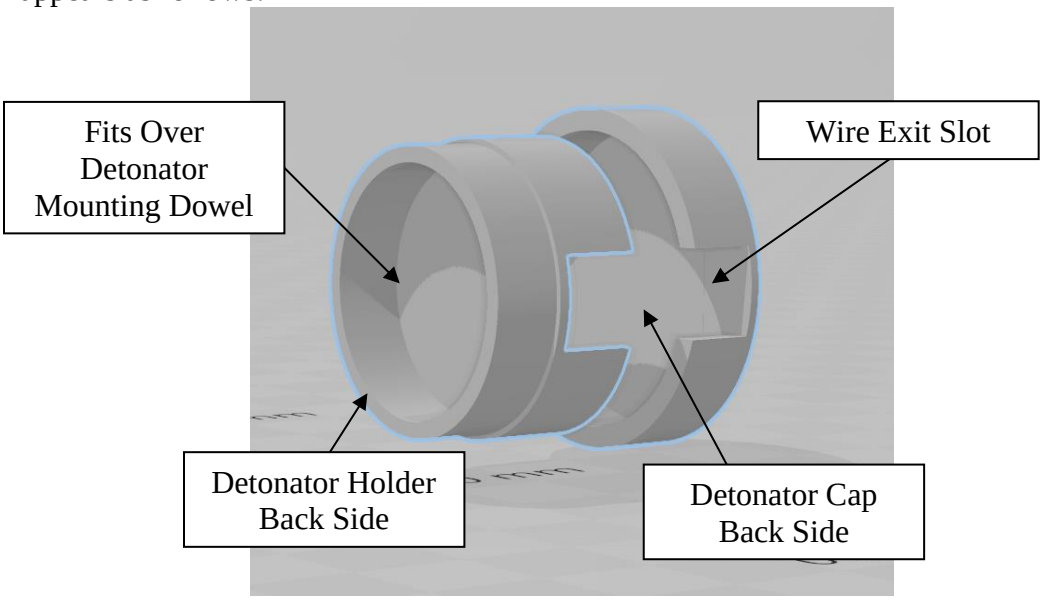

Figure 3-12 Detonator Holder and Cap Rear View

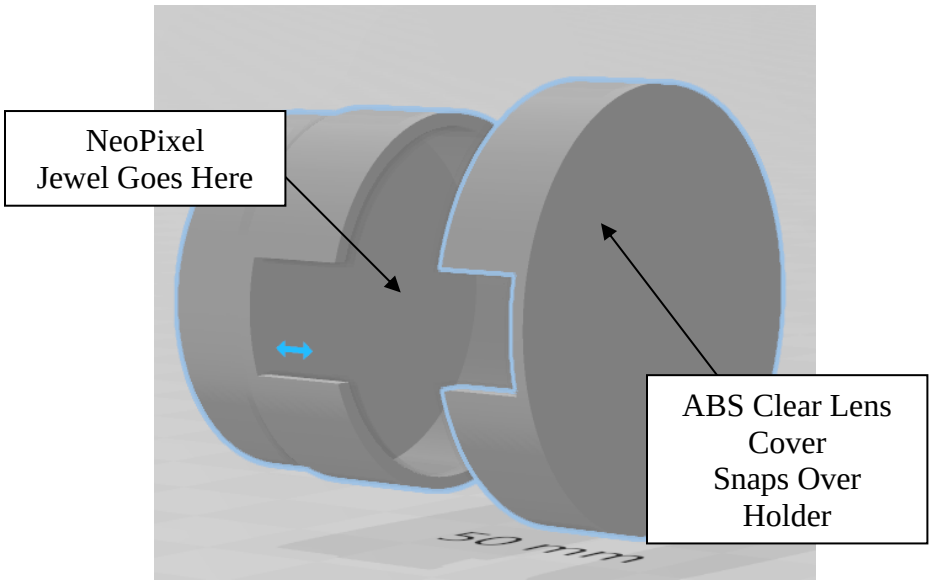

Figure 3-13 Detonator Holder and Cap Front View

I had issues printing the Detonator holder and retainer. To resolve this, I used the settings below. I printed the Detonator Holder and Retainer as an afterthought on a different printer so I am not sure about what changed but these values worked.

- Layer Height = .25 mm
- Infill Density = 100%
- Printing Temperature = 240 Degrees C
- Bed Plate Temperature = 110 Degrees C
- Supports = Yes
- Support Pattern = Lines
- Support Density = 15%
- Adhesion Type = Brim
- Cooling = Off
- Top Layer = 2

3.6 Eyes and Long Tube Lens

The Eyes and Long Tube have a diffuser lens installed. The lens is shown below. I used WYZworks 3D Printer Filament ABS Clear filament to print three lens pieces.

The Eye and Long Tube Lens .stl file is included in the files section and is shown below:

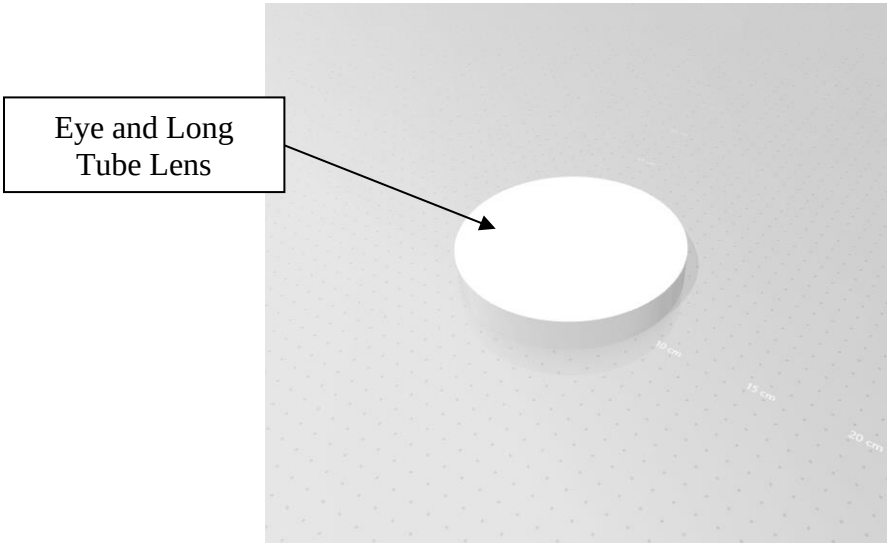

Figure 3-14 Eye(s) and Long Tube Lens

3.7 Long Tube Sleeve / Spacer

A spacer was placed in the long tube so the NeoPixel would not recess too far into the tube. I used eSun PLA + Filament to print the Long Tube Spacer.

The Long Tube Spacer .stl file is included in the files section and is shown below:

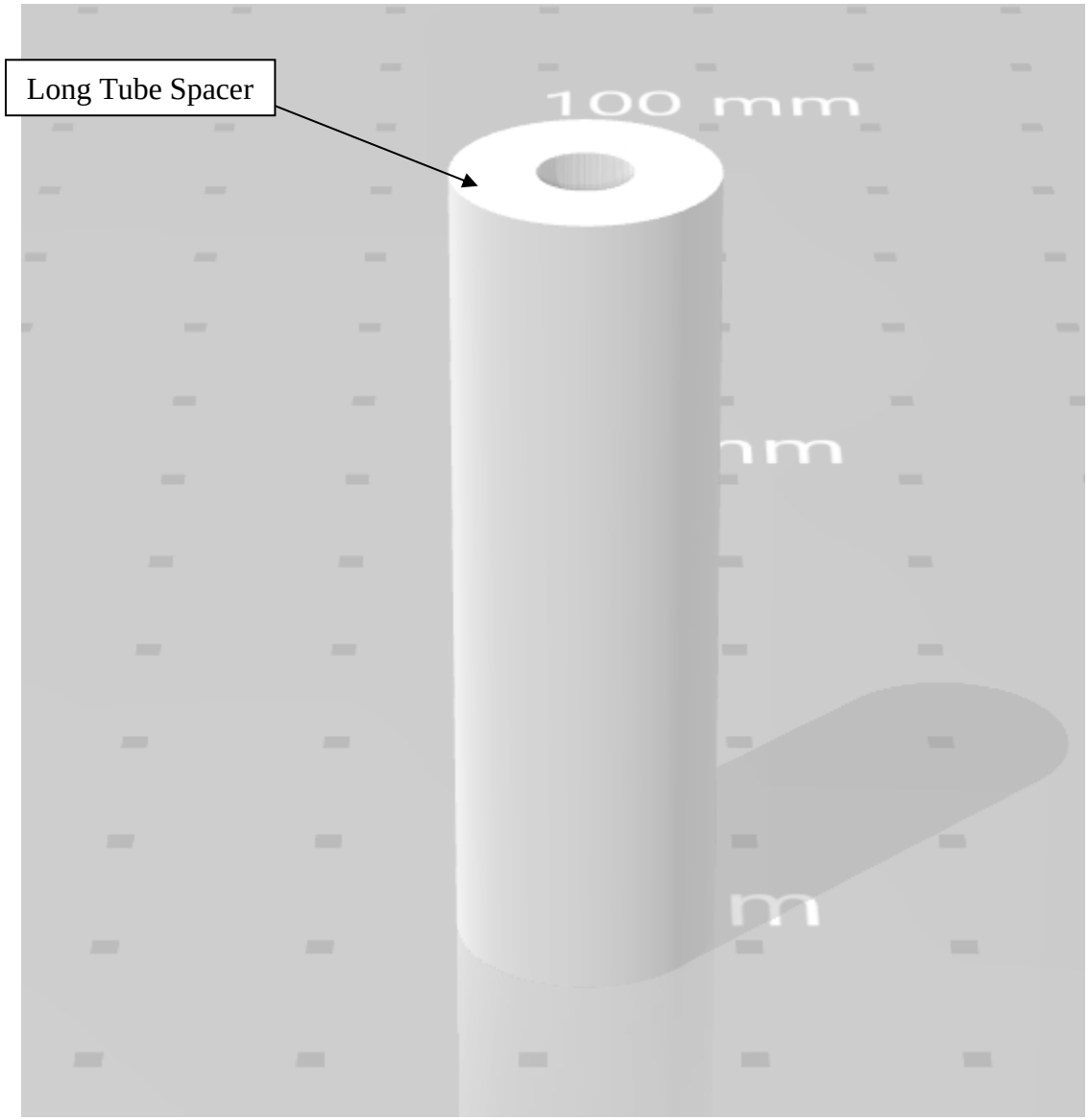

Figure 3-15 Long Tuber Spacer

3.8 Foot Power Connector Plate

A plate is mounted on the rear of the foot to house a 2.1 mm DC barrel jack. The foot power connector plate is shown below. I used eSun PLA + Filament to print the foot power connector plate.

The Foot Power Connector Plate .stl file is included in the files section and is shown below:

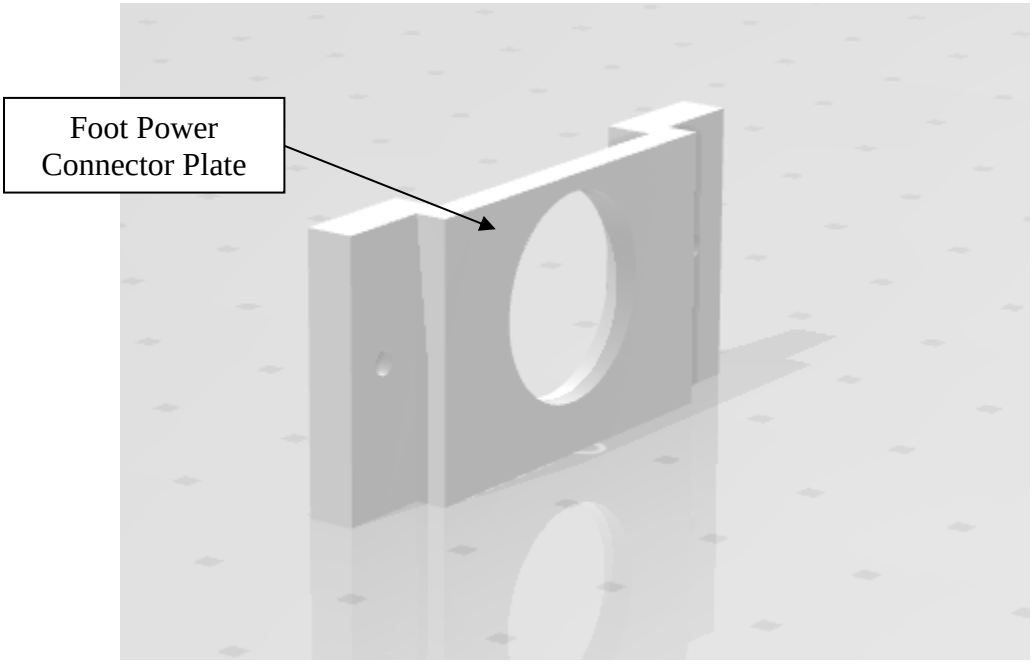

Figure 3-16 Foot Power Connector Plate

4 NeoPixel Wiring

4.1 NeoPixel Dots

The NeoPixel Dots shown below are used for illuminating each of the larger holes in the IG-11 head. There are 20 NeoPixel dots in the strand that are spaced 4 inches apart.

Figure 4-1 NeoPixel Dots

Since we will be only using 13 of the 20 NeoPixel Dots, we are going to remove the last 7 NeoPixel Dots in the strand.

Since the NeoPixel string has a defined (In / Out) connection, it is important to identify the input side of the strand that we will be wiring to. Both ends of the strand are shown below. The end with the male pins is the side we will be wiring to (Input Side).

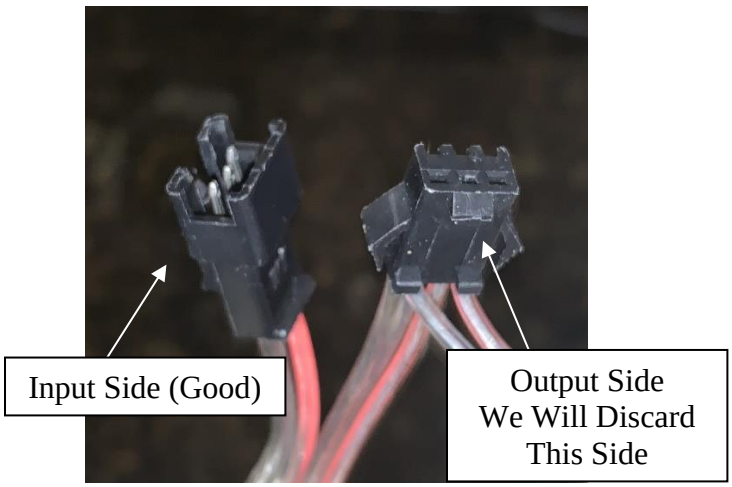

Figure 4-2 Wiring Connectors

Layout the NeoPixel Dots and cut the wire after the 13 th Dot. Be sure to remove the last 7 Dots on the 'Output Side' and *not* the'Input Side'. Once this is done, install a NeoPixel Dot lens and retainer on Dots 1, 2, 3 , 4, 6, 7, 9, 11 and 13. Use the picture below as a guide.

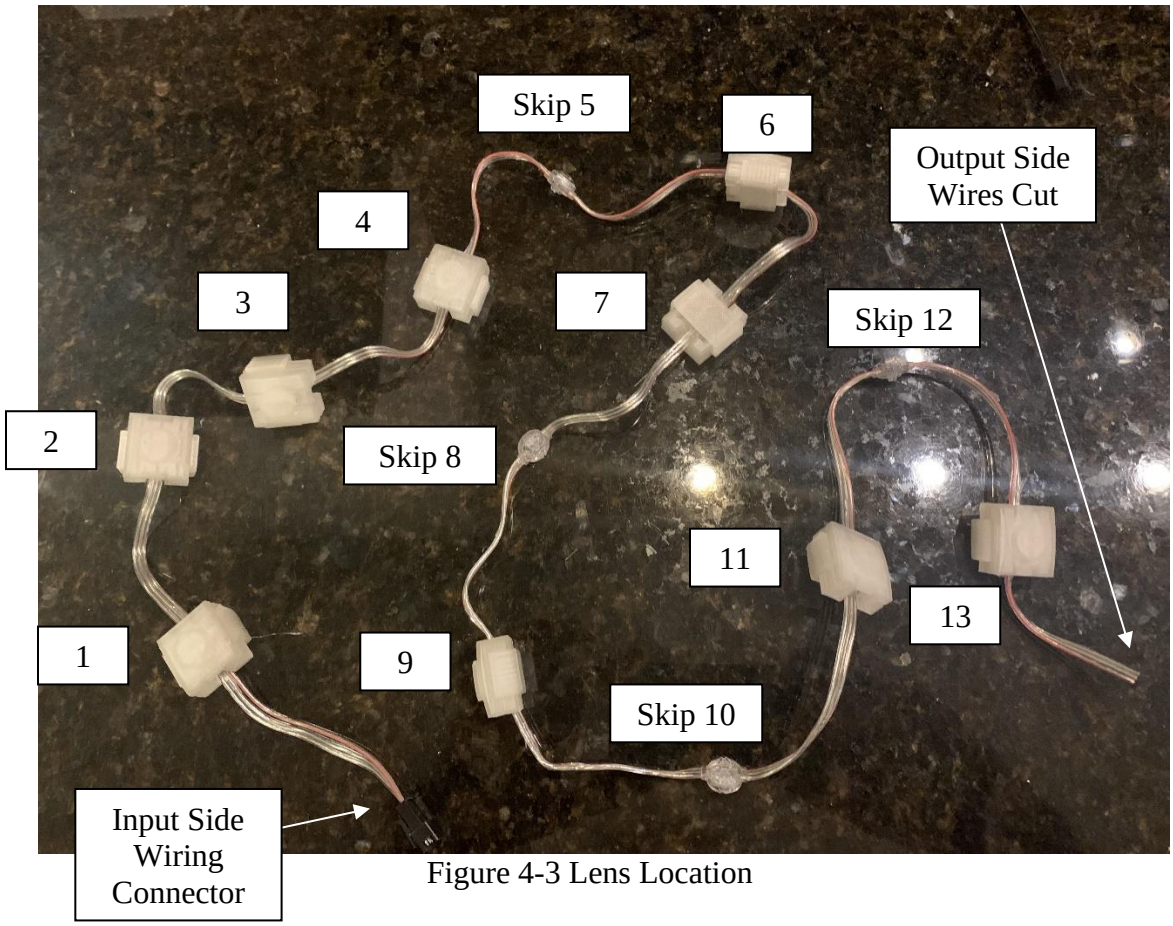

Figure 4-3 Lens Location

Toinstall the NeoPixel Dot into the lens assembly the picture below illustrates the Dot Installation methodology..

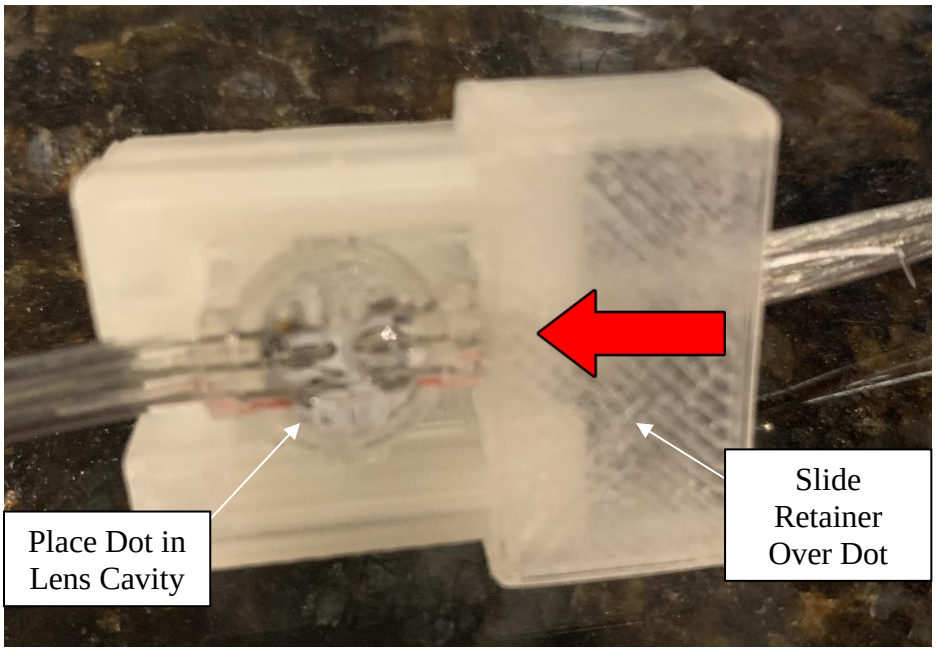

Figure 4-4 Lens Installation

4.2 NeoPixel Mini Button (Tube and Eyes)

A single NeoPixel Mini Button will be placed into the long tube, short tube and a single NeoPixel Mini Button will be placed into each eye. The Mini Button is not an actual pushbutton but just a single NeoPixel that happens to be called a 'button'. A Mini Button is shown below.

Figure 4-5 NeoPixel Mini Button

Cut 4 lengths of three conductor wire (3 feet / 1 meter). I used wire that I purchased from Amazon but most any wire will do.

https://www.amazon.com/gp/product/B07Y33PQ6M

Striveday 28 AWG 3 conductor wire Power Cable Audio Cable Signal Line (Red & Black & yellow) 33ft UL certification

Figure 4-6 Three Conductor Wire

The wiring color code I used is as follows:

- Red – 5 VDC
- Black – Common
- Yellow - Data

Turn a single Mini Button over and using one of the three cables you just cut, solder the Red wire to the (+) pad, the Black wire to the (–) pad and the Yellow wire to (DIN) pad. Note: There are two (+) pads and two (–) pads on the Mini Button. The pads are connected internally to the button so you can use either one. The critical part is that you solder the Yellow wire to the (DIN) pad and ***not*** the (DOUT) pad. Repeat this process for all four Mini Buttons.

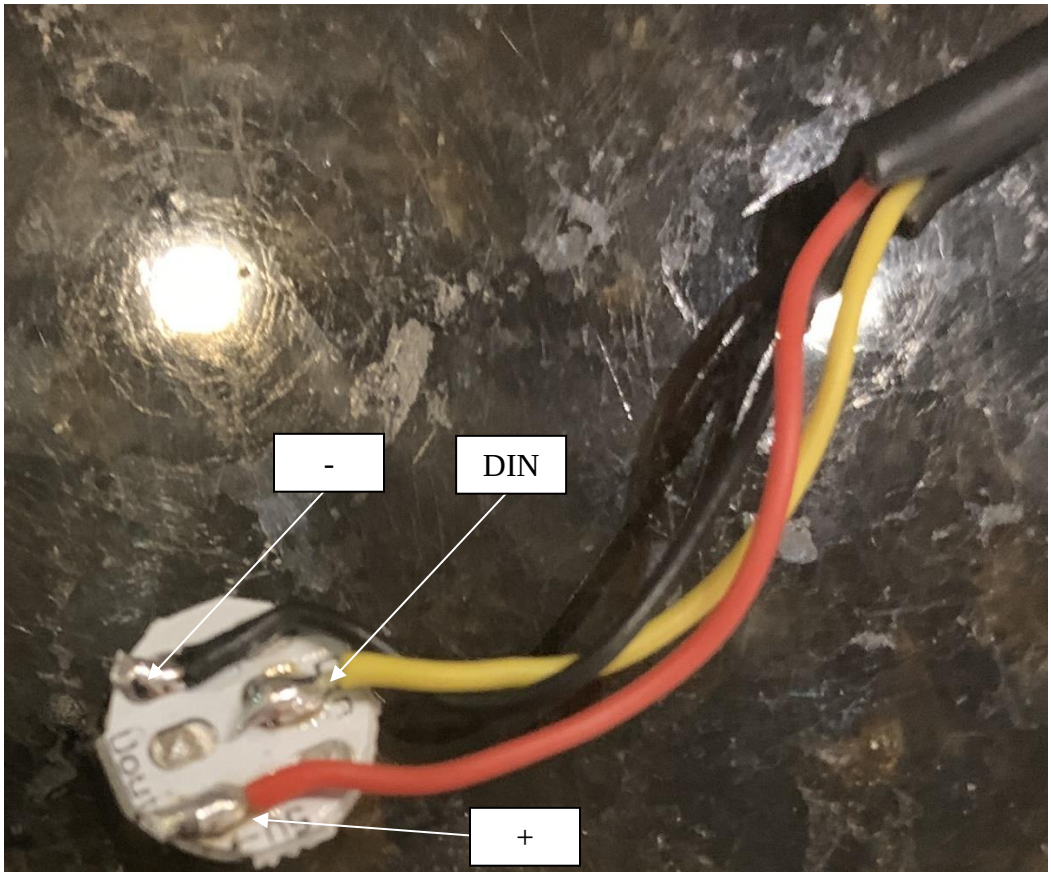

Figure 4-7 Solder Mini Button

4.3 NeoPixel Jewel (Detonator)

A single NeoPixel Jewel will be placed inside the Detonator. The NeoPixel Jewel has (7) NeoPixels that will be used to bring the Detonator to life. The NeoPixel Jewel is shown below.

Figure 4-8 NeoPixel Jewel

Cut (1) length of three conductor wire (3 feet / 1 meter). Turn the NeoPixel Jewel over and solder the Red wire to the (5V) pad, the Black wire to the (GND) pad and the Yellow wire to the (Data Input) pad. Note: There are two (GND) pads on the Jewel. The pads are connected internally so you can use either one. The critical part is that you solder the Yellow wire to the (Data Input) pad and *not* the (Data Output) pad. In the picture below, the red wire shown should be a Yellow wire. I wired this one up before I received the three-conductor wire that I used for the Mini Buttons.

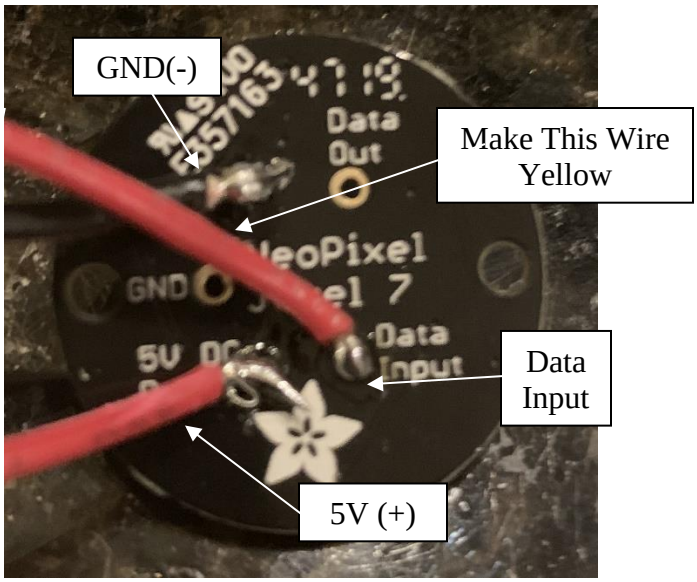

Figure 4-9 Solder NeoPixel Jewel

4.4 NeoPixel Short Tube

I realized when I was nearly complete that I forgot about the short tube. Since everything was glued and completed, I did not want to take a chance and mess things up. I decided to install a single NeoPixel Mini Button in the short tube. I drilled a hole into the short tube to run the a single NeoPixel Mini Button wire through the tube. Since the button was not recessed, I found a pushbutton lens on amazon that fit the short tube perfectly with not modifications. In the picture below, I just unscrewed the red cap and stuck it into the short tube. It can be purchased at Amazon using the link below:
https://www.amazon.com/gp/product/B07DH9Q2N1

Figure 4-10 Short Tube Lens

5 Test NeoPixels

5.1 Temporary Wiring

Temporary wire the NeoPixels to the Arduino as shown in the IG-11 NeoPixel wiring diagram .pdf file located in the files section. Once wired, load the Arduino Nano file included in the files section. If everything works correctly, you should have a light show.

Do not proceed to section 5 unless you have all of this working.

6 Installation

6.1 NeoPixel Dot Lens Installation

Each lens is contoured to the IG-11 head and is glued to the inside of the IG-11 head. It is much easier to install the NeoPixel dots into each lens assembly with the retainer attached prior to gluing the lenses in place. Since the NeoPixel dots are spaced in 4-inch intervals, the wiring does not reach all of the holes in the IG-11 head. To make this simple, you should install the NeoPixel dots into the lens assemblies as shown below. You will see a few a few NeoPixel dots along the string with no lens assembly connected. This is intentional to allow wiring to reach each of the holes. Install the lens assemblies on the NeoPixel string as shown in figure 6-1 below.

Note: I slightly enlarged the holes on the head of the IG-11 using a step drill bit since I did not want to sand each hold and wanted the perfectly round. Be sure to check the fit before you start.

In the picture below, the installation of the lenses is shown. I used SCIGRIP 16 to glue each lens to the head.

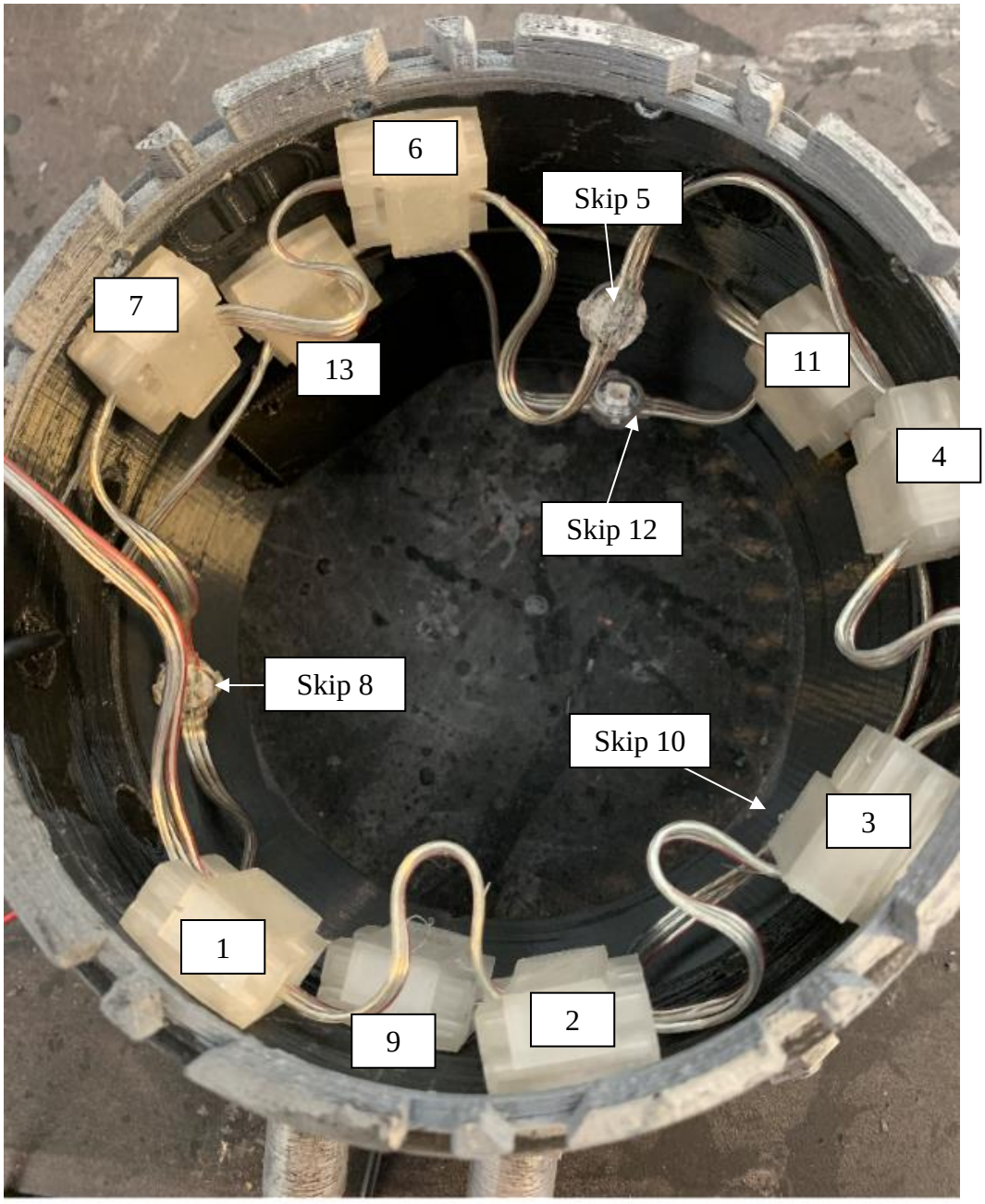

Figure 6-1 Lens Mounting

6.2 NeoPixel Button into Eyes Installation

I drilled a hole through each eye tube to allow the NeoPixel Button wire to pass through. I also recessed the eye socket so that the NeoPixels would be recessed into the eye sockets and a small lens could be added to each eye. The NeoPixel wiring is placed through the holes and routed to the holes in the bottom of the head as shown.

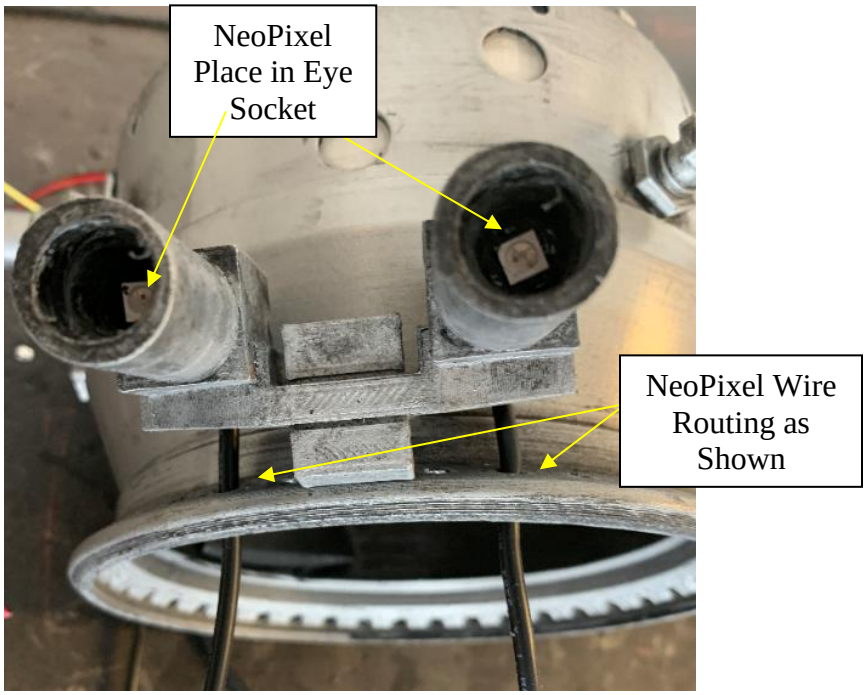

Figure 6-2 NeoPixel Eye Mounting

When everything has been completed, the end result will be as follows:

Figure 6-3 NeoPixel Finished Eyes

6.3 NeoPixel Button into Long Tube Installation

I drilled a hole through the long tube for the NeoPixel Button wire to pass through. Since the tube is recessed, I added a small spacer tube that fits in the long tube to prevent the NeoPixel from recessing all the way into the tube.

When everything has been completed, the end result will be as follows:

Figure 6-4 NeoPixel Finished Long Tube

6.4 NeoPixel Button into Short Tube Installation

I drilled a hole through the short tube for the NeoPixel Button wire to pass through. Since this was an afterthought, I used the pushbutton lens as described in section 4.4.

When everything has been completed, the end result will be as follows:

Figure 6-5 NeoPixel Finished Short Tube

6.5 Detonator Holder Installation

The Detonator NeoPixel must be wired to the Arduino. To accomplish this, we run wires from the Detonator cavity to the IG-11 Head. When this is all completed, the base of the head will be affixed to the Torso so the lower part of the head will not rotate independent of the upper Torso.

The first step is to drill a hole between the base of the head to the Detonator cavity.

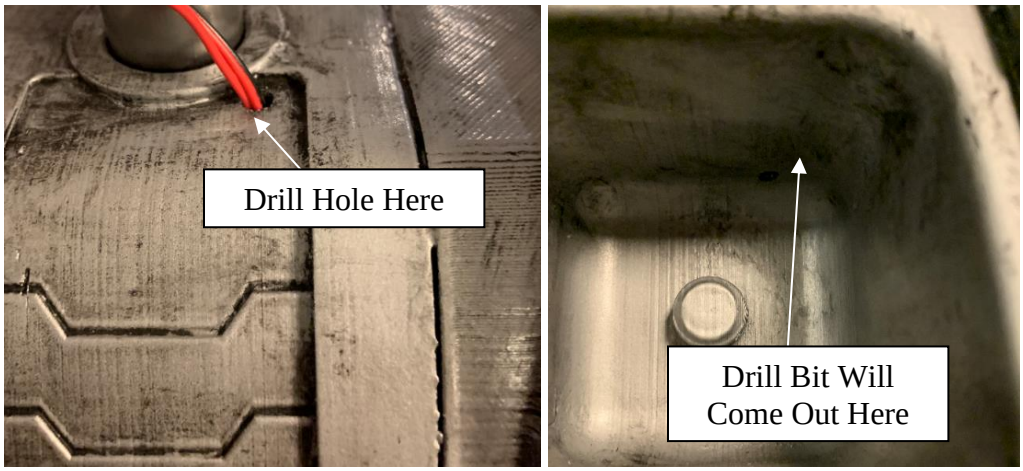

Figure 6-6 Detonator Drilling Location

At some point you will need to drill a hole in the neck to allow the Detonator wires to pass through.

Figure 6-7 Lower Head Detonator Drilling Location

The picture below shows the mounting of the NeoPixel assembly onto the Detonator.

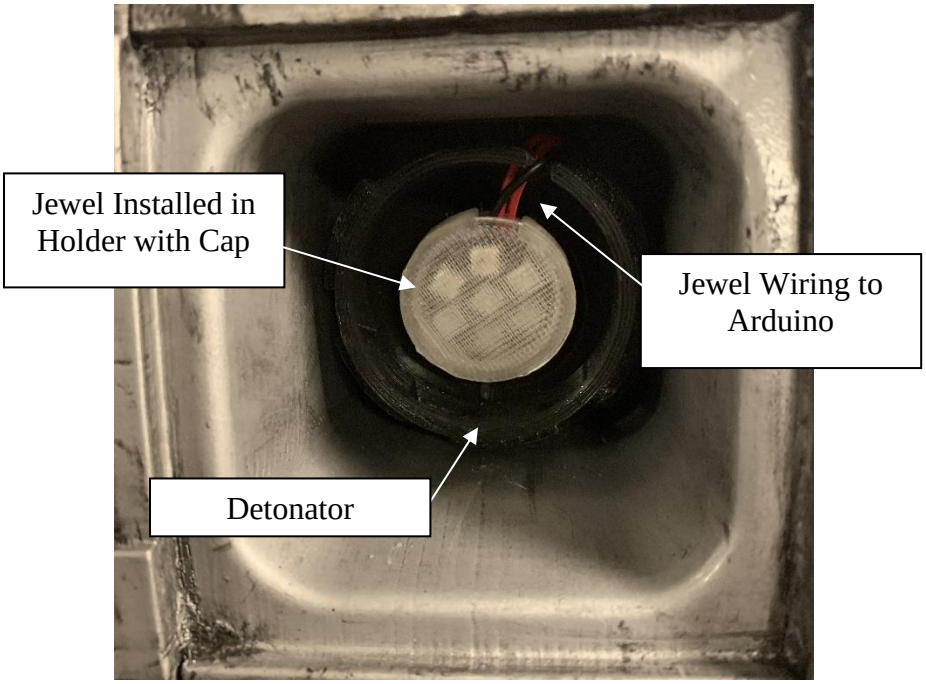

Figure 6-8 Detonator Holder Installation

When everything has been completed, the end result will be as follows:

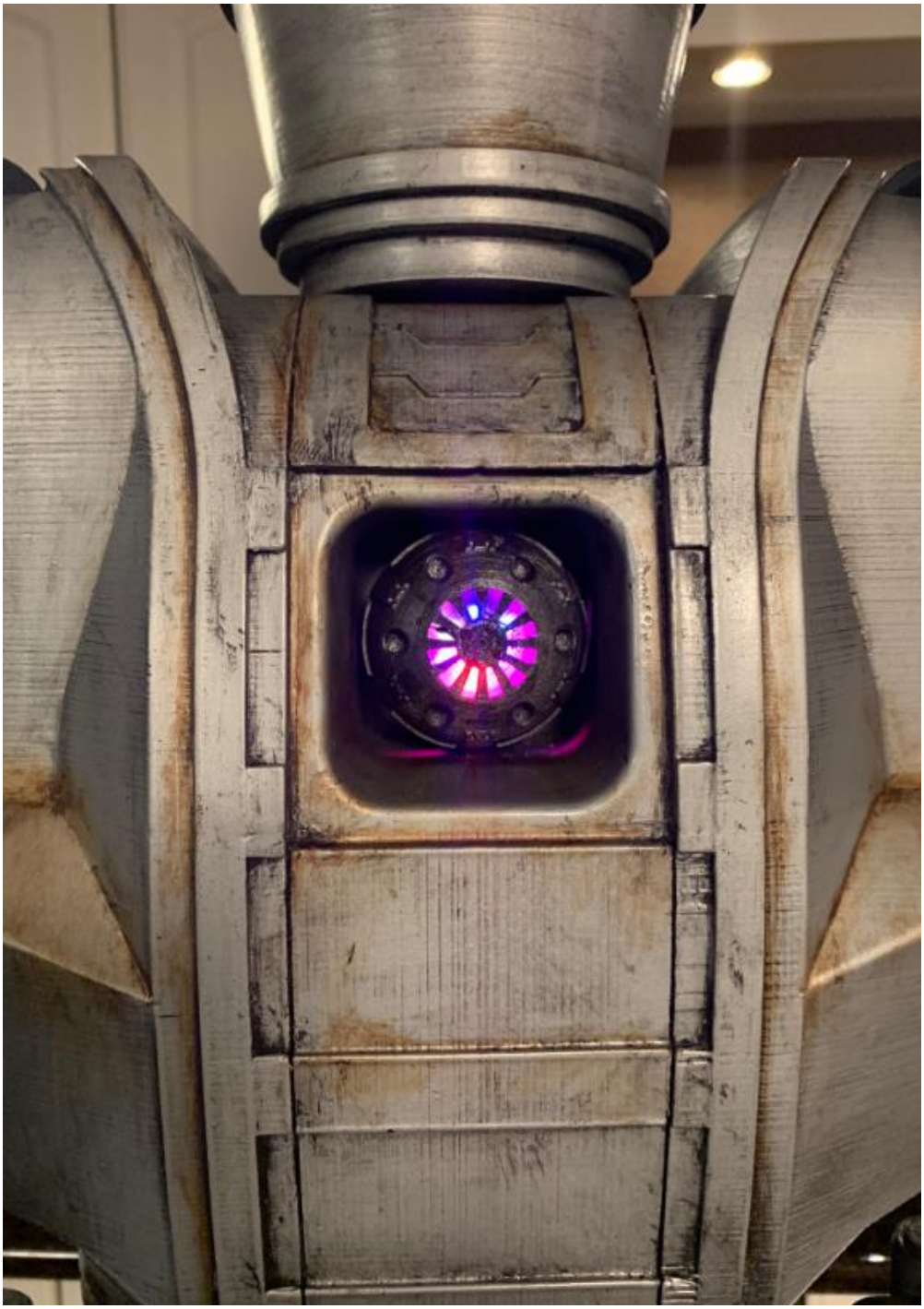

Figure 6-9 NeoPixel Finished Detonator

7 Getting Power to Arduino / NeoPixels

To get 5VDC power to the IG-11 Arduino and NeoPixels, I installed a panel Mount 2.1mm DC barrel jack into the rear of the IG-11 right foot.

The wire is run through the foot and up through the leg via the 1" pipe used to support the leg. A hole was drilled in the pipe where the 'Thigh Top' meets the 'Thigh'. A hole was drilled so the wire can exit the pipe and run through the hole on the right thigh top. The wire exited the right thigh and was run through a hole drilled into the bottom of the 'Hip Center'. The wire was then run through the pipe that is located in the 'Hip Center' and up into the head.

The best way to visualize this is through pictures.

7.1 Right Foot Modification

I drilled a hole in the foot base as shown. The diameter of the hole is the diameter of the barrel jack. The barrel jack will go through the foot power plate and a portion of the jack will recess into the hole. Once the barrel jack recess hole was complete, I drilled a ¼" hole in the center of the large hole. This ¼" hole will be explained in the next step.

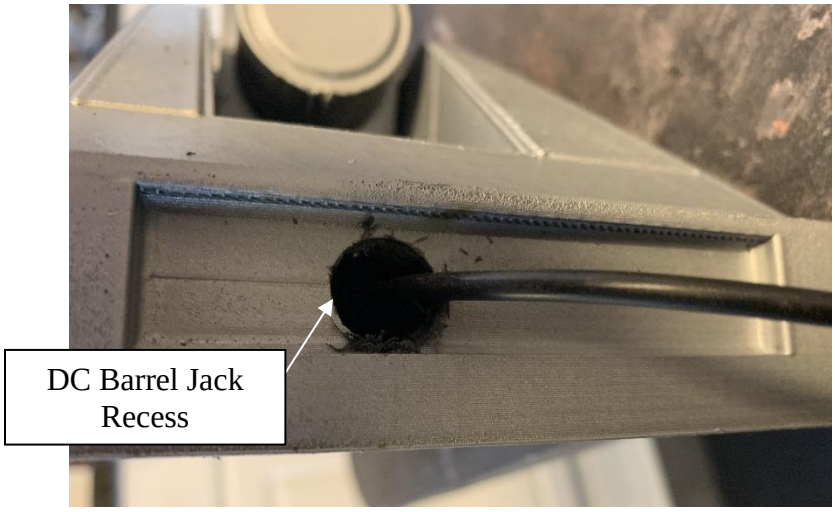

Figure 7-1 DC Right Foot DC Barrel Jack Hole

I also performed the following surgery on the foot.

1) I drilled a hole from the center of where the support hole is mounted into the foot through the bottom of the foot. The hole will exit the bottom of the foot in the location shown.
2) I channeled a trough in the foot and stopped a few inches from reaching the rear of the foot (Barrel Jack Location).
3) Remember the ¼" hole you drilled in the center of the barrel jack? I now drilled a hole in the channel to connect to the ¼" barrel jack hole you drilled earlier.

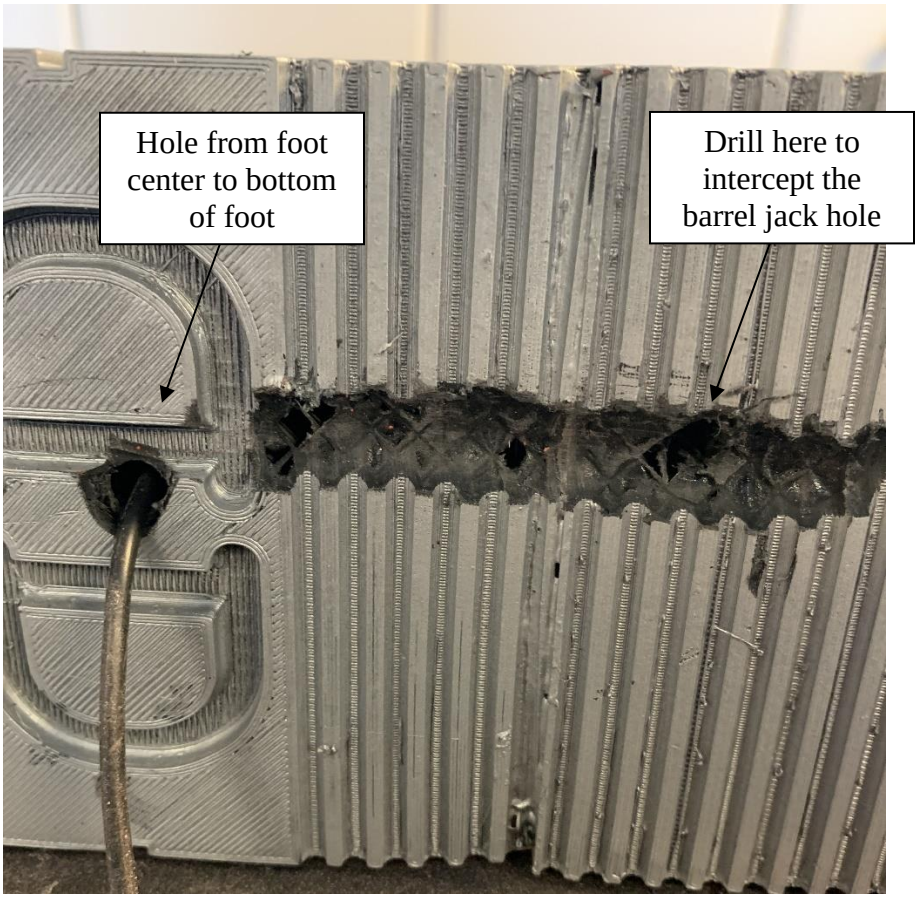

Figure 7-2 Channel and Holes

Insert the barrel jack into the Foot Power Connector Plate as shown and solder to the terminals shown. I am using a positive tip 5VDC power adapter so be sure the positive tip is soldered to the correct terminal with red wire. Be sure to have the wire length long enough to reach the 'Hip Center'.

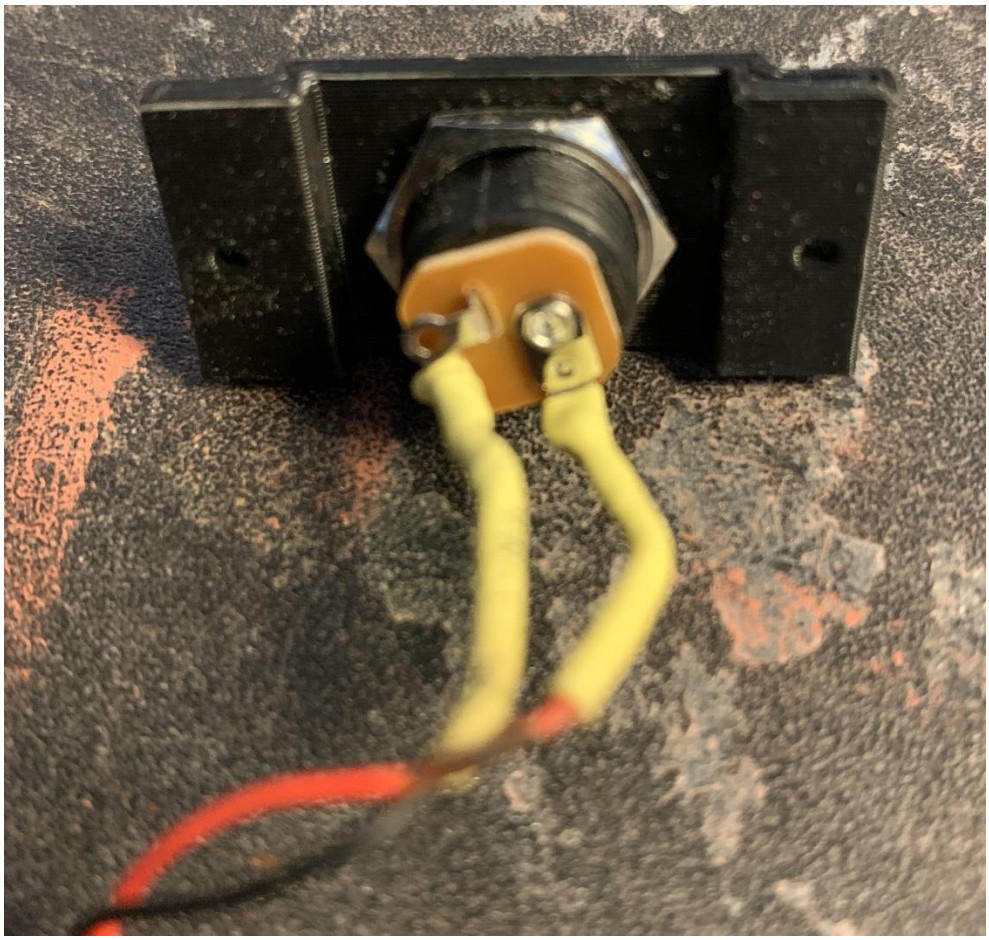

Figure 7-3 Barrel Jack Power Connector

Run the wire through the barrel jack hole and fish it into the channel you created earlier. Run the wire through the channel and into the foot tube hole. Pull out all of the excess wire through the foot hole. At this point you can glue, the wire into the channel.

Attach the power connector plate to the foot with two small screws as shown below.

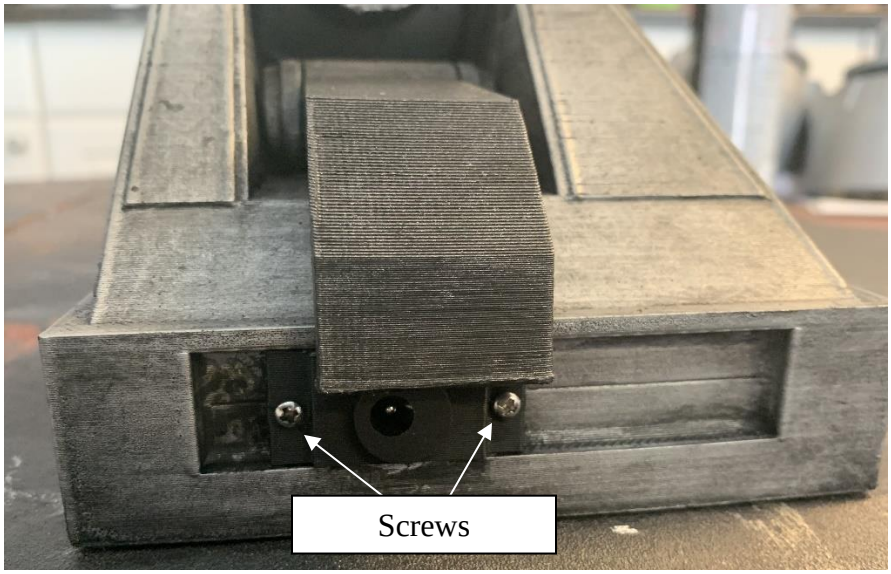

Figure 7-4 Mounting Power Connector Plate

At this point the bottom of the foot looks hideous. Furthermore, it is best to avoid scratching the floor and keeping the peace at home. To solve all your problems, install felt to the foot bottom as shown to both feet.

Figure 7-5 Foot Felt Attachment

In the right leg support, drill a hole as shown. I made this hole pretty large since I wanted to be able to turn the leg assembly 10 degrees without pinching the wire. Once I drilled the hole, I filed off the rough edges and used liquid electrical tape around the opening to prevent wire nicks.

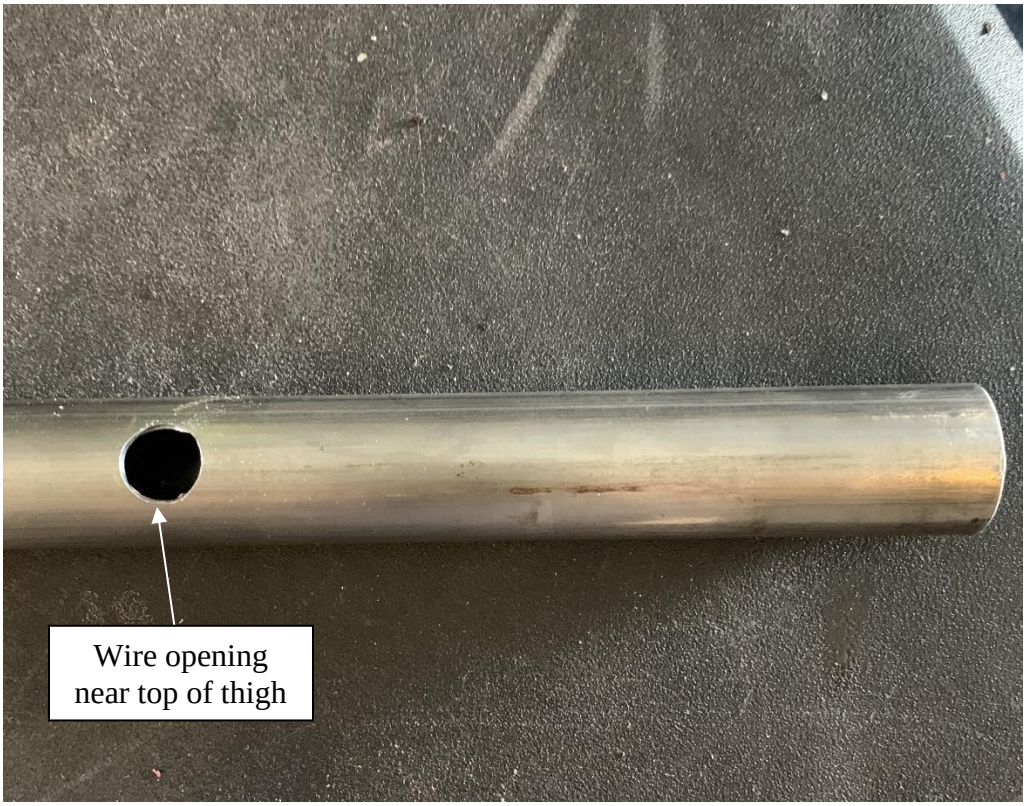

Figure 7-6 Right Leg Support Hole

In the right thigh, I drilled a hole that will line up with the leg support hole I drilled. As you can see, the wire will exit the leg support and be routed through the hole in the thigh.

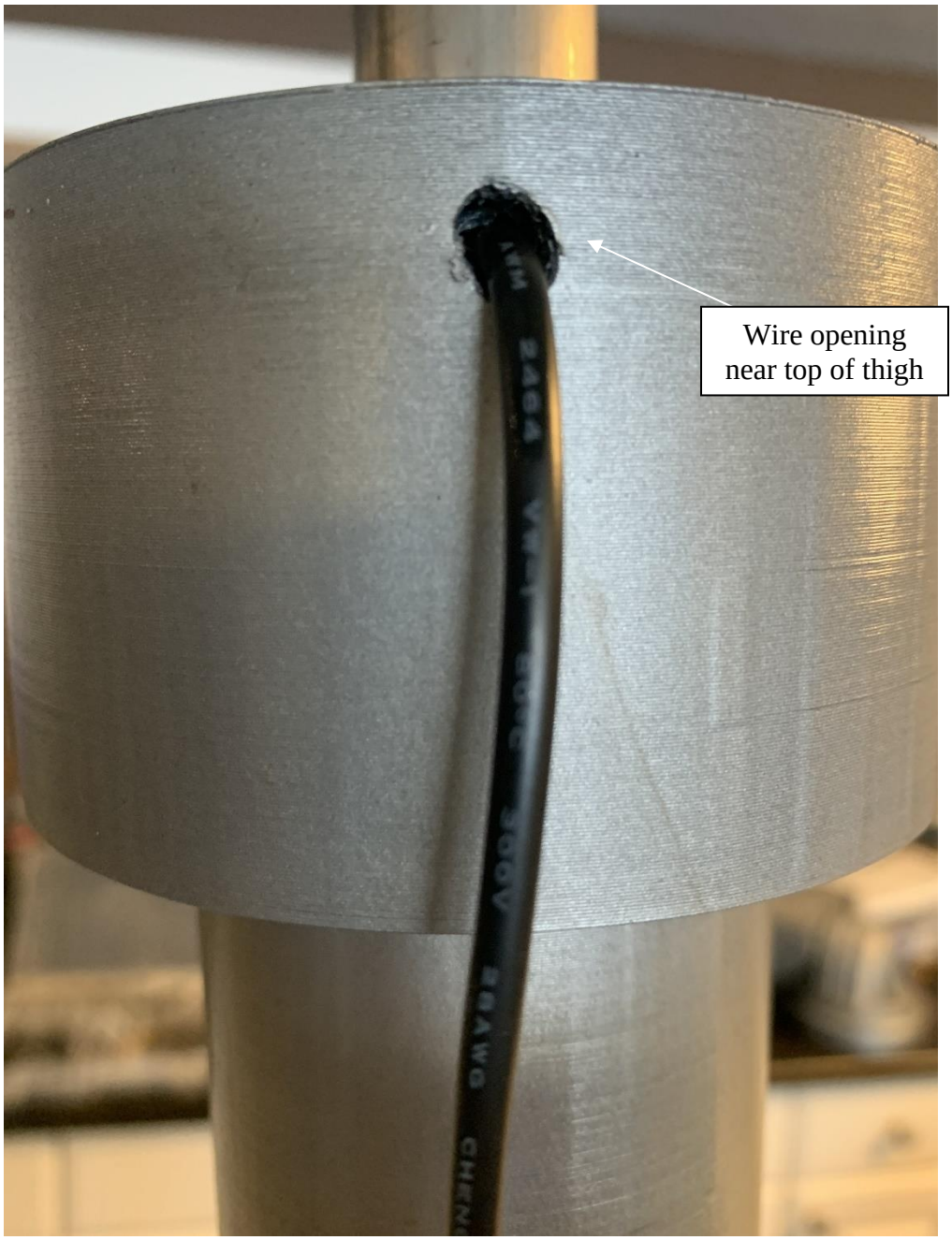

Figure 7-7 Right Thigh Wire Opening

There is a hole is already located in the ‘Thigh Top’. Run your drill bit through the hole to channel out small area for the wire to run from the right thigh opening and out through the ‘Thigh Top’.

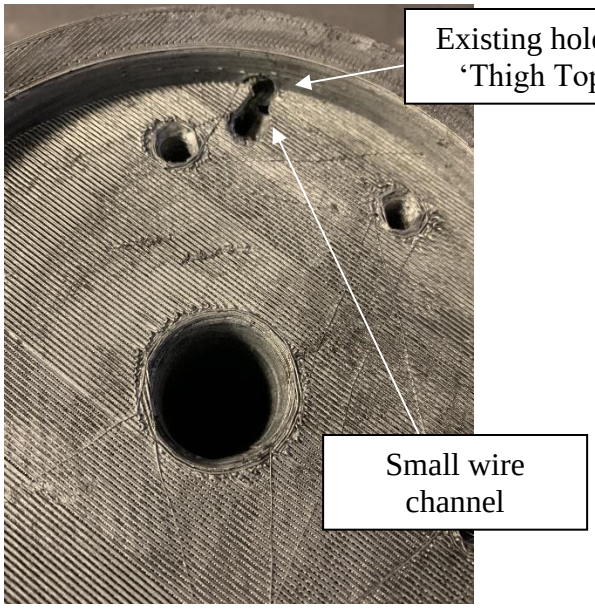

Figure 7-8 Thigh Top Wire Channel

Drill a hole in the hip center as shown below. This hole is where the wire exits the thigh and is routed up through the torso and head.

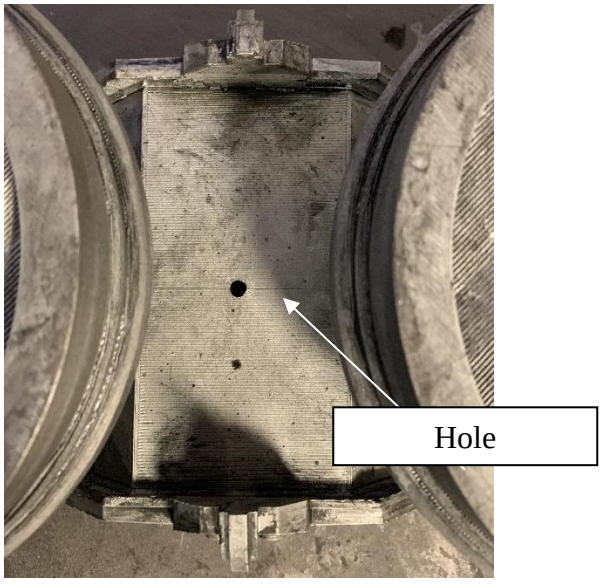

Figure 7-9 Hip Center Wire Hole

When it is all said and done, it should end up looking like this. I ran my wire through some ¼ inch tubing for effect. At this point you should have power wire run from the right foot to the head.

Figure 7-10 Wire Routing – Thigh to Hip

8 Complete Wiring Connections

The NeoPixel Dots use a JST connector. In the parts list I have included a JST pigtail for connecting to the NeoPixel Dots. The connector is shown below. Be sure to make you power connections as shown. The Yellow wire is the data lead and goes to the center conductor of the pigtail.

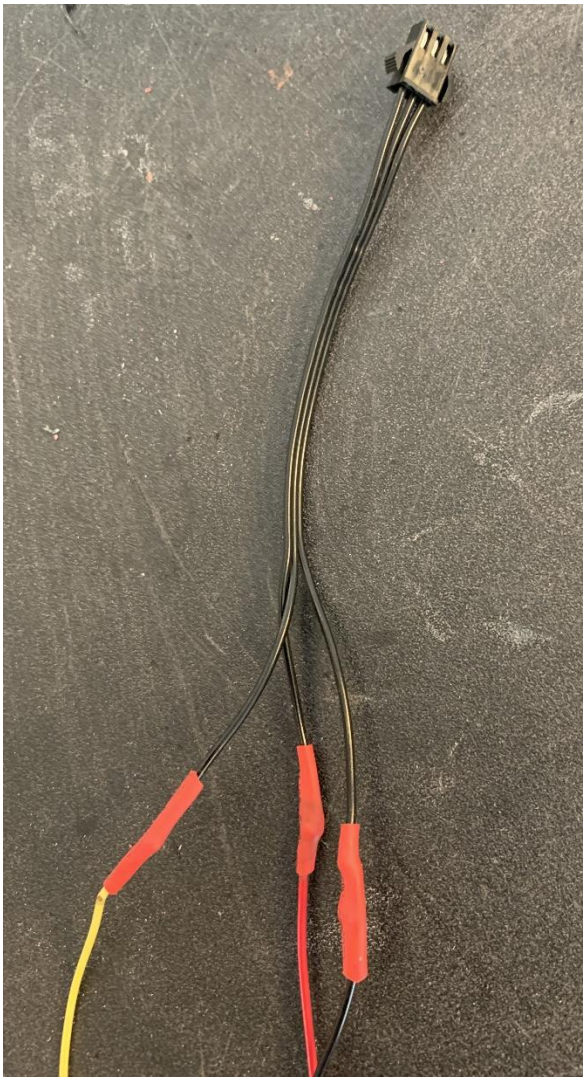

Figure 8-1 JST Pigtail

Review the wiring diagram for connections. I soldered all red NeoPixel wires together and all black NeoPixel wires together with the exception of the Detonator. I then soldered three (2) pin connector cables (I used bread board female jumper cables) to the black and red wires. The connectors are for the following:

- Arduino power connection
- NeoPixel detonator connection
- Main power feed connection

I soldered a (2) pin mating connector cable to the detonator power wires and the power (feed) wiring that was run from the foot to the head. You do not need to do this for the Arduino since the female breadboard wires you used previously will slide over the Arduino pins.
On each yellow NeoPixel wire, solder a female breadboard jumper wire. The female end will plug into the pins on the Arduino. I am leaving a short USB cable plugged into the Arduino so I can access it easily for reprogramming later. When everything is done it should look like this. Not pretty but functional.

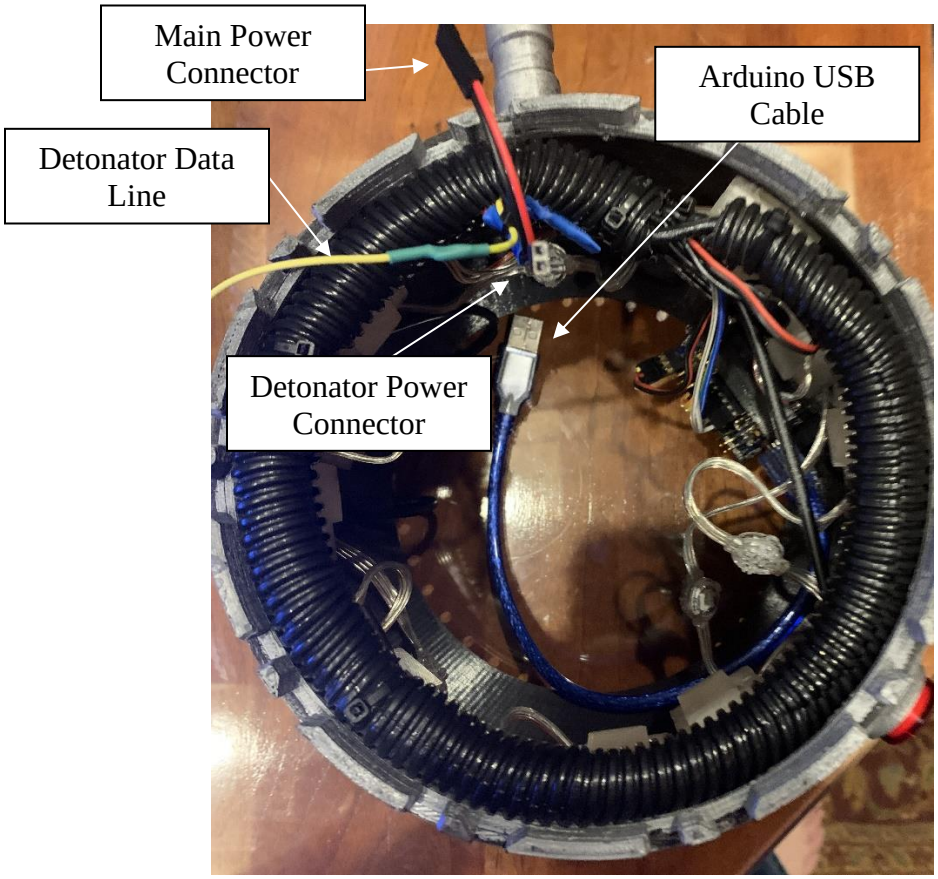

Figure 8-2 Inside Head Top View

This is what the Arduino wiring looks like.

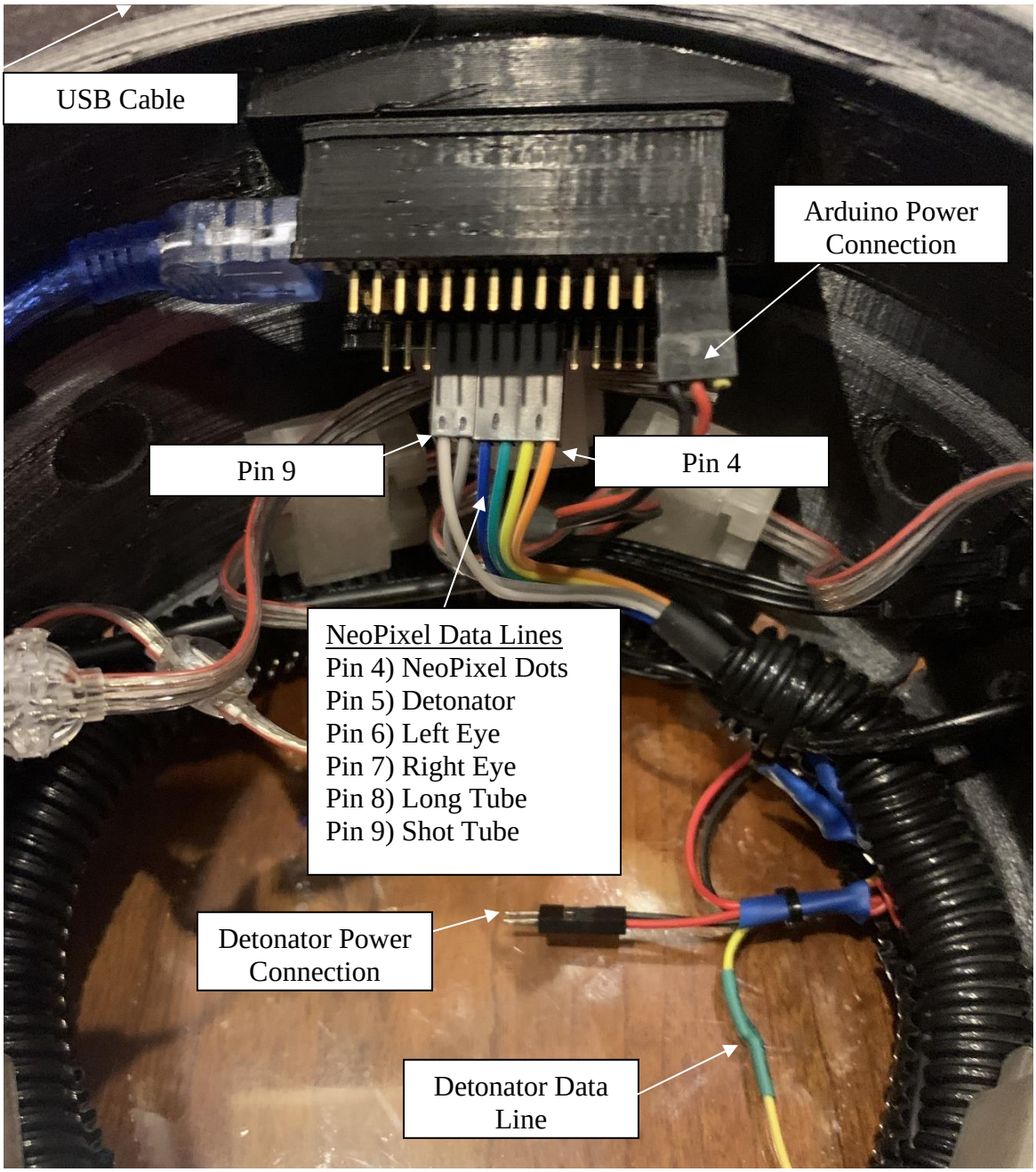

Figure 8-3 Inside Head Arduino View

9 Arduino Nano Controller

The Arduino Nano shown below provides the control of the NeoPixels. The Arduino is mounted in the IG-11 (Pin Side Up) so we can easily make the power and NeoPixel connections. The Arduino programming software is free and can be obtained from the following link: The wiring diagram will provide you with all of the connections between the NeoPixels and the Arduino.

https://www.arduino.cc/en/main/software

The Arduino code I developed for the IG-11 can be found in the files section.

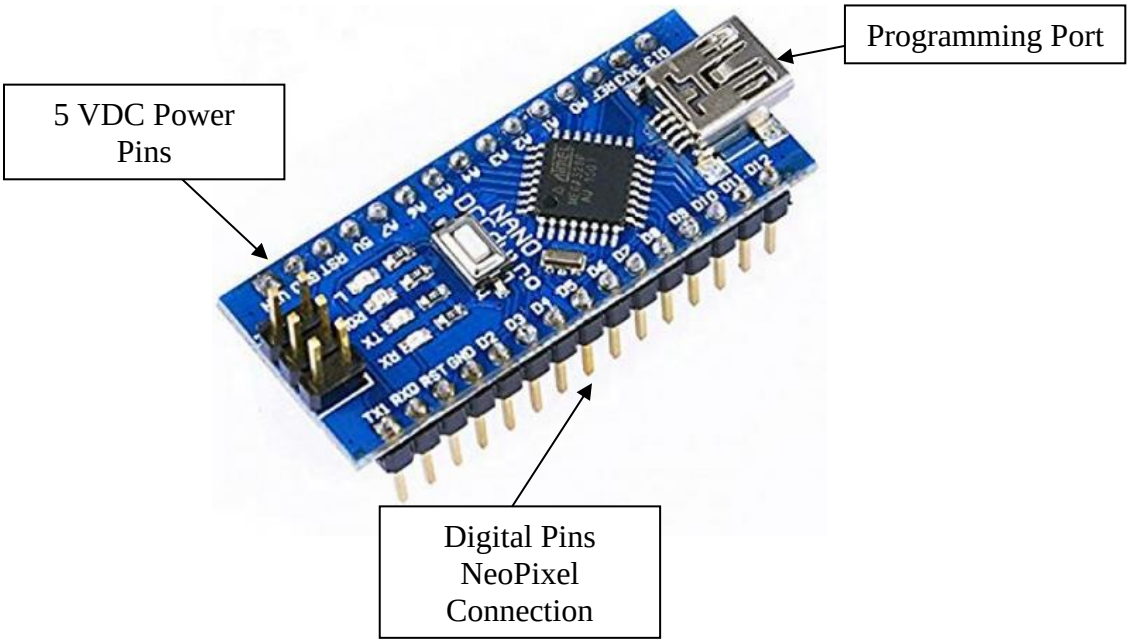

Figure 9-1 Arduino Nano

9.1 Arduino Programming

I documented the Arduino code so that it can be followed easily. The code is not fancy and basically bit bangs each NeoPixel. You have total control over each NeoPixel and the program I provided can be used as is or modified to change colors, patterns, etc.

10 Parts List

The following list details all of the electrical components used in the system.

Description	Part Number	QTY	Purchased From
Panel Mount 2.1mm DC barrel jack	ID:1612	1	Adafruit.com
3-pin JST SM Plug + Receptacle Cable Set	ID:1663	1	Adafruit.com
Adafruit NeoPixel LED Dots Strand - 20 LED 4" Pitch	ID:3631	1	Adafruit.com
NeoPixel Jewel - 7 x 5050 RGB LED with Integrated Drivers	ID:2226	1	Adafruit.com
uxcell Indicator Lights AC/DC 12V Pilot Light Red LED, Flush Panel Mount 5/8" 16mm 3Pcs	-	1	amazon.com
iMBAPrice 5V DC Wall Power Adapter UL Listed Power Supply (5-Feet, 5V 2A(2000mA))	-	1	amazon.com
Striveday 28 AWG 3 conductor wire Power Cable Audio Cable Signal Line (Red & Black & yellow) 33ft UL certification	-	2	amazon.com
Arduino Nano	-	1	amazon.com