

Regenerating Tissues



Exhibit Description:

“Regenerating Tissues” is a stand-alone interactive component of the *Nanomedicine* exhibition. A copy panel describes how Nanomaterials are able to form tiny structures called Nanoscaffold that help the body repair damaged muscle, bone, and nerve tissues. A side monitor to the right of the panel shows different ways that Nanoscaffold is currently being researched.

Nanoscaffold is a mechanical interactive that demonstrates how nanotechnology can help the body repair a damaged nerve. When the visitor approaches this interactive, they see a severed nerve that no longer functions. Sensory messages, indicated by chasing LED lights, originate at the nerve cells on the left but cannot get through to the brain on the right. The visitor has two options: to leave the injury alone or to inject nanoparticles. When nanoparticles are injected, they self-assemble into a Nanoscaffold. Visitors can watch as the nerve endings grow back together, and sensory messages are once again able to reach the brain.

This exhibit component consists of one copy panel, the tabletop Nanoscaffold interactive, and a flat-screen monitor slideshow that can be updated to keep the exhibit content current and relevant. Like all of the exhibit components in the *Nanomedicine* package, headphone listening stations with both English and Spanish audio description labels are included. These audio labels serve two functions—to explain the “Big Idea” content of the exhibit and to provide illustrative descriptions of the interactive experience.

Exhibit Interface:

Interactive

- LED's on left side of component light up in sequence one at a time, starting at the nerve cells and moving towards the center circle. As one LED lights up, the previous goes dark.
- LED's, in acrylic tube, lights up at the end of the sequence.
- Lighting sequence runs continuously.
- Visitor sees the enlarged damaged nerve. Rollover is in "blank state".

Visitor chooses Option A or Option B

- Option A (let heal on own)
 - Visitor pushes button A.
 - Button A becomes lit. Button B is now inactive until interactive finishes and resets.
 - Rollover flips to Scar tissue
 - Left backlit panel becomes lit.
 - After 10 seconds, interactive resets by Rollover rotating to "blank state".
- Option B (Nano treatment)
 - Visitor pushes button B next to syringe graphic.
 - Button B becomes lit. Button A is now inactive until interactive finishes and resets.
 - Rollover flips to "Nano Scaffold"
 - Tubes come together to meet in the middle.
 - Lighting sequence now continues across tubes up through brain graphic.
 - Right backlit panel becomes lit.
 - After 10 seconds, interactive resets by Rollover rotating to "blank state" and lighting sequence resetting to Step1.

Side Monitor

The monitor, on the right side of the interactive, displays images of nanotechnology.

- Images self scroll.
- Visitors can press the “Next” button to scroll to the next image.

Audio

- Visitor wears the headphones.
- Visitor chooses to listen to English or Spanish by pressing the “English” or “Española” button.
 - Audio starts.
 - Audio explains the content of the exhibit
 - Audio provides instructions of the interactive.
- Visitors can adjust the volume of the audio.

Exhibit Components:

The following lists of components combine to make the exhibit.

Base Cabinet:

- Weighing, 100 lbs.
- Dimension, 57" H x 66" W x 32"D

Graphic Panel:

- Weighing, 20lbs.
- Dimension, 34"H x 38" W x 2"D

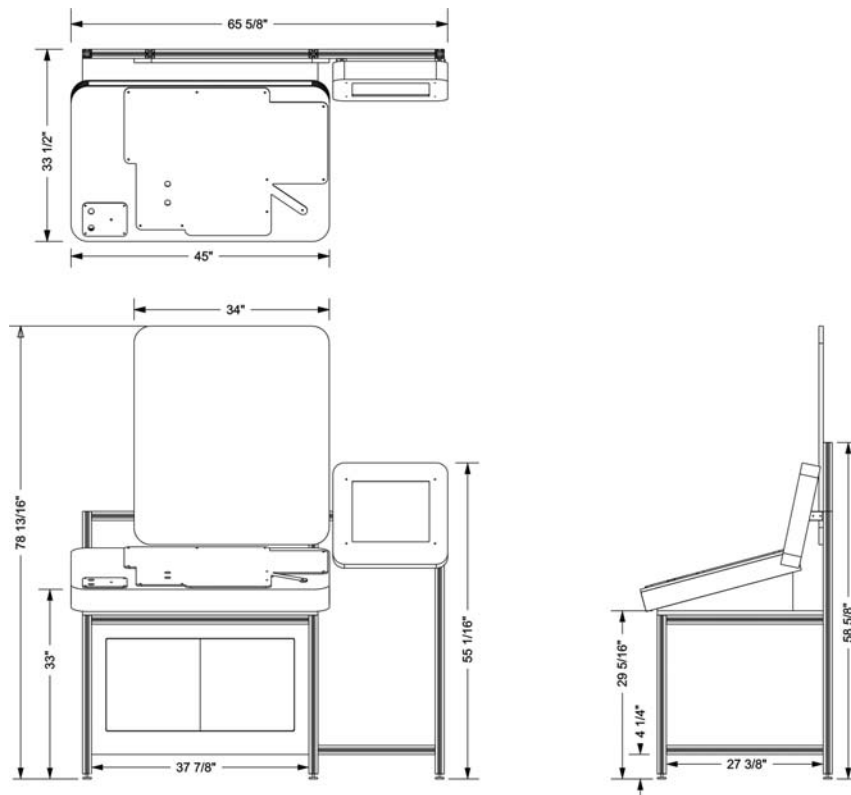
Exhibit Specifications

Dimensions:

- Exhibit Dimensions:
 - 79"H x 66"W x 31"D
- Exhibit Foot Print:
 - 66"W x 31"D
- Recommended Exhibit Floor Space:
 - 72"W x 62.5"D

Power Requirements

- 110-volt, 15-amp.
 - Accessed through base cabinet of the exhibit



Tools and Hardware:

Tools and Hardware needed for installation, maintenance and repairs to the exhibits.

Key

- 415-A
 - To open base cabinet.

Cam Wrench

- Cam locks
 - Securing Side Monitor to exhibit frame
 - Securing exhibit frame

9/64" Allen Wrench

- All ¼ x 20 button head bolts
 - Securing the exhibit monitor to interactive cabinet
 - Securing the Graphic Panel to the exhibit frame

5/32" Allen Wrench

- Security screws
 - Securing all second surface graphic panels

3/32" Allen Wrench

- Machine screws that secure Side Monitor shroud

#2 Phillips Screwdriver

- Machine screws
 - Securing Side Monitor shroud back panel

6" Crescent Wrench

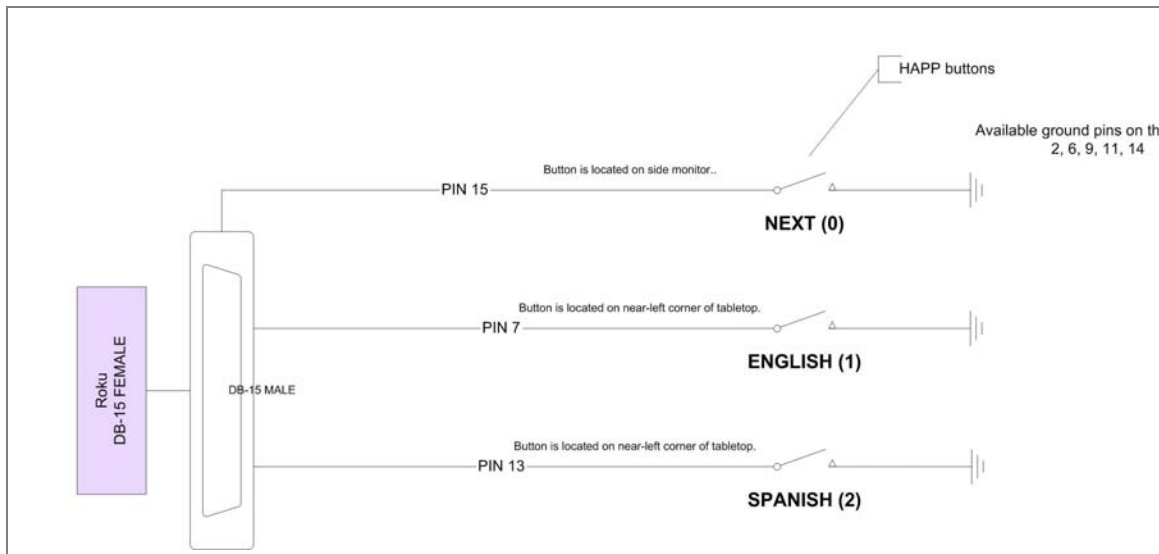
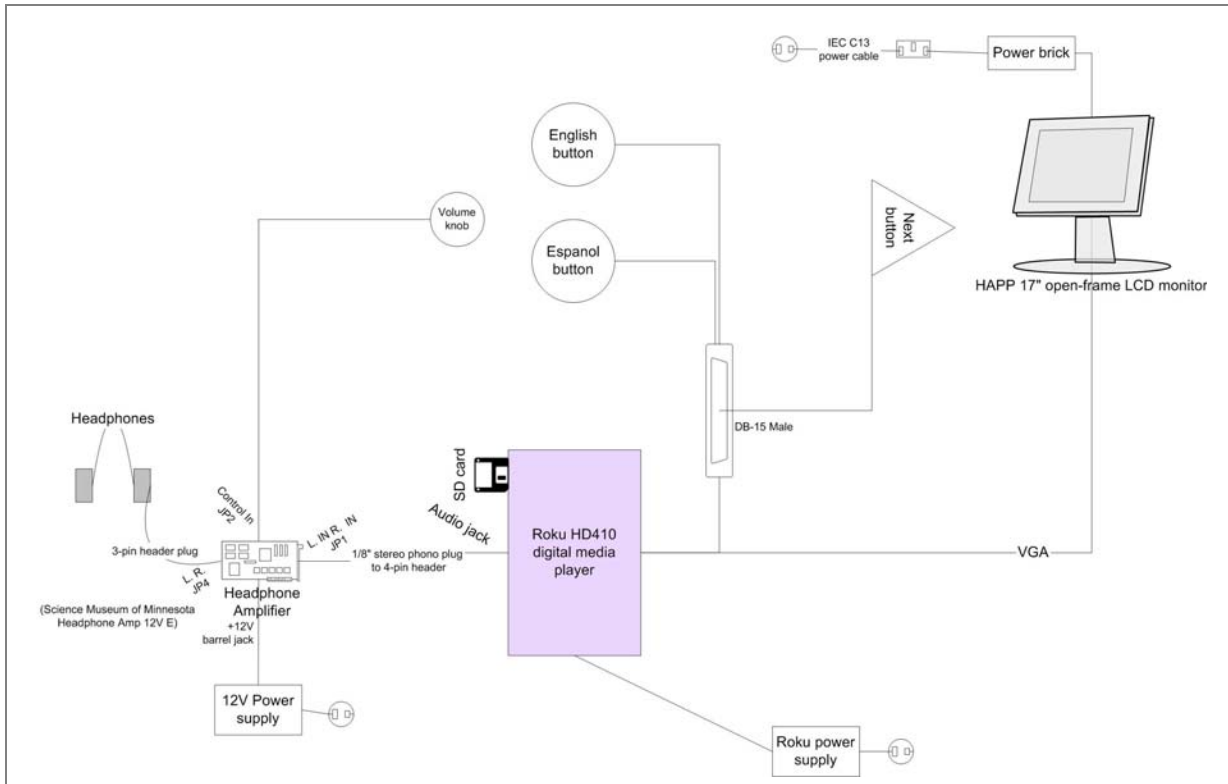
- To adjust leveling feet

Parts:

Parts needed for installation, maintenance and repairs to the exhibit.

- Headphones
 - AKG K77
- Monitor
 - 17" Happ, 49-2603-30
- Media Player
 - Roku HD410
- Amplifier
 - Produced by The Science Museum of Minnesota (SMM).

Media:



Electronics:

The electronics in the Regenerating Tissues interactive exhibit consist of:

- A microcontroller board
- Two illuminated pushbuttons
- Three stepper motors
- Two limit switches
- An absolute position rotary encoder
- Two graphic backlights
- Five surface mount LED boards

At power-up

Two of the stepper motors drive the sliding tubes away from center until they close the limit switches at the ends of the aluminum rail assembly. Then, the third stepper motor turns the center rotating assembly until the “INJURED NERVE” side of the rotating assembly is approximately flush with surrounding panel.

In the exhibit’s resting state both pushbuttons are illuminated, the rotating assembly in the center of the magnified circle is in the “INJURED NERVE” position and a chase light effect begins in the peripheral nerves, on the left side of the exhibit, and stops at the damaged nerve.

When the “OPTION A – LEAVE IT ALONE” pushbutton is pressed, that button stays lit and the option B button goes out; the light behind the left graphic panel comes on. The center rotating assembly turns 120 degrees to the “SCAR TISSUE” position. The sliding tubes, which represent nerve growth, move towards center. They (almost) bump into the scars, retract slightly, and try again, three times. They stop, briefly, and the exhibit returns to its resting state, first by retracting the sliding tubes and then rotating the center assembly. Throughout the option A cycle the chase light effect continues, with the lights stopping at the injury site.

When the “OPTION B – INJECT NANOPARTICLES” pushbutton is pressed, that button stays lit and the option A button goes out; the light behind the right graphic panel comes on. The center rotating assembly turns 120 degrees to the “NANO SCAFFOLD” position. The sliding tubes move towards center. When the tubes (almost) meet in the center, representing successful nerve regeneration, the chase light effect changes – the nerve impulses now travel across the injury site, clear to the brain. After a brief delay, the exhibit returns to its resting state.

The sliding tubes

Each time the sliding tubes are driven to the outer, home positions, they move until they close their respective limit switches. When the tubes move towards center, the controller counts steps.

The center rotating assembly

The center assembly is driven by a stepper motor at the left side. An absolute position encoder is mounted to the right end of the assembly’s axle. The encoder outputs a square wave, with the positive pulse width proportional to the center rotating assembly’s position. The controller monitors the encoder whenever the rotating assembly is driven to its home (injured nerve) position. When the assembly rotates to either of the other positions, the controller counts steps and ignores the encoder.

If the center rotating assembly does not line-up with its surrounding graphic, when it should be in the home position, the encoder requires adjustment.

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Center rotating assembly adjustment

Unplug the connector labeled “center motor” from the controller board. This will prevent voltages generated by manually turning the rotating assembly’s stepper motor from damaging the controller.

Two very flexible blue wires connect the LED strip on the rotating assembly to a terminal block inside the plywood frame which supports the entire mechanical assembly. The terminal block and wires can be seen through a gap in the front of the frame. When turning the rotating assembly manually, watch the blue wires and avoid turning in a direction which will strain them.

Align the “injured nerve” side of the rotating assembly with the surrounding graphic.

Put an oscilloscope on pin 34 of the 40 pin microcontroller chip.

Loosen the ½” nut which secures the encoder. (The encoder is gold colored, about ½” in diameter, and has a cable with brown blue and orange wires.) Rotate the encoder until a 500 uS positive pulse width is seen. Tighten the nut

Move the rotating assembly a quarter turn, or so, away from it’s home position.

Plug in the center motor connector.

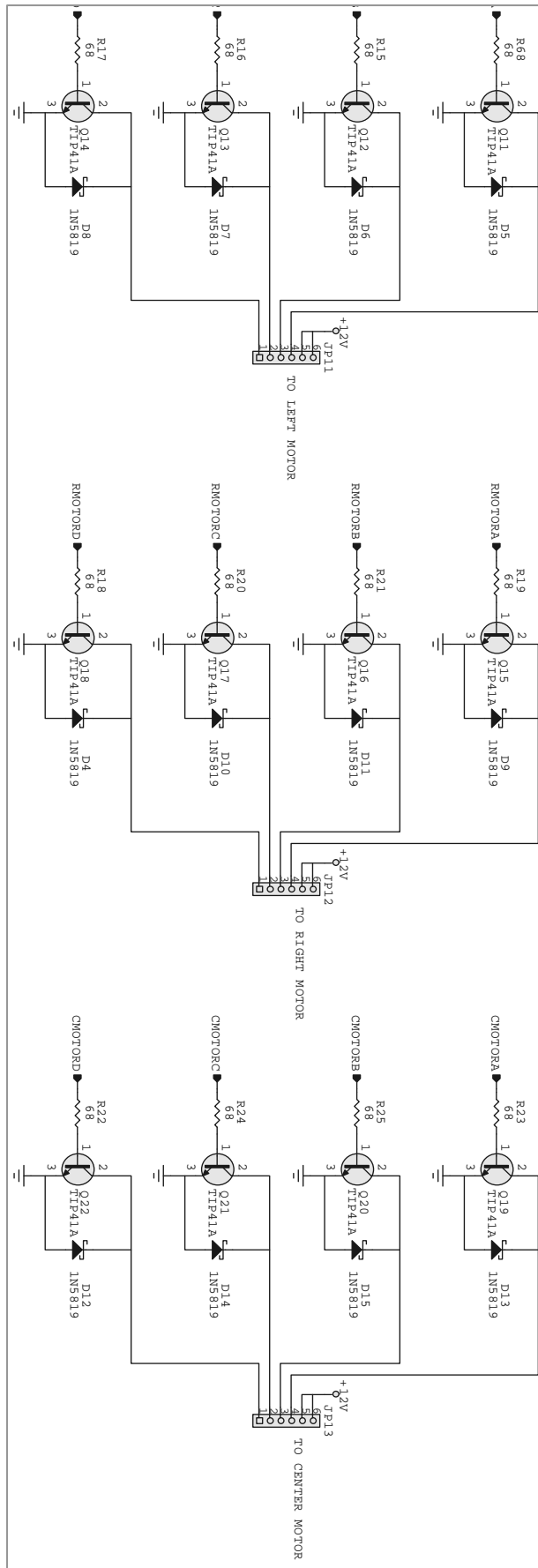
Push the red reset button on the controller.

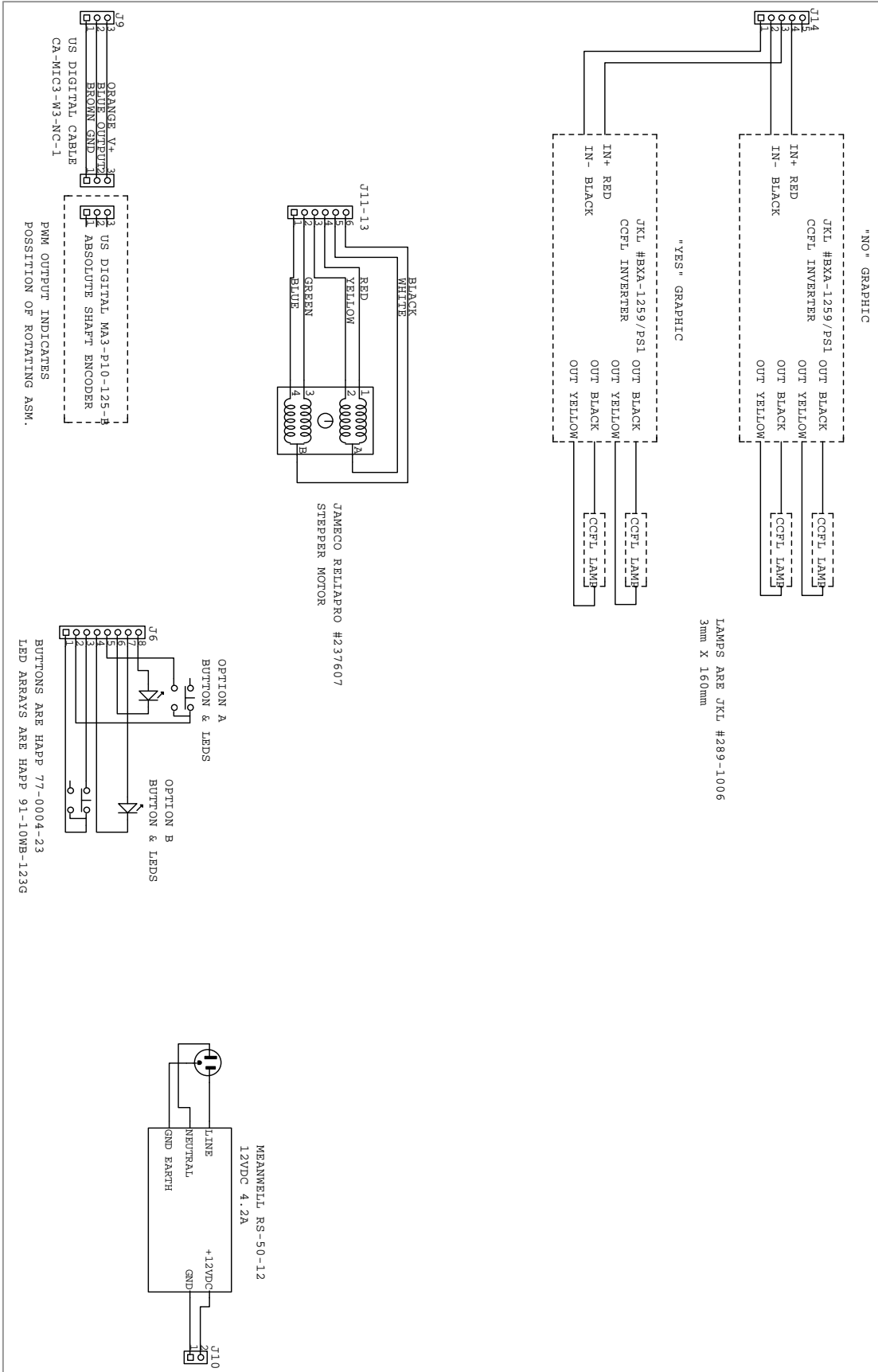
The rotating assembly will turn to its home position (according to the encoder.) If the injured nerve side of the assembly is close to parallel with its surrounding graphic, you’re done. The bottoms of the inner ends of the sliding tubes are cut at a taper which allow the tubes to align the rotating assembly if it’s close to the correct position when the tubes slide. This function defines the degree of accuracy required for encoder adjustment.

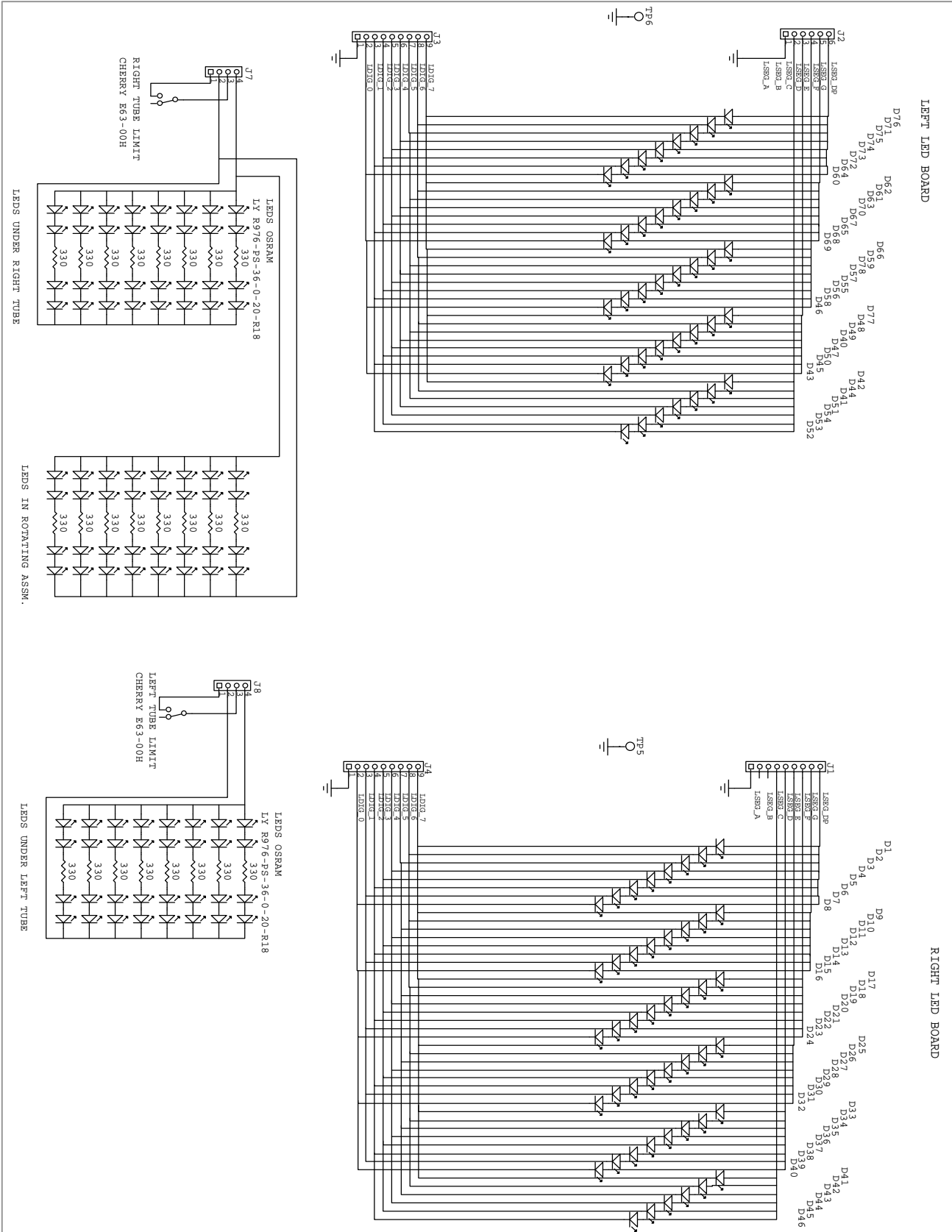
The surface mount LED boards

Two of the boards are mounted under the peripheral nerve and brain images on either side of the main graphic panel. The LEDs on these boards are driven in a chase light sequence to portray nerve conduction.

Everything inside the center circle is conceived to be at the scale of one of the nerve conduction LEDs. So, the yellow LEDs inside the circle that are going to light, will all light at once. This model breaks down, a bit, as we try to show nerve conduction right up to the injury site. When the exhibit is in the “injured nerve” or “scar tissue” states, only the led strip under the left sliding tube will light. When the exhibit is in the “nano scaffold” state, the LEDs under both sliding tubes and on the rotating assembly will all light at once, as though they were one LED in the nerve conduction chase light sequence.





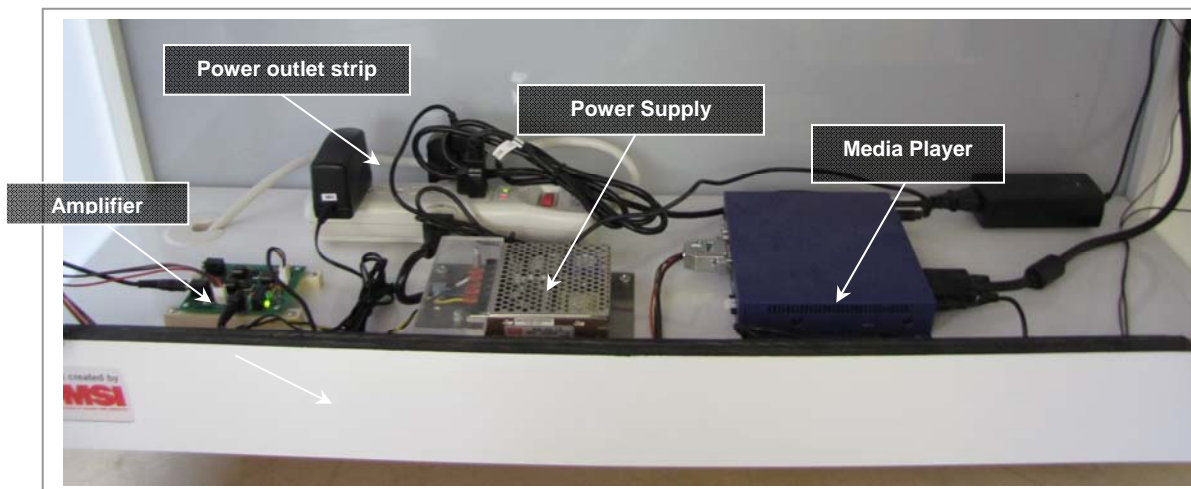


Service Access



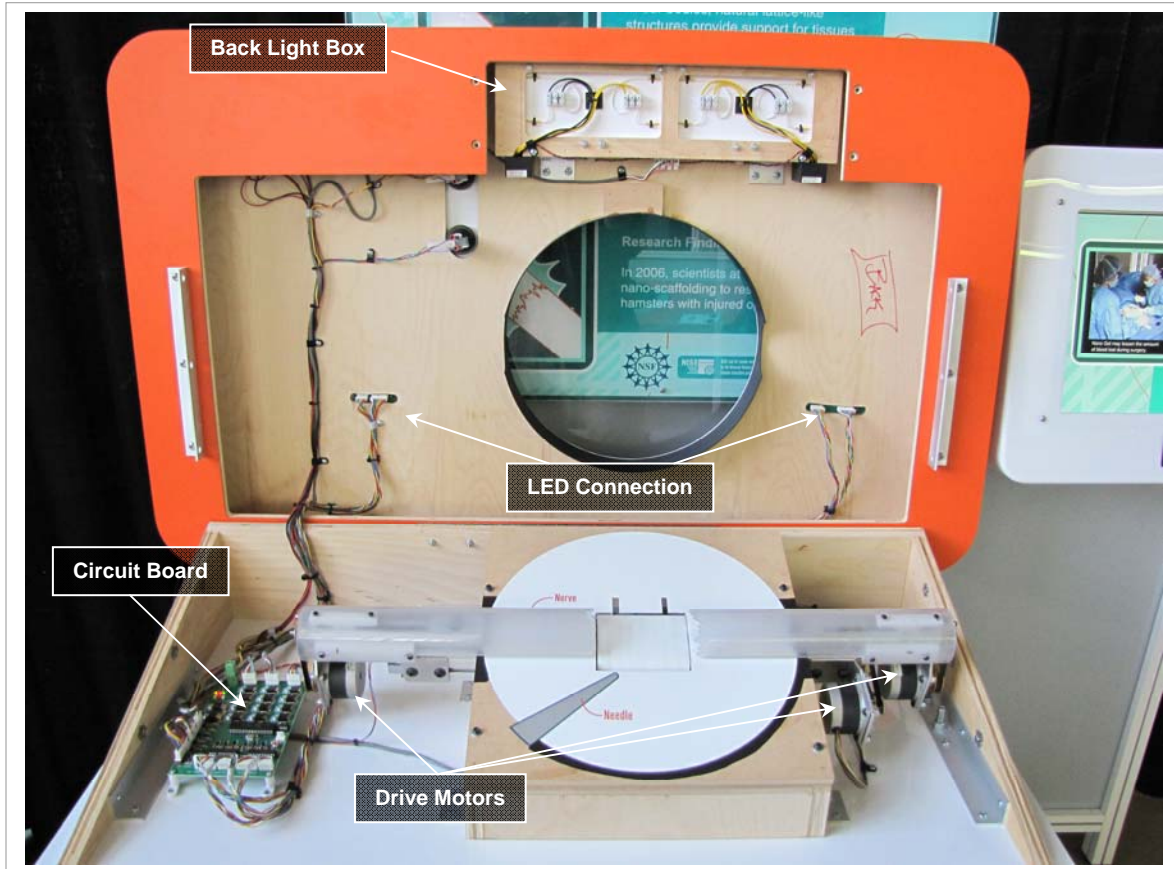
Base Cabinet Access

- Accessed with a 415-A key
- Contains
 - Power outlet strip
 - Media player
 - Interactive power supply



Interactive Access

- Accessed with 5/32" Allen Wrench, 6 bolts secure the top
- Contains
 - Interactive Circuit Boards
 - Back light box
 - Interactive Mechanics
 - Interactive drive motors (3)



Trouble-Shooting

Interactive:

- No interactive LED lights on power up or during interaction.
 - Ensure there is power to the exhibit.
 - Ensure power strip is switched to the “ON” position.
 - Check to ensure all power plugs are connected to power strip.
 - Check to ensure all plugs are connected to LED Boards and to the circuit board.

➔ **If the above conditions are met the interactive power supply may be faulty, replace as needed.**
- Center section does not rotate when prompted.
 - Ensure there is power to the exhibit.
 - Ensure power strip is switched to the “ON” position.
 - Check to ensure all power plugs are connected to power strip.
 - Check to ensure all plugs are connected to Drive Motor and to the circuit board.
 - Ensure the Drive Belts are in good condition.

➔ **If the above conditions are met the Drive Motor may be faulty, replace as needed.**
- “Nerves” do not come together when prompted.
 - Ensure there is power to the exhibit.
 - Ensure power strip is switched to the “ON” position.
 - Check to ensure all power plugs are connected to power strip.
 - Check to ensure all plugs are connected to Drive Motors (2) and to the circuit board.
 - Ensure the Drive Belts is in good condition.

➔ **If the above conditions are met the Drive Motor(s) may be faulty, replace as needed.**

Side Monitor:

- No picture or auto scroll.
 - Ensure there is power to the exhibit.
 - Ensure power strip is switched to the “ON” position.
 - Check to ensure all power plugs are connected to power strip and to the back of the Monitor.
 - Check to ensure source plug is connected to the media player and to the back of the Monitor.
 - Check to ensure media card is securely inserted into the media player.

➔ **If the above conditions are met the media card, media player, or side monitor may be faulty, replace as needed.**
- Pictures do not advance when prompted.
 - Check to ensure all plugs are securely connected to the “NEXT” button and the Signal cable is securely connected to the media player.
 - Check to ensure media card is securely inserted into the media player.

➔ **If the above conditions are met the media card, media player, or button may be faulty, replace as needed.**

Audio:

- No Sound
 - Check to ensure all plugs are securely connected to the Amplifier.
 - Check to ensure plugs are securely connected to the “ENGLISH” and “ESPANOLA” buttons and the Signal cable is securely connected to the media player.
 - Check to ensure media card is securely inserted into the media player.
- ➔ **If the above conditions are met the media card, headset or buttons may be faulty, replace as needed.**