

How to Build the Dementia Friendly Music Player

14 March 2020, <http://DementiaMusicPlayer.org>, Ross Porter rosswesleyporter@gmail.com



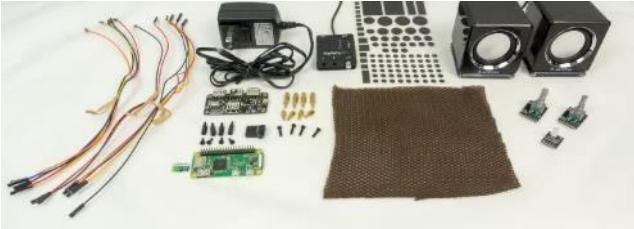
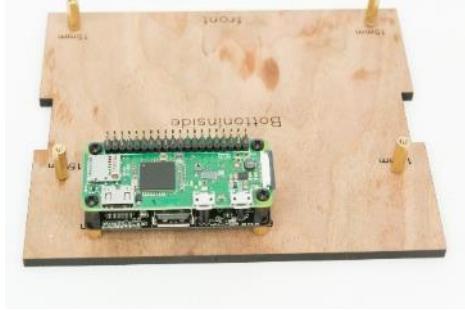
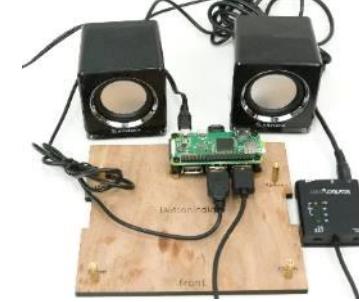
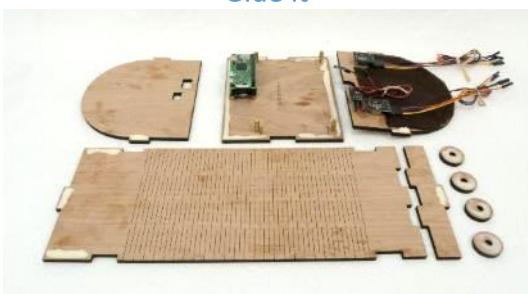
My Dad could not operate normal music players. But he could operate this music player because it operates like a familiar two-knob radio. My son & I were inspired to design this by the documentary [Alive Inside](#) which shows the profound joy felt by some people with dementia when listening to their favorite music.

It's easier than you think to make one. Everything I did (e.g. software, wood case design) is open source. This document contains all the information you need. You can order the parts online. Good project for kids. A 13 year old can do this with minimal assistance. Younger kids with more assistance.

Parts cost	~\$215 + tax + shipping (drops to ~\$120 if make 10 or more at a time, see Appendix 1)
Music cost	Minimal as you should use the recipient's existing music collection
Build time	About six hours, once you have the parts & music
Parts source	All parts can be mail ordered, links below
Soldering?	No
Woodworking?	No
Laser cutter needed?	No, you can mail order the pre-cut pieces for the wood case
With a friend?	Good idea, especially if your friend has the basic tools required
Beverage?	I recommend a hoppy IPA while you are assembling



Preview of the steps

<p>Order parts</p> 	<p>Order the case</p> 	<p>Assemble recipient's favorite music</p> 
<p>Copy software to micro SD card</p> 	<p>Add the Pi</p> 	<p>Test it</p> 
<p>Glue it</p> 	<p>Wire it</p> 	<p>STEP 9: Enjoy!</p> 

No warranty

USE THESE DQMUSICBOX PLANS AND SYSTEM AT YOUR OWN RISK. THE DQMUSICBOX PLANS ARE PROVIDED AS IS WITHOUT WARRANTY OF ANY KIND EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PLANS AND SYSTEM IS WITH YOU. SHOULD THE PLANS OR SYSTEM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION. IN NO EVENT WILL ANY PARTY BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PLANS OR SYSTEM.

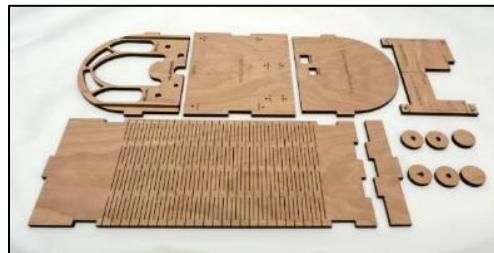
Acknowledgements

People were very generous with their time, and I really enjoyed the experience. This is certainly an incomplete list: Alex & Mike & others at [Ada's](#), the super smart staff at [Metrix](#), neighbor Randy, [Stephen Christopher Phillips](#), [Bob Rathbone](#), [Stephen Rusk](#), [Graham Hill](#), support at [Ponoko](#), [Florian Festi](#), and my son.

How it works



STEP 1: Order or make the case



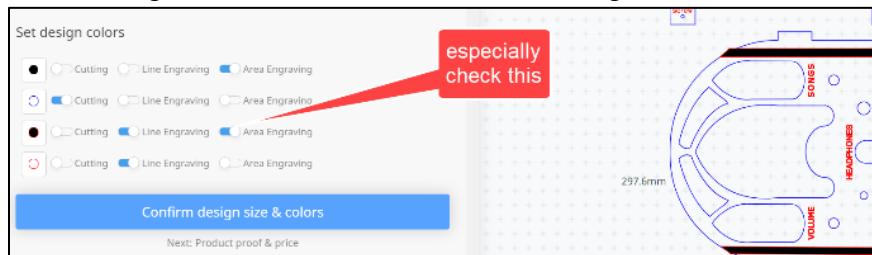
Create a Ponoko account (optional but convenient)

Ponoko is a company that laser cuts wood and sends you the precisely cut pieces. You don't need to use Ponoko – you are welcome to download my case design files (from [Ponoko](#) or [github](#)) and go to your local maker space and use the laser cutter there. Or buy yourself a laser cutter (if you do, will you be my friend?). In other words, Ponoko is convenient but not necessary. I have no affiliation with them, other than being a happy customer. To create a Ponoko account:

1. Go to <https://www.ponoko.com/>
2. Choose "Get Making"

Order from Ponoko

1. Go to https://github.com/rosswesleyporter/dqmusicbox/tree/master/case/laser_cut/cherry_with_small_speakers
2. Right-click on PONOKO_dqmusicbox_with_small_speakers_5point7mm_cherry.svg, choose "Save link as..."
3. Go to <https://www.ponoko.com/>
4. Login
5. If prompted in blue at the top of the screen, choose to switch to Ponoko 5.0
6. Click on "Reorder" and/or click on "Make your first product"
7. Choose wood, Cherry Veneer MDF
8. Choose "Upload your design" and upload the file that you downloaded just above, wait while Ponoko validates the design
9. Then set design colors as below, and click "Confirm design size & colors"



10. Click "Add to Cart"

STEP 2: Order the parts



Item	Supplier	Cost	Notes & alternatives
Cherry case	Ponoko	\$69.28	See instructions above.
Raspberry Pi Zero WH	Pi Shop	\$14.95	
power supply: 5V 3A, micro-USB	Pi Shop	\$6.20	Or Pi Shop SKU 1260
USB hub HAT for Pi Zero	Amazon	\$13.99	Or search for "MakerSpot 4-Port Stackable USB Hub HAT"
USB DAC	Amazon	\$22.99	Or Amazon B00F7120TQ
M2.5 standoffs (spacing screws)	Amazon	\$11.99	
M2.5 screws length=10mm ThreadPitch=0.45	Amazon	\$5.59	
Micro SD card	Amazon	\$4.75	Or upgrade to Amazon B06XWN9Q99 . Any brand name card that is 8GB or larger will do.
USB thumb drive	Amazon	\$5.60	This one is helpfully physically small, but many USB drives will work. Or Amazon B077Y149DL .
Arvicka speakers	Amazon	\$19.99	These speakers sound quite good and just barely fit. Alternatively, use other speakers that are no larger than 56W x 56D x 66H mm per speaker & take 3.5mm audio jack input & USB power
Speaker cloth	Amazon	\$9.99	
Light dimming stickers	Amazon	\$5.99	Optional, but the status LED is really bright. You could also use dark tape.
E6000 adhesive	Amazon	\$3.17	If you have a crafting friend, they probably have some
KY-040 rotary encoder knobs	Amazon	\$7.99	Or buy Amazon B06XQTHDRR .
Female-female jumper wires 30cm	Amazon	\$5.79	
KY-016 indicator LED	Amazon	\$6.99	Or buy Amazon B07KJYR8K1 . Or search Amazon for KY-016.
TOTAL		\$215.25	Prices will vary. Does not include tax, shipping.

STEP 3: Get headphones (optional)



You can just use the built-in speakers. But I recommend also having headphones – more immersive. Most headphones with a 3.5mm plug will work just fine. I tried out a lot of headphones for this project. Here are my suggestions.

Item	Cost	Notes and alternatives
The recipient's existing headphone	\$0.00	The best headphones are the headphones that the recipient is already used to.
Monoprice over the ear headphones	\$15.99	Amazing sound.
Sony MDR7506	\$79.99	Amazing sound. Perennial favorite.

STEP 4: Gather tools & supplies



You probably have some of these supplies. If you don't, you have a friend that does. This is exactly the sort of project that a friend would be happy to help you with.

Link to order item	Notes & alternatives
Isopropyl alcohol	You will use isopropyl alcohol to clean the wood before staining.
Wood stain or oil	If you have a friend that does woodworking, ask them for advice and they'll probably give you the little bit of product that you need. I used Tried & True Varnish Oil (linseed oil) because I like the result, it's easy, and non-toxic.
Brush or cloth	
Duct tape	Any duct tape will do. You will use duct tape as a clamp while gluing.
Painter's tape	Any tape that comes off easily will do. Painter's tape is great. Regular masking tape is probably fine too.
Needle nosed pliers	Handy for grabbing screws that drop into the case and for extracting small USB drives
Philips screw driver #0	#0 i.e. small
Elmer's wood glue	Any wood glue will do
3/16 th nut driver	Or wrench. Or needle-nosed pliers. Or really strong fingers
SD card reader/writer	Your computer may have an SD card reader/writer. If not, you probably have a friend that does. Or order a USB SD-card reader .

STEP 5: Assemble the personalized collection of music

Choosing the music – go for familiar favorites

This is the most important step. The personalized (familiar) music is the fundamental magic. You don't need much music, perhaps 10 albums. But only familiar favorites. In my case, my Mom mailed me my Dad's favorite CDs. It will take two weeks for the parts above to arrive, so you have time to do this well. Though it is easy to change the set of music later.

Put the music on the USB memory stick

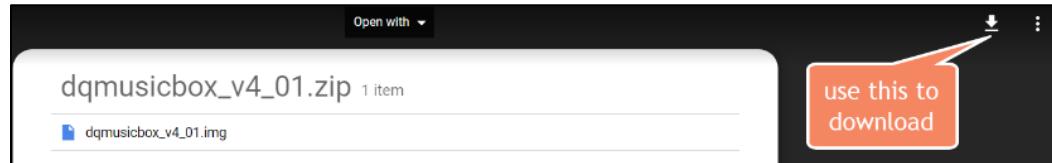
Organize the digitized music into folders on the USB memory stick, one folder per album. MP3, iTunes, and FLAC files are supported i.e. files with extensions .mp3, .m4a, .flac. In the end, you should have a set of folders that looks something like this:

Name	Date modified	Type
A_Beethoven9	10/24/2015 6:25 PM	File folder
B_Eli_Porter_-_Eli_Porter	10/24/2015 6:25 PM	File folder
C_Mozart_-_Overtures	10/24/2015 6:25 PM	File folder
D_Tchaikovsky_-_Concerto for Violin i...	10/24/2015 6:25 PM	File folder
E_Vivaldi_Telemann_Bach_Mercadante...	10/24/2015 6:25 PM	File folder
F_Samuel Barber_-_Barber; Adagio for ...	10/24/2015 6:26 PM	File folder
G_James Galway_-_Serenade	10/24/2015 6:26 PM	File folder
H_Giacomo Puccini_-_Madama Butter...	10/24/2015 6:26 PM	File folder
I_Giacomo Puccini_-_Madama Butterfl...	10/24/2015 6:26 PM	File folder
J_Giacomo Puccini_-_Madama Butter...	10/24/2015 6:26 PM	File folder
K_Leontyne Price_-_Arias	10/24/2015 6:26 PM	File folder

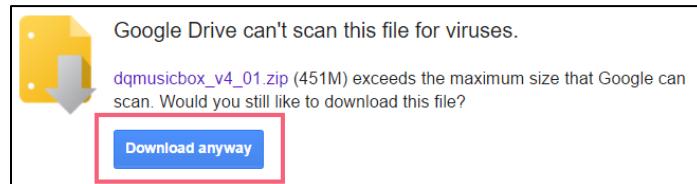
STEP 6: Copy software to the micro-SD memory card

I prepared a disk image for you. It has all the required software. Your job is to download this disk image and then write it to the micro-SD card. The steps:

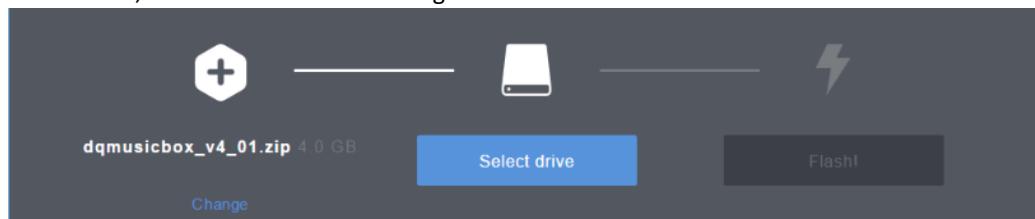
1. Install [Etcher](#) on your PC or Mac or Linux computer. [Win32 Disk Imager](#) also works.
2. Download the [Dementia Friendly Music Player disk image](#).



3. Confirm download – “Download anyway”



4. Put the micro-SD memory card into the SD card adapter that it came with i.e. put the tiny card into the larger card.
5. Put the SD card adapter into the SD reader/writer in your computer.
6. Start Etcher, instruct it to write the image file to the SD card:



7. Wait for the writing to complete, ~10 minutes. This would be a good time to make a sandwich.

STEP 7: Stain it or oil it

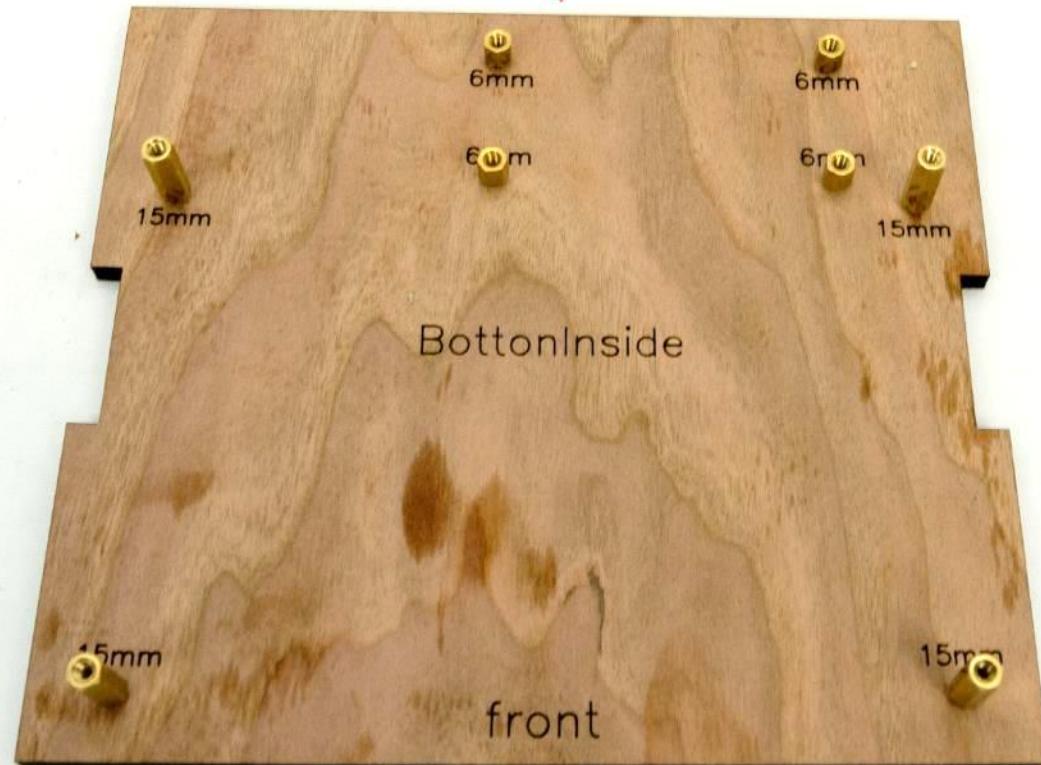
Ask a woodworking friend for help. They probably have everything you need.



Use whatever stain or oil you like. I used the relatively non-toxic Tried & True Varnish Oil. If you use this, my suggestion: apply a thin coat to outside surfaces (see above), wipe away excess, let dry for a day indoors, apply a second coat the same way, 0 coats for inside surfaces.

STEP 8: Add standoffs

Screws in 4x 6mm standoffs and 4x 15mm standoffs. Put your finger underneath and stop screwing just as the standoffs are about to go all the way through - the bottom of the music box should not have little bits of standoffs poking through.

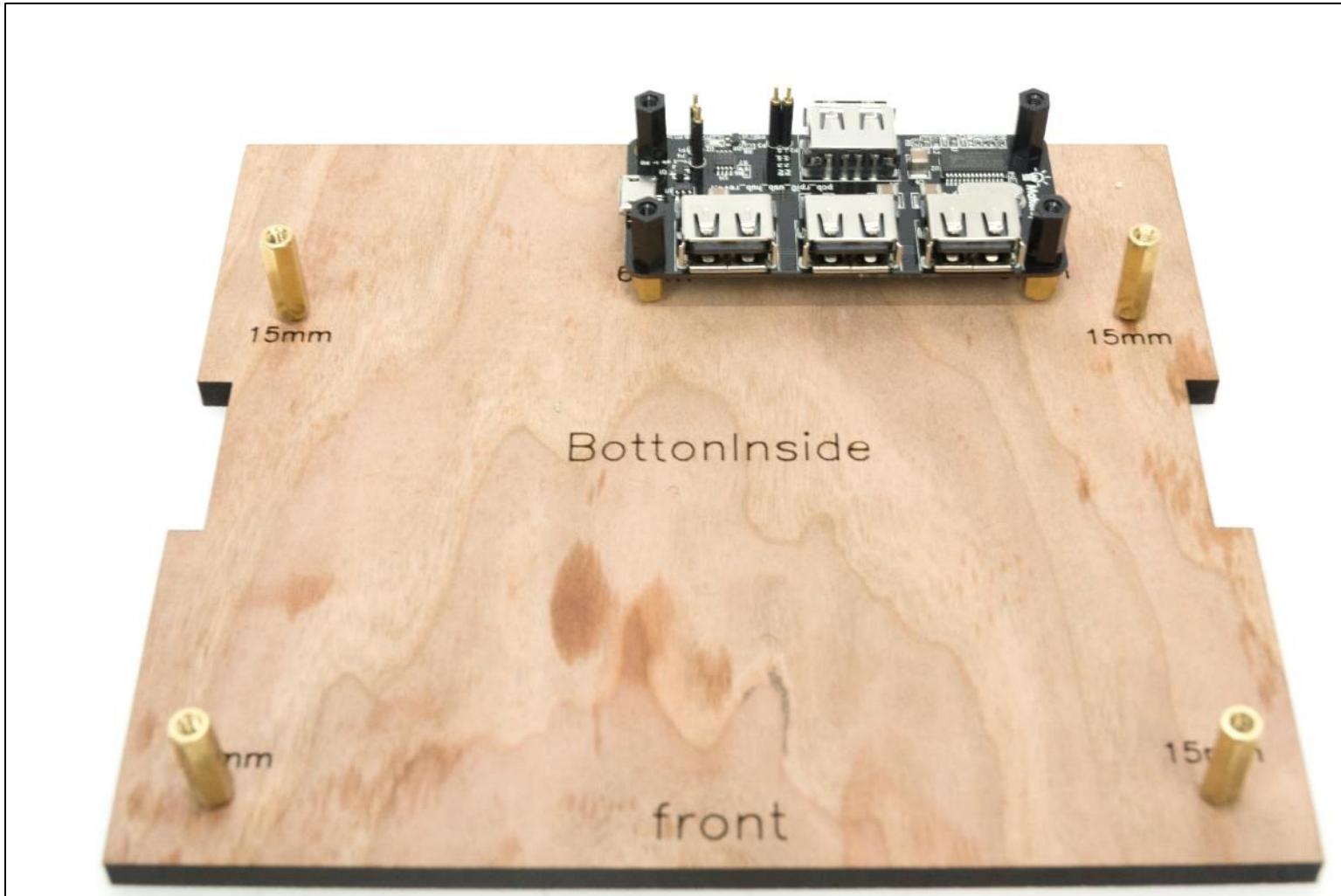


STEP 9: Adhere the speaker fabric

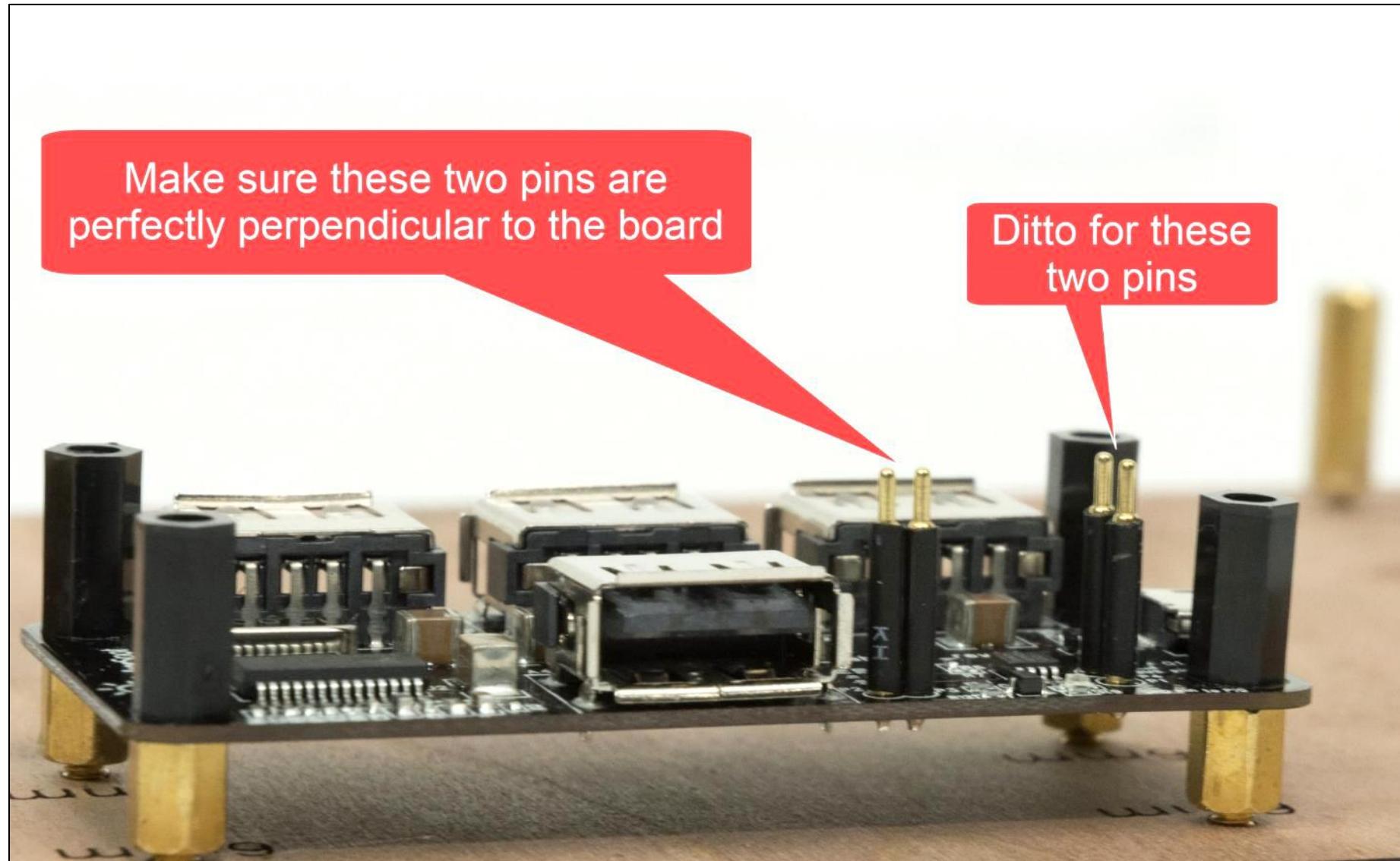
Use the E6000 adhesive. The side of the cloth with big holes should face out, thus from this inside view you are looking at the side of the cloth with small holes.



STEP 10: Add the USB hub

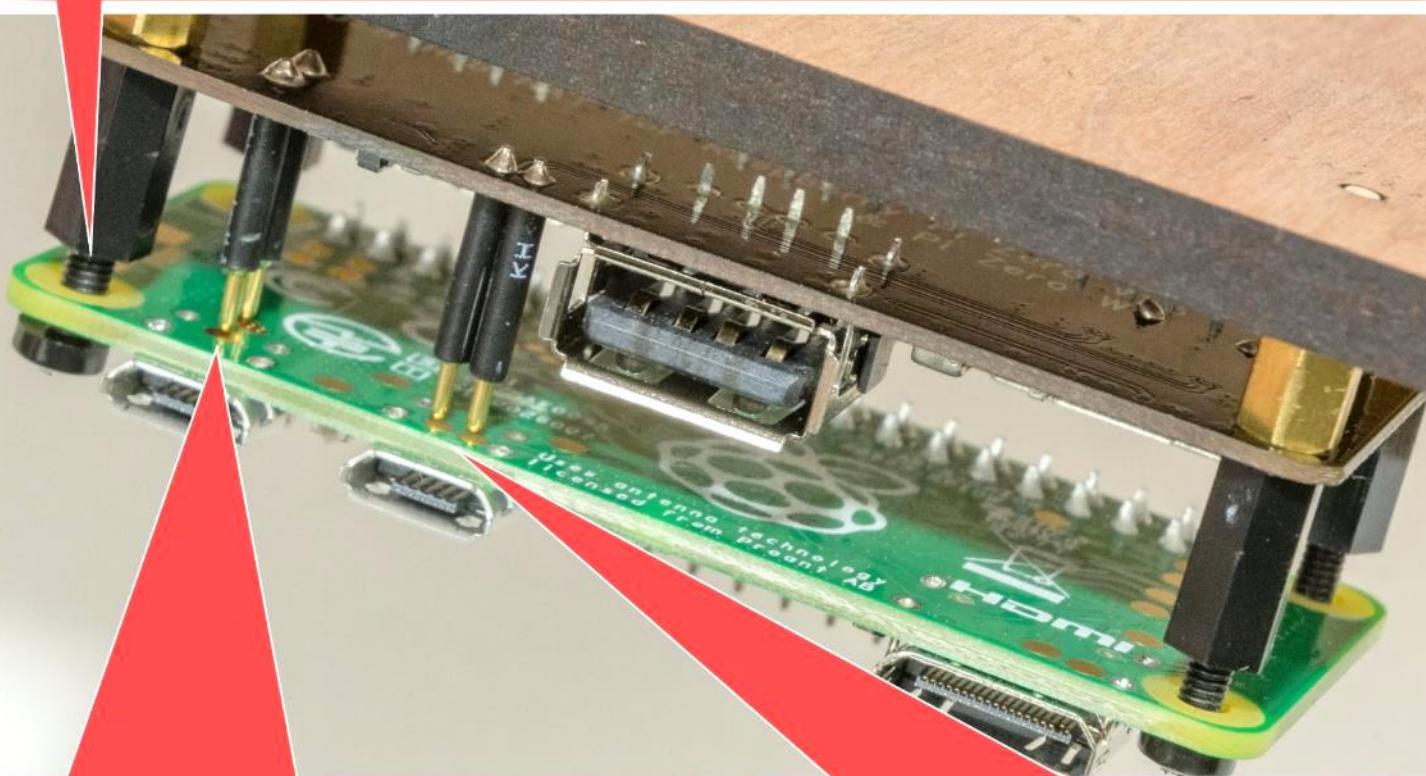


STEP 11: Make sure the pins are straight



STEP 12: Loosely attach the Pi

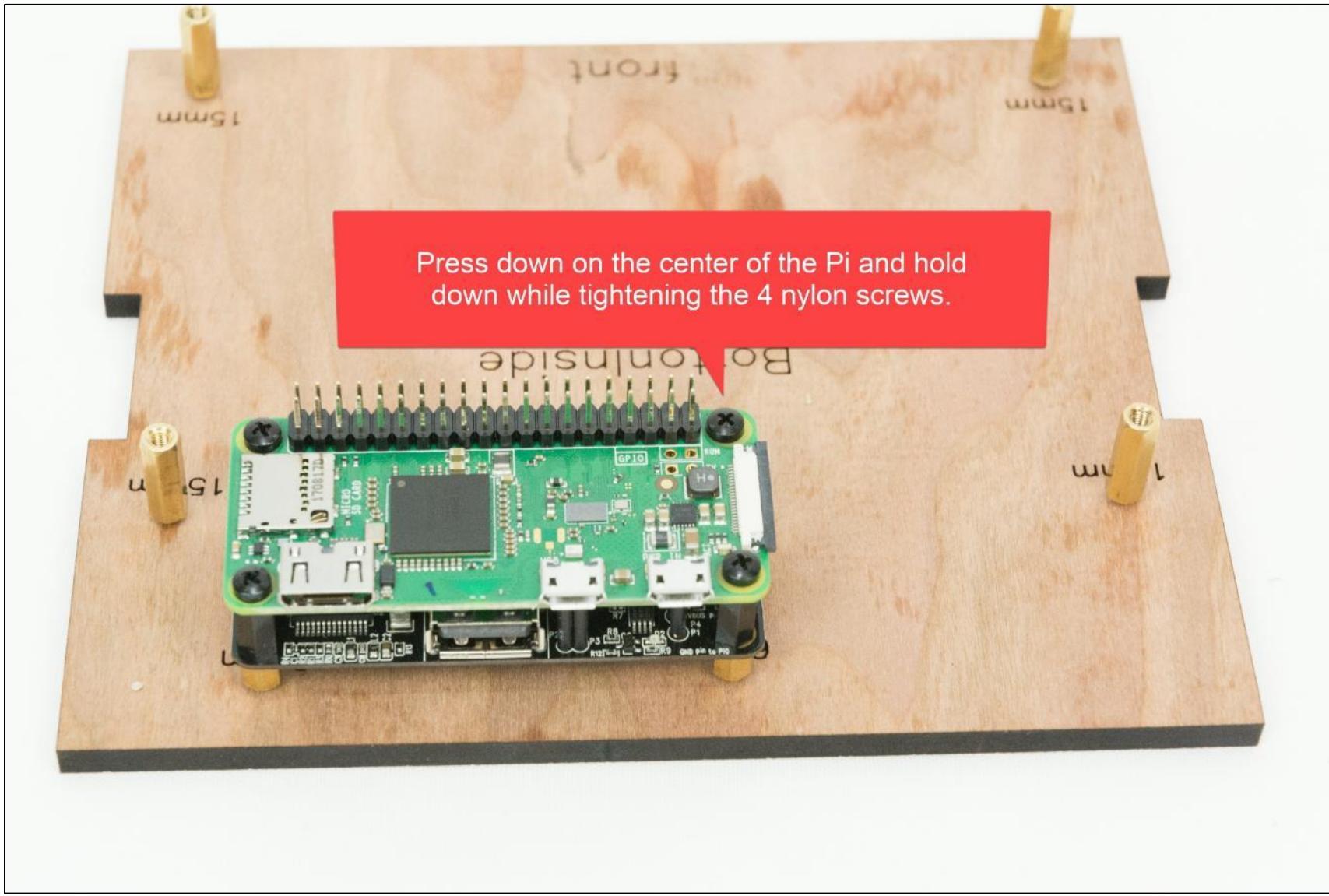
Loosely attach the Pi using the 4 nylon screws.
Look at it upside down.



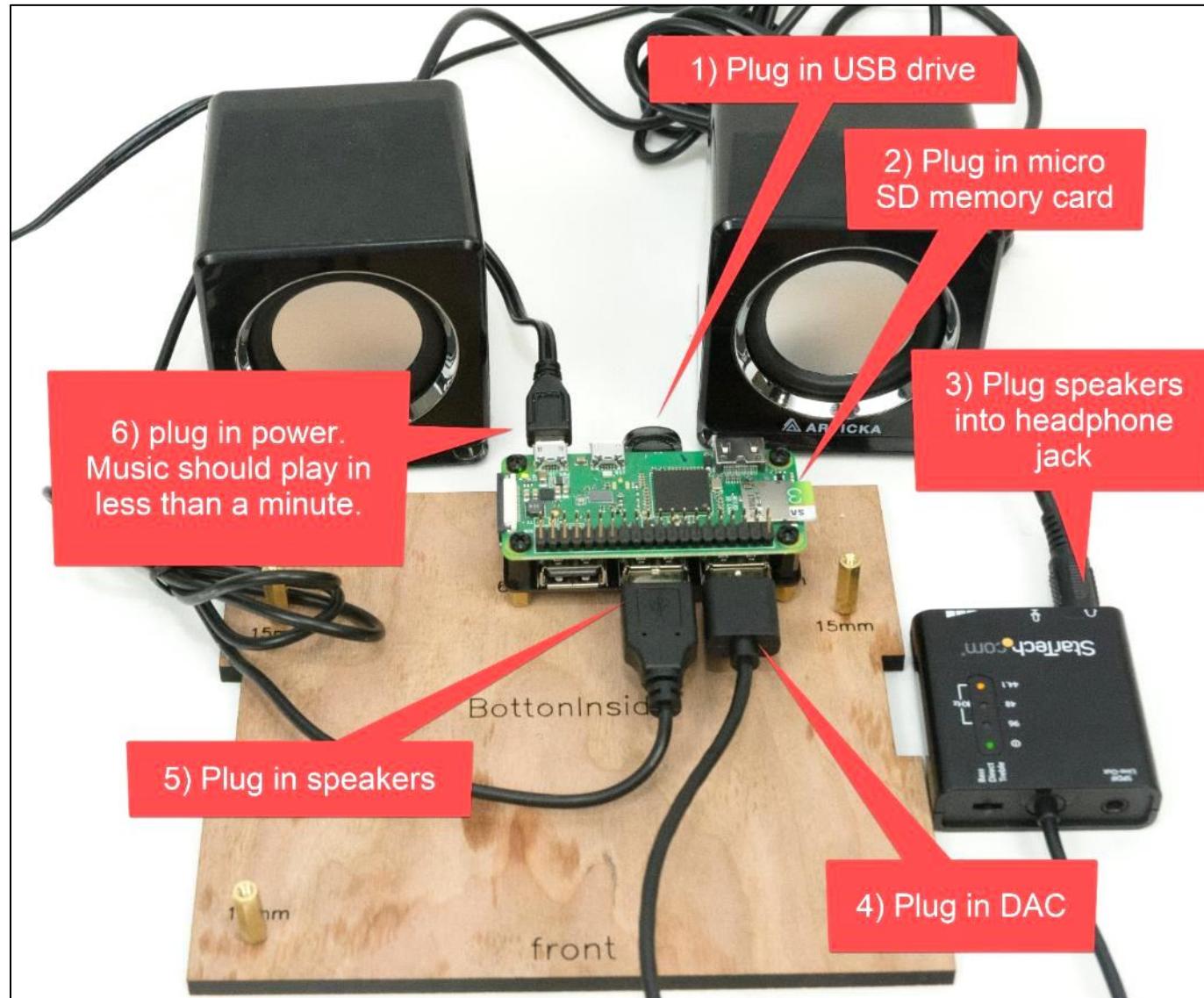
Make sure these two pins are aligned with the small gold pads

Make sure these two pins are aligned with the small gold pads

STEP 13: Firmly attach the Pi



STEP 14: Test #1



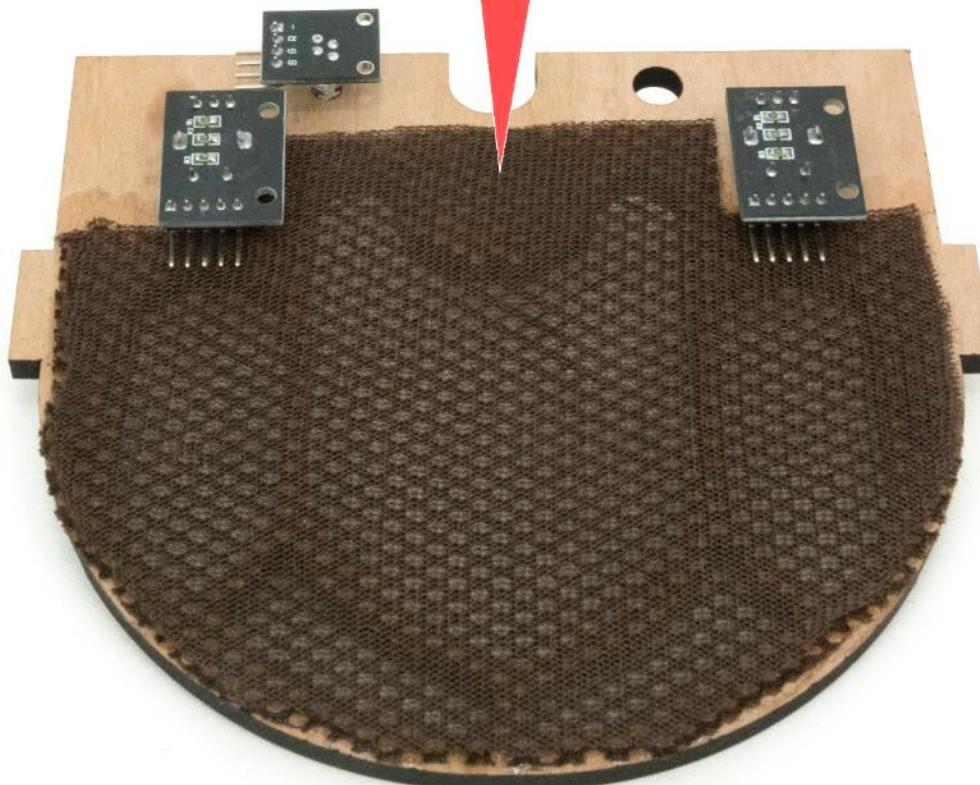
STEP 15: Adhere the indicator LED

Use the E6000 adhesive. Keep working - don't let the adhesive dry - as you may need to briefly remove the LED in the next step.

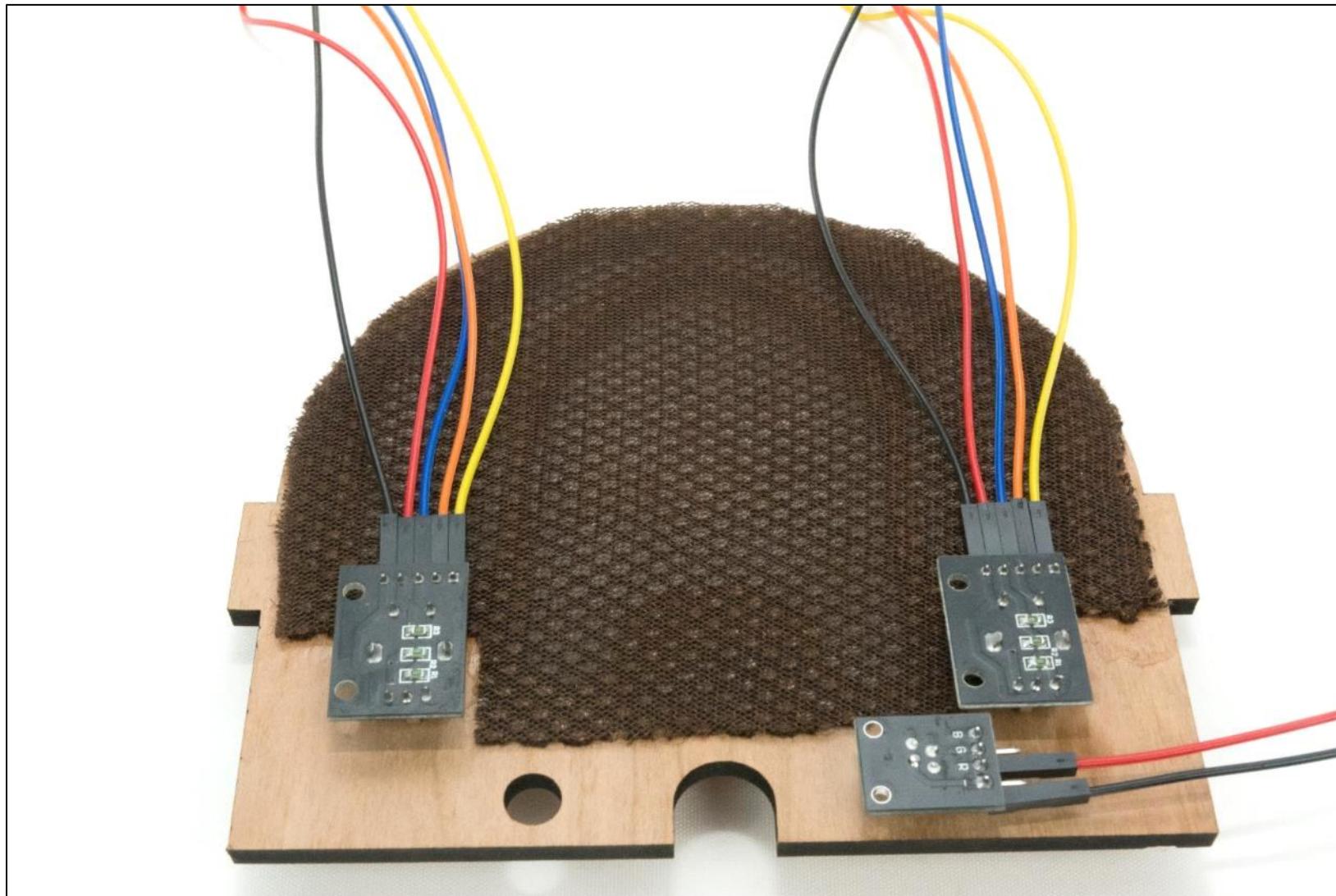


STEP 16: Screw in rotary encoders

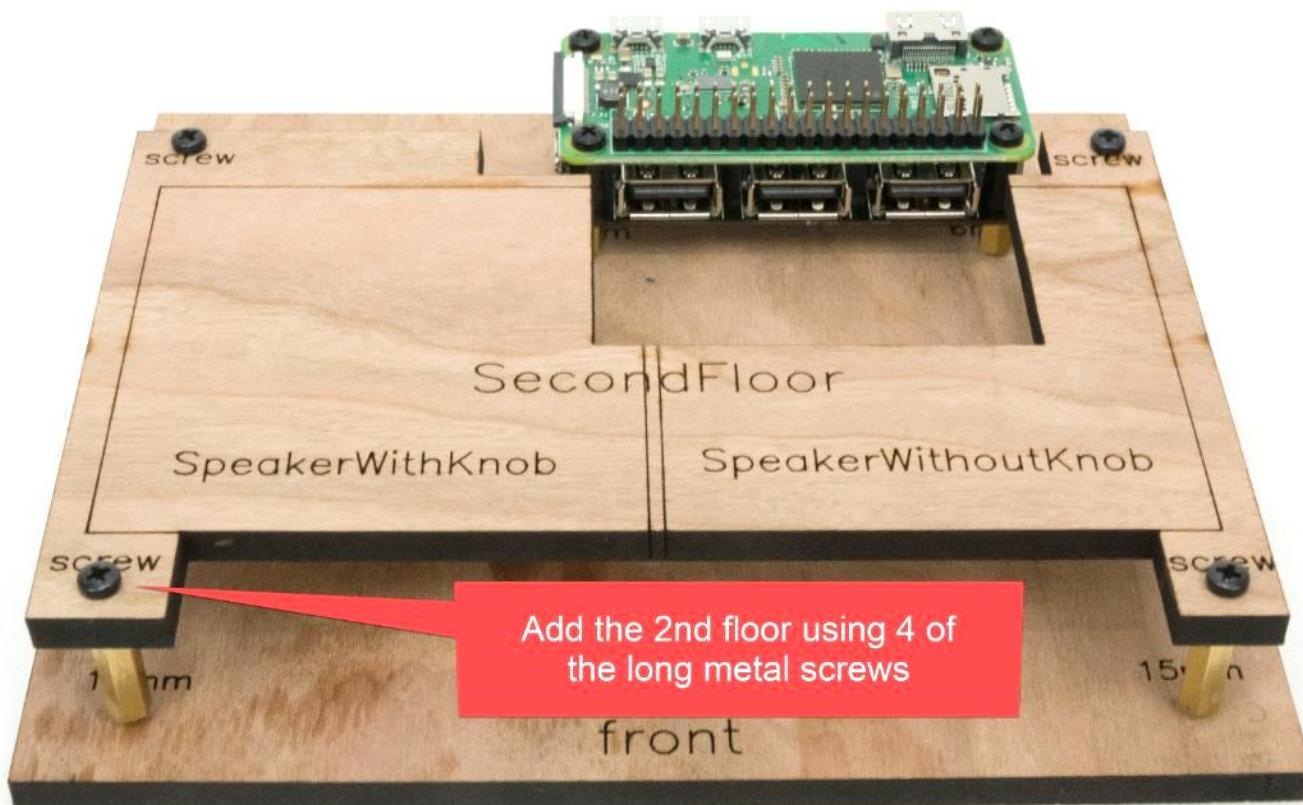
Make sure that the two rotary encoders go in straight, or the knobs will look funny later. Don't screw quite all the way in, or the upcoming wiring work will be difficult.



STEP 17: Wire the front panel components



STEP 18: Add the 2nd floor

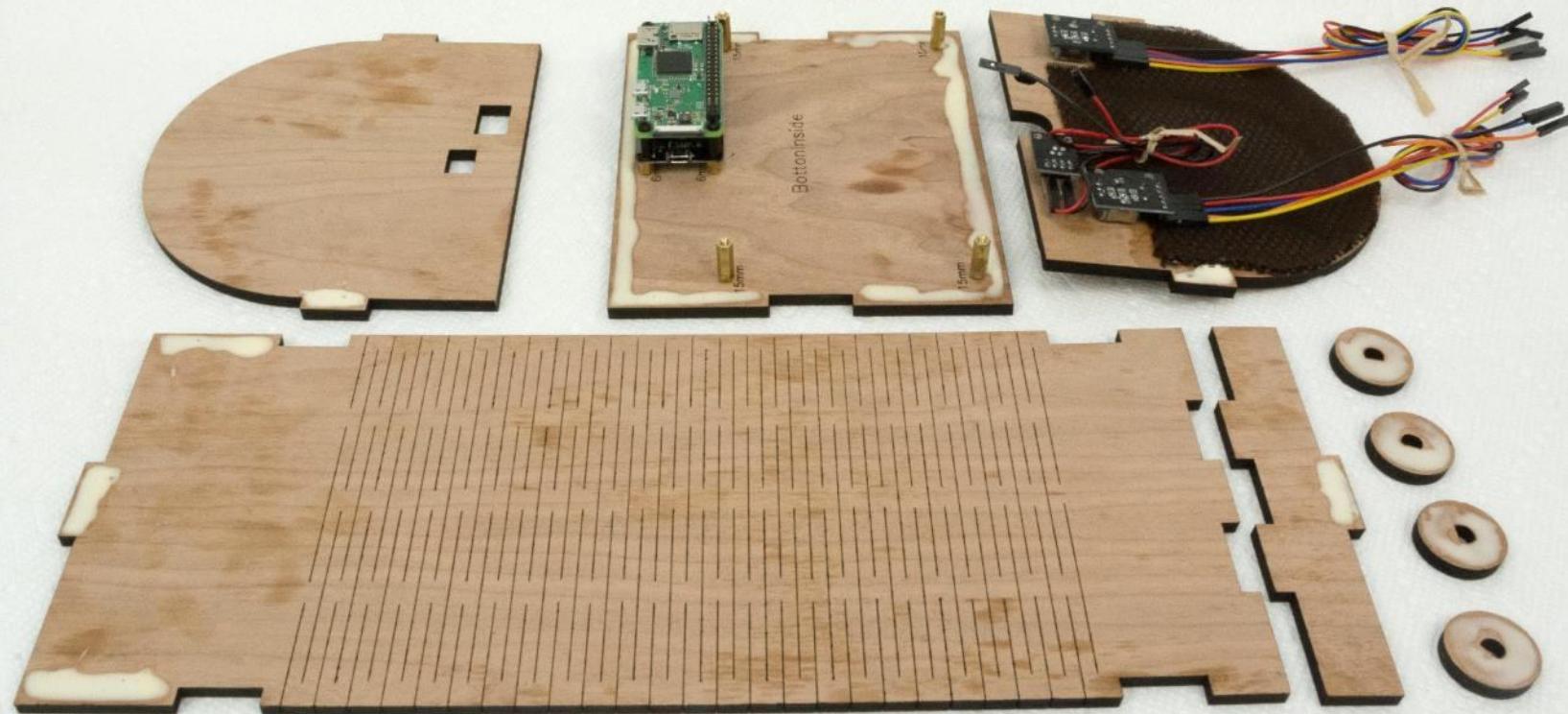


STEP 19: Review how the wood pieces will fit together



STEP 20: Apply glue

Apply glue only in the spots below. Go slow - it is easy to make a mistake here.



STEP 21: Clamp it

1) Put all the pieces together, wiping off excess glue with a wet rag

2) Fully cover with painter's tape (blue)

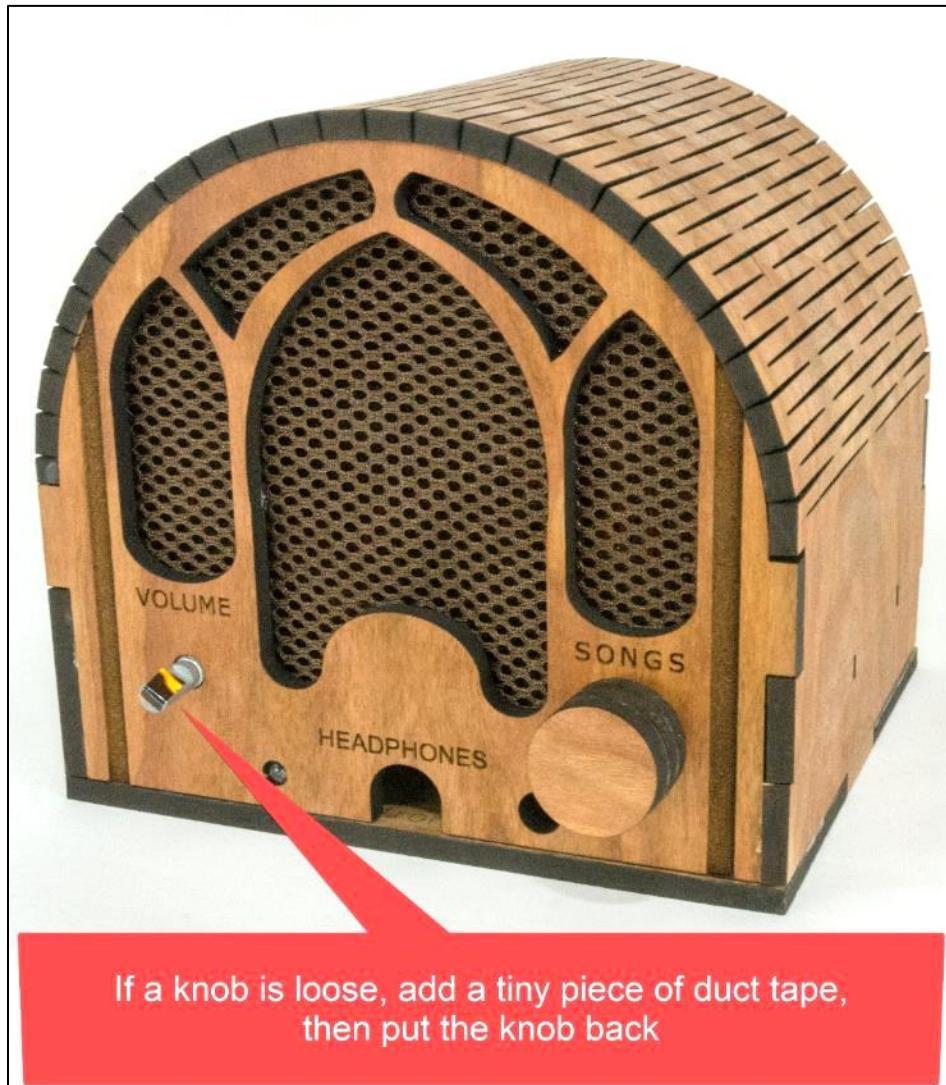
3) Use duct tape (flames, colorburst) as clamps i.e. put on *really* tightly. Use a lot of it. The painter's tape will protect the wood from the duct tape's adhesive.



5) Let the glue dry overnight

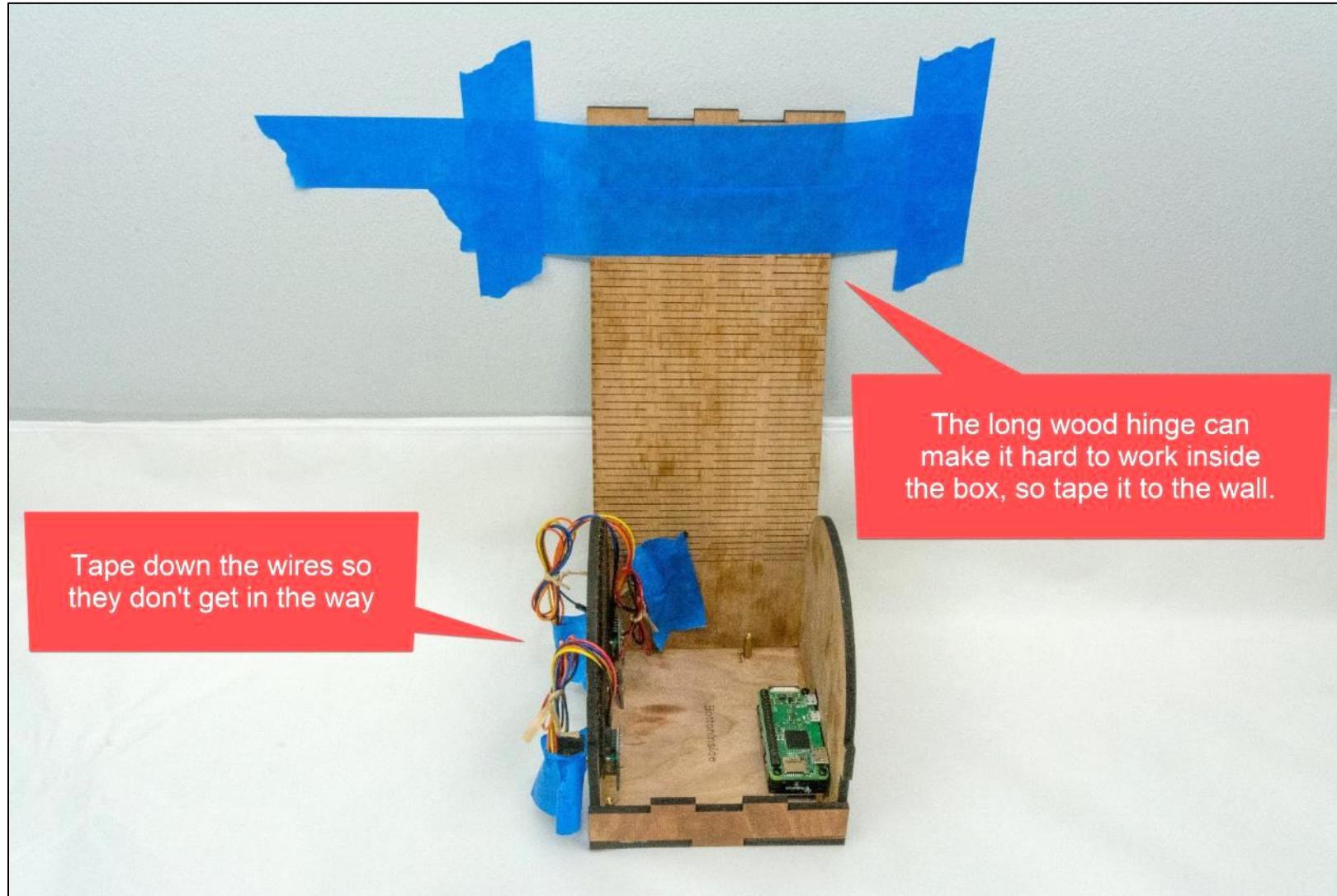
4) Use the metal shafts to align the wood knob pieces. But remove wood knobs before they glue to the metal.

STEP 22: Adjust knobs if needed

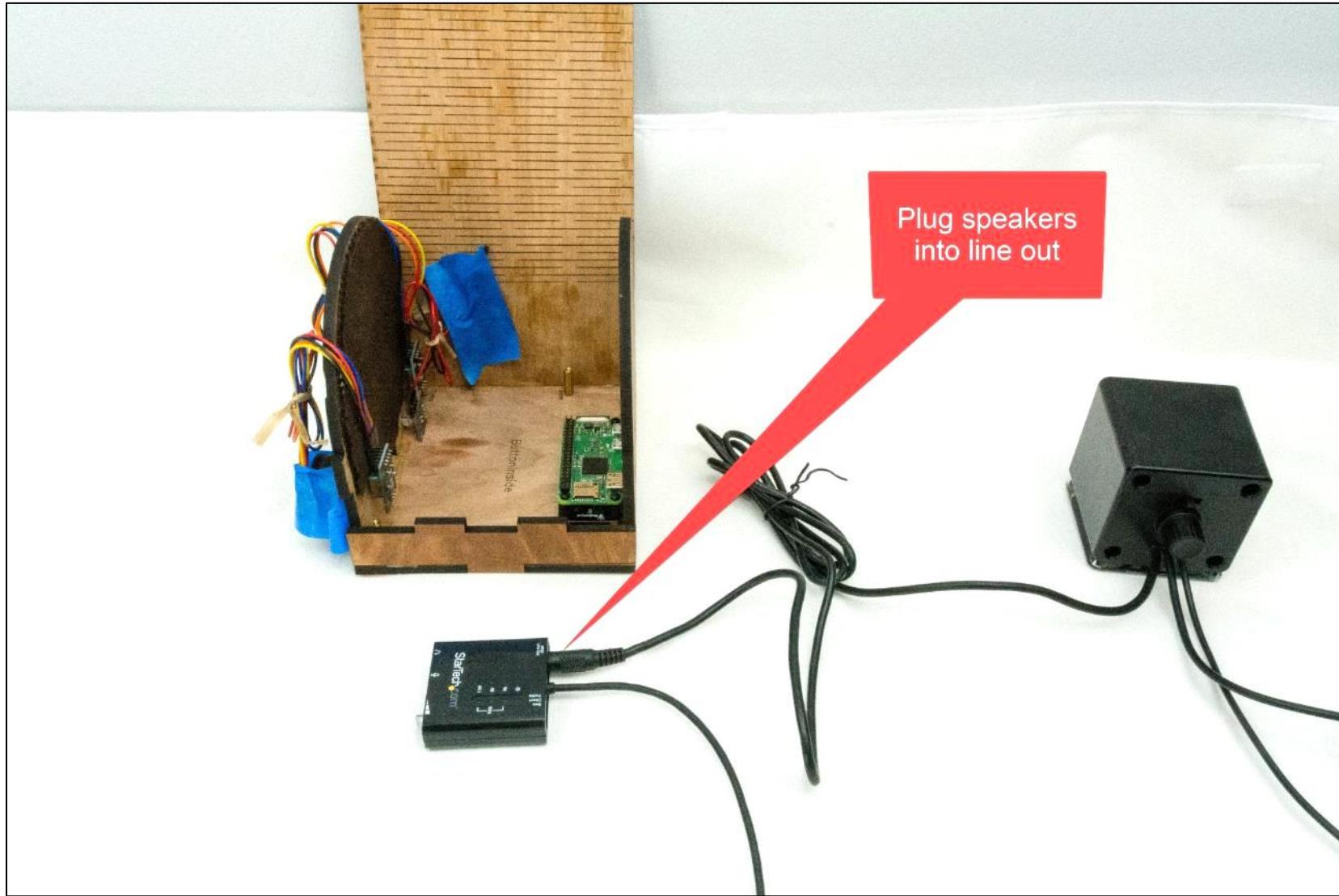


If a knob is loose, add a tiny piece of duct tape,
then put the knob back

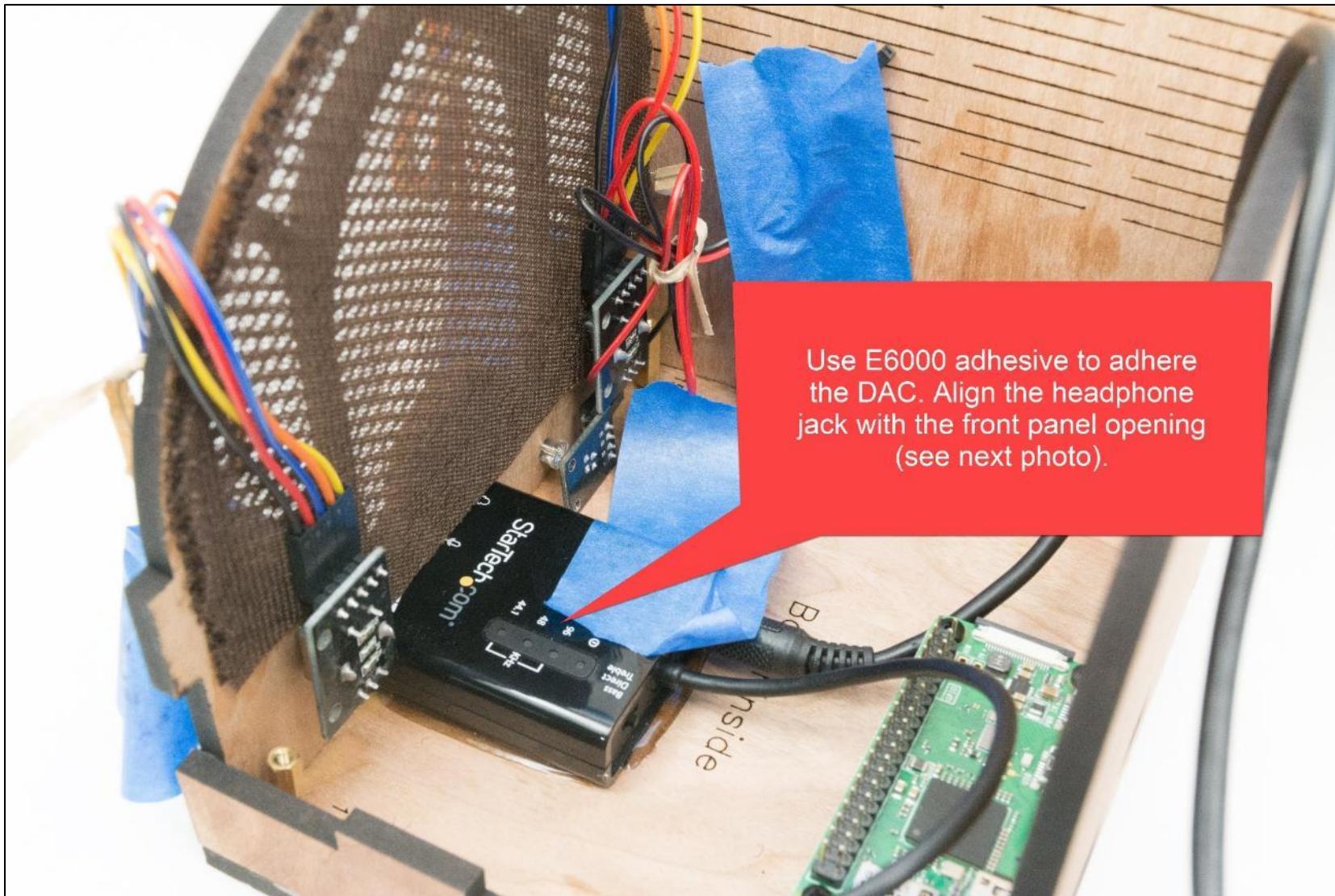
STEP 23: Create a rig



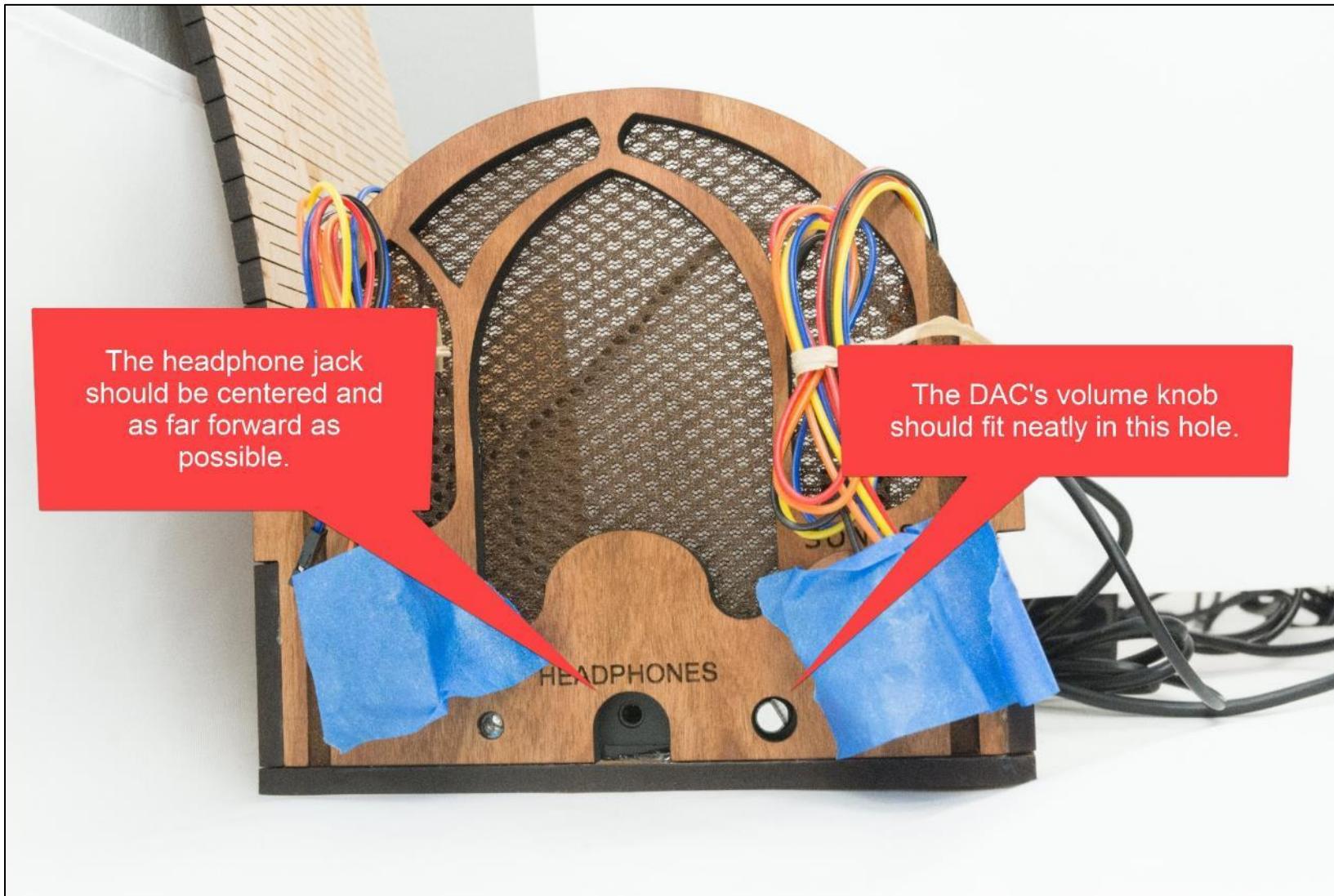
STEP 24: Plug speakers into line out



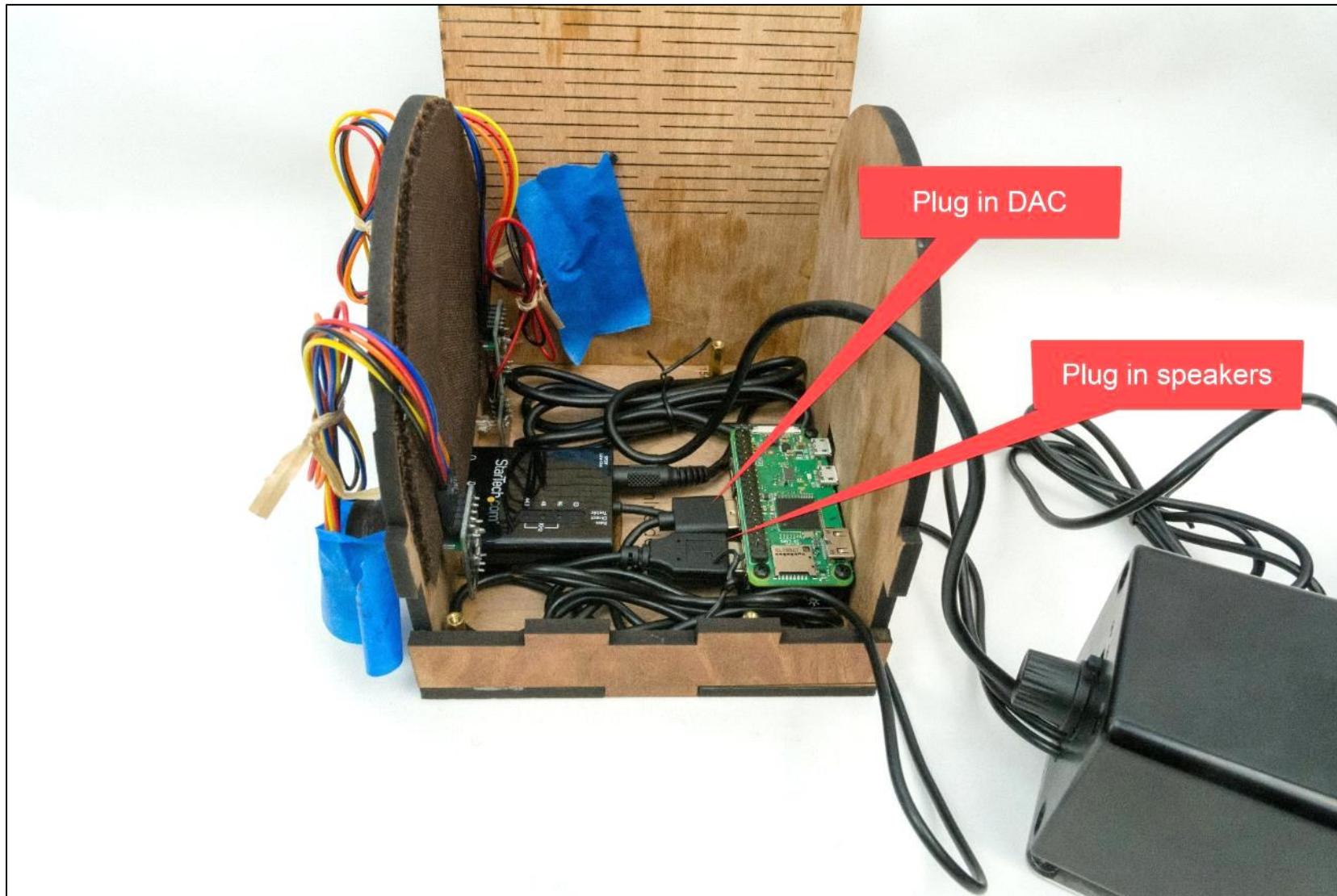
STEP 25: Adhere the DAC



STEP 26: Check DAC alignment



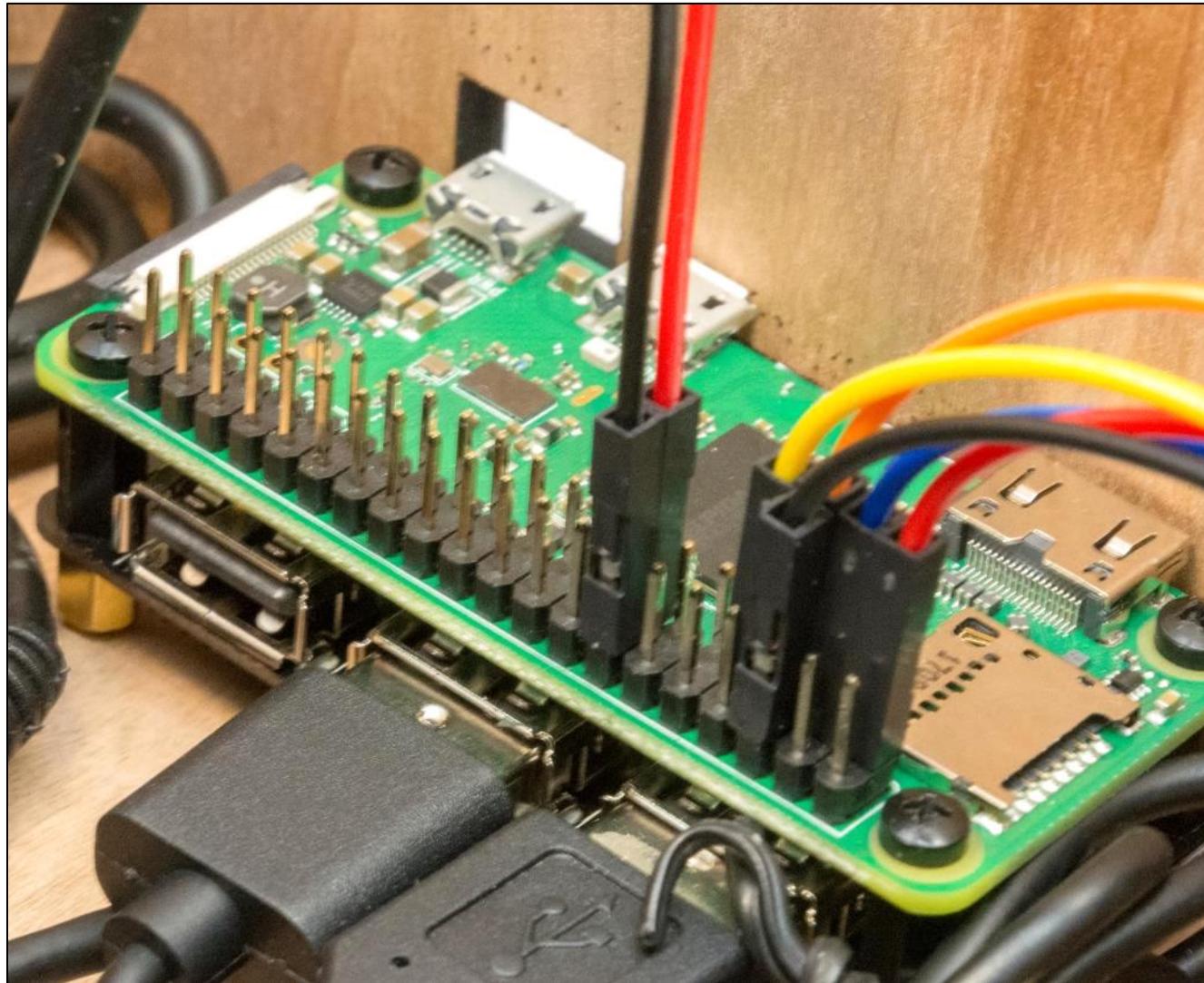
STEP 27: Plug in DAC & speakers



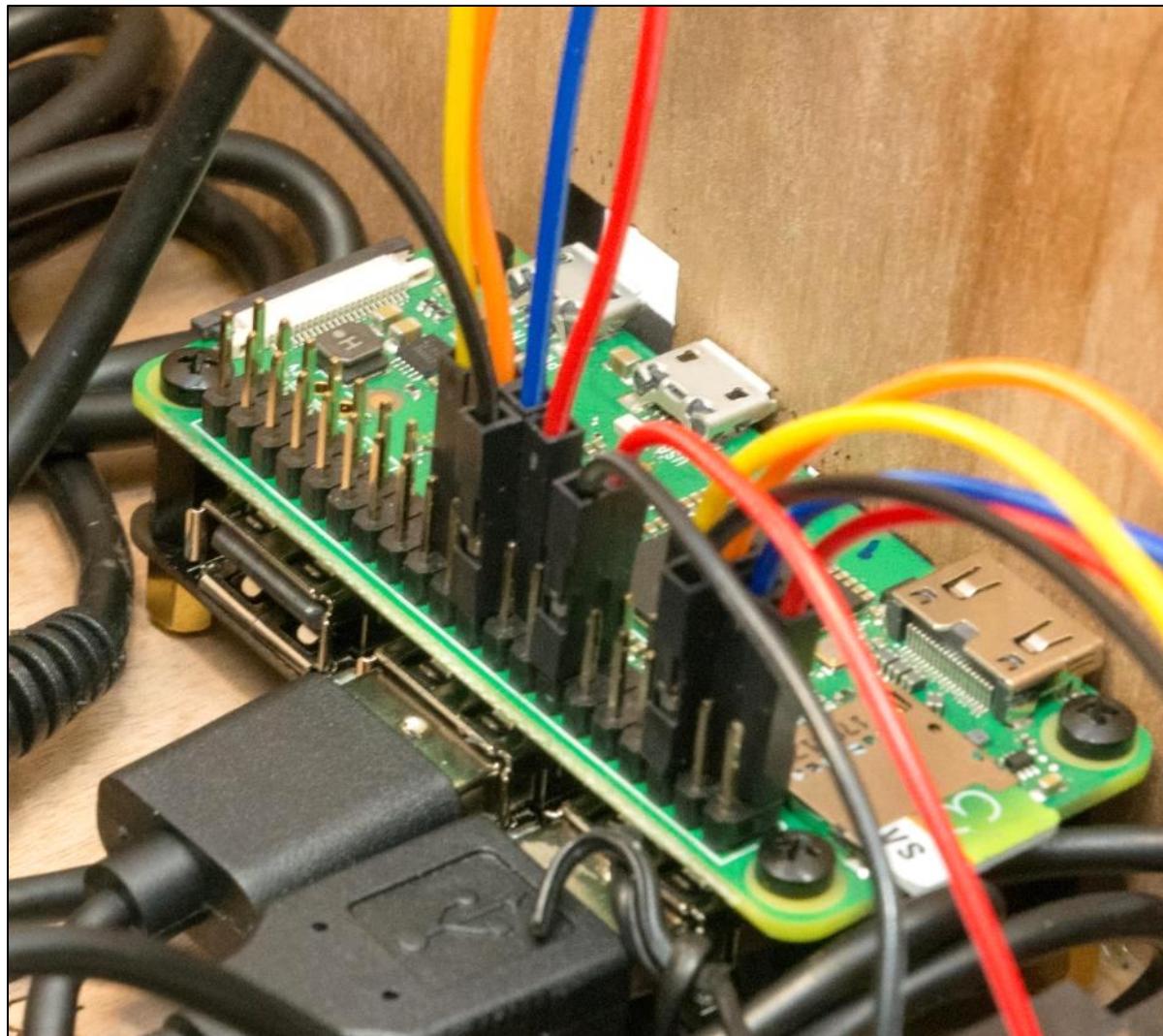
STEP 28: Wire the songs knob



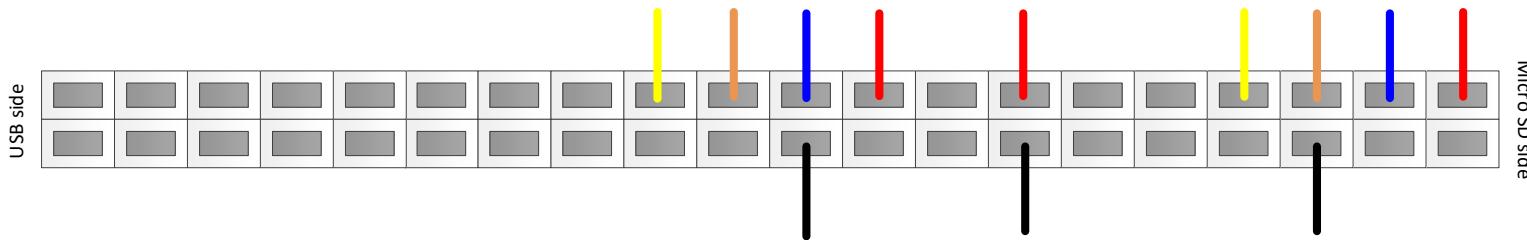
STEP 29: Wire the LED



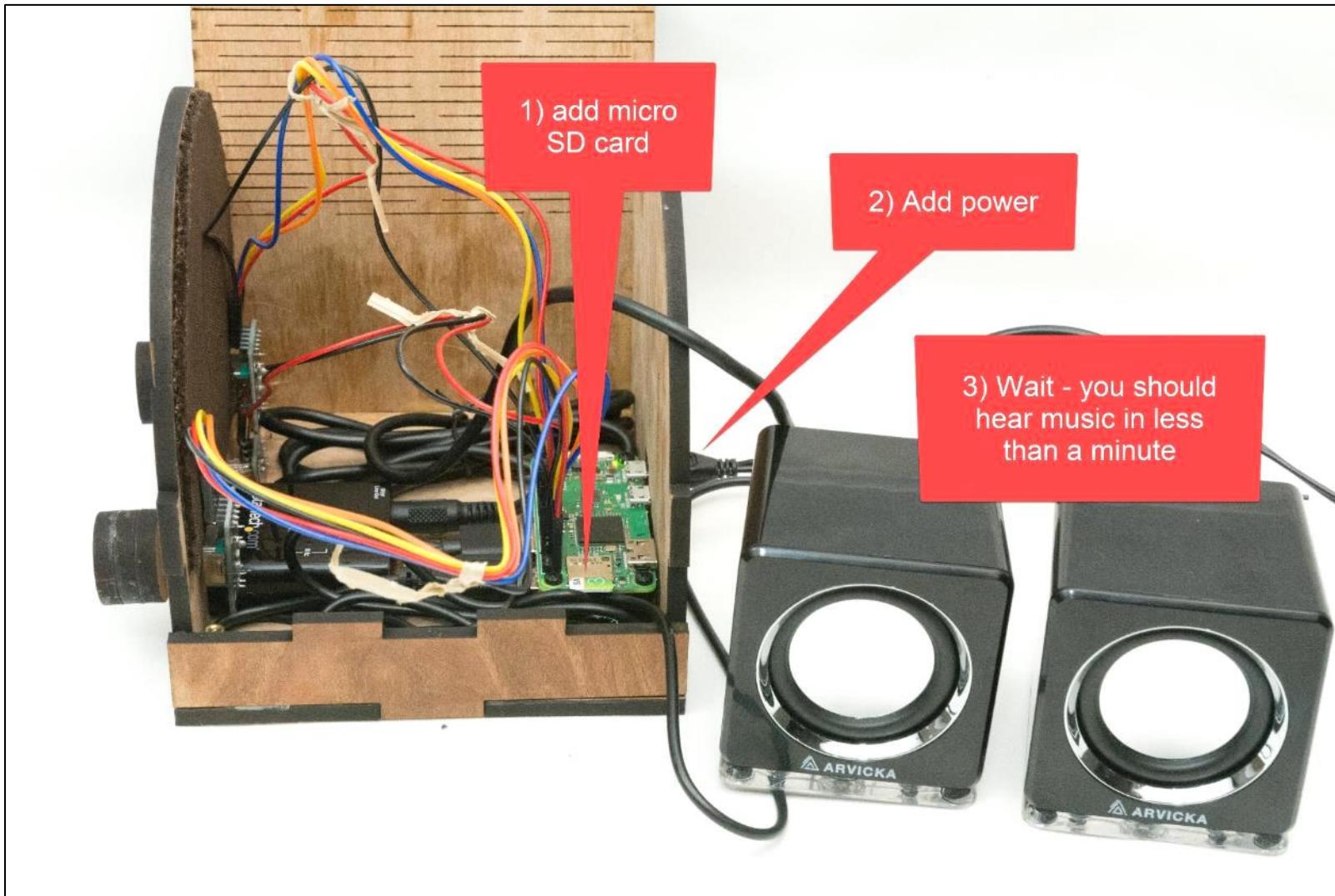
STEP 30: Wire the volume knob



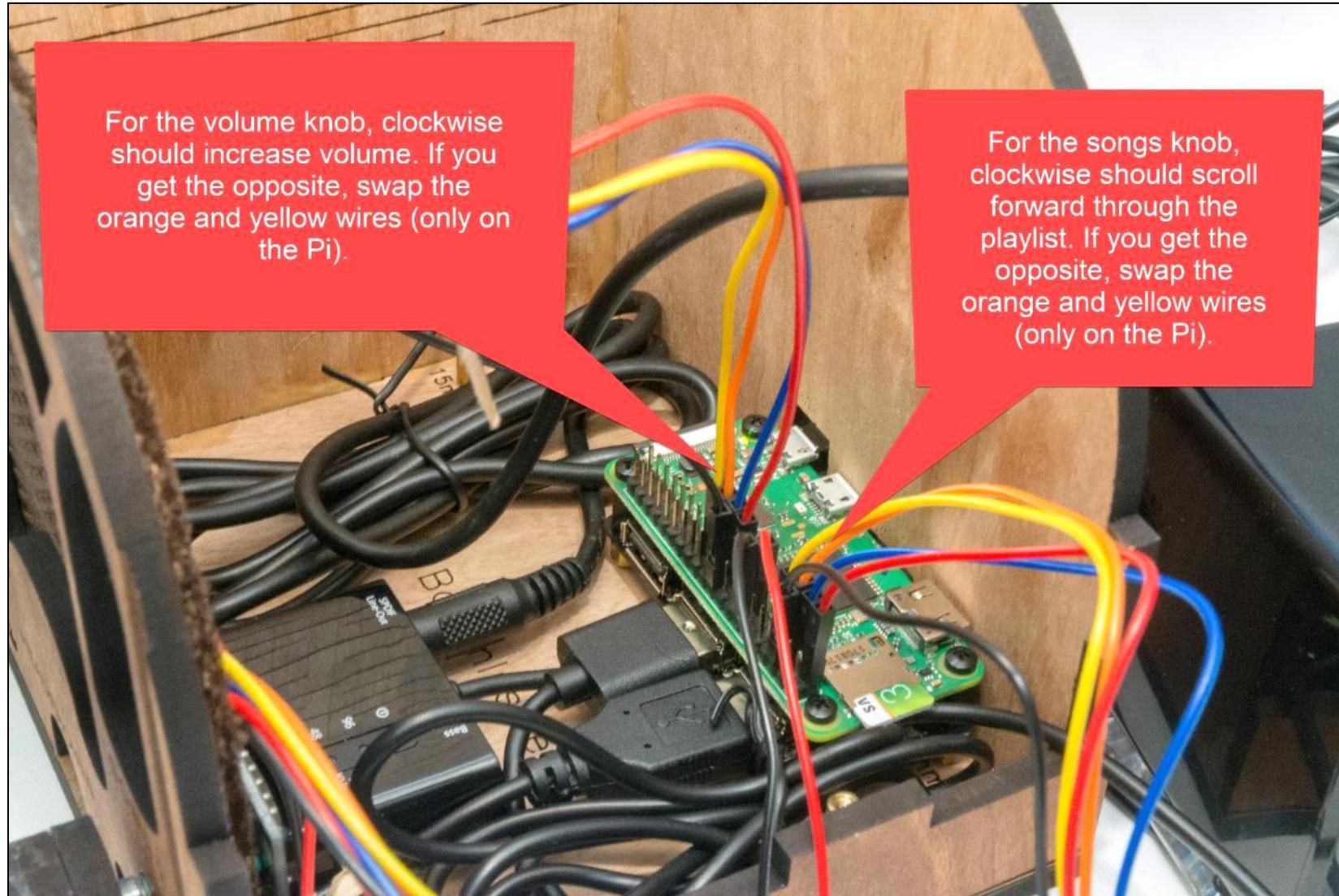
STEP 31: Check the Pi wiring against this diagram



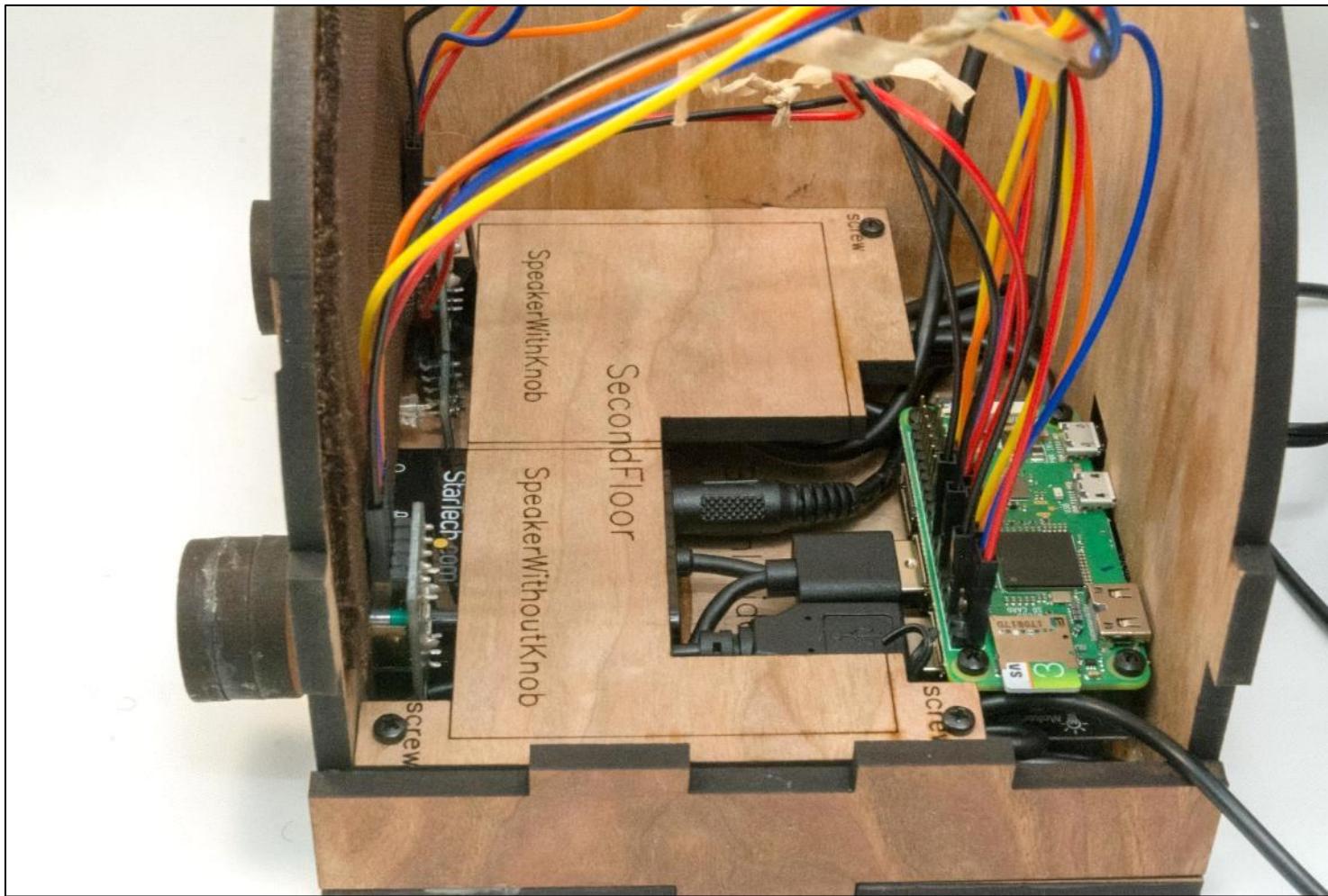
STEP 32: Test it



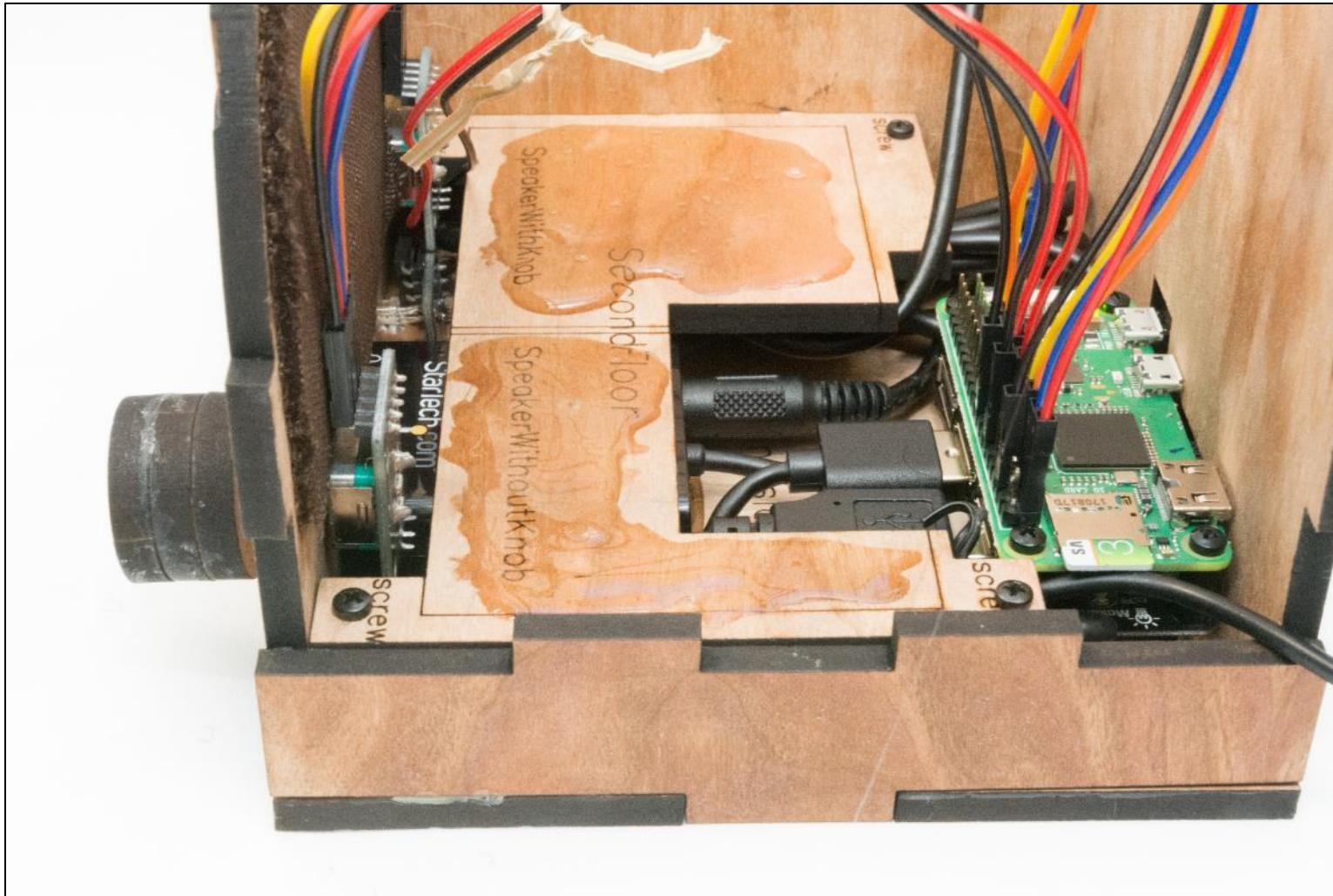
STEP 33: Test knobs & fix if needed



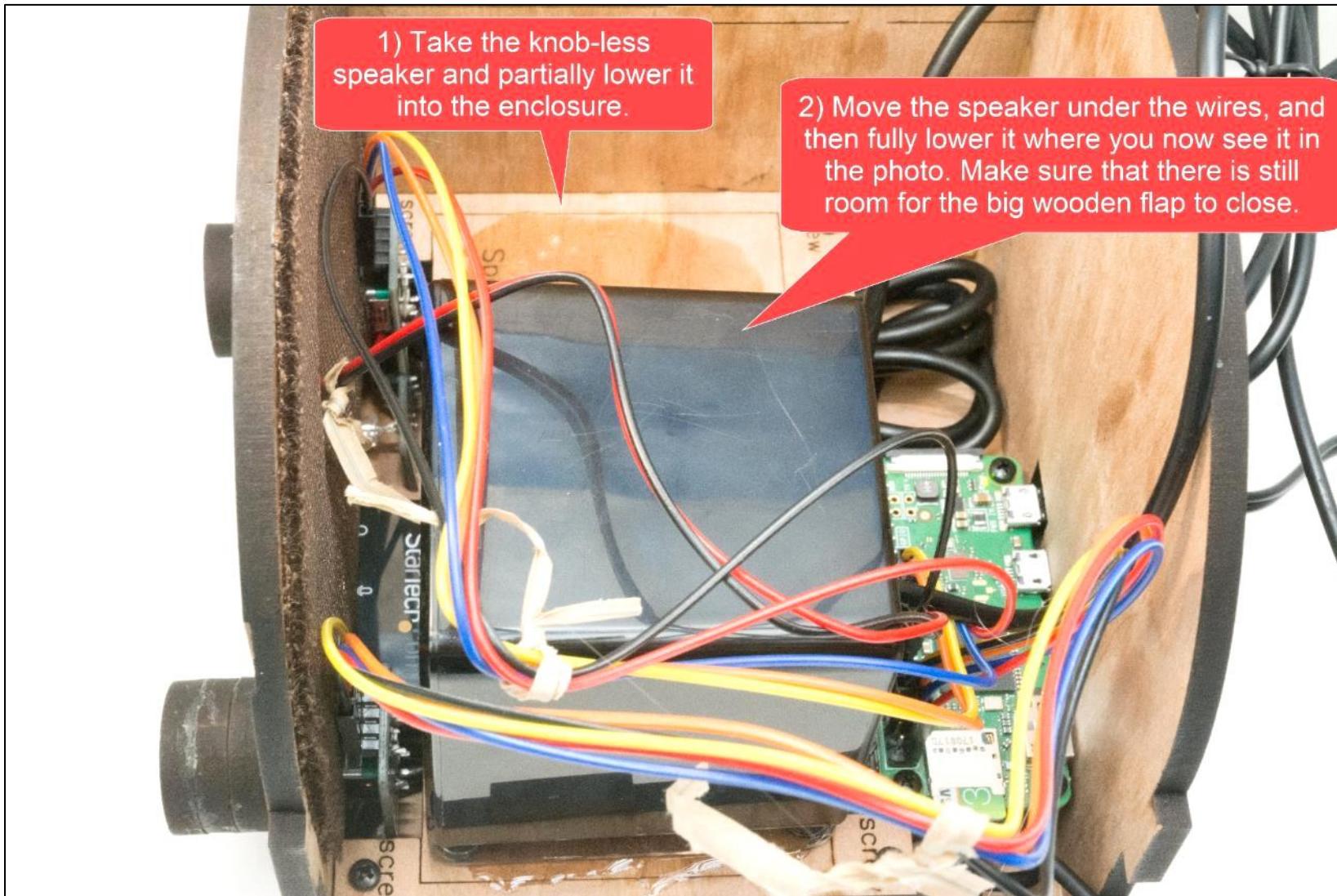
STEP 34: Put the 2nd floor back on



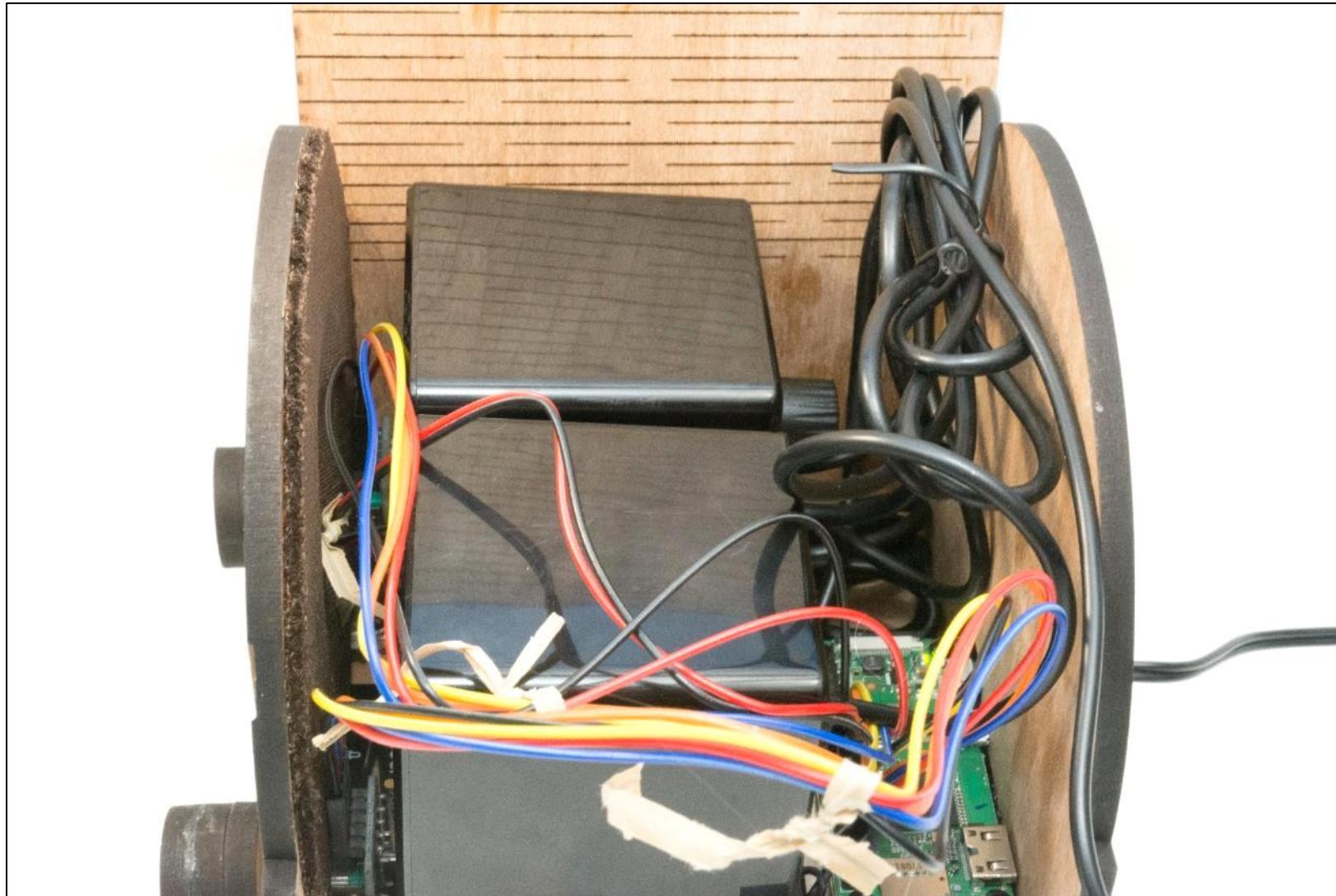
STEP 35: Add adhesive for speakers



STEP 36: Place the speaker that doesn't have a knob



STEP 37: Place the speaker that does have a knob

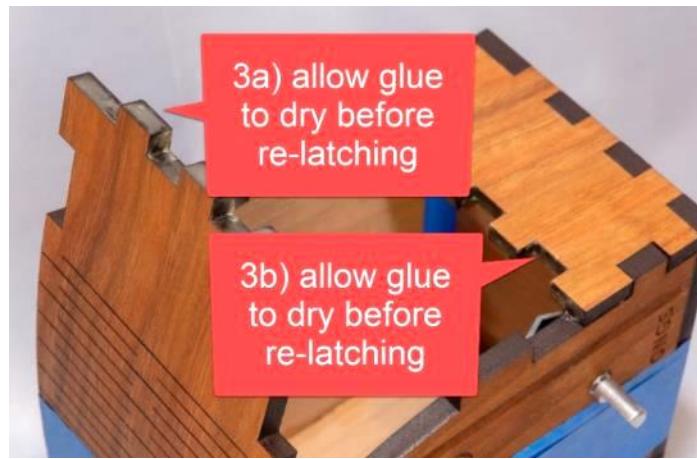
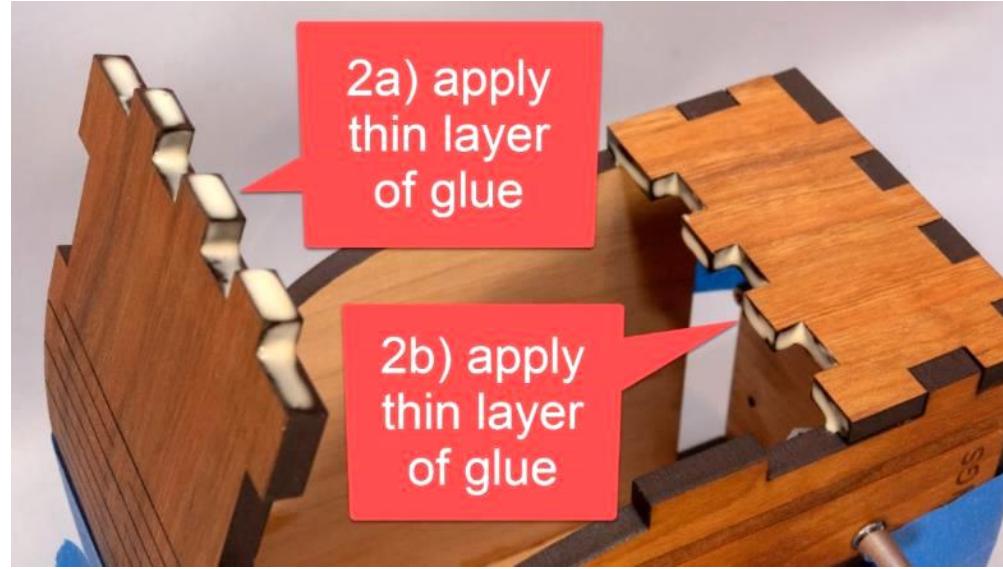


STEP 38: Make sure that the case closes



STEP 39: If needed, tighten the clasp

If the clasp is a bit loose, very slightly increase the size of the tabs by applying a thin layer of glue and allowing to dry before re-latching. It's a friction clasp, so you are essentially adding more static friction – slightly thicker tabs can mean much more static friction. The photos below are from a different case, but you'll get the idea.



STEP 40: Add round dimming stickers



STEP 41: Test it

Test	Description & Expectation
Light 30sec after power on	Give it power, after 20-30 seconds, the LED should turn on (green) and music should start playing a few seconds later.
Change song	Turn the songs knob. If you go forward and backward through the song list as expected, then all is well.
Change volume	Turn the volume knob. If the volume goes up and down as expected, then all is well.
Pause	Tap the volume knob, song should pause. Tap the songs knob, this should also pause the song.
Unpause	Tap a knob

STEP 42: Tape the instructions to the bottom

Print this page and tape the instructions in the box below to the bottom of your new Dementia Friendly Music Player:

To create personalized music

Organize the music on your computer

- A_Beethoven_9th
- B_AndrewsSisters_Hits
- C_GlennMiller_Hits

One folder per album. Use MP3 files, must have .mp3 file extension. Or iTunes files (.m4a). Or FLAC files (.flac). Optionally, use folder names prefixes to specify the play order e.g. A_, B_

Copy the music to the USB thumb drive



1. Unplug your Dementia Friendly Music Player.
2. Remove the USB thumb drive and place in your computer.
3. Copy music files from your computer to the USB thumb drive.
4. Put the USB thumb drive back in the player.
5. Plug in your player.

STEP 43: Done!



Appendix 1: Building 10+ at a time

Assumptions:

- You want to build 10 or more units at a time
- You are planning this far enough in advance (6 weeks or more) that you can order some of the parts directly from China
- You are working with a maker space where you can do your own laser cutting & wood finishing (if not, see below)
- If laser cutting yourself, I'm assuming that you will use 5.2mm cherry MDF wood:
 - Looks great
 - Is commonly available
 - Laser cuts well
 - At my supplier, a 4'x8' sheet is \$55, and you can make as many as 12 cases from it
 - Be sure to use the matching laser cutting file from [github](#)

# units to make	10					
Item	Supplier	Quan	Each	Total	Per unit	Notes
Cherry case	Ponoko	10	\$25.00	\$250.00	\$25.00	Or order 10+ from Ponoko for @\$43.71
Raspberry Pi Zero WH	Pi Shop	10	\$14.95	\$149.50	\$14.95	
power supply: 5V 3A, micro-USB	Pi Shop	10	\$6.20	\$62.00	\$6.20	
USB hub HAT for Pi Zero	Amazon	10	\$13.99	\$139.90	\$13.99	
USB DAC	Amazon	10	\$22.99	\$229.90	\$22.99	
M2.5x6mm + 6mm standoffs (50 pieces)	Ali Express	2	\$2.43	\$4.86	\$0.49	
M2.5x15mm + 6mm standoffs (50 pieces)	Ali Express	1	\$3.49	\$3.49	\$0.35	
M2.5 screws length=10mm ThreadPitch=0.45	Amazon	1	\$5.59	\$5.59	\$0.56	
Micro SD card	Amazon	10	\$4.75	\$47.50	\$4.75	
USB thumb drive	Amazon	10	\$5.60	\$56.00	\$5.60	
Arvicka speakers	Amazon	10	\$19.99	\$199.90	\$19.99	
Speaker cloth (large cloth)	Amazon	1	\$9.99	\$9.99	\$1.00	
Light dimming stickers	Amazon	1	\$5.99	\$5.99	\$0.60	
E6000 adhesive	Amazon	1	\$3.17	\$3.17	\$0.32	
KY-040 rotary encoders (knobs) (5 pieces)	Ali Express	4	\$2.11	\$8.44	\$0.84	
Female-female jumper wires 30cm	Ali Express	10	\$1.24	\$12.40	\$1.24	
KY-016 indicator LED (10 pieces)	Ali Express	1	\$1.86	\$1.86	\$0.19	
					\$119.05	+tax + shipping

Appendix 2: Change log

v1, November 2015	Original release
v2, September 2016	<ul style="list-style-type: none"> Changed music storage from a micro-SD memory card to a conventional USB memory stick. Changed the base Operating System from full Raspbian to DietPi – much smaller, so faster to boot, and less to go wrong.
v3, January 2017	<ul style="list-style-type: none"> Changed from USB audio to Pi built-in audio, including a firmware update for excellent audio quality.
v4, May 2017	<ul style="list-style-type: none"> Switched to bamboo for durability and use of standoffs. Switched to Pi A+ to lower cost. Made USB thumb drive externally accessible, to make it easier for the caregiver to organize music.
v4.01, 25 June 2017	<ul style="list-style-type: none"> Minor edits.
v4.01_1, 20 July 2017	<ul style="list-style-type: none"> Minor edits.
v4.01_2, 11 August 2017	<ul style="list-style-type: none"> Added links for ordering parts in the UK. Added detailed instructions for write protecting a micro-SD card.
v4.01_3, 12 August 2017	<ul style="list-style-type: none"> Minor edits
v4.01_4, 12 August 2017	<ul style="list-style-type: none"> Minor edits
v4.01_5, 14 October 2017	<ul style="list-style-type: none"> Edited text and updated photographs to reflect the change from an HDD-style LED to a KY-016 LED module.
v4.01_6, 26 February 2018	<ul style="list-style-type: none"> Updated the links for purchasing the parts. No changes to the parts themselves, just the links. Minor change to the instructions, noting how the build can be accomplished in one sitting, if desired.
v4.1, 7 April 2018	<ul style="list-style-type: none"> Reflects that the software has been updated to support the new Raspberry Pi 3 B+. No new software features.
v4.1_1, 23 April 2018	<ul style="list-style-type: none"> Updated to reflect the new bamboo case design.
v4.1_2, 22 July 2018	<ul style="list-style-type: none"> Updated for the new cherry wood version
v4.1_3, 18 January 2019	<ul style="list-style-type: none"> Created a version of the instructions for the model that includes tiny speakers.
v4.2, 1 March 2019	<ul style="list-style-type: none"> Formalized support for StarTech/Syba USB DAC. Switched to pmount for USB drive auto mounting.
v4.2, 7 April 2019	<ul style="list-style-type: none"> Removed instructions for write protecting the SD card – rarely used and may cause certain rare problems
v4.2, 26 October 2019	<ul style="list-style-type: none"> Updated the parts list Updated the Ponoko instructions
v4.2, 28 October 2019	<ul style="list-style-type: none"> Updated the parts list Updated the Ponoko instructions
v4.2, 30 October 2019	<ul style="list-style-type: none"> Corrected typo/calculation
V4.2.1, 14 March 2020	<ul style="list-style-type: none"> Updated to include tips for building 10+ at a time