

# How to Build the Dementia Friendly Music Player

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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.

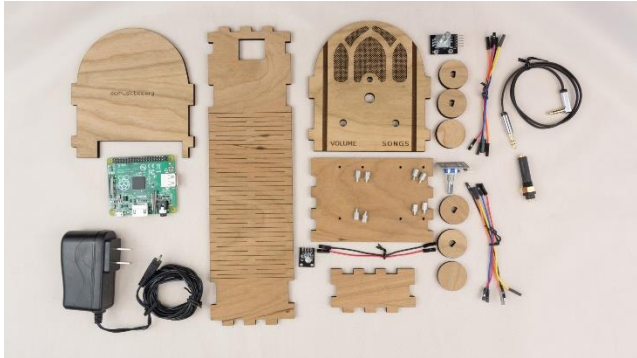
It's easier than you think to make one. Everything I did (e.g. software, wood case design) is open source. This document contains all the information you need. You can order the parts online. Good project for kids. A 13 year old can do this with minimal assistance. Younger kids with more assistance.

<b>Parts cost</b>	~\$110 + tax + shipping
<b>Music cost</b>	Minimal as you should use the recipient's existing music collection
<b>Build time</b>	About three hours, once you have the parts & music
<b>Parts source</b>	All parts can be mail ordered, links below
<b>Soldering?</b>	No
<b>Woodworking?</b>	No
<b>Laser cutter needed?</b>	No, you can mail order the pre-cut pieces for the wood case
<b>With a friend?</b>	Good idea, especially if your friend has the basic tools required
<b>Beverage?</b>	I recommend a hoppy IPA while you are assembling



## Preview of the steps

STEP 1: Order parts



STEP 2: Assemble recipient's favorite music



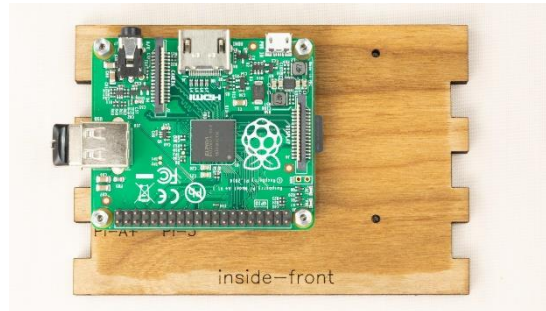
STEP 3: Copy software to micro SD card



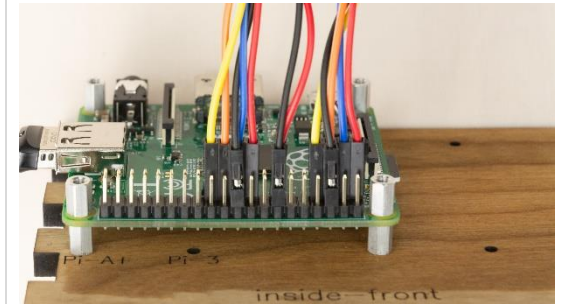
STEP 4: Stain it



STEP 5: Add the Pi



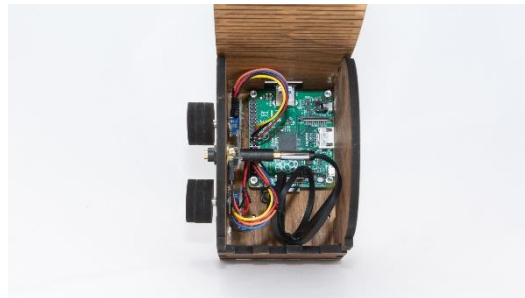
STEP 6: Wire it



STEP 7: Glue it



STEP 8: Add audio cable



STEP 9: Enjoy!



## 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.

## What DQMusicBox does For the person with dementia

Name	Description & implementation
Start song	Turning either of the knobs will start music playing.
Change song	Turn the songs knob.
Change volume	Turn the volume knob.
Pause	Tap the volume knob. Note that this also happens automatically – music pauses if there are no knob events in one hour.

## For you

Name	Description & implementation
Shut down	Pull the power plug or long hold (15-30 seconds) on the volume knob.
Reboot	Pull the power plug and re-insert or long hold (15-30 seconds) on the songs knob.
Add/remove music	By adding/removing files on the USB memory stick.

## STEP 1: Order the parts

Here are the parts that you will be using





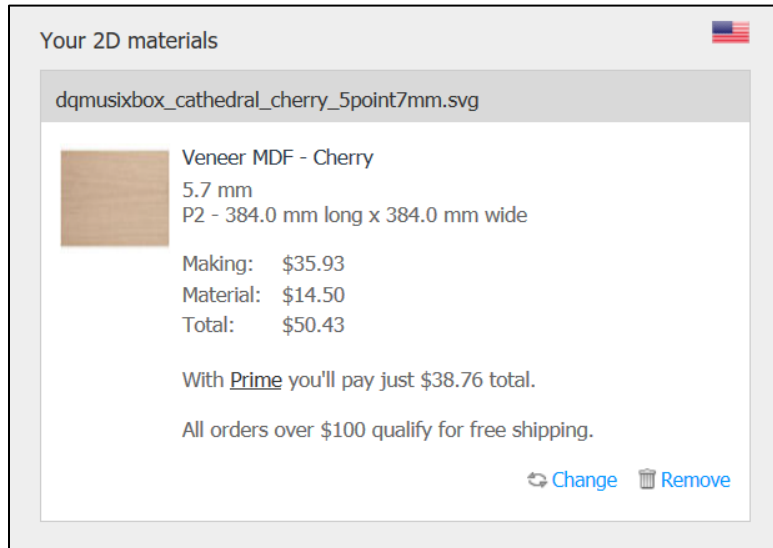
## Create a Ponoko account (optional but convenient)

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 take [my case design files](#) 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://www.ponoko.com/design-your-own/products/case-for-dementia-friendly-music-player-cherry-14954>
2. Click on “Add to Personal Factory”
3. Login
4. Check to accept the license, click “Add”
5. The result should be:



6. Click “Make it”

## Order the remaining parts - US

Item	Supplier	Cost	Notes & alternatives
DQMusicBox cherry case	Ponoko	\$50.43	See instructions above.
<a href="#">Raspberry Pi 1 A+ single board computer</a>	Newark	\$18.00	Tested with a Raspberry Pi 1A+, 2B, 3A+, 3B, 3B+. Do not use Pi Zero.
<a href="#">Power supply</a>	Newark	\$6.19	This is the US model. Any micro USB 2A or better supply will do.
<a href="#">Female-female jumper wires</a>	Newark	\$3.56	Or buy Amazon <a href="#">B01L5ULRUA</a>
<a href="#">Panel mount 3.5mm headphone jack</a>	Newark	\$2.69	Or buy Amazon <a href="#">B004JX64FE</a>
<a href="#">M2.5 standoffs (screws) – 8 of them</a>	Newark	\$3.84	Or by Amazon <a href="#">B06XXV8RTR</a>
<a href="#">Micro SD card 32GB</a>	Amazon	\$5.99	Any brand name micro SD card that is 8GB or larger will do.
<a href="#">USB thumb drive 16GB</a>	Amazon	\$6.50	Any USB thumb drive will work, but many will protrude greatly from the case
<a href="#">Audio cable</a>	Amazon	\$5.88	Or find a short audio cable with a right angle bend.
<a href="#">KY-016 indicator LED (note shipping time)</a>	eBay	\$1.62	Seller ships from China, takes 2-3 weeks, but the case takes a while too. Or order as one piece of this kit - Amazon <a href="#">B013UL6LFS</a> , which will arrive in a few days.
<a href="#">KY-040 rotary encoders (knobs)</a>	eBay	\$6.36	Or buy Amazon <a href="#">B074TJ8RSX</a> .
<b>TOTAL</b>		<b>\$111.06</b>	Prices will vary. Does not include tax, shipping.

## About headphones

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.
<a href="#">Monoprice On-Ear headphones</a>	\$10.99	Very good sound.
<a href="#">Monoprice Over-the-Ear headphones</a>	\$15.99	Amazing sound. My musician son rates the sound as better than the ever-popular Sony MDR7506 headphones.
Other		Look for high sensitivity headphones, as the Pi's output is a bit weak.

## 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
Elmer's wood glue	Any wood glue will do
3/16 <sup>th</sup> 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 <a href="#">USB SD-card reader</a> .
Painter's tape	Any tape that comes off easily will do. Painter's tape is great. Regular masking tape is probably fine too.
Light blocking sticker	The LED is bright, so I prefer to block some light. You can use the tape above. Or light blocking stickers e.g. Amazon <a href="#">B009WSJNCW</a> .
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 <a href="#">Tried &amp; True Danish Oil</a> (linseed oil) because I like the result, it's easy, and non-toxic.

## STEP 2: 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 6-10 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

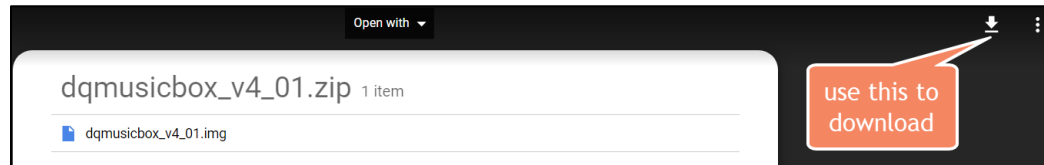
Organize the digitized music into folders on the USB memory stick, one folder per album. MP3, iTunes, and FLAC files are supported i.e. files with extensions .mp3, .m4a, .flac. In the end, you should have a set of folders that looks something like this:

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 Butterf...	10/24/2015 6:26 PM	File folder
K_Leontyne Price_-_Arias	10/24/2015 6:26 PM	File folder

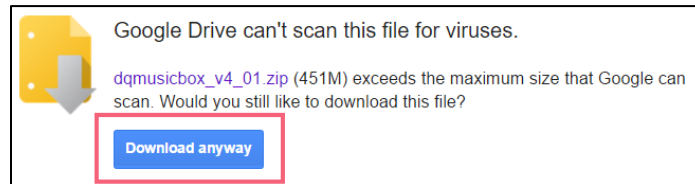
## STEP 3: Copy software to the micro-SD memory card

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:

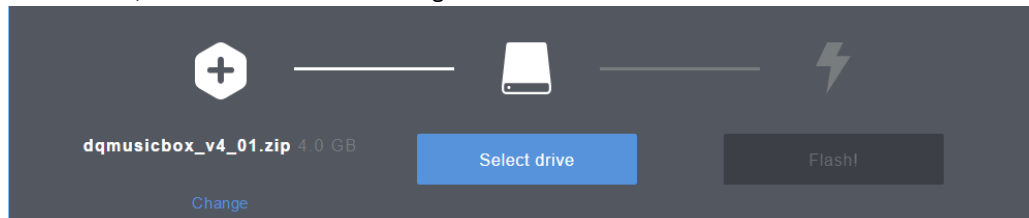
1. Install [Etcher](#) on your PC or Mac or Linux computer. [Win32 Disk Imager](#) also works.
2. Download the [Dementia Friendly Music Player disk image](#).



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.
8. If you are a nerd or your friend is a nerd, see the optional step in Appendix 1.



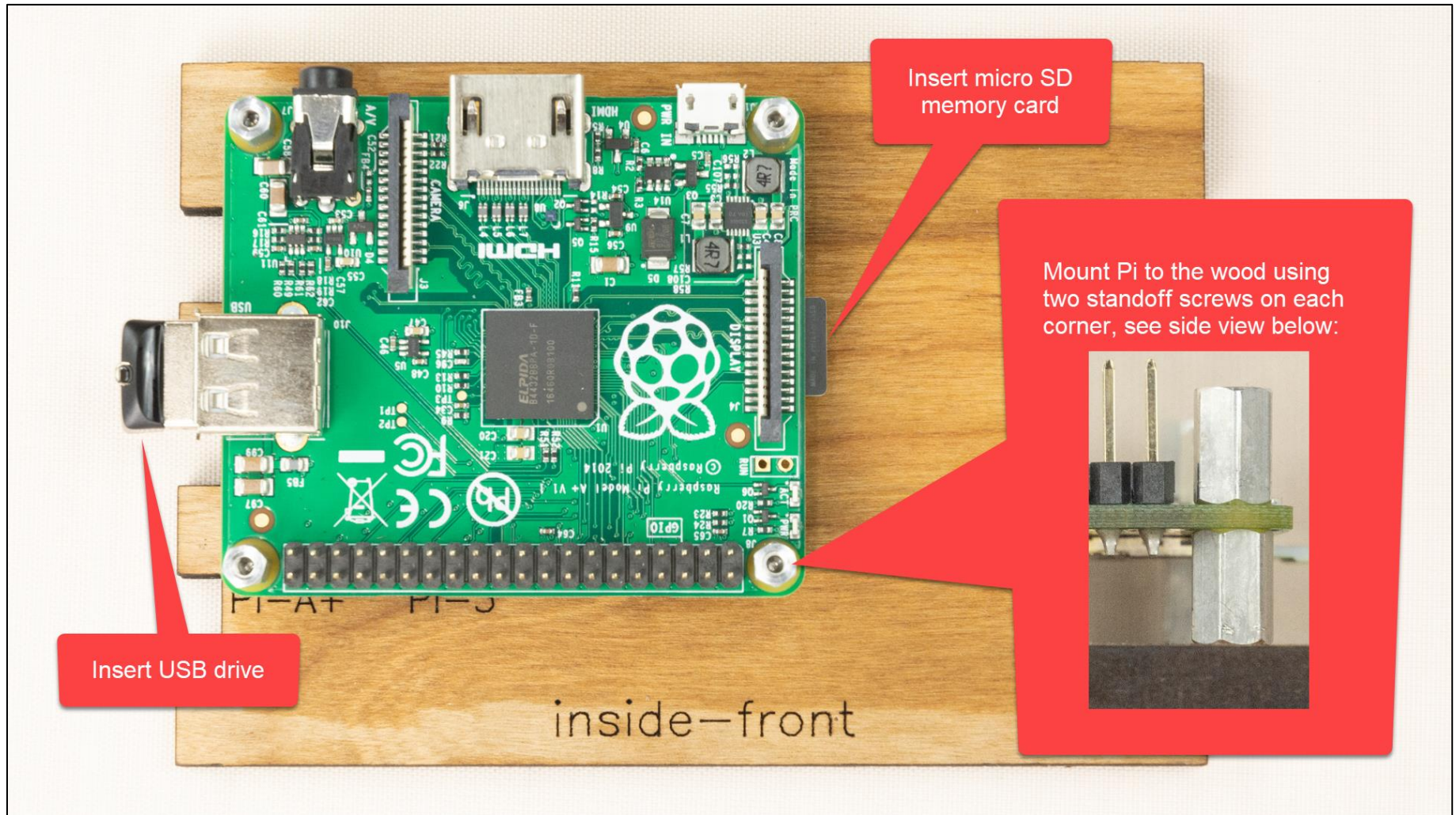
## STEP 4: Stain it or oil it

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



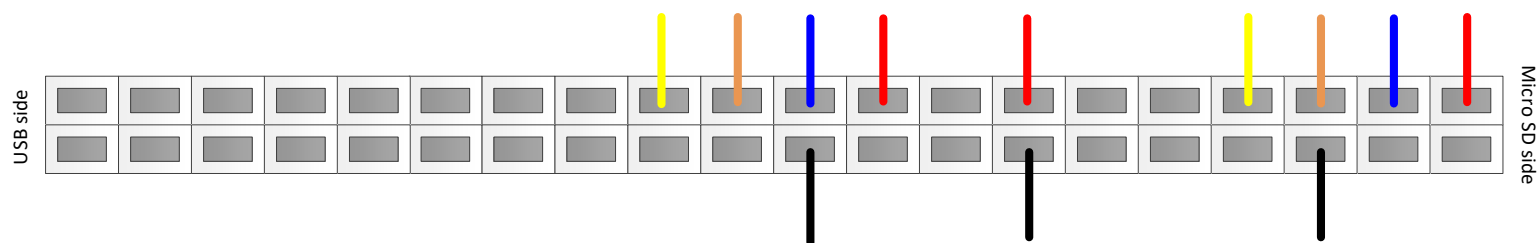
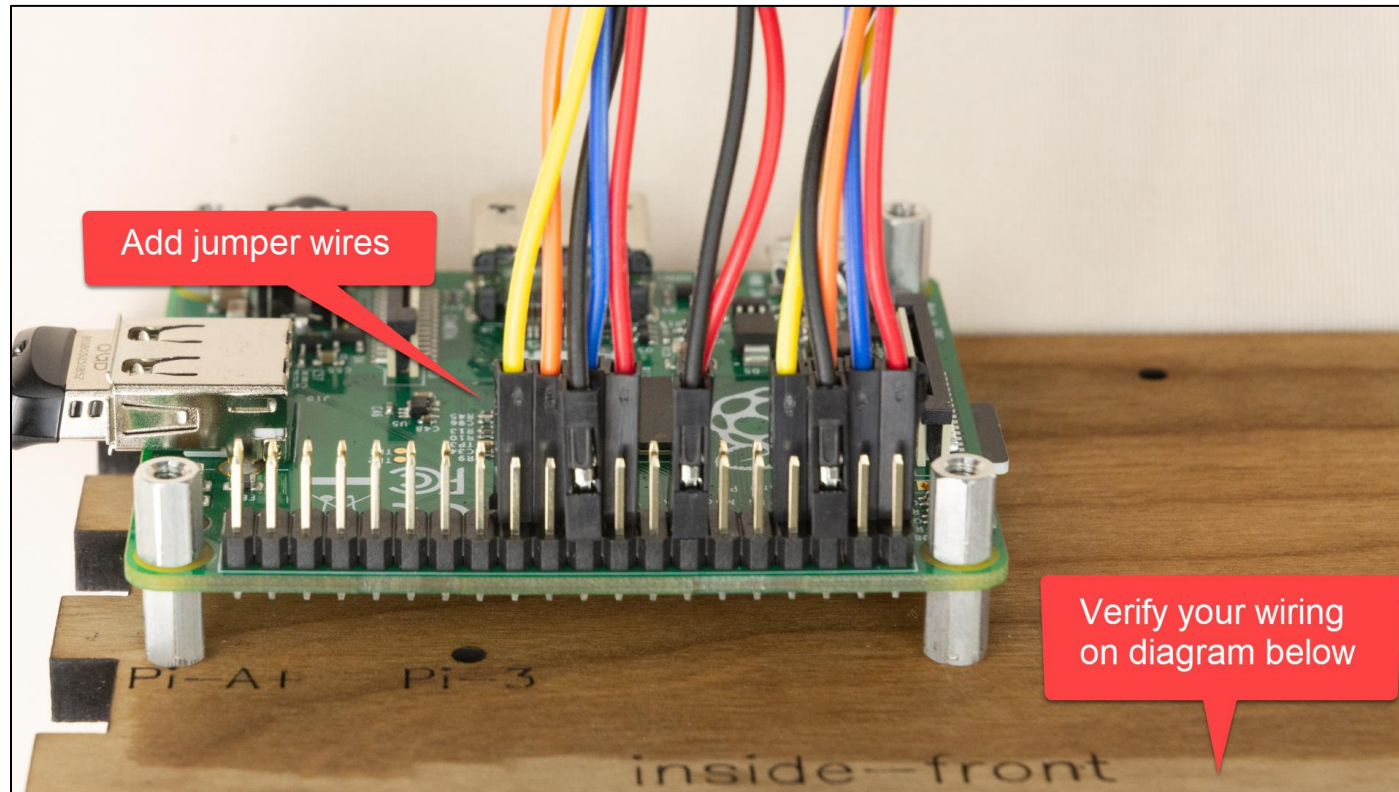
I used the non-toxic Tried & True Danish Oil i.e. flax seed oil. Three thin coats (three days) for outside surfaces. One thin coat for inside surfaces. Follow directions on the can.

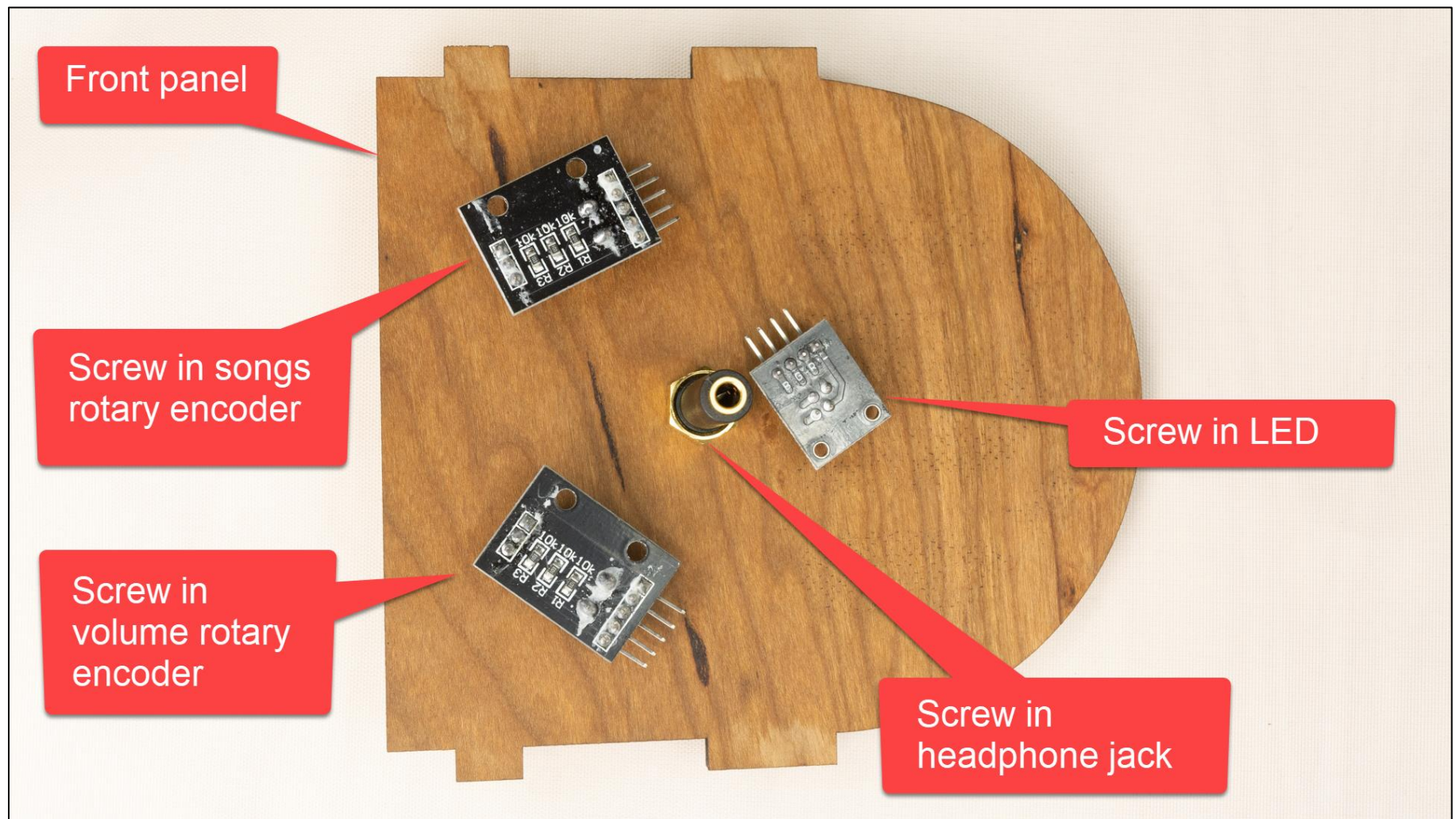
## STEP 5: Add the Pi



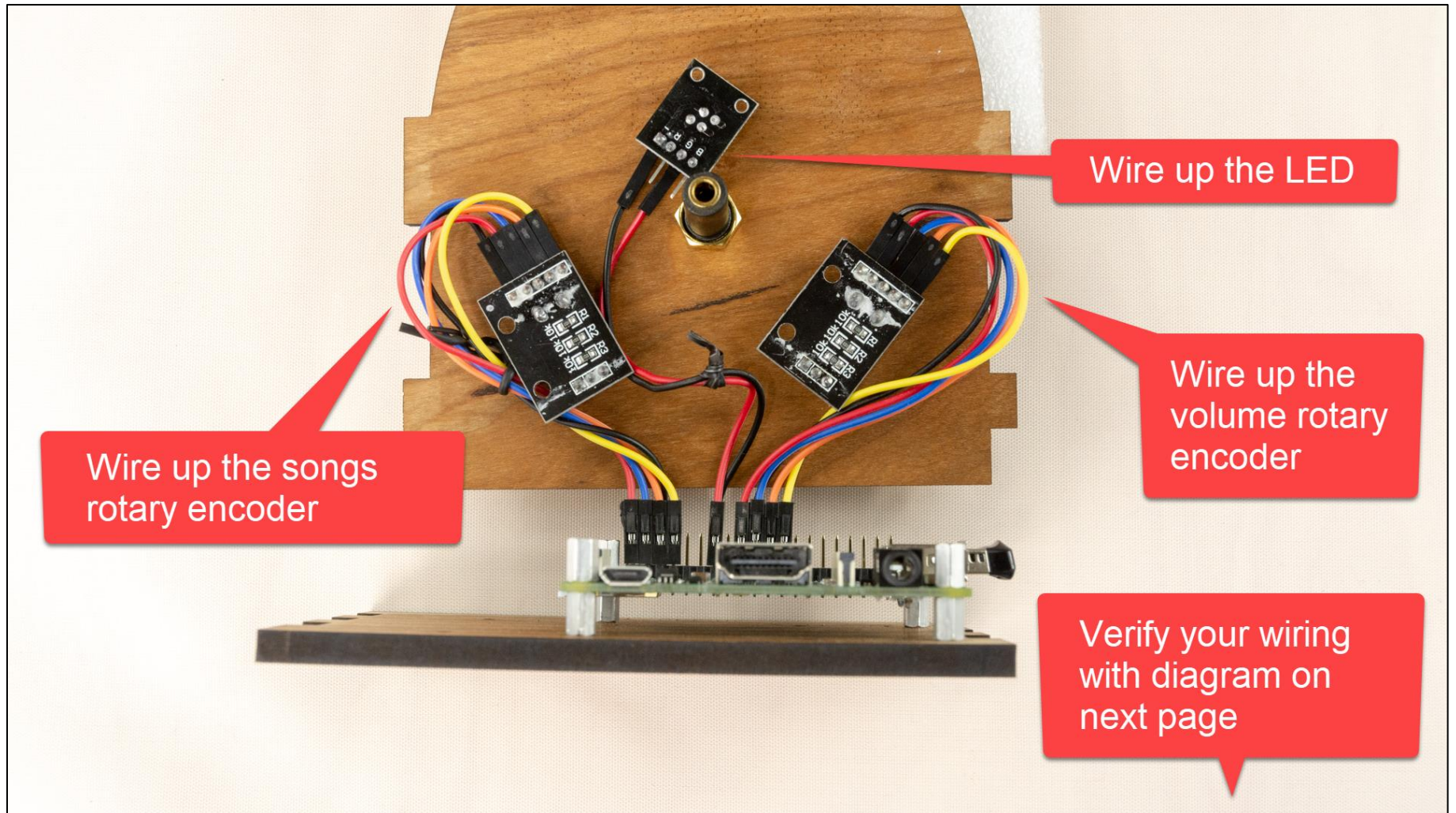


## STEP 6: Wire it





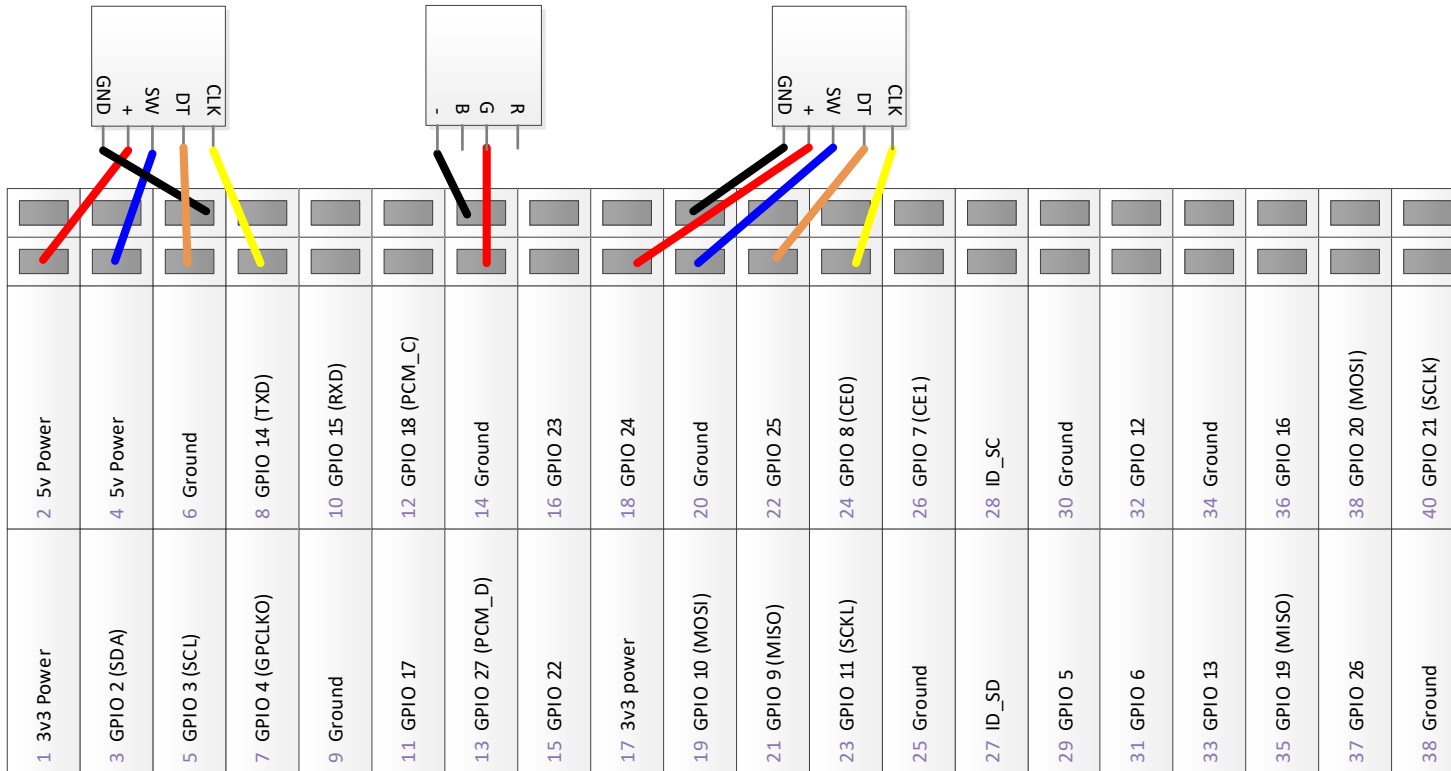




Songs knob (rotary encoder)

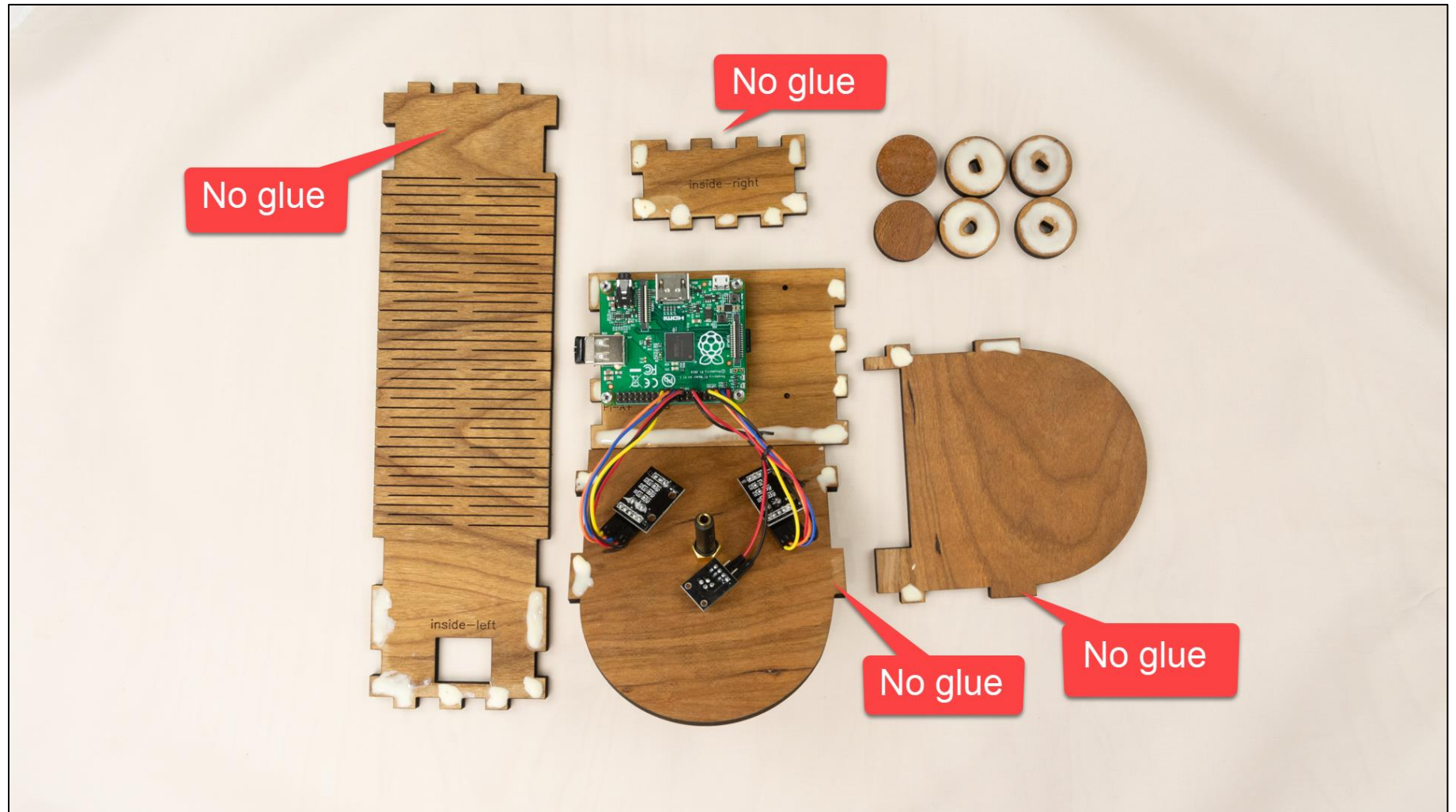
On/off indicator LED

Volume knob (rotary encoder)

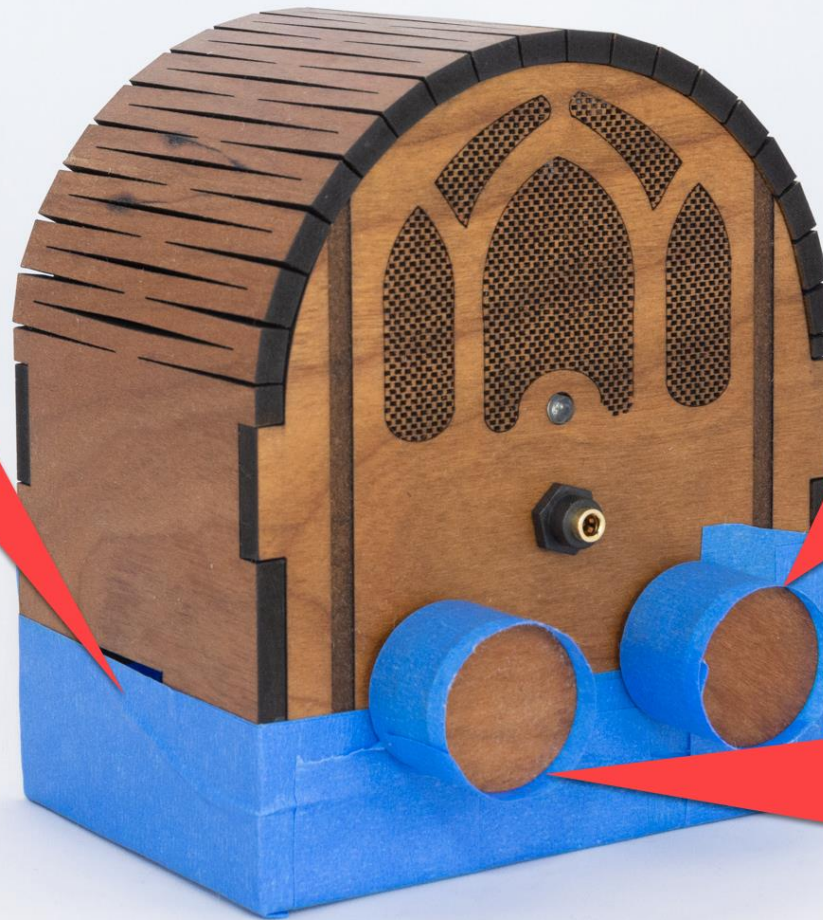




## STEP 7: Glue it



Use painter's tape as a vice - nice and tight while the glue is drying. Let dry overnight.

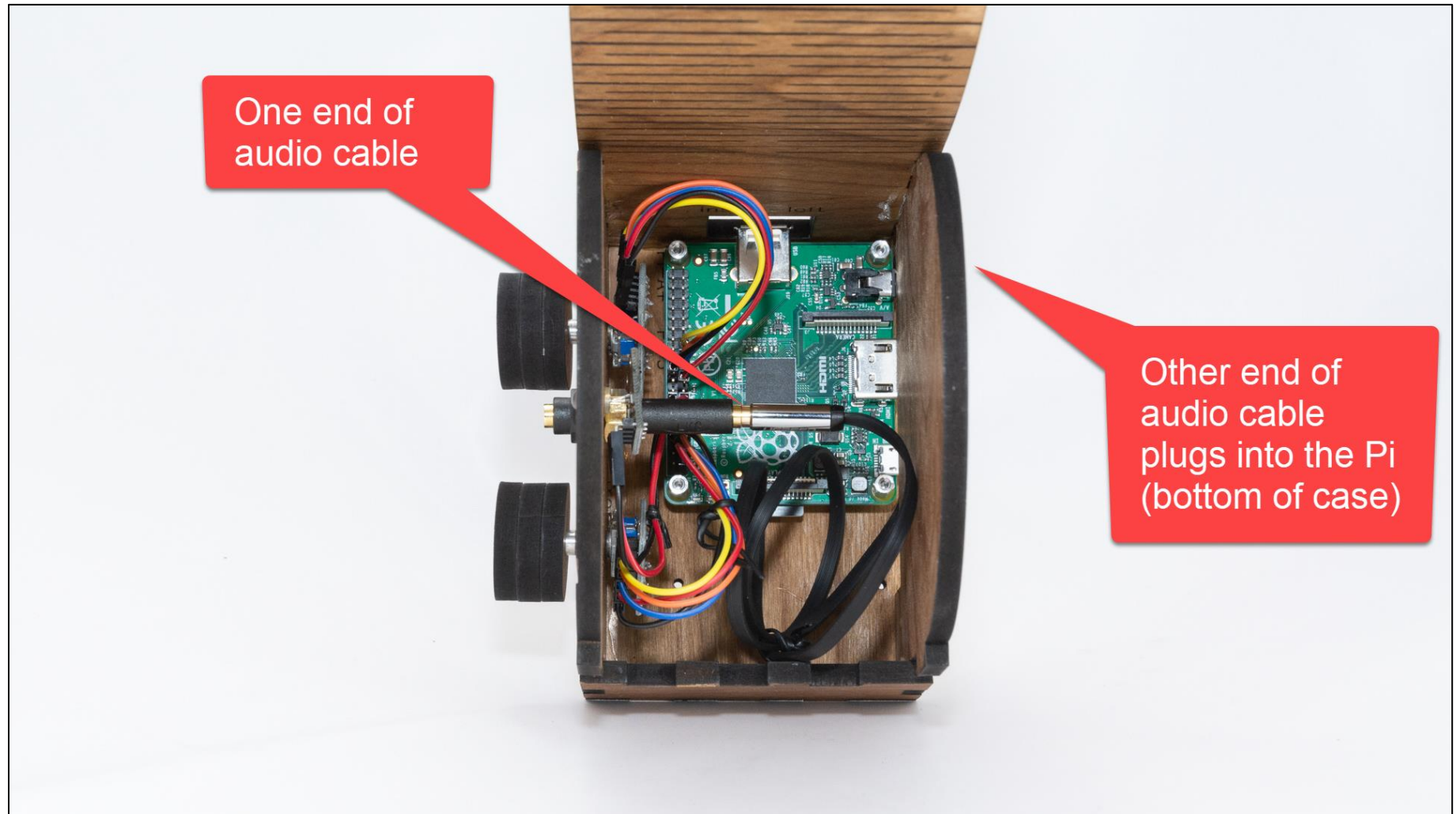


Each knob is 3 pieces. To align pieces, place on rotary encoder's metal shaft.

Don't glue knobs to rotary encoders, unless the knobs are otherwise loose.

If a wood knob doesn't fit on a metal shaft, use a Philips screwdriver to carve out the knobs holes a bit

## STEP 8: Add audio cable



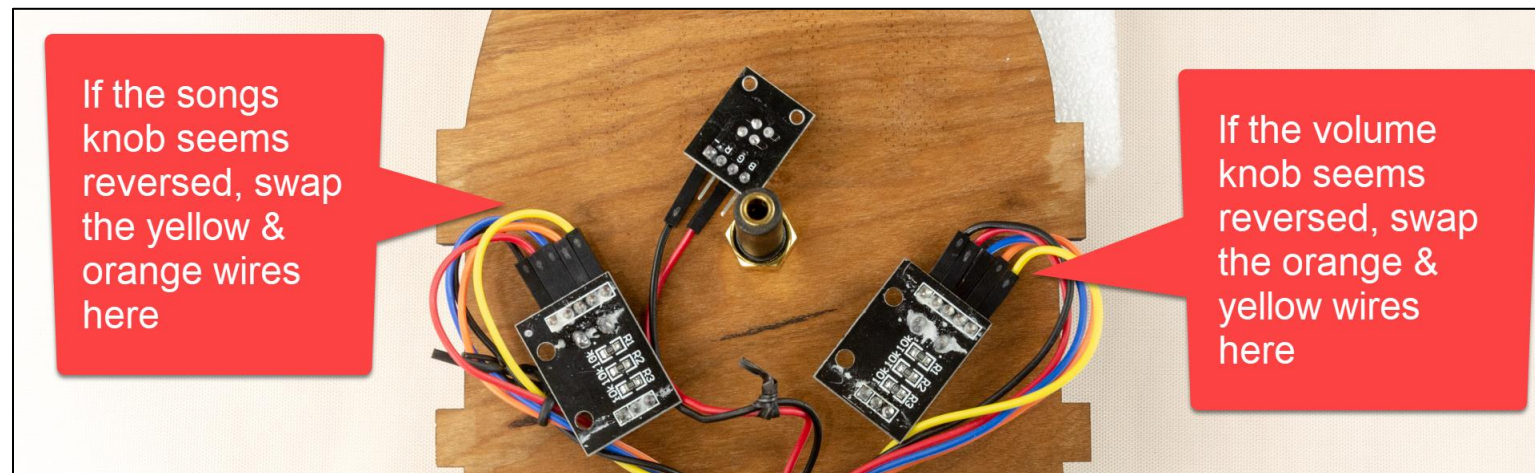


# Test it

Test	Description & Expectation
Light 30sec after power on	The indicator LED turns on when DQMusicBox is ready to play music, which is generally 20-30 seconds after power on.
Start song	Turning either of the knobs will start music playing.
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

## If one or both knobs do the opposite of what you expect

Once assembled, you may find your knobs doing the opposite of what you expect e.g. a clockwise turn decreases the volume. This is because there are two kinds of rotary encoders out there. Happy, the fix is easy, just switch the orange and yellow wires on the misbehaving rotary encoders(s) (don't touch the Pi itself):

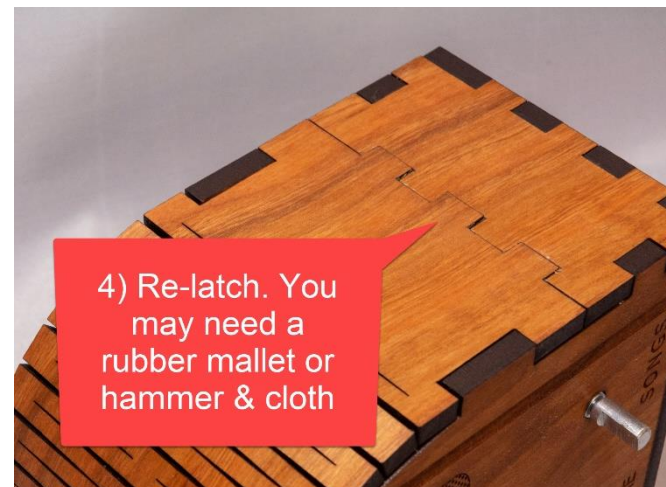
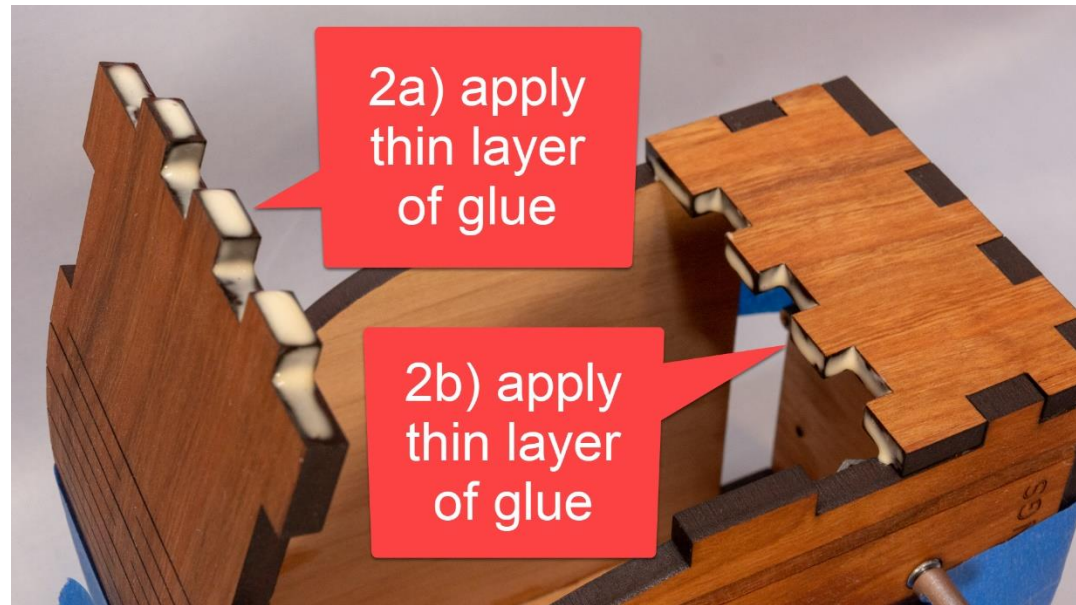


## If the wood knobs are loose on the metal shafts

Just glue the wood knobs to the metal shafts. But only if it is really necessary. Once the knobs & shafts are glued, it's harder to disassemble the box to fix any problems.

## If the top does not latch securely

To resolve, 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 latch, so you are essentially adding more static friction – slightly thicker tabs can mean much more static friction.



## Tape instructions

Print this page and tape the instructions in the box below to the bottom of your new DQMusicBox:

### 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 DQMusicBox.
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 DQMusicBox.
5. Plug in your DQMusicBox.

## Congratulations

Congratulations! You should have a fully functional DQMusicBox.



## Appendix 1: Write protect the SD card

### About SD card write protection TMP\_WRITE\_PROTECT

**This step is optional.** It will increase the durability of the system. If you or your friend already work with Raspberry Pis, you may find this fun. If you don't then you might find this frustrating and it's perfectly OK to skip this optional step.

About TMP\_WRITE\_PROTECT:

- Raspbian and DietPi, don't generally like to be rudely shut down i.e. having the power plug pulled.
- Rude power downs can interrupt writes to the micro SD card and potentially corrupt the OS.
- But we have a special case here, because DQMusicBox does not need to be online and does not need to be updated. In other words, it is safe to write protect the micro SD card.
- The SD card standard has a rarely used feature known as TMP\_WRITE\_PROTECT (which is a useful google search term) i.e. temporary write protection.
- When in this mode, the SD accepts write requests, but any such writes are made to temporary storage and are deliberately lost upon reboot or power loss.
- In other words, if you pull the plug on a DQMusicBox you are effectively doing a factory reset. Music stored on the USB thumb drive is unaffected.
- To enable this, set the TMP\_WRITE\_PROTECT bit in the Card Specific Data on micro-SD card (more on this below).
- Here is the SD Association's official description of TMP\_WRITE\_PROTECT from the [SD Specifications Part 1 Physical Layer Simplified Specification Version 6.00](#): *Temporarily protects the entire card content from being overwritten or erased (all write and erase commands for this card are temporarily disabled). This bit can be set and reset. The default value is 0, i.e. not write protected.*
- For the curious, here are some of the other fields in the Card Specific Data, chart taken from the same document linked just above:

File format group	FILE_FORMAT_GRP	1	xb	R/W(1)	[15:15]
copy flag	COPY	1	xb	R/W(1)	[14:14]
permanent write protection	PERM_WRITE_PROTECT	1	xb	R/W(1)	[13:13]
temporary write protection	TMP_WRITE_PROTECT	1	xb	R/W	[12:12]
File format	FILE_FORMAT	2	xxb	R/W(1)	[11:10]
reserved		2	00b	R/W	[9:8]
CRC	CRC	7	xxxxxxb	R/W	[7:1]
not used, always '1'	-	1	1b	-	[0:0]

Table 5-4 : The CSD Register Fields (CSD Version 1.0)

- References:
  - [SD Card Write Protection](#)
  - [Build the SD Locker and Make Your SD Cards More Secure](#)

### Option 1: Build the SD locker project

There are several ways to implement TMP\_WRITE\_PROTECT. I was originally inspired by the [SD locker project on Hackaday](#) and by its [successor](#). Both of which look like fun. But I ended up using Option 2 below as it is more consistent with Raspberry Pi work.

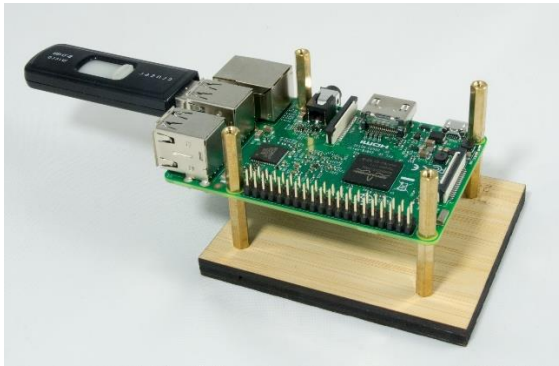
## Option 2: Use a Raspberry Pi 3

This is the option that I used. In brief, the write protection process is:

1. Write the DQMusicBox image to a micro-SD card, as per the instructions above.
2. Boot a Raspberry Pi 3 from a USB thumb drive.
3. Once booted, insert a micro-SD card and issue the following command:  

```
sudo ./sdtool/static/arm-sdtool /dev/mmcblk0 lock
```

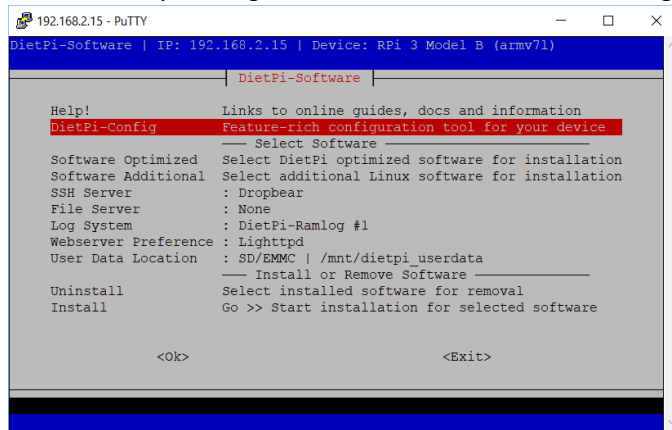
This is my setup for doing so:



The slightly tricky bit is to get the Raspberry Pi 3 to boot from USB. See below for the process that I used to create to create the setup above. You will only have to do this once.

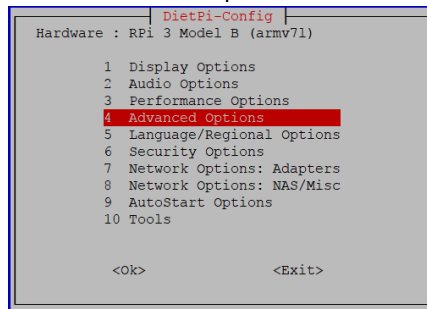
1. You'll need:
  - a. **A Raspberry Pi 3.** I keep a Pi 3 just for this purpose i.e. I don't use this Pi 3 inside a DQMusicBox.
  - b. **A good USB thumb drive.** I keep a thumb drive just for this purpose. Apparently this won't work with some low performance USB thumb drives, although it worked with my old 2GB thumb drive (pictured above). I now use a [SanDisk Extreme 32GB thumb drive](#).
  - c. **A micro-SD card.** You will only need for 30 minutes to complete the steps below, then you can use the card for other purposes.
2. Download [DietPi](#).
3. Write the DietPi image to the micro-SD card (using Etcher or Win32diskimager).
4. Write the same DietPi image to the USB thumb drive.
5. Attach Ethernet to your Raspberry Pi 3.

6. Insert the micro-SD card.
7. Start the DietPi installation process i.e.:
  - a. Boot the Pi 3 from the micro-SD card
  - b. Connect to the Pi 3 over the network with Putty or something similar, login with username=root password=dietpi
8. After a while, you will get to this screen, choose DietPi-Config



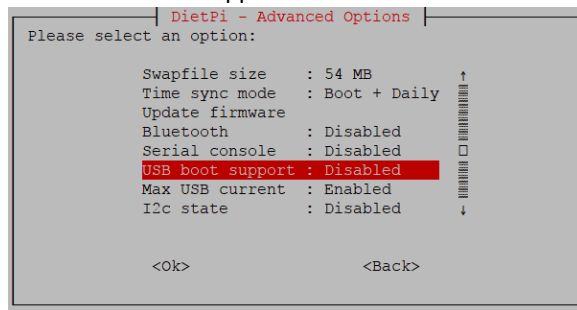
The screenshot shows a terminal window titled "192.168.2.15 - PuTTY". The terminal displays the "DietPi-Software" menu. The menu options are: Help! (Links to online guides, docs and information), DietPi-Config (Feature-rich configuration tool for your device), Software Optimized (Select DietPi optimized software for installation), Software Additional (Select additional Linux software for installation), SSH Server (Dropbear), File Server (None), Log System (DietPi-Ramlog #1), Webserver Preference (Lighttpd), User Data Location (SD/EMMC | /mnt/dietpi\_userdata), Uninstall (Select installed software for removal), and Install (Go >> Start installation for selected software). The "DietPi-Config" option is highlighted in red. At the bottom, there are "<Ok>" and "<Exit>" buttons.

9. Choose Advanced Options:

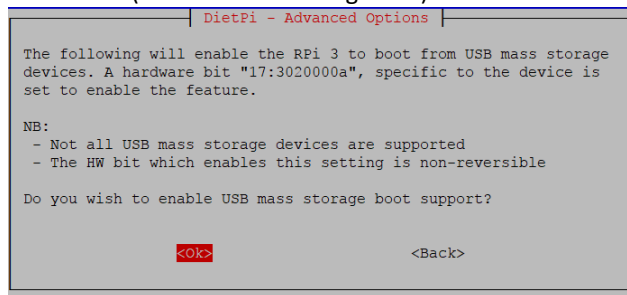


The screenshot shows a terminal window titled "DietPi-Config". The terminal displays the "DietPi-Config" menu. The menu options are: Hardware : RPi 3 Model B (armv7l), 1 Display Options, 2 Audio Options, 3 Performance Options, 4 Advanced Options, 5 Language/Regional Options, 6 Security Options, 7 Network Options: Adapters, 8 Network Options: NAS/Misc, 9 AutoStart Options, and 10 Tools. The "4 Advanced Options" option is highlighted in red. At the bottom, there are "<Ok>" and "<Exit>" buttons.

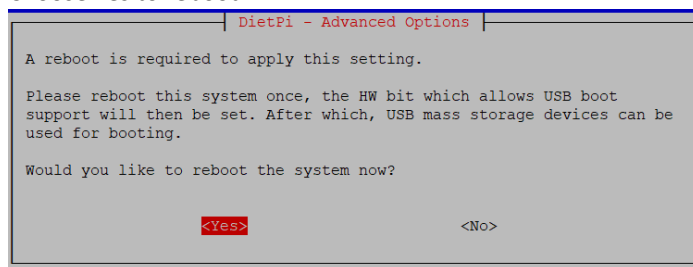
10. Choose USB boot support and choose to **enable** it:



11. Choose OK (read the full message first):



12. Choose Yes to reboot:



13. After rebooting, choose Install:

```
DietPi-Software | IP: 192.168.2.15 | Device: RPi 3 Model B (armv7l)

DietPi-Software

Help!                               Links to online guides, docs and information
DietPi-Config                       Feature-rich configuration tool for your device
                                   — Select Software —
Software Optimized                  Select DietPi optimized software for installation
Software Additional                 Select additional Linux software for installation
SSH Server                         : Dropbear
File Server                        : None
Log System                         : DietPi-Ramlog #1
Webserver Preference               : Lighttpd
User Data Location                  : SD/EMMC | /mnt/dietpi_userdata
                                   — Install or Remove Software —
Uninstall                          Select installed software for removal
Install                            Go >> Start installation for selected software

<Ok>                               <Exit>
```

14. Let the installation run and finish.

```
DietPi-Software
Mode: Update & upgrade APT
Please wait...

[Ok] cron

DietPi-Software
Mode: stop
Please wait...

[Ok] cron
```

15. Once the installation is complete, switch to a USB setup:
  - a. Unplug the Pi.
  - b. Remove the micro-SD Card.
  - c. Insert the USB thumb drive.
  - d. Plug the Pi back in and boot.

16. Install DietPi on the USB thumb drive. Start by letting DietPi update itself:

```
[Ok] NTPD: time sync | Completed

[Info] Detecting drives, please wait...
[Info] Detected PARTUUID mount: /dev/sda1 > /boot
[Info] Detected PARTUUID mount: /dev/sda2 > /
[Info] Processing drive information, please wait...
[Info] Checking available free space on RootFS, please wait...
[Ok] 28348 MB available, 500 MB required
[Info] Testing connection to http://mirror.ox.ac.uk/sites/archive.raspbian.org/
archive/raspbian
[Info] Max duration of 20 seconds, please wait...
[Ok] Connection test | Completed

Get:1 http://mirror.ox.ac.uk jessie InRelease [14.9 kB]
Get:2 http://archive.raspberrypi.org jessie InRelease [22.9 kB]
Get:3 http://mirror.ox.ac.uk jessie/main armhf Packages [9,535 kB]
Get:4 http://archive.raspberrypi.org jessie/main armhf Packages [170 kB]
```

17. When prompted, restart your Pi:

```
DietPi Update Completed

DietPi has been updated to the latest version.
Your system will now reboot. Once completed, simply login to
resume DietPi Setup.

Press Enter to Continue.

<Ok>
```

18. Install:

```
DietPi-Software | IP: 192.168.2.15 | Device: RPi 3 Model B (armv7l)

DietPi-Software

Help!           Links to online guides, docs and information
DietPi-Config   Feature-rich configuration tool for your device
                ----- Select Software -----
Software Optimized  Select DietPi optimized software for installation
Software Additional Select additional Linux software for installation
SSH Server         : Dropbear
File Server        : None
Log System         : DietPi-Ramlog #1
Webserver Preference : Lighttpd
User Data Location  : SD/EMMC | /mnt/dietpi_userdata
                ----- Install or Remove Software -----
Uninstall         Select installed software for removal
Install           Go >> Start installation for selected software

                <Ok>                                <Exit>
```



19. Let DietPi do more updating:

```
DietPi-Services
Mode: stop
Please wait...

[Ok] cron

DietPi-Software
Mode: Update & upgrade APT
Please wait...

Hit http://mirror.ox.ac.uk jessie InRelease
Hit http://archive.raspberrypi.org jessie InRelease
Hit http://mirror.ox.ac.uk jessie/main armhf Packages
```

20. DietPi will reboot to complete the installation, then you'll get a normal command prompt:

```
DietPi | 04:22 | Sat 12/08/17
V154 | RPi 3 Model B (armv7l)
IP Address | 192.168.2.15

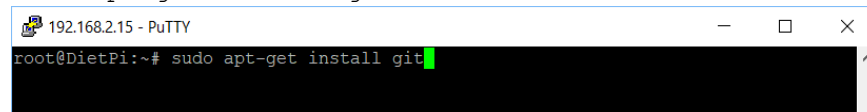
Created by : Daniel Knight
Web : http://DietPi.com
Twitter : http://twitter.com/dietpi_
Donate : http://goo.gl/pzIst9
DietPi's web hosting is powered by: MyVirtualServer.com

dietpi-launcher = All the DietPi programs in one place.
dietpi-config = Feature rich configuration tool for your device.
dietpi-software = Select optimized software for installation.
htop = Resource monitor.
cpu = Shows CPU information and stats.

root@DietPi:~#
```

21. Install git with

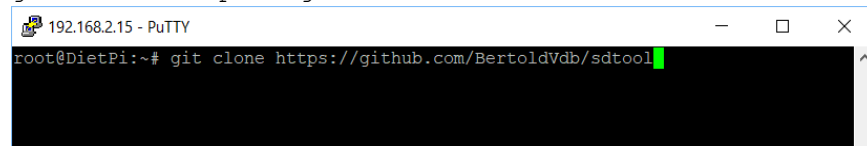
`sudo apt-get install git`



```
192.168.2.15 - PuTTY
root@DietPi:~# sudo apt-get install git
```

22. Get the write protection tool [sdtool](https://github.com/BertoldVdb/sdtool) with

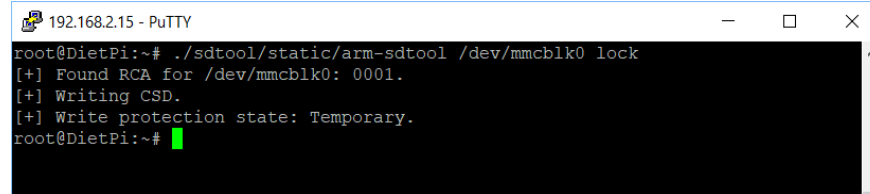
`git clone https://github.com/BertoldVdb/sdtool`



```
192.168.2.15 - PuTTY
root@DietPi:~# git clone https://github.com/BertoldVdb/sdtool
```

23. Put an micro-SD card in the slot, practice enabling TMP\_WRITE\_PROTECT:

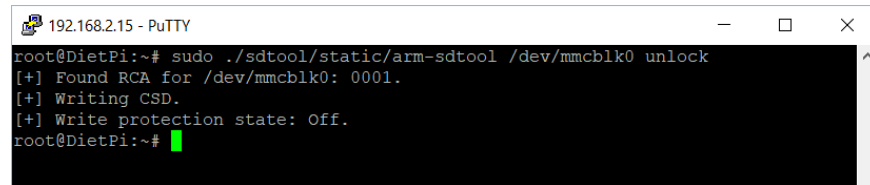
```
sudo ./sdtool/static/arm-sdtool /dev/mmcblk0 lock
```

A terminal window titled "192.168.2.15 - PuTTY" showing the execution of the command `sudo ./sdtool/static/arm-sdtool /dev/mmcblk0 lock`. The output shows the tool finding the RCA for /dev/mmcblk0: 0001, writing the CSD, and setting the write protection state to Temporary. The prompt returns to `root@DietPi:~#` with a green cursor.

```
192.168.2.15 - PuTTY
root@DietPi:~# ./sdtool/static/arm-sdtool /dev/mmcblk0 lock
[+] Found RCA for /dev/mmcblk0: 0001.
[+] Writing CSD.
[+] Write protection state: Temporary.
root@DietPi:~#
```

24. Now practice reversing the above:

```
sudo ./sdtool/static/arm-sdtool /dev/mmcblk0 unlock
```

A terminal window titled "192.168.2.15 - PuTTY" showing the execution of the command `sudo ./sdtool/static/arm-sdtool /dev/mmcblk0 unlock`. The output shows the tool finding the RCA for /dev/mmcblk0: 0001, writing the CSD, and setting the write protection state to Off. The prompt returns to `root@DietPi:~#` with a green cursor.

```
192.168.2.15 - PuTTY
root@DietPi:~# sudo ./sdtool/static/arm-sdtool /dev/mmcblk0 unlock
[+] Found RCA for /dev/mmcblk0: 0001.
[+] Writing CSD.
[+] Write protection state: Off.
root@DietPi:~#
```

25. You are done!

## Appendix 2: Change log

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