

DQMusicBox - music player for people with dementia

How to build one - it's easy

12 August 2017, rosswesleyporter@gmail.com



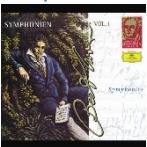
My Dad could not operate normal music players. But he could operate this music player because it operates like a familiar two-knob radio. My son & I were inspired to design this by the documentary [Alive Inside](#) which shows the profound joy felt by some people with dementia when listening to their 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	~\$95 + tax + shipping
Music cost	Minimal as you should use the recipient's existing music collection
Build time	About four 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



1 Preview of the steps

1) Order parts  	2) Assemble recipient's favorite music 	3) Copy software to micro SD card 
4) Receive the parts 	5) Glue 	6) Wire the knobs 
7) Wire everything else 	8) Enjoy 	

2 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.

3 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](#), and my son.

4 What DQMusicBox does

4.1 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.

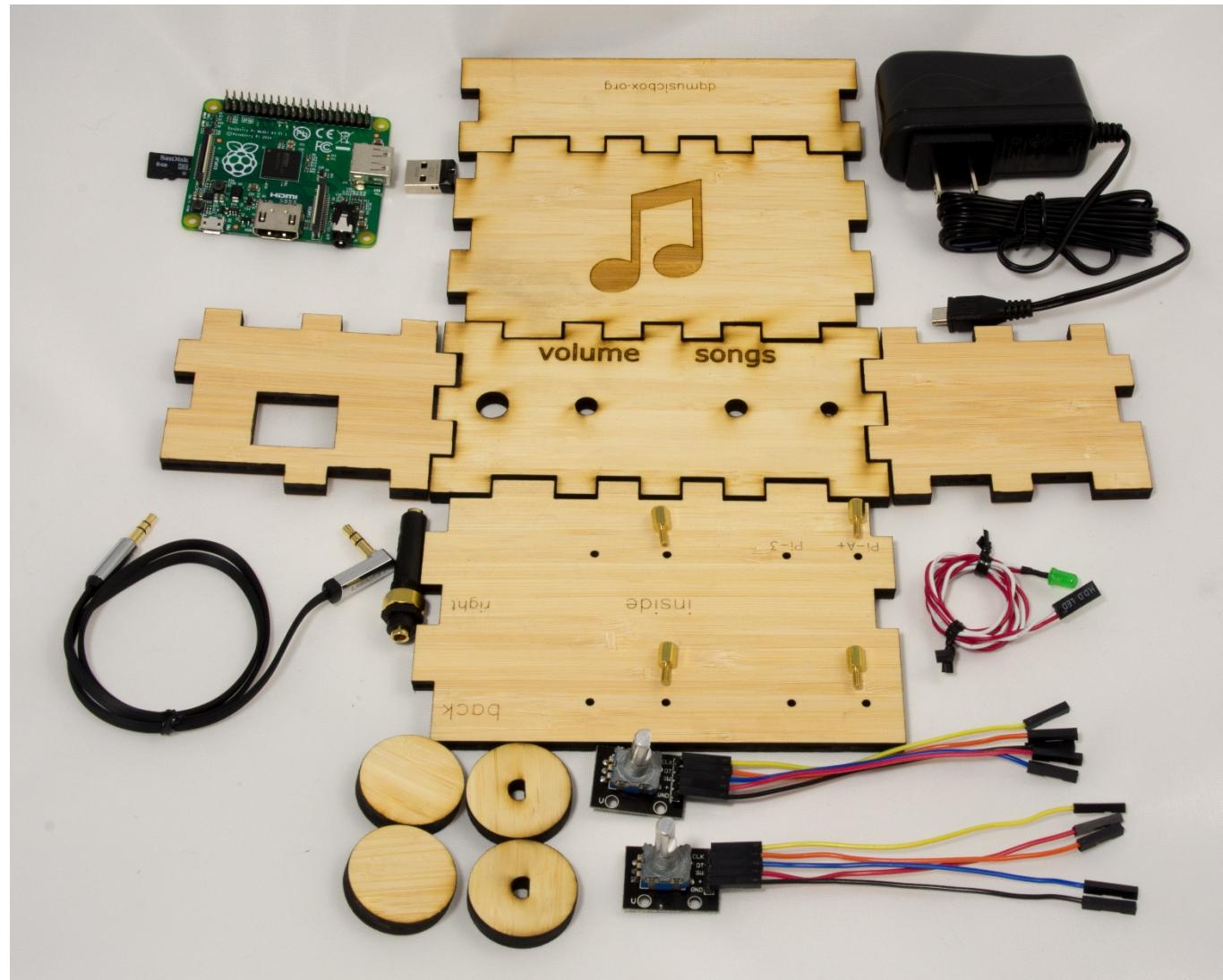
4.2 For you

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.

5 Order the parts

5.1 The parts

Here are the parts that you will be using:



5.2 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"

5.3 Order from Ponoko

1. Go to <https://www.ponoko.com/design-your-own/products/dqmuiscbox-case-bamboo-14248>
2. Click on "Add to Personal Factory"
3. Login
4. Check to accept the license, click "Add"
5. The result should be:

The screenshot shows the Ponoko interface for managing 2D materials. At the top, it says "Your 2D materials" and has a flag icon. Below that, there are two items listed in separate boxes:

dqmuiscbox_2p1_bamboo4a.svg

Bamboo - Blonde - 3 Ply
6.7 mm
P1 - 181.0 mm long x 181.0 mm wide

Making: \$5.33
Material: \$5.50
Total: \$10.83

With Prime you'll pay just \$9.10 total.
All orders over \$100 qualify for free shipping.

[Change](#) [Remove](#)

dqmuiscbox_2p1_bamboo4b.svg

Bamboo - Blonde - 3 Ply
6.7 mm
P1 - 181.0 mm long x 181.0 mm wide

Making: \$12.30
Material: \$5.50
Total: \$17.80

With Prime you'll pay just \$13.80 total.
All orders over \$100 qualify for free shipping.

[Change](#) [Remove](#)

6. Click "Make it"

5.4 Order the remaining parts - US

Item	Supplier	Cost \$US, May 2017	Notes & Alternatives
DQMusicBox bamboo case	Ponoko	\$28.63	See instructions above.
Raspberry Pi A+ single board computer	MCM	\$20.00	Or buy from Amazon. You can also use a Raspberry 2 or 3.
Power supply	MCM	\$5.99	This is the US model. Any micro USB 2A or better supply will do.
Female-female jumper wires	MCM	\$3.79	Or buy Amazon ASIN: B00KOL5BCC
Panel mount 3.5mm headphone jack	MCM	\$2.69	Or buy Amazon ASIN: B004JX64FE
M2.5 standoff with 6mm thread and 7mm spacer	Amazon	\$1.99	Or buy Amazon ASIN: B06XXV8RTR and use the 6mm+6mm standoffs i.e. the smallest ones.
Micro SD card 8GB	Amazon	\$5.99	Any brand name micro SD card that is 8GB or larger will do.
KY-040 rotary encoders (knobs)	Amazon	\$8.99	Search for KY-040 on Amazon or your favorite supplier. Look carefully at the product photo -- you need encoders with screw threads.
Indicator LED	Amazon	\$4.49	Search for "HDD LED", look for a nearly identical LED.
USB thumb drive 8GB	Amazon	\$7.14	While nearly any USB thumb drive will work, I recommend one that is physically tiny so it doesn't protrude much from the case.
Audio cable	Amazon	\$4.99	Search "audio cable right angle".
TOTAL		\$94.69	Prices will vary. Does not include tax, shipping.

5.5 Ordering parts - UK

I have not used the UK suppliers below, but the parts below are likely to work. Alternatively, you can order from the US, using the list above.

Item	Supplier	Cost, Aug 2017	Notes & Alternatives
DQMusicBox bamboo case	Ponoko US	£ 21.93	Alas, £24 in shipping from US. But it is the easiest method. Perhaps find other people that want to build one, and split the shipping charges. As per above, you are also welcome to download the plans and find a local laser cutter.
Raspberry Pi A+ single board computer	Amazon UK	£ 22.29	Made in the UK!
Power supply	Amazon UK	£ 9.60	Or any micro USB 2A or better supply will do.
Female-female jumper wires	Amazon UK	£ 5.85	
micro SD card 8GB	Amazon UK	£ 5.69	Any brand name micro SD card that is 8GB or larger will do.
USB thumb drive 8GB	Amazon UK	£ 7.99	While nearly any USB thumb drive will work, I recommend one that is physically tiny (like this one) so it doesn't protrude much from the case.
KY-040 rotary encoder (knobs)	Amazon UK	£ 5.18	Or search for KY-040 at your favorite supplier. Look carefully at the product photo -- you need encoders with screw threads.
Indicator LED	Amazon UK	£ 5.49	Or search for "HDD LED", look for a nearly identical LED.
Audio cable	Amazon UK	£ 5.29	Or search "audio cable right angle".
M2.5 standoffs with 6mm thread and 7mm spacer	Amazon UK	£ 7.99	Or buy Amazon ASIN: B06XXV8RTR and use the 6mm+6mm standoffs i.e. the smallest ones.
Panel mount 3.5mm headphone jack	eBay UK	£ 10.88	On eBay this is listed as a 2.5mm jack, but I'm pretty sure it's a 3.5mm jack. The part will ship from the US and this seems the cheapest way to buy it in the UK.
TOTAL		£ 108.18	Prices will vary. Does not include tax, shipping.

5.6 About headphones

Item	Cost \$US, May 2017	Notes and alternatives
The recipient's existing headphone	\$0.00	The best headphones are the headphones that the recipient is already used to.
Panasonic RP-HT21	\$7.74	Acceptable sound. Long cord.
AmazonBasics On-Ear Headphones	\$13.99	Very good sound. Cord is a bit short.
AmazonBasics Over-Ear Headphones	\$19.99	Very good sound. Fully covers the ear.
Sony MDR7506	\$79.99	Amazing sound. My Dad loved the sound. But found the headphones to be a bit frustrating – they tend to fold themselves up.

5.7 Tools & supplies

You probably have some of these tools & supplies. If you don't, you have a spouse or child or friend that does. This project is exactly the sort of thing 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 th wrench or nut driver	Or have 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 for your computer.
Painter's tape	Any tape that comes off easily will do. Painter's tape is great. Regular masking tape is probably fine too. I haven't tried Scotch tape.
Raspberry Pi 3 (optional)	This is completely optional. If you are nerd like me, or you have nerdly friend, see details in the appendix 1.

6 Assemble the personalized collection of music

6.1 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.

6.2 Put the music on the USB memory stick

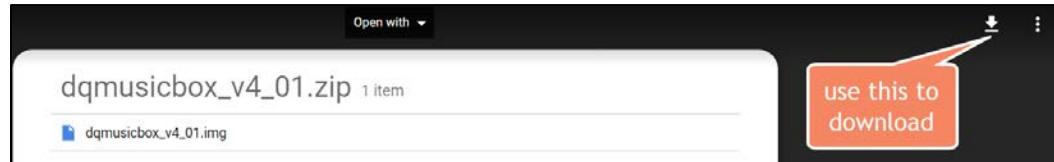
Organize the digitized music into folders on the USB memory stick, one folder per album. MP3, iTunes, and FLAC files are supported i.e. files with extensions .mp3, .m4a, .flac. In the end, you should have a set of folders that looks something like this:

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

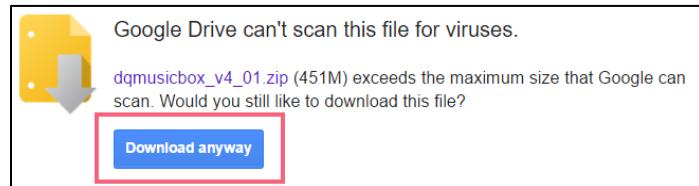
7 Prepare the micro-SD memory card

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:

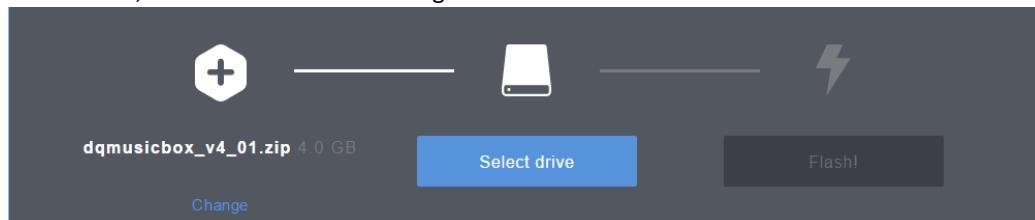
1. Install [Etcher](#) on your PC or Mac or Linux computer. [Win32 Disk Imager](#) also works.
2. Download the [DQMUSICBOX disk image](#). 461MB.



3. Confirm download – “Download anyway”



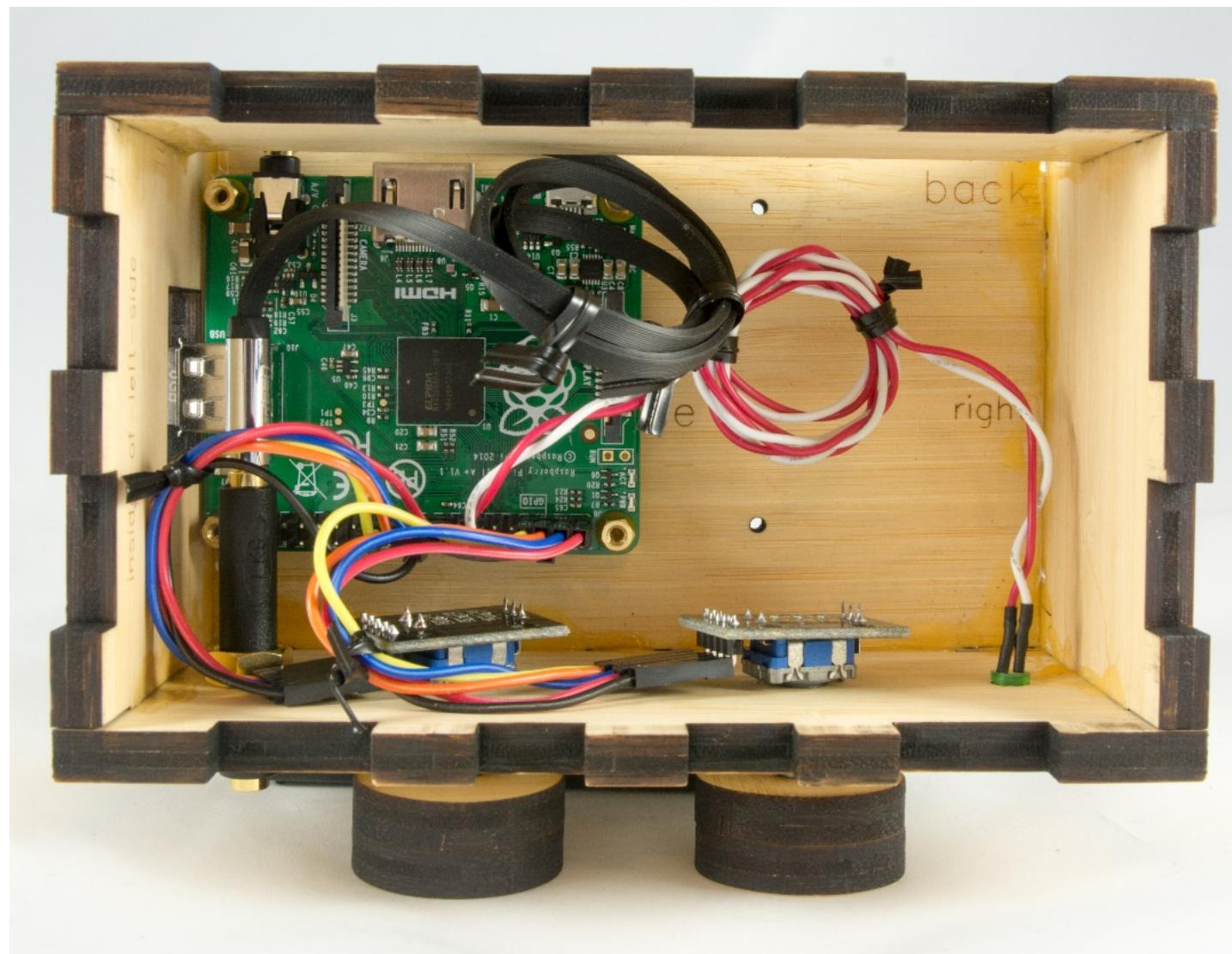
4. Put the micro-SD memory card into the SD card adapter that it came with i.e. put the tiny card into the larger card.
5. Put the SD card adapter into the SD reader/writer in your computer.
6. Start Etcher, instruct it to write the image file to the SD card:



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.

8 Make it

Below is finished product that you will create in the steps further below.

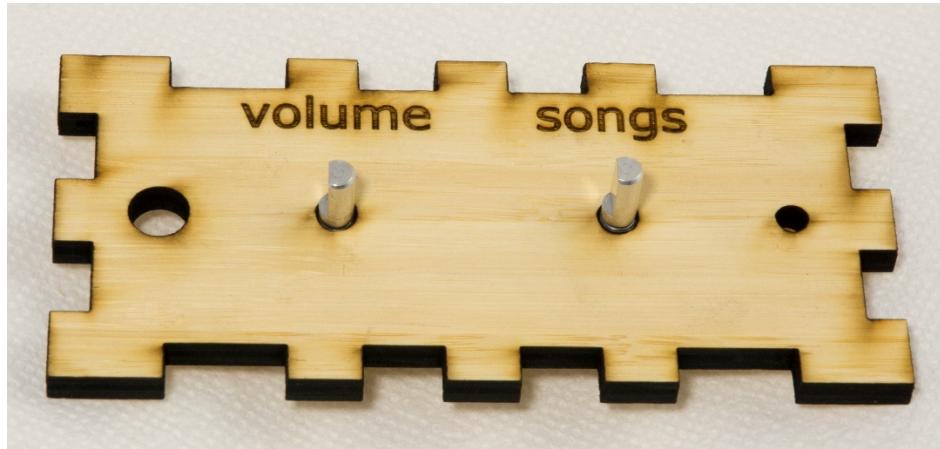


8.1 Screw in the standoffs

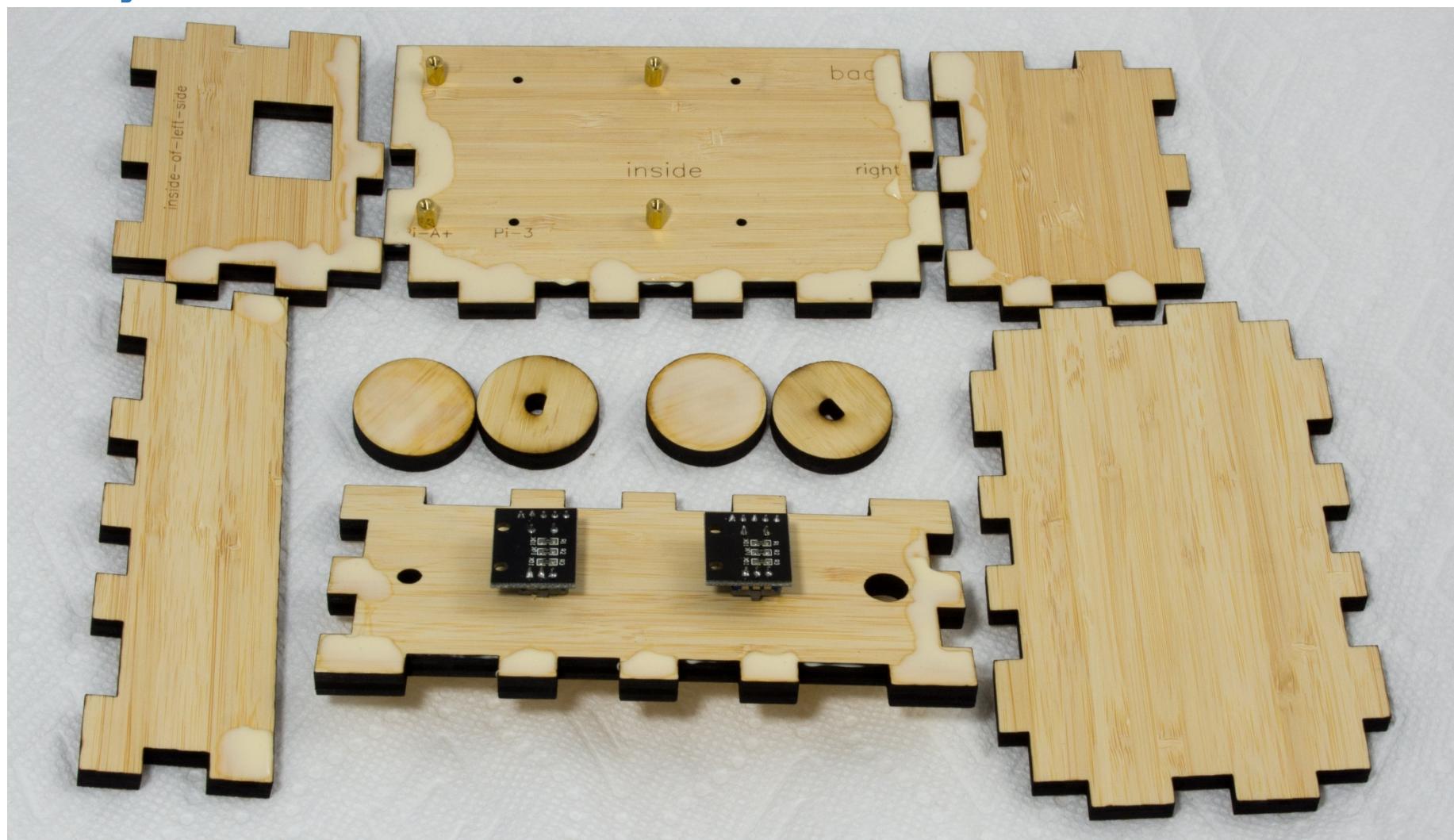
If you are using the default 7mm standoffs with 6mm threads, then no special instruction. If you are using 6mm standoffs with 6mm threads, then it may work best if you don't screw all the way into the wood – leave a 1mm gap.



8.2 Screw in knobs (rotary encoders)

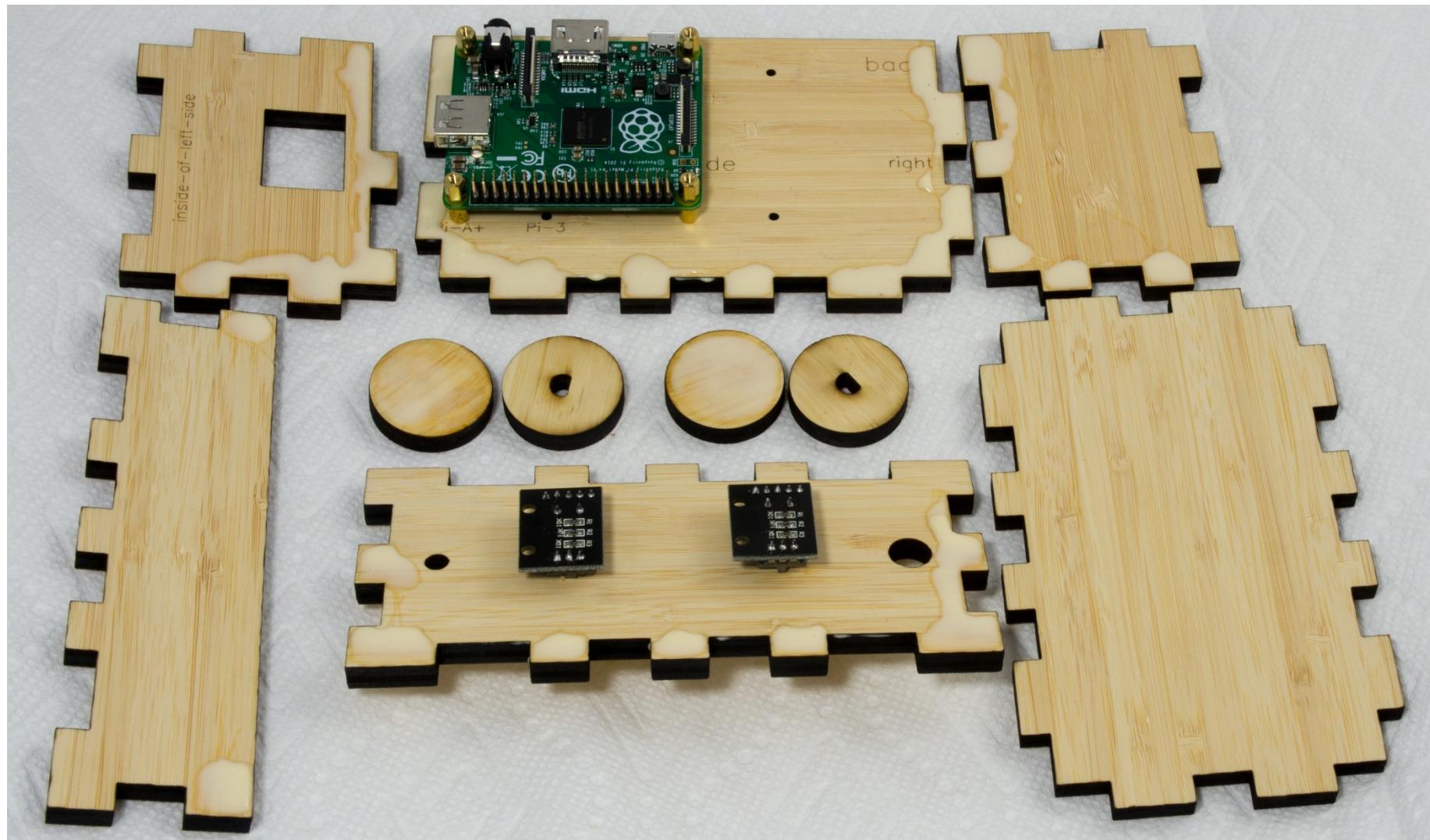


8.3 Add glue



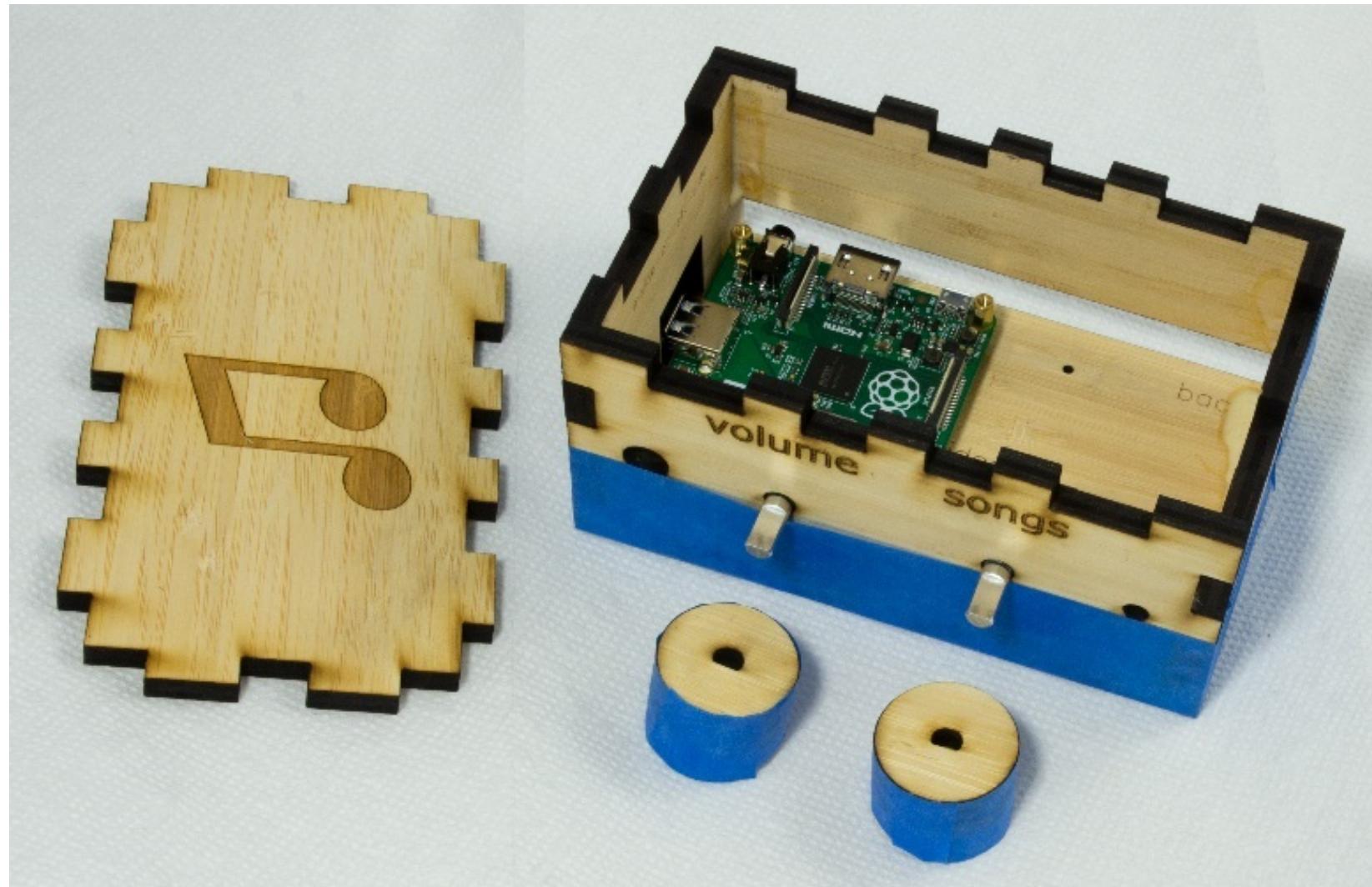
8.4 Add Raspberry Pi

To attach the Raspberry Pi, use four more standoffs.

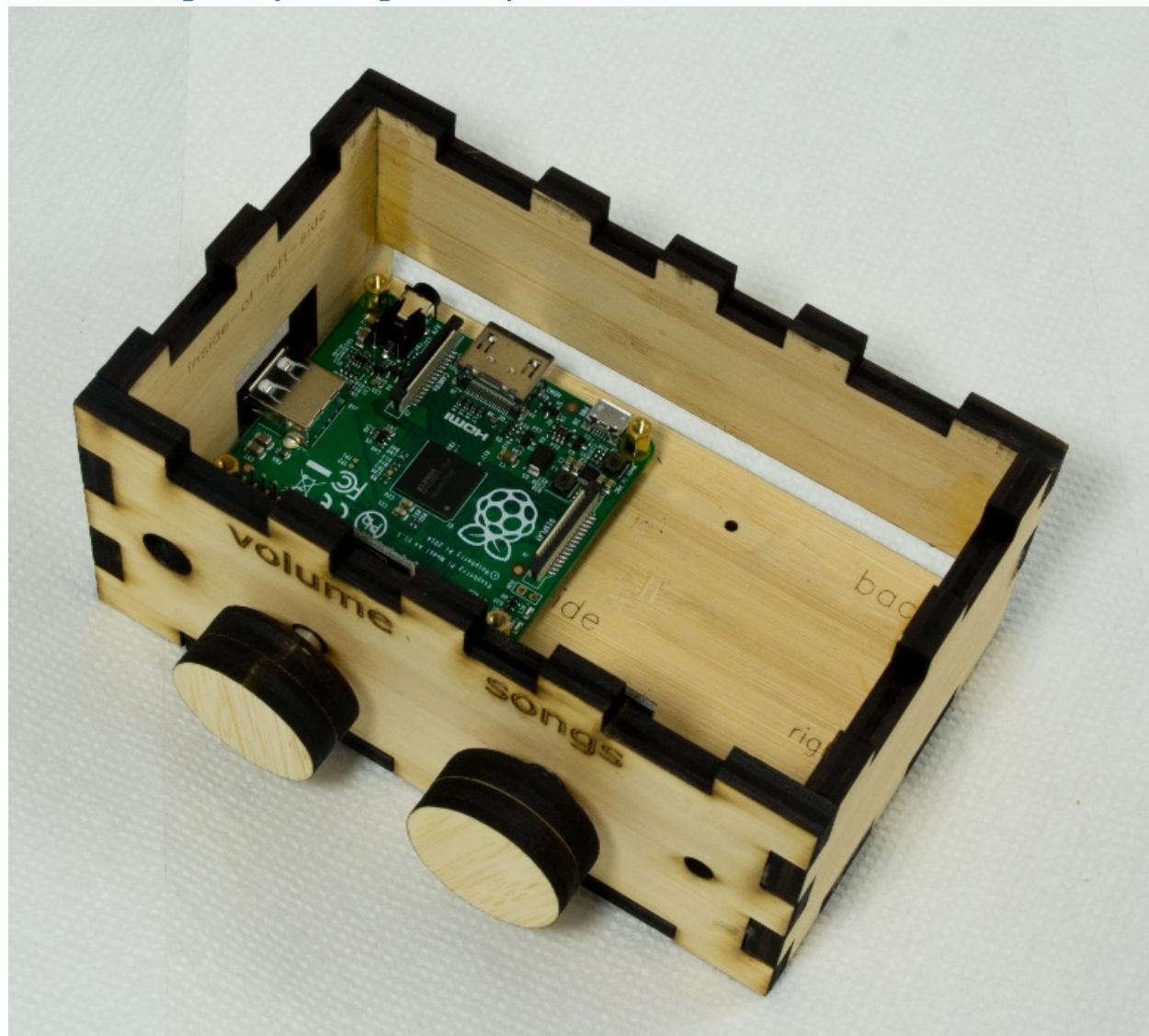


8.5 Glue all but the lid

Glue all but the lid together. To hold it together while drying, use painter's tape. After you have taped it, make sure that the lid fits. **But don't glue the lid on.** I suggest checking the lid fit again after 30 minutes. The lid should be fit snugly, but come off with a bit of effort. **Again, don't glue the lid on.**

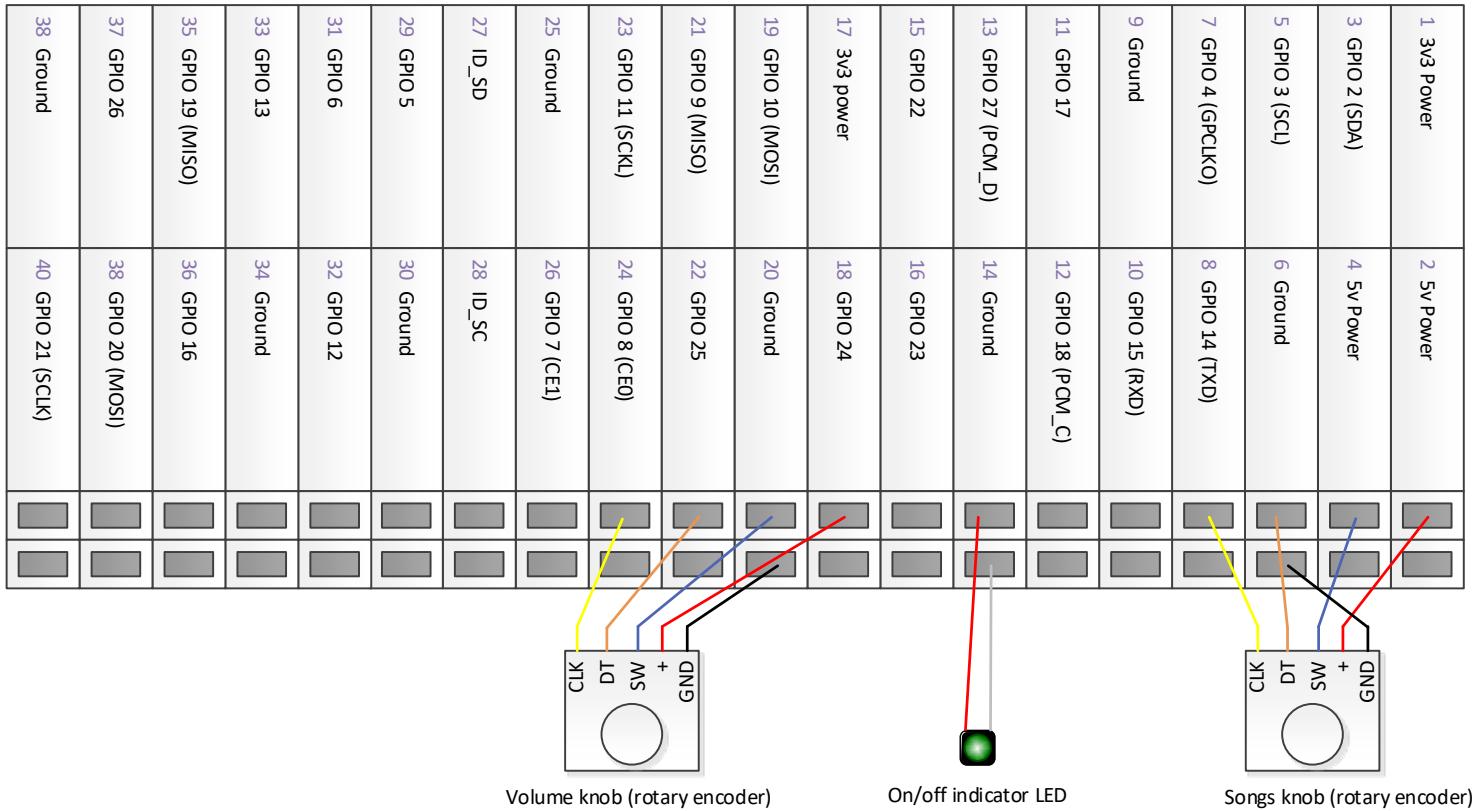


8.6 Let the glue dry overnight, then press to attach wood knobs

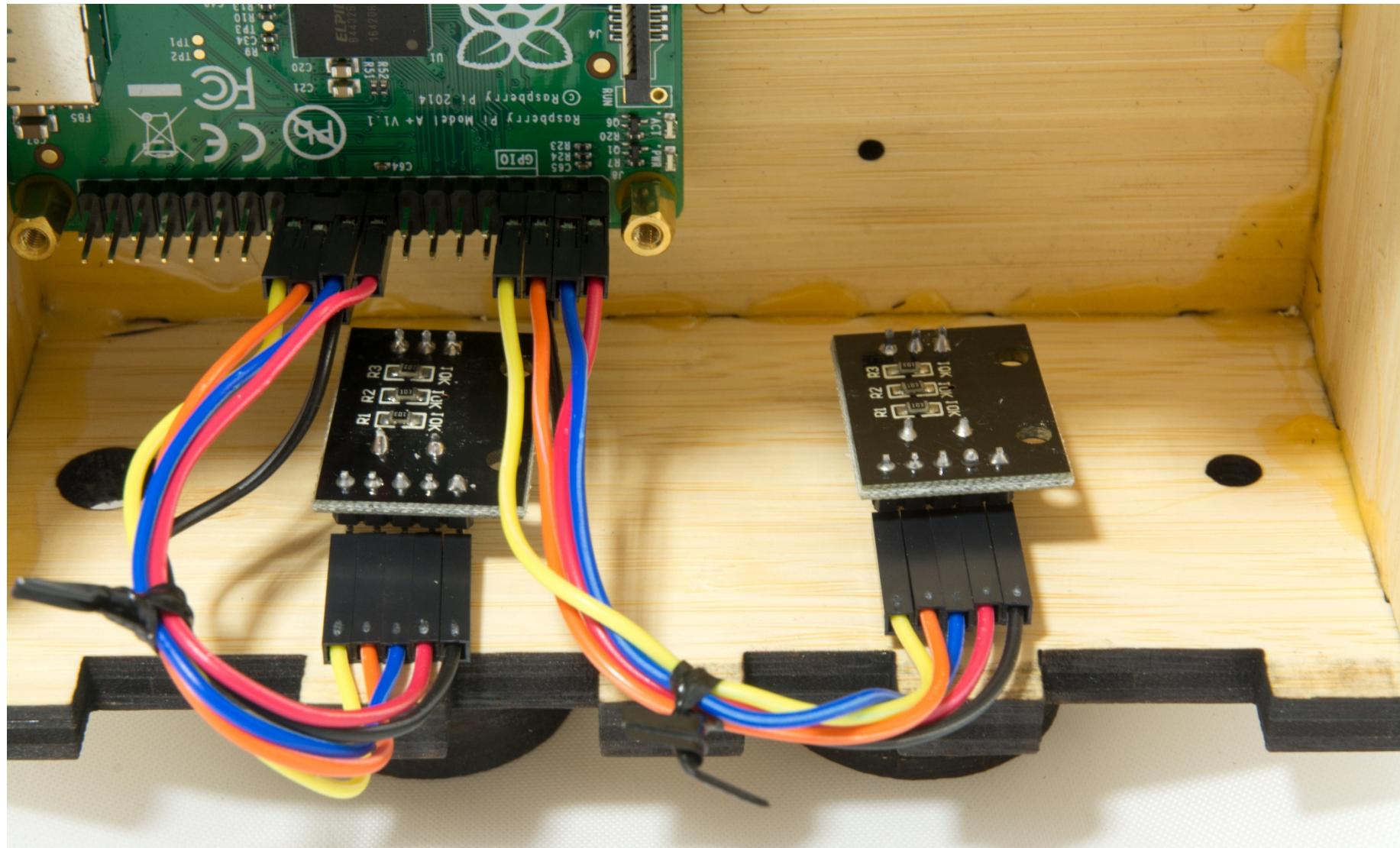


8.7 Wire up the knobs and the LED

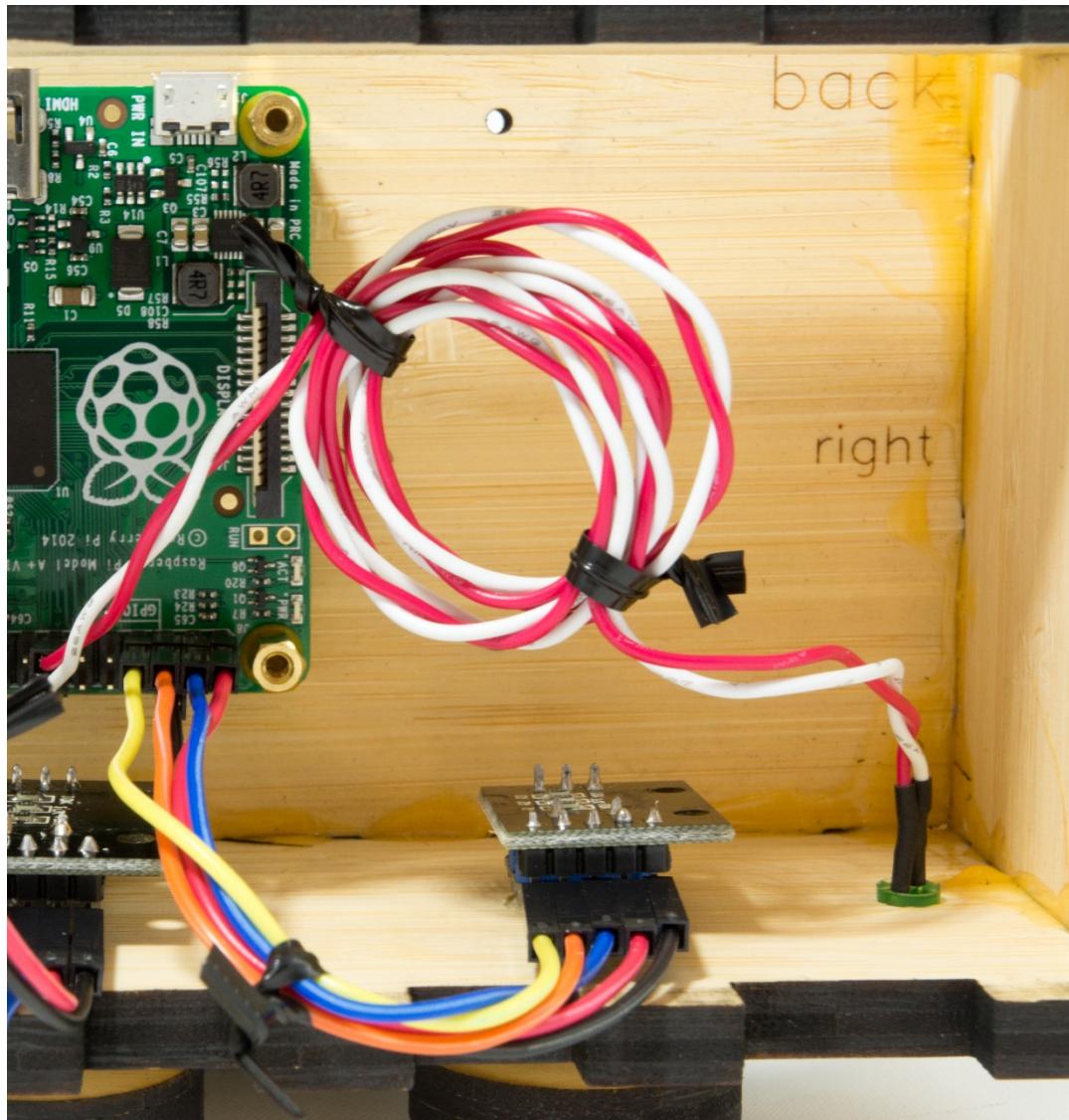
Attach wires from the knobs and the LED to the Raspberry Pi as per the diagram and photos below. No soldering required – just press the wires into place.



For the knobs, the result should be:



If the LED does not fit snugly in the wood, then just use a bit of glue. The result should be:

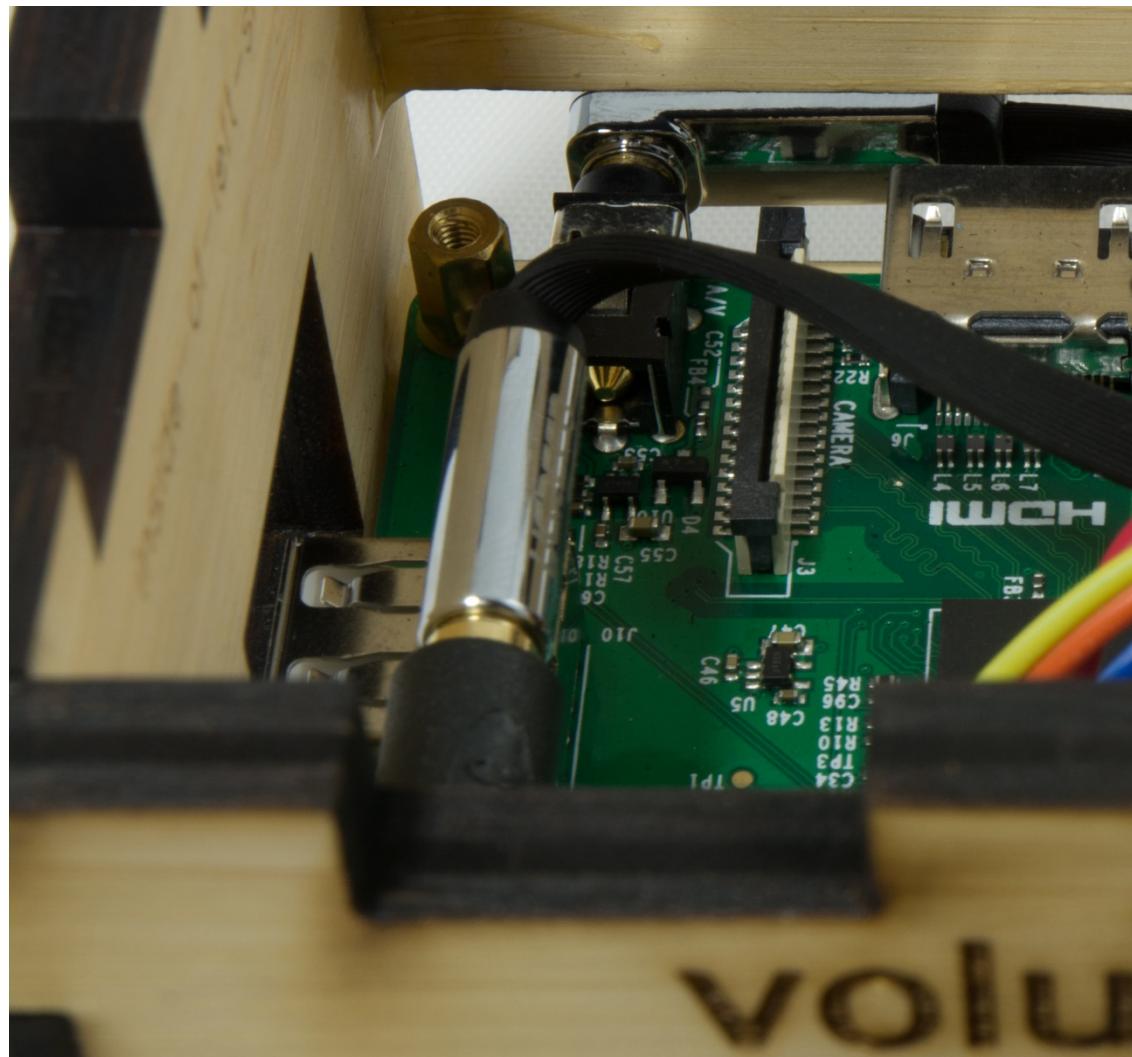


8.8 Screw in the headphone socket



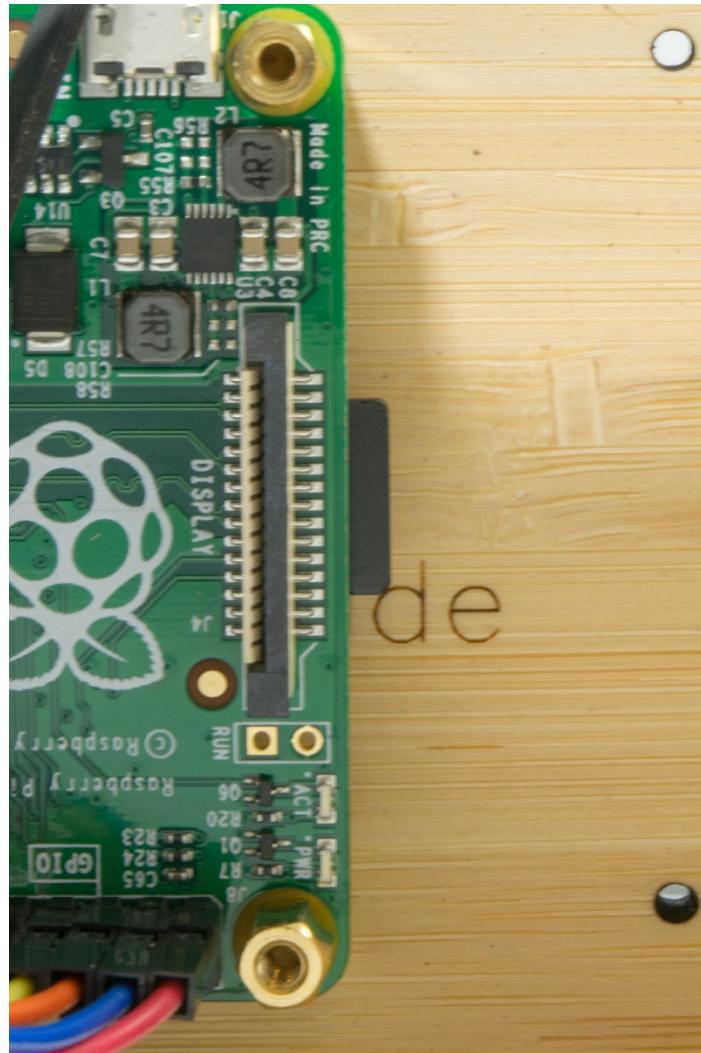
8.9 Connect the audio cable

Connect the audio cable from the headphone socket that you just installed to the headphone socket on the back of the Raspberry Pi, see the silver bits below:

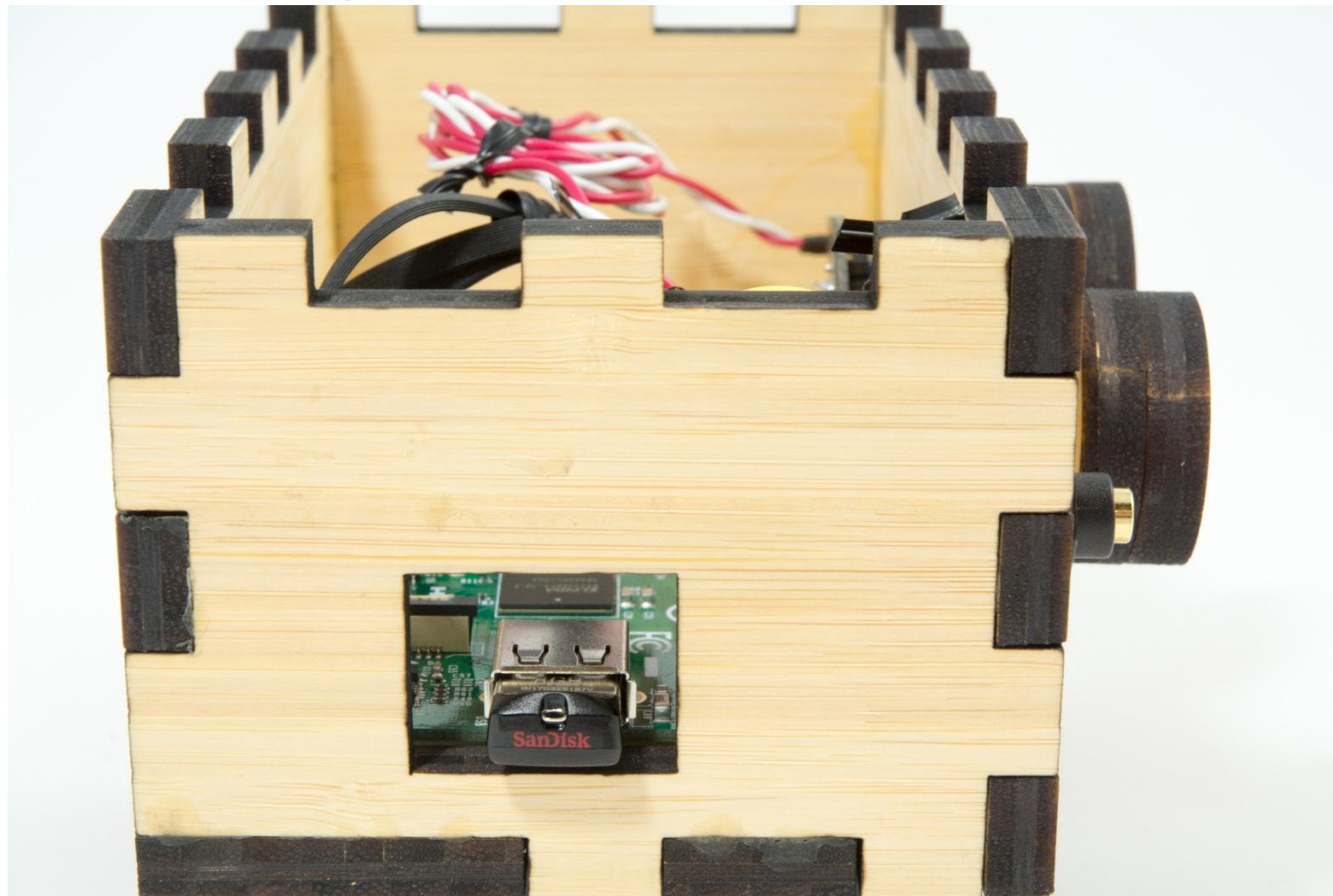


8.10 Insert the micro SD card

The micro SD card goes in a socket on the underside of the Raspberry Pi. Once inserted, only a small portion of the micro SD card is visible. See the photo below showing the micro SD card just above the letters "de".



8.11 Insert the USB memory stick (the music)



8.12 Put the lid on



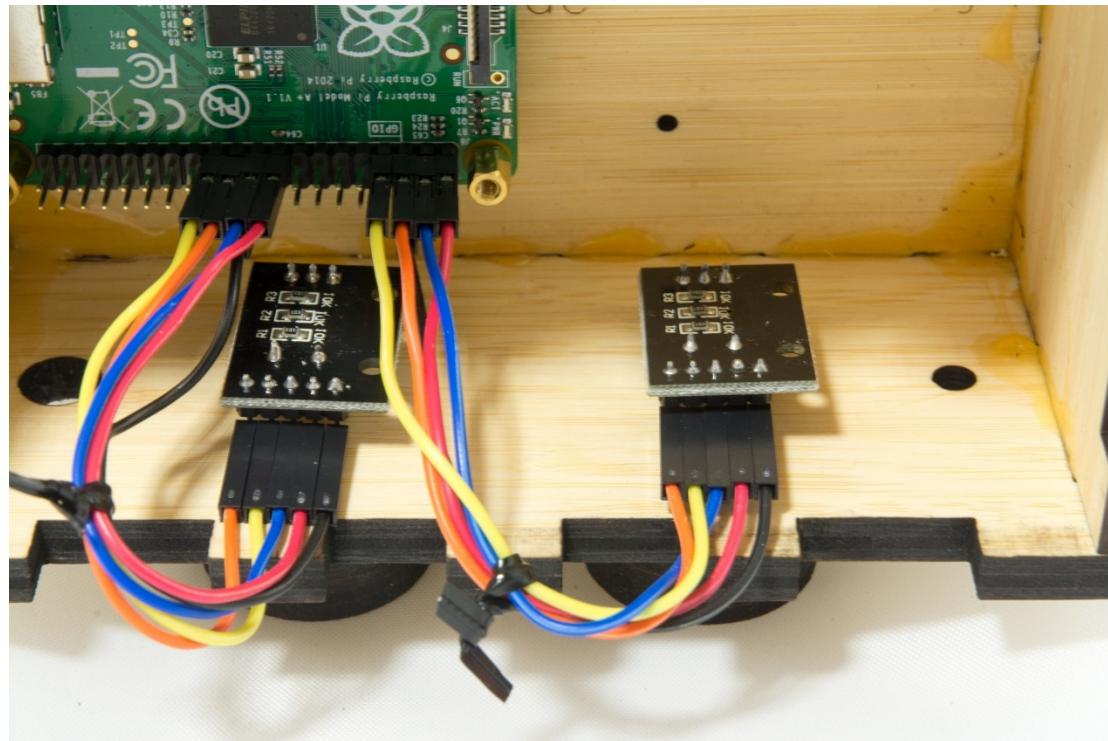
8.13 Test it

Now that you have assembled everything, it is time to test.

Test	Description & Expectation
Light 15sec after power on	The indicator LED turns on when DQMusicBox is ready to play music, which is generally about 15 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

8.14 If one or both knows 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 knob(s) i.e.:

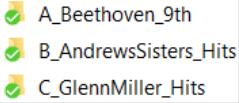


8.15 Tape instructions

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
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.

8.16 Congratulations

Congratulations! You should have a fully functional DQMusicBox.

9 Appendix 1: Write protect the SD card

9.1 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	xxxxxxxxb	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](#)

9.2 Option 1: Build the SD locker project

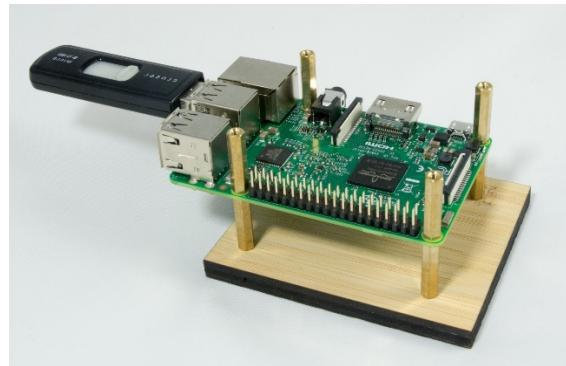
There are several ways to implement TMP_WRITE_PROTECT. I was originally inspired by the [SD locker project on Hackaday](#) and by its [successor](#). Both of which look like fun. But I ended up using Option 2 below as it is more consistent with Raspberry Pi work.

9.3 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`

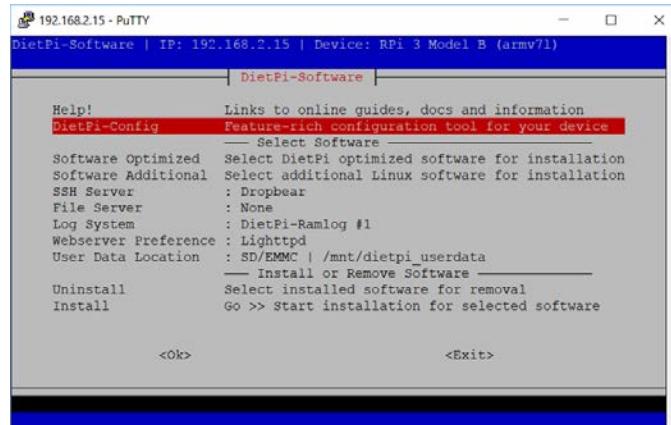
This is my setup for doing so:



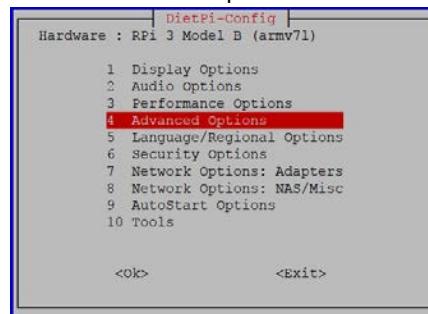
The slightly tricky bit is to get the Raspberry Pi 3 to boot from USB. See below for the process that I used to create to create the setup above. You will only have to do this once.

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.

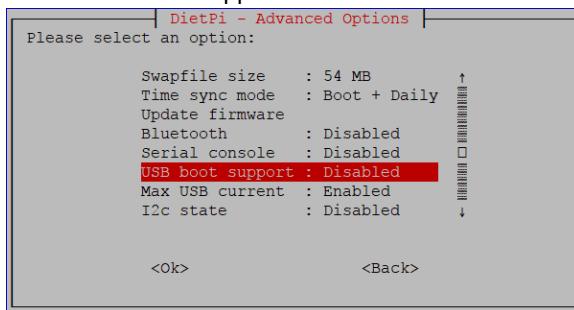
5. Attach Ethernet to your Raspberry Pi 3.
6. Insert the micro-SD card.
7. Start the DietPi installation process i.e.:
 - a. Boot the Pi 3 from the micro-SD card
 - b. Connect to the Pi 3 over the network with Putty or something similar, login with username=root password=dietpi
8. After a while, you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



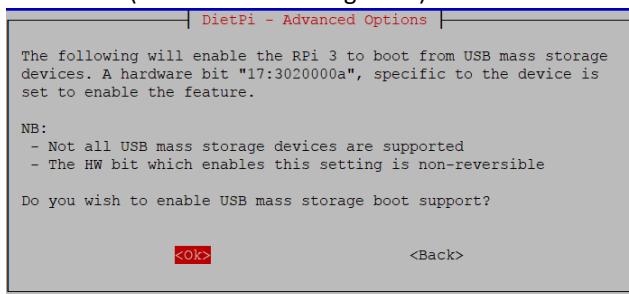
9. Choose Advanced Options:



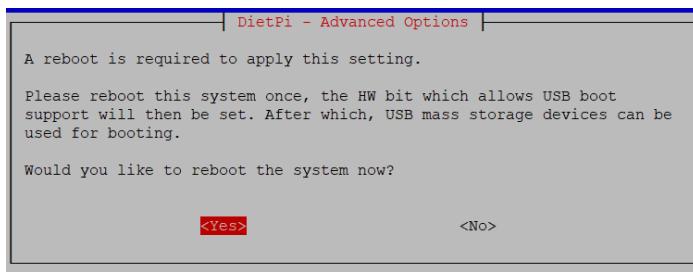
10. Choose USB boot support and choose to **enable** it:



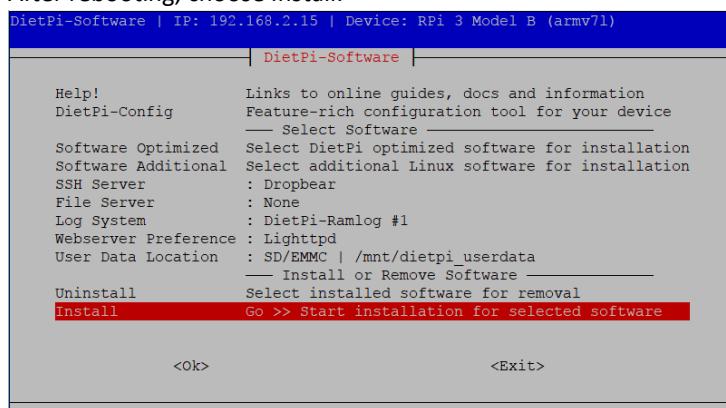
11. Choose OK (read the full message first):



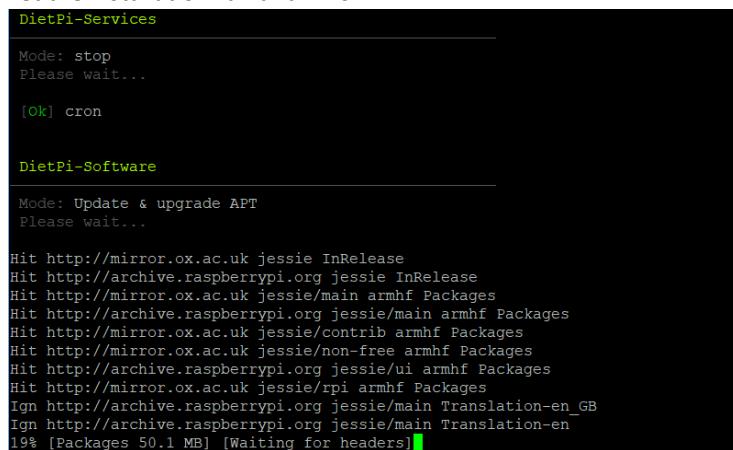
12. Choose Yes to reboot:



13. After rebooting, choose Install:



14. Let the installation run and finish.



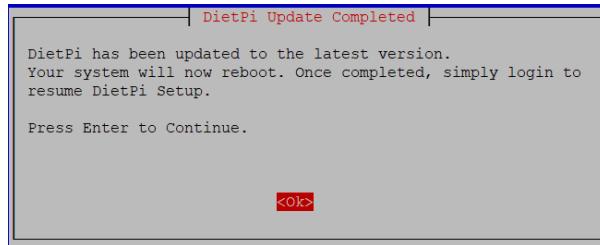
15. Once the installation is complete, switch to a USB setup:

- a. Unplug the Pi.
- b. Remove the micro-SD Card.
- c. Insert the USB thumb drive.
- d. Plug the Pi back in and boot.

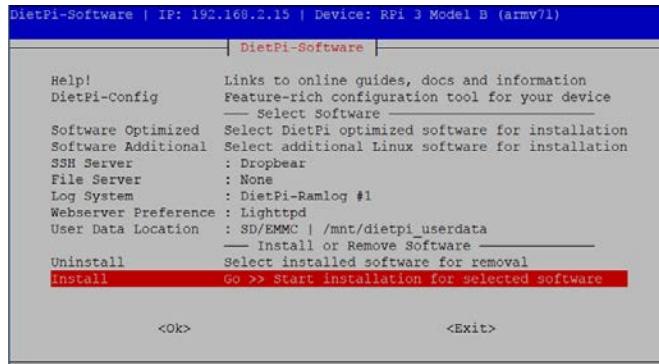
16. Install DietPi on the USB thumb drive. Start by letting DietPi update itself:

```
[Ok] NTPD: time sync | Completed  
[Info] Detecting drives, please wait...  
[Info] Detected PARTUUID mount: /dev/sdal > /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:



18. Install:



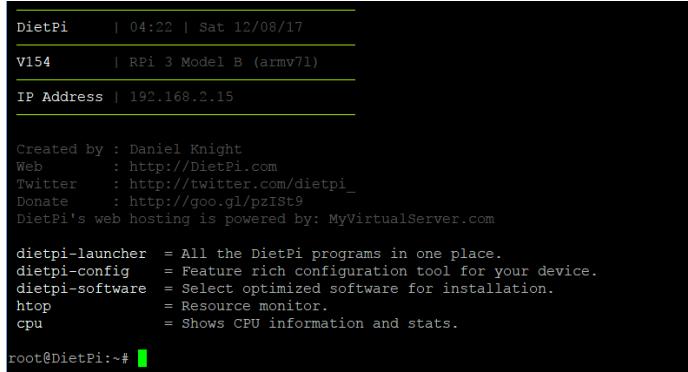
19. Let DietPi do more updating:



```
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

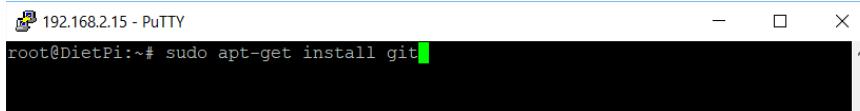
Created by : Daniel Knight
Web : http://DietPi.com
Twitter : http://twitter.com/dietpi_
Donate : http://goo.gl/pzIS9
DietPi's web hosting is powered by: MyVirtualServer.com

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](#) with

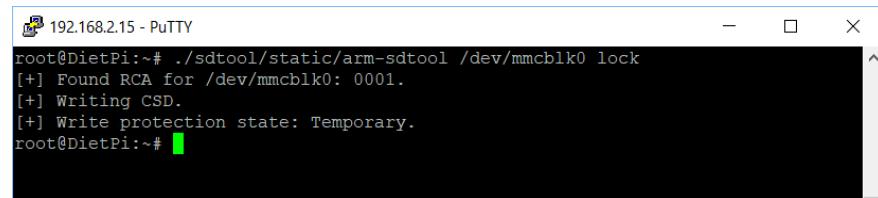
```
git clone https://github.com/BertoldVdb/sdtool
```



```
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:

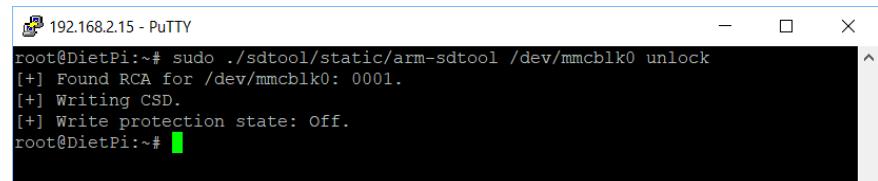
```
sudo ./sdtool/static/arm-sdtool /dev/mmcblk0 lock
```



```
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
```



```
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!

10 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