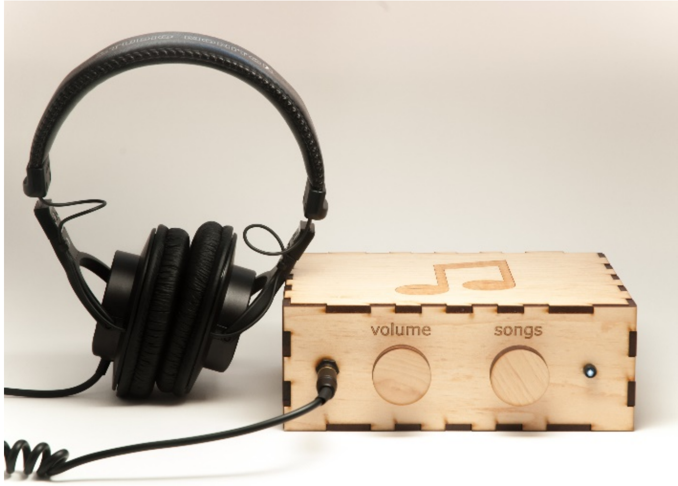
DQMusicBox

30 August 2015



DQMusicBox allows some people with dementia to listen to and control their favorite music. It uses a familiar car radio user interface to control what is effectively a big MP3 player.

That's my Dad, DQ, in the photo. My son & I were inspired to make a music box for him when I read a review of the documentary Alive Inside. The documentary suggests that people with dementia come alive when listening to their favorite music. Following that suggestion, I put DQ's favorite music on an iPad with good headphones. There was sustained joy on his face – joy from the familiar music and joy from the fact that nothing else in the frustrating world mattered for a few minutes. My Dad is doing pretty well at home. But he can't operate their big stereo or their iPad. But he can use DQMusicBox without assistance.

DQMusicBox is a fun maker project. Laser cutting, optional 3D printing, soldering, Python code, and a Raspberry Pi. But most importantly, there is music – a personalized selection that you choose on behalf of whomever you are gifting this to.

Now let's talk about you. I'm assuming that you are a nerd. Like me. This was my first time laser cutting, 3D printing, and working with a Pi. So if you are a nerd, you can do this. Once you have the parts you can do this in about a day, depending on your soldering skills and Pi skills.

I'm assuming that you will be giving this to someone who cannot use other music players. The goal is self-sufficiency. And the principal tactic is to use a familiar and simple user interface, modeled on old car radios.

I could not have done this without help. People were very generous with their time, and I really enjoyed the experience. This is almost certainly an incomplete list: Alex & Mike & others at Ada's, the super smart staff at Metrix, Stephen Christopher Phillips, Bob Rathbone, Stephen Rusk, support at Ponoko, and my son.

1 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.

2 Use cases

2.1 End user use cases

There are deliberately only three end user use-cases:

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.

There are no end user use-cases for turning the device on, turning the device off, viewing the name of the current song, etc.. This is by intent. An underlying assumption is that the end user does not need much music. One of the few benefits of dementia and memory issues is that you never get tired of your favorite music. My Dad is quite happy with ten albums. He has not asked for more music. Thus the songs knobs is a sufficient for scrolling.

2.2 Caretaker use-cases (that's you)

You have the power of an Internet connected Raspberry Pi at your disposal. Here are things that I tend to do:

Name	Description & implementation
Pause	Tap the volume knob. Note that this also happens automatically – music pauses if there are no knob events in one hour.
Shut down	Long hold (15-30 seconds) on the volume knob.
Reboot	Long hold (15-30 seconds) on the songs knob.
Troubleshoot	I just use PuTTY. Note that the DQMusicBox system verbosely logs to /var/log/dqmusicbox.
Add/remove music	As per above, you probably won't do this often. I use SFTP via WinSCP.
Maintain Raspbian	I just use PuTTY. You could also use RDP or VNC.

My Dad and I live 1,000 miles apart. So remote access is important for me. I use the logmein service to access my Dad's old computer and Putty from there to his DQMusicBox.

3 The parts

Here are the parts. To be practical, I'm linking to suppliers.

- The wood case – see below.
- From Adafruit
  - 1 Raspberry Pi 2
  - 1 plastic case base
  - 2 rotary encoders (order more if you are not comfortable soldering)
  - 1 indicator LED (comes in a pack of 25)
  - 1 USB audio adapter
- From Amazon
  - 1 16GB micro-SD card
  - 1 wi-fi adapter
  - 1 case mount LED holder
  - 1 10K Ohm resistor. If you don't have, here is a kit of resistors.
  - 1 set of 80 male-female jumper wires (you don't need 80, but you'll get the desired set of colors)
  - 1 power supply (USB)
  - 1 short headphone cable
  - 1 roll of sticky back velcro
  - 1 panel mount headphone jack
  - 1 set of good headphones
  - 1 bottle of wood glue
  - 1 roll of painter's tape
  - 1 spray can of matte clear protective finish
- Tools that you will need
  - Soldering iron & solder
  - USB keyboard (temporary)
  - Monitor or TV with HDMI input (temporary)

4 Create the case

The laser cutting plans are in the same github repository as this document. You have some choices in how to turn the plans into a laser cut wood case:

Option 1 – easy, mail order maker space (Ponoko)

Takes ~10 minutes and the case pieces will arrive in ~10 days. Ponoko charges ~$50 + tax + shipping (no money goes to me). I did the later revs on the case via Ponoko, in part to give you a convenient option. In full disclosure I'll note that a friend is an investor in Ponoko, not that I'm expecting this project to generate a lot of business for them. Ponoko ships to New Zealand and the United States. If prompted, choose Premium Veneer MDF – Maple, size is 24'x12'.

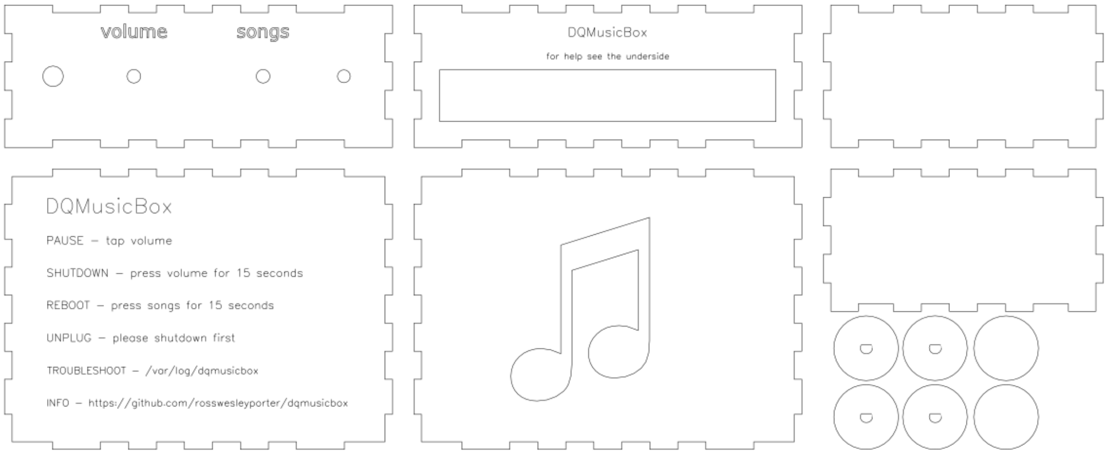
To order: http://www.ponoko.com/design-your-own/products/dqmusicbox-case-12685, and choose "Add to Personal Factory". If prompted, choose Premium Veneer MDF – Maple, size is 24'x12'.

Option 2 – fun, your local maker space

Many cities have a maker space. I went to Metrix in Seattle, which was a lot of fun for a nerd like me. I got lots of great help. If desired, you can customize the plans e.g. add the recipient's initials. I used Inkscape (free) to create the plans. Adobe Illustrator also works well. The plans assumes a 3.5mm thick wood product. If you want to use a different wood thickness, then you may want to create a new set of plans via http://www.makercase.com/, and then paste in elements from my plan.

To find a local maker space, hit Google or see this directory: http://spaces.makerspace.com/makerspace-directory

In any case, pun intended, the result is a pile of precisely cut wood pieces that you glue together. Here is a preview of what those pieces will look like:


volume
songs
DQMusicBox
for help see the underside
DQMusicBox
PAUSE – tap volume
SHUTDOWN – press volume for 15 seconds
REBOOT – press songs for 15 seconds
UNPLUG – please shutdown first
TROUBLESHOOT – /var/log/dqmusicbox
INFO – https://github.com/rosswesleyporter/dqmusicbox

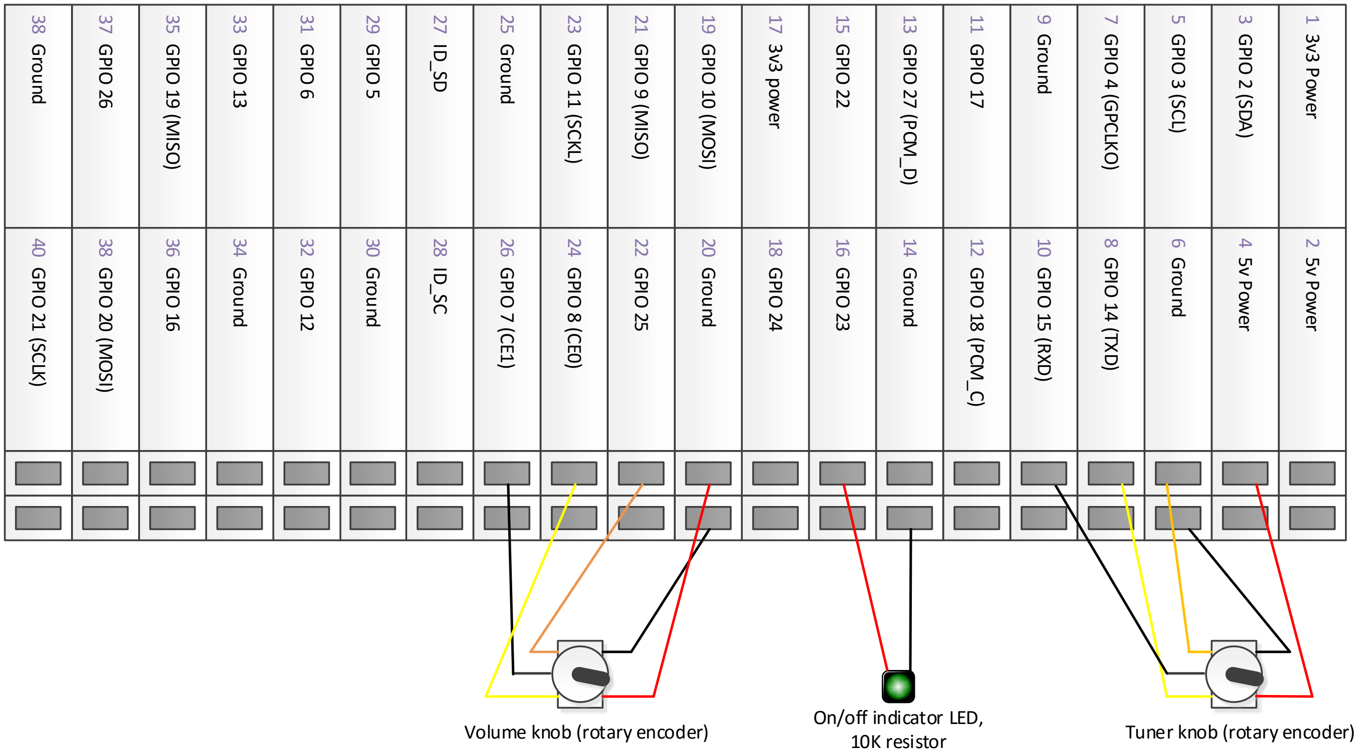
5 Prepare the wiring

Now it is time to solder.

1. **Rotary encoders.** Solder M-F jumper wires to the rotary encoders as shown below. Solder the M end to the rotary encoder, leaving the F end for connecting to the Pi later. There isn't much space between the rotary encoder pins, so soldering skill is needed. I bought some staff labor from my local maker space to do this. I watched and was able to solder later rotary encoders myself.

2. **LED & resistor.** I put the resistor in-line with the ground/black wire.

Later, you'll use the wiring diagram below to connect the rotary encoders and the LED to the Pi.



6 Setup the Pi

6.1 The basics

There are many guides for the following, so they are not repeated here:

- Install Raspbian
- Enable ssh
- Configure wi-fi

6.2 Set the USB audio device as the default

Linux sound is wonderfully complicated. Below is the simplest method that I have found for setting the default audio device to be USB audio.

First, disable the built-in sound device so the USB audio device is the only remaining audio device:

```
sudo nano /etc/modules
Change:     snd-bcm2835
To:         #snd-bcm2835
```

Now remove the default override of USB audio:

```
sudo nano /etc/modprobe.d/alsa-base.conf
Change:     options snd-usb-audio index=-2
To:         #options snd-usb-audio index=-2
```

While the above simplifies the audio configuration, it does cause a problem for a panel item in the startx desktop of recent versions of Raspbian. To remove that unhappy audio control panel item, comments out the five lines associated with the volumealsa plugin:

```
sudo nano ~/.config/lxpanel/LXDE-pi/panels/panel
#Plugin {
#       type=volumealsa
#       Config {
#       }
#}
```

Reboot. Then verify with `aplay -l` that the USB audio device is the only device shown. For more information above changes: disable the built-in sound device, remove default override of USB audio, panel

6.3 Install VLC (music player)

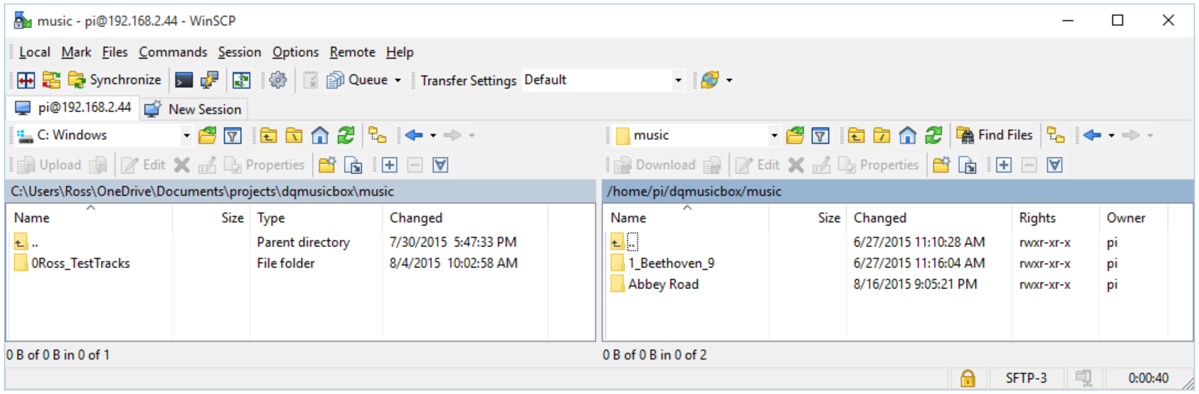
```
sudo apt-get install vlc
```

6.4 Install/clone dqmusicbox

```
cd ~
git clone https://github.com/rosswesleyporter/dqmusicbox/
```

6.5 Add personalized music

This is the most important step. Without personalized (familiar) music, the whole system is less valuable. My Mom mailed me my Dad's favorite CDs. In some cases, I purchased better recordings of the same songs for him e.g. upgraded him from a generic recording of Beethoven's 9th, to the 1977 Berlin Philharmonic recording. Place your music in the music folder. Subfolders are preferred i.e. one subfolder per album as you see below. I have not tested the code with any other subfolder structure. DQMusicBox plays the music in alphabetical order by folder name (note the use of numbers in folders names below to make the ordering obvious). MP3, FLAC, and AAC/MP4/iTunes files are supported. I used WinSCP to transfer music files to DQMusicBox:



Transfer Settings Default

C:\Users\Ross\OneDrive\Documents\projects\dqmusicbox\music

Name	Size	Type	Changed
..		Parent directory	7/30/2015 5:47:33 PM
0Ross_TestTracks		File folder	8/4/2015 10:02:58 AM

0 B of 0 B in 0 of 1

/home/pi/dqmusicbox/music

Name	Size	Changed	Rights	Owner
..		6/27/2015 11:10:28 AM	rwxr-xr-x	pi
1_Beethoven_9		6/27/2015 11:16:04 AM	rwxr-xr-x	pi
Abbey Road		8/16/2015 9:05:21 PM	rwxr-xr-x	pi

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6.6 Install Python bindings for VLC

Download vlc.py from https://wiki.videolan.org/Python_bindings, place in the bin folder.

6.7 Add shell script to automatically start the musicbox

```
sudo cp bin/dqmusicbox.sh /etc/init.d
chmod 755 /etc/init.d/dqmusicbox.sh
sudo update-rc.d dqmusicbox.sh defaults
```

For more information, see Stephen Christopher Phillips' terrific page.

6.8 Reboot

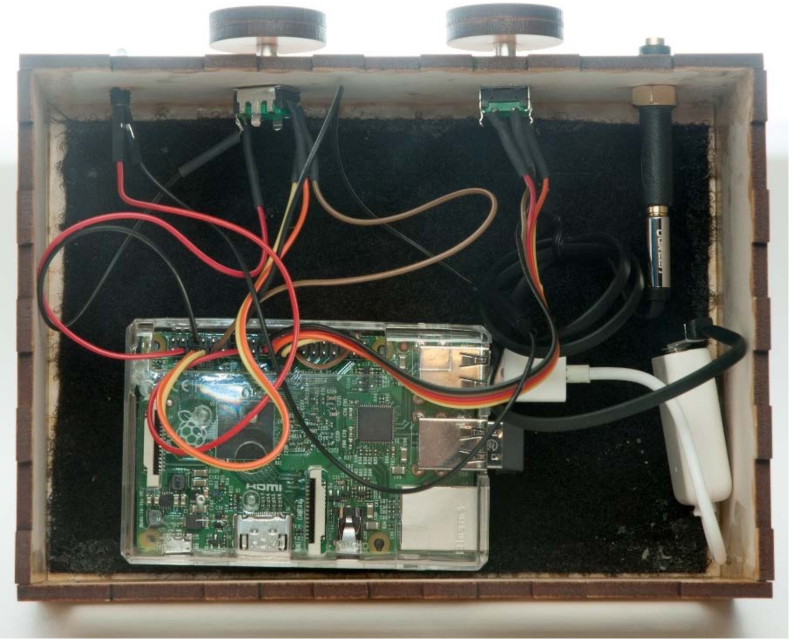
```
sudo reboot
```

7 Put it all together

I don't think you need all the steps listed out. But here are a few tips for putting it all together:

1. Mount the front panel items before gluing i.e. mount the rotary encoders, the indicator LED, and the headphone jack.
2. Attach velcro to the bottom before gluing.
3. Glue the bottom and sides of the wood case. Put the top on, but don't glue the top on.
4. Use painter's tape (clamps would be better) to hold the box together while the glue dries.
5. Use velcro to hold the raspberry pi plastic case in place.
6. Use velcro to hold the thick end of the USB audio adapter in place.
7. I obsessed a bit about the knobs, so you have some choices:
    a. Use the wood knobs from the case cut. If desired, glue together a few of the knob circles to make deeper knobs.
    b. Use the plastic knobs that came with the rotary encoders. But I don't like that they have a prominent white line.
    c. Eagle knobs from mouser. Black rubber. I like these better than the knobs that come with the rotary encoders. The knobs are a bit small. But it's good that there is no prominent white line.
    d. 3D print some knobs, such as this one from thingiverse. But note that I had to print a few before I got the mounting size just right (+15%). These are the knobs on the dqmusicbox in the photo with my Dad on page 1.

And here is a photo of the inside:



8 Test cases

Congratulations on assembling everything. To test:

Name	Description & Expectation
Light 1min after power on	The indicator light turns on when DQMusicBox is ready to play music, which is generally about 1 minute after power on.
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. Tap the songs knob. Both should work.
Shut down	Long hold (15-30 seconds) on the volume knob.
Reboot	Long hold (15-30 seconds) on the songs knob.
SSH	Connecting via PuTTY should work.
SFTP	Transferring files via WinSCP or similar should work.