How to Build the Dementia Friendly Music Player - 3D Printed Case
3D Printed Model – Use with Headphones or External Speakers

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3D printed case designed by Trey Bagley

I was inspired to design this by the documentary Alive Inside which shows the profound joy felt by some with dementia when listening to their favorite music.
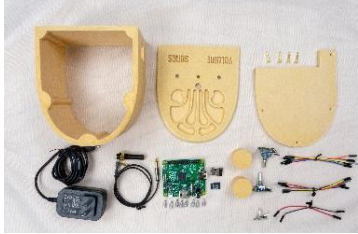
My Dad could no longer operate the home stereo. But he could operate this music player because it operates like a familiar two-knob radio. The vintage style fit with his old intact memories – for most people with dementia, the old memories are the strong memories.

It's easier than you think to make one. Everything I did is open source. This document contains all the information you need. You can order the parts online, including the cut & engraved wood. It's a good family project – kids do well with this. It's also a project that friends would love to help you with.

Parts cost	~$75 + tax + shipping (drops to ~@$45 if make 10+ at a time, see Appendix 1)
Music cost	Minimal as you should use the recipient's existing music collection
Build time	About 3 hours once you have the parts & music, Best if those 3 hours are spread across two days
Parts source	All parts can be mail ordered, links below
Soldering?	No
3D printer needed?	Yes, or work with a friend that has a 3D printer
3D printing time	About 18 hours
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 build steps

1) Order parts	2) 3D print pieces	3) Stain the pieces (optional)
amazon Prime	VOLUME SONGS	VOLUME SONGS
4) Assemble recipient's favorite music	5) Copy software to micro SD card	6) Collect the parts & pieces
SYMPHONIEN VOL. 1	Kingston 8GB microSDHC 4	
7) Add Pi	8) Install front panel components	9) Glue it
	VOLUME SONGS	VOLUME SONGS
10) Wire it	11) Screw on back	12) Enjoy!
		VOLUME SONGS

No warranty

USE THESE DEMENTIA FRIENDLY MUSIC PLAYER PLANS AND SYSTEM AT YOUR OWN RISK. THE DEMENTIA FRIENDLY MUSIC PLAYER 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

How it works

Tap to pause

Also pauses automatically after 1 hour of no knob activity

Turn to change volume

Music on USB drive

Turn to start music playing

Turn to go to previous or next song

VOLUME

SONGS

STEP 1: Order the parts
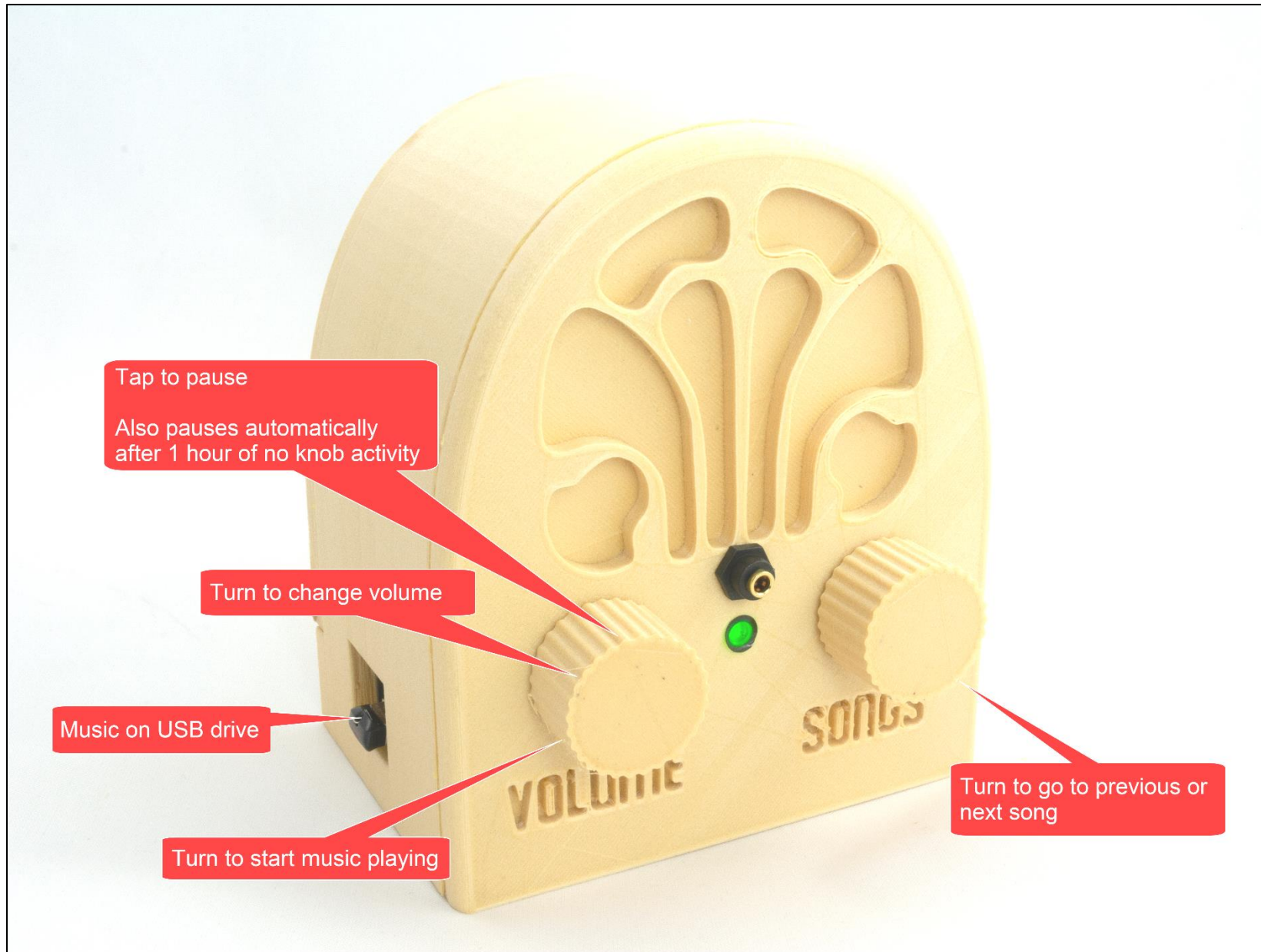
Item	Supplier	Cost	Notes & Alternatives
Raspberry Pi 1 A+ single board computer	Newark	$20.00	Also tested with a 2B, 3A+, 3B, 3B+, 4B. Do not use Pi Zero.
Power supply	Newark	$4.99	Or Newark 81AC2845. Or order one for your region/plug.
Female-female jumper wires	Newark	$3.95	Or Amazon B01L5ULRUA
Panel mount 3.5mm headphone jack	Newark	$2.69	Or Amazon B004JX64FE
M2.5 standoffs (screws) – 8 of them	Newark	$4.32	Or Amazon B06XXV8RTR
Micro SD card	Amazon	$4.75	Or upgrade to Amazon B06XWN9Q99. Any brand name card that is 16GB 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.
Audio cable	Amazon	$5.89	Or Amazon B00SUIKMJ8. Or find a short audio cable with a right angle bend.
KY-016 indicator LED	Amazon	$6.99	Or Amazon B07KJYR8K1. Or search Amazon for KY-016.
KY-040 rotary encoders (knobs)	Amazon	$7.99	Or Amazon B06XQTHDRR.
#4 x 5/8" flat head wood screws	Amazon	$6.75	Also tested with a 2B, 3A+, 3B, 3B+, 4B. Do not use Pi Zero.
TOTAL		**$73.92**	Prices will vary. Does not include tax, shipping.

STEP 2: Get 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.
Monoprice On-Ear headphones	$10.99	Very good sound. High sensitivity (which is important). Also available from Amazon for a slightly higher price but with Prime shipping: B014399CWK.
Monoprice Over-the-Ear headphones	$15.99	Amazing sound. High sensitivity (which is important). Also available from Amazon for a slightly higher price but with Prime shipping: B007SP2CO2.
Other		Look for high sensitivity headphones, as the Pi's output is a bit weak.

STEP 3: Gather 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
3/16th wrench or nut driver	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 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.
Light blocking tape or sticker	The unit's LED is quite bright, so I prefer to block some of the light. You can use the tape above. Or order light blocking stickers such as B009WSJNCW.
PLA wood filament (optional)	This document assumes that you have a 3D printer, or you have a friend with a 3D printer. So you already have some regular PLA filament. I chose to use a PLA wood filament, specifically Monoprice PLA wood filament.
Wood stain (optional)	If you print with PLA wood filament, you can optionally apply wood stain. I used a pre-stain, a stain, and a protective finish. I went to the local hardware store and purchased what they recommended: Minwax Pre-Stain Wood Conditioner, Minwax Wood Finish Cherry.

STEP 4: 3D print the pieces

The key assumption is that you have a 3D printer, or you have a friend with a 3D printer. Thus, this document is not intended as an introduction to 3D printing.

You will be printing the pieces that you see below. You should print in the orientation that you see below i.e. flat side down. On my basic 3D printer, the total print time was about 18 hours.

3D printed case designed by Trey Bagley

General instructions
1. Download the stl files from Github.
2. 3D print the files.

My experience

Trey Bagley designed the case. I think he did a great job. But I'm a novice at 3D printing. Nonetheless here is what I did, and I'm happy with the result:

- Monoprice Maker Select v2 3D printer

- [Monoprice PLA wood filament](#)
- [Cura slicing software](#)
- Key settings
    - Layer height: 0.3mm
    - Initial layer height: 0.3mm
    - Wall thickness: 0.8mm
    - Top/bottom thickness: 0.8mm
    - Infill: 10%
    - Print temp: 188C (this low temperature reduced stringing issues)
    - Build plate temp: 50C
    - Diameter: 1.75mm
    - Flow: 100%
    - Enable retraction: yes
    - Retraction distance: 10mm
    - Retraction speed: 60mm/sec
    - Print speed: 45mm/sec
    - Infill speed: 50mm/sec
    - Travel speed: 120mm/sec
    - Initial layer speed: 5mm/sec
    - Enable print cooling: yes
    - Fan speed: 100%
    - Minimum layer time: 5 sec
    - Print sequence: all at once
- Post printing
    - My prints came out fairly clean, but I did use a tiny knife to extract extraneous strands from the lettering.

STEP 5: Stain the pieces (optional)

This step is optional. I wanted to make something that seems familiar to someone with dementia i.e. make something that looks very much like a radio from the 1930s. These antique radios are made of wood and generally dark stained. Thus, I chose to print with a wood PLA filament and stain the print. You could choose to print with regular PLA filament. Or print with wood PLA but not stain it.

Here is the before and after of staining the front face:

I'm not a woodworker. Nonetheless, this is the process that I used:

1. Sand the parts with a fine grit sandpaper.
2. Apply Minwax Pre-Stain Wood Conditioner, let dry. Or a similar product. Minwax is what my neighborhood hardware store has…
3. Apply Minwax Wood Finish, Cherry. I applied a thin even coat. Minwax suggests waiting 15 minutes then wiping off the excess stain. I found this removed too much of the stain. So I didn't do any wiping off and just let it dry overnight. The photo above is with a Minwax red mahogany stain, which I found a bit too dark – thus the cherry stain suggestion.

STEP 6: 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 7: Prepare the micro SD 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.
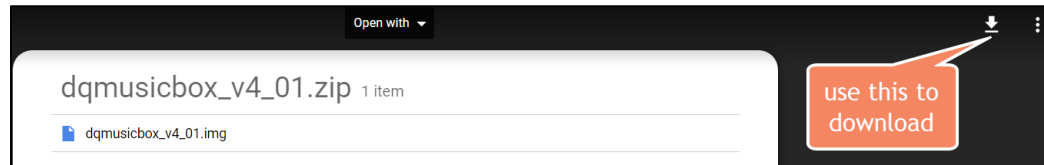
3. Confirm download – "Download anyway"
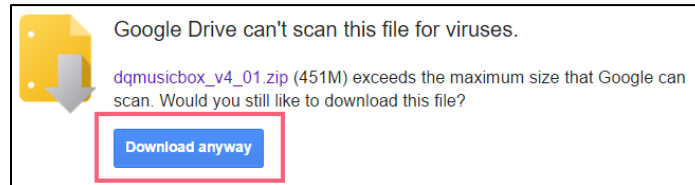
4. Put the micro-SD memory card into the SD card adapter that it came with i.e. put the tiny card into the larger card.

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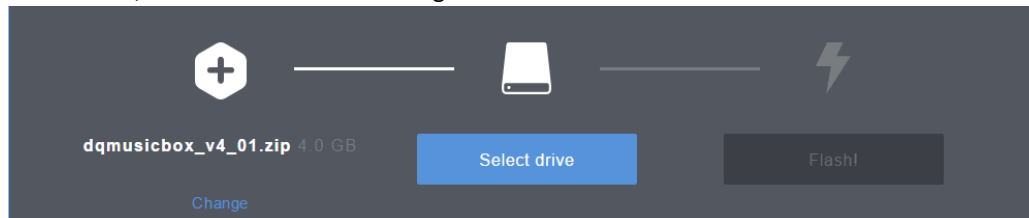
7. Wait for the writing to complete, ~10 minutes. This would be a good time to make a sandwich.

STEP 8: Collect the parts & pieces
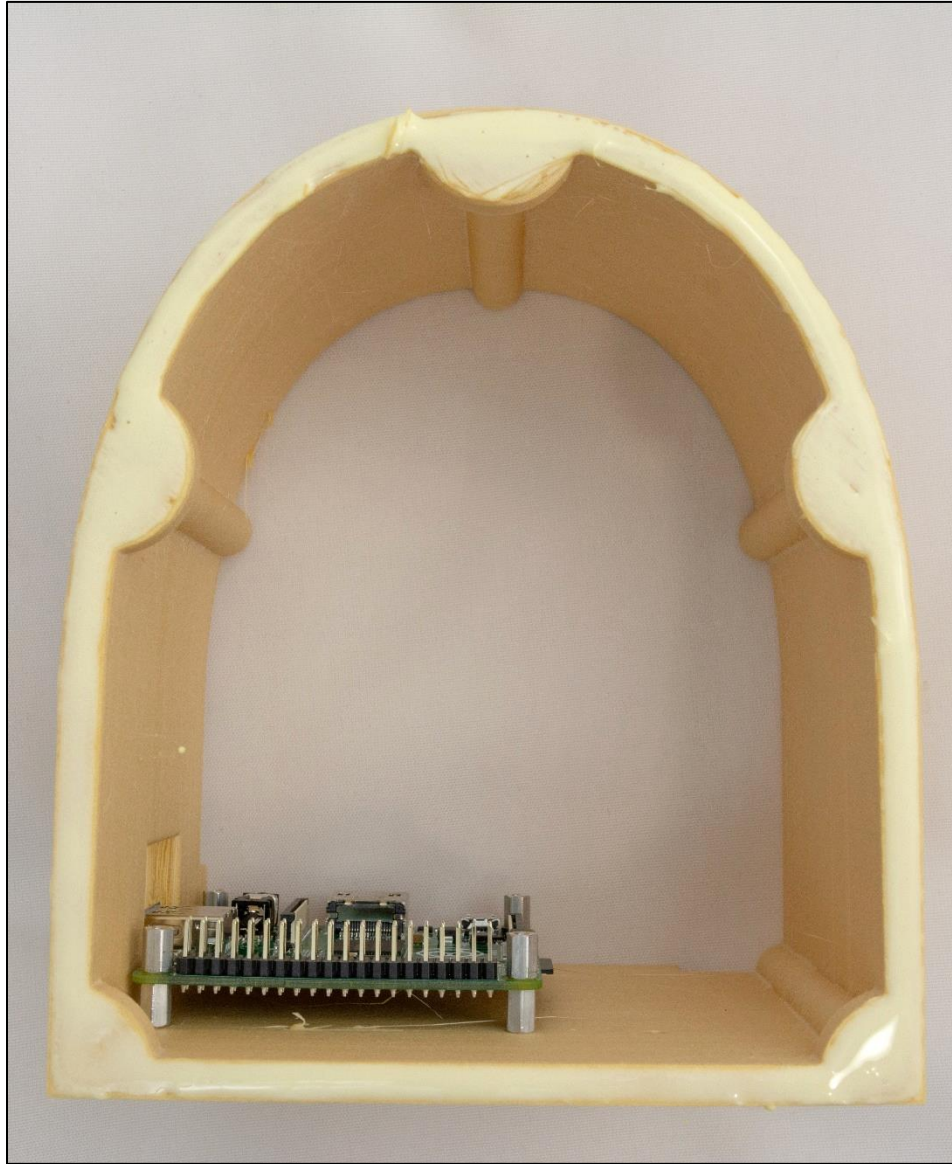
STEP 9: Add Pi
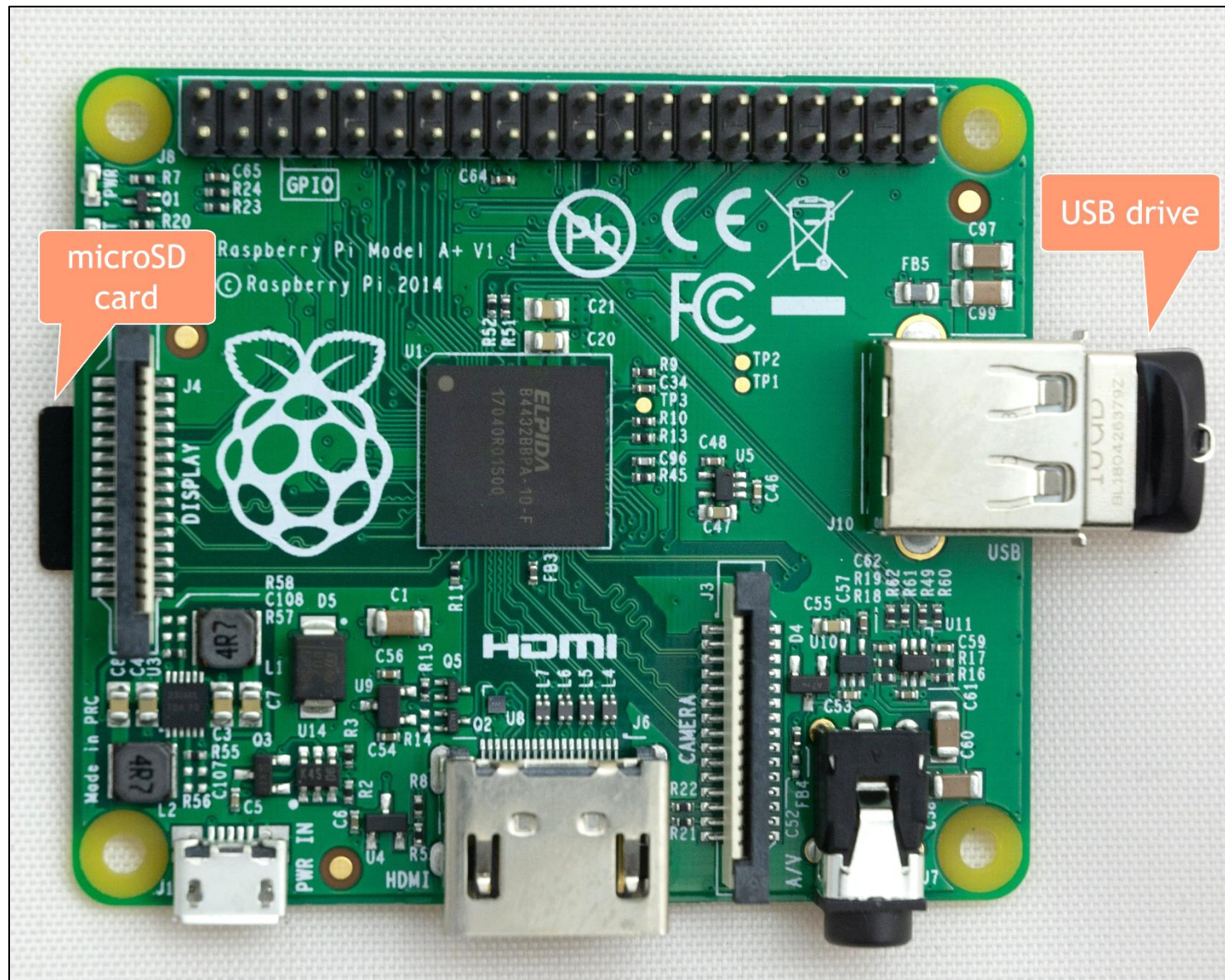
STEP 10: Mount the Pi

STEP 11: Install the front panel components

Install the two rotary encoders (knobs), the LED, and the headphone jack. The rotary encoders need to be screwed in as far as they will go, or the button press won't work – test the rotary encoders to make sure they rebound from a button press.

STEP 12: Apply glue

Apply glue to the front of the body piece:

STEP 13: Glue the face
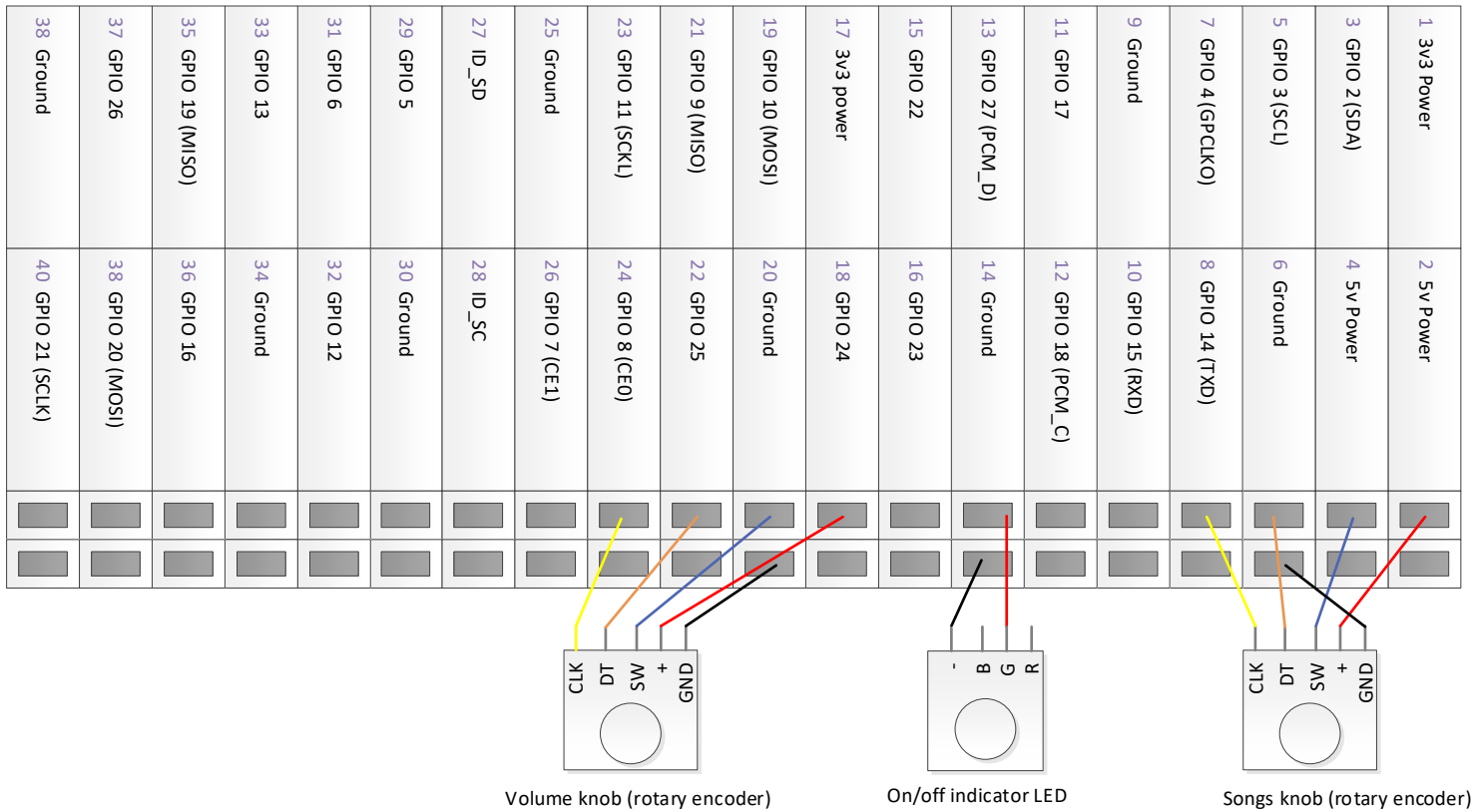
Glue on the face, using painter's tape to clamp:

STEP 14: Wire it

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. **This is where most build errors happen, so please carefully check your work.**

Volume knob (rotary encoder) On/off indicator LED Songs knob (rotary encoder)

The result should be as you see it below. The front of the LED should be flush with the front of the face. If the LED is a bit loose, just use some glue.
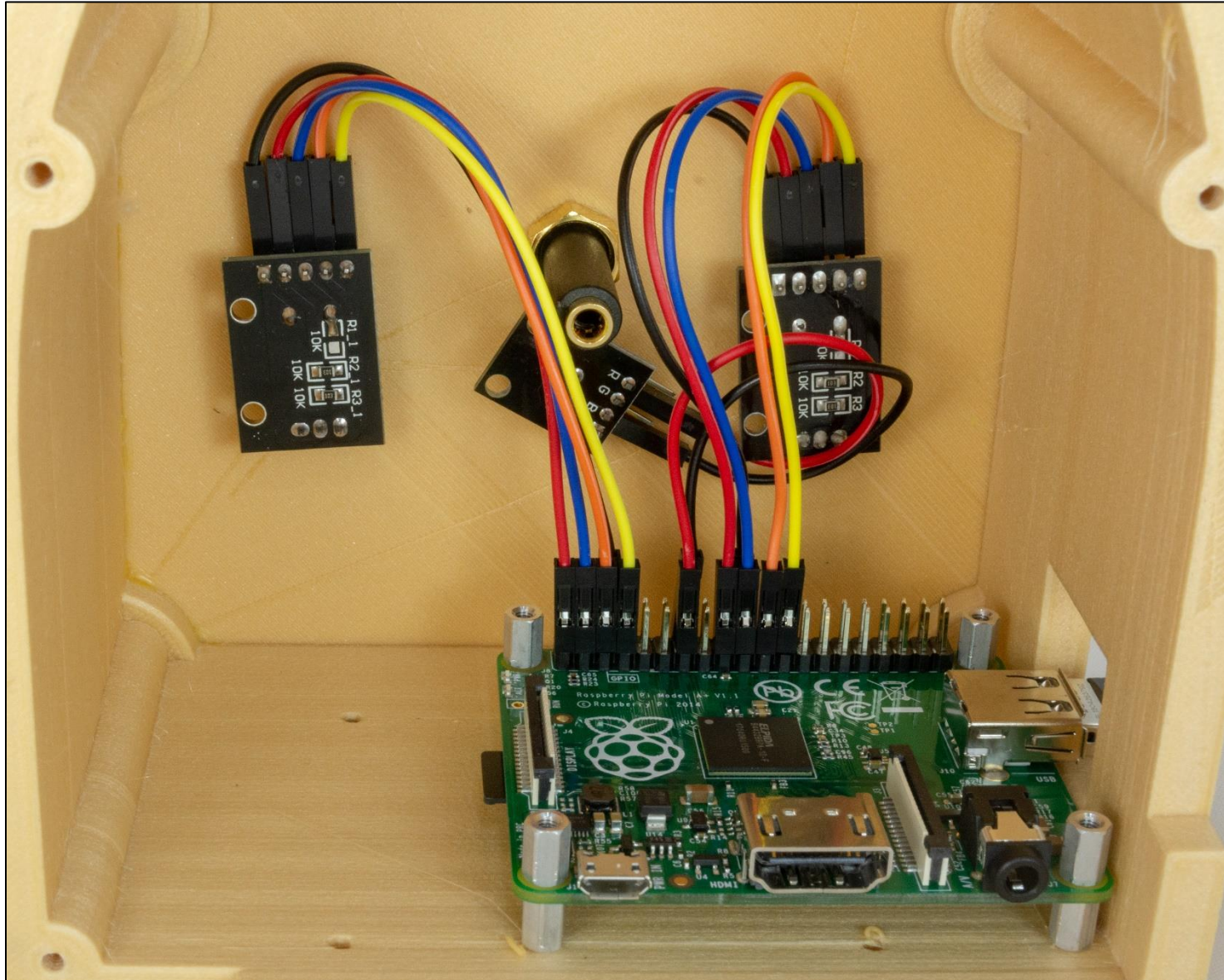
STEP 15: Add audio cable

The audio cable goes from the back of the Pi to back of the front panel's headphone jack:

STEP 16: Screw on the back

STEP 17: Put on the knobs & enjoy

If the knobs don't easily slide on the metal shafts, just heat the knobs up with a heat gun or hair dryer or (last resort) boiling water. You can also put some grease or cooking oil on the metal shafts.

STEP 18: Test it

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

Test	Description & Expectation
Light 20sec after power on	The indicator LED turns on when Dementia Friendly Music Player 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

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) (don't touch the Pi itself):
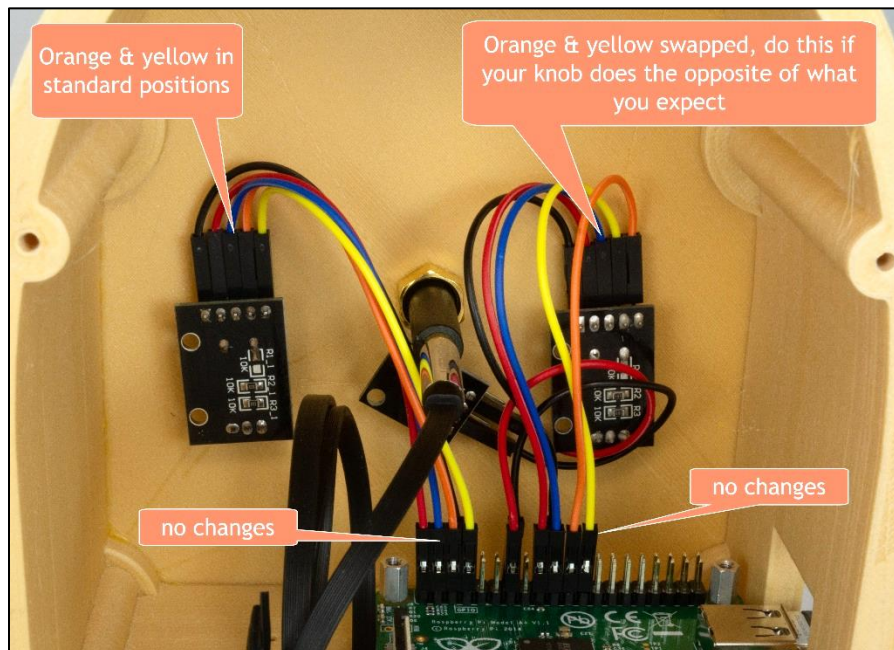
STEP 19: Tape on the instructions

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 the 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.
5. Plug in your Dementia Friendly Music Player.

Congratulations!

Congratulations! You should have a fully functional Dementia Friendly Music Player.

Let me know how it went

I'd love to hear how your build process went and if it was useful for the recipient. rosswesleyporter@gmail.com

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

# units to make	10					
Item	**Supplier**	**Quan**	**Each**	**Total**	**Per unit**	**Notes**
Raspberry Pi 1 A+ single board computer	Newark	10	$20.00	$200.00	$20.00	
Power supply	Newark	10	$4.99	$49.90	$4.99	
Panel mount 3.5mm headphone jack	Newark	10	$2.69	$26.90	$2.69	
Female-female jumper wires	Ali Express	10	$0.60	$6.00	$0.60	
M2.5 4mm thread + 6mm standoff screws (30 pieces)	Ali Express	3	$4.99	$14.97	$1.50	
Audio cable	Ali Express	10	$2.45	$24.50	$2.45	
KY-016 indicator LED (10 pieces)	Ali Express	1	$1.92	$1.92	$0.19	
KY-040 rotary encoders (knobs) (5 pieces)	Ali Express	4	$2.11	$8.44	$0.84	
16GB micro SD card	Amazon	10	$4.75	$47.50	$4.75	
USB thumb drive	Amazon	10	$5.60	$56.00	$5.60	
#4 x 5/8" flat head wood screws (100 pieces)	Amazon	1	$6.75	$6.75	$0.68	
					$44.29	+ tax + shipping

Appendix 2: Change log

v1, November 2015	Original release
v2, September 2016	• 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	• Changed from USB audio to Pi built-in audio, including a firmware update for excellent audio quality.
v4, May 2017	• 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	• Minor edits.
v4.01_1, 20 July 2017	• Minor edits.
v4.01_2, 11 August 2017	• Added links for ordering parts in the UK. • Added detailed instructions for write protecting a micro-SD card.
v4.01_3, 12 August 2017	• Minor edits
v4.01_4, 12 August 2017	• Minor edits
v4.01_5, 14 October 2017	• 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	• 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	• 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	• Updated to reflect the new bamboo case design.
V4.1_1, 6 May 2018	• Adapted the existing instructions to match the new 3D printed case design.
27 January 2019	• Noted support for the Raspberry Pi 3A+.
v4.2, 1 March 2019	• Switched to pmount for USB drive auto mounting.
v4.2, 7 April 2019	• Removed instructions for write protecting the SD card – rarely used and may cause certain rare problems
v4.2, 8 May 2019	• Noted that it may be necessary to do in-slicer scaling of one the STL files prior to 3D printing.
v4.2, 26 October 2019	• Updated the parts list
v4.2, 28 October 2019	• Updated the parts list
v4.2.1, 14 March 2020	• Added tips for making 10+ units at a time