

Hacking



Joe Grand (@joegrand)

Tooth Tunes



www.youtube.com/watch?v=JRUHGmpik24

Tooth Tunes

- Plays two-minute song clip of selected popular artists
- Originally released in 2007 by Hasbro/Tiger Electronics
- Re-released by Arm & Hammer in 2012
- U.S. Patent #6,115,477, Denta-mandibular sound-transmitting system
 - Prior art dates back to 1931: Apparatus for bone audition

Problems



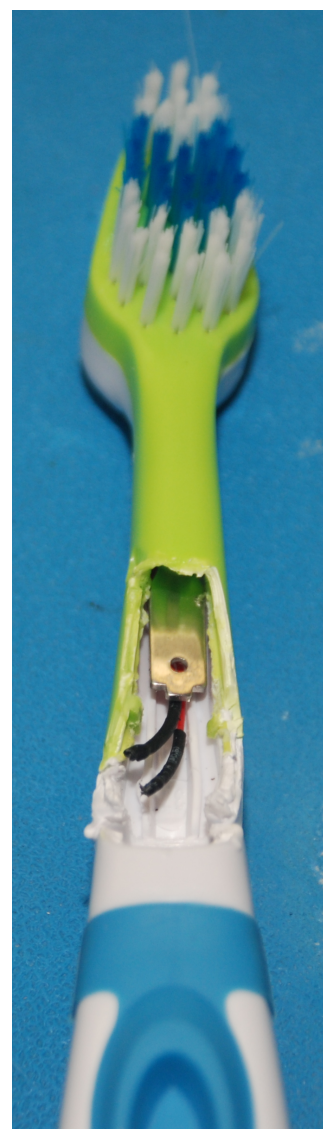
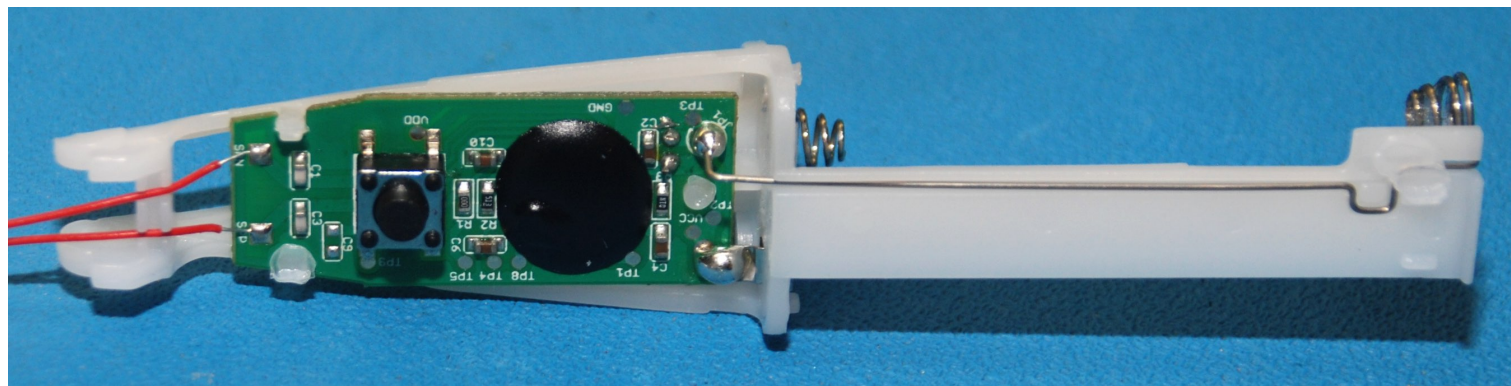
Problems



Timeline

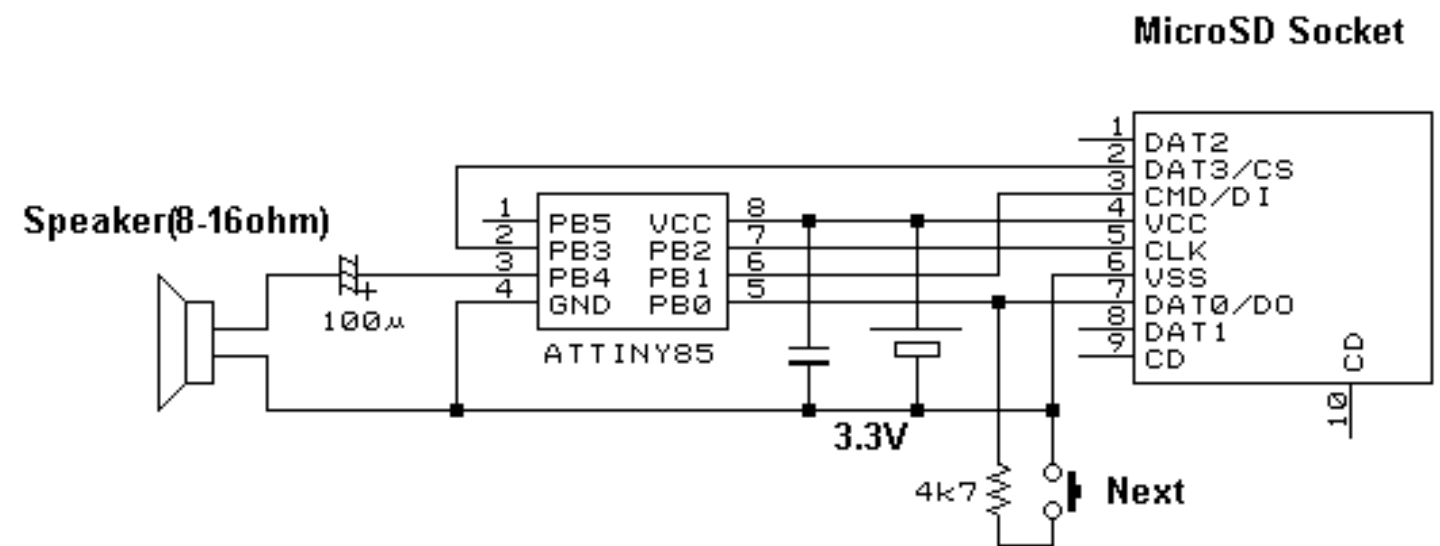
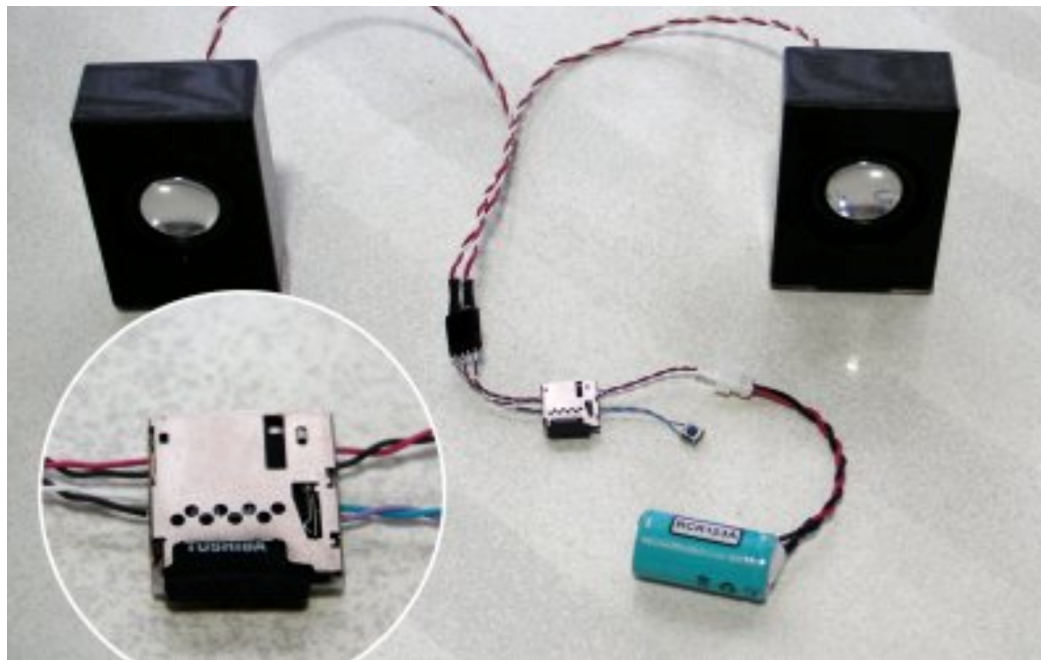
- 2012: Purchased
- 2013: Prototype
- 2014: Moved to Portland
- 2016: Found in a box
- 2017: Hacked!

Tear down

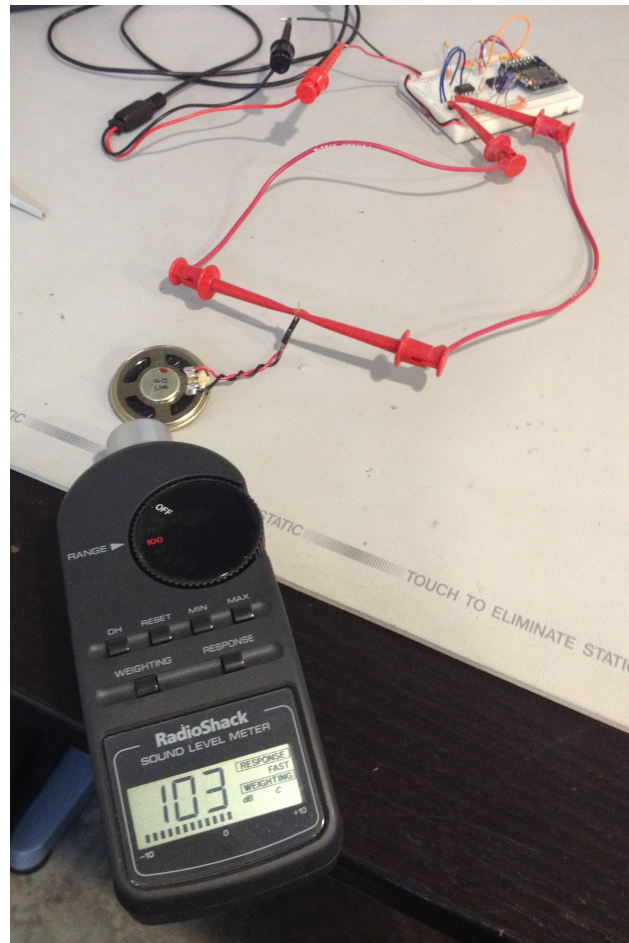
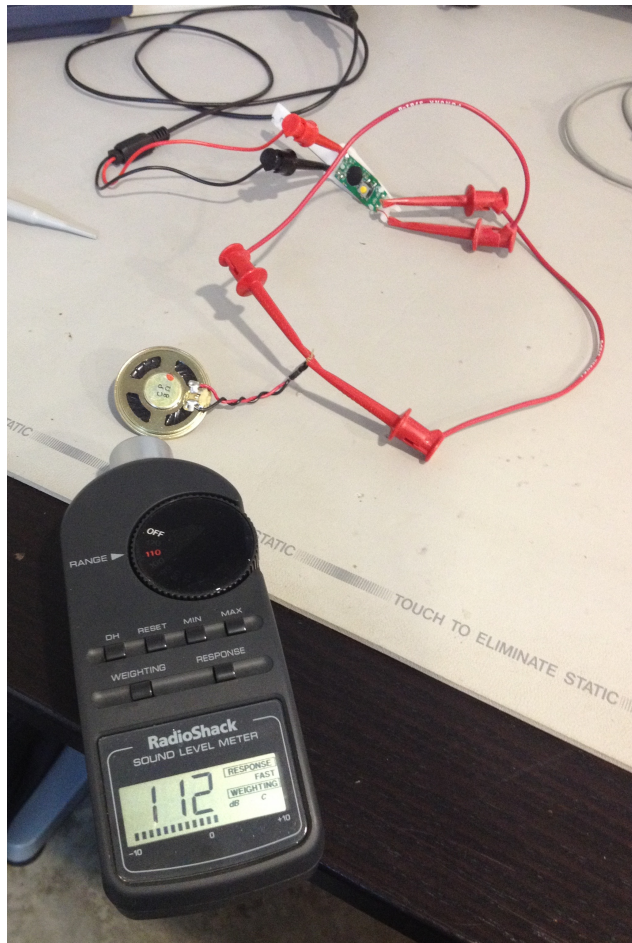
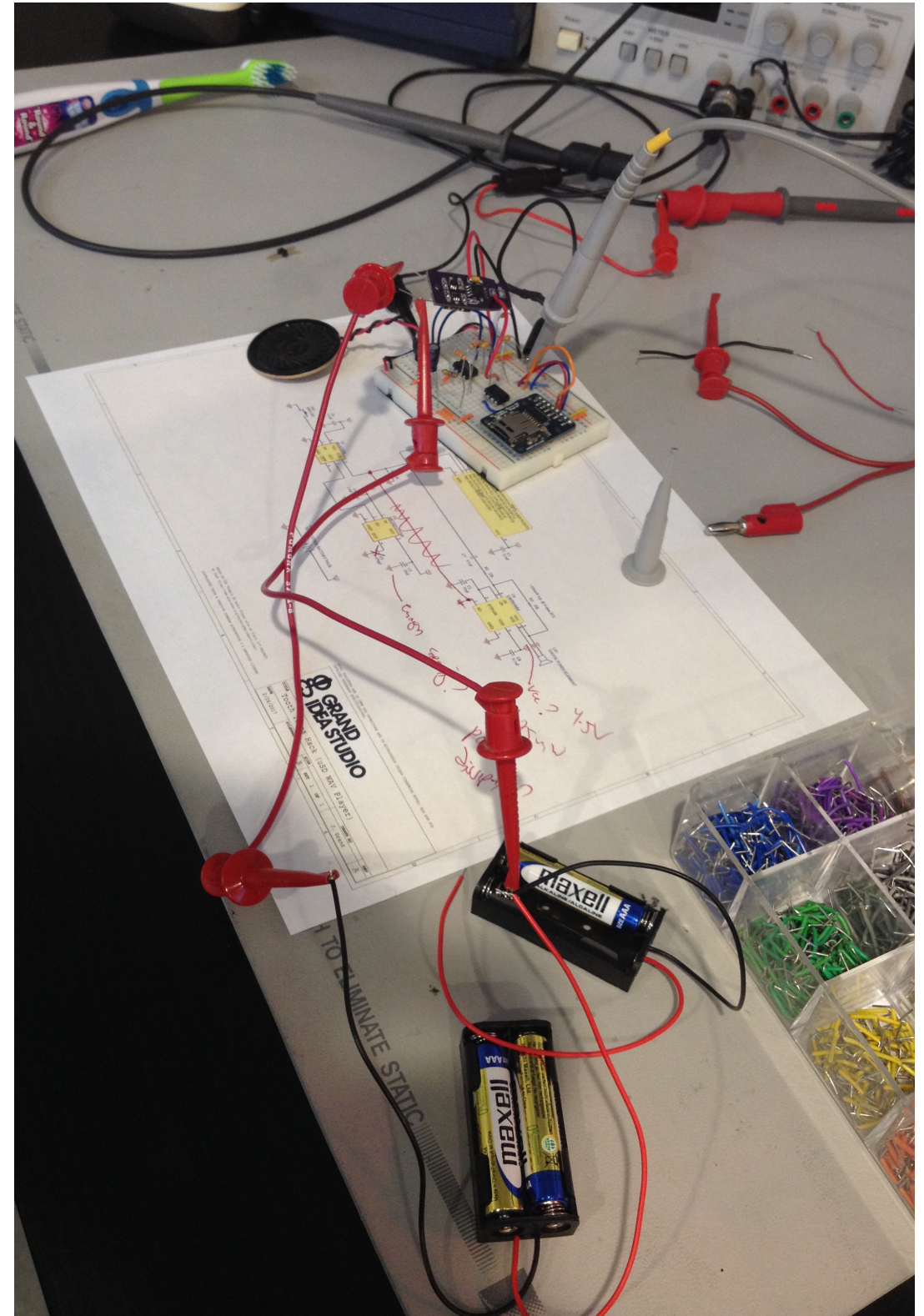
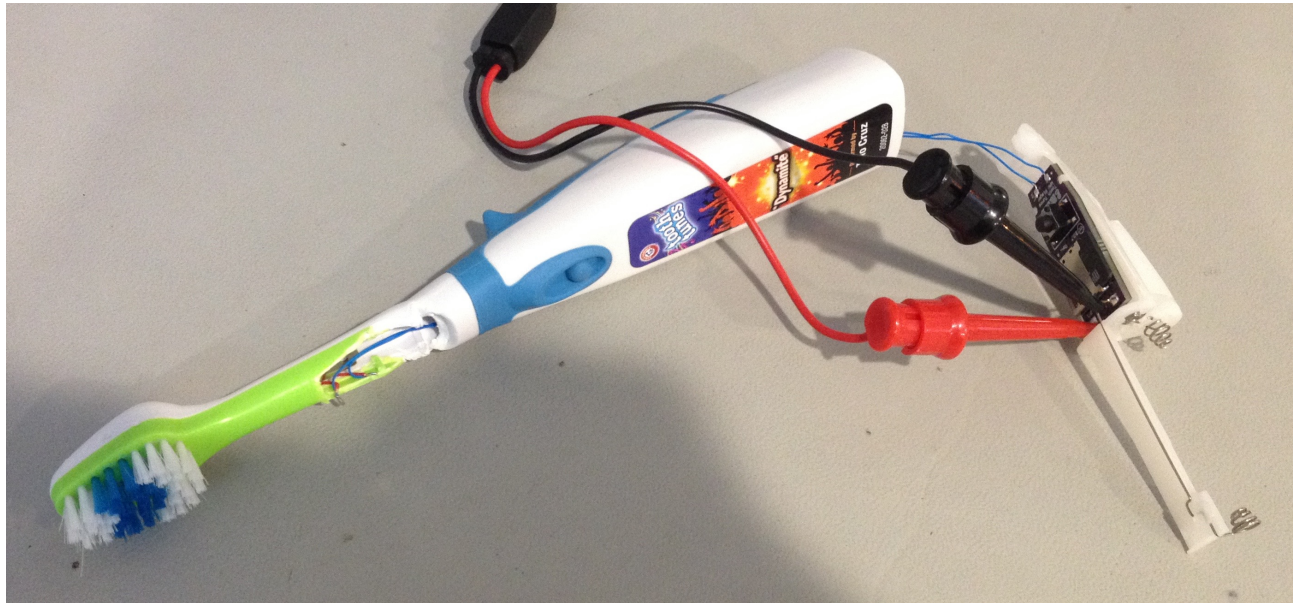


Chan's Simple SD Audio Player

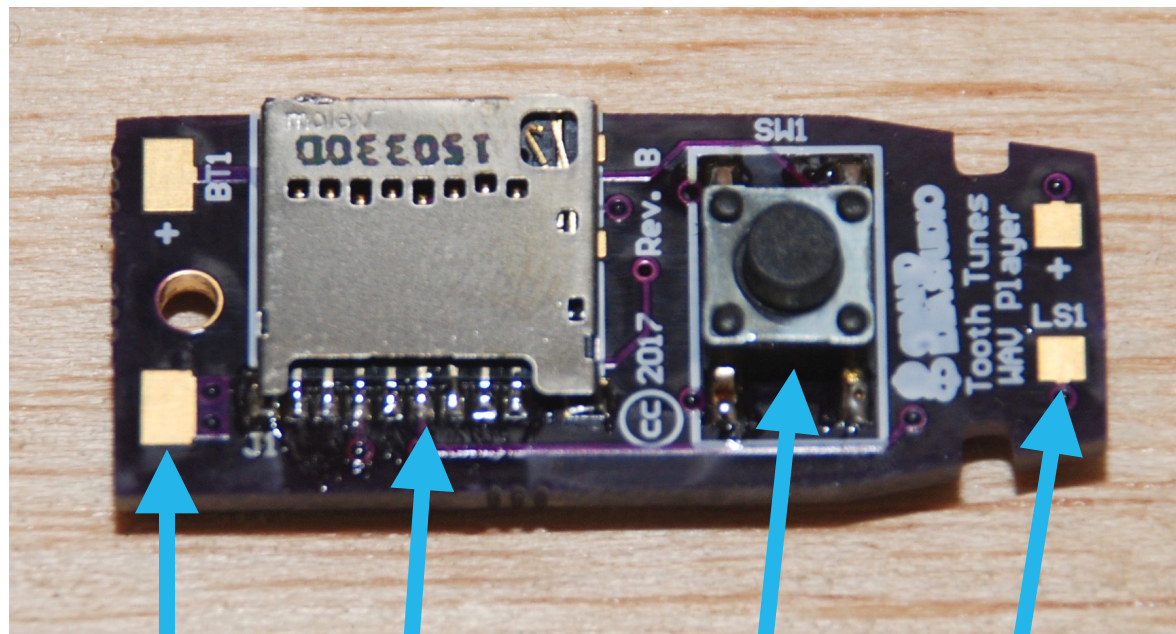
- 2009-2012
- SD/MMC via bit-banged SPI
- Petit-FatFs for FAT (subset of FatFs, < 512 bytes RAM)
- WAV format (Microsoft RIFF), 8/16-bit, mono, 8-48kHz
- <http://elm-chan.org/works/sd8p/report.html>



Testing



Replacement Circuitry

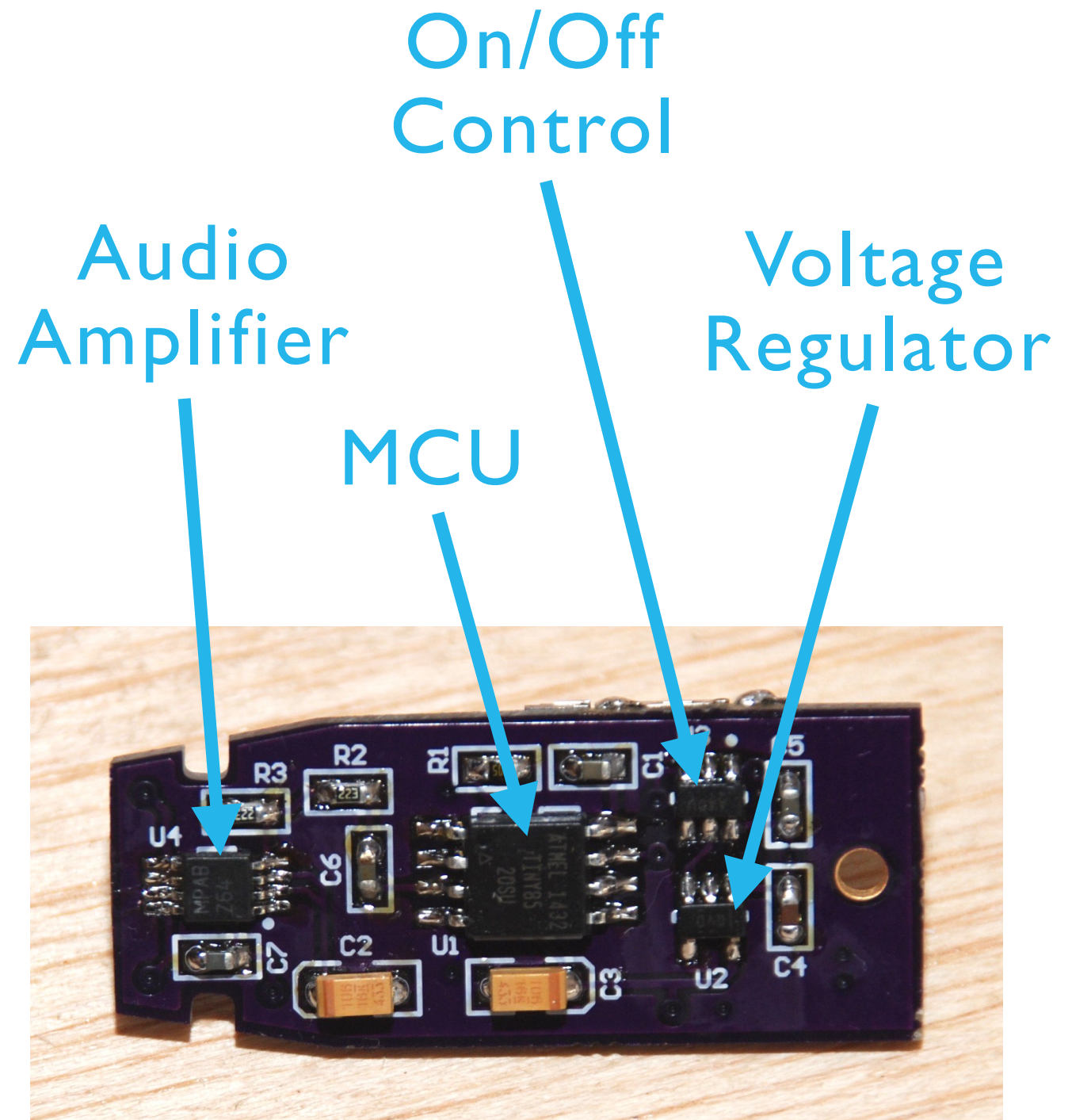


To
Battery
Pack

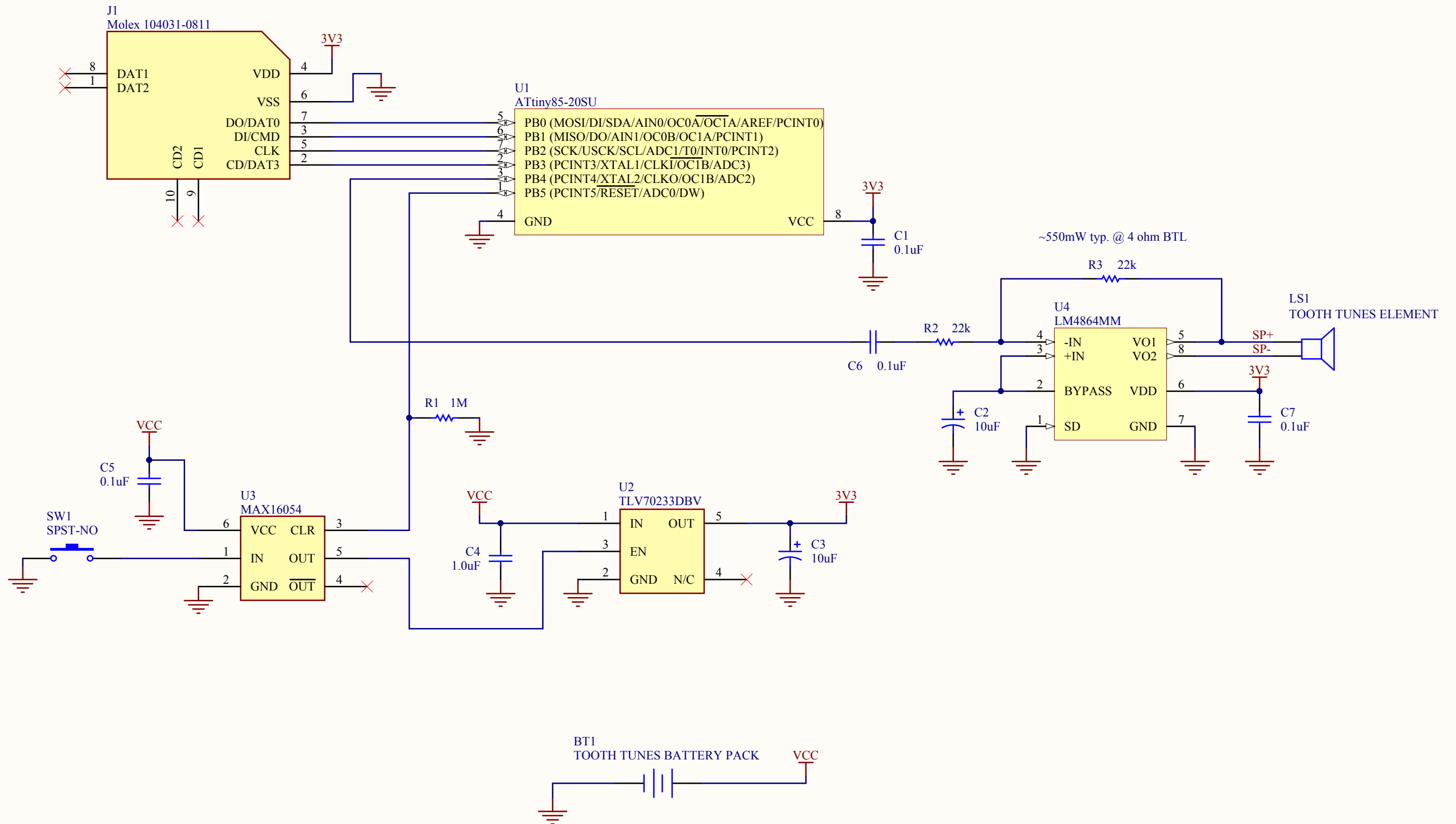
uSD
Card

Button

To
Transducer



Schematic



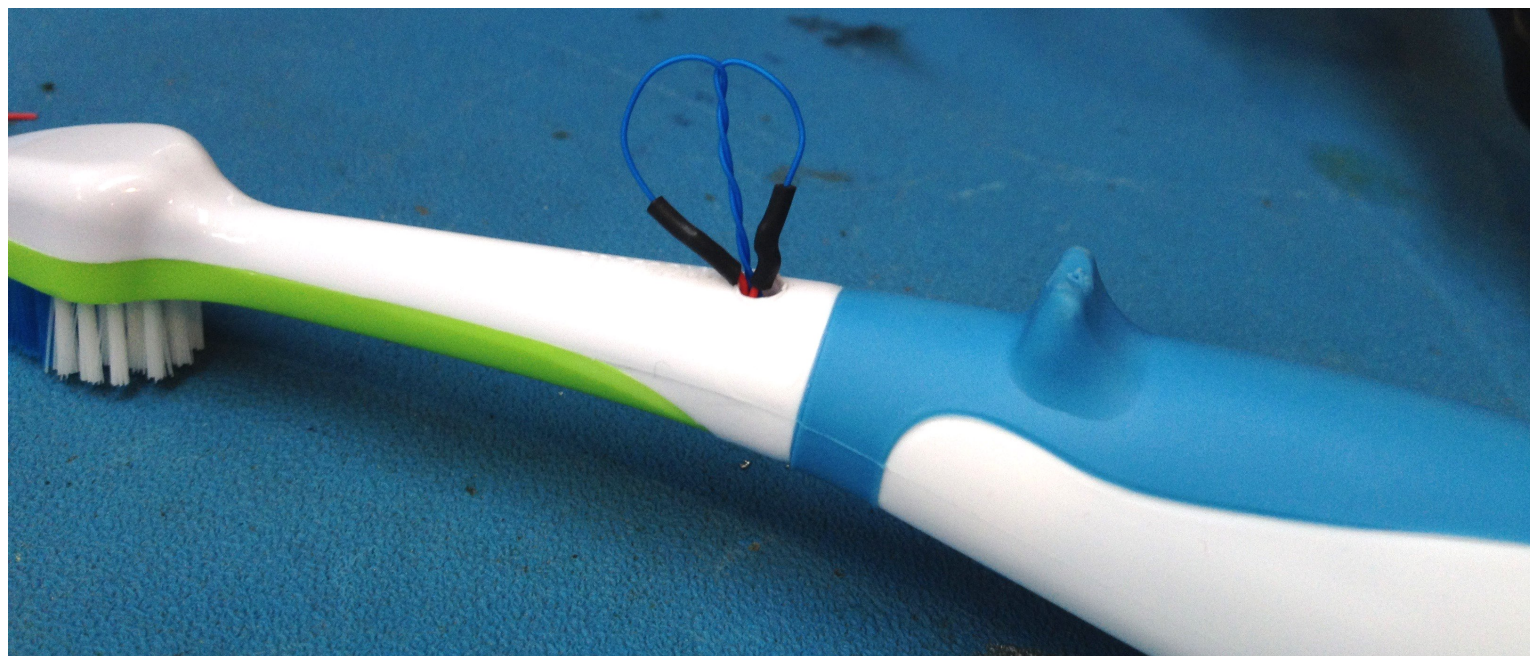
Code Changes

- Added #define to fix depreciated prog_char
- Change main() to play the first detected file only one time (no repeat)
- Change PB5 from external /RESET pin to GPIO (prevents subsequent in-circuit programming)
- Assert PB5 at end of the song, which will cause MAXI6054 to power off circuit
- Removed unused frequency/OSCCAL adjustment code

Code Injection

- Compiled with avr-gcc 4.9.1
 - make -f Makefile_mo
- Programmed with USBtinyISP 2.0
 - avrdude -c usbtiny -p t85 -U flash:w:sd8p_mo.hex:i
 - avrdude -c usbtiny -p t85 -V -U lfuse:w:0xe1:m -U hfuse:w:0x7d:m

The Final Countdown



The Final Countdown



Demonstration!



Possible Enhancements?

- Easier access to microSD card
- Bluetooth connectivity
- Inductive charging

Build Your Own

- www.grandideastudio.com/portfolio/tooth-tunes-hack
 - *** Schematic, BOM, Gerber plots, assembly drawing
- <http://oshpark.com/profiles/joegrand>
 - *** Bare boards

Keep That
Positive Dental
Outlook!



Ken Salerno Photo