ECE 471 Final Project (Sample)
AY3-8910 Chiptune Player

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http://www.deater.net/weave/vmwprod/hardware/ay-3-8910/

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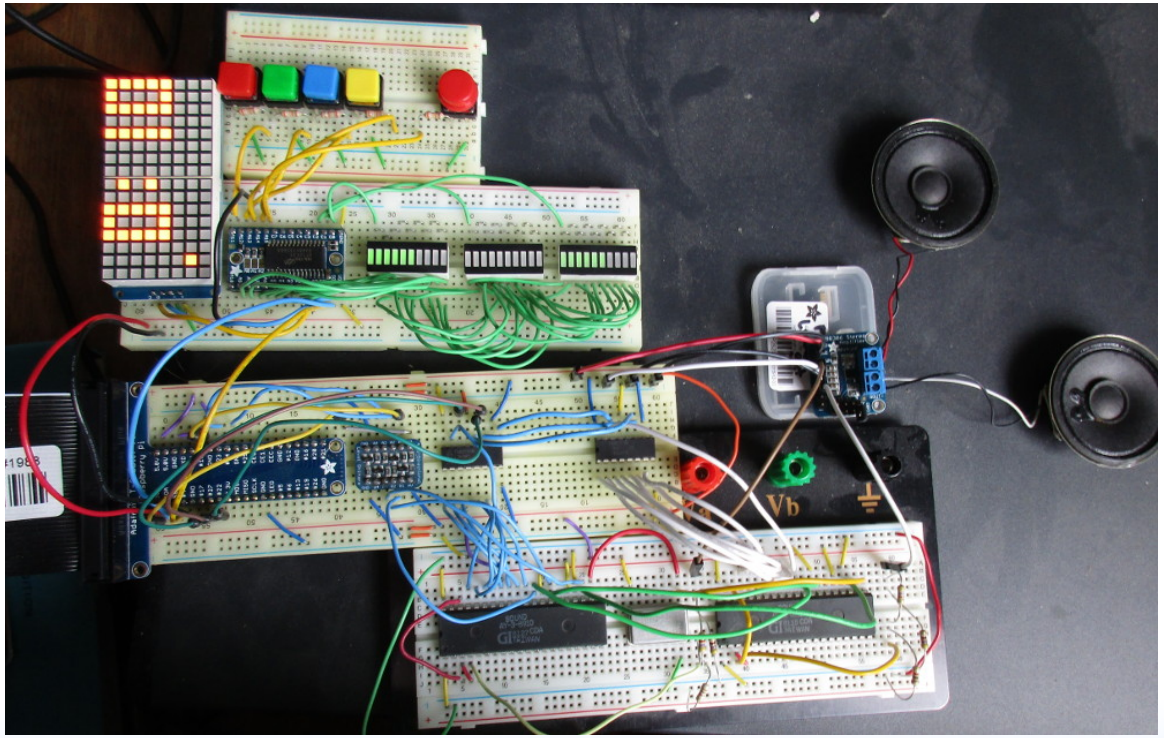
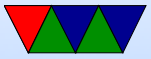
Overview

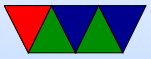
- Raspberry Pi 1980s chiptune music soundcard





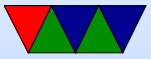
Hardware: Summary

- Raspberry Pi2
  Quad Core Cortex-A7, 1GB RAM
- Dual AY3-8910 sound chips.
  - 1MHz-2MHz,
  - 3-channel square wave generation
  - noise and envelope effects.



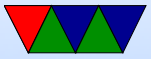
Hardware: Input

- Sound files, stored on Linux filesystem
  - YM5: 50Hz register dumps from Spectrum/Atari compressed via LHA, use library to decompress them.
  - PT3: tracker format, more compact, more trouble
- Input via keyboard and keypad
  - Keypad uses i2c htk1633 with 8 buttons: (play, stop, menu, cancel, next, last, FF, rewind)
- Miscellaneous
  - 1-wire temperature sensor, Real-time clock



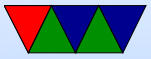
Hardware: Output

- Displays
  - 16x8 LED display, htk1633 adafruit, i2c
  - 6 GYR bargraph LEDs. htk1633 breakout, i2c
  - 3 4x14 alphanum LEDs. htk1633 breakout, i2c
- Audio
  - Dual AY3-8910 chips take parallel input
  - 74HC595 serial/parallel shifters, accessed via SPI
  - Audio out to Adafruit MAX98306 Class-D amp
  - Line out jack, with manual switch



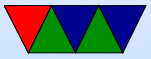
Hardware: Power Concerns

- Plugs into wall, so no battery related power concerns
- Pi2 is low power (less than 3W) so overall power not a concern
- To save power could disable the display and shut down amplifier when idle which might save some power



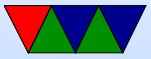
Software Summary

- Running Raspbian Linux
- Coded in C because I like C.
  Quicker to implement than assembly.



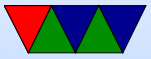
Software Concerns: Real Time

- Audio: firm realtime.
  - really need to hit the 50Hz deadline, moreso when stereo.
  - Harder because sending 5 i2c displays and SPI
  - Increasing the SPI bus speed helped
    (each transaction you send 14 registers, each 8 bit address, 8 bit data for both chips)
  - If you miss deadline can hear it in audio



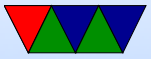
Software Concerns: Code Density

- Code density – not an issue, as the pi has relatively large amounts of RAM and disk.



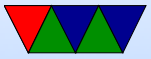
Computer Security

- could in theory compromise over internet or via malicious sound files
- Standard Linux-machine on network security risk
- Hardware itself not really life critical.



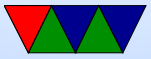
Ethical Concerns

- Does not track user information
- No personal information is logged
- Does try to credit original authors of music
- Users could potentially upload music that was not properly sourced



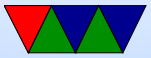
Challenges

- Hitting 50Hz. Use libbcm2835 direct to GPIOs. SPI.
- Decoding the YM5 file format. LHA, and interlaced for better compression. Documentation a bit sparse.
- Also PT3 file format implementation
- 5V to 3.3 level converters
- Initially had trouble getting SPI working
- Tried to get auto-sense of line-out jack. Complicated for many reasons (with most jacks you have to detect impedance which I couldn't get working)



Future Work

- Kiosk mode (standalone, buttons only)
- Try it out in my car.



Demo/Questions

- Was a featured on official Raspberry Pi Foundation Blog
- Also featured on Hackaday
- See also a video:
  `https://www.youtube.com/watch?v=g8rch0i2Evc`