sdmay19-11: MIDI Zeusaphone (Singing Tesla Coil)
Week 5 Report
September 26 - October 3
Client
Joseph Zambreno
Advisor
Craig Rupp
Team Members
Gunnar Andrews — *Webmaster*
Leo Freier — *Interrupter and Micro Controller Lead*
Luke Heilman — *Technical Architect*
William Brandt — *Pulse Width Modulation Expert*
Greg Harmon — *Tesla Coil Construction Expert*
Jacob Feddersen — *Communications Specialist*

Summary of Progress this Report

- Finished POC code
- Updated website
- Started implementing logging in C code
- Created code to output square waves on the PI
- Documented and formated experimental code
- Set up MIDI keyboard to interface with Raspberry PI
- Researched function of the feedback and OCD CT portion of controller circuit

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Past Week Accomplishments

- Finished small POC code for midi in python - Gunnar Andrews
    - I wrote a small program that shows how midi files are encoded then placed into a queue and played through my computer's sound card. My next step may be trying to play streamed input.
- Updated website - Gunnar Andrews
    - Updated the website to show our recent status reports and started updating the folders on the server so I can update our biographies and pictures this week.
- Logging in C code - Gunnar Andrews
    - Starting working on implementing logging capabilities within some of the code that we are currently using. This will come in very handy when we start testing a lot
- Wrote program to output square waves with a frequency - Leo Freier
    - Wrote a C program on the Raspberry Pi to output a 'square wave' on a GPIO pin. So far, it is not as modular as it should be so that will be worked on in the following week or two weeks.
    - The program also runs a parallel thread that tracks the duty cycle of the wave. This was done mainly for practice on threads, but also could prove useful as a failsafe if the duty cycle gets too high that it could damage or destroy the coil.
- Practiced with C sockets - Leo Freier
    - Refreshed myself on C sockets and wrote a program that can read from a local socket.
    - The program was designed to be similar to what we will be doing to communicate from the MIDI

keyboard to the Pi. It will eventually be a combination of both C programs that can create square waves based on a socket.

- Function of The Feedback and OCD CT Portion of Controller Circuit - Greg Harmon
    - Current Transformer Placement
        - The current transformers consist of two 1:33 primary:Controller in series.
        - Current Reduction Ratio of 1: 1089
    - Feedback
        - Purpose is to sync the signal from the interrupter to the oscillating primary circuit
        - This is acheived by clamping the voltage with zener diodes. Then the signal is smoothed out through hysteresis.
        - This signal goes clocks a D flip-flop which alternates it's output depending on the signal from the interrupter.
    - OCD
        - This is used for circuit protection for when the current becomes to large in the primary
        - The stepped down current is rectified and goes to a comparator.
            - If the voltage of the rectified current is greater than what's set at the positive node, then a D flip-flop is cleared and that stops the signal of the interruptor going through the circuit.
- Function of a Music Modulator circuit - William Brandt
    - Methodology for the frequency of the arcs
        - Make sure the duty cycle isn't too high, which will damage the circuit
        - Can adjust duty cycle to make different notes
    - Circuit construction
        - Looked at examples of other circuits
- Document and format experimental code - Jacob Feddersen
    - Driver emulator and MIDI file reader app were in an experimental branch
    - Clean up the code, add comments, and apply readable formatting
    - Create documentation to compile and run code
- Set up MIDI keyboard to interface with Raspberry PI
    - Research USB MIDI interface
        - Drivers generally provided only for Windows, iOS
    - Linux: ALSA - Advanced Linux Sound Architecture
        - Able to function in place of driver for most keyboards
        - No driver needed for Raspberry PI
    - Demonstrated MIDI keyboard connected and recognized by Raspberry PI
- Read MIDI events from keyboard - Luke Heilman
    - Connected keyboard to Ubuntu laptop with USB
    - Again, ALSA was used as the driver
    - Had to pipe keyboard input to recording program with qJackCtl
    - Recording program used was KMidimon
        - Displays all MIDI events sent by the keyboard
        - Filtered out timing events (100's sent a second)

Pending Issues

None to report this week

Plans for Upcoming Reporting Period

- Gunnar Andrews
  - Create fully functioning logging capabilities in code
  - Fully updated website with pictures and bios
  - Keep working on POC code
- Leo Freier
  - Work on modularizing the wave program and have it output frequency based on input
  - Prototype wave with string inputs from a socket
- Greg Harmon
  - Continue research on how the different circuits function and interact
  - Research different ways the driver, interruptor, and bridge are implemented
  - Solidify parts list on audio modulator circuit
  - Begin calculating size of coil.
- William Brandt
  - Continuing research on music modulation circuit including construction of 555 timer.
- Jacob Feddersen
  - Determine how to read MIDI events from keyboard programmatically
  - Research testing framework and automated CI
- Luke Heilman
  - Continue exploring KMidimon program
  - Develop program to output MIDI events received from keyboard
  - Explore automating qJackCtl

Individual Contributions

Team Member	Contribution	Weekly Hours	Total Hours
Gunnar Andrews	• Researched how MIDI files are transmitted • Started to add logging libraries into code for future testing • Updated website with reports and started adding pictures and bios • Pushed POC python code to GitLab	6.5	22
Leo Freier	• Developed program to output square wave on a GPIO pin • Program also tracks duty cycle	6	22
Luke Heilman	• Got MIDI keyboard to test receiving MIDI messages • Found and analyzed open source program to log received MIDI messages	6	25.5
William Brandt	• Learned construction for music modulation circuit	6	15.5

Greg Harmon	● Researched: ○ Use of overcurrent and feedback portions of driver ○ Different ways music modulation can be implemented ● Began updating parts list & prices	9	27
Jacob Feddersen	● Set up keyboard to connect MIDI to raspberry pi ● Document driver emulator and MIDI file reader	6	23

Gitlab Activity Summary

commit f2778de01c26c7845ba84e3a4a67c3619801ab18 (origin/Python_MIDI_testing)
Author: gunnara <gunnara@iastate.edu>
Date: Wed Oct 3 15:31:46 2018 -0500

Sail MIDI file for script to play

commit d1bc0ef582da81ced948418a7baf8e12cff19e72
Author: gunnara <gunnara@iastate.edu>
Date: Wed Oct 3 15:29:55 2018 -0500

Uploaded Python Files. Not used at the moment

commit 2c7dff9f8a1ac406e51f3f4df45eefe34b2a9097
Author: gunnara <gunnara@iastate.edu>
Date: Wed Oct 3 15:28:14 2018 -0500

Add new directory

commit 0220a80c0e8e47b2269d3829d4f2777313e0faa9 (HEAD -> midi-receiver, origin/midi-receiver)
Author: Luke Heilman <lheilman@iastate.edu>
Date: Tue Oct 2 20:58:54 2018 -0500

Add source files for kmidimon

commit 045f63e8c27261d893b78ad51c3ab33736fc9f7f (origin/pi_generate_wave)
Author: Leo Freier <lmfreier@iastate.edu>
Date: Tue Oct 2 19:24:17 2018 -0500

Added previous tests to git.

commit bd3a2218de5937eef82afcc43348eb865df64d01
Author: Leo Freier <lmfreier@iastate.edu>
Date: Tue Oct 2 19:22:18 2018 -0500

Generates waves for GPIO pin 17.

commit df6fa39a0086ff436af395c793cd0a0337cad7f9 (origin/midi-file-player)
Author: Jake <jtfedd@iastate.edu>

Date: Sat Sep 29 17:50:03 2018 -0500

Remove tempo print at start of program

commit d170c1039945b020e69e9841467255f78e63d514
Author: Jake <jtfedd@iastate.edu>
Date: Sat Sep 29 17:48:48 2018 -0500

Add comments

commit 3751663340f01c116b219a8bf3fd4bb2f0b9f2f5
Author: Jake <jtfedd@iastate.edu>
Date: Sat Sep 29 17:38:57 2018 -0500

Correct document formatting

commit 767e07a535347075ce96b5e38e2b5381cb7a892a
Author: Jake <jtfedd@iastate.edu>
Date: Fri Sep 28 14:05:51 2018 -0500

Remove old folder

commit a76443fd7a6ed4df7b3e6ae8ae645aac51c09257
Author: Jake <jtfedd@iastate.edu>
Date: Fri Sep 28 14:04:27 2018 -0500

Rename folder

commit 86809a671bd8bb1f74d4c8071d4296a75230d0a2
Author: Jake <jtfedd@iastate.edu>
Date: Fri Sep 28 14:02:08 2018 -0500

Add MIDI application

commit f7184cbf1c5fec1689c9f70ffce650e95cf87bdd (origin/master, origin/HEAD, master)
Merge: 2991e20 97ce3a2
Author: Jake Feddersen <jtfedd@iastate.edu>
Date: Fri Sep 28 13:53:03 2018 -0500

Merge branch 'driver_emulator' into 'master'

Driver emulator

See merge request sd/sdmay19-11!2