Design of a Theremin with Switchable Audio Effects

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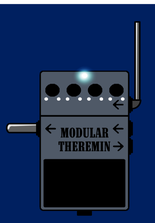


Motivation

Project goals:
- Build a theremin with at least three octaves of pitch range and a clear sound
- Create a cheap alternative for theremins on the market right now, which are upwards of $400
- Build a portable encasement for the instrument that allows for easy use by musicians
- Build a digital effects module on a raspberry pi that alters the tone of the theremin and allows for adjustment of effects
- Design and implement a UI for the digital effects that works on a 7-inch touchscreen

Methods & Materials

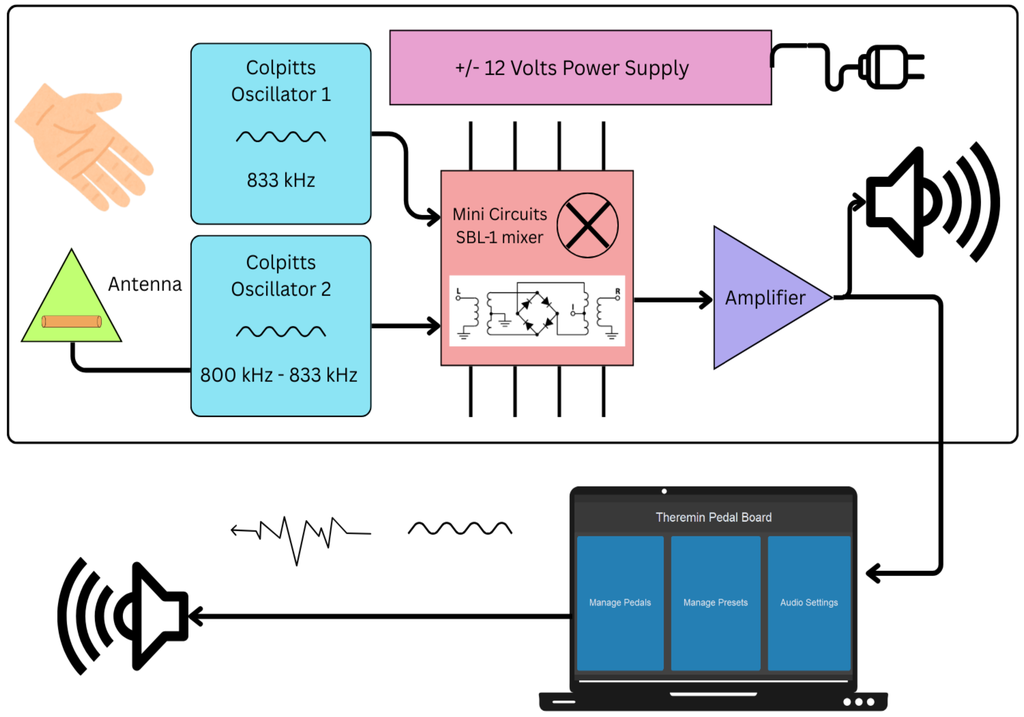
- Theremin constructed on breadboards for prototyping purposes
- PCB in progress
- Mixer: Mini Circuits SBL-1 double balanced heterodyne mixer
- Runs on +/- 12 volts DC
- Box built with acrylic plexiglass
- Digital effects on Raspberry Pi 4
- Hifiberry DAC+ADC
- 7" LCD touchscreen

Results

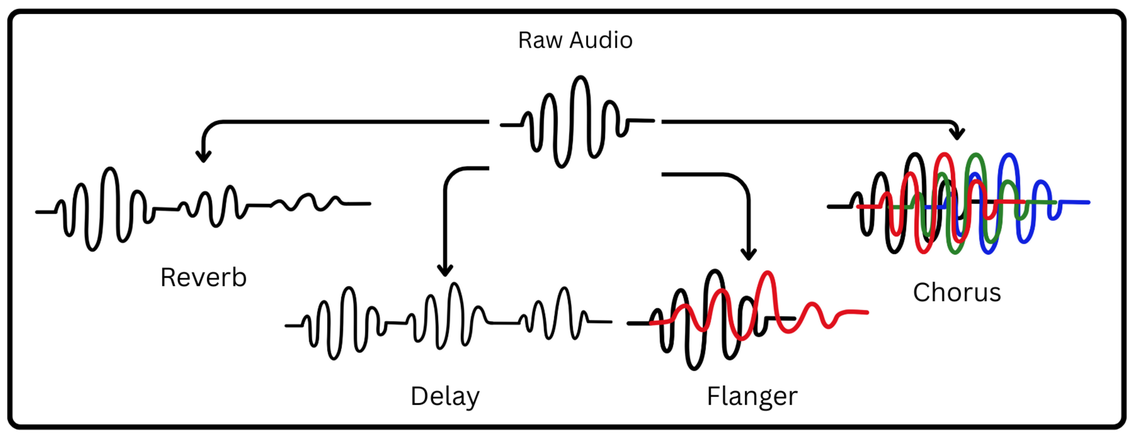
The final product is a theremin in a plexiglass case that has over two octaves of pitch range. A PCB was developed for the circuit but errors in its design caused its implementation to be delayed. Future work could include implementing this PCB as well as developing even more sound modulation effects for the instrument.

With all materials accounted for, this project could be recreated for about $250, which is a significant reduction in price from traditional theremins, especially considering its small scale production. Although this device does not have all the features of the expensive theremins on the market, it provides a cheaper alternative for musicians with a lower budget.

System Block Diagram



Digital Effects



Background

The theremin is an instrument that was developed in 1920 by Russian physicist Leon Theremin while he was researching proximity sensors. It relies on the human body's ability to function as a capacitor and hold charge. Due to the low capacitance of the human body, resonance is only possible at a frequency much higher than that of sound. The theremin uses the nonlinear effects of a mixer to subtract two frequencies resulting in an audible pitch that is adjusted by changing the distance of the hand or body from the antenna, which in turn adjusts the body/antenna capacitor's capacity to store an electrical charge.

Digital Audio Effects

- Reverb: This effect simulates the sound reflections of a space, adding depth and ambiance by creating a series of echoes that decay over time.
- Delay: A time-based effect that plays back the input signal after a short period, creating an echo effect.
- Flanger: Combines the original signal with a modulated + delayed signal, producing a swoop sound as the delay signal shifts in and out of phase.
- Chorus: Like flanging w/ longer delay times and less modulation. This effect creates the illusion of multiple instruments playing the same note.

Acknowledgements

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References

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