Team E2.02 - Electro-Sonic

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Sponsor: Texas State University

TEXAS STATE UNIVERSITY
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Project Description

The Electro-Sonic Analog Synthesizer is a musical device that uses analog components to create sounds that match musical notes.

Key Functions:

- Battery powered
- Keyboard controlled
- Plays through a speaker
- Tuned to A = 440 Hz within 12 musical cents
- Generates a square, triangle and sine wave

Why Electro-Sonic

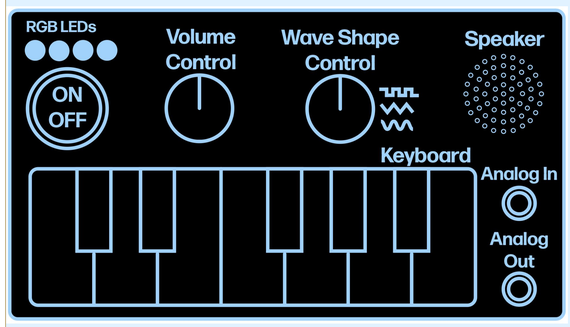
Electro-Sonic provides a physical and interactive display of an analog system and how it relates to music theory.

This synthesizer will be used as a learning tool for Dr. Compeau as he teaches electrical engineering students, as analog systems may be a difficult concept to understand.

Team Members

Project Manager Brandon Ussery | Tim Watson | Fabiana Jaimes | Daniel Sandoval

Design Approach

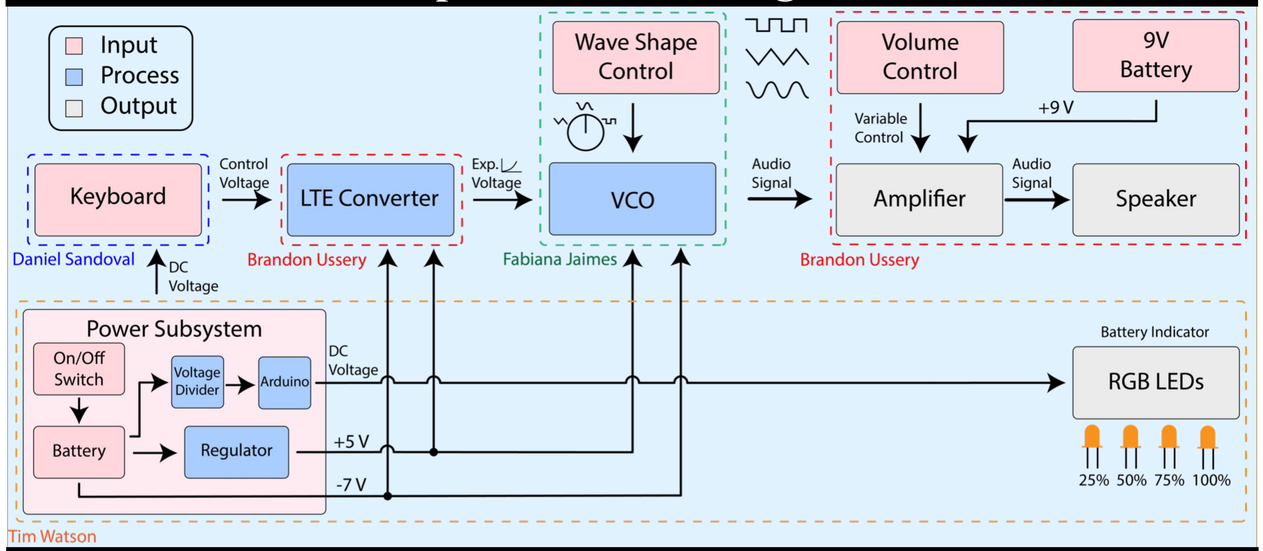


User Interface Concept

Features

- Waveform selection control allows users to select between the three available waveforms: **Square**, **Triangle**, and **Sine**.
- Piano Style Keyboard Controller: **One octave of piano style keys** provided for user input to control sound.
- Internal speaker and volume control: A control knob for the user to control the volume of the speaker: **range of 0 dB to 80 dB.**
- **Battery level indicator:** Four LEDs provide user with remaining battery life.
- **Analog Input:** To allow user to control the device with off the shelf MIDI-controllers.
- **Analog Output:** To allow user to pair with external speakers or further analog modulation devices.

Top Level Block Diagram



Subsystems

Power

- Two packs of 5 AA batteries
- Dual rail (+7.5 V and -7.5 V)
- 1019 Limiter for positive rail
- Arduino battery life indicator

Keyboard

- Input: +5V from Power, Keyboard key pressed as User Input.
- Output: Control Voltage for LTE.
- Purpose: Uses a voltage divider to output a control voltage for the LTE converter as well as take in user input.

LTE

- Input: linear control voltage from Keyboard controller.
- Outputs: exponential voltage curve for the VCO.
- Purpose: to create a 1 volt/octave scale and achieve system tuning.

VCO

- Input: exponential voltage from LTE subsystem.
- Output: Sine, Triangle, Square voltage waves at frequencies ranging from 440 Hz to 880 Hz.
- Purpose: to generate the voltage waves at various frequencies that will create the tones for the notes in the octave.

Speaker

- Input: voltage wave from VCO.
- Output: audible sound wave.
- Purpose: utilizes a class D amplifier, logarithmic potentiometer, and two 8 ohm low sensitivity speakers to output the voltage waves audibly.

Results

Requirement	Measured Data	Result
Min 4hr Battery Life	6 hours 20 minutes worst case, 3 trials	Pass
One octave keyboard following 1v/octave scale	Each key produced the correct associated frequency: when pressing A4 output is 440 Hz	Pass
Monophonic Keyboard	If two keys are pressed a random frequency is produced	Fail
Octave contains A=440Hz	Our First key is A4 which outputs 440Hz	Pass
Generates square, triangle, sine waves	Measured all waves using an oscilloscope	Pass
In tune within 12 cents (+/- 3 Hz)	The A note was measured at 442 Hz	Pass
Internal speaker reaches > 80 dB	Square wave: 81 dB SPL at 1 meter Triangle wave: 80 dB SPL at 1 meter Sine wave: 75 dB SPL at 1 meter	Fail

Acknowledgments

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