Project Proposal

**Objective and Motivation**

Analog and digital components can be used to control frequency and power. We will demonstrate the ability to create, modify, and analyze signal with an analog synthesizer/keyboard. The ability to create and analyze frequency dependent signal is generalizable to a variety of fields such as communication. We will demonstrate signal creation by making a keyboard which will play selected frequencies through a speaker. Audio output is one of the main channels that humans interact with electricity. Our project will demonstrate audio output by using a summing amplifier to combine all the signal we create and power a speaker. Our signal analysis will be to differentiate the output signals into bass, midrange, and high frequency bins and light up LEDs. Creating the frequencies can be done by controlling the inputs to a 555 timer. We also seek to modify the signal using capacitors. By allowing the user to control what parts of the circuit are used the user can distort the signal. Clearly circuits that can respond to a variety of mechanical input have a wide range of uses such as alarm clocks, thermostats, and cruise control. We will implement this utility into our circuit with button’s to control which frequencies are played and how they sounds. Potentiometers can be used in tandem with our switches to allow for not only on/off but volume control of the frequencies and a master volume control.

Overall, we will need to research what power to run each part of the circuit and how amplification will affect signal quality so we know where to have amplifiers. Running the circuit with too low power will make the output inaudible and, too much amplification may make the output very noisy. The maximum specs of each component must be identified so that we do not break components nor clip our signal. We will use 555 timers to create the frequencies; this will require further research on how to create frequencies and their harmonics using timers. We will also research band amplifiers to allow the frequencies we create to be isolated. Using band amplifier in combination with potentiometers to tune the 555 input should allow our output signal to have good resolution, but we need to research how to construct such an idea. We will analyze the output powering LEDs which correspond to frequency ranges. This will require us to analyze multiple ranges simultaneously. We will need to research how to divide the signal in an unbiased way so that band amplifiers can power the LEDs and have the lights correspond to the relative power of each frequency. Finally, we will look into the best way to make keys to select the notes such as transistor switches or pot switches.

**Project Description**

The project will embody signal creation, modification, and analysis with a keyboard synthesizer. We will limit the physical construction by not making any casing and only demonstrating the electronics behind the idea. We hope to leverage timing, band filtering, and amplifying components to create a keyboard with eight sets of switches corresponding to eight frequencies and their harmonics. We would also like to have capacitors behind switches to create optional distortive effects. Finally, we will use filters amplifiers and LEDs to create a light up output for analyzing the frequency composition of the circuit.

We will test our circuit with a oscilloscope and tuner to see what frequencies are created by the 55 and what audio signal the speaker outputs. We will test the filters and amplifiers by using the oscilloscope to measure the gain throughout the circuit. The distortive capacitors will be tested by using the oscilloscope to observe the shape of the waves in the distortive part of the circuit. We do not expect our synthesizer to perform well compared to industry standard keyboard synthesizer, but we will define success as having audibly differentiable notes, octaves, and distortion, as well as light up display that corresponds to what frequency is played.

**Parts List**

15 556 timers

**Schedule**