555 Timer

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Purpose:

To use the control pin in the 555 Timer in order to change the threshold and trigger voltages, and to make a Voltage Controlled Oscillator (VCO).

Procedure:

1) Build the VCO circuit as shown in Fig. (1) using a 1 kOhm potentiometer input. The potentiometer in series with C_1 changes the frequency by changing the rate at which the capacitor charges, and the potentiometer on pin 5 (control) changes the frequency by changing the voltage at which the on and off transitions occur. Once the VCO is working properly replace the potentiometer at pin 5 with a variable power supply, and the potentionmeter in series with C_1 will remain as parameter for “tuning”.

2) Now we would like to control the circuit with a photodiode, and well be using an amplifier circuit previously built from the LabVIEW part 1 module. Recreate the photodiode circuit and connect the output to the control pin of the 555 timer in place of the potentionmeter.

3) Build your complete circuit and demonstrate it by playing a recognizable tune.

4) Build one additional 555 Timer circuit from either the 555 website linked in the course home page or from a text reference available in room 108, such as “Timer, Op-Amp, and Optoelectronic Circuits and Projects” by Forrest Mimms III.

Data:

1) The VCO circuit as represented by Fig. (1) was built, and after verifying that it was operating properly, the potentiometer at the control pin was replaced with a variable power supply. The variable power supply made it much easier to control the frequency that was best for our ears to bleed.

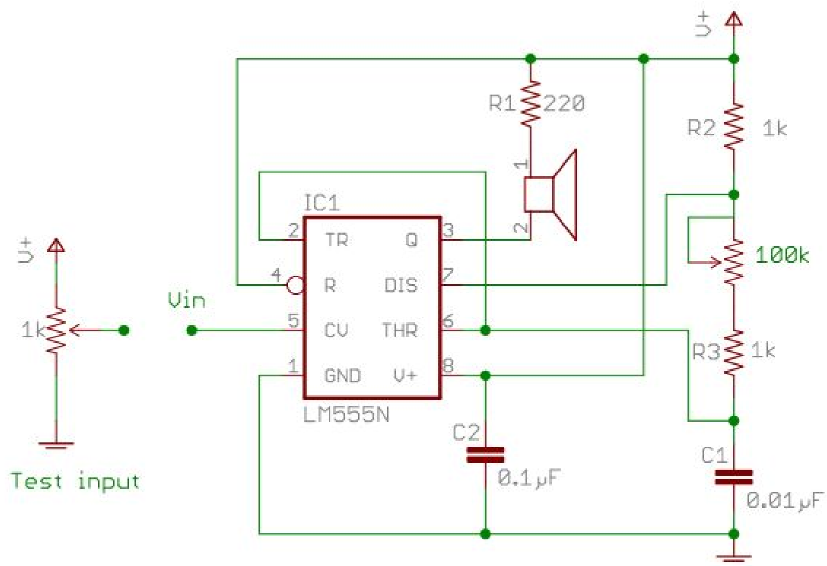

Figure 1: VCO Circuit

2) Next we replaced the variable power supply with a photodiode circuit once built in the module LabVIEW Part 1, shown by Fig.(2). This circuit controlled the frequency of the photo-theremin by varying the voltage at pin 5 on the 555 Timer. The amount of light that the photodiode measured changed the output voltage from the Op-Amp circuit, thus acting as a light interactive variable voltage supply. A photo of our completed circuit is shown in Fig. (3).

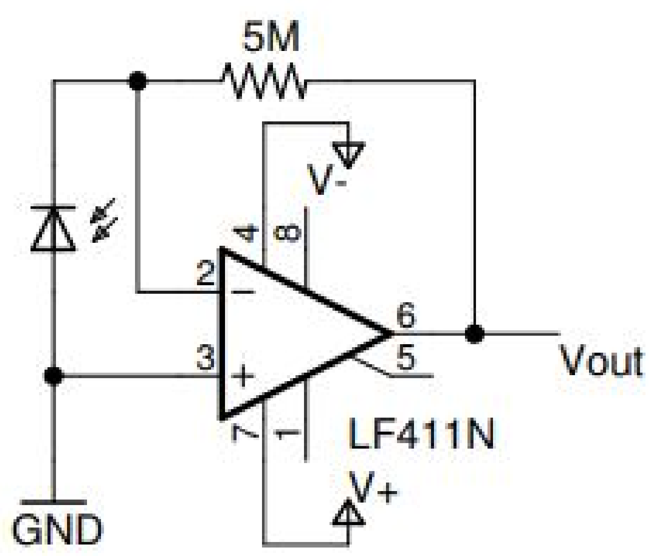

Figure 2: Photodiode on Amplifier.

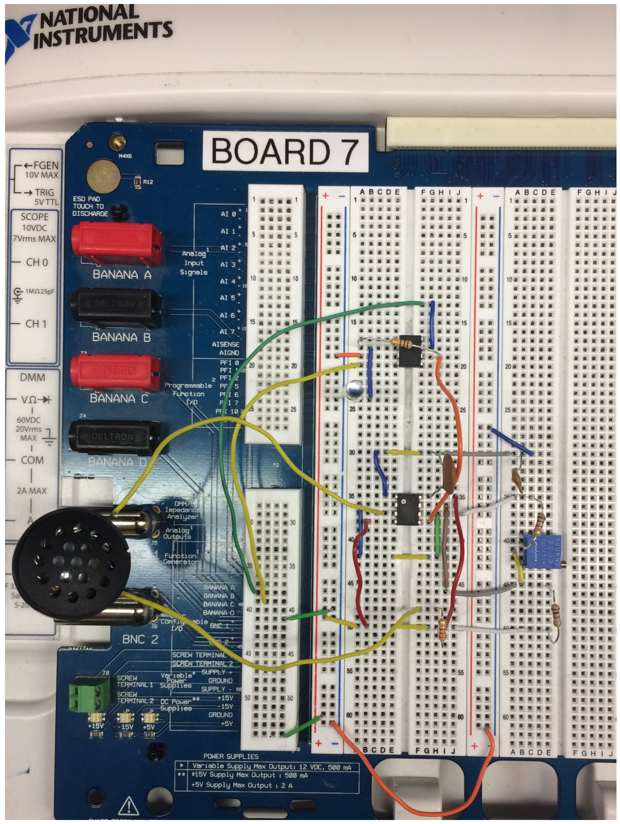

Figure 3: VCO circuit with Photodiode circuit as variable voltage supply.

3) This part of the lab was not actually completed, because our instrument was worse than bagpipes.

4) The circuit that Forrest and I decided to build was a Touch-Activated Switch, and was referenced from "Timer, Op-Amp, and Optoelectronic Circuits and Projects" by Forrest Mimms III. The schematic for the circuit is shown in Fig. (4) and an actual photo of our completed build of the Touch-Activated circuit is shown in Fig. (5).

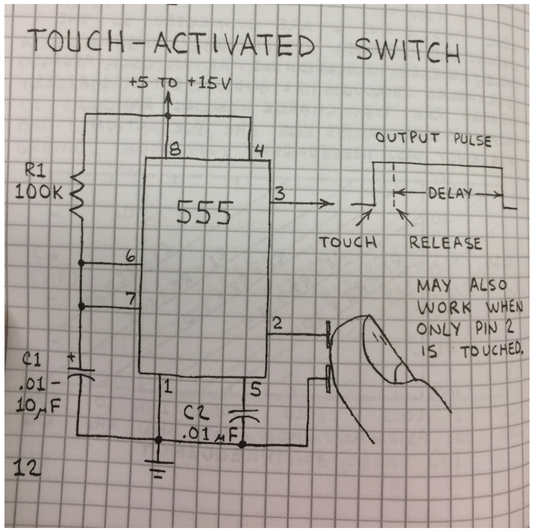

Figure 4: Touch-Activated Switch Schematic.

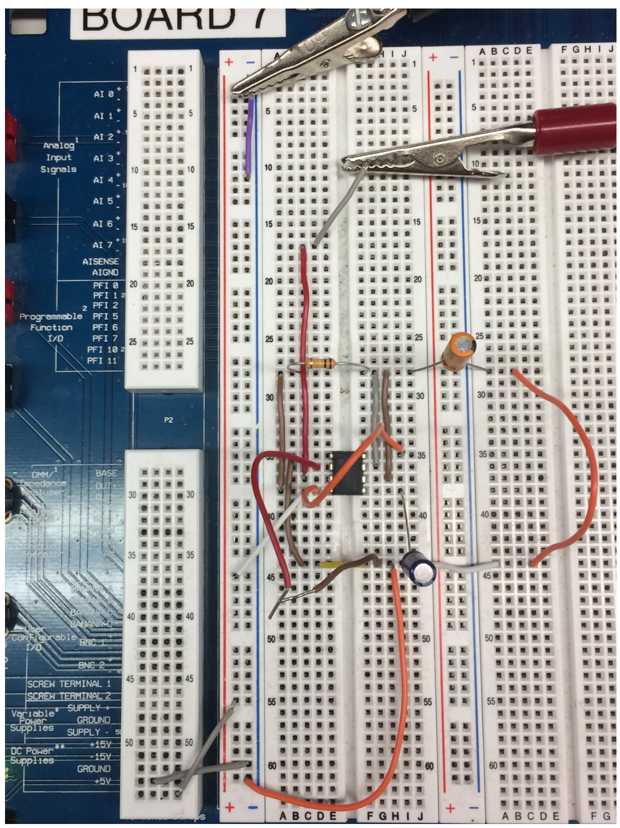

Figure 5: Touch-Activated Switch Build.

Theory Questions:

1) It's possible that your theremin produces higher frequencies for lower light levels. How would you change your circuit so that increasing the light level increased the frequency?

By changing the voltage applied on pin 8 (V_{cc}) from 15 V to 5 V you reverse the direction at which the variable voltage is approaching or fleeing from the voltage at pin 8, meaning the voltage across the photodiode must be greater than 5 V. Reversing the direction at which these voltages are separated changes how the photodiode responds to light, whether more or less light increases the frequency that the 555 on/off transitions occur.

2) The sound quality of the theremin is low, partly due to the fact that the output to the speaker is a square wave (with high frequency Fourier components) rather than a smooth sinusoid. How would you change this?

The square wave output that goes to the speaker could be modified by a type of low pass filter such as an integrating circuit. The square wave will then change into a triangle wave, which will have a more continuous slope to its min and max voltage allowing some smoothing to take place. Attaching another integrating circuit to the output of the first one would integrate once again yielding a sinusoidal waveform allowing even more smoothness. It appears from past experimentation that the amplitude of these output waveforms takes a decrease after passing through an integrating circuit, so after smoothing the square wave as previously suggested, amplifying it with a non-inverting Op-Amp circuit could help regain some of the lost voltage.