A Simple Theremin

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This simple version of the pitch theremin consists of a fixed oscillator and variable oscillator, as well as a "mixer" and a driver to produce sound in the speaker.

The fixed oscillator is made using the IC 555 timer, with the frequency dependent on the resistors attached to pins 6,7, and 8, as well as the capacitor attached to pin 6. The 555 timer was chosen since a potentiometer could be added to one of the resistors, which makes changes to the "fixed" frequency to match the variable oscillator easier. The output is then passed through a low pass filter with a cutoff frequency of about 130 kHz, to adjust for a more triangular shape (by removing some higher harmonics) and an op amp follower to act as a buffer to the mixer. All op amps are connected to +/- 12 V rails and decoupling 0.1 uF capacitors.

The variable oscillator is a LC Colpitts oscillator consisting of an LC tank and NPN transistor amplifier. This option was chosen since the placement of the antenna would be straightforward, in parallel with the 100 pF capacitor, without the need for an additional LC tank. The frequency varies between about 245 to 250 kHz depending on the hand placement. An additional op amp follower acts as a buffer to the mixer.

Initial attempts for the mixer involved polarizing an NPN transistor outside its linear zone, which multiplies the waves, resulting in a signal containing both the sum and difference of the input signals. This method was inconsistent and didn't always result in the expected output signal. The alternative method used here is a summing op amp, which outputs a wave with a beat frequency of the two input waves. An envelope detector is then used to extract just the beat frequency and passed through a passive low pass filter with a cutoff frequency of about 11 kHz. Finally, the wave is passed through a push-pull driver to amplify the signal (gain of about 3) and

power the speaker. An additional 4.7 nF capacitor right before the speaker creates an additional low pass filter with a cutoff frequency of about 1 kHz.

The theremin is sensitive to hand placement with clearly audible changes in pitch, but the changes are not always consistent or controlled. Additionally, the final wave still consists of many harmonics, so the sound is not clear. Potential changes in the future include retrying the transistor as the heterodyne mixer, as well as adding more effective filters like an active filter using an op amp.