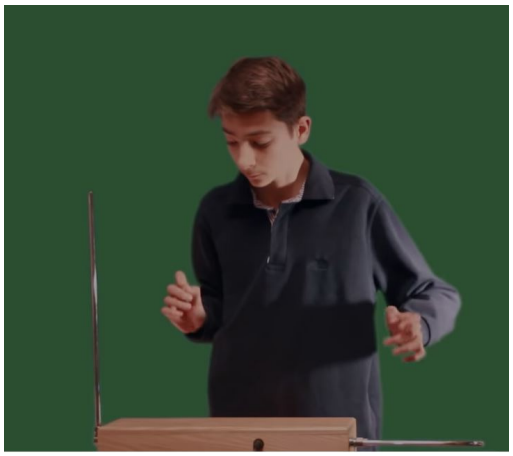
ECE 376 - Homework #10

Timer1 Capture / Compare. Due Monday, November 13th
Please email to jacob.glower@ndsu.edu, or submit as a hard copy, or submit on BlackBoard

$65 Theremin

A Theramin is a musical instrument which is controlled by moving your hands around the device.

- One hand controls the frequency (this homework set)
- The other hand controls the amplitude (not part of this homework set)



https://youtu.be/PjnaciNT-wQ

Timer1 Capture

Write a C program which uses Timer1 Capture along with an ultrasonic range sensor to measure the distance to an object that is 10cm to 30cm away from the sensor. The range measurements should be taken every 10ms (100Hz).

1) Give a flow chart for this program

2) Wrte the C code using Timer1 Capture

3) Record and plot 10 seconds (or more) of the distance measurements at
   - 10cm
   - 30cm

(note: use the serial port to record this data. Just include the plot of your data, not all 1000+ data points)

4) From your data, determine
   - The mean and standard deviation at 10cm
   - The mean and standard deviation at 30cm

Note: Keep your data. You'll need it for homework set #11

5) Demo: in person or on video. Demo can be combined with problem #10.

Timer1 Compare

Use Timer1 Compare iterrupts to output

- 130.81Hz at 10cm (C3)
- 261.63Hz at 30cm (C4)

7) Determine the relationship

$$N_2 = f(N_1)$$

where

- N2 is the number of clocks between interrupts to generate notes C3 to C4, and
- N1 is the number of clocks for an object that is 10cm to 30cm away (problem 1-4)

8) Give a flow chart for your resulting code

- Measure distance using Timer1 Capture1
- Generating frequency using Timer1 Compare2

9) Test & Validation: Collect data to verify

- Distance is measured correctly from 10cm to 30cm
- The frequency output is correct from 10cm to 30cm

10) Demo. In person or on a video.