ECE 376 - Homework #10

Timer1 Capture & Compare - Due Monday, April 14th

Cat Off the Table

1) Requirements: Specify the input, outputs, and how they relate. Also specify which interrupts you'll be using and their funcitons.

Inputs

- Range sensor measuring 10cm to 100cm

Outputs

- Speaker
- LCD display

Relationship:

- Measure the distance to the nearest object.
- If something (cat) comes within 20cm, turn on an alarm at 220Hz
- Once the cat moves more than 25cm away, turn off the alarm

Interrupts Used

- Timer0: Output a 50Hz square wave to trigger the range sensor every 20ms
- Timer1: Measure time since reset to 100ns
- Timer2: Output 220Hz when the alarm is on
- Capture1: Measure the pulse width from the range sensor to 100ns

2) C Code & Flow Chart

Code Size:

```
Memory Summary:
    Program space        used  120Ah (  4618) of 10000h bytes   (  7.0%)
    Data space           used   49h (    73) of   F80h bytes   (  1.8%)
    EEPROM space         used    0h (     0) of   400h bytes   (  0.0%)
    ID Location space    used    0h (     0) of     8h nibbles (  0.0%)
    Configuration bits   used    0h (     0) of     7h words   (  0.0%)
```

Interrupt Service Routine:

```
void interrupt IntServe(void)
{
   if(TMR0IF) {
      TMR0 = -12500;
      RC0 = !RC0;
      TMR0IF = 0;
      }
   if (TMR1IF) {
      TIME = TIME + 0x10000;
      TMR1IF = 0;
      }
   if(TMR2IF) {
      if(ALARM) RC3 = !RC3;
      else RC3 = 0;
      TMR2IF = 0;
      }

   if (CCP1IF) {
      if(CCP1CON == 0x05) {
          TIME0 = TIME + CCPR1;
          CCP1CON = 0x04;
          }
      else {
          TIME1 = TIME + CCPR1;
          CCP1CON = 0x05;
          dT = TIME1 - TIME0;
          }
      CCP1IF = 0;
      }
    }
```

Main Loop:

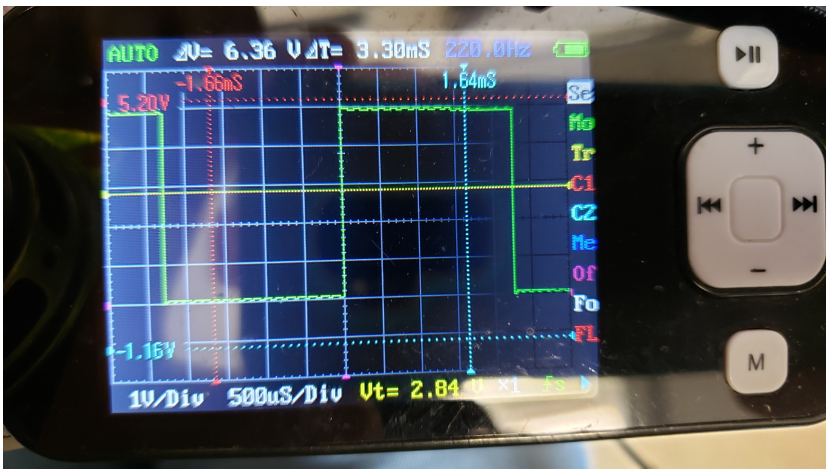
```
   while(1) {
      mm = dT * 0.01715;
      if(mm < 200) ALARM = 1;
      if(mm > 250) ALARM = 0;

      LCD_Move(1,8);  LCD_Out(ALARM, 1, 0);
      LCD_Move(1,0);  LCD_Out(mm, 4, 0);
      }
```

3) Validation: Collect data to verify

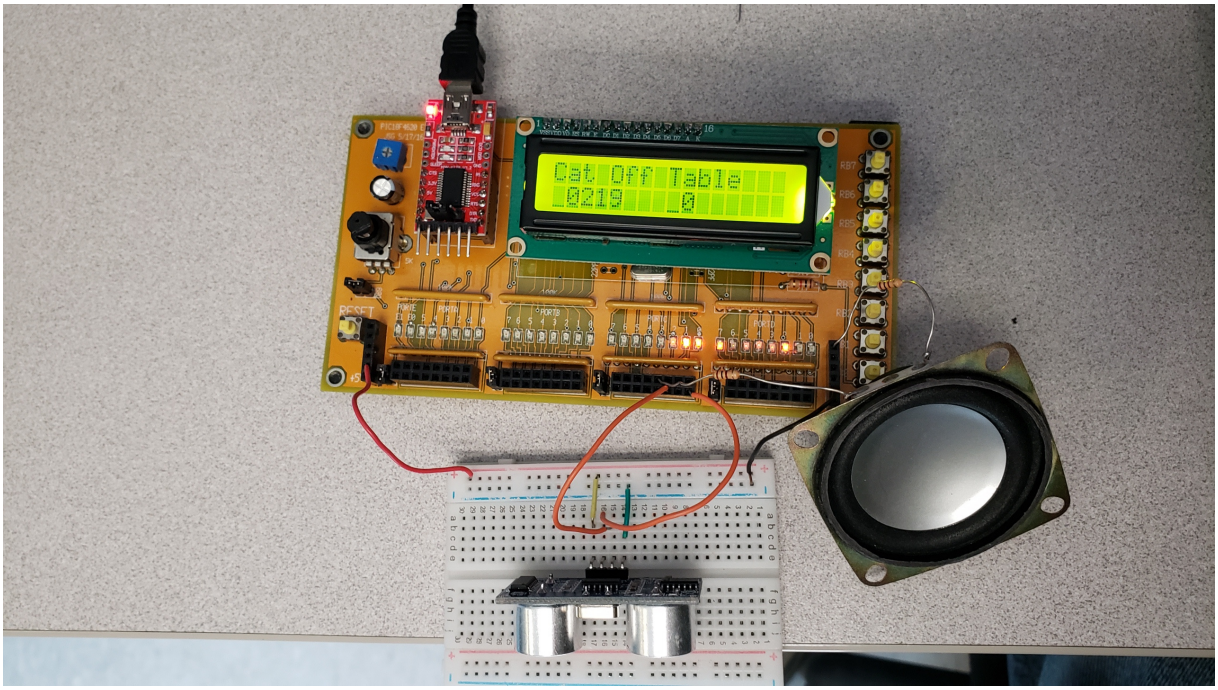
- The range sensor is working
- Interrupts are working
- Your C code is working

Range	250mm	200	150	100	50
Measured	243mm	206	154	110	56

- Alarm turns on at 196mm
- Alarm turns off at 253mm
- Timer2 outputs a frequency of 220.0Hz
- Timer0 outputs a frequency of 50.05Hz



4) Demo (video or in-person)



Timer1 Compare

4) Requirements:

Same as before but use Timer1 Compare to output 220Hz precisely when the alarm is on

5) C Code & Flow Chart

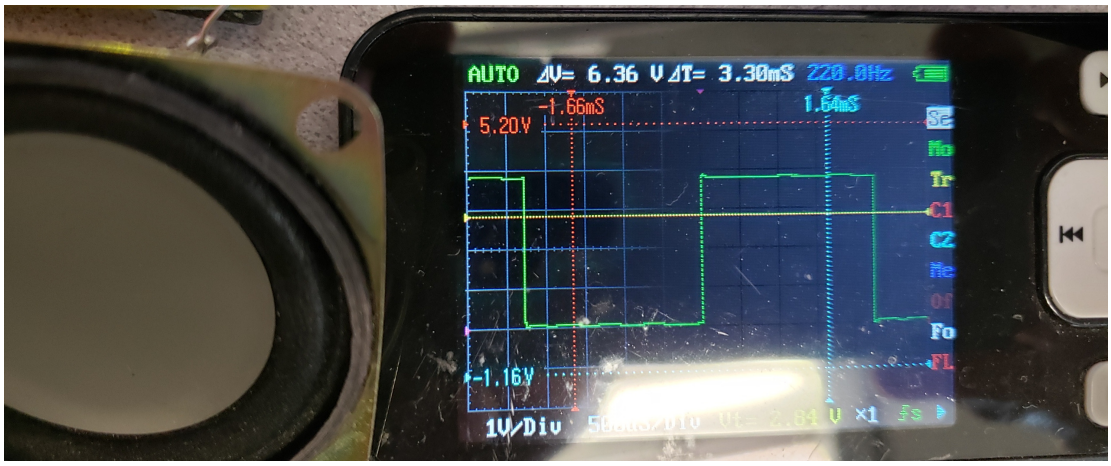
Same as before but add Timer1 Compare2 interrupt controlling pin RC2

- Timer1 Compare2 always runs at 220Hz (22727 clocks)
- If the alarm is on, switch between setting and clearing RC1
- If the alarm is off, no change on RC2

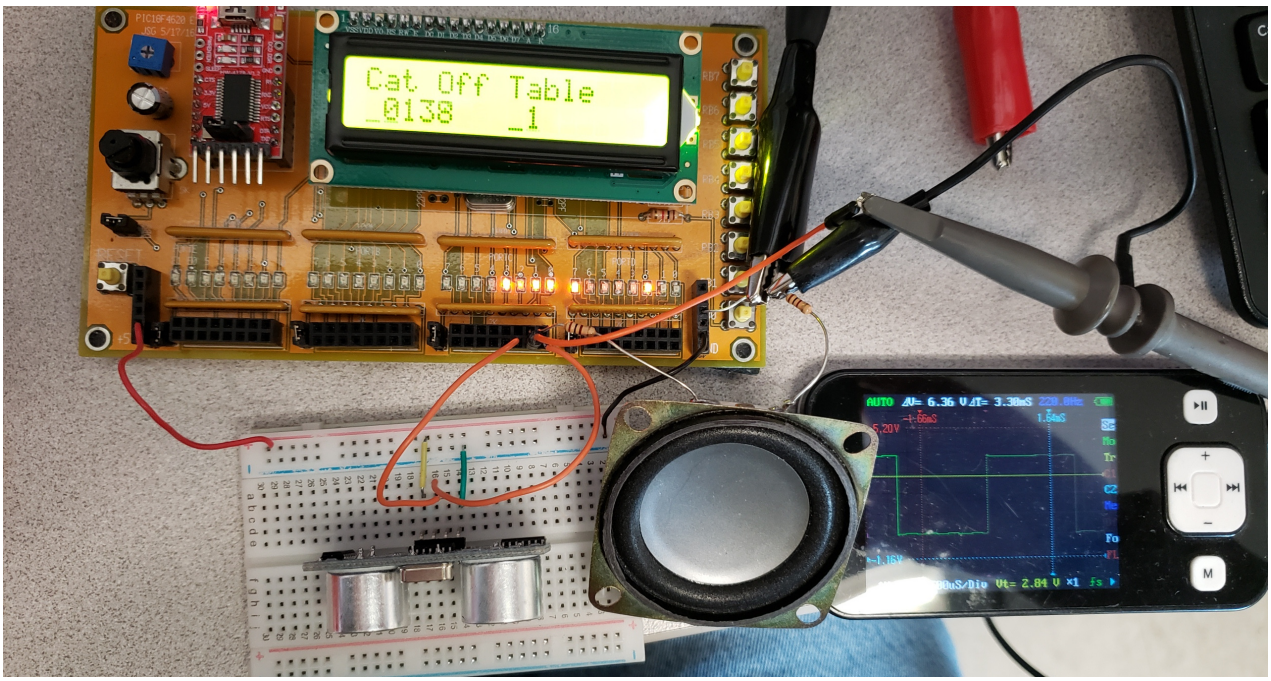
```
if (CCP2IF) {
   CCPR2 += 22727;  // 220Hz
   if(ALARM) {
       CCP2CON &= 0xFD;
       CCP2CON ^= 0x01;
       }
   else CCP2CON |= 0x02;
   CCP2IF = 0;
   }
```

6) Validation: Collect data to verify that Timer1 Compare is working correctly

Same as before but when the alarm is on, RC1 outputs 220.0Hz



7) Demo (video or in-person)


Cat Off Table
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