

ECE 376 - Homework #4

C Programming and LCD Displays. Due Monday, September 27th

Please make the subject "ECE 376 HW#4" if submitting homework electronically to Jacob_Glower@yahoo.com (or on blackboard)

1) Determine how many clocks the following C code takes to execute

- Compile and download the code (modify working code and replace the main loop)
- Measure the frequency you see on RC0 (toggles every loop).
 - Use an oscilloscope - or -
 - Connect a speaker to RC0 with a 200 Ohm resistor and measure the frequency with a cell phone app like Piano Tuner
 - RC1 is 1/2 the frequency of RC0, RC2 is 1/4th, RC3 = 1/8th, etc
- The number of clocks it takes to execute each loop is

$$N = \left(\frac{10,000,000}{2 \cdot \text{Hz}} \right)$$

1a) Counting mod 256

- note: if using your cell phone to measure the frequency, you might have to try different pins on PORTC until you get one in the audio range. Each pin is 1/2 the frequency of the previous pin

```
unsigned char i
while(1) {
    i = (i + 1) % 256;
    if(i == 0) PORTC += 1;
}
```

1b) Counting mod 255

```
unsigned char i
while(1) {
    i = (i + 1) % 255;
    if(i == 0) PORTC += 1;
}
```

1c) Integer Multiply

```
unsigned int A, B, C;
unsigned char i;
A = 0x1234;
B = 0x5678;
while(1) {
    i = (i + 1) % 256;
    if(i == 0) PORTC += 1;
    C = A*B;
}
```

1d) Floating point multiply

```
float A, B;
A = 1.0002;
B = 0.02;
while(1) {
    i = (i + 1) % 256;
    if(i == 0) PORTC += 1;
    B = B * A;
}
```

\$65 Cat Nap Alarm

- 2) Write a C program which turns your PIC into an alarm clock with a resolution of 100ms
 - On reset, TIME is set to 0 (0.0 seconds)
 - RB0: When you press RB0, TIME is reset to 150 (15.0 seconds)
 - Every 100ms, TIME is decremented by one, stopping at 0.0 seconds
 - When TIME reaches zero, PORTA turns on for 1 second (approx)
- 3) How many lines of assembler does your code compile into?
- 4) Collect data to determine how accurate your program is (one count = 100ms ideally)

\$65 Banjo - 20 Sided Die - Roulette Wheel - Other

Design an embedded system which uses the LCD display and C programming. Some suggestions are

- PIC Banjo. Play notes (G4, C3, G3, B4, D4) when you press buttons RB0..RB4. Display the note you're playing on the LCD display.
 - 20-Sided Die: Roll a d20 every time you press RB0 with the roll displayed on the LCD display. When you roll a 20, play 220Hz on RC0 for 1/2 second.
 - Roulette Wheel: Roll an 8-sided die when you press RB0. Have a light on PORTC shift left $32+N$ times at a speed of 100ms/step when you press the button. Beep at 220Hz for 1/10 second each step on RA1. Display the winning number on the LCD display.
 - Door Lock: Unlock a door (PORTA turns on for 1 second) when you input the correct key: RB0 - RB1 - RB2 - RB3.
 - Other
- 5) Requirements: Specify the inputs / outputs / how they relate.
 - 6) C code, flow chart, and resulting number of lines of assembler
 - 7) Validation: Collect data in lab to verify you met the requirements.
 - 8) Demo