ECEN 2020 Homework 3: Architecture and Programming

Due: 09/23/2013 11:55pm
Submit zip/rar file to Moodle
20 Points Total

1. (2 point) What is the AVR status register? What is its memory-mapped address? What is its default value? Briefly what does bit 1 do?

   A register which contains status bits for arithmetic or logical operations. It also has the global interrupt enable bit. Its address is 0x5F. The default value is 0x00, and bit one indicates a zero result of an operation.

2. (4 points) Write a program (you **can use their libraries**) to check the AVR status register (SREG) and display the results meaningfully. For example your output might look like:

   AVR status register
   Bit 0 Status: Off
   Bit 1 Status: Off
   Bit 2 Status: On

   …

   In your submission, include a text file called AVRstatus.txt which contains the code from your Arduino program. Comment your code well.

   See AVRstatus.txt

3. (4 points) Get a blink program working using **for loops and writing to registers**. **Do not use their libraries.** The datasheet is your friend. Your code might look something like:

   ```
   void loop() {
         //turn LED on
         for(…) {} //wait for a little while
         //turn LED off
         For(…) {} //wait for a little while
   }
   ```

   In your submission, include a text file called myblink.txt which contains the code from your Arduino program. Comment your code well.

   See myblink.txt

4. (4 points) Use your code from question 3. Without using nested for loops and using an unsigned integer as the loop counter, what is the slowest you can get the LED to blink? Why is this the case? What could you do to make the LED blink even slower (besides using nested for loops)? *The easiest way to measure the timing is using an oscilloscope to measure the time between LED turn on events.*

About 7 Hz is the slowest it will blink using an empty for loop, but it could be slower if you put something in the for loop. The loop counter can only count up so far before it reaches its roll over point, which is 65535 for a 16-bit integer. With and unsigned int, this means the loop will only execute 65535 times, which results in a limit for how slow we can make the light blink. We could use a long, unsigned long, etc.

5. (4 points) If I define a variable as follows below, what is the range of memory addresses where this variable could be expected to exist? *Look at the data memory section of the ATmega328 datasheet, and know that variables are not stored in registers.*

   int Count_Rotations = 0;

0x0100 to 0x08FF (as in the datasheet)

What is the problem with defining an array as follows below?

   volatile int my_array[2048] = {0};

Not enough space in data memory. This requires 4K, we only have about 2K in the Arduino.

If I define two variables as shown below, and the first is at address 0x0120, assuming nothing else happens between the definitions, what would you expect the address of the second variable to be?

   double my_number = 5;

   char my_letter = 'b';

We expect the second variable to be at 0x0124, because the first one is a double.

6. (2 points) What are the differences between Harvard Architecture and von Neumann architecture?

Harvard architecture uses two separate memory busses and two separate spaces to store data and program memory. This allows von Neumann to be simpler while Harvard is faster. In a Harvard architecture system, we can have 0x0000 program address and also a 0x0000 data address.

(2 points) Extra Credit: What is required to slow the clock frequency down. You will want to look at section 8.11 'System Clock Prescalar' in the ATmega328P datasheet. *In your submission, include a text file called clockdivision.txt which contains the code from your Arduino program. Comment your code well.*

Turning in your assignment:
1. Answer all questions (this can be a .doc, .docx, .pdf, .txt, …).
2. Code should be in .txt files
3. Zip your answers and your code into a .zip (or .rar) file called *lastname*_HW3.zip
4. Submit this zip file to the Moodle website
5. Email the instructor/TA if you have any questions.