ECEN 5803- Mastering Embedded System Architecture

Homework set 2

Due 2021/09/25

Theory and Analysis:

1. You are given 2 versions of a string copy function in C, version A or B:

A.

```
void strcpy1(char dest[], const char source[]) {
	int i = 0;
	while (1) {
		dest[i] = source[i];
		if (source[i] == '\0') break; // we're done
		i++;
	}
}
```

B.

```
void strcpy2(char dest[], const char source[])
{
	while (*dest++ = *source++) ;
}
```

a.) Which version would you pick to use and why?

b.) Do both versions provide the intended function?

c.) Which is most efficient?

d.) Why use the const keyword in the source declaration?

e.) Can you write a better version of the string copy function? If so, show it here:

2. Describe the meaning and use of the C keyword *volatile*. Give example code using this keyword.

3. Translate the below C fragment into an equivalent ARM assembly language program, using registers corresponding to the variable names. (As it happens, this code has the effect of placing into r2 the product of r0 and r1's initial values.)

```
r2 = 0;
while (r1 != 0) {
   if ((r1 & 1) != 0) {
      r2 += r0;
   }
   r0 <<= 1;
   r1 >>= 1;
}
```

4. For the below ARM assembly code, trace the values as it executes that will be placed into the registers R4, R5, and R6.

```
      MOV R4, #7
      MOV R5, #4
      MOV R6, #4
again  MOV R7, R4
      ADD R4, R5, R4
      MOV R5, R7
      SUBS R6, R6, #1
      BNE again
```

R4 _____

R5 _____

R6 _____

R7 _____

5. Embedded C. Evaluate the following code and determine what will print when using an ARM Cortex-M0+ processor:

```
#include <stdio.h>

union word
{
        short x;   /* use as word */
        char bytes [2];  /* use as byte */
};

int main()
{
        union word w;
        w.x = 0x08F0;  /* 08 F0  */
        printf("LSB = %x, MSB = %x\n", w.bytes[0], w.bytes[1]);
        return 0;
}
```

What is the purpose of this code – what is it telling you?

6. Complete the simple model Simulink simulation in the Simulink startup guide, sl_gs.pdf chapter 2. Show both the finished block diagram and scope screenshots.

7. Select the best processor to meet the listed requirements. Limit your search to processors from Atmel, Freescale, and Microchip. Use the processor selection spreadsheet you have been given, or any online processor selection tools. Document the steps you took to come to your conclusions.

Requirement for an **Electronic Cigarette**

1. Very lowest cost
2. Low power, < 1 mW average.
3. 3v operation
4. Internal oscillator
5. Package must be smaller area than 25 mm squared.
6. Code must be secure, not possible to read out to prevent reverse engineering.
7. >=4 kB SRAM, 8 kB FLASH on chip
8. UART and I2C port for BLE and pressure sensor.
9. 4 PWM outputs
10. MicroUSB OTG or Device port

8. Select the best processor to meet the listed requirements. Limit your search to processors from NXP (not including Freescale), ST, and Texas Instruments (TI). Use the processor selection spreadsheet you have been given, or any online processor selection tools. Document the steps you took to come to your conclusions.

Requirement for an **USB Audio Concentrator**

1. Cost under $10
2. USB 2.0 Device Interface
3. 4 channels I2S
4. DSP processing requires 100 DMIPS per I2S channel
5. SPI port to Serial FLASH
6. > = 40 kB SRAM on chip, can be in cache.
7. > 100 kB FLASH on chip
8. OS must support USB Audio class

Questions from the textbook: Review 9.10, 9.17; Thought 9.19
Review 6.5, 6.11, 6.21, 6.24; Thought 6.4
Review 7.5, 7.63; Thought 7.40 Problem 2.18

9.10 Identify and briefly discuss the steps that comprise the Spiral model?

9.17 For Whom is the requirements document written?

Chapter 9: Thought Questions

9.19) A Version control system is generally used to manage code revisions on most embedded designs. Should the requirements and design specifications be managed in similar manner? Explain your thinking?

Chapter 6: Review Questions

Problem 6.5.
What is relocatable code?

Problem 6.11.
What is boot code, and what is its purpose?

Problem 6.21.
What is the purpose of the const qualifier?

Problem 6.24.
Within an embedded C program, what does the term scope mean?

Chapter 6: Thought Questions

Problem 6.4.
What is a symbol table? What information is stored in a symbol table and what is its purpose?

Chapter 7 Review Questions

7.5: Following declaration and definition, a variable is stored somewhere in memory. How can one find out where the variable is stored?

7.63: Identify and briefly describe the steps necessary to handle an interrupt.

Thought Question
7.40: Why do interrupt service routines typically accept no arguments and have no return value?

Chapter 2 Problems

Problem 2.18: A junior engineer has proposed the design in Figure P2.60 for a portion of a circuit she is working on. She has said the design works perfectly, but has asked you to review it anyway. She gives you the information shown in the figure from the vendor's data sheet.
a. Using the information from the data sheets, complete the timing diagram in Figure P2.61 for the identified signals based on the conditions shown.

b. Based on your analysis, what can you tell her about the design?

Grading Rubric:

1) - [5 points]
    [1 point] each question

2) - [2 points] Complete and Correct Definition

3) - [2 points] Correct Code

4) - [4 points] traced code for completion
    [1 point] each question

5) [2 points]

6) - [4 points]
    [2 points] block diagram
    [2 points] screenshots

7) - [4 points] Correct processor choice

8) - [4 points] Correct processor choice

Book Questions [1 point each]