CSE/EE 5/7385 Microcontroller Architecture and Interfacing

HOMEWORK 5

1. An embedded systems designer is writing the controlling software using a combination of **C** and ARM inline assembly.

a) Give two valid reasons why the designer would choose to use inline ARM assembler language for portions of the software.

1. To optimize (increase) the speed
2. To optimize (reduce) the instruction memory required
3. To optimize (reduce) the power requirements

b) Give two valid reason why the designer would choose to use the **C** language for portions of the software.

1. To increase portability among different processors
2. To utilize higher-level constructs such as loops and function calls
3. To utilize libraries such as stdio.h and math.h
4. To produce code that is easier to read and understand

2) Consider the following **C** code and assume that a variable of type **int** occupies 32 bits in a byte addressable memory with little endian storage. Also assume that the variable **test_data** is stored at address **0x200**.

```
#include <stdio.h>
void  main (void)
{
      int  test_data;
      int *test_pnt;
      test_data = 0x100;
      test_pnt=&test_data;

      printf("%d\n",test_data);       /* Statement A */
      printf("%x\n",test_data);       /* Statement B */
      printf("%d\n",&test_data);      /* Statement C */
      printf("%x\n",&test_data);      /* Statement D */
      printf("%d\n",test_pnt);        /* Statement E */
      printf("%x\n",test_pnt);        /* Statement F */
      printf("%d\n",*test_pnt);       /* Statement G */
      printf("%x\n",*test_pnt);       /* Statement H */
}
```

a) Statement A will causes the following value to be output **stdout**: ___256_____

b) Statement B will causes the following value to be output **stdout**: __0x100____

c) Statement C will causes the following value to be output **stdout**: ___512_____

d) Statement D will causes the following value to be output **stdout**: ___0x200____

e) Statement E will causes the following value to be output **stdout**: ____512_____

f) Statement F will causes the following value to be output **stdout**: ____0x200____

g) Statement G will causes the following value to be output **stdout**: ____256____

h) Statement H will causes the following value to be output **stdout**: ___0x100____

3) An embedded systems designer is using a polling loop to periodically access an I/O device.

a) Give an advantage of using a polling loop for this purpose.

No extra hardware (timer) required and does not utilize the interrupt mechanism so no handler is required nor a need to worry with priorities

b) Give a disadvantage of using a polling loop for this purpose.

The processor is tied up doing NOPs or repeatedly accessing the device and cannot be doing other useful work.

4. An embedded systems designer is using an onboard programmable hardware timer to generate an interrupt periodically that causes the system to periodically access an I/O device.

a) Give an advantage of using the timer for this purpose.

This frees up the processor to perform other processing when the device does require servicing.

b) Give a disadvantage of using the timer for this purpose.

Requires a hardware timer and code to initialize the timer. Also requires implementation and loading of an appropriate interrupt/exception handler and incorporation of the interrupt into the appropriate priority scheme.

5) An embedded systems designer implemented the system using a real-time operating system that supports task synchronization and contains deadlock avoidance.

a) What is a valid reason for implementing a system in the form of two or more tasks?

Whenever the system must perform more than one independent function, it is convenient to separate each function into an independent task and use OS services for task scheduling.

b) Name two methods commonly used to avoid deadlock.

1. use of Semaphores
2. use MUTEX (Mutual Exclusion) blocks

c) Describe the concept of deadlock by indicating how it can happen.

Deadlock can occur when all tasks are waiting for a resource that will never become free. (We used the dining philosopher's problem to describe this situation in class).