CSE/EE 5/7385 Microcontroller Architecture and Interfacing

HOMEWORK 1

1. An embedded systems engineer is designing a room temperature controller that has a digital thermometer that outputs temperature (in Fahrenheit) with an accuracy of $1/10^{th}$ of a degree. Her choices include microcontrollers with 4-, 8-, 16-, and 32-bit word sizes and bigger word sizes are most expensive. Of these four choices, which is the most appropriate and lowest cost? For full credit, give numerical calculations that justify your choice and you can assume room temperature ranges from 55 to 95 degrees.

2. An embedded systems designer is designing a handheld data collection device. The handheld device is battery powered and is used to collect data in the field. The handheld device is then plugged in to a USB port at the company headquarters where stored data is downloaded into a server. The designer must choose a type of memory for the handheld device. His choices are RAM, ROM, and Flash. Which type of memory should he choose for his device among these three? For full credit, you must give the REASON why a particular type is chosen.

3. The handheld device in question three (3) uses a microcontroller with a 12-bit address bus and an 8-bit data bus. The memory chips selected have a size of 4K×4 bits. If the handheld device is to have a maximum amount of addressable memory, how many memory chips are required per device?

4. If a microcontroller contains a Harvard architecture, give an example of one advantage it offers as compared to a microcontroller with a von Neumann (or Princeton) architecture.

5. If a microcontroller contains a Harvard architecture, give an example of one disadvantage it has as compared to a microcontroller with a von Neumann (or Princeton) architecture.

The following questions refer to a portion of a byte-addressable memory is shown in the table below.

ADDRESS	DATA
E20C2	C8
E20C3	20
E20C4	0E
E20C5	04
E20C6	DA
E20C7	65
E20C8	91
E20C9	9A

6. How many wires are required for the address bus that interfaces to this memory?

7. How many wires are required in the data bus? HINT: assume the data bus is bidirectional

8. An ARM halfword is stored at location E20C7 in big endian format. What is the value of this halfword?

9. An ARM word is stored at E20C5 in little endian format. What is the value of this word?

10. Location E20C4 contains a pointer to an ARM halfword that is stored in the portion of memory shown in the table, what is the value of this halfword?