2004-2013 Linden H. McClure, Ph.D. – 1 – Embedded System Design

**ECEN 4613/5613 Embedded System Design Week #1**

**Spring 2013 Homework #1 1/16/2013**

1. By **5:00pm on Tuesday, January 22nd**, e-mail a message to the instructor (**Linden.McClure@Colorado.EDU**) with the subject line "**ESDF13 HW #1**". This will verify that the instructor has your correct e-mail address for class correspondence. The instructor will reply with a brief message so that you know your e-mail got to its destination. Answer the following questions in the body of your e-mail (**do not** put your answers in an attachment):

(a) What is your Buff OneCard number? (this is not your student ID number)

**6014235004720051**

(b) Do you have any preferred times/days for TA office hours?

Friday, Saturday, Sunday

(c) Can you attend instructor office hours if they are offered on Saturdays from 11:30am-3:00pm?

Yes.

(d) If you have a job, what kind of work do you do for a living?

I have a campus-job on Monday and Friday at the AHEC as a hut attendant.

(e) Have you ever built an embedded system before? If yes, please list the microprocessor(s) and programming language(s) you used.

In my previous Undergrad courses I have done the following projects in embedded systems:

Project 1:

Title: (Mini Project) Digital Calendar

Processor: 8051

Project 2:

Title: Automatic Room-Light Controller with counter and daylight sensor

Processor: 8051

Project 3:

Title: Bluetooth Enabled Cellphone controlled based Home Automation System for disabled and Elderly

Processor:8051

Project 5:

Title: RFID based deadbolt door lock system

Processor : Arduino UNO Kit /ATmega328

(f) What was your favorite technical course in college and **why**?

Embedded Systems Engineering 2 . I was able to work on Arduino Processor which was new and exciting.

(g) In which technical class in college did you learn the most and **why**?

Digital Design was also a favorite class for me as I was learnt programming modules in Verilog language and also was able to code program for a Door lock and Spartan3 FPGA.

(h) In your opinion, what are the characteristics of a good professor?

Able to explain concept clearly.

(i) What made you interested in this course?

* My fascination with mobile computing and wearable computing .
* The fact that such computing will play a great role in future.
* Mmy need to contribute to this niche market drives me to pursue this course.

(j) What do you want to gain from taking this course?

I would like to brush up my skills in interfacing, c programming and power requirements for embedded systems.

(k) Do you have the prerequisite hardware and software knowledge for this course? If your answer is 'no', what is your plan for successfully completing the course assignments?

Yes. I am competent at basic HW/SW skill required for the course. Though I would like to achieve a advanced level contributing to my goal.

(l) Do you have any concerns about this course? If so, please describe.

Yes. As I pursuing my degree from Denver Campus and my apartment is in Denver also. I fear I might keep running into conflicting situations between my courses at Boulder and Denver. The commute to and fro is a major concern.

(m) Do you understand that this course has a significant workload? (Note: Undergraduate students are advised not to attempt ECEN 4613 and Capstone in the same semester).

Yes, as the schedule dictates, the coursework will get tougher as it progresses

(n) In the event that a key lecture needs to be cancelled (e.g. for a blizzard, business travel, sickness, etc.), what is your availability for a make-up lecture on a different day of the week?

• Monday evening: No

• Tuesday evening: No

• Thursday evening: No

• Friday evening: No

• Saturday morning/afternoon: Yes

• Sunday afternoon: Yes

**NOTE: While a brief submission is acceptable, remember that every submission you make this semester is an opportunity for you to demonstrate thoroughness and quality.**

**The following tasks will not be checked off and your answers to the questions will not be collected.**

2. If you do not already have one, obtain a Buff OneCard, needed for access to the laboratory. CAETE students not seeking a degree can obtain a card for $25. For more information, see https://services.jsatech.com/index.php?cid=59 . **When you get your card, please provide the card number to the instructor via e-mail so that you can get access to the lab areas**.

3. Read the course syllabus and FAQ, available on the course web site.

4. Read the specified pages in the course documentation (also available from the course web site):

- "Siemens C501 Users Manual." Read sections 1–5. Skim the rest.

- "Siemens C500 Architecture and Instructdion Set." Read sections 1–3. Skim the rest.

- "Siemens C501 Data Sheet." Skim pages 1–48.

- C501 Errata sheet

Additional documents have been placed on the course web site:

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They contain similar information, but provide additional details you may find useful. Some of the Philips (and Atmel) documents contain more detail and diagrams than the Siemens documents. Use them in addition to the above documents if you like.

- "Philips 80C51 Family…80C51 Family Architecture." pp. 1-15.

- "Philips 80C51 8-bit Microcontroller Family Data Sheet." pp. 1–18, 22, 25, 26.

- "Philips 80C51 Family…80C51 Family Hardware Description." pp. 1–24.

- "Philips 80C51 Family…80C51 Family Programmer's Guide and Instruction Set." pp. 1–16.

5. If necessary, review your old course notes on digital logic, microprocessors, and circuits.

**6. What is the address space of the 8051?**

The address bus is 16 bit wide hence can access external 65536 memory locations i.e 64Kb

**7. What is the purpose of the pin on the 8051? *EA***

EA(External Access) Enable signal is a active low signal to to access the external memory.

When this pin is tied to high it access the internal memory.

**8. What is the purpose of the ALE signal? How do you use this signal?**

ALE or Address Latch Enable. The Address and Data bus for the 8051 are multiplexed so the ALE signal activates the Latch IC74373 which holds the address lines A0-A7 in the output buffer.

**9. What is the purpose of ? *PSEN***

PSEN or the program store enable is a output signal on pin29. This signal acts as a reading strobe for the memory.

**10. In a system with external memory, for what purpose are ports P0 and P2 used?**

The Ports P0 and P2 are used as a multiplexed Address and Data bus.

**11. Does the stack grow toward higher or lower memory in the 8051?**

Stack grows higher in the memory in the 8051 i.e. By default The stack pointer points to 07 so the stack will increment to 08 location and store the value PUSH ’ed.

**12. At what address is the reset vector located in the 8051? What constraint does this impose on the addition of external memory for an 8031 which does not have internal ROM?**

The Reset interrupt vector points to the location 0000H. The basic constraint is that the 8031’s two ports (Port 0 and Port 2) are permanently appointed for interfacing the external memory.

**13. What interrupts are available on the 8051?**

The 8051 has five interrupt sources.

* Two external interrupts INTO-bar and INT1-bar, available on port 3, pin 2 and port 3 pin 3, respectively.
* Two internal interrupts are generated by timer 0 overflow and by timer 1 overflow.
* The serial port on the 8051 can generate an interrupt when a byte has been transmitted or when a byte is received.

**14. What memory locations do the interrupt vectors occupy, and why do you think the vectors are spaced at 8-byte intervals?**

Interrupt Flag Vector

System reset RST 0000H

External interrupt 0 IE0 0003H

Timer 0 TF0 000BH

External interrupt 1 IE1 0013H

Timer 1 TF1 001BH

Serial port RI or TI 0023H

The vector interrupts are spaced at eight bytes so a JUMP instruction and memory address( to where the jump should take place) can be written in the eight byte designated space .

**15. How many bytes of internal RAM are implemented in the 80C51? How about on the C501? Why is the inclusion of RAM on a micro controller important?**

The lowest available on chip memory on th 80C51 is 128 bytes of memery. Upto 64 bytes can be added externally.

The internal RAM of the C501 is 256 bytes.

The inclusion of RAM on the micro controller is important because the purpose of micro-controllers are to be designed for embedded applications as compared to microprocessors which are more general purpose.

**16. If the first instruction of my code was PUSH ACC (or PUSH A), what memory address would contain the pushed copy of the accumulator?**

Once the 8051 is initialized the Stack Pointer is initialized to memory location 07**h.** Hence If the PUSH ACC is executed then the SP is incremented and the copy of the accumilator value is stored at the 08h location in the RAM.

**17. For what purpose is DPTR used?**

The DPTR or the Data Pointer is a 16 bit register. This register is used to point to data in the external memory for access and write. It can also be used as a general purpose register.

**18. If I wanted to combine the external program and external data memory into one addressing space, what would I have to do to the and control signals? *PSEN RD***

For external program and data memory the connections would have to be made in a fashion as shown below for port 0:

During the memory access cycle the port 0 is used in the multiplexed fashion as shown in figure above.

The PSEN and RD signals are used as address lines for differentiation between the rom and the ram.

The PSEN signal when “LOW” will enable the ROM.

To access the RAM the RD pin will be turned “LOW”.

This will generate a contiguous addressing for the external ROM and RAM use.

**19. In order to reset the processor, is it necessary to supply a logic high or a logic low voltage to the reset pin? Why is a reset signal required? What is the minimum voltage required on the RST pin to hold the processor in reset? What is the purpose of the diffused resistor inside the processor?**

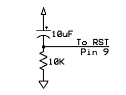
An active high signal is required too reset the processor.

The minimum Voltage required on the RST pin to hold the processor in reset is

0.7\*Vcc = 0.7\*5V =3.5V

The internal diffused resistor connected to Vss permits a power on reset using an external capacitor connected to the Vcc pin.

**20. Review RC circuits. Now design an appropriate power on reset circuit for the 8051. Be prepared to discuss the nuances of this circuit in depth. How does the threshold of the RST pin input impact your design? How do the tolerances of resistors and capacitors impact your design? How does the tolerance of the power supply impact your design?**



The RC circuit for power on reset for the 8051 is as shown above.

The threshold of the RST pin is sufficiently overcome by choosing a RC combination which has a time constant fort charging the capacitor equal to 2 machine cycles of the processor. In this case R\*C ~= 100ms.

The tolerance of the resistor and capacitor plays a crucial factor as it can change the RC time constant value causing the charging capacitor to be pulled down by the resistor so quickly that the Reset pin never reaches the threshold voltage.

The tolerance of the power supply may cause the processor to reset whenever fluctuations occur randomly. This problem can be eliminated by using voltage regulator ICs (7805) or a “reset supervisor IC” (MN13811)

21. Refer to http://www.okindustries.com (see the wire wrapping tips and hints/overview) and learn about wire wrapping. Note that the wire connecting any two pins should have a small amount of slack, so that you can move the wire a little to aid in debugging if necessary; however, there shouldn't be too much slack, since it will make the circuit more electrically noisy and may be hard to debug. When stripping wire wrap wire, at least 3/4" (about 2 cm) of bare wire should be showing. 0.75 inches is about this long:

22. Refer to the "Metcal Hand Soldering Basics" document on the course web site and review the basics of soldering. Numerous soldering videos are also available on http://www.youtube.com. Another interesting and detailed web site containing a basic soldering guide is: http://www.epemag.wimborne.co.uk/solderfaq.htm.

23. Obtain a suitable lab notebook. Your notebook will not be graded. Preferably, you should use a notebook with sewn-in pages. Put your name in the book. You should use this notebook for embedded system notes and designs during the semester. Document your work in ink and date each page as you use it. Number the pages in your lab notebook from beginning to end. You may want to consider leaving the first page to use as a Table of Contents. You can tape photocopies of data sheets (including pinouts, etc.) in your notebook for later reference. During the course, document your discoveries and do your circuit designs and analysis work in the notebook. Your notebook does not have to be a work of art, but it does need to be legible. Capture ideas as you think of them—someday you may use your notebook to recall design details about your circuits. You may want to capture most of your notes on the right-hand pages, and use the left-hand pages for drawings, photocopies, etc. Your notebook is a good place to write down URLs for web pages containing good embedded systems info.