ECEN 5803- Mastering Embedded System Architecture

Homework set 1

Due 2021/09/08

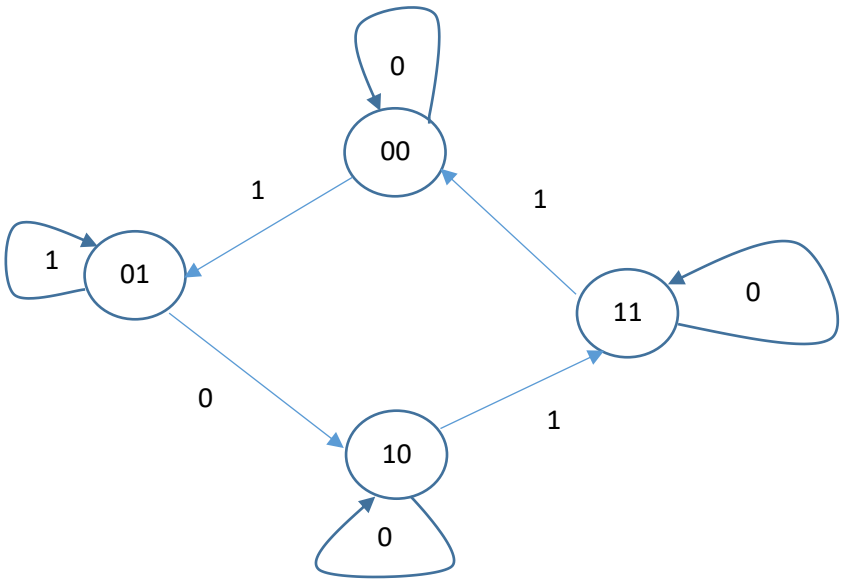
Theory and Analysis:

1. Visit the https://os.mbed.com/handbook/Homepage website. Find the Freescale Freedom board KL25Z enable platform and answer the following questions
   a. How many UARTs does this device have?
   b. What is the part number of the on-board accelerometer?

2. Draw a UML, flowchart or similar sequence diagram that will find the smallest of 3 numbers, A, B, and C and list them in ascending order. Write a C program that implements this flowchart.

3. At what stage of the design methodology or development cycle should we determine what type of CPU to use (8-bit versus 16-bit versus 32-bit, memory size, etc.)?

4. Given the State Diagram below, provide a state table with binary encoding and design a circuit to implement the corresponding state machine using
   a. gates and D flip-flops
   b. a control memory (FLASH or EPROM memory with added registered outputs) See http://fourier.eng.hmc.edu/e85_old/lectures/processor/node11.html and http://drshoabkhan.com/_assets/chapter_10.pdf and http://www.cs.binghamton.edu/~reckert/hardwire3new.html.



5. What organization is most involved in creating standards to assure quality control in product development?

   Look up this organization's standard 8601 and explain how it impacts embedded systems design.

Name	GPS Navigator
Purpose	Consumer-grade easy to use GPS Navigator with moving map for driving navigation
Inputs	Power Button, 2 control buttons, GPS receiver
Outputs	Back-lit LCD Display VGA resolution
Functions	Uses 5-receiver GPS system, 3 user-selectable resolution; always displays current position and latitude and longitude
Performance	Updates screen with 0.25 s of movement
Manufacturing Costs	< $40
Power	100 mW, 24 hour battery life.
Physical size and weight	No more than 2" x 6", 12 ounces

6. Given the GPS Navigator product requirements above, what would you base the Embedded System Architecture on, given the following options:

   a. ASIC
   b. MCU
   c. MPU
   d. Discrete Circuits
   e. Programmable Logic (FPGA)
   f. Embedded PC

   Justify your answer using ARM's Embedded System Options Criteria (see Lecture Notes) and be sure to include Time to Market.

7. a. What benefit is provided by the use of indirect addressing?

   b. For each Processor Architecture Listed, answer the question: Does this processor use indirect addressing, and if so, what register or memory location is used to store the address?

      1. ARM M0+
      2. PIC 16F
      3. TI C55x DSP

8. Answer the following questions about the ARM programming model:
    a. How many general purpose registers are there?
    b. What is the purpose of the CPSR?
    c. What is the purpose of the Z bit?
    d. Where is the program counter kept?

9. How would the ARM status word be set after these operations?
    a. 2-3
    b. -232 + 1 -1
    c. -4+5

10. What is the meaning of these ARM condition codes?
    a. EQ
    b. NE
    c. MI
    d. VS
    e. GE
    f. LT

Questions out of the book:

Review

F.3 What are the three kinds of computing engine that are utilized in embedded systems?

F.6 What is an instruction cycle?

F.12 Briefly describe the major elements of the embedded system development life cycle.

Thought

F.8 Today, in the typical embedded system development cycle, hardware design precedes software design. Discuss the advantages and disadvantages of developing the hardware and software components of the system at the same time

Review:

1.11 How do we distinguish a signed integer from one that is unsigned?

1.12 What do the terms little endian and big endian mean? Why are they important?

1.17 How are alphanumeric characters and symbols represented inside of a microprocessor?

Thought:

1.16 The essential components of an instruction are the opcode and operand(s) on which the operation is to be performed. Is it necessary that the opcode always contain the same number of bits? Why or Why not?

1.24 If one has an assembly code listing for an embedded program that has been running on a Motorola processor, will that program run on an AMD processor?

1.30 Explain why a register access is generally faster than a memory access.

Grading Rubric

1) - [2 points]
    [1 points] # UART
    [1 points] correct part number
2) - [4 points]
    [2 points] flowchart
    [2 points] C Program correct

3) - [3 points] correct stage

4) - [4 points]
    [2 points] gates
    [2 points] Control Memory

5) - [2 points]
    [1 points] Standard identified
    [1 points] Embedded Impact

6) - [5 points] Correct Option chosen

7) - [4 points]
    [1 points] Benefits described
    [3 points] 1 for each correct Architecture

8-10) [2 points each]

Book Question
    Review problems, 1 point each
    Thought problems, 1 points each