CPE 301 - EMBEDDED SYSTEMS DESIGN
Fall 2019

HOMEWORK No. 04 – Due BEFORE 11:59 PM, **October 2**, Wednesday

Description of Purpose

The purpose for this assignment is to teach us how to use the Arduino Board as well as familiarize us with the pins and ports of the Arduino. In addition, this homework is helping build our knowledge from class on how to design memory by having us map out the address to specific chips. Overall, this homework is the intro to Arduinos as well as a build off on how memory works.

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1. Read Chapter 6 in the Textbook "*Introduction to Embedded Systems: Using ANSI C and the Arduino Development Environment*".

2. Answer Question 6.1 as **modified to read as follows**:

    a. Using the ATmega328P pin configuration table and the Arduino Duemilanove Schematic in Appendix A, identify in a new Table all of the pins on the three ports (PB, PC, and PD) that are already dedicated to an alternative function via pin-muxing.

    b. Make an equivalent Table for the ATmega2560 used in the Arduino Mega SBC for pins on the **same three ports** PB, PC, and PD (for example, we found that the LED is connected to PB5 on the Arduino UNO and PB7 on the Arduino Mega).

Hint: all the pins in the table correspond to pins on the schematic; the pins to be identified will go to specific circuitry other than the headers. The schematic for the Arduino Mega is posted on webcampus.

3. Answer questions 6.2, 6.3, and 6.4.   Hint: read the switch de-bounce pdf.

For the questions below do the following decoder design steps:

Use **ABSOLUTE** decoding with no fold-back for the external **DATA** memory.
 Show your work and include the following items:

    a. **MEMORY MAP**
    b. **MEMORY ADDRESS TABLE**
    c. **BOOLEAN EQUATIONS** for each chip select signal
    d. Full schematic logic diagram of your **DECODING CIRCUITS**

4. Design an 8085 microprocessor system (Princeton Architecture) that has a total of 8Kx8 EPROM space using two 4Kx8 chips and a total of 8Kx8 RAM using eight 1Kx8 chips. The EPROM should be mapped in two 4K blocks starting at addresses 0000 and 8000 hex respectively and the RAM should be mapped in two 4K blocks starting at addresses 1000 and 9000 hex respectively.

5. Design an 8051 microprocessor system (Harvard Architecture) that has a total of 32Kx8 EPROM space using four 8Kx8 chips for code and a total of 32Kx8 RAM using two 16Kx8 chips for data. The EPROM should be mapped as CODE memory in a single block starting at address 0000 hex and the RAM should be mapped as DATA memory in a single block starting at address 0000 hex.

6. Design an Atmega 2560 microcontroller system (Harvard Architecture) which has two chips mapped as external DATAmemory. The first chip is an 8Kx8 RAM chip starting at address 0x8000 and the second chip is an Intel 8255 Peripheral Interface chip starting at address 0xFC00.

The Intel 82C55 Programmable Peripheral Interface chip is designed to be connected to a microprocessor as a memory mapped I/O device which provides 3 additional 8-bit GPIO ports for connecting to external devices. The ports are referred to as PA, PB, and PC in the data sheet.   (See 8255 data sheets for details.)