# CmpE213 – Digital Systems Design

## Homework 9
Applications of the 8051

Note: The following assignment is long, *but* you will be given 2 weeks to complete it. I suggest you start early.

1. For this problem, you will write a short C program for the 8051 which will read a binary value from an external location and will then display that value on an external 7-segment display. The hardware setup would look something like this:

   This program will consist of the following functions, definitions, etc.

(a) **Function "main"**. The main function will endlessly perform the following loop: a) read a value from external memory, b) call a function to display that value on a 7-segment display, c) call a function to wait for MSDELAY mS (MSDELAY is a constant, defined later), d) go back to a). Give this function the following characteristics:

- Implement the loop using a for() instruction.
- The external memory location containing the number to be displayed might be an external I/O port expansion chip like the 8255. Read the value from this port using the XBYTE instruction/directive.
- Define INPUTVAL at the location in external memory, such that XBYTE[INPUTVAL] reads a byte from external memory location 0x5280.
- Define MSDELAY as a constant equal to 20 at the top of your code.
- The function to display the value on the seven-segment display will return a bit indicating if the value was successfully displayed. Create a variable located "_at_" external memory 0x5281. If the display function returns a 1, write an FF to this location. If it returns a 0, write a 00.

(b) **Function "display"**. This function will accept a number as input and will create the appropriate output to display that number on an external 7-segment display.
The 7-segment display has the following appearance:

It is attached to P1, such that segment 0 is tied to bit 0, segment 1 to bit 1, etc. A segment is ON when P1 writes a 1 to that segment and OFF when it writes a 0. Numbers are displayed by turning the appropriate segments on or off. For example, to display the number "0" one would write the number 01110111 to P1 (turning on segments 6,5,4,2,1,0 and turning off segment 3).
Give this function the following characteristics:

- The number to be displayed is passed as an unsigned char.
- Only numbers from 0 to 9 are displayed.
- The function returns a bit variable equal to 1 if the number is displayed successfully (is a value from 0 to 9) and a value of 0 otherwise.
- To improve readability of your code, create and use a special function register variable named seven_seg instead of P1. (i.e. seven_seg and P1 represent the same SFR, but are called by different names).
- Values to write to P0 are stored in a lookup array in code memory. (e.g. The first value in this array would be a binary 01110111).

(c) **Function "delay"**. Use the function delay() you created in the last homework.

Create your code in uVision and simulate in dScope. Turn in a hardcopy of your code and email a copy of your *project* to daryl@ece.umr.edu (i.e. your c-code, your project file(s), your

executable, etc). Please include your project as an attachment and use the subject header "HWK9.1 - program". **Please put your name at the top of your program (and anyone you worked with) and comment your code appropriately.**

2. Information on controlling a unipolar 4-phase stepper motor was discussed in class. Create a C-program which will drive the stepper motor 100 steps in the forward direction at a speed of 42 revolutions per minute (RPM), then 200 steps in the reverse direction at 42 rpm, and will then repeat (so: 100 forward, 200 backward, 100 forward, 200 backward, etc – assume the example in the book drives the motor forward). Email me a copy of you completed (debugged and working) program, turn in a hardcopy of your code, and answer the following questions:

   (a) When calling the function msec, where is the number of milliseconds (variable x in msec(x) ) stored in the assembly language translation so that it can be accessed by the function (i.e. how are parameters passed to the function)?

   (b) In the function *step*, how is the static variable $i$ stored? What register or memory location is used?

   Please send your code as an attachment to an email with subject line "HW9.2 - program". **Please put your name at the top of your program (with the names of anyone you worked with) and comment your code appropriately.**