Laboratory Assignment #3:
"LCD Desk Clock"

Due Monday, October 21, 2002

In order to be a successful embedded system designer, it is important to learn how to interface embedded microcontrollers to common peripherals. Your objective in this lab is to connect a typical alphanumeric LCD (provided) to your AVR and write code to create a working desk clock. You will need to read the interface specification for the LCD and decide how to wire up the display to the AVR port pins. You may use either assembly or C to complete the code for this lab. Your clock may operate in fun, creative ways but must include at least features 1 and 2 below. Any two of features 3,4, and 5 can be implemented for 10% extra credit each.

1.   A display of current hours, minutes, and seconds, and AM/PM (example: 7:45:05pm) (required)

2.   A user interface that allows setting the clock. (required)

   The user interface can be done any way you choose within the following guidelines: The interface should be simple and intuitive. The hours, minutes, and seconds fields must be individually settable and you must provide some indication of which field is currently being set (for example: blinking the field on the LCD). You must devise a way to enter and exit the "clock setting mode" to prevent mishaps like accidentally altering the time.

3.   Adjustable LCD contrast via the user interface. (optional/extra credit)

   In other words, your code should have control over the contrast, and you must provide a way to set the contrast via the user interface. Using PWM output is recommended, but other methods are also possible.

4.   Beeping Alarm Clock (optional/extra credit)

5.   Fun animation using LCD custom characters (optional/extra credit)

The LCD you will use in this lab is based on the Hitachi HD44780 LCD controller chip. Dozens of manufacturers produce literally hundreds of models of LCD displays using this controller chip. The smallest of these displays is only one line of 8 characters; the largest is four lines of 40 characters each. Other common sizes are 16x1, 20x1, 20x2, 20x4, 40x1, and 40x2 (characters x lines). Fortunately, all HD44780-based displays (of any size) use the same standard 14-wire interface. Therefore, code and hardware made for one size/type display can be painlessly adapted to work for any HD44780 compatible. Information about these displays can be easily obtained on the web by including '**HD44780**" in your search keywords. Because of their widespread use, these displays can be purchased surplus with typical prices of $3 for small displays to $20 for large ones.

A brief LCD starter guide explaining the hardware interface and including example pseudo-code will be posted to the course web page shortly. Detailed information about the HD44780 LCD interface and command structure is already available on the course web page (under Lab#3) and all over the web. Please read at least the "**hd44780 lcd concise reference**" before attempting to connect your display to the AVR. **PLEASE, pay special attention when connecting power to the displays! Accidentally connecting power backwards or connecting power to the LCD I/O pins will burn out the LCD**. You are responsible for keeping your LCD healthy.

Submit: Your *.asm file(s) or *.c and *.h file(s), and a readme.txt explaining your code in reasonable detail (a few paragraphs). Zip these files and submit them to the TA by the due date.