mbed Lab 3: Do You See What I See?

CS 220

Nov. 6

Introduction

Using a host computer to display output from the KL25Z board is a bit of a drag. Who wants to carry a computer around with them just to find out what the current temperature is? A small LCD display panel would be a far better solution. In this lab, you'll use an mbed Components library to conveniently access a two lines by 16 characters LCD display, the Newhaven Display NHD-0216HZ-FSW-FBW-33V3C. (That's a mouthful. From now on, I'll just refer to it as the LCD display.) The Components Libraries are similar to the basic interfaces (DigitalOut, etc.) provided by the mbed system, but on a larger scale. These libraries amount to being small device drivers — pieces of software that interface complex I/O peripherals to a computer system.

Lab Objectives

1. Use the mbed's TextLCD library to display text on an LCD display.
2. Display temperature readings from the TMP36 temperature sensor on an LCD display.
3. Gain confidence in using the mbed development system, and designing and wiring circuits.

Lab Procedure

Read each of the following steps **completely** before acting on them.

1. You won't need to apply power to the KL25Z until later, so set the USB cable aside for now.
2. Visit the `developer.mbed.org` website and sign-in.
3. Find the mbed Components page. In the search box at the top of the page, enter "TextLCD" (You *do* know to leave the quotes out when entering this into the search box, right?) Select the result for the HD44780 Text LCD component. (Don't click on "Components" — doing so will take you back to the Components page.

   You're in the right place if you see Simon Ford listed as the author.
4. By now you should know the drill — import the Hello World program for the TextLCD. Open `main.cpp` and take a look at TextLCD's constructor — six pins with the functions `rs`, `e`, and `d4`–`d7`. `rs` is register select. The LCD's command register is selected when this pin is low, otherwise the data register is selected. `e` is the operation enable pin. It's similar to the load pin that you've used with sequential chips in Hack. The four remaining pins are used for transferring display data or commands.

   As you've done before, you'll ultimately need to replace the six pin names with six KL25Z pin names.

5. Take a look at the LCD display's datasheet. (It's on the course web site.) You'll notice that there are actually eight data pins. We're only using four. What gives? These displays have two data modes — eight-bit mode, in which an entire byte of display or command data is transferred in one clock cycle, or four-bit mode, in which a byte of display or command data is transferred in two clock cycles, with the two four-bit nibbles multiplexed over four of the data pins.

   What are the pros and cons of each of these two modes? For our application, which mode is better, and why is it better?

6. There's a mechanical drawing of the LCD on page 3 of the datasheet. Note that pin 1 is on the far left along the bottom edge of the display and that pin 16 is on the far right. Now turn to page 4. The block diagram for four-bit mode suddenly has pin 1 on the far right. I have no idea why it was drawn this way, but it's wrong. Be careful to not get confused by this.

7. For the LCD display interface, I suggest that you use the six KL25Z pins starting with `PTE30` and ending with `PTE20` — six pins in a row.

8. To guide your actual wiring work, write out a wiring list. Make a list showing which LCD pin connects to which KL25Z pin. Include power and ground connections.

   The LCD runs on 3.3V. You'll be making several power and ground connections. To make power and ground wiring easier, connect a `P3V3` pin from the KL25Z to the "`+`" bus strip on the breadboard and a `GND` pin from the KL25Z to the "`-`" bus strip on the breadboard. Use these bus strips for any power or ground connections to LCD pins.

   The one pin not accounted for in the TextLCD component is the LCD's R/W pin. Looking at the description of this pin on page 4 of the datasheet, to what value should this pin be set?

9. Let me review your wiring list before you proceed.

10. Make the wiring connections. I'm not sure there's enough black wires for ground connections and red wire for power connections to go around. Try to use one color for ground, another color for power, and other colors for the remaining connections.

11. Let's turn our attention back to the TextLCD Hello World program. Don't forget to correct the TextLCD constructor pins in your program.

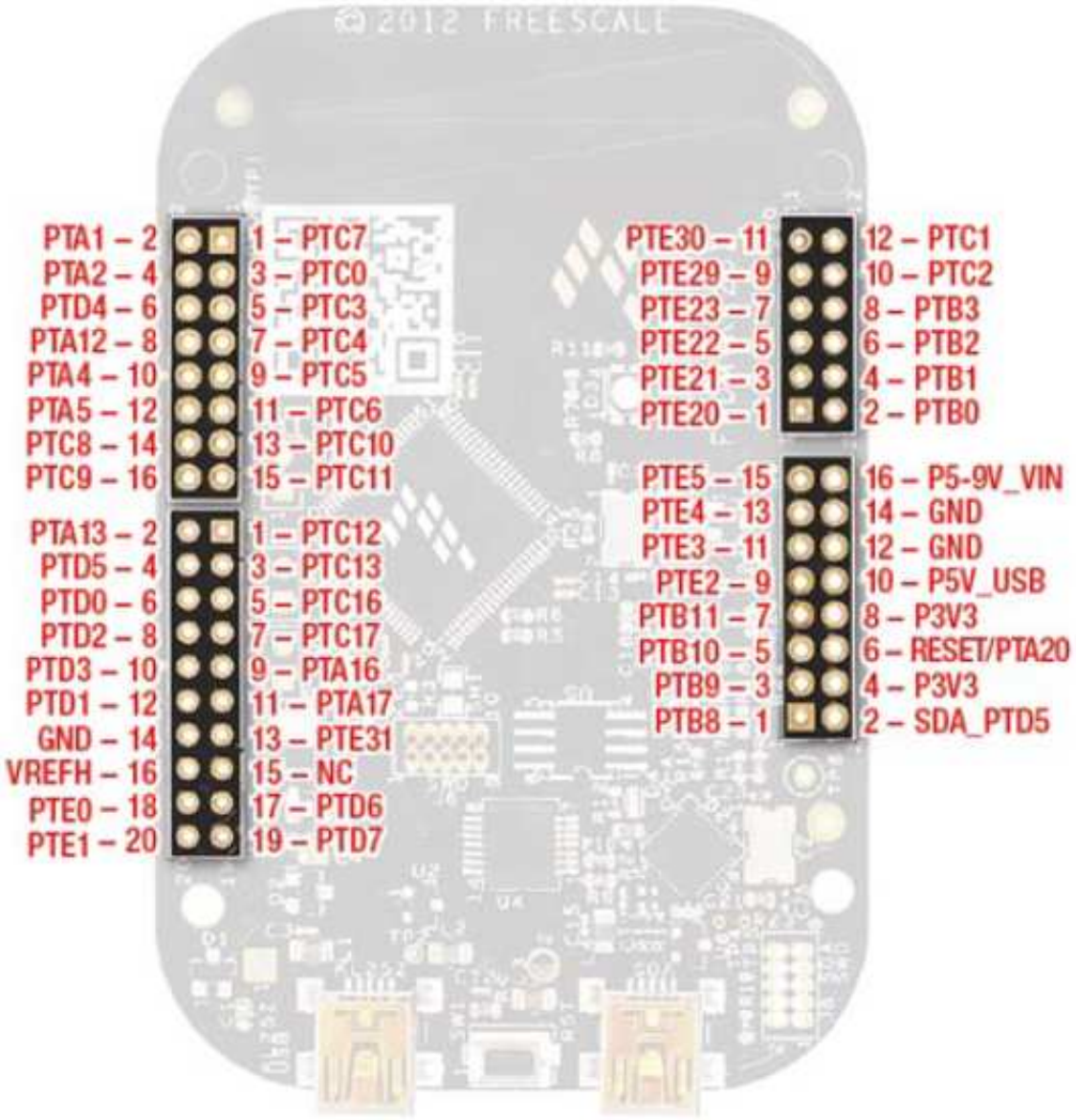
12. Connect the KL25Z to your host computer, compile and download your program, and run your program.

13. Now, let's use the LCD to display the current temperature. Open your temperature sensor program from last week. Comment-out any lines referring to the Serial interface that we used last week. Import the TextLCD component into this program and modify the program so that the current temperature is displayed on the LCD, updated once per second. The temperature display should be similar to

    > The temperature is 72.45°F.

    The character code `\337` will print the ° symbol.

KL25Z Pin Diagram



USB connector-end of the KL25Z