

Digital Input and Output with the Handy Board

Pre-Lab Questions

1. What function do you use to determine the state of one of the digital input pins on the Handy Board?
2. What function do you use to change the state of one of the digital output pins on the Expansion Board?

Purpose

- To become familiar with the features of the Handy Board (HB) and the Expansion Board (EB)
- To explore how to interface digital sensors with the Handy Board
- To practice programming in C

Components

<u>Qty.</u>	<u>Item</u>
1	Handy Board with expansion board and serial interface/charger
1	Serial cable with DB-9 to DB-25 adapter
1	RJ-11 cable
1	2N3094 transistor
1	Red or green LED
1	10 k Ω resistor
1	220 Ω resistor
1	Subminiature lever switch
1 ft	28 AWG stranded cable (a pair of wires peeled from ribbon cable)
1 in.	1/16 in. dia shrink tubing
1 in.	3/32 in. dia shrink tubing
1	Male header pins, single row (4 pins)

Introduction

In this lab you will investigate how to handle digital input and output with the Handy Board (HB) and the Expansion Board (EB). You will also practice wiring a connector to a digital sensor that will enable it to be easily plugged into the pins of the digital input port.

Procedure

Wiring the switch and connector

1. Split the pair of stranded wires approximately 1¼ inches at each end.
2. Strip approximately 1/2 inch of the insulation off of each end of the wires. Twist the conductors, so the wire strands do not splay out.

3. Cut the shrink tubing into four, 1/2-inch sections, and slide the 3/32 in. dia. sections over the ends of the wires to be soldered to the switch. Slide the 1/16 in. dia. sections over the ends of the wires to be soldered to the switch.
4. Solder one pair of ends to the common and normally open (NO) pins on the body of the switch. If the pins are not marked, determine which pin is which using the multimeter continuity test function. (Keep the shrink tubing as far away from the soldering iron as possible to avoid shrinking the tubing prematurely.) Verify that you have a good solder joint for each wire before you go on to the next step.
5. Slide the heat shrink tubing over the pins.
6. Solder the other pair of ends to the two outermost male header pins, because the switch will close a circuit between the signal pin and ground. (Note: it may help to make a few wraps of the wire around the pin on the switch before you try to solder the wire to the pin. Also, look at the schematic for the digital output port and verify that you are selecting the correct header pins to solder to.)
7. Slide the heat shrink tubing over the pins.
8. Use the heat gun to shrink the tubing over the pins. Keep an eye on the tubing as you heat it. Keep the heat on just long enough to shrink it: only a few seconds. Be careful that you don't burn your fingers in the process.

Testing the switch

9. Write a test program called `switch_test.c` that will allow you to test that the switch has been wired correctly. Your program should read the state of pin that you connect the switch to using the `digital()` function and print the result to the LCD screen. Verify that your program functions properly by checking that the state of the pin changes when you alternately close and open the switch. (You may want to also print out the state of one of the pins that is not connected and compare its value to the pin that has the switch connected to it. Before the switch is closed, the state of both pins should be the same.)

Building the digital output circuit

10. On the solderless breadboard, build a circuit that will enable you to turn on an LED using one of the digital output pins. (An 74HC374 chip drives the digital output pins on the EB. It is *possible* to drive the LED directly from one of the output pins, because each pin can source 35 mA or sink 20 mA at most, and the chip can handle a maximum of 75 mA as a combined total for the eight outputs. But it is good practice to stay away from the maximum limits, and interface the digital circuit to a power control circuit. Therefore, drive the LED using a transistor!)

Important: when you use an external power supply to power the LED, the external supply common and the ground associated with the pin must be at the same potential. This can be done by connecting a wire from the power supply common to one of the grounds of a digital pin.

Don't forget current limiting resistors for the base and collector. Calculate the collector and base currents. Include this in your report.

Applying what you've learned

11. Write a program that will check the state of the switch and turn on the LED if the switch is closed.
12. Modify your program to turn off the LED when the switch is pressed.
13. If you have time, write some other programs to explore the digital input/output capability of the Handy Board and Expansion Board.

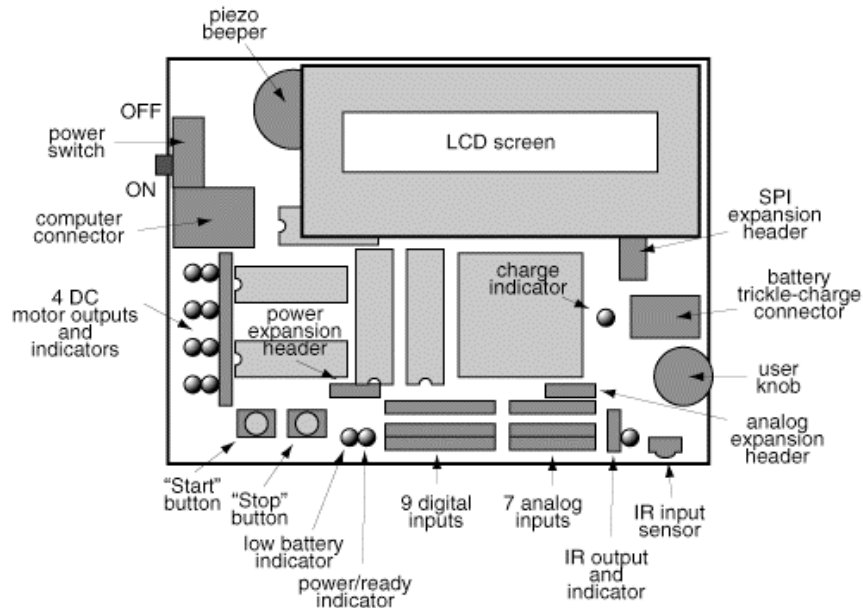


Figure 1 Handy Board Diagram. The Handy Board is based on the 52-pin Motorola MC68HC11 processor, and includes 32K of battery-backed static RAM, four outputs for DC motors, a connector system that allows active sensors to be individually plugged into the board, an LCD screen, and an integrated, rechargeable battery pack. (ref.: <http://handyboard.com/hardware/index.html> and <http://handyboard.com/hlabel.html>)

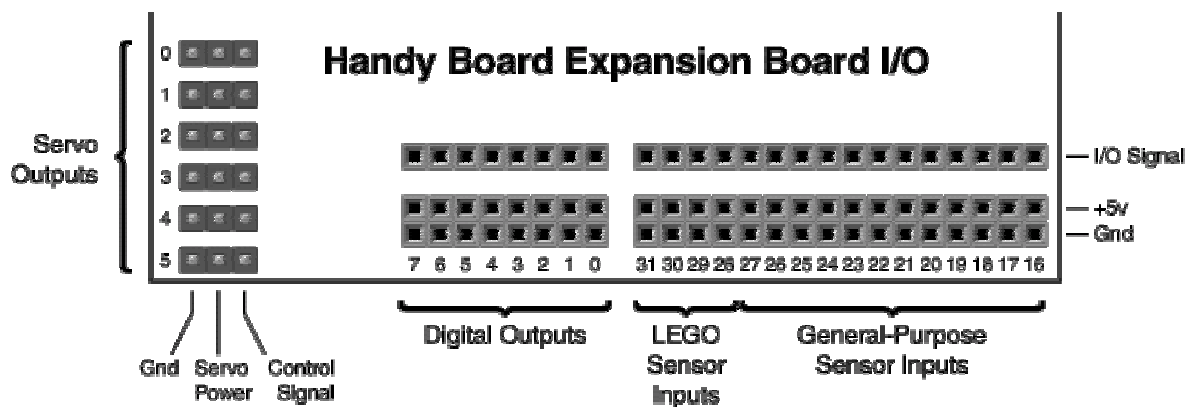


Figure 2 Expansion Board Diagram. The expansion board plugs on top of the Handy Board and provides additional I/O pins as well as R/C servo outputs. (ref.: <http://handyboard.com/hbexp30/>)