CEEN 1060 Microprocessor Applications Spring '07

LABORATORY 7
Completion Demo: week of 4/2/07

TekBot^{TM} MICROCONTROLLER BOARD

OBJECTIVES:

The purpose of Laboratory 7 is to replace the Analog Brain Board on the TekBot with a digital microcontroller board. This will provide the existing TekBot platform features such as added control and expandability.

PROCEDURE:

Several files have been included on the CEEN 1060 Blackboard site to aid in the assembly of your TekBot microcontroller board. Two video files provide clear instructions. These should be viewed along with this handout. The AVR tutorial file should be read before and consulted during the programming of your ATmega32 microcontroller. In the past, several students have damaged equipment and their systems because of failure to ***READ*** the instructions. Don't consult the handouts to solve problems; use them to avoid problems. Of particular interest is the disabling of the JTAG interface and the powering of the ISP.

REPORT:

No report is required for Lab 7. Twenty course points will be awarded by the lab instructor for your demonstration of a working, microcontroller based TekBot. This is an individual assignment and must be completed during your lab period of the week of 4/2/07.

CEEN 1060 Microcontroller Assembly Instructions
Ver. 1.1

1. Verify Parts Kit

The parts kit should include the parts and quantities listed in Table 1. Verify your kit includes these before constructing the board. A photograph of the parts is shown in Fig 1.

Part	Quantity
ATmega32	1
40 Pin Soldertail Socket	1
SIP Resistor - 470	2
Potentiometer -10k	1
Resistor - 10k	1
Resistor - 470	1
Diode - 1N4001	1
8 Position DIP Switch	1
Lumex 16X2 LCD Display	1
Female Header 0.100 36 Contacts	2
Male Header 0.100 36 Contacts	2
Tactile SPST	1
7805 Regulator	1
4.7uF capacitor	2
.1uF capacitor	1
Shunt Connector	4
LED Bar Graph 10-Segment Green	1

Table 1

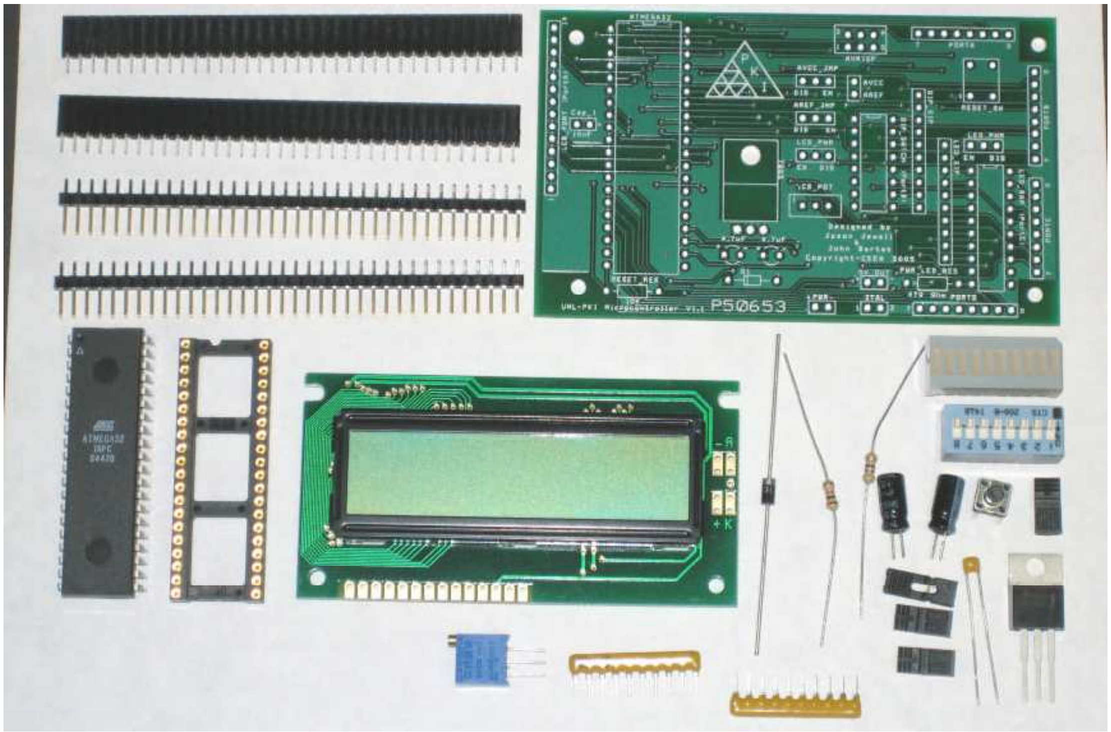


Figure 1

2. 40 Pin Soldertail Socket

Solder the 40 pin Soldertail Socket into position. Place the socket into the board with the notch pointing toward the top of the board. Results shown in Fig 2.

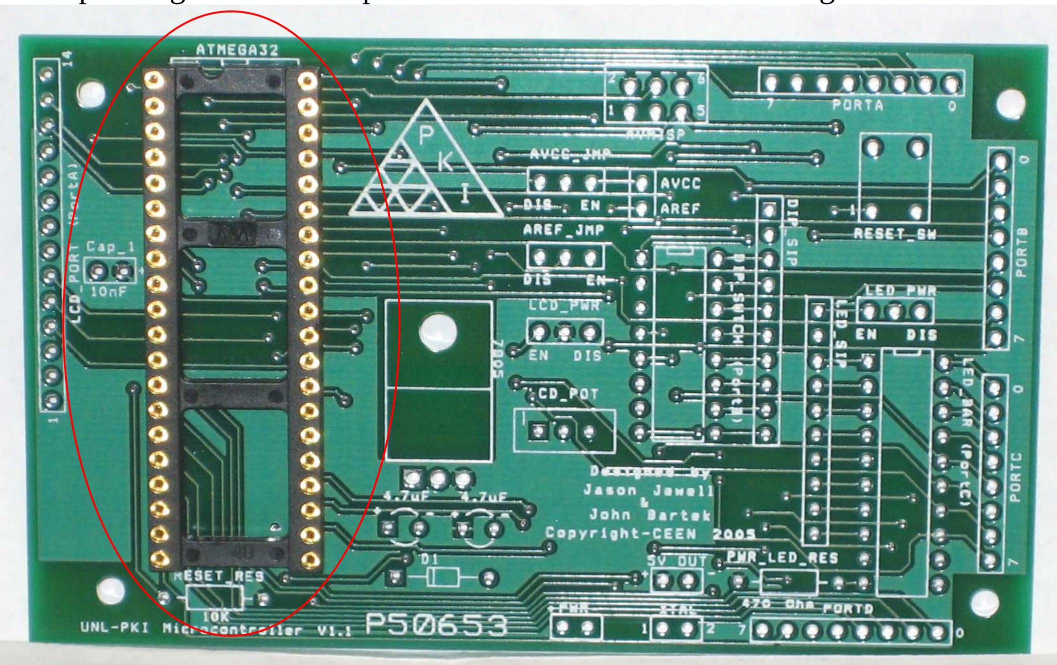


Figure 2

3. 7805 Regulator

Insert the 7805 into the board and bend down so it lays on the board as shown in Fig 3.

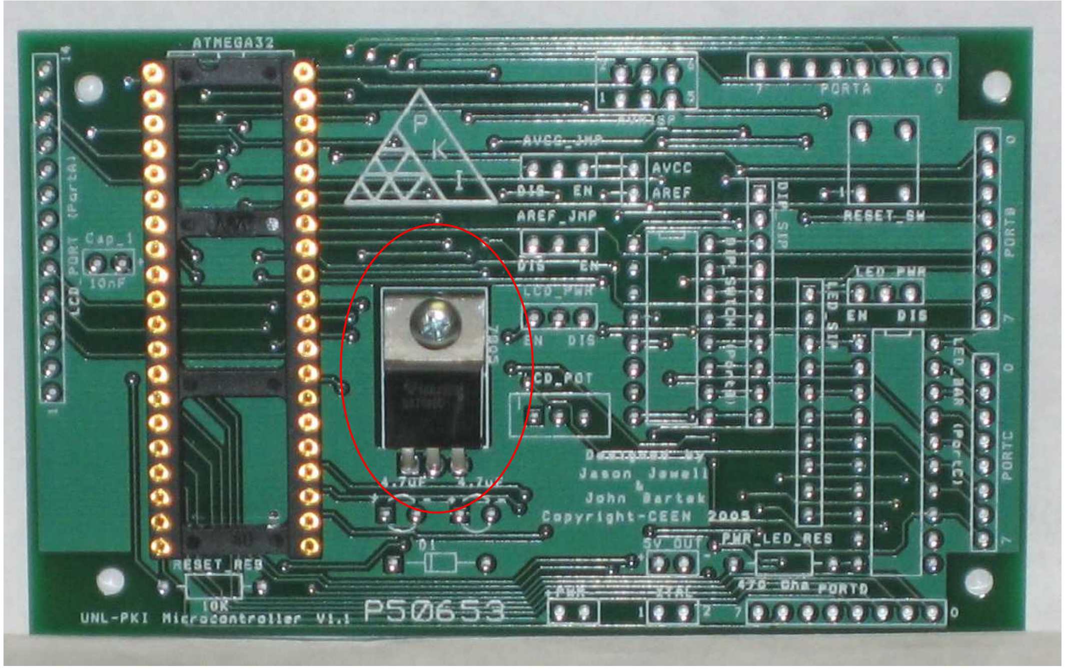


Figure 3

4. **Sip Resistors**
   Insert the two SIP resistors making sure the dot is pointing toward the top of the board. The board should now look like Fig 4.

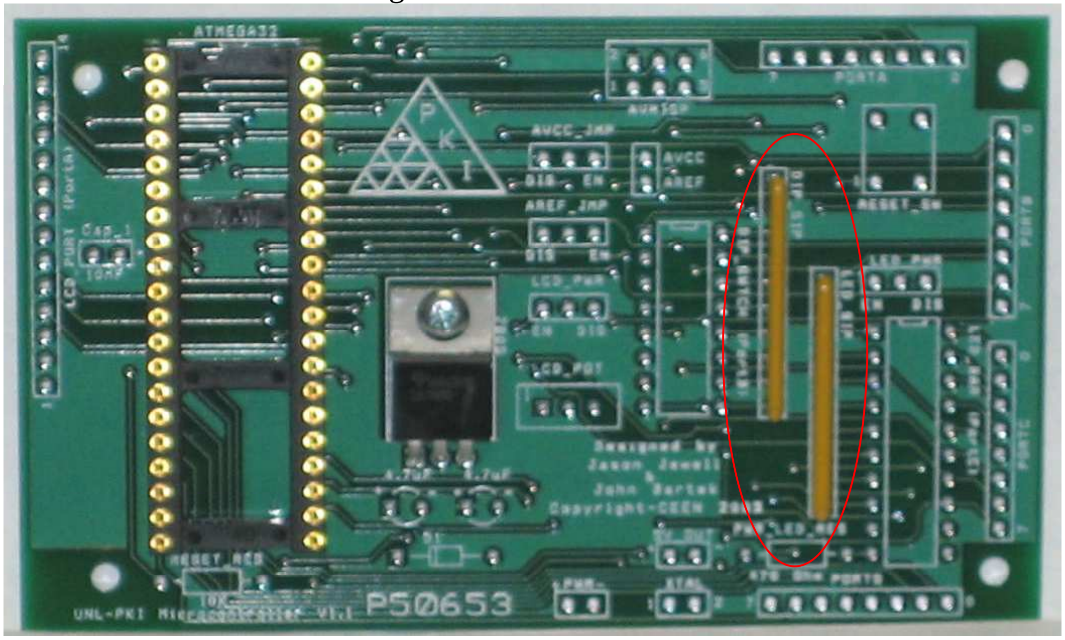


Figure 4

5. **Power LED Resistor**
   Insert the 470 Ohm resistor in the location labeled PWR_LED_RES as shown in Fig 5.

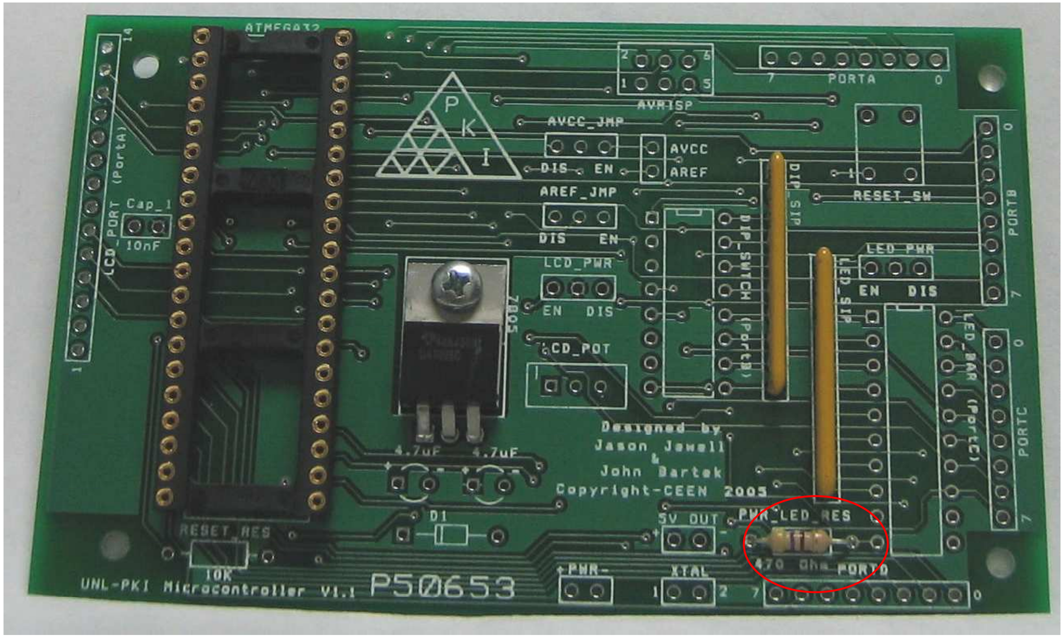


Figure 5

6. **Pull-up Resistor**
   Insert the 10K resistor as shown in Fig 6.

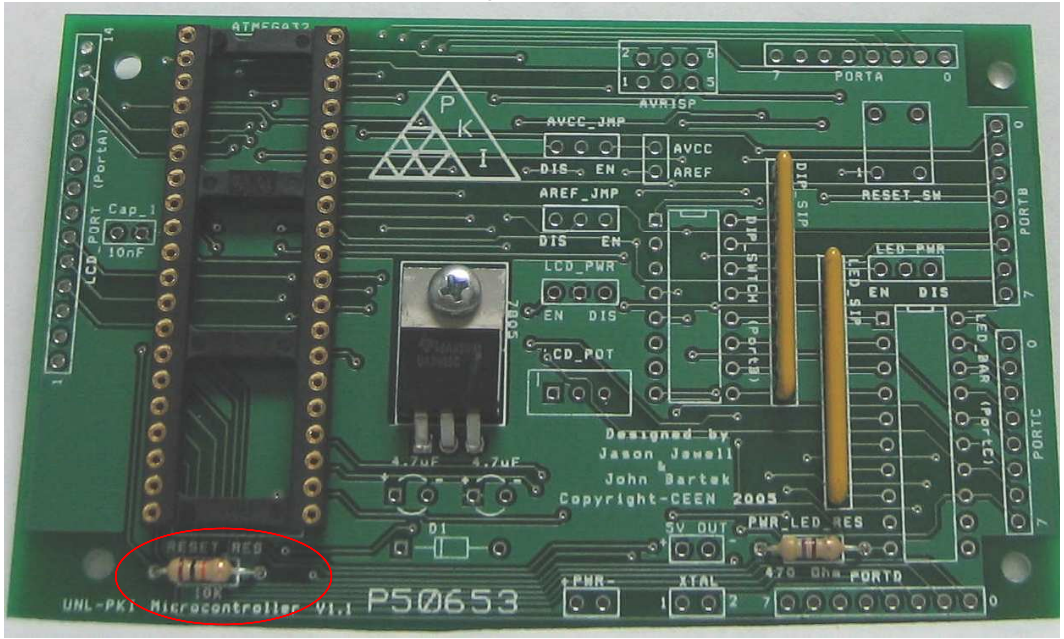


Figure 6

7. **Diode**
   Insert the diode as shown in Fig 7.

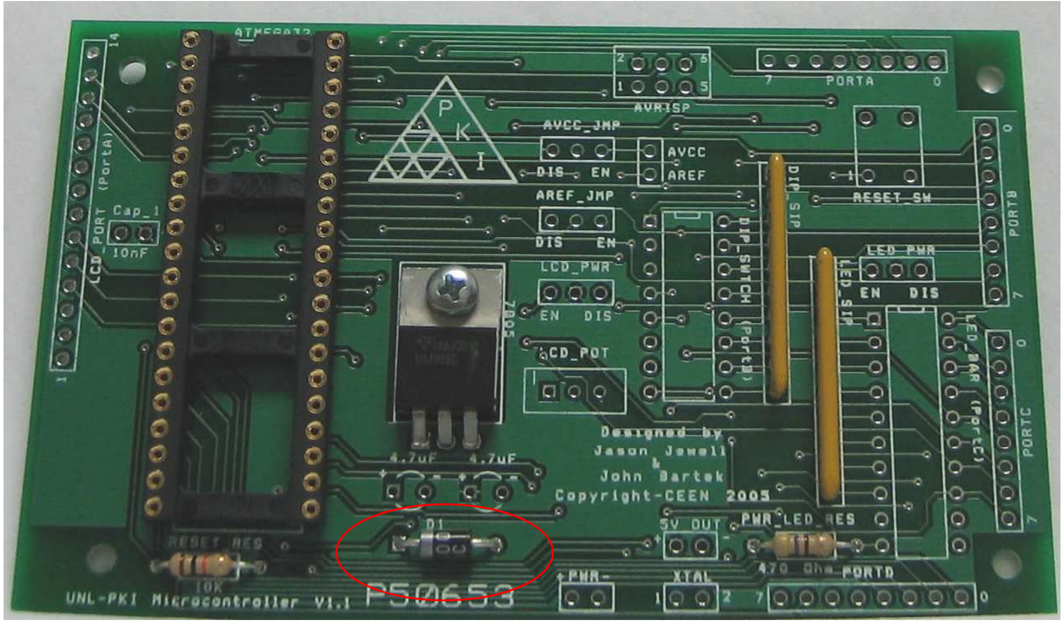


Figure 7

8. **100nF Cap_1**
   Insert the 100nF capacitor as shown in Fig 8.

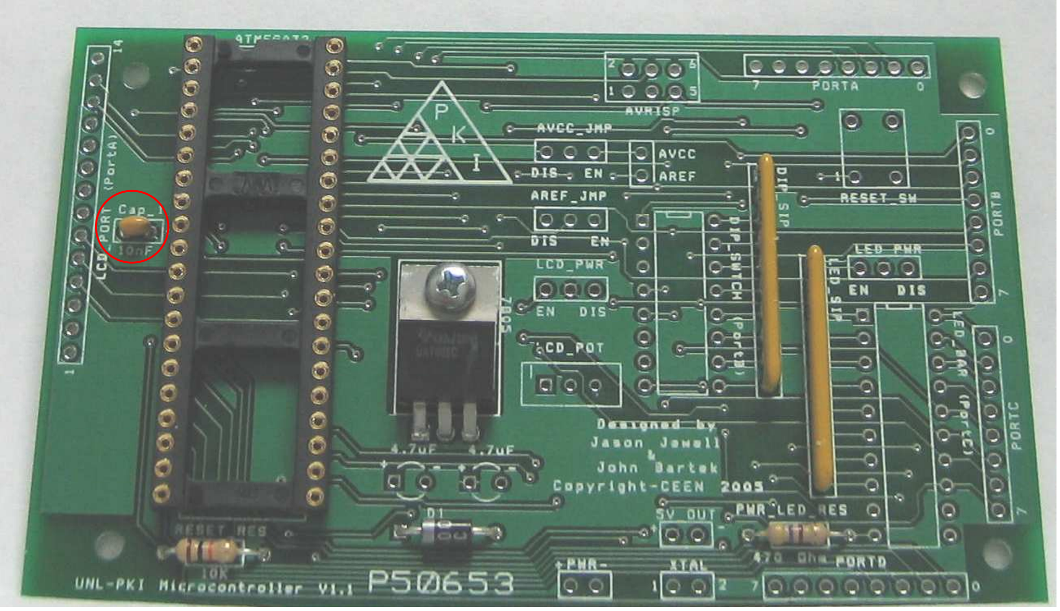


Figure 8

9. **Tactile SPST (Reset Switch)**
   Insert the switch as shown in Fig 9. The legs should match with the holes exactly. The switch is not square, if the legs do not match with the holes rotate the switch 90 degrees.

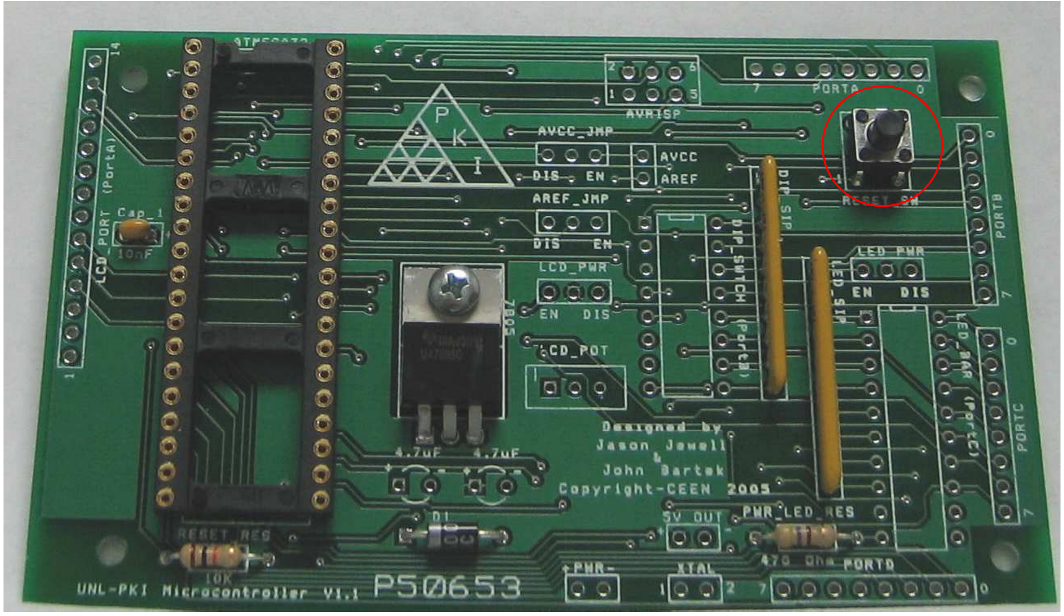


Figure 9

10. Male Header

Solder male headers for the AVRISP, AVCC_JMP, AREF_JMP, LCD_PWR, LED_JMP. When finished the board should look like Fig 10.

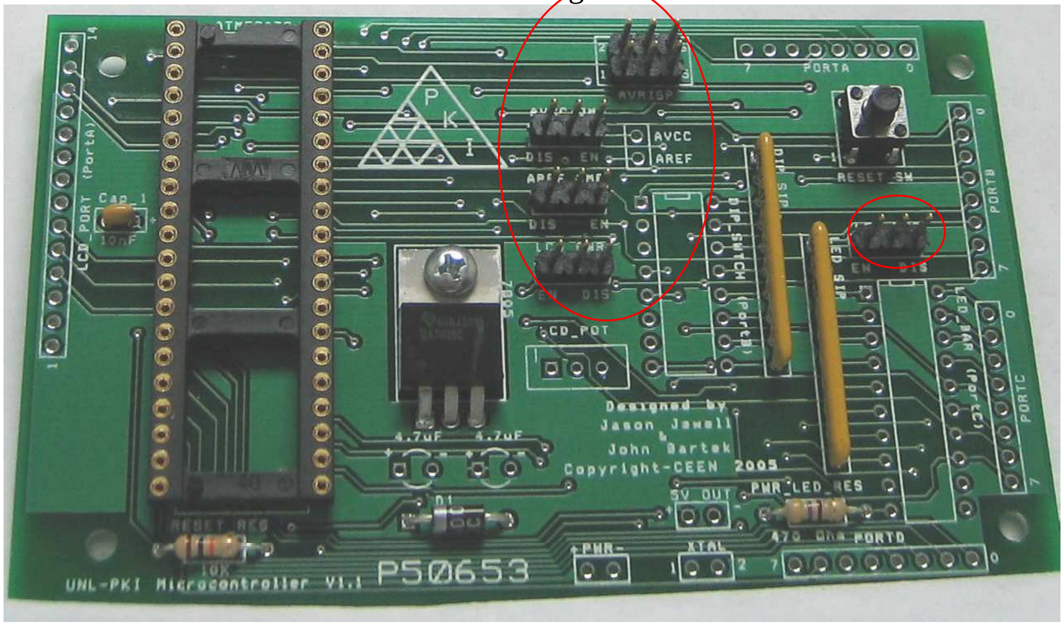


Figure 10

11. Female Header

Solder female headers for PORTA, PORTB, PORTC, PORTD, LCD, PWR, 5V_OUT, XTAL, and AVCC/AREF. When finished the board should look like Fig 11.

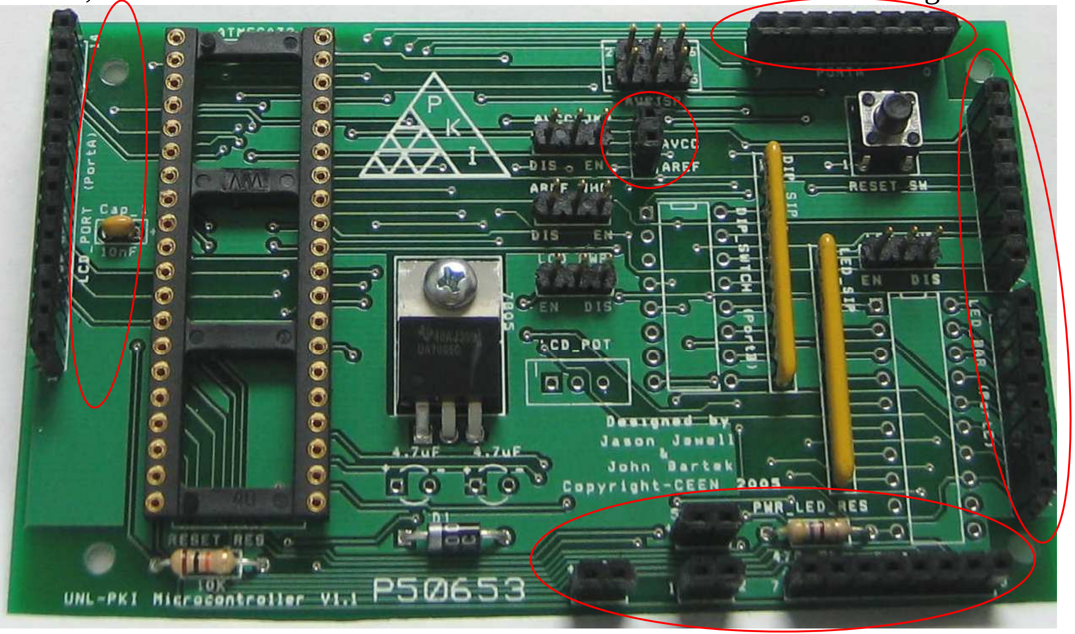


Figure 11

12. Capacitors

Insert both capacitors with proper polarity per the notations on the board. The result should look like Fig 12.

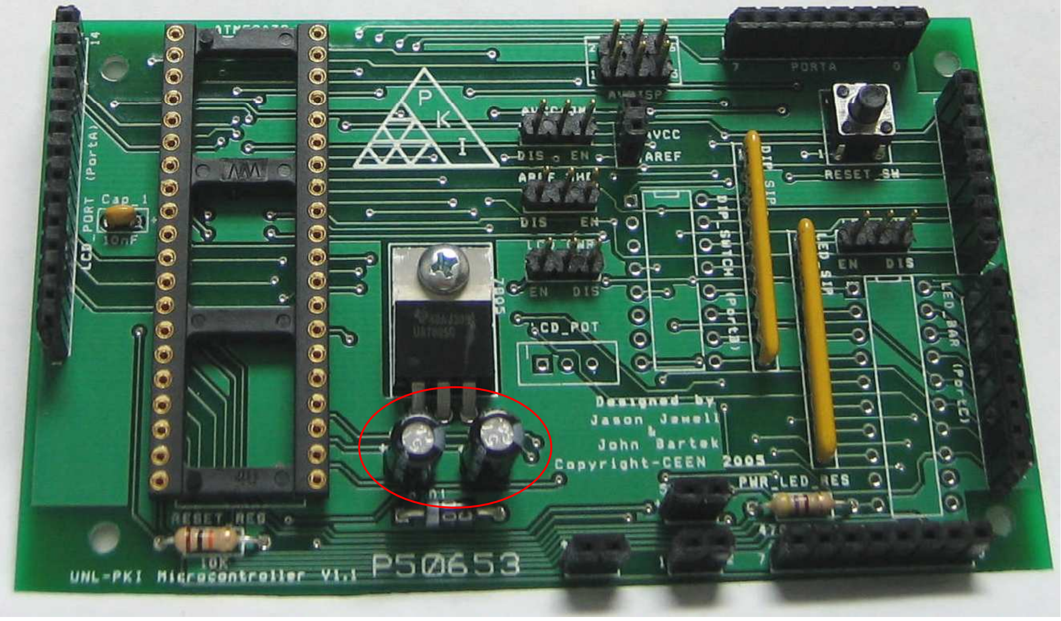


Figure 12

13. Potentiometer

Insert the potentiometer in the location marked LCD_POT. The resultant board should look like Fig 13.

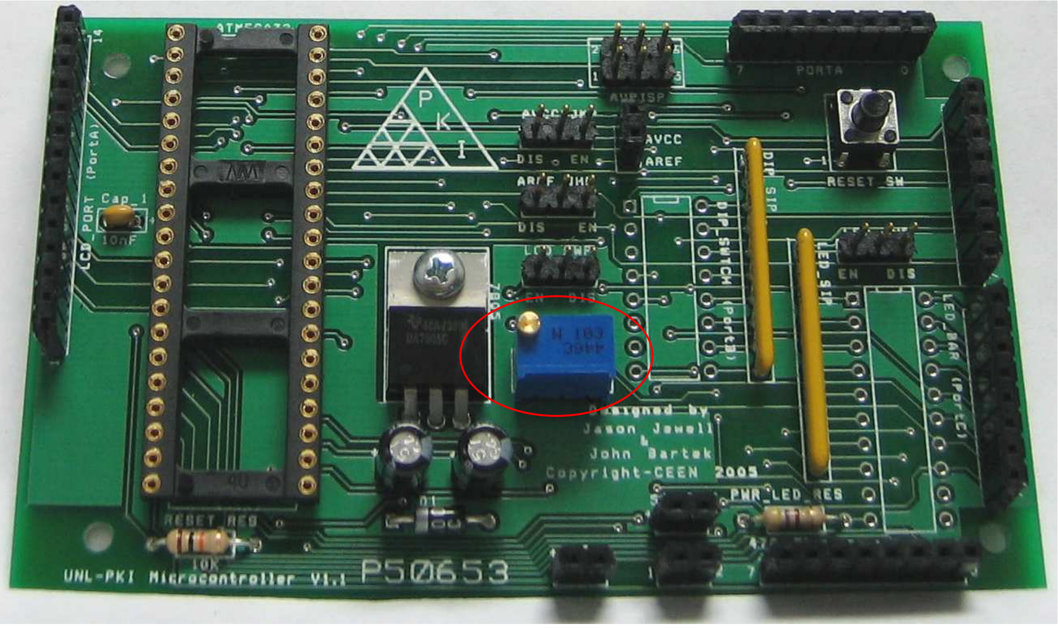


Figure 13

14. DIP Switch

Insert the DIP switch with the dot facing toward the top. The board should look like Fig 14.

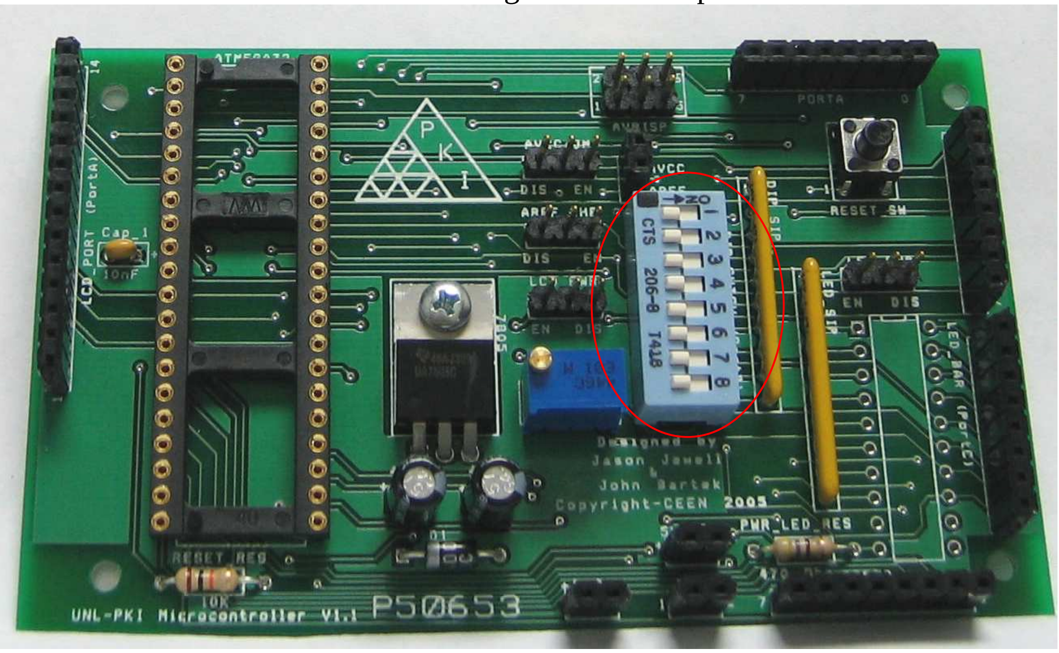


Figure 14

15. LED Bar

Insert the LED bar with the notch facing toward the top of the board. Board should now look like Fig 15.

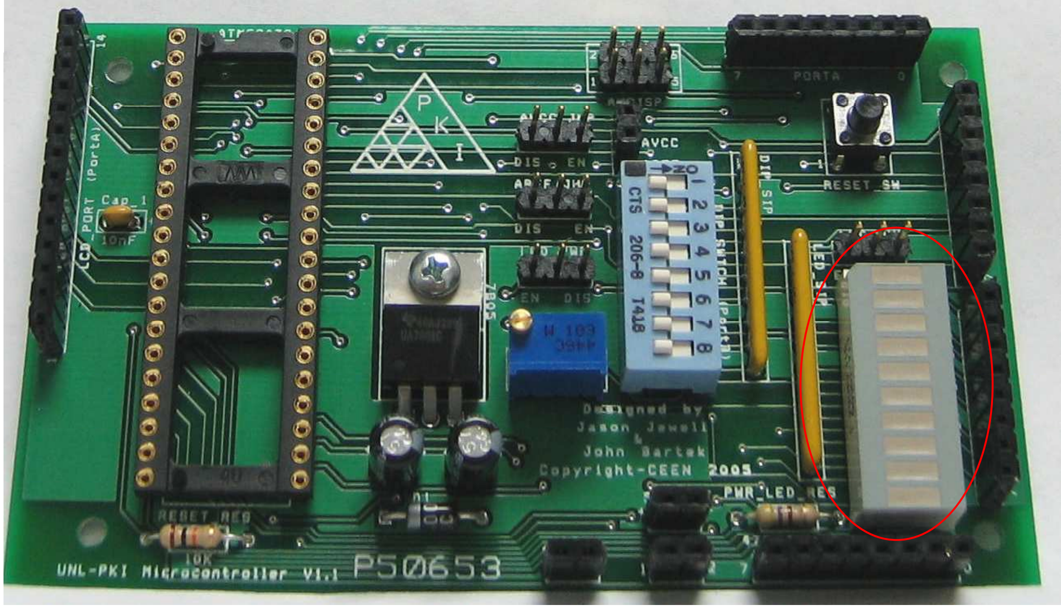


Figure 15

16. LCD Display

Solder the Male header into the LCD display so it looks like Fig 16.

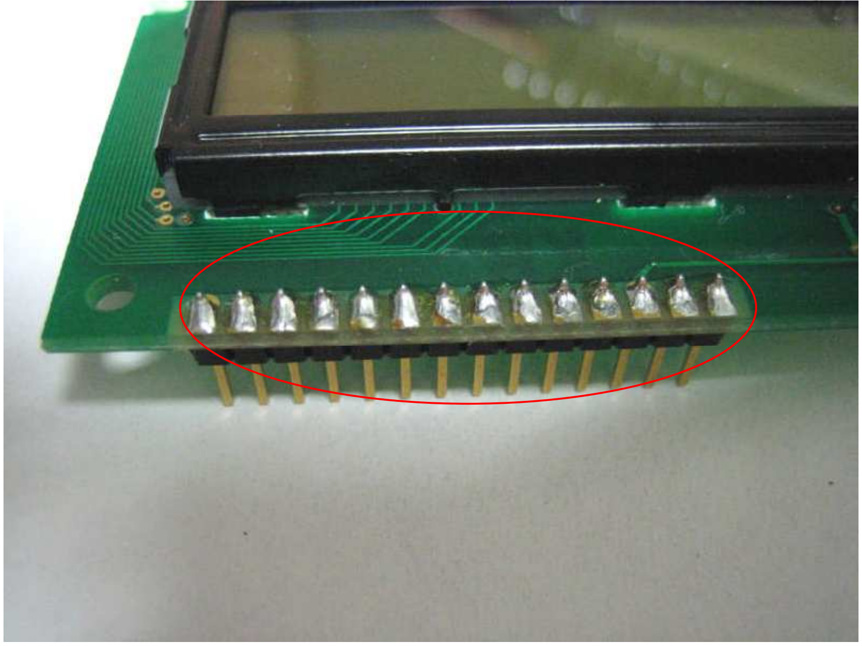


Figure 16

17. Connecting LCD to LCD Port

The LCD connects into the LCD Port as shown in Fig 17.

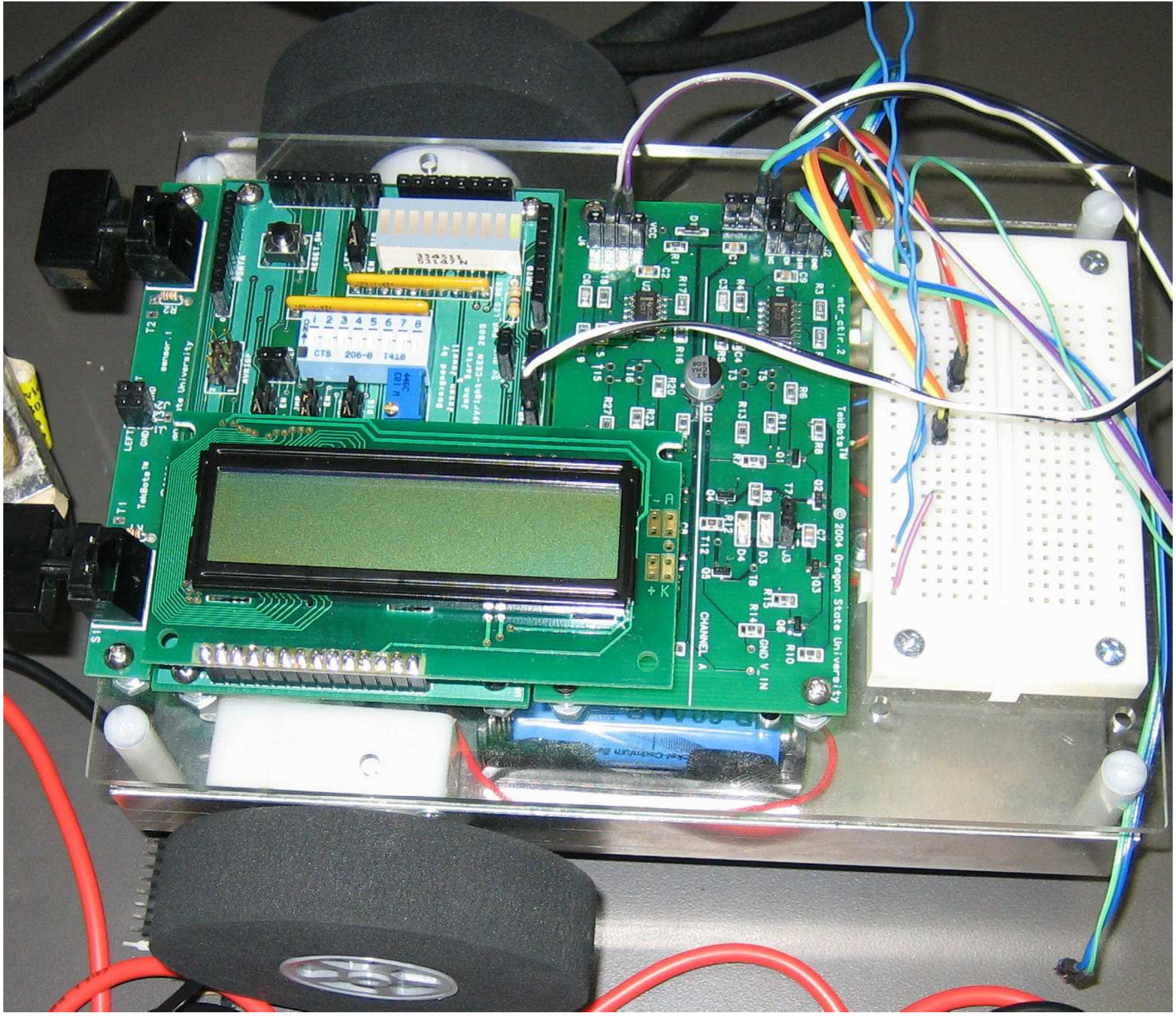


Figure 8

PROCEDURE:
Programming The Microcontroller Board

The objective for Laboratory 7 is to introduce programming the AVR microcontroller. For this particular laboratory, the assembly file has already been written. This will be the file that will be assembled and used to program your microcontroller.

Future TekBot laboratories will require you to write, assemble, and program the microcontroller with your own source code. To this end, a supplemental tutorial is included that will aid you in the process.

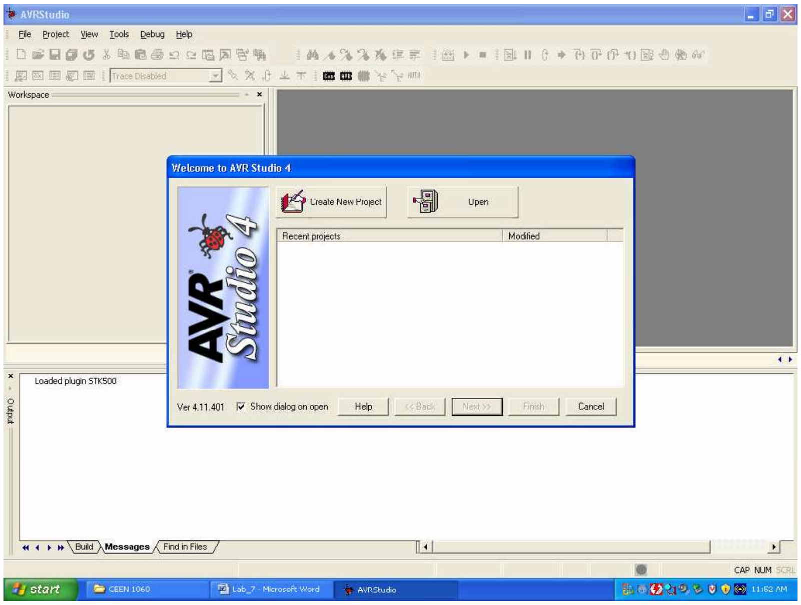
1. Before any type of programming is done, the target board must be set up properly. Disconnect the LCD from the board. Disconnect the motors and the sensors from the target board. We need to make sure that the power is conserved for programming via the ISP, since the microcontroller board is the supplier of power to the ISP Programmer.

2. Next, note that a text file named "TekBot_code" should be downloaded to the desktop. Assemble this code to create a hex file for programming your TekBot.

3. Connect the ISP Programmer to the back of the computer through COM port 2 and fasten down.

4. THE POWER ON YOUR TEKBOT MUST BE "OFF"!! MAKE SURE THIS IS THE CASE, OTHERWISE, IT WILL DAMAGE THE ISP PROGRAMMER!! Connect the ISP Programmer to the target board.

5. From the Start Menu, select AVR Studio and open. From here, you should see a pop-up screen that will ask you if you would like to create or open an existing project. Click "cancel" to exit out of this.

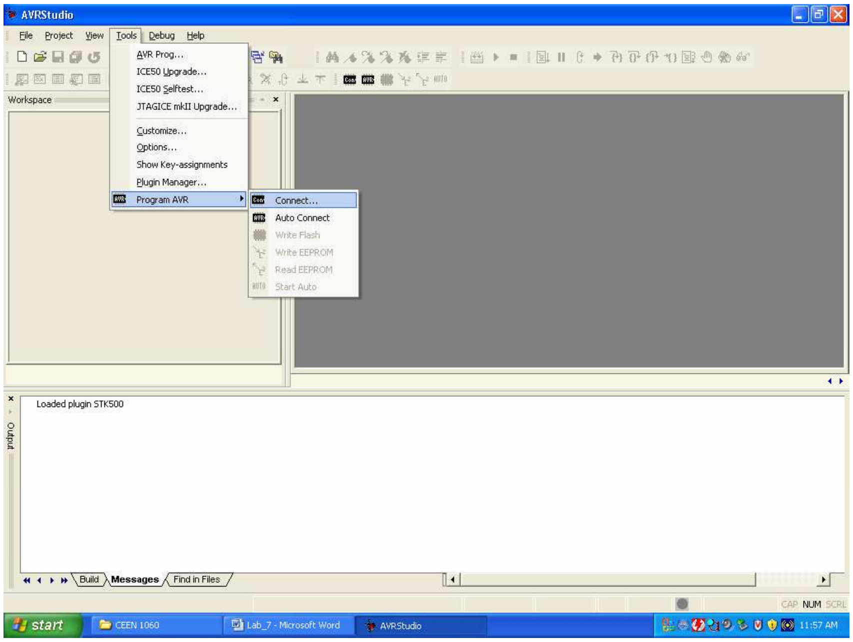


Loaded plugin STK500

Ver 4.11.401 ☑ Show dialog on open

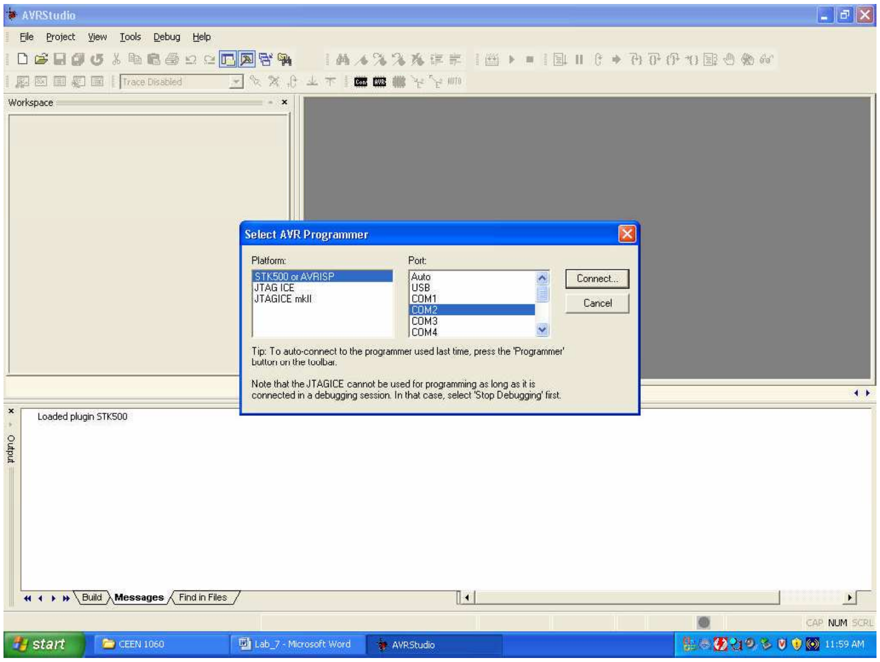
6. Next, turn on the power to the microcontroller board. Make sure the LED comes on. You should also see that the LED on the ISP will transition from red-orange-green, then remain green. This means that the ISP is ready for programming.

7. Select **Tools—Program AVR—Connect**.



Loaded plugin STK500

8. Select AVR ISP and COM2 from the popup window. Then hit “Connect”



Loaded plugin STK500

Select AVR Programmer

Platform:
STK500 or AVRISP
JTAG ICE
JTAGICE mkII

Port:
Auto
USB
COM1
COM2
COM3
COM4

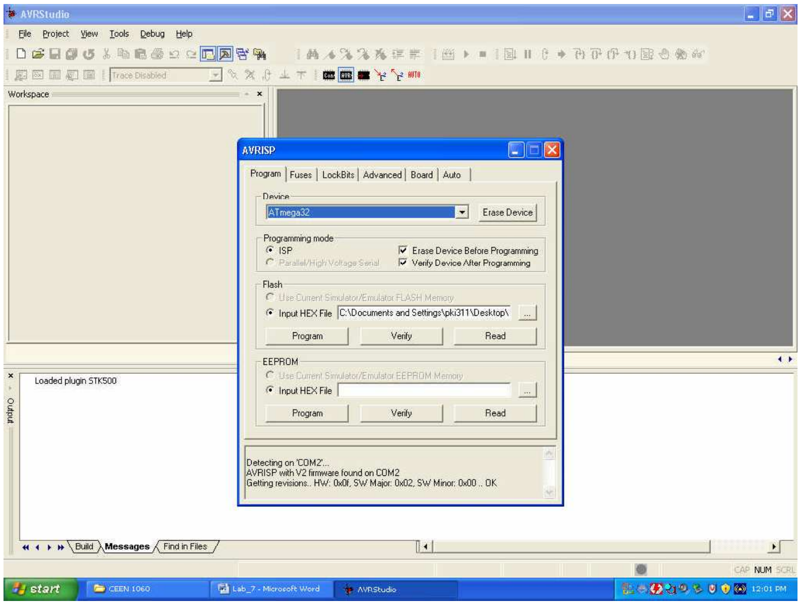
Connect...

Cancel

Tip: To auto-connect to the programmer used last time, press the 'Programmer' button on the toolbar.

Note that the JTAGICE cannot be used for programming as long as it is connected in a debugging session. In that case, select 'Stop Debugging' first.

9. From the popup window below, you need to select the ATMega32 from the device list.



Device: ATmega32

Programming mode
● ISP
○ Parallel/High Voltage Serial
☑ Erase Device Before Programming
☑ Verify Device After Programming

Flash
○ Use Current Simulator/Emulator FLASH Memory
● Input HEX File C:\Documents and Settings\pki311\Desktop\

EEPROM
○ Use Current Simulator/Emulator EEPROM Memory
● Input HEX File

```
Detecting on 'COM2'...
AVRISP with V2 firmware found on COM2
Getting revisions.. HW: 0x0f, SW Major: 0x02, SW Minor: 0x00 .. OK
```

```
Loaded plugin STK500
```

10. Verify that device is “ATmega32.” Then click the “Fuse” tab. Verify that “Enable JTAG Interface” is disabled. Verify that “Brown-out detection level=2.7 V” is enabled. Verify that “Int. RC Osc. 1 MHz, Start-up time: 6 CK + 0 ms” is selected. Lastly verify that “Boot flash section size =256 words” is selected. Everything else should not be selected.

11. Click the “Program” tab. Click the “…” icon by “Input HEX File.” Select the hex file that will be used to program the ATmega32. This HEX file will have the same name as the assembly file.

12. After the HEX file has been selected click “Program.” This will program the ATmega32. Once this is completed verify that the code works as expected. ***Please note: The light on the ISP will signal orange when in the programming mode. If the light is green after programming, the ATmega32 has been programmed successfully. If the light is red, you must re-program. (Refer to Message Window in AVR Studio)***

INSTRUCTOR VERIFICATION SHEET
(Turn This In to Receive Completed 20 Points For this Laboratory)

VERIFICATION OF FUNCTIONALITY AFTER PROGRAMMING:

Light Turns On______________________

Motors Work________________________

RESET Works_______________________

LEDs Work_________________________
(Test Separately)

LCD Display Works__________________
(Test Separately)

Programmed Correctly_______________