M.E. 530.420 Lab 3: Getting Started with the 
JHURSAEB and the MaEvArM Microprocessor
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Laboratory Due Date: 5:30PM Tuesday September 27, 2011 at 115 Hackerman Hall
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Reading:  
Text Section 7.1, 7.2  
JHURSAEB Manual: Download the latest version here:  
https://jshare.johnshopkins.edu/lwhitco1/JHURSAEB  
MaEvArM Website: Contains information on setup and basic functionality of the  
MaEvArM:  
https://alliance.seas.upenn.edu/~medesign/wiki/index.php/Guides/MaEvArM

Apparatus:  
MaEvArM, JHURSAEB, AVR Studio 4 on a PC, Flip 3.4.3 on a PC, USB Mini B cable, Oscilloscope.

Software:  
The computers in the Wyman 140 lab are loaded with a complete set of  
development software for you to use. If you prefer to install the development  
software on your own computer, see the JHURSAEB manual section entitled  
“Development Environment Installation” for detailed instruction on how to  
install development software.

Header Files/Source Code Required:  
  • maevarmGEN.h/.c,  
  • maevarmUSB.h/.c

Pre-Lab Preparation:  
You must read the following webpages and JHURSAEB Manual sections covering the following  
topics and commands in advance of the lab:  
  □ The entire JHURSAEB Manual section entitled “Creating, Compiling, and Running  
    Code on the JHURSAEB/MaEvArM”  
  □ The entire JHURSAEB Manual section entitled “USB Communication –  
    maevarmUSB.h/.c” documenting functions including  
    a. usb_initialize() and  
    b. usb_printf().  
  □ The entire JHURSAEB Manual section entitled “General MaEvArM Functions -  
    maevarmGEN.h/.c” functions functions including the following:

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a. delay_ms(),
b. delay_us(),
c. IO_mode(),
d. IO_out(), and
e. IO_read().

☐ MaEvArM Getting Started in Windows:
https://alliance.seas.upenn.edu/~medesign/wiki/index.php/Guides/MaEvArM-starting
☐ MaEvArM usb communication page:
https://alliance.seas.upenn.edu/~medesign/wiki/index.php/Guides/MaEvArM-usb

Review and how to use the following C language concepts:
☐ Declaring/using variables (char, int, float)
☐ Math operations (+,-,*,/,etc.)
☐ Preprocessor directives (#define, #include)
☐ Commenting (// or /* */)
☐ For loops
☐ While loops
☐ If else loops
☐ Function declarations/calls

For each question in this lab, please hand in a copy of your program, relevant circuit diagrams and derivations, and (when appropriate) a printout of the oscilloscope plot (and/or PC Terminal) that demonstrates the operation of your program. Hand in a printout of each program you write. Be sure to identify your secret code and your partner’s secret code in the comments of your program.

Note on printing the serial terminal screen: The terminal does not provide a facility to print the terminal output, but there are several methods to accomplish this task.

a) Method 1:
   i) Run the “printkey.exe” utility. When printkey.exe is running, its icon will appear in the program tray at the lower right of your screen. Printkey.exe is installed on the lab PCs, and is posted on the course web site.
   ii) When you press “ALT-PRINTSC” when the terminal window is the active window, the printkey utility will pop up, showing a screen capture of this active window. Press the big “PRINT” button on the printkey window to send this image to the printer.

b) Method 2:
   i) COPY the terminal output image by pressing ALT-PRTSC when the terminal window is the active window.
   ii) PASTE the image into Windows “paint” program.
   iii) Print the file (use landscape page format). You can also save the file, or paste it into a document.
1) Create and run a program to display the words “Hello World”, once each second, once on each line, on the terminal of a PC connected to a MaEvArM. Hand in a printout of your program. For example, my program reads as follows:

```
// My first program to write a single line to the terminal
// 2011 06 27 LLW
// First include the standard header files
#include "maevarmGEN.h" //include the general header
#include "maevarmUSB.h" //include the USB header

// Second here is the main program itself
int main()
{
    //initialize usb communication
    usb_initialize();

    // loop forever in this while loop
    while(1)
    {
        // top of loop

        // Write a line saying "Hello World" to the terminal
        usb_printf("Hello World\n");
        //delay 1000 ms
        delay_ms(1000);
    }
    // bottom of loop

} // end of main()
```

2) Digital Output:
   a) Write a program using while loops, the delay_ms() function, the IO_mode() function, and the IO_out() function that generates a 1 Hz square wave output on pin B0 of the MaEvArM. Run it, and verify that it accomplishes this objective with the oscilloscope. Hand in a printout of your program.
   b) Hand in an annotated scope plot of your 1Hz output. Be sure to annotate voltage level, amplitude, and period of the signal.
   c) What voltage is Vss?
   d) What voltage is Vdd?
   e) Use your voltmeter to measure the diode drop of your LED. What is it?
   f) Design a circuit that attaches a LED to the digital output B0 of the MaEvArM. Design your circuit to ensure that the diode current does not exceed the current capability of the MaEvArM and the diode – I recommend your LED draw about 10 mA. Show your full circuit. Label all external connections where they connect to the MaEvArM.

**With the MaEvArM turned off (i.e. no power) wire up your circuit, show your circuit schematic, calculations, and wiring to the TA before proceeding to the next step!**

   g) Power up and run your program. Debug as necessary. Verify that the LED is flashing as desired.
3) Experiment with variables.
   a) Write a program that uses integer int and floating-point double variables. Hand in a copy of your program. Be sure to comment your program.
      Your program should:
      i) Allocate one of each of these variables.
      ii) Initialize their value to zero
      iii) Perform an infinite loop in which:
            (1) A label indicates the top of the loop
            (2) The variable values are each incremented by one.
            (3) The variable values are printed out as decimal values on a single line, For example, if your int and double variables were named I and D, respectively, use a printf statement something like:

               \texttt{usb_printf(\texttt{\textquotedblleft I is \texttt{\%d} and D is \texttt{\%f} }\texttt{\textbackslash n\textquotedblright},I,D);}

            (4) The program jumps to the top of the loop.
   b) How many bits comprise a variable of type int in this development environment?
   c) How many bits comprise a variable of type double in this development environment?
   d) Hand in a screen shot of the terminal output.

4) Digital input and if else statements:
   a) Design a circuit using momentary pushbutton switch and a 1,000 Ohm resistor such that:
      i) When the button is pressed, B7 is HIGH (5V).
      ii) When the button is NOT pressed, B7 is LOW (0V).

      With the MaEvArM tuned off (i.e. no power) wire up your circuit, show your circuit schematic, calculations, and wiring to the TA before proceeding to the next step!

   b) Write a program that reads a digital input from B7 of the MaEvArM, and performs an action (such as blinking the LED that is attached to B0) when this digital input is HIGH, but DOES NOT perform this action when the input from B7 is LOW. Use the if else statement in your program.
      Your program comments should clearly explain the intended function of your program.
      Hand in a printout of your program.
   c) Power up and run your program. Debug as necessary. Verify that the program performs as desired. Hand in a screen shot of the terminal and/or scope shot of the signals if it contains relevant information.
5) **Design Project:** Design input and output circuits to perform a function of your choosing. Your system must use at least

- One (or more) pushbutton input
- Two (or more) LED outputs

and one or more of each of the following:

- a variable,
- `usb_printf` function
- `if` statement

a) Describe in words the operation of your system.

b) Document your program and circuit. Hand in a COMMENTED program and a clearly labeled circuit diagram.

c) Demonstrate your system to your TA. Have your TA sign your lab cover sheet.

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- For each question be sure hand in a copy of your program, relevant circuit diagrams and derivations, and a printout of the oscilloscope plot (and/or PC Terminal) that demonstrates operation of your program.
- Note your secret code on your lab report.
- Note your lab partner’s secret code on your lab report.
- Note your workstation number on your lab report.
- Remember to show your work.
- Typed or hand-written lab reports are OK. Messy or ambiguous lab reports will be rejected.
- Please clean up your workstation to perfection when you are done!
Cover Sheet for 530.420 Lab #3: Getting Started with the JHURSAEB and the MaEvArM Microprocessor

Use this cover sheet for your lab writeup.

My Secret Code: _______
Fill in the secret code which was provided to you on your graded lab#1.

My Lab Station: _______

My Partner’s Secret Code: _______

Design Project Demonstration! TA’s Signature & Date:
Your TA will sign here after you have demonstrated your working project (question 5) to him/her

Lab Station Clean! TA’s Signature & Date:
Your TA will sign here after you have finished your lab, cleaned up your lab station to perfection, and shown your lab station to your TA.