Experiment #9: (Not so) Simple Three Function Calculator

ECE 367 – Microprocessor Design (Spring 2013)

PROFESSOR: Robert Becker

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MWF – 10:00AM – 11:50PM

T Lab: 8:00AM – 10:50AM

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Date Prepared: Sunday, March 31st, 2013

Date Submitted: Tuesday, April 2rd, 2013

I. Logic Diagram

II. Schematic Diagram
    I. See attached sheet following this page.

III. 9S12 Assembler Program

IV. USER MANUAL

I. Start Up

I. To start this system, use the USB to miniUSB cable and connect to computer. If you have a USB-outlet adapter, power may be supplied this way as well.

II. Verify the system is in “Run” mode (the switch on the microcontroller board).

III. Press the reset button to begin (left-most black button).

II. Operation

I. After pressing the reset button, the system directions will be displayed on the screen.

II. At any time during operation, you can press “C” once to clear the last entered number, and “C” twice to clear all variables.

III. The calculator will then display the currently loaded operands and answer. Line 1 will display “1:0000 2:0000”, followed by line 2 “Ans: 000000”.

IV. To operate the calculator, simply enter the first operand by typing in the desired value. The numbers will load from right to left.

V. Then enter in the operator denoted by the following:

I. A – addition

II. B – Subtraction

III. C – Multiplication

VI. After you have pressed the operator button (A,B,or C) you will then enter the second operand by typing in the desired numerical value. The numbers will load from right to left.

VII. When both operands have been entered and the operator has been entered, pressing the “E” button will give you the answer to the problem.

VIII. At this point, if you have another operation you would like to complete, simply begin entering the first operand, and the calculator will automatically clear all variables for you and enter the next number.

III. Shut Down

I. To shut the system down, disconnect the power source (USB cable) from the breadboard.

V. Conclusion.
    I. How well does your project meet the specifications?
        I. It meets the basic 3 operator experiment requirements (Addition, Subtraction, Multiplication)
        II. It also implements the double clear. Pressing C once will clear the last digit, while pressing C twice in a row will clear all memory.
        III. The system is also capable of continuous operation, meaning after the user finds a solution to one problem, they simply need to begin entering the first number of the next problem and the calculator will automatically clear the variables.
    II. What were the most difficult issues in realizing the system?
        I. I wanted to enter the inverse function as well as the four decimal place division, but I didn't plan well and was unable to complete them with the time I had.
    III. Were you able to add extra features? If so, explain them.
        I. As stated above, I added the double clear functionality.
        II. It is capable of continuous operation.
    IV. What would you have done differently if you were to do this project again?
        I. I would have planned out the functions better, they're a little messy and I would have also figured out how to perform the inverse function as well as the 4 decimal division.
    V. What did you learn from working on this project?
        I. I learned that I need to plan larger projects a little better and use psuedocode to start with.
        II. I also understand the basic math functions of the calculator much better than I had before.
        III. This project also gave me some good ideas on simplifying number displaying, and ASCII conversion.
        IV. Because this was a relatively complex project, I learned many different methods of manipulating registers and using dummy variables to store temporary values for subroutines.
        V. It has also given me better ideas for code organization, and standard processing, such as pushing variables onto the stack and saving variables for use by other procedures, etc.