Laboratory 3 – C Programming

This Laboratory should take an average student 6 hours (2 lab sessions) to complete.

Task 1: Analog Input

Objectives:

In this experiment you will learn how to use the analog input functionality of the 68HC11.

At the end of the session you should know how to determine voltages by using the analog input subsystem of the 68HC11.

Before the Lab:

- Make sure you understand the ‘C’ programming language. Do some private revision if you feel you may have forgotten any part of the material taught in the first year ‘C’ programming course. Make sure you bring a ‘C’ programming reference book to the lab – the tutors are not going to solve general ‘C’ programming issues for you.
- Revise the work you have done in previous labs. You have now implemented programs dealing with almost all of the facilities available to you in the Motorola 68HC11 chip.
- Skim through your textbook by Spasov. There are numerous examples showing the relationship between assembler and the equivalent ‘C’ code.
- Read the 68HC11 reference material and familiarise yourself with the registers associated with analog I/O, making sure you understand their purpose.
- Read Chapter 12 of your textbook by Spasov.

Part 1: Analog Input

Write a ‘C’ program that reads in the voltage on pin PE7. Use the bank of 8 LEDs on Port B to implement a bar graph based on the value read from PE7. On the EVBPlus board you are using, PE7 is permanently connected to the variable resistor on the bottom left of the board. Have a look at the circuit schematic to verify this information.

Hint: Make sure you configure the analog subsystem before you try to read any data.

Question 1: What is the smallest increment in voltage that the A/D can measure?
Question 2: What is the range of voltages possible on pin PE7?
Question 3: If a sensor has output in the millivolt range, how would you interface it to the A/D system of the 68HC11?
Part 2: Revision

If you did not complete any of the previous labs for any reason, take the time now to try and finish them off.

Extension:

Write a ‘C’ program that reads the voltage on pin PE7 and writes the voltage to the seven segment display. Use 2 digits. One before and one after the decimal point. E.g. 4.7 volts

If you complete the extension, you have just created a simple digital voltmeter.
Task 2: Serial I/O (again!)

Objectives:

In this experiment you will continue to learn how to program the 68HC11 using the ‘C’ programming language.

By the end of this lab you should know how to implement any of your previous assembler programs using ‘C’. This includes the use of interrupts, and both the low and high-level language features of ‘C’.

Before the Lab:

- Read the 68HC11 reference material and familiarise yourself with the registers associated with serial I/O (SCI in particular), making sure you understand their purpose.
- Read Chapter 10 and Section 4.4 of your textbook by Spasov.

Part 1: Interrupt Driven Serial I/O

Write software to implement interrupt driven serial I/O. Verify the operation of your program by sending the string “x data received” back to the PC each time a byte is received, where ‘x’ is the data sent from the terminal emulator on the PC.

Extension:

Write a program that counts from 0 to 9999 (decimal) or 0 to FFFF (hex) using the four seven segment displays. The numerical format should be chosen by sending the character ‘d’ or ‘h’ for decimal and hex respectively over the serial port from a terminal emulator on the PC. The time interval between successive counts shall be selected by sending the digit ‘0’ – ‘9’ over the serial port. The 10 selectable time intervals can be any value, but should be long enough that the counting process may be clearly seen.
Marking Scheme

Minimum 45

- Meets Specification? 25
- Quality of Solution 20
  - Code documentation
  - Code/algorithm structure

Extension 25

- Meets Specification? 15
- Quality of Solution 10
  - Code documentation
  - Code/algorithm structure

Record Keeping 30

- Lab Notebook (documentation)
  - Completeness
  - Conciseness
  - Clarity/Layout

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