

The University of Texas At Dallas
Electrical Engineering Department
EE 2110: Beginning Digital Logic and Computer System Fundamentals
Experiment #6 – A Manufacturing Simulation Using a Simple Loop

- 1. Introduction:** The problem below emphasizes programming a simple loop, which also requires system calls to simulate input/output. In this case, the student will provide simulated factory process input data using system call 5.
- 2. Goal of this exercise:** This exercise is designed to provide experience in (1) designing a basic program, (2) programming a simple loop structure, (3) using MIPS instructions, and (4) using system calls for data input and output.
- 3. Basis of experiment:** Many manufacturing processes are controlled by computers on a real-time basis. A control system might be set up to monitor and adjust a chemical process. The computer might gather temperature information from one or more temperature sensors, and perhaps adjust an energy input (heat from a boiler or heating element) to keep the process operating smoothly. In this exercise, you will provide the temperature data via syscall 5 input from the keyboard, and the computer will adjust the process heat with messages to the console.
- 4. Experimental Equipment List:** The following items are required for this experimental procedure:
 - Pervin text for reference.
 - SPIM installed on your PC.
- 5. Pre-Work:**
 - Make sure that you are up-to-date on readings in Pervin and P&H in EE 2310.
 - Read the program description below and make sure that you clearly understand it.
 - It would be worthwhile to flow-chart the program to make sure that you and your lab partner understand the sequence of events as the program executes.
 - Both lab partners should work on and attempt to complete the program before coming to lab, including program debug. Again, the software experiments are the only part of EE 2110 where you are allowed to work outside the lab on your exercise.
- 6. Program Description:** You are to write a program that does the following:
 - The program will take inputs from you via the keyboard using syscall 5. A prompt to request the temperature should say “Temperature query: ”
 - The temperatures you will input are in Centigrade (do not have your program require a °C symbol; simply require the whole number temperature).
 - The temperature range you can input from the console is 100 °C to 400 °C.
 - The computer program must be able to sense five ranges:
 - ≤ 235 °C – process severely under-temperature
 - 236-285 °C – process under-temperature
 - 286-315 °C – process at correct temperature
 - 316-335 °C – process over temperature
 - 336 °C+ – process severely over-temperature
 - Your computer program must then adjust the process temperature by adjusting the heater voltage.

- **The computer feedback response is (which should be printed out on the console):**
 - ≤ 235 °C – abort (i.e., turn off, since the process has failed)
 - 236-285 °C – increase heater voltage 5%
 - 286-315 °C – maintain heater voltage
 - 316-335 °C – decrease heater voltage 5%
 - 336 °C+ – abort (i.e., turn off, since the process has failed)
- **The computer should respond to each input with the appropriate control instruction.**
- **To turn the program off, input an abort condition and the program should respond accordingly and then do a syscall 10.**
- **In order to slow down the process and let the computer “think” a while, also include a timer that counts down from 0x 25000 to 0 after each response. The countdown cycle will provide a delay of 1 second or a little more before the next query.**

7. Experimental Procedure: Note: Bring a thumb drive to class with your program on it.

- **Load your program onto the PC or simply open it from the flash drive.**
- **Open SPIM and begin debug if not completed. If you have any serious issues or problems, please consult the TA.**
- **If the program runs, make sure that you can input the desired temperatures and get the correct response.**
- **When you are satisfied that your program runs correctly, please call the TA to verify correct operation with a demonstration.**
- **When your program is verified, you have completed the exercise.**

8. Software Removal: The experimental procedure is complete. Please close the PCSPIM program and remove your storage media. Make sure that your work area is clean before leaving.

9. Laboratory Report: As before, your laboratory report should follow the standard report form. In your write-up, discuss any problem you had getting the program to run, and the actual verification of the correct assembly of each. Be sure to include a complete print-out of the final program. Also include the following items:

- **Discuss how the loop works that services the syscall 5 temperature inputs.**
- **How did you handle the limits of temperature to be input by the operator?**
- **Did you make sure that no possible input by you could stop the program incorrectly (except for a system abort)?**
- **Did you have any particular difficulties completing the program?**
- **Did you have any problems with SPIM?**
- **Write down some other factory control scenarios (i.e., situations where a computer process control would be useful).**