ECE352F

Lab Test

November 6, 2002

Instructions:

- The solutions to this test are to be submitted electronically. E-Mail the solutions to:
  - **manohv@eecg.toronto.edu** and
  - **yiannac@ecf.utoronto.ca**
- You may submit several solutions to the test. Only the final submission will be marked.
- You have 2 hrs to complete the test. Any solution arriving with a timestamp later than the 2 hr limit will not be marked.
- A portion of the mark for each question will be based on the solution's efficiency. Efficiency will be measured by the number of cycles taken to compute the answer for a wide variety of inputs.
- You are advised to comment complicated sections of your assembly and VHDL code. If the solution does not work, part marks will be assigned based on how well the TA understands your code. And the TA has a greater chance of understanding your code if it is commented.

The Task

Your task is to count the number of ones set in a 16-bit word. For example, the 16-bit word, “1011000110000011”, has seven ones set.

Assembly Language Implementation

Total Mark: 6

Efficiency Mark: 2

Design a M68000 assembly language program to count the number of ones set in the lower 16-bit word of register **d6**. The result is to be placed in register **d7**. The program is to start at 20000 (hex).

Test Procedure:

Your program will be compiled and uploaded to the UltraGizmo board. A 16-bit value will be loaded into **d6** using the register modify command:

rm d6 <hex value>

The program will then be executed using:

go 20000

Finally, the results of the computation will be checked using the register display command: **rd**.

Hardware Implementation

Total Mark: 14

Efficiency Mark: 3

Design a M68000 hardware register that performs the one-counting task. The register is to respond when the top four bits of the address are “1010” (hex A). A write to the register triggers the one counting process on the 16-bit word that was written. A read from the register returns the number of ones set in the 16-bit word that was last written.

You may assume that only word operations will be performed on this register. Therefore, you can ignore **UDS** and **LDS**.

Note: Include wrapper.acf as part of your submission.

Test Procedure:

Your VHDL/Verilog code will be compiled and uploaded to the UltraGizmo board. A 16-bit value will be written to the register using the byte fill command:

bf a00000:1 <hex value>

The results of the computation will be obtained by reading the register using the memory display command:

md a00000:1