

Digital System Design and Implementation

Lab. 4 (Due on 2022/05/27)

Note: Please just upload your codes (*.v, *.bit, *.xdc).

Total points :50 points.

In this Lab., we will learn the VGA display for a simple game “eePac Man”.

Please use VGA to show the following figure. In the next lab., we will do something based on this figure. In the following figure, one square has 80 pixels×80 pixels. First draw the lines for the boundary. Each line has 5 pixels wide. Define the line color by yourself.

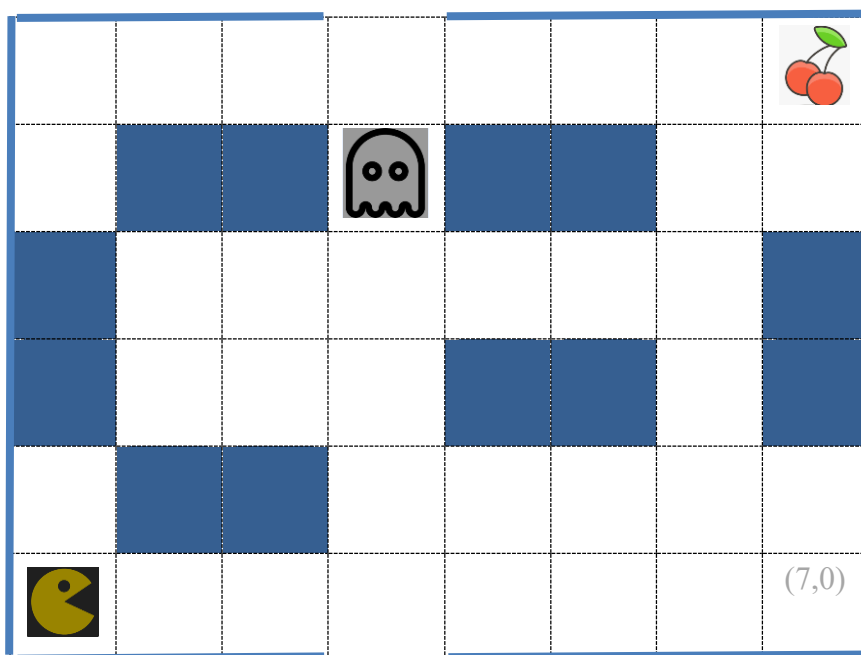


Fig. 1: The VGA screen

Draw the 8×6 square grid on the screen. Let the position in the 8×6 square is denoted as (x, y) , where $0 \leq x \leq 7$, $0 \leq y \leq 4$. Now, put a **ghost** in position (a, b) . **Please select your own ghost icon arbitrarily.** Note that the icon must be larger than 20 pixels×20 pixels. Now, use your last 2 digits of your student ID (d_2, d_1) and define $a = [d_2]_6 + 1, y = [d_1]_6$, where $[\cdot]_p$ is the modulo by p operation (除 p 之餘數). For example, if my last two digits of student ID is (24). Then, the ghost is in (3, 4). Note that the x position of the ghost denotes the tunnel and thus the boundary lines must be removed. Then select another icon of your eePac Man. Put the eePac Man in position

(0,0) and a fruit in position (7,5). You have 4 2×1 bricks and 2 1×2 bricks. Put them **arbitrarily** but they can not be in front of the tunnel.

Since this design can not be checked by the test bench, we omit writing the test bench. Please simply check the correctness on the FPGA board.

1. Write verilog codes for the required functions in the lab.
 - a. Show that boundary lines are drawn with correct position of the tunnel.
 - b. Show that there are one ghost, one eePac Man, and one fruit in the current positions.
 - c. Show that the 4 2×1 bricks and 2 1×2 bricks are well put.
2. Demo in the lab time.