

## Lab 11: VGA

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### Objective

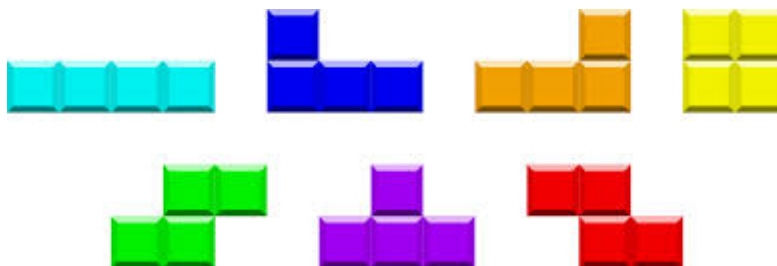
- ✓ Implement VGA display function.

### Prerequisite

- ✓ Fundamentals of logic gates.
- ✓ Logic modeling in Verilog HDL.
- ✓ VGA displaying techniques

### Experiments

- 1 VGA displaying functions.
  - 1.1 Inputs of the VGA controller are **clk**, **reset**, **en** and outputs of the VGA controller are **hsync**, **vsync**, **vga\_red[3:0]**, **vga\_green[3:0]**, **vga\_blue[3:0]**.
  - 1.2 At the beginning or when **reset** (button) is pressed, the VGA display shows the image (e.g. amumu.jpg). The VGA image stay still until **en** (button) is pressed.
  - 1.3 Pressing odd times **en** button to start/resume scrolling. Pressing even times **en** button to pause scrolling. Counter for **en** press is reset to zero when **reset** is pressed.
- 2 Calculator display.
  - 2.1 Combine the key board controller and VGA displaying controller to design a calculator with 2-digit addition/subtraction/multiplication. The display function should be the same as usual calculator or APP in the smartphone.
- 3 TETRIS element generator
  - 3.1 Generate basic elements of TETRIS (as follows) randomly in the VGA monitor, and plot each of them in the center of the first row of the display, which is a 10 x 20 (WxH) square 2D playing space.
  - 3.2 Each generated basic element moves down by the step of a square at the speed of 1Hz. Finally, they disappear below the playing space. When a basic element disappears, a new basic element is generated again and fall down again repeatedly.
  - 3.3 (Bonus) The same function of 3.1 and 3.2 are designed except that basic elements are stacked up until they are higher than the height of the playing space.



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