

Assessment 2 – Traffic Light

Requirements

- Develop an application to simulate traffic lights' operation based on the hardware platform given in the Assessment 2 folder on Learn. The hardware platform can be found in the folder **es3_hw_assmnt_2**. Note that the hardware timer is set to give interrupts every 0.004 s and there are three additional regions on the VGA. **Note that the region mapping has been changed from that of Lab 6; each region is now represented by a 12-bit XGpio object as shown in Figure 1 and Table 1.** The value written on the region's **XGpio** object is actually the colour for the corresponding region.
- The basic operation involves traffic lights for three roads (see Figure 2). There are 3 traffic lights for each road: red (R), yellow (Y) and green (G). Each light can be represented by one of the regions in the VGA display. Just as the traffic lights in the UK, these three lights operate as: $R \rightarrow RY \rightarrow G \rightarrow Y \rightarrow R \rightarrow RY \rightarrow G \rightarrow Y \rightarrow R \dots$ (duration should be set to 1 sec for each light and should be displayed on the 7-segment display). The traffic lights for road 1 should run through this cycle first, then those of road 2, then road 3 should run, and then road 1, and so on. This cycle should continue forever unless a pedestrian button (on the Basys 3 board) is pressed.

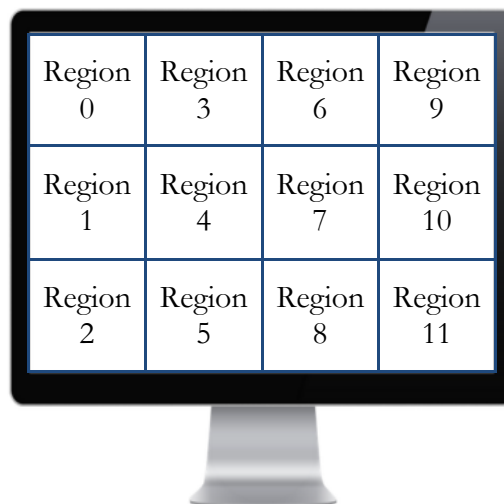


Figure 1

Region	XGpio Object
0	REGION_0_COLOUR
1	REGION_1_COLOUR
2	REGION_2_COLOUR
3	REGION_3_COLOUR
4	REGION_4_COLOUR
5	REGION_5_COLOUR
6	REGION_6_COLOUR
7	REGION_7_COLOUR
8	REGION_8_COLOUR
9	REGION_9_COLOUR
10	REGION_10_COLOUR
11	REGION_11_COLOUR

Table 1: VGA region selection mapping to XGpio VGA_REGION object

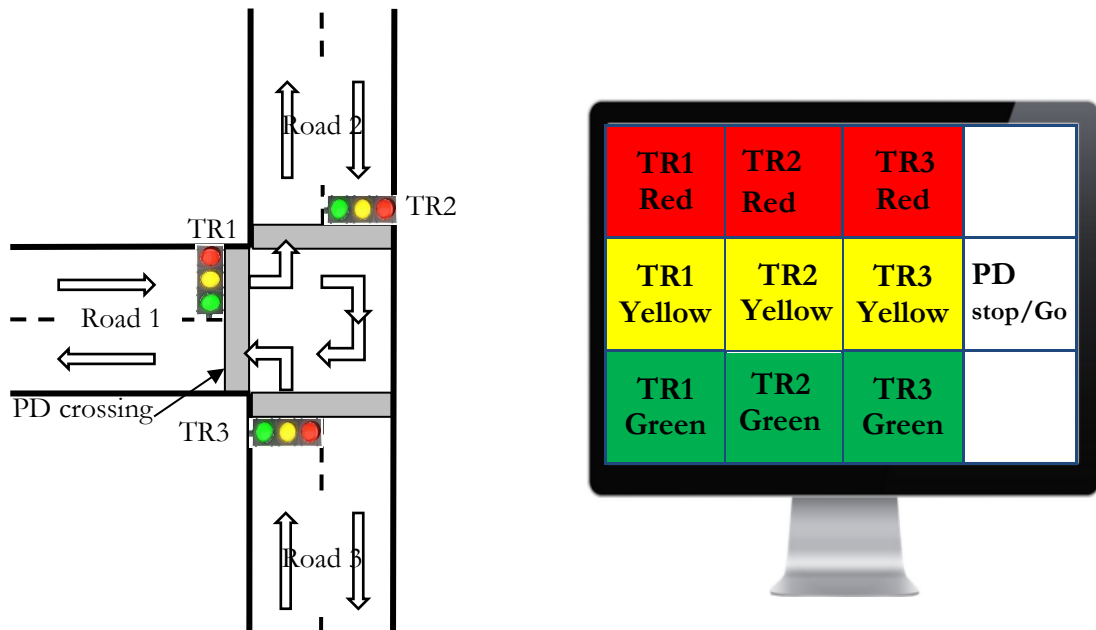


Figure 2: TR1 – Traffic lights for road 1, TR2 – Traffic lights for road 2, TR3 – Traffic lights for road 3, PD – Pedestrian

- Every time a pedestrian button is pressed, the pedestrian light (PD) should be turned on for 5 seconds indicating that it is time to go across. This time should also be displayed on the 7-segment display. Moreover, when the pedestrian has 2 (out of 5) more seconds to go, the pedestrian light should blink 5 times (in these remaining 2 seconds). Note that the same region on the VGA is used for **PD Go** (which should be colour **green**) and **PD Stop** (which should be **red**). There are three pedestrian crossings which should share the same pedestrian button and pedestrian light.
- An indicator LED on the Basys 3 board should light up once the pedestrian button is pressed. This LED should go off once the pedestrian has been allowed to cross.
- Depending on when the pedestrian button is pressed, detailed operation of the traffic lights should be:
 1. If the button is pressed when the green light is on:
G → Y → R → pedestrian light → RY → continue the basic operation
 2. If the button is pressed when a red light is on:
R → pedestrian light → RY → G → Y → continue the basic operation
 3. If the button is pressed when a yellow light is on, either of the following possibilities exist:
RY → G → Y → R → pedestrian light → RY → continue the basic operation
G → Y → R → pedestrian light → RY → continue the basic operation
- Demonstrate the traffic light sequence also on the LEDs (3 for each road and one for PD).
- **Note that you are required to submit and demonstrate two separate projects**, one for the basic functionalities specified in this guideline and the other for the extra features you are implementing (if applicable).
- Extra credits will be given for extra features, especially those done in software. You are free to add extra features in hardware, but it is **IMPORTANT** to make sure that these have good software components.
- Note that button BTNC on the board is reserved for “reset” and cannot be used by your application.
- You should reuse the codes from the labs as much as possible