Introduction to Programmable Logic Controllers Ex6_trafficlight

DTU 31343

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Only a .pro file incorporating the sensor & button functions was saved, as this was only mentioned at the end of the exercise. However, screenshots are provided for the continuous running mode.

Part 1

The traffic light model was connected to the PLC and the inputs and outputs were labelled accordingly in the PLC configuration. The following table describes the relation between inputs and outputs on the PLC and the traffic light model.

It was assumed that the main road was the one with the sensors (a clear distinction wasn't made in the questions), and that the pedestrian main crossing was crossing the side road (parallel with the main road). The label allocation is shown in Table 1.

Table 1: Labels for the relevant traffic light components.

Component	Label			
Pedestrian Buttons	P1	P2	P3	P4
Car Sensors	CS1	CS2		
Main Road (R, Y, G)	CMR	CMY	CMG	
Side Road (R, Y, G)	CSR	CSY	CSG	
Pedestrian Main (R, G)	PMR	PMG		
Pedestrian Side (R, G)	PSR	PSG		

Part 2

To create a repeating timing sequence for the street lights, a simplified version of the timers from Ex_3_plc_startup was arranged in a ladder diagram. The ladder diagram used to create a repeating cycle is shown in Figure 1, and the street light sequence for the main and side road are shown in Figure 2 and 3, respectively.

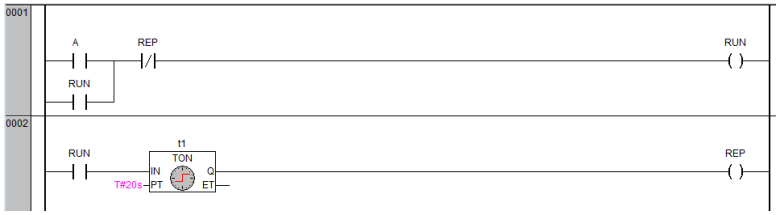

Figure 1: Arrangement to give a repeating cycle with a period of 20 s.

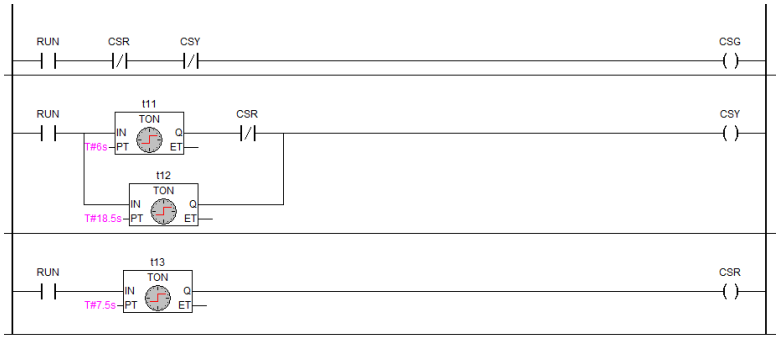

Figure 2: Ladder diagram that gave the desired timing sequence on the side road.

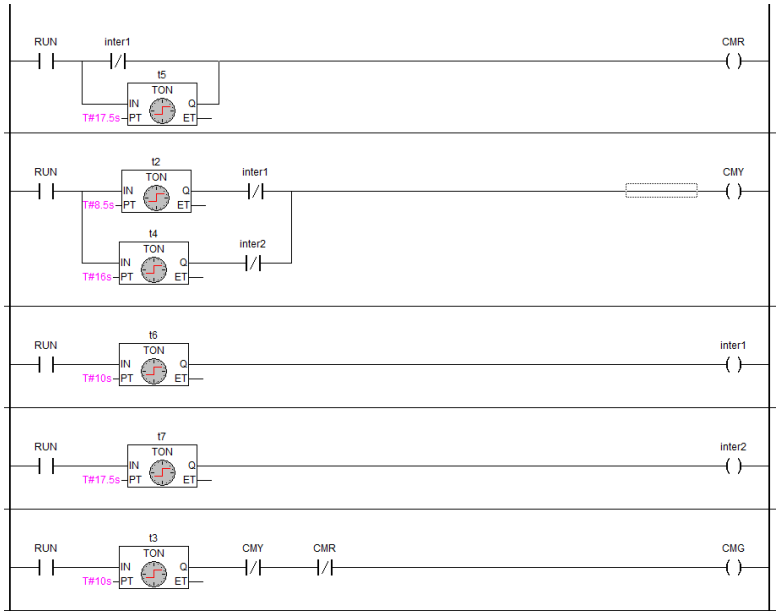

Figure 3: Ladder diagram that gave the desired timing sequence on the main road.

Part 3

To add the pedestrian light sequence, the following logic was added to the previous ladder diagram sequence (see Figure 4). This essentially mimicked the solution from the previous part and applied it to the given sequence.

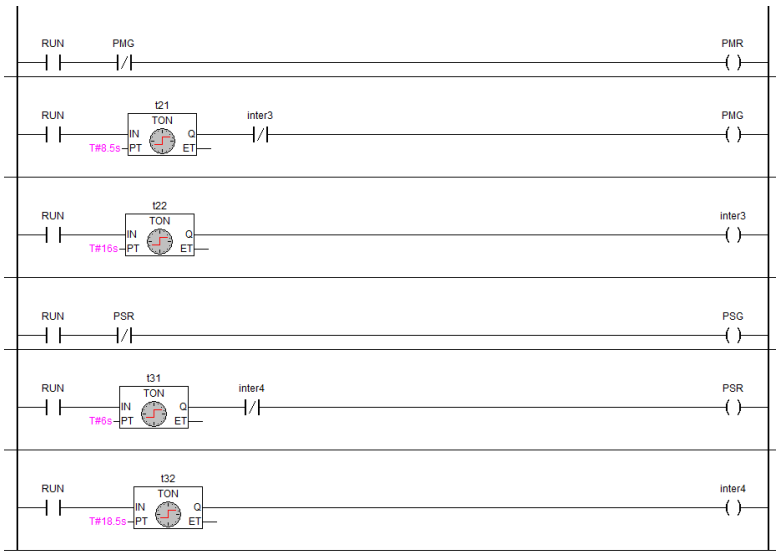

Figure 4: Ladder diagram that gives the desired timing sequence for the pedestrian lights.

Part 4

To implement the usage of the buttons within the sequence in Part 3, the logic in Figure 5 and 6 was added.

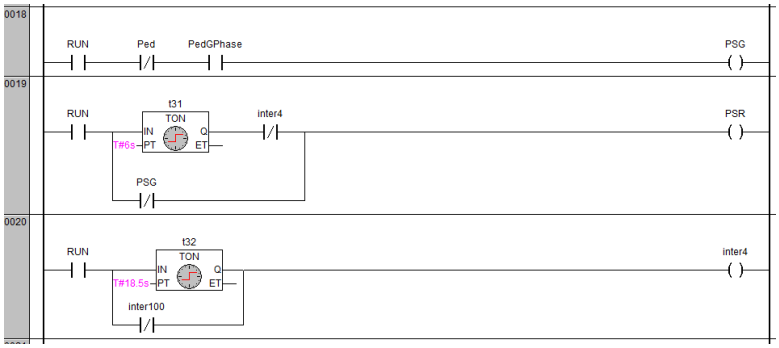

Figure 5: Ladder diagram enabling the desired interval of the green phase after pressing the button.

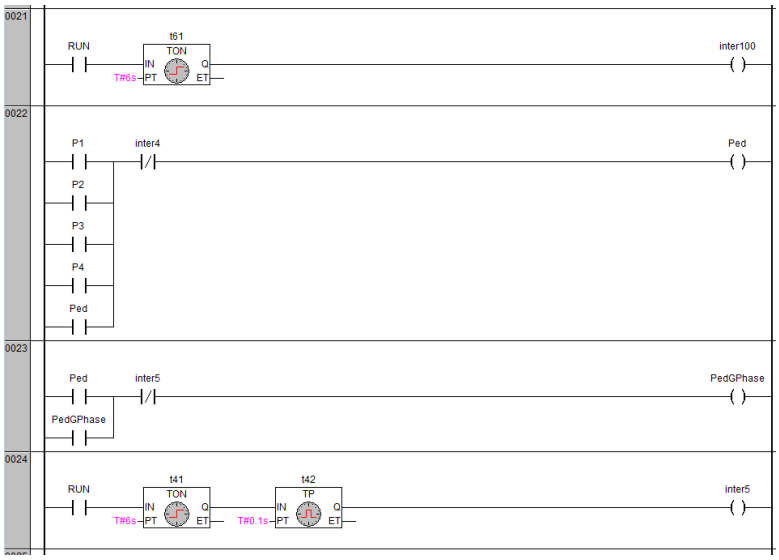

Figure 6: Ladder diagram enabling the use of the pedestrian buttons.

The idea was to perform a state that was activated when pressing the pedestrian button anywhere in the "normal" cycle, and allowing the green light to turn on only when the "normal" green cycle was usually on. However, it had to be made sure that this only occurred on the next green cycle, in case the button was pressed when the "normal" green cycle was running. Therefore, an activation logic was introduced in Figure 5 based on whether or not Ped was reset with PedGPhase being active.

Part 5

To implement the usage of the car sensors within the sequence in Part 3, the logic in Figure 7 was added. Note, that the sensor was required to be active for at least 5 s for the car sensor to engage.

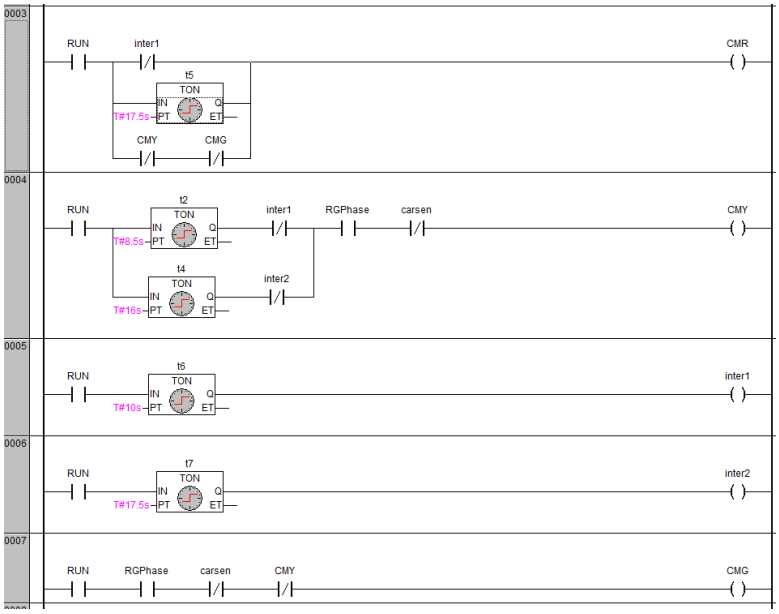

Figure 7: Ladder diagram enabling the desired interval of the green phase after setting off the car sensors.

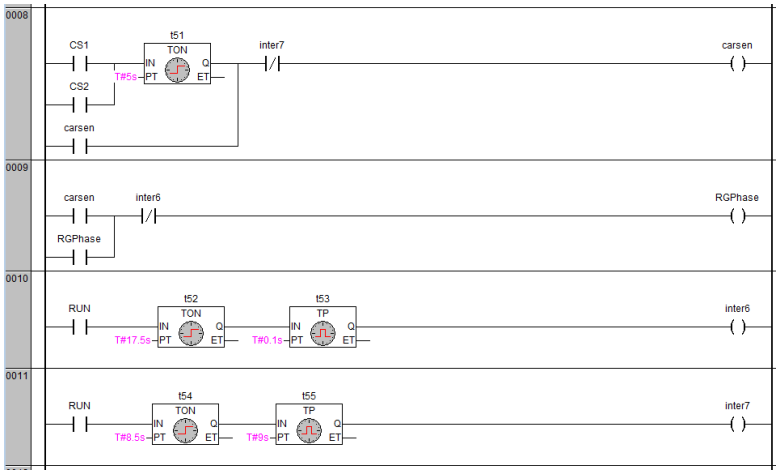

Figure 8: Ladder diagram enabling the correct use of the car sensors.

This solution essentially mimicked what was conducted in the previous part. However, the yellow light functionality had to be added within the RGPhase active state.

Part 6

To keep track of the number of pedestrian button presses, the following logic was implemented (see Figure 9). Note, that Ped already only activated once per press before an activated green phase, ensuring the desired counting of the presses.

Figure 9: Counter keeping track of button presses.

Part 7

When switching from sequence mode to sensor based mode, the traffic light system should count the number of presses or sensor engagements that occur. Then, when a certain threshold is fulfilled e.g. out of 10 cycles, 1 car sensor engagement (lower ratio preferred) occurred within sequence mode, the traffic system would switch to sensor mode. Conversely, if the sensor mode is engaged and e.g. the car sensor has been activated 5 times within 200 s (higher ratio preferred), the traffic system would switch to back to sequence mode. To achieve this, no additional equipment would be required, only a timer and a counter to keep track of the ratios within the given modes. Then, the continuously updating count would have to be compared with the chosen reference, and the mode of the traffic light system could be switched accordingly.