SMITH ENGINEERING
Queen's University

MREN 320 – Industrial Automation
Mechatronics and Robotics Engineering Program
Queen's University, Kingston

Assignment #5: Zen and the Conveyor Module

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Summary:
This assignment sets out to simulate the activation and deactivation of the conveyor module using sensors A, B, and C. Initially there is no part on the conveyor and it is not moving. Then, when a part is placed at the front of the conveyor, Sensor A gets triggered and waits 5 seconds before starting the conveyor forward. Once the part gets halfway across the conveyor, it triggers Sensor B which stops the conveyor for 10 seconds. The conveyor then moves forward again until the part reaches the end where it triggers Sensor C. Once Sensor C gets triggered the conveyor stops for 5 seconds then it starts moving backwards. However, when the part triggers Sensor B on its way back, the conveyor is not stopped. Once the part reaches the start of the conveyor it triggers Sensor A, which repeats the cycle once again. Omron's **ZENTool** was used for the simulation. The template for the PLC rendering is given as **Fig. 1**. The momentary input switches are **I1** (Start Sensor A), **I2** (Mid Sensor B), and **I3** (End Sensor C), and the output indicators are **Q0** (Conveyor forward) and **Q1** (Conveyor Backwards).

Sequence of Operations:
The operation of the program for **Stage 1** is as follows:

a) Click momentary switch **I1**.
b) Light **Q1** turns off, after a 5 second delay, light **Q0** turns on (solid).
c) Click momentary switch **I2**.
d) Light **Q0** turns off for 10 seconds then turns back on (solid).
e) Click momentary switch **I3.**
f) Light **Q0** turns off, after a 5 second delay, light **Q1** turns on (solid).
g) Click momentary switch **I2**.
h) Light **Q1** stays on.
i) Repeat cycle starting at a).

Discussion:

1) I believe the simplest way to reintroduce the Key Switch to the ladder program is by adding it right in front of the Timer 2 latch, enabling the on/off control of **QO**, and right in front of the Conv Backwards output, enabling the on/off control of **Q1**. This would be very easy to do since it would just require adding two relays connected to the **I0** (Key Switch) input switch.

2) My stage 3 program in lab 5 used a combination of both pulse and ON-delay timers. For example, when **I3** (End Sensor C) was pressed, it would trigger a pulse timer which would send a signal to an ON-delay timer for 3 seconds. After 2 seconds of receiving the signal, the ON-delay timer would cut the power to **Q0** (Conveyor Forward) and its latch by opening a normally closed relay. Additionally, when **I2** (Mid Sensor B) was pressed, it would trigger a pulse timer which would cut the power to **Q0** (Conveyor Forward) for 5 seconds by opening a normally closed relay for its pulse duration (5 seconds). My stage 4 program incorporates the first technique (pulse timer

powering an ON-delay timer which triggers a relay after the ON-delay time has elapsed) for the 5 second delay that occurs after Sensor A and C are triggered. Additionally, it also uses the second technique (pulse timer that opens a relay for a certain amount of time) for the 10 second pause after Sensor B gets triggered. Finally, I used the approach recommended in class while completing all four stages. This approach made tackling the problems at each stage easier since I was able to build upon the previous stages while working on the current stage.

Figure 1 depicts the PLC rendering for stage 4, notice that I3 is a **momentary closed contact** switch. The program listing for stage 4 is given in **Appendix A.**

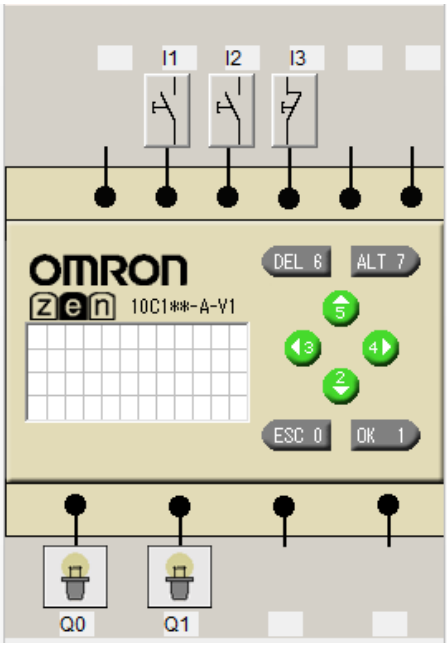

Fig. 1. PLC rendering for Stage 4.

Appendix A: Program Listing for Assignment #5