Exercise 3: Traffic Lights

# Objective

Design and implement a two-traffic light intersection control system. The system should use one PLC to control two red-green-yellow traffic lights. One traffic light should control north-south traffic and the other east-west.

# Build the circuit

Build a circuit with 3 LEDs: 1 for each light in the north-south stack. Control the LEDs with your ladder logic. There are only 4 digital outputs on Arduino Uno so we can only have one physical red-yellow-green traffic light stack. The second light stack will be present in ladder logic and the HMI only.

# Build the Ladder Logic

* Each light should use timers to cycle the lights through red-green-yellow.  The lights should cycle with green on for 10 seconds, yellow on for 5 seconds, and then red on for 15 seconds.  The north-south red light should be on when the east-west green or yellow lights are on. The east-west red light should be on when the north-south green or yellow lights are on.
* Add safety logic in the ladder to ensure the following properties.
  1. To be green, the red LED in the other stack must be on and the green and yellow LED in the other stack must be off.
  2. To be yellow, the red LED in the other stack must be on and the green and yellow LED in the other stack must be off.

# Build the HMI

* The HMI should display each LED's state.
* The HMI should display a counter next to each light in the stack that counts down the time left on each transition.
* In the HMI add a background image that shows the intersection.

# Post Exercise Report

Answer the following questions.

1. (60 points) Upload a cell phone video of your traffic lights solution functioning.

1. (15 points) Breadboard Function- show that red, yellow, lights function correctly. The lights should adhere to the timing requirements from the project description.

2. (45 points) HMI Function

(a) (15 points) show that the north-south and east-west light stacks in the HMI exhibit the correct timing.

(b) (15 points) show that the north-south and east-west light stacks in the HMI follow safety rules described in the project description.

(c) (15 points) show that each LED has a correct countdown timer in the HMI.

1. (10 points) What is the correct Modbus address for %QX100.5? Specify the address and the data type (coil, input status, holding register, input register).
2. (10 points) What is the correct Modbus address for %MW103? Specify the address and the data type (coil, input status, holding register, input register).
3. (20 points) For the OpenPLC would it be correct to state that Modbus Coil address 0 and Modbus Holding register address 0 both point to the same location in the PLC memory? What kind of memory map model does OpenPLC follow? Explain your answer.