Robotics, Integration, and Automation

INTEGRATING THE SMART SENSORS: PART 2

Name	Class/Period	Date

1. Overview

In this lab activity, you will build a SmartCart application that integrates data from several of the IO-Link smart devices.

2. Performance Objectives

After completing this lab activity, you will be able to:

- Integrate smart device module tags into PLC logic.
- Bind smart device module tags to graphic elements of the HMI screen.
- Create a SmartCart application involving robot jobs, PLC logic, sensor values, and the HMI.

3. Required Materials

You need the following materials to complete the lab activity:

- SmartCart 4.0
- Computer
- Ethernet cables
- Workpiece (colored block)
- RFID tag

4. Required Software

Logix Designer and View Designer are required for this lab activity. They are included in the Studio 5000 suite. Ensure that Studio 5000 is installed on your PC and has a valid license. If you are having problems installing or licensing the software, contact your instructor or IT manager.

5. Inventory and Safety

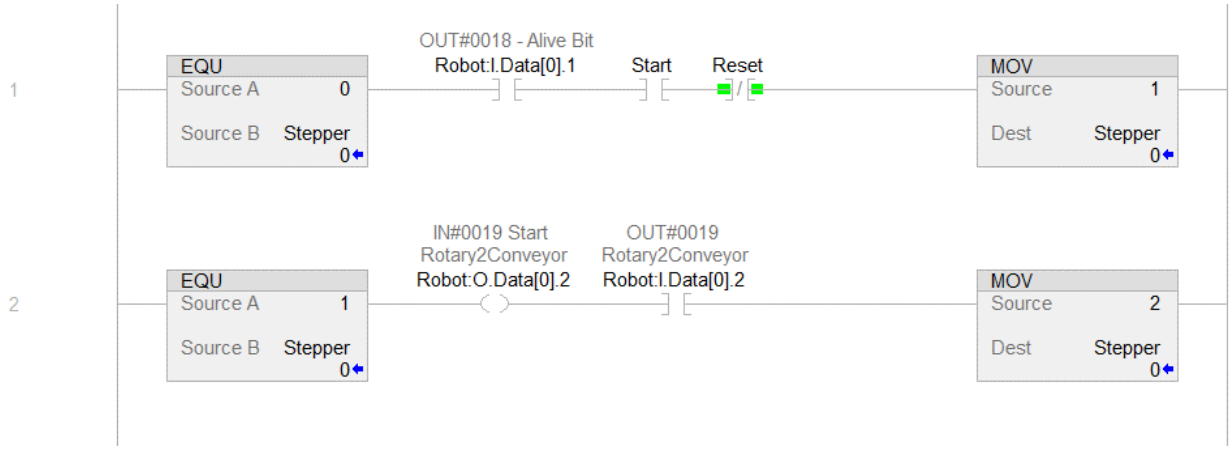
Before beginning the lab activity, review this checklist and mark off each item as you complete it.

- ☐ All hardware components are available for this lab activity.
- ☐ Hands, hair, and clothing are securely away from the work area.
- ☐ The work area is clean and devoid of food or drink.
- ☐ Review the SmartCart safety guidelines.
- ☐ Read through the entirety of this lab activity to familiarize yourself with the requirements.

6. Background

6.1. Integrating Sensor Memory Addresses into PLC Logic

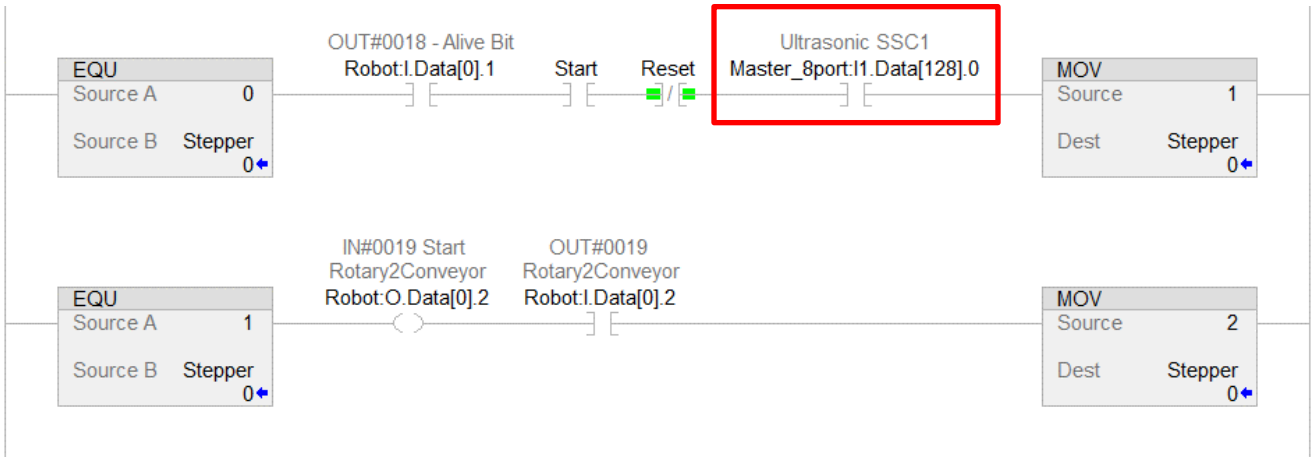
In Section 3 of this course, you created a PLC logic sequencer routine which triggered three robot jobs in a specified order. Shown here are two rungs from that routine:



You saw that the conditions across each rung must be met before the execution of the routine moves to the next rung. For example, in Rung 1, the conditions are that:

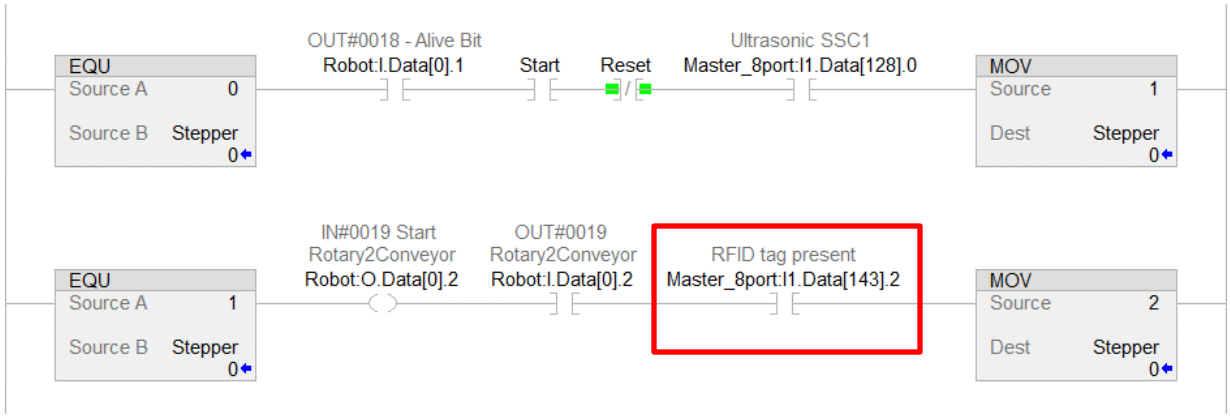
- The Stepper tag must be equal to 0,
- Robot:I.Data[0].1 is on,
- The Start tag is on, and
- The Reset tag is off.

Integrating a sensor value into this type of logic is relatively simple. Say, for instance, you wanted to add another condition on Rung 1: that there is an object in range of the ultrasonic sensor. More specifically, the first switching (on/off) signal of the sensor is on. To add this condition, you would insert an XIC instruction onto Rung 1 and address it to the BOOL tag linked to the ultrasonic sensor's SSC1 bit.



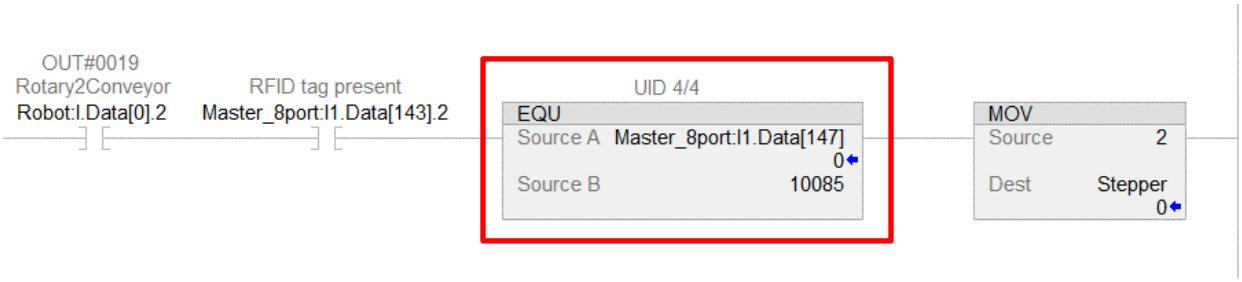
6.2. Integrating RFID Values

Integrating the RFID read/write head can be just as easy. If your only condition is to ensure that a tag is detected by the RFID head, you would insert an XIC instruction addressed to the BOOL tag that is linked to the RFID tag present bit. In the example below, this is added as a condition for completion of the second rung.



If you are looking to ensure that only a specific RFID tag is detected, you can make use of the UID (unique ID) values of the RFID tags. One way is via an EQU instruction, which will ensure that the UID or UID component is equal to the desired value before the ladder execution continues.

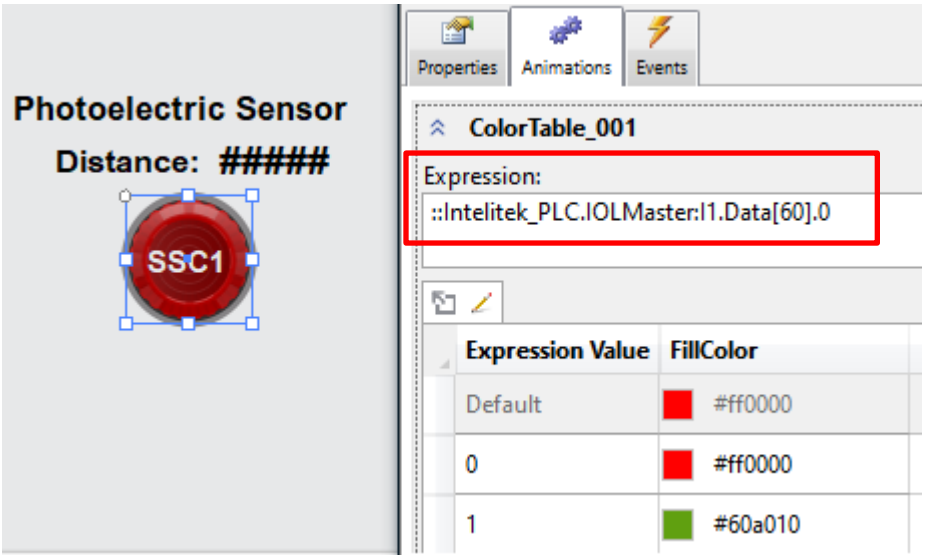
In the example shown below, not only does the RFID tag have to be present, but the 4th component of the UID must be 10085, which corresponds to a specific RFID tag (which must be read by the read head in order to know what value to enter into the EQU instruction).



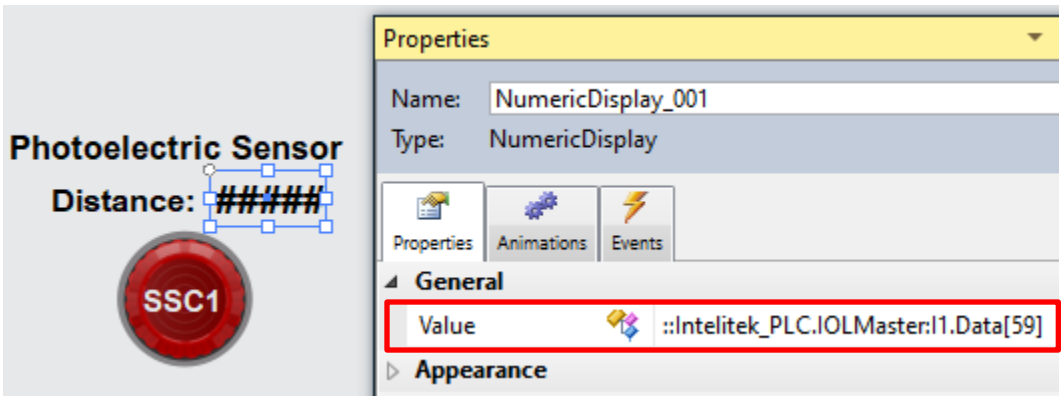
6.3. On the HMI

Sensor values can be displayed on the HMI screen in real time using several of View Designer's graphic elements.

One nice way to display the switching signal of a proximity sensor is to insert a simple graphic element such as an ellipse or LED (*pilot light* in View Designer) onto a screen and give the element a color state animation. The color table would be bound to the sensor's switching signal BOOL tag and have two colors, with each color corresponding to a different value (0 or 1) of the SSC bit.



If you want to include the distance value itself, a numeric display would probably be the most appropriate graphic element. The numeric display's value would need to be bound to the INT tag that is linked to the sensor's distance memory word.



7. Lab Activity

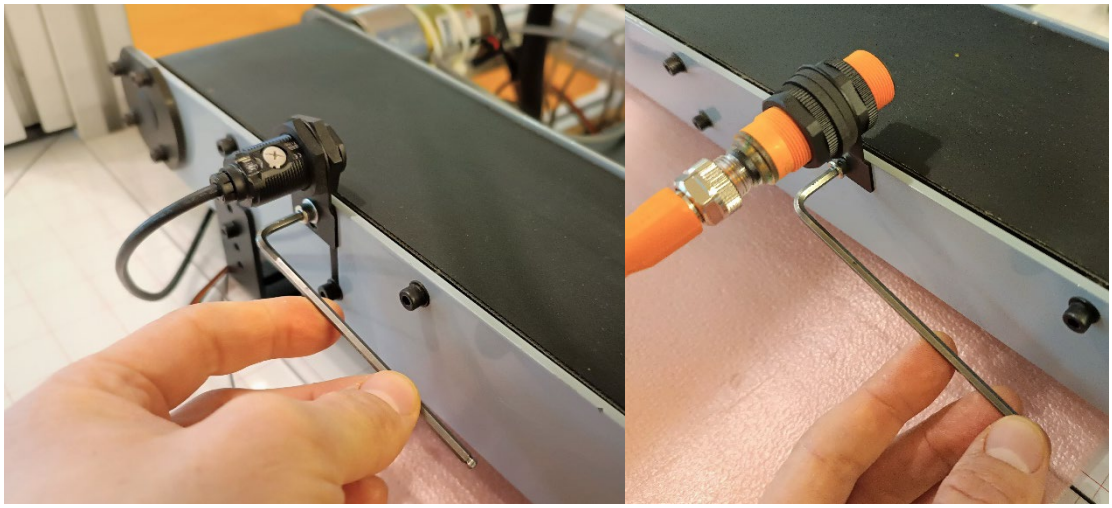
In this lab activity, you will create a SmartCart application that includes the robot, a PLC program, the HMI, at least one proximity sensor of your choice, the RFID read/write head, and the signal lamp. Follow the guidelines in the subsections below and show your final application to your instructor for approval.

7.1. Guidelines for the Overall Process

The overall process is as follows:

1. When the process is ready to be started, the signal lamp shines green.
2. The operator places a workpiece (block) with an RFID tag on the conveyor near the front of the SmartCart table.
3. The operator presses the Start button on the HMI.
4. The process is initiated. The signal lamp turns red to indicate that all human workers must distance themselves from the SmartCart area.
5. The conveyor turns on and moves the workpiece towards the middle of the conveyor until it reaches a proximity sensor.
6. The robot picks up the workpiece and places it onto the rotary table.
7. The rotary table turns until the RFID head mounted on the table detects the workpiece's RFID tag.
8. The robot moves the workpiece to the front of the conveyor, where the process can start again if desired. The lamp shines green.

The physical setup of the SmartCart needs to be aligned to the process. Ensure that the smart devices are mounted at the correct locations.



Use a hex key to remove and mount sensors on the peripheral devices.

7.2. Guidelines for Robot Jobs

Your application should include five robot jobs:

- A job that turns the conveyor on and off and controls its direction.
- A job that commands the manipulator to move the workpiece from the middle of the conveyor to the rotary table.
- A job that turns the rotary table on and off and controls its direction.
- A job that instructs the manipulator to move the workpiece from the rotary table to the front of the conveyor.
- A main job that conditionally calls the above four jobs when the robot receives a signal from the PLC. This job is played before the overall process begins.

Warning: *Always test your jobs individually (in Teach mode using the INTERLOCK + TEST START option and then in run mode) without and then with the workpiece before you test them collectively in the SmartCart application with the PLC. When playing the jobs, ensure that all safety measures are in place and that you are ready to press the programming pendant's Emergency Stop button if needed.*

Tip! *There is no need to create the aforementioned jobs from scratch. Use jobs that you have created in previous lab activities and make minor changes to instructions and positions where necessary.*

7.3. Guidelines for PLC Logic

There are no specific requirements for the PLC routine, but it is advisable to create a sequencer as you did previously and then incorporate the IO-Link module tags where necessary as described above in Section 6.

The ladder routine should have a condition that checks whether or not the robot is ready, i.e., an XIC instruction addressed to the "alive bit." No timers should be used in the routine.

Tip! *You do not have to create the PLC project from scratch. Save the project you used in the previous lab activity with a new name and start from there.*

7.4. Guidelines for the HMI Screen

Your HMI must have a system Start button and a system Reset button. It also needs a dashboard that shows the following:

- Whether or not the proximity sensor detects an object.
- Whether or not the RFID head detects an RFID tag.
- The UID of the detected tag (use four numeric displays).
- Which job is currently running.

8. Authentic Skill Assessment

Have your instructor verify that your work meets the requirements in the performance objectives and sign below. Keep this lab activity sheet for future reference.

Instructor Signature	Date

9. Reset Steps

This lab activity does not have any reset steps.

10. Shutdown

Unless instructed otherwise by your instructor, review and complete each of the items on the checklist below.

- ☐ Ensure the pendant mode key is in Teach mode.
- ☐ Return the pendant to its storage hook on the side of the SmartCart.
- ☐ Power down the robot.
- ☐ Turn off the air compressor.
- ☐ Close Logix Designer and View Designer.
- ☐ Power down the I/O box.