Lab 10 – Proximity Sensors and Switches

Format
This lab will be conducted during your regularly scheduled lab time in a group format. I strongly recommend that you rotate roles during the lab - don't let one person do all of the programming at the computer. You may ask the lab instructor for assistance if needed, but successful completion of the lab is your responsibility.

Report
A short individual informal report is due for this lab at 8:00 AM on the Thursday of the week after you perform the lab. This short report may be neatly handwritten, and should be stapled in the upper left-hand corner. At a minimum, all of the information specifically requested in this lab handout must be present in your report. As part of your report, please include a brief description of the objective of this lab. (Yes, in this one case, “education” can be an objective, but you should be specific about what material is being used in the education.)

Procedures

10.1 Testing Different Proximity Switches:

Four different proximity switches will be provided. The switches will be connected to a PLC. As you bring different targets to close (a relative term) proximity to the different sensors, LEDs on the PLC rack will go “on” or “off,” depending on the “normal” state of the switches (open or closed). For each of the sensors, you are to determine the capability of the sensor in determining the proximity of each of a different set of targets. “Capability” includes, among other things, distance to the target, and angle of incidence (is the target “at an angle” with respect to the switches’ sensing axis?).

There are 7 target objects to be detected for each of the sensors as given in the table below:

<table>
<thead>
<tr>
<th>Objects to be sensed:</th>
<th>Material:</th>
</tr>
</thead>
<tbody>
<tr>
<td>washer</td>
<td>Steel</td>
</tr>
<tr>
<td>disk</td>
<td>Aluminum</td>
</tr>
<tr>
<td>disk</td>
<td>Brass</td>
</tr>
<tr>
<td>Piece of wood (terminal strip mount)</td>
<td>Wood</td>
</tr>
<tr>
<td>plastic cup</td>
<td>Plastic</td>
</tr>
<tr>
<td>metallic foil</td>
<td>Aluminum</td>
</tr>
<tr>
<td>metal strip (shim-stock)</td>
<td>Steel</td>
</tr>
</tbody>
</table>

There are 7 target objects to be detected for each of the sensors as given in the table below:

Figure L10-1. Sensing Distance Definition
For each switch and object combination,
1. Record the approximate distance at which the object is sensed, i.e., when the LED signal on the PLC changes.
2. Record whether the light goes on when object is sensed (NO-“normally open”), or if the light goes off when object is sensed (NC-“normally closed”).
3. Record any effects due to the target being “at an angle” to the sensor.

Outside of Lab:
1. Create a table that clearly presents the information requested above.
2. For each sensor, write a brief paragraph that describes your observations of the strengths and weaknesses of each sensor. (There will not necessarily be a great difference between some of the sensors.)
10.2 PLC Programming *DirectSoft Tutorial*

Follow the steps given in the *DirectSoft* tutorial – a single copy is provided for each PLC station. When you are finished with this tutorial, you should be familiar with the following:

- Starting a new ladder diagram (called a “project” in *DirectSoft*)
- Inserting and deleting entire rungs from the ladder diagram
- Creating nicknames and comments
- Inserting and editing individual elements in a ladder diagram
  - N.O and N.C. contacts
  - Output coils
  - Timers and counters
  - End statement (one required for each program!)
- Downloading an edited program to the PLC
- Monitoring the status of the inputs and outputs on the PLC screen

10.3 PLC Program - *Sample1*

- Load the program *Sample1* (look under File/Open Project on menu bar).
- Download the program to the PLC by clicking on the icon.
- You can monitor the status of the PLC program by entering the “debug” mode through either the menu bar (Debug / All Status On) or by clicking the icon.
- Execute the program several times (by pressing the appropriate pushbutton on the operator interface panel). What does it do?
- Change the NC contacts C41 to NO contacts (see the comments below for tips on editing a *DirectSoft* ladder diagram). How does program *Sample1* work now?

*Note – Solenoid and limit switch assignments are shown in Figure L10-2, pushbutton and indicator light assignments are shown in Figure L10-3.*

⇒ *Outside of lab:*

1. Sketch the ladder logic diagram for both cases described in 10.3.
2. Give a brief description of the operation of each configuration. *Demonstrate* that you truly know what the program is doing. Make sure that you answer any questions listed above.
Operator Interface Panel

Write to internal contacts C12 - C17 to turn on the “lamps”

Read from internal contacts C40 - C50 to read status of the pushbuttons

<table>
<thead>
<tr>
<th>C12</th>
<th>C13</th>
</tr>
</thead>
<tbody>
<tr>
<td>C14</td>
<td>C15</td>
</tr>
<tr>
<td>C16</td>
<td>C17</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C40</th>
<th>C41</th>
<th>C42</th>
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<td>C43</td>
<td>C44</td>
<td>C45</td>
</tr>
<tr>
<td>C46</td>
<td>C47</td>
<td>C50</td>
</tr>
</tbody>
</table>

Figure L10-3. Pushbutton and Indicator Light Assignments
10.4 PLC Program – Sample2

- Load the program Sample2.
- Download the program to the PLC.
- Execute the program several times. What does it do?
- Change the NO contacts X3 to a N.O. contact Y2. How does program Sample2 work now?

⇒ Outside of lab:

1. Sketch the ladder logic diagram for both cases described in 10.4.
2. Give a brief description of the operation of each configuration. Demonstrate that you truly know what the program is doing. Make sure that you answer any questions listed above.

10.5 PLC Program – Sample3

- Create the program shown below and name it Sample3.
- Download the program to the PLC and execute the program several times. What does it do?
- Change the N.C. contacts X1 to N.O. contacts. How does program Sample3 work now?

⇒ Outside of lab:

1. Sketch the ladder logic diagram for both cases described in 10.3.
2. Give a brief description of the operation of each configuration. Demonstrate that you truly know what the program is doing. Make sure that you answer any questions listed above.

![Ladder diagram for PLC program Sample3](image)

Figure L10-4. Ladder diagram for PLC program Sample3.