**NUST School of Electrical Engineering and Computer Science**

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Department of Electrical Engineering EE-428: Industrial Process Control

LAB PROJECT : E3

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# E3: Part Separation

## Introduction

The objective of this lab project is to design a Programmable Logic Controller (PLC) program for a part separation task. The task involves commanding a robot to move a part to a new location. The PLC program is designed to control the operation of the robot and the conveyor system. The PLC used in this project is a Mitsubishi FX Series PLC.

## Device Assignment

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## Control Objective

Give the command to a robot to move a part to a new location.

## Control Specifications

1. Give the command to a robot to move a part to a new location.
2. The operator supplies parts. The operator confirms the indicator lamp [Supply allowed] is lit and supplies a part to the conveyor. If the indicator lamp is always lit, the operator continuously supplies parts.
3. While the PLC is in RUN status, the conveyor always moves forward.
4. When [PB1] (X20) on the operation panel is pressed, Supply command (Y0) is turned ON and the [Supply allowed] indicator lamp is lit. The operator supplies a part. When [PB1] (X20) is released, the indicator lamp is extinguished. However, if a part is still located on the table, Supply command (Y0) is not turned ON so that the indicator lamp [Supply allowed] is not lit.
5. When Part on table (X1) is turned ON in the robot, Unload command (Y2) is set ON. When Robot operation finished (X2) is turned ON (it is ON when a part is placed on the tray), Unload command (Y2) is set OFF. Unload command (Y2) should be set ON only when the robot is at the starting point.

## Ladder Logic

## Screenshot

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## Demo Video

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Attached as well.

## Working of the Ladder Logic

The ladder logic program for this task is designed with four rungs. Each rung of the ladder logic program is explained as follows:

1. **Rung 1**: [M8000] --[ ]-- (Y0)
   * This rung ensures that the supply command (Y0) is activated when the PLC starts. M8000 is a special relay that is always ON.
2. **Rung 2**: [X20] (Button) --[X1] --[/]-- (Y0)
   * This rung is a start-stop circuit. When the button (X20) is pressed and there is a part on the table (X1 is ON), the supply command (Y0) is activated. If the button is not pressed or there is no part on the table, the supply command is deactivated.
3. **Rung 3**: [X1] --[ ]-- [X0] --[ ]-- [X2] --[/]-- (Y2)
   * This rung activates the unload command (Y2) when there is a part on the table (X1 is ON), the robot is at the starting point (X0 is ON), and the robot operation is finished (X2 is ON). This tells the robot to move the part to the tray, and a new process cycle begins.
4. **Rung 4**: [Y2] --[ ]—[X2] – [/] – (Y2)
   * This rung is essentially connected in parallel to Rung 3 after X0. It ensures that the unload command (Y2) remains activated even if the robot leaves the starting point (X0 turns OFF), as long as there is a part on the table (X1 is ON) and the robot operation is finished (X2 is ON).

## Conclusion

The ladder logic program developed for the motorized gate control system is an efficient solution for controlling the opening and closing of gates, such as those found in parking lots or security entrances. It incorporates not only basic functionality but also safety and convenience features. These include a safety sensor to prevent the gate from closing when an obstruction is detected, an auto-close feature to close the gate after a set period, an alarm system to alert if the gate is left open for too long, and a manual override for direct control in emergency situations.