

Data Science and Automation

Lesson 22 – Laboratory B&R Automation Studio

Tool-chain

As we said before during this morning introduction, this afternoon we are going to see how the software B&R Automation Studio 4.1 works.



- You can download Automation Studio 4.1 (trial version) from the following link:
- https://www.br-
- automation.com/index.php?eID=dumpFile&t=f&f=2%3A%2FB RP44400000000000000515253&token=084d860a13ed034f66 04600d2c4d81d8a1f1cae0



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Ladder exercises

- Develop a <u>Ladder</u> software that allows the control of an industrial oven with the following operating mode.
- When the operator press the start button (START=1), the PLC starts the warming cycle of the material (OP=1) for 30 seconds. After that interval, the OP command must be reset by the PLC (OP=0). The completion of the process have to be signaled by the powering on of a green light (GREEN=1) for 10 seconds.
- After this interval, the green light must be powered off (GREEN=0).

The only <u>input</u> of the system is:

• START: Button that starts the oven

The <u>outputs</u> are:

- OP: Oven enabling
- GREEN: Led that indicates the end of the oven functioning.

Develop a <u>Ladder</u> software that allows the control of an hydraulic carlifter for the tyres change with the following operating mode:

- The car arrives in proximity of the lifter and it is detected by a photocell.
- The piston starts the lifting of the car in slow forward mode (suppose that the piston starts from the FIP point) until the reaching of the RMP point.
- The piston lift the car until the reaching of the FAP point, in rapid forward mode.
- The piston stays in its position until the tyres change has finished (for our simulation purposes, we can suppose that FC=0 instantly when the piston reach the FAP point)
- The piston put down the car until the reaching of the FIP point with the VI command.



OUTPUTS:

- VAP: Command to send the piston forward in slow mode(0 deactivated 1 activated)
- VAV: Command to send the piston forward in rapid mode(0 deactivated 1 activated)
- VI: Command to send the piston backwards (0 deactivated 1 activated)



INPUTS:

- FC: End of the tyres change (0 change occurring- 1 change not occurring)
- FAP: Forward limit of the piston (0 not active 1 active)
- FA: Car photocell (0 car not present 1 car present)
- RMP: Reaching of the half turn of the piston (0 piston extended for less than half turn 1 piston extended for more than half turn)
- FIP: Backward limit of the piston (0 not active 1 active)

Notes:

- FA=0 only after the complete moving of the car away from the lifter, that can happen also many cycles after the lowering of the piston to the FIP point.
- We have to create a program that assure the lowering of the piston in any time if FA=0 (independently on the condition in which the piston is).

- Develop a <u>Ladder</u> software that allows the control of an industrial drill with the following operating mode.
- When the operator press the START button (START=1), the PLC must turn on the drill's motor (MOTOR=1), but only if the security protection is activated (PROTECTION=1).
- Otherwise, the PLC have to signal to the operator with an alarm (ALARM=1) that the protection has to be activated.
- When the operator activate the protection, the PLC must turn off the alarm (ALARM=0) and the operator can press again the START button (START=1) to make the motor turn on (MOTOR=1).
- To stop the drill, the operator can press the STOP button (STOP=1). If the operator doesn't press the stop button, the drill stops itself automatically after 10 seconds.

The <u>inputs</u> of the system are:

- START: Button that starts the drill's motor (0 button not pressed 1 button pressed)
- STOP: Button that stops the drill's motor (0 button not pressed – 1 button pressed)
- PROTECTION: Sensor on the security protection (0 deactivated – 1 activated)
- The <u>outputs</u> are:
- MOTOR: Command that enable the drill's motor (0 deactivated – 1 activated)
- ALARM: Alarm that signal the need of activation of the security protection (0 deactivated – 1 activated)

SFC exercises

- Develop a <u>SFC</u> software that allows the control of an industrial oven with the following operating mode.
- When the operator press the start button (START=1), the PLC starts the warming cycle of the material (OP=1) for 30 seconds. After that interval, the OP command must be reset by the PLC (OP=0). The completion of the process have to be signaled by the powering on of a green light (GREEN=1) for 10 seconds.
- After this interval, the green light must be powered off (GREEN=0).

The only <u>input</u> of the system is:

• START: Button that starts the oven

The <u>outputs</u> are:

- OP: Oven enabling
- GREEN: Led that indicates the end of the oven functioning.

Develop a <u>SFC</u> software that allows the control of an hydraulic car-lifter for the tyres change with the following operating mode:

- The car arrives in proximity of the lifter and it is detected by a photocell.
- The piston starts the lifting of the car in slow forward mode (suppose that the piston starts from the FIP point) until the reaching of the RMP point.
- The piston lift the car until the reaching of the FAP point, in rapid forward mode.
- The piston stays in its position until the tyres change has finished (for our simulation purposes, we can suppose that FC=0 instantly when the piston reach the FAP point)
- The piston put down the car until the reaching of the FIP point with the VI command.



OUTPUTS:

- VAP: Command to send the piston forward in slow mode(0 deactivated 1 activated)
- VAV: Command to send the piston forward in rapid mode(0 deactivated 1 activated)
- VI: Command to send the piston backwards (0 deactivated 1 activated)



INPUTS:

- FC: End of the tyres change (0 change occurring- 1 change not occurring)
- FAP: Forward limit of the piston (0 not active 1 active)
- FA: Car photocell (0 car not present 1 car present)
- RMP: Reaching of the half turn of the piston (0 piston extended for less than half turn 1 piston extended for more than half turn)
- FIP: Backward limit of the piston (0 not active 1 active)

Notes:

- FA=0 only after the complete moving of the car away from the lifter, that can happen also many cycles after the lowering of the piston to the FIP point.
- We have to create a program that assure the lowering of the piston in any time if FA=0 (independently on the condition in which the piston is).

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- Otherwise, the PLC have to signal to the operator with an alarm (ALARM=1) that the protection has to be activated.
- When the operator activate the protection, the PLC must turn off the alarm (ALARM=0) and the operator can press again the START button (START=1) to make the motor turn on (MOTOR=1).
- To stop the drill, the operator can press the STOP button (STOP=1). If the operator doesn't press the stop button, the drill stops itself automatically after 10 seconds.

The <u>inputs</u> of the system are:

- START: Button that starts the drill's motor (0 button not pressed 1 button pressed)
- STOP: Button that stops the drill's motor (0 button not pressed – 1 button pressed)
- PROTECTION: Sensor on the security protection (0 deactivated – 1 activated)
- The <u>outputs</u> are:
- MOTOR: Command that enable the drill's motor (0 deactivated – 1 activated)
- ALARM: Alarm that signal the need of activation of the security protection (0 deactivated – 1 activated)

Structured Text exercises

- Develop a <u>Structured Text</u> software that allows the control of an industrial oven with the following operating mode.
- When the operator press the start button (START=1), the PLC starts the warming cycle of the material (OP=1) for 30 seconds. After that interval, the OP command must be reset by the PLC (OP=0). The completion of the process have to be signaled by the powering on of a green light (GREEN=1) for 10 seconds.
- After this interval, the green light must be powered off (GREEN=0).

The only <u>input</u> of the system is:

• START: Button that starts the oven

The <u>outputs</u> are:

- OP: Oven enabling
- GREEN: Led that indicates the end of the oven functioning.

- Develop a <u>Structured Text</u> software that allows the control of an hydraulic car-lifter for the tyres change with the following operating mode:
- The car arrives in proximity of the lifter and it is detected by a photocell.
- The piston starts the lifting of the car in slow forward mode (suppose that the piston starts from the FIP point) until the reaching of the RMP point.
- The piston lift the car until the reaching of the FAP point, in rapid forward mode.
- The piston stays in its position until the tyres change has finished (for our simulation purposes, we can suppose that FC=0 instantly when the piston reach the FAP point)
- The piston put down the car until the reaching of the FIP point with the VI command.



OUTPUTS:

- VAP: Command to send the piston forward in slow mode(0 deactivated 1 activated)
- VAV: Command to send the piston forward in rapid mode(0 deactivated 1 activated)
- VI: Command to send the piston backwards (0 deactivated 1 activated)



INPUTS:

- FC: End of the tyres change (0 change occurring-1 change not occurring)
- FAP: Forward limit of the piston (0 not active 1 active)
- FA: Car photocell (0 car not present 1 car present)
- RMP: Reaching of the half turn of the piston (0 piston extended for less than half turn 1 piston extended for more than half turn)
- FIP: Backward limit of the piston (0 not active 1 active)

Notes:

- FA=0 only after the complete moving of the car away from the lifter, that can happen also many cycles after the lowering of the piston to the FIP point.
- We have to create a program that assure the lowering of the piston in any time if FA=0 (independently on the condition in which the piston is).

- Develop a <u>Structured Text</u> software that allows the control of an industrial drill with the following operating mode.
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- To stop the drill, the operator can press the STOP button (STOP=1). If the operator doesn't press the stop button, the drill stops itself automatically after 10 seconds.

The <u>inputs</u> of the system are:

- START: Button that starts the drill's motor (0 button not pressed 1 button pressed)
- STOP: Button that stops the drill's motor (0 button not pressed – 1 button pressed)
- PROTECTION: Sensor on the security protection (0 deactivated – 1 activated)
- The <u>outputs</u> are:
- MOTOR: Command that enable the drill's motor (0 deactivated – 1 activated)
- ALARM: Alarm that signal the need of activation of the security protection (0 deactivated – 1 activated)