



Lab 5

It is required to design a ladder diagram to control the production line machine which is responsible for filling bottles with four different soda products and this machine can serve three different sizes of bottles.

Production Line Overview:

- This machine consists of one main conveyor and three fill stations connected together with one gate which decides the bottle will enter which fill station.
- Gate is made from two opposite solenoid, each solenoid can control the arm length with two levels.
- Fill station can fill only one bottle at a time. So, the gate should route the next bottles to the next station in order from right to left if more than one station is empty or to the empty station in case there is only one empty station.
- At each station there're two IR sensors: one on the start of the station to detect if bottle enters the station and the other at the end of the station to detect that the bottle goes out of station and station is empty now.
- Main conveyor and each fill station have separate DC motors to control its conveyor movement.
- Bottle takes 1 second to move from the first IR to the middle of station where filling should take place.
- When bottle enters the fill station its conveyor should stop until the bottle is filled.
- Above each station there are four valves one for each product and each bottle has a barcode with required product and the size of this bottle and there's bar code reader to read the bottle barcode and encode it into four bits 2 for size and 2 for the product.

Size Code		Size	Product Code		Product
0	0	S1	0	0	P1
0	1	S2	0	1	P2
1	0	S3	1	0	P3
		-	1	1	P4

- When bar code reader detects the required product and bottle size it should open the equivalent valve for a specific time for each size.

Time	Size	Product	Valve Code	
3 sec	S1	P1	0	0
5 sec	S2	P2	0	1
10 sec	S3	P3	1	0
	-	P4	1	1

- At each fill station, there is optical sensor to detect if the bottle is filled to add more safety to fill station.
- When the optical sensor detects the bottle is filled or valve is open to the specific time system should close the valve.
- After the bottle is filled the station conveyor should start again to make bottle go out of the station.
- There's new bottle inserted to main conveyor each five seconds while the conveyor is moving. If the main conveyor is stopped, system can't add new bottles until it starts to move again.
- When all fill stations are full the main conveyor should stop until at least one station is empty.

Inputs and outputs:

Input	Description	Output	Description
X0	Right station first IR	Y0	Main conveyor motor
X1	Right station second IR	Y1	Right station conveyor motor
X2	Middle station first IR	Y2	Middle station conveyor motor
X3	Middle station second IR	Y3	Left station conveyor motor
X4	Left station first IR	Y4	Right solenoid level 1
X5	Left station second IR	Y5	Right solenoid level 2
X6	Right station optical sensor	Y6	Left solenoid level 1
X7	Middle station optical sensor	Y7	Left solenoid level 2
X8	Left station optical sensor	Y8	Right station valve bit0
X9	Size bit0	Y9	Right station valve bit1
X10	Size bit1	Y10	Middle station valve bit0
X11	Product type bit0	Y11	Middle station valve bit1
X12	Product type bit1	Y12	Left station valve bit0
		Y13	Left station valve bit1
		Y14	Close right station valve
		Y15	Close middle station valve
		Y16	Close left station valve

Notes:

- Use LadSim to draw your ladder diagram.
- Use LadSim register to represent main conveyor each item on conveyor represent with one bit.
- Bottle on the main conveyor moves from slot to the next each 2 seconds.