

A SIMPLE STUDY ON PLC AND PLC PROGRAM FOR AN AUTOMATED BOTTLE SORTING, FILLING AND CAPPING PROCESS

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Abstract-In modern era of industrialization, automated industrial process is a must to increase the production rate and make good profit. PLC based industrial automation process is widely used throughout the world. So, PLC and PLC programming has become the main concern for modern day manufacturing. In this study, an investigation on PLC has been done thoroughly with proper programming named ladder diagram which is very popular form of PLC program. The main core of the automation process is the programming which also has been showed through a simple of real life automated process of bottle sorting according to size, filling and capping. The program used for this process is ladder diagram. The simulation of the program is successful and shown properly in this process works with proper figures which is easily understandable. .

Keywords: Industrial automation, PLC, Ladder diagram, Simulation.

1. INTRODUCTION

Automation is the utilization of gadgets and PC controlled devices to control the procedures [1]. The point of automation is to increase efficiency and unwavering quality. Industries will be profitable just when they will use the high-end innovation accessible in the business sectors [2]. So by executing the utilization of PLC's in their procedures, businesses will go ahead towards the era of new industrialization.

Programmable logic control or PLC is one of the most used control system in industries [3]. The PLC is like a mini computer that consists of many hardware parts such as the external parts as Input and Outputs, CPU, devices for programming, and a power supply [1]. It is like an industrial computer that is used to observe and check the progress of inputs or outputs and directs the process according to the inputs and make proper decisions based on the control.

Role of PLC is very significant in this modern world of automation. The main objective of the system is to make the total process simple, accurate and flexible.

In this study, many information about PLC have been gathered and the working principal of PLC has been understood. All the parts of PLC and the input and output process is studied. The core part is the programming. Ladder diagram is also studied which is the programming language of PLC used in this study and how the logic of the program works is also shown in this project. A bottle filling process controlled by PLC permits to fill the bottle up to a desired level without wastage of the liquid. Not only the filling process, sorting of different sized bottle and the capping process is also controlled by PLC in this

study. Ladder diagram is used as the programming language to control the sequence.

2. PROGRAMABLE LOGIC CONTROL (PLC)

Input Module: These are directly connected to main devices like switches, motors, sensors etc. Input modules are used to convert electrical signals from input field devices to electrical signals that is understandable for the PLC. Inputs can be either a digital input or analog input [4].

2.1 Output Module

Output modules receives signals emitted from the PLC and change the signals to electrical signals and which is catchable by the output devices like a motor ,hydraulic solenoid valve etc. Outputs can also be analog output or digital output [4].

2.2 Power Supply

The main purpose of the power supply is to supply the DC electric power needed to operate the PLC system. A single-phase 120 or 240V AC line power supplies the required powers for running of the PLC system. Power supply converts this power into 24V DC line [4].

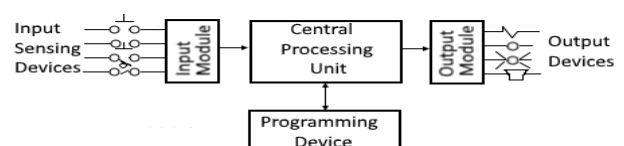


Fig.1: Block diagram of PLC process [4]

2.3 CPU

The central processing unit or CPU supervises all performances and operations that happens within the PLC. There are memory in a PLC. All the programs those are carried out are stored in the memory section. A bus system like an internal communication system serves and passes data and information to and from the memory, CPU and input or output units. CPU Consists of several parts [5]. These are-

- 1- Arithmetic logic unit (ALU)
- 2- Memory- RAM, flash memory, ROM, EEPROM, EPROM.
- 3- Timer.
- 4- Register.
- 5- Counter
- 6- Process image area.

2.4 System Busses

The digital signals that are received and transmitted through the internal paths which flows within the PLC. These internal paths are called BUS system [5].

2.5 Types of PLC

- 1- COMPACT - For compact PLC the internal memory is flexed with input module. Compact PLC has less memory. . In compact, if there is any fault any observed in any slot then changes are required in full hardware [5].
- 2- MODULAR-In modular PLC input module depends on project need. In modular PLC according to project, there are more memory. If there is any fault any observed in any slot then it is easier to handle the fault by replacing the slots only [5].

The PLC can be further classified such as mini PLC, medium OLC and large PLC according to their slot size that means input and output number and their memory [5].

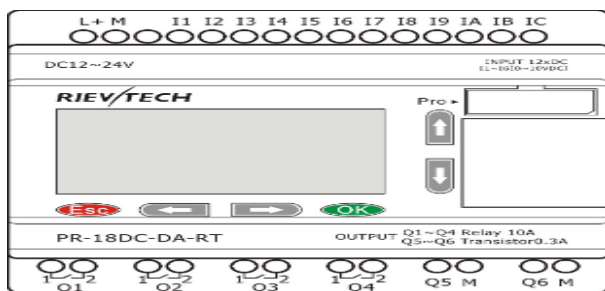


Fig.2: Linear diagram of a PLC [5]

3. DESRIPTION OF THE AUTOMATION PROCESS

First is sorting. Different sized bottles are being moved on the conveyor belt. Different sized bottle must pass through different conveyor. Separation of these bottles is to be controlled. Beverage bottles are moving on a conveyor belt. Then each bottle must be filled with liquid properly and capping of these bottles is to be performed. Crown cork caps are used for these bottles. Automation is to be implemented to perform this

operation in PLC using Ladder Diagram programming language.

When the Large bottle touches proximity sensor it automatically energies the solenoid operated gate and he gate directs the large bottle to a different path on he conveyor.

After sorting process bottles are passed throug the conveyor. When a bottle touches proximity 2 the conveyot stops and the solenoid valve in the reservoir tank opens and the liquid fills the bottle for 10 seconds for saller bottles and 20 seconds for the larger bottle. After that the conveyor starts moving again and solenoid valves stops. After touching th proximity 3 the cappig machine seals the bottle. It takes 2 seconds and then conveyor starts again and carries the bottle to the end of the conveyor for packaging.

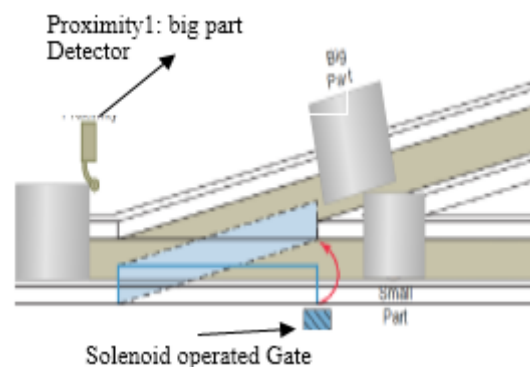


Fig.3: Right side view of sorting process

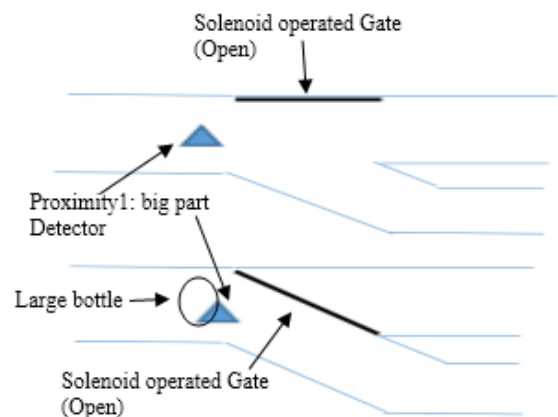


Fig.4: Top view of sorting process

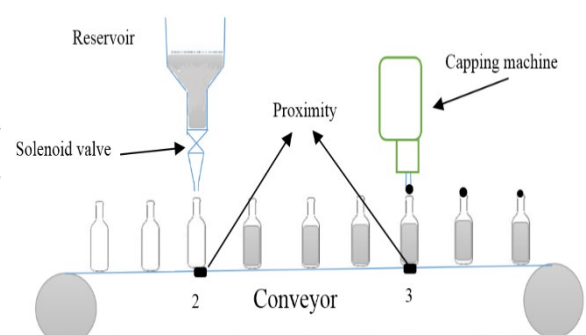


Fig.5: 2D diagram for bottle filling and capping process

4. LADDER DIAGRAM

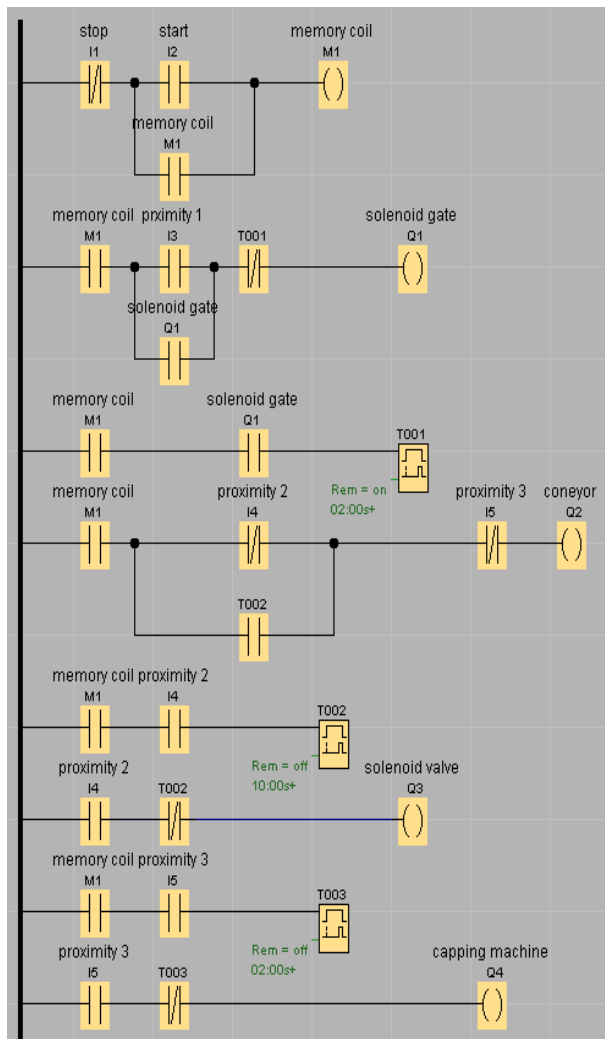


Fig.7: Ladder diagram for bottle sorting, filling and capping process

5. RESULTS AND DISCUSSION

Simulation results are shown below:

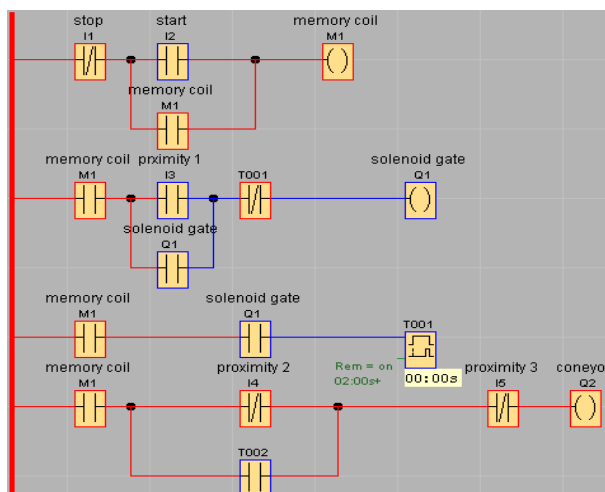


Fig.8: Conveyor Q2 starts with start button I2

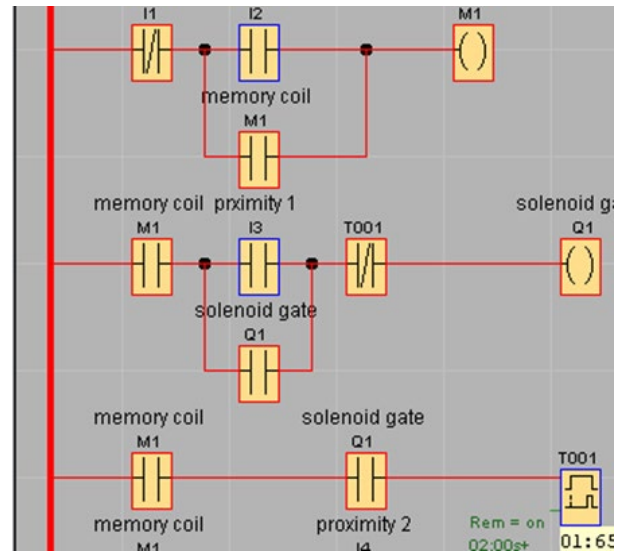


Fig.8: Solenoid gate Q1 starts with proximity1 (I3)

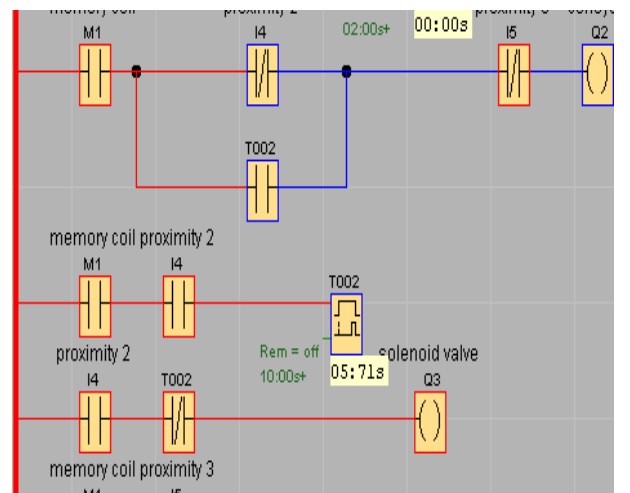


Fig.9: Conveyor Q2 stops and solenoid valve starts with proximity2 (I4)

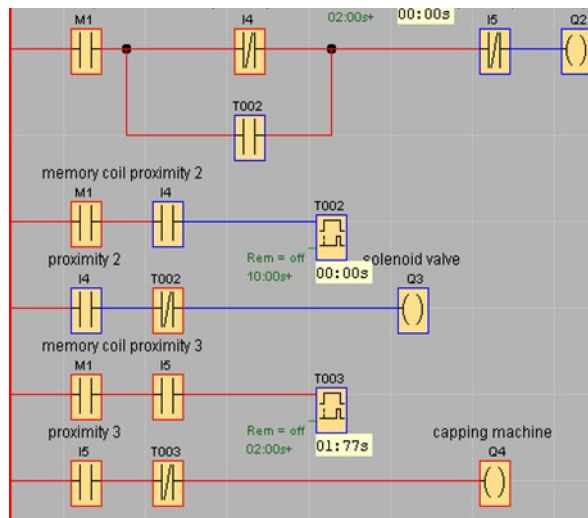


Fig.10: Conveyor Q2 stops and capping machine Q4 starts with proximity3 (I5)

Program Description is given below:

I1 is a push button used for emergency stop. I2 is the start button. M1 is memory coil. When the large bottle touch the proximity sensor 1 then I3 is activated which energizes the solenoid gate Q1. Q1 activates the timer T001 for 2 seconds. Thus larger and smaller bottles are separated and passed through different conveyor.

Now considering the incident only on one conveyor, when a bottle touches proximity 2, the I4 switch is activated and it energizes the on delay timer T002 for 10 seconds which stops the conveyor Q2 for that period of time and solenoid valve Q3 is opened and the bottle starts to fill up.

After 10 seconds, when the bottle is filled up it runs on the conveyor and after reaching the proximity 3 the I5 switch is activated and which in turn stops conveyor Q2 for 2 seconds and starts capping process as the Q4 is on. After that Q2 means the conveyor starts again and the process is complete.

To sum up, Simple basic study on PLC has been done properly. The results of the study are something like how a PLC works, what are the main components, its input, output and the processor, types of PLC. The main of the automated process using PLC is the correct implementation of PLC program. An Actual world PLC program is done. This program is suitable for learning the basic of ladder diagram program language. Some basic knowledge for the program like make contact, break contact, timer, memory coil, relay coil and their uses has been gained. This program can be used in an automated bottle filling and capping process in an industry. The simulation result is seen that the program runs perfectly. All the inputs and outputs of the program are clearly describes liked proximity switch, timer, solenoid valve, conveyor motor etc. It can be said that the study is successfully done.

7. CONCLUSION

Study on PLC and the sample program for industrial automation process has been quite fascinating as a project. Introduction and basic level knowledge about PLC has been gained and basic programming like ladder logic is also learned through this study. The program runs according to the intended plan. The result is satisfactory and there is a future scope to do more complicated process to run and implant the program in actual life use. Automation is the new hot topic in modern world especially in the manufacturing criteria. So, this study is worth doing and it helps to gather plethora of knowledge about this modern field

8. REFERENCES

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