Overview of Automatic Bottle Filling Plant based on PLC

Rohit Gautam[1] Rohit Yadav[2] Sandeep Sharma[3] Dr. Deepak Paliwal[4]
[1,2,3]Student [4]Professor
[1,2,3,4]Department of Mechanical Engineering
[1,2,3,4]GITS- Dabok, India

Abstract— In present scenario, a trend can be found in manufacturing processes that they are replacing existing manual systems with automatic, reconfigurable processes so as to enhance the overall production of respective industry. This paper provides an idea about Automatic Bottle Filling Industry based on PLC (Programmable Logic Controller). Such automation will be helpful in industries like milk industry, soft drinks, mineral water, oil and other liquid filling industry. The traditional method of filling is very time consuming and requires a huge labour work. The proposed system is fully controlled by PLC's and different sensors. Use of PLCs make it more flexible, cost effective and space efficient.

Keywords: Automatic Bottle Filling, PLC, Sensors

I. INTRODUCTION

In the industrial revolution-4 (IR.4), the atomization is the leading factor. And the aim of atomization is to substitute man power with the machines or machine controls which will result in enhancing the production rate, easy control and maintenance and reduction in cost and expenses, size of the industry, power consumption etc. The proposed automatic system based on PLC and sensors and can be applied to any type of beverages or liquid. In the proposed system various sensors, motors, solenoid valves works simultaneously. The proximities senses the presence of the bottle or filling entity and then water filling action take place. Amount of water to be filled is controlled by solenoid valves in a calculative manner (discharge rate and time). Filled bottles are capped and packaged further. This whole process is controlled by just a single PLC and this PLC is programmed in RxLogics.

II. OBJECTIVE

- To design the appropriate model of Automatic Bottle Filling system.
- To create program to operate the PLC using RxLogics (Ladder programme)

III. COMPONENTS

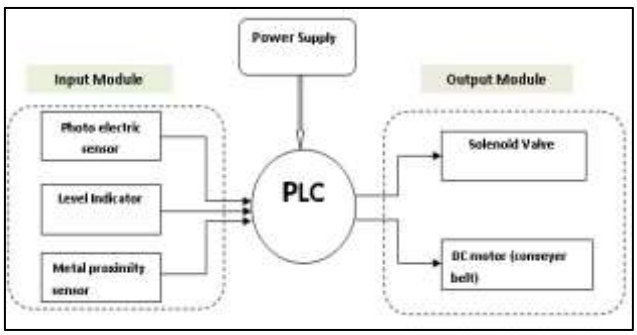

Fig. 1: Block dig. of proposed system

A. PLC (Allen Bradely Micrologix 1000)

A PLC i.e. Programmable Logic Controller is the brain of this system. Basically PLC's are used to perform various relay operation in a sequential way. The programme for PLC is made using Ladder Logic and we used RxLogics to create the ladder logic for the model. It receives the input from various sources like photo sensors, level indicator and proximities and after applying the ladder logic it shows the output in form of indicator, solenoid valves, dc motor etc.

In this project we have used Allen Bradely Micrologix 1000 PLC which has 8 digital inputs and 5 digital outputs. An SMPS is used to control the input supplies and this SMPS is rated as 24V and 5amp DC.

Fig. 2: PLC (Allen Bradely Micrologix 1000)

B. Switch Mode Power Supppy (SMPS)

A switched-mode power supply works as an switching regulator to convert electrical power efficiently. It is used to attain regulated DC output voltage from the DC input voltage or unregulated AC. In SMPS, a series of switching elements switches the current supply to a smoothing capacitor turn ON and OFF. The voltage on the smoothing capacitor controls the time when the series element is switched.

Fig. 3: Switch Mode Power Supppy (SMPS)

C. Water Level Sensor float switch P43

Water level sensor float switch P43 is a device used to sense the level of liquid within a tank. It does not have a complex circuit. It can be easily converted from normally open to normally close by inverting the float.

Fig. 4: Water level sensor float switch

D. Photoelectric Sensors

Photoelectric sensors are used to detect the presense or absense of any metallic object in their path. Such sesnors are the combination of Emitter (emitting light) and Receiver (receiving light). This sensor detects the presence of any object when it receives the changed amount of light with respect to emitted light.

E. Solenoid Valve

Solenoid valve is an electromechanically operated valve which is commonly used to control the flow of liquids. This valve consists an electric coil. When electric current is passed through the coil, an electromagnetic field generates and this casuses the plunger to shift up and down.

Fig. 5: Solenoid valve

F. Gear Motor

A gear motor is the combination of a DC motor and a gear box. This motor has a primary functions like other DC motors but the gear box installed in it provides high toruqe at low speed or rpm that helps in carrying the heavy bottles(water filled bottles) gentely on covnveyer belt.

Fig. 6: DC Gear Motor

IV. PROCESS DESCRIPTION

Initially the tank or the reservoir are at its full capacity and the water lever sensor float switch is installed at the bottom of reservoir. This process starts with a "Auto start push button" which enables gear motor. The shaft of the gear motor is coupled with the roller of the conveyer. The shafts of the rollers are heavy so that they can bear the load of the unfilled as well as filled bottles. And these heavy rollers can be easily operated by the gear motor which provides heavy torque. Two to three bottles are placed simultaneously on the conveyor belt. Now as the bottle approaches towards the photoelectric sensor, the sensor senses the bottle and the conveyor stops running. A timer is provided in the ladder logic which controls the valve opening time for the solenoid valve. This time is calculated considering the discharge through the valve and size of bottle to be filled. As the conveyor stops, the solenoid valve gets energized and the water starts filling in the bottle. When the given time is over, then the solenoid valve gets de-energized completely and water flowing through the valve is stopped and the conveyor belt starts moving again. Then comes the next bottle which follows the same process. During this process, the level of water in reservoir keeps on decreasing. When the water level falls to the water level sensor (which is installed at calculated distance form bottom to prevent the lack of water while filling), the float switch sends a signal to PLC which enables the another solonoid valve which fills the water reservoir. And this whole process of filling bottles continues. Emergency Switch has also been introduced in the system which works like a circuit breaker that disconnects the entire PLC system whenever any unfavorable conditions arise.

V. LADDER LOGIC

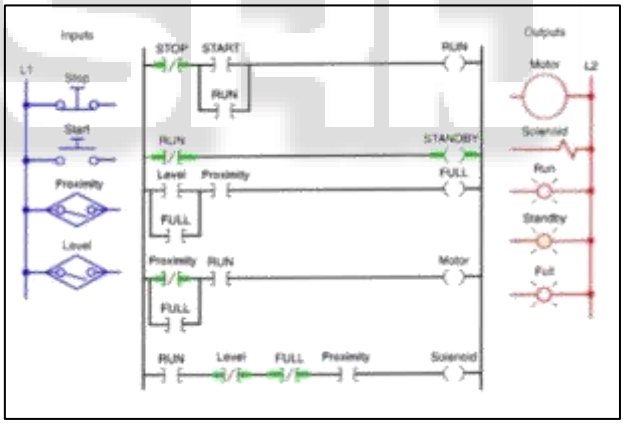

Fig. 7: Laddder Logic Diagram

VI. CONCLUSION

Traditional Bottle filling system has various shortcomings like spilling of water/liquid, wastage of time and labour work, cost of individual industry for individual task etc.The main purpose of this paper is to give an idea about designing automatic system for low scale industries. This system can be extended by adding some more task simultaneously with the bottle filling like capping, filling bottle of different size, sorting of bottles etc.

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