Review of Design and Development of Bottle Filling Plant using PLC

Dargude Rahul[1] Lahane Sachin[2] Kadam Bholenath[3] Jondhale Harshad[4] Prof. Gujrathi T. V.[5]
[1,2,3,4]BE Student [5]Assistant Professor
[1,2,3,4,5]Department of Mechanical Engineering
[1,2,3,4,5]SND COE & RC, YEOLA, Maharashtra, India

Abstract— Recent trend of manufacturing processes, like Industry 4.0 (I4.0), strive to replace existing manual systems with fully self-controlled, reconfigurable processes to improve the overall production system. This paper develops a strategy to track closely the production, reduce the manual control and efficiently monitor the bottling process of a small beverage plant by implementing I40 basic concepts such as decentralization and real-time data analyses. A Siemens S7-1200 PLC communicating via Ethernet TCP/IP with a ZENON SCADA Human Machine Interface (HMI) was used to simulate the operations of a bottling process. The proposed strategy, developed by modeling bottling production as a time function, allows supervisors to be free from manually configuring bottling process parameters and monitor production steps directly on the SCADA with relevant information. This optimizes production time by reducing users' interferences with the overall process. At the end of the paper, the experimental results were graphically plotted to illustrate the benefits of the proposed strategy.

Keywords: Automation, PLC, Sensors, Ladder Logic

I. Introduction

The main idea behind "automation" implies the control of industrial processes and machines with very little intervention of human operators. Companies in the industrial sector are therefore required to adopt flexible, cost effective and efficient processes to be competitive. Innovative industrial control and automation systems are more than ever needed within the process and manufacturing industries to boost their operations in terms of speed, reliability and product output Industry 4.0, the current trend of automation, has been developed to answer these challenges by offering various advantages like interoperability, virtualization, decentralization, real-time data acquisition etc. Although many people in the industrial sector seem very interested by the concept of Industry 4.0, there is not only a single way to describe or define it. It can be seen as a way to combine complex machineries and devices with sensors and software connected together in a network, utilized to control, predict and organize better outcome for business processes or "an innovative level of organizing logistics and management throughout product lifecycle" An efficient way to expand automation in Industry 4.0 is to make use of a self-running Cyber Physical Systems (CPS) interacting with the environment in which production takes place. The interaction is done via actuators, sensors and microcontrollers The aim of this paper is to design, through a logical program in a S7-1200 Siemens PLC controller, an AUTOMATIC and independent experimental bottling process that reconfigures machines parameters, interprets production output and strives to meet daily target. Some intelligent strategies, functions are used in the program to carefully monitor hourly, daily and monthly the production without any manual control. The paper is composed of four sections. The first section is an introductory part on the overall topic. The second section is the presentation of a brief review on automated bottling process and its major components. The third section explains the theoretical modeling of our proposed automation strategy, the structure, the control system design of our experimental bottling process and the results obtained; the fourth section is a conclusion of the work done.

II. Problem Statement

- The main aim is to save the data by using data acquisition system.
- The aim of microcontroller based automatic filling system is to reduce the human effort by using automatic control system.
- We have design is block separately and integrate by using control circuits
- The technique is used for filling any liquid type by considering the all liquid properties

III. Objectives

- To design the appropriate model of automatic bottle filling and tank level control.
- To design program using PLC and make ladder diagram of the system.
- To design a human interface for monitoring and controlling of the system.
- To store the data by using data acquisition system.

A. Programmable Logic Controller

According to National Electrical Manufactures Associations (NEMA), PLC is a digitally operated electronic system for use in an industrial environment, which uses a programmable memory for the internal storage of user-oriented instructions for implementing specific functions such as logic, sequencing, timing, counting and arithmetic to control, through digital or analog inputs and outputs for various types of processes.

PLC consists of an I/O unit, central processing unit, and a memory unit. The input/output unit of the PLC acts as an interface to the real world. Inputs from real work are given to the input unit which is manipulated based on the programming, and the results are given back to the real world through the output unit of the PLC. All logic and control operations, data transfer and data manipulation operations are done by the central processing unit. The results and statuses are stored in the memory of the PLC. PLC's are used for a wide range of applications especially in the field of control and automation

- Block Diagram

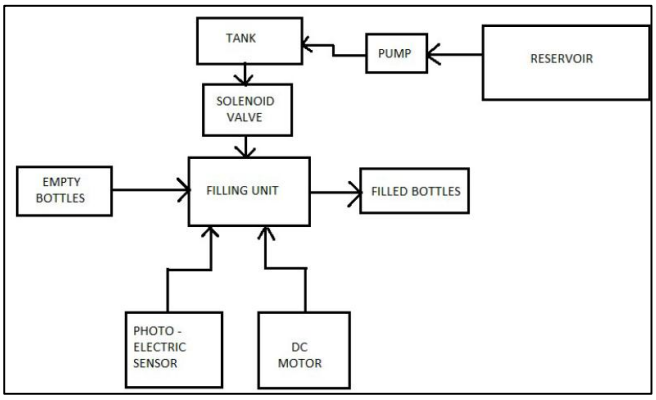


Fig. 1: Block diagram of system

1) Storage Tank

The storage tank is used to store water which is to be lifted using submersible water pump. It also possesses float type sensor to detect fault i.e. non availability of water.

2) Feeder Tank

This tank is used to feed water to bottles. It also host various sensors to indicate water level to PLC and also solenoid valve to control the flow of the water.

3) Submersible Pump

This is motor which has hermetically sealed motor close couple to the main body. Whole assembly is submerged in the fluid which is to be pumped. The pump used in this project is the miniature of large submersible pumps.

4) Sensors

– Photoelectric Sensors

Photoelectric Sensors detect objects, changes in surface conditions, and other items through a variety of optical properties. A Photoelectric Sensor consists primarily of an Emitter for emitting light and a Receiver for receiving light. When emitted light is interrupted or reflected by the sensing object, it changes the amount of light that arrives at the Receiver. The Receiver detects this change and converts it to an electrical output. The light source for the majority of Photoelectric Sensors is infrared or visible light (generally red, or green/blue for identifying colors)

– Capacitive Sensor

Their operating principle is based on a high frequency oscillator that creates a field in the close surroundings of the sensing surface. The presence of any material (capacitive) in the operating area causes a change of the oscillation amplitude. The rise or fall of such oscillation is identified by a threshold circuit that changes the output state of the sensor. The operating distance of the sensor depends on the actuator's shape and size and is strictly linked to the nature of the. A screw placed on the back of the capacitive sensor allows regulation of the operating distance.

– Level Sensor

Level sensor is the float type switch used to sense the level on the tank. It can be easily converted from normally open to normally close.it provides discrete output. It consists of a snap-action switch and a long lever arm with a float attached to the arm. As the liquid level rises, the lever arm presses on the switch's actuator button. It can be easily converted from normally open to normally close.it provides discrete output.

5) DC Motor

In a simple dc motor when the coil is powered, a magnetic field is generated around the armature. The left side of the armature is pushed away from the left magnet and drawn towards the right causing rotation. The armature continues to rotate. When the armature becomes horizontally aligned, the commutator reverses the direction of current through the coil, reversing the magnetic field. The process then repeats. When the current passes through the coil wound around a soft iron core, the side of the positive pole is acted upon by the upward force, while the other side is acted upon by a downward force. According to Fleming's Left Hand Rule, the force causes a turning effect on the coil, making it rotate. To make the motor rotate in a constant direction "direct current" Commutators makes the current reverse in direction in every half cycle (in a two pole motor) thus causing the motor to continue to rotate in the same direction. DC motor is commonly constructed with wound rotors and either wound or permanent At first, the auto selection switch is selected so that the entire system operates automatically.

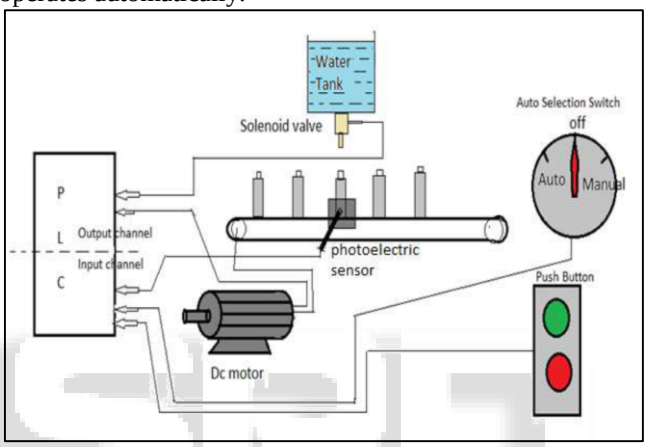


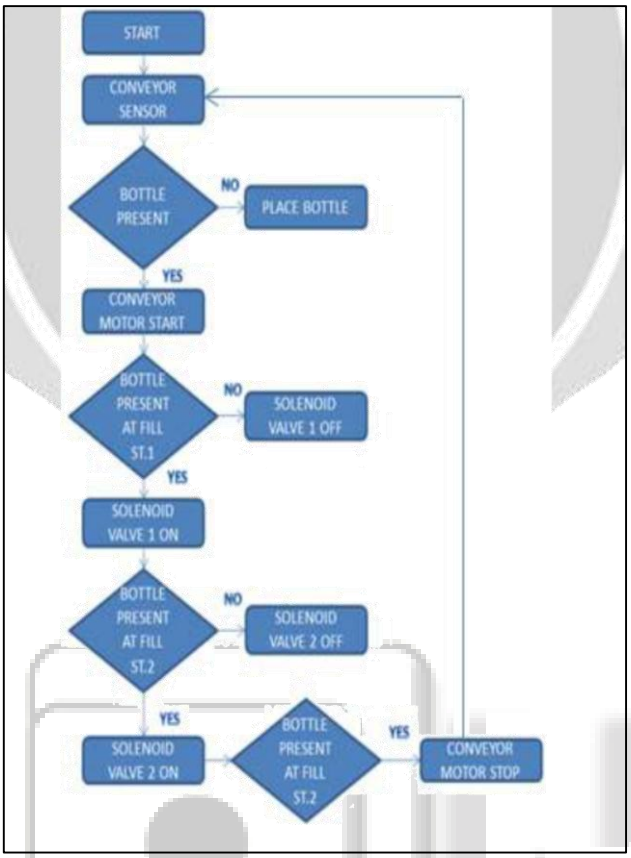
Fig. 2: layout of bottle filling plant

IV. SPECIFICATION OF COMPONENT

COMPONENTS	SPECIFICATION
PLC (ALLEN BRADLEY)	Input Power: 120/240 AC 24 DC 20 Digital Inputs 12 Digital Outputs 2 Analog Inputs and Outputs
DC MOTOR (JOHNSONS)	Revolution per minute: 30rpm Torque: 6.5kg-cm Voltage: 12V
LEVEL SENSOR	Maximum contact rating: 10 W Maximum switch current: 0.5 A Maximum switch voltage: 100 V DC Maximum breakdown Voltage: 220 V DC Temperature Rating: -10°C to +85°C Weight: 25 gm
PHOTOELECTRIC SENSOR (IDEAL)	Sub Type: Through Beam Rated Voltage: 12-24 V DC Sensing Range: 5000 mm Weight: 50 gm Response Time: 1 ms
CAPACITIVE SENSOR (IDEAL)	Power Supply: +10 to +30V DC @ 10mA max Output: 1.8V @200 mA Max sensing Distance: 5mm Wire Color Code: Brown=+V DC Blue=Common Black=Output Operating Temperature: -25°C to +70°C

SOLENOID VALVE (ITALY)	Voltage: 24 V Response Time: <20ms

V. FLOW CHART



VI. CONCLUSION

- The main purpose of PLC base system is to increase the productivity, which reduces the human effort. This system is more reliable and user friendly. It can be work efficiently for a longer period of time.
- The unnecessary loss of electric energy is used by infrared sensor.
- We gained more knowledge about various processes directly used in industries such as filling capping etc.
- The main purpose of PLC in automation is used to control the whole system .the performance, flexibility and reliability is depend on the investment.

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