RESEARCH ARTICLE

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Bottle filling system for different height bottles using programmable logic controller

Akhil Chillashette¹, Dr. V S Krushnasamy², Shashwatha S A³ Shilpa S Shet⁴, Srinivasa P⁵

1(Electronics &Instrumentation, Dayananda Sagar College of Engineering, Bangalore-78 Email: <u>akhilchilshetty@gmail.com</u>)

2(Associate Professor, Electronics &Instrumentation, Dayananda Sagar College of Engineering, Bangalore-78 Email: krushnasamy-inmt@dayanandasagar.edu)

3(Electronics &Instrumentation, Dayananda Sagar College of Engineering, Bangalore-78 Email: shashwathaanand18@gmail.com)

4(Electronics &Instrumentation, Dayananda Sagar College of Engineering, Bangalore-78 Email: <u>shilpasshet2000@gmail.com</u>)

5(Electronics &Instrumentation, Dayananda Sagar College of Engineering, Bangalore-78 Email: srinivasap632000@gmail.com)

Abstract:

An Automation is the utilization of different control techniques for operating equipment's such as operations in factories, aircraft and other applications with reduced human power. The filling process is a mission performed by a machine that fills liquid products such as liquid or cold drinks. Traditional bottling methods include placing bottles on a circular disc and filling only one bottle at a time. In this proposed work, it has been designed and implement liquid filling machine system for different sized bottles by using PLC. This idea will become a great solution for small and medium scale industries because they can produce different types of products at different heights in a single conveyor line. Here sensors act as the input device. PLC acts as the real time decision maker, so it makes the decision according to the control logic fed into it based on the respective input signals. PLC actuates the field instruments to perform specified operation in accordance with the program. Where the liquid filling machine using the solenoid valve and sensors which gives the appropriate information to control unit then design the controller using PLC. The PLC plays important role to implement automatic filling process by using PLC is less operational cost and less power consumption than the traditional control systems, in addition more flexible and time saving.

Keywords — Automation, PLC module, Bottle filling of different heights, inductive sensor, Ladder logic, Arduino UNO.

I. INTRODUCTION

Industry automation becomes a spacious field in manufacturing which had important role in an extensive range of industries beyond manufacturing. Nowadays the rapid development of manufacturing and technology has led to an increase in production level. Where the production managers are faced challenged to reduce the cost of the product with maintaining product quality within a time framework. Programmable logic controller (PLC) is extensively used in industrial automation, and it act as a brain in industry application. PLCs in the industrial field are utilized to control a certain process in order to get

better performance and higher accuracy to give more production in an efficient manner.[1]

This proposed work present, design and implementation liquid filling machine system for different sized bottles by using PLC. The liquid filling machine system consist of prototype circular disc section, filling section with sensors and control section using PLC. The PLC control unit is utilized to reduce the human work and increasing the production with less time. A filling machine with PLC controller allows the user to choose the size of bottles. The filling process is based on the selection of the size of the bottles by the user, through which the user can select the size of the liquid to be filled. An inductive sensor is placed at the circular disc

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section in order to detect the position of the bottle under the valve and the corresponding valve is switched on to fill the bottle by using control unit.[2]

II. PROBLEM IDENTIFICATION IN EXISTING SYSTEM

i) The problems that are existing in the traditional methods are the system can fill only fixed height of containers. They cannot be used to fill different heights of bottles. If filling is carried out for another size of bottle, then operator has to change the time for filling and program also must be changed or separate production line must be preferred for another height.

ii) small scale industries produce different types of liquid products, in that some may be produced only in particular part of the year and are seasonal. If each one of the products is produced in different conveyor lines, it requires vast area and investment cost also becomes high for such type of system.[3]

III. OBJECTIVES OF PROPOSED WORK

There are four objectives to be achieved in this work. Below are the following objectives:

- 1. To design appropriate model for automatic filling bottle of different height.
- 2. To design program using PLC for automation filling bottle.
- 3. To interface PLC module with the inputs and outputs component.
- 4. To design appropriate system for automatic filling bottle.[1]

IV. DESIGN AND METHODOLOGY

Automatic Bottle Filling (ABF) through PLC control process and resource utilization as the name suggests, fills the bottle based on the data obtained by the sensors (the height and the specific quantity of the liquid) using PLC. This system contains

A. Sensor Bank

Sensor bank is a collection of different ranges of sensor which is used in detecting and monitoring the bottle moving in rotary filling mechanism, detecting the height of the bottle used in the process. Inductive sensor to sense the metallic nails in the circular disc holder of the bottles, Ultrasonic sensor to detect the height of the bottle, Photoelectric sensor to detect the presence of the bottles and flow sensor to determine the amount of liquid pumped out of the pump.

B. Programmable Logic Controller

PLC is the brain of the Automatic Bottle Filling. PLC contains logical and sequential steps on which the process is automatically controlled. All the inputs, outputs, display devices and transmitting devices shown are connected to the PLC to achieve the task. The model we have used is PLC FX1N-20MR as shown in the Fig. 1.

- Model: FX1N-20MR
- Made in: Chinese (Mitsubishi Compatible)
- CPU Chip: STM32F103
- Output Type: Relay
- Working Voltage: DC24 (V)
- Wide Power Supply Voltage: 10-28VDC
- Baud Rate: 9600
- Programming Software: for GX-Developer, for GX-works2.
- Size: Approx. 86 x 73 x 20mm / 3.4 x 2.9 x 0.7inch
- Weight: 120g



Fig. 1 PLC module FX1N-20MR

C. Arduino UNO

Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. The Arduino UNO board used in shown in the Fig. 2.

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Fig. 2 Arduino UNO board

Arduino UNO is a low-cost, flexible and easy to use programmable open-source microcontroller board that can be integrated into a variety of electronic proposed works.

D. Implementation



Fig. 3 Block Diagram of the proposed work

The above Fig. 3 shows the block diagram of the bottle filling system implemented. PLC is the main controller used in the presented proposed work. Sensors are used to provide input to the controller to provide the knowledge of the current situation of the working of the system setup. We have used Inductive sensor to sense the metallic nails in the circular disc holder of the bottles, Ultrasonic sensor to detect the height of the bottle, Photoelectric sensor to detect the presence of the bottles and flow sensor to determine the amount of liquid pumped out of the pump.

The working model is shown in Fig. 4:



Fig. 4 Working model of the proposed work

When the main switch is turned on in the software, the system process begins by running of the motor. The inductive sensor placed above the circular disc to detect the metal nail attached to each holding. The counter is set to the count 3, so the motor stops when the inductive senses three times where the ultrasonic sensor finds the distance to the bottle and sends the data to the Arduino Uno where the analog data is converted to the digital data which is fed to the PLC. Once the ultrasonic sensor senses the height and sends the data, the motor again starts running again to the count 3 of the inductive sensor and stops where the filling process takes place.

In the filling process, the flow sensor continuously sends the data of how much amount of liquid is flowing out the pump. Once the data matches to the data criteria stored in the PLC, the pumping process stops. And again, the motor starts and stops according to the inductive sensor and the counter combination. The bottle is now removed, and another bottle is fixed to continue the process. Photoelectric sensor is used to sense the bottle and also to continuously run the process.

V. RESULT

Software Test:

According to the working process of the system PLC programming, Ladder Logic (LAD) simulation software GX works has been used. PLC programming in the form of Ladder Diagram has been designed to work this proposed work.

Pump Control:

Used to control the pump during the filling of the

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bottles fixed to the holder of the circular disc. It works using the motor. The pump will help to fill the fluid inside the bottle.

Filling Process:

As the empty bottle sent in to filling area the inductive sensor and the ultrasonic sensor placed at the circular disc setup, confirmed the perfect position of bottle for filling. The pump pumps the certain amount of liquid according to the flow sensor data. When the bottle gets filled, then it will be sent for the next operation.

VI. CONCLUSION

The purpose of this proposed work is to develop a PLC based automatic bottle filling system, which consumes less time and cost efficient. Automation systems are used to increase productivity, which in turn brings economic progress. The main purpose of PLC in automation is used to control the whole system. The cost of installation is not cheap, but it can efficiently run for a long period of time. The performance, flexibility and reliability are based on the investment. A PLC based control system was applied to the automatic liquid filling station previously specified and the performance was measured. The entire system is more reliable, time saving and user friendly.

We gained more knowledge about various processes directly used in industries such as filling etc. which are used in automation system in which we specially learn about Programmable Logic Control.

REFERENCES

- 1. Mamatarani Panny, Dr. M. S Aspalli, "Automatic Liquid Filling to Bottles of Different Height Using Programmable Logic Controller", Professor and PG Coordinator Department of EEE Poojya Dodappa Appa College of Engineering Kalaburgi, Karnataka, India. International Journal of Scientific Engineering and Research (IJSER) www.ijser.in ISSN (Online): 2347-3878
- T.Kalaiselvi, R.Praveena, "PLC Based Automatic Bottle Filling and Capping System With User Defined Volume Selection", Easwari Engineering College, Chennai. International Journal of Emerging Technology and Advanced Engineering (ISSN 2250-2459)2012.

3. Savita M.tech, R.N College of Engineering & Management,Rohtak,India, Lokeshwar Assistant Prof, R.N College of Engineering & management,Rohtak,India. "Implementation and performance analysis of bottle filling plant using ladder language". International Journal of Science and Research (ISSN 2319-7064) 2012.