AUTOMATIC LIQUID FILLING TO BOTTLES OF DIFFERENT HEIGHT USING PROGRAMMABLE LOGIC CONTROLLER

[1]MALLARADHYA H M, [2]K R PRAKASH

[1]Department of Industrial Automation Engineering, VTU-RO, Mysore, Karnataka, India
[2]Department of Mechanical Engineering, National Institute of Engineering, Mysore, Karnataka, India
Email: aradhyahulikere@gmail.com, prakash_kupparavalli@yahoo.com

Abstract - Filling is a task carried out by a machine that packages liquid products such as cold drinks or water. Traditional methods of bottle filling involved placing bottles onto a conveyor and filling only one bottle at a time. This method is time consuming and expensive.

The present work briefs about a machine that used to prepare automatic filling of liquid in to the bottle of different height is fully controlled by the plc which acts as the heart of the system. The system sequence of operation is designed by ladder diagram and the plc programming software. Sensor usually plays its vital part as an input signal transmitter for the plc in the system. During this project sensor has been used to detect the bottle position that move along the conveyor belt at the low speed while the machine operates. The input signal that has been sent from the sensor to the plc has being made as a reference. Signal in order to determine the output signal that exactly a same with the plc programming language based on the user requirement. The entire system is more flexible and time saving.

Keywords -PLC, Sensors, Automation

I. INTRODUCTION

The field of automation has had a notable impact in a wide range of industries beyond manufacturing. Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. In the scope of industrialization, automation is a step beyond mechanization. Whereas mechanization provides human operators with machinery to assist them with the muscular requirements of work, automation greatly decreases the need for human sensory and mental requirements as well. Automation plays an increasingly important role in the world economy. One of the important applications of automation is in the soft drink and other beverage industries, where a particular liquid has to be filled continuously. For these kinds of applications. The trend is moving away from the individual device or machine toward continuous automation solutions. Totally Integrated Automation puts this continuity into consistent practice. Totally Integrated Automation covers the complete production line, from receipt of goods, the production process, filling and packaging, to shipment of goods. Our project is also an application of automation wherein we have developed a liquid filling to bottles of different height. The various processes are controlled using a PLC (Programmable Logic Controller).

II. OBJECTIVE

The main objective of the project is to Design and Develop a Automatic liquid filling to bottles of different height with PLC Integration. Programming the system in PLC ladder logic diagram. To develop a filling machine which can fill different sizes of containers on the bases of height same principle can be used in different industries like medicine, oil, chemical industries for filling liquid to different sized component by one machine.

III. PROBLEM DEFINITION

The problems that are existing in the present machines are that it can fill only a particular type of containers of certain height, and the filling amount is as set by the operator. If the machine has to fill different type (size) of container then again the operator has to set the filling amount for each container. Time taken for filling will become more in such conditions. Sometimes in special environments which are dangerous and not conductive for human operation, the operator cannot go and set the filling amount. By this the rate of production was affected due to the use of manual inspection systems. Sometimes in special environments which are dangerous and not conductive for human operation.

IV. METHODOLOGY

Bottles are kept in position in a carton over a conveyor belt; they are sensed to detect their presence. Capacitive sensors are used for sensing the bottles. Depending on the output of the sensor the corresponding valve switch on and filling operation takes place. If the particular bottle is not present then the valve in that position is switched off, thereby avoiding wastage of the liquid. The filling process is done based on timing. Depending on the preset value of the timer the valve is switched on for that particular period of time and the filling is done.

V. PROCESS DESCRIPTION

This chapter gives the brief description about the hardware components in this project and complete idea of the components used in the system.

A. BLOCK DIAGRAM

The basic block diagram (as shown in FIG. I) of the process and its explanation is given as follows

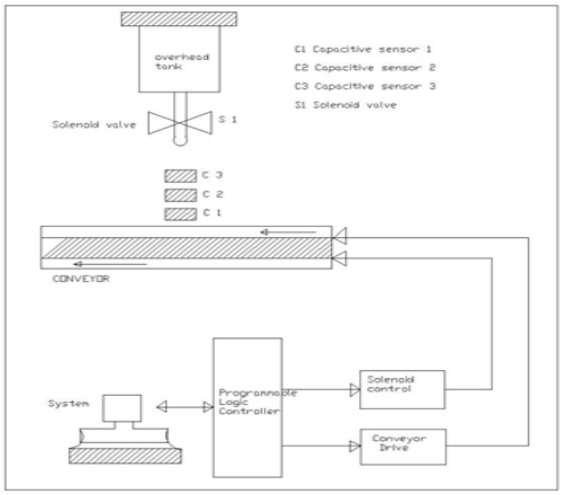


Fig I Block Diagram Of The Process

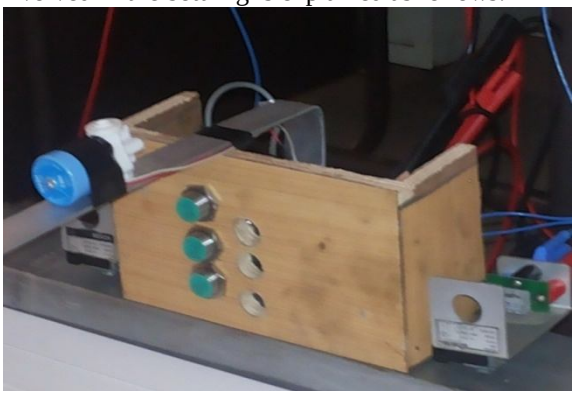
B. INPUTS

The input module includes the capacitive sensors and start/stop button. There are three capacitive sensors whose output is given as an input to the PLC.

Three capacitive sensors are used to detect the bottles position. These sensors kept near the input side, where the bottles are fed into the conveyor, are called detection sensors. And one push button to start the cycle and push button to stop the cycle

C. OUTPUTS

The various output devices used in the bottling process are A C synchronous motor, solenoid valve. These are connected to the output module. The synchronous motor is used to run the conveyor in forward direction. One solenoid valve is used for the filling process, and are connected to the overhead tank. These are the various output devices used in the bottling process. The basic process (as shown in fig I) involved in the bottling is explained as follows:

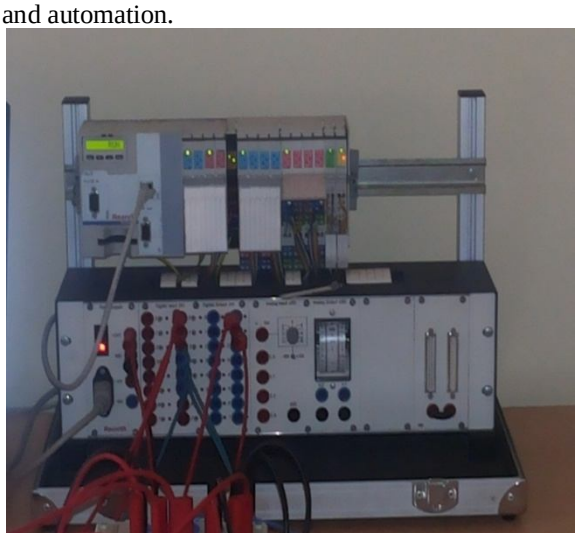


VI. SIGNAL CONDITIONING

The output of the sensors cannot be given directly to the PLC as the input voltage to the PLC should be 24V. Hence they are given through signal conditioning circuits which condition the input signals and in turn give it as an input to the PLC. For safety purposes the inputs are not given directly to the PLC. They are given through relay circuits. The relay consist of 3 terminals – common, NO and NC. The 24V which is to be inputted into the PLC will be available in the common terminal. Hence depending upon the necessary signals, the circuit closes or opens thereby connecting to the PLC.

VII. PLC

PLC is a solid state device. They are well-adapted to a range of automation tasks .All control operations are done using the PLC. The entire bottling process is automated by feeding the necessary conditions into the PLC using ladder logic. Ladder logic is one of the methods of programming a PLC. Thus, depending on the logic developed the filling of bottles is done. 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.



VIII. RELAY DRIVE UNIT

The operating voltage of the output devices is low when compared to that of the PLC. The output of the PLC is 24V whereas output devices such as ac synchronous motors and valve require only 12V for

their operation. Hence the output signals from the PLC are given through a relay drive unit which drives the output devices by supplying the optimum voltage required for their operation. The 12V required for their operation is available at the common terminal of the relay unit

IX. LIQUID FILLING UNIT

In this unit it consists of overhead liquid tank, one capacitive sensor, flow control (solenoid) valve connected to liquid tank. After inspection done by the inspection unit the container comes below the solenoid valve there one capacitive sensor placed below the valve and when it sense the container the conveyor stops, then the solenoid valve get ON and fills the liquid to the component based on the instruction given by inspection unit(i.e. which size container has to be filled). Liquid will be as soon as the conveyor stops. Solenoid control valves are electromagnetic plunger valves which control flow rates of liquids or gases. The input to solenoid valve is given by PLC. Three different timings are given to three different containers. The timing of solenoid valve and conveyor stopping is set by the timers used in program. We can change the timing based on the requirement. Conveyor stopping time also varies for three containers. The overhead liquid tank will supply liquid to the solenoid valve. After filling liquid to container the solenoid valve gets OFF and conveyor starts to run. And automatically cycle repeats.

1. Solenoid valve to control the flow of liquid
2. Liquid filled tank
3. Pipe connected to solenoid valve

CONCLUTION

The thesis presents a automated liquid filling to bottles of different height using PLC. A total control is made in a filling is achieved. The present system will provides a great deal of applications in the field of automation, especially in mass production industries where there are large number of components to be processed and handled in a short period of time and there's need for increased production. The programming to this system developed is flexible, quickly and easily. This will increase the total production output; this increase in production can yield significant financial benefits and savings. This concept can be used in beverage and food industries, milk industries, medicine industries, mineral water, chemical product industries and manufacturing industries.

REFERENCE

[1] Kelvin T Erickson, "*A* Programmable logic controllers", IEEE potentials, pp.14-17, march-1996.

[2] Nabil Shaukat, "*A* PLC Based Automatic Liquid Filling Process", IEEE, publication page No. 226-233, 2002.

[3] Gerardo Gonzalez-Filgueira, "Modeling of an Olive Oil Plant as a Digital Ecosystem" University of A Coruna, Ferrol, Spain, IEEE, pp. 3942-3947, 2009.

[4] Hong-bo Liu, Li-zhong wang, Zhen-yu Hou and Guang-de WANG "Research on System of Liquid Automatic Filling" IEEE 2011.

[5] W.Bolton, "Programmable logic controllers", fifth edition, published by Elsevier, a division of Reed Elsevier India Private Limited.

★★★