AN ANALYSIS AND CONTROL OF A CLOSED LOOP CONVEYER SYSTEM USING PLC AND SENSORS

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ABSTRACT:
This paper aims to explain the design and implications of a closed loop system using PLC and sensors which can control conveyer that limits the water flow into the bottle. A discussion on the same in a practical scenario has also been discussed. The aspects discussed are towards ease-of-use, design complexity and market acceptance.

Keywords: PLC, Closed loop system, Conveyor, Ladder logic diagram, Sensors.

I. INTRODUCTION
Nowadays, the application of PLC is widely known and used in this digital world. PLC’s application is obviously applied at the industrial sector. Normally, the PLC’s that have been used at the industrial field is usually to control a mechanical movement either of the machine or heavy machine in order to create an efficient production and accurate signal processing [1].

A machine that used to prepare automatic filling water into the bottle and dispatching using the arrangement is fully controlled by the PLC, which acts as the vital part of the system. The system sequence of operation is designed by ladder diagram. Sensor usually plays vital role as an input signal transmitter for the PLC in this system [1]. Here, sensor has been used to detect the bottle position that move along the conveyor belt at the low speed while the machine operates. Besides that, the electronics and electric devices that usually been controlled by the PLC are like a motor, pump, sensor, conveyor belt and the others devices. The assemblies of these all elements work together and make a complete system known as “CONTROL OF CONVEYOR SYSTEM USING PLC AND SENSORS” [2].

II. PREFERENCE TO THE CLOSED LOOP CONVEYER SYSTEM
Control engineering has evolved overtime. In the past, humans were the main method for controlling a system. More recently, electricity has been used for control and early electrical control was based on relays. These relays allow power to be switched on and off without a mechanical switch. It is common to use relay to make simple logical control decisions. The development of low cost computer has brought the most recent revolution, the Programmable Logic Controller (PLC). The advent of the PLC began in the 1970s, and has become the most common choice for manufacturing controls [4]. “Control of conveyer using PLC and sensors” is a closed loop control system. This system is broadly used to fill different types of liquid such as water, syrup, cold drinks, soft drinks, hard drinks, milk, etc in to the bottle. This system consists of rubber conveyor belt, DC motor, proximity sensors, and liquid filling device as solenoid valve, programmers as PLC, and other devices such frame structure on which the complete system will stand [2]. The system sequence of operation is designed by ladder diagram and the programming of this is done by using Programmer software. Sensor usually plays its vital part as an input signal transmitted to the PLC in this system. In this scheme, sensor will be used to detect the bottle presence that move along the conveyor belt at the low speed while the machine operates. The input signal will be sent from the sensor to the PLC will be considered as a reference. Signal in order to determine the output signal that is according to the PLC programming language based on the user requirement. Besides that, other devices also controlled by the PLC are like a motor, pump, sensor, conveyor belt and the others devices [8].

A. OBJECTIVES
The main objective of this system is to apply PLC to design automatic filling liquid system. To drive the main objectives, there are several supporting goals are required to be achieved [7].
- To perform a filling liquid process into the bottle using PLC programming.
To make a proper program for PLC in order to perform the activities.
To construct the actual working model of the complete system.

B. PROBLEM STATEMENT
To design a close loop system which can control conveyor.
To make sure that the bottle doesn’t overflow and conveyor must be stopped as long as sensors and filling process is in work.
To design a controller system that limits the water flow in to the bottle.
To make sure that the bottle does not fall from the conveyor in the empty condition at the starting of conveyor.

III. WORKING
The working of the proposed conveyer system is described step by steps [6]:
Step1- Put empty bottle on conveyor.
Step2- Push the ON button to start the system. Sensor-1 senses the object and motor starts. Actually sensor gives output of 12V to PLC which in turn on its output at Q0.0 at which motor is controlled through relay and motor starts when PLC turn its output ON as per program.
Step3- As soon as gear motor runs, conveyor starts moving. Bottle kept on the conveyor will be detected by the proximity sensor-2.
Step4- As far as bottle is sensed, conveyor motor will be stopped and solenoid valve will be opened.
Step5- Liquid will start filling the bottle until and unless the preset timer is deactivated.
Step6- Once the bottle is filled, solenoid valve will be stopped, and conveyor motor starts moving again.
Step7- At the end the bottle will be detected by another sensor located at the end of the conveyor in order to detect a bottle and transmit a signal to PLC. PLC will get the signal and stops the conveyor motor until and unless another bottle is placed on the conveyor belt at the start point.

A. Main Parts of the system
1) PLC (Programmable logic control)
2) Rubber conveyor belt and pulley
3) Solenoid valve
4) Proximity sensors
5) DC motor
6) Relay
7) Base frame

Figure 1. Actual Working Model of the system
IV. REALY PIN DIAGRAM AND OPERATION

The Operation of the proposed system is explained below [5]:

**Network-1**
- As soon as the power button of PLC is ON and if bottle is placed on a conveyor sensor-1 (I0.0) senses the object and motor (Q0.0) starts rotating. Sensor gives its output to the PLC which in turn operates motor through relay. System will again start when we placed once again object on conveyor.
Network-2
- A Bottle which is on the conveyor gets detected by proximity sensor2 (I0.1) which further activates timer (T33) for 10 seconds.

Network-3
- As soon as timer gets energized valve (Q0.1) starts filling water into the bottle for 10 seconds as per programming.
- When valve start conveyor motor stop.
- As soon as timer (T33) gets deactivated, conveyor (Q0.0) starts moving and valve stops.
- Bottle which is on the conveyor will be detected by another proximity sensor3 (I0.3) located at the end and stops the conveyor.

<table>
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<tr>
<th>SR NO.</th>
<th>PERSCRIPTION</th>
<th>QTY</th>
<th>RATE</th>
<th>AMOUNT</th>
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<tbody>
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<td>PVC pipe (180CM)</td>
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<td>150</td>
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<tr>
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<td>Ball bearing</td>
<td>7</td>
<td>30</td>
<td>210</td>
</tr>
<tr>
<td>3</td>
<td>Conveyor belt</td>
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<tr>
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<td>Proximity sensor</td>
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<td>Solenoid valve</td>
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<td>6</td>
<td>DC motor</td>
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<td>7</td>
<td>Electronic devices</td>
<td>1</td>
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</tbody>
</table>

Table 1. Fabrication of the system

V. FINAL RESULT

The Prototype
The prototype was mainly built by combining the mechanical design and the Electrical designs. The system require three external DC power supply for input and output devices, two DC power supply for supplying pump and motor. The pictures below show that the prototype of system [5].

Figure 4. Elevation view of the system
VI. ADVANTAGES

- Reduces the labour errors
- Introduces automation
- Reduces overall processing time
- Each important individual part required for autoclaving/sterilization can be removed easily
- Can run in dry and wet conditions.
- PLC gives ease of operation and it is flexible because can be used for other devices too.
- Machine height can be adjusted to match with other machines so as to synchronize with each other efficiently.

Useful in food processing industries, Pharmaceuticals, Cosmetic applications and other relevant companies / industries [5].

VII. FUTURE RECOMANDATIONS

- Actually, a lot of weakness from the proposed scheme can be taken as future works so that the improved system will be better in terms of performance [3].
- So that, there are several recommendations or suggestions that we can take to increase performance in this scheme [7].
- The performance of Automatic Filling Water System can be increased based on two recommendations which are; the system that is proposed now is using only three sensor that is IR sensor to detect position of bottle. It will be better if we add more sensors in this system like a flow sensor to detect water flow or use level sensor to detect water level [8].
- Thus, the system will be more sensitive as there will be more sensing points Besides using PLC as controller, the other controller can be used in this future work is like Microcontroller[9].
- However, many factors must be considered like cost [1].

VIII. CONCLUSION

In a nutshell, the theory and concept of automatic filling system is based on the control system. Understandings of the desired control system and how to use the ladder diagram to translate the machine sequence of operation are the most important parts, because it has direct effect on the system performance. Finally, the basic control system and logic design explained in this paper, can be used as references to design other applications of automation system, and also can be used as a teaching material for the industrial control subject.

IX. REFERENCES


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