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Automatic Bottle Filling System Using Plc Based Controller

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***Abstract*— This paper presents a bottle filling machine that utilizes a PLC (programmable logic controller) in the automation business. The primary goal of the article is to use PLC to design and build a compact, straightforward filling system. The bottle is moved by means of a belt conveyor. Water flow is regulated by a DC pump that is set to tank. An infrared sensor uses the bottle's position to determine when to operate the pump. The pump is turned on and the bottle is filled with water when it is beneath the tank. Every component functions properly. This filling machine is affordable and suitable for small-scale bottle filling systems in establishments like juice bars, coffee shops, and other.**

Keywords*— *Automation, PLC, Bottle Filling.

I. INTRODUCTION

PLC applications are now generally recognized. PLCs are mostly employed in the industrial sector in today's digital environment. PLCs are typically employed in the industrialized industry to regulate mechanical movements in heavy machinery or machines to create production that is accurate and efficient with regard to signal handling. In this project, the PLC has complete control over a machine that prepares automatic mixing and filling into bottles. This serves as the system's central component.

Ladder diagrams and fully integrated automation portal software programming are used to plan the system's order of operation. Several electronics and electric devices, such as submersible motor pumps, sensors, conveyor belts, solenoid valves, push buttons, relays, and other devices, are typically controlled by PLCs. One type of solid state device is a programmable logic controller (PLC). It was intended to be completed using electromechanical relays beforehand. PLCs are essentially on-off controllers with logic states. Thus, logic state structures are coded. Every operation is done to regulate a process, such as the use of industrial machinery and apparatus. PLCs belong to the family of processors.

They are employed in manufacturing and commercial settings. Relay logic was initially replaced by PLCs, but due to their expanding functionality, PLCs are now used in a wide variety of intricate applications. Based on the same principles used in computer design, a plc's structure allows it to do a variety of tasks, including counting, calculating, comparing, and analyzing analog signals, in addition to relay switching.

II. LITERATURE SURVEY

Filling is the process of packing liquid into a bottle using techniques like bottled water and other drinks. Arduino or a programmable logic controller (PLC) can be used to automate it. PLCs, or programmable logic controllers, are employed for this function in the modern world. The main component of the entire process is the PLC. It is an effective tool for managing the manufacturing system. It automates industrial tasks by acting as a digital computer. It has a CPU, memory, and numerous input and output units. It provides output outcomes based on the input's state. It is ready to have the relay circuit replaced.

The logic of a programmed PLC is used to control the automation process. A PLC has a set number of connections for inputs and outputs. High filling speed, low cost, and seamless operation are the benefits of utilizing PLC. PLC must be used in automatic filling systems in order to increase filling accuracy. Ladder logic is used to control the procedure. Numerous devices, including a motor, proximity sensor, level sensor, conveyor belt, PLC, and solenoid valve, are used to control filling.

The filling system was controlled by a simulation model created with Simulink. The accidents and labor expenses were decreased by this computer-based technology. An automated bottle plant was created by Kunal Chakraborty et al. [5]. The filling and capping method's foundational step is explained in this study. Maintaining the filling and capping operation at a time is the aim of this paper. Bottles are set up on the conveyor to begin the filling process. Following the filling process, they replaced the empty bottles beneath the solenoid valve with a fresh batch. The system was controlled by PLC. A bottle filling system using a PLC microcontroller was created by Kulkarni, S.L. et al. [6].

They conducted research on beverages and medication in the food and healthcare sectors. As the need for beverages and medications grows daily, filling is necessary to meet this need. Manual filling out is risky in the healthcare sector. In the beverage sector, manual filling results in financial loss. Compared to an automatic filling system, it takes longer. They used PLC to build an automatic bottle filling machine in order to get rid of these drawbacks. Research on the PLC concept and its significance in automation was conducted by Kiran, A.R. et al. [7].

They worked on automation based on PLCs, which is crucial in today's environment. They suggested that PLC is crucial to the mass manufacturing of more accurate and productive products in a variety of industries. To run PLCs, engineers create ladder logic. Their goal was to use this microcontroller in contemporary industry. An automatic filling machine was invented by H Ahuja and colleagues [8]. Automation is required in this era of industrial revolution to support human labor in a variety of industrial tasks. With their new products and brands, industries are becoming more and more competitive on a daily basis. Automation is necessary to maintain their goods on the market and deliver it on time. For this automation, PLC was employed. Schwager, A., and colleagues created automated bottle filling machine by PLC [9].

They researched industrial process automation, which clarifies the process development for the automated system's production phases. It increases the filling system's efficiency. A filling system requires control over a number of factors. For this, PLC was employed. This study aims to show how industry 4.0 concepts are implemented in a water refining facility using PLC. They intended to use this research to quickly meet market demand. Silva, J.M. et al. used PLC to investigate an automated foundry facility [10]. They have described the automation that manages the operating device in this study. It increased production rate, dependability, adaptability, and reduced human labor. For small and medium-sized businesses, it is helpful. They used PLC to design this procedure.

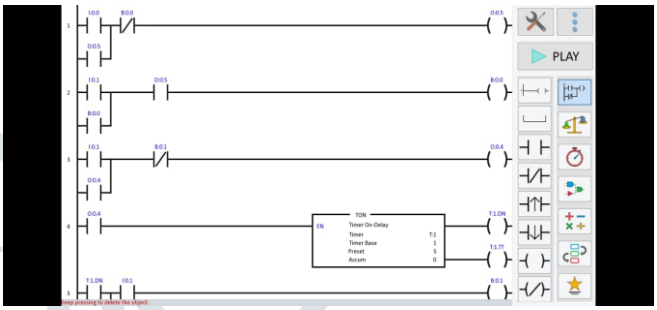
This study aims to design and develop an automated bottle filling system using a PLC-based microcontroller. Previously, numerous researchers have studied bottle filling systems using various techniques. The field of automation has had a notable impact in a wide range of industries beyond manufacturing. The machines being developed can fill only a specific type of container with a specific volume and can automatically cap the bottle. These machines can be used in different industries like chemical, oil, medicine, etc.

A. *Objective of proposed work*

1. To perform filling liquid process in bottle using PLC.
2. To develop an infrared sensor to detect position of bottle.
3. To develop prototype which is in light weight , low cost and user friendly.

III. PROPOSED WORK

Ladder Diagram:



We have a start and stop pushbuttons for controlling the bottle filling process.

PLC Bottle Filling Examples

Note: In this example, we are filling the bottles based on a timer (fixed time duration). You have to write the PLC logic only for the given problem. In a real-time application, there will be more safety functions and logic will be involved.

Bottle Filling PLC Ladder Logic

According to the problem, we need a valve to be open for 7 seconds, and if there is a fault in between then when the fault is resolved the timer opens the valve for the remaining time so that the bottle gets completely filled, and does not get overflow.

In order to do so, we have used a TONR that does not get reset completely even after power is cut. It needs a reset input to do so. This timer can be used to control the filling valve.

Network 1

It is a simple holding circuit that is used to control the state of the memory bit. An NO is connected in parallel to the start input with the same address as the output, which helps us to hold the circuit.

An NC is connected in series with the output to stop the ON state of the output.

Bottle Filling PLC Ladder Logic

Network-2:

It contains a TONR whose state is controlled by the memory bit status from network 1. As the timer is turned on the memory bit M0.1 is activated after 7 seconds.

If the supply is interrupted in between then it starts again from the time it has been covered before, so that the bottle does not overflow.

Network-3:

It is a simple interlock to control the filling valve as per the memory bit M0.1 which is in turn controlled by TONR. As soon as the start is activated in network 1, M0.0 gets high and remains in the high state until stopped.

The fill valve will be in the open state until the timer TONR is not in the active state.

Network-4:
When the filling of the bottle is complete the conveyor motor should be turned on for 2 seconds.
To turn on the motor for 2 seconds we can use TP, after which the timer TONR is made to reset the timer TONR using the output bit Q0.1 and the process continues.

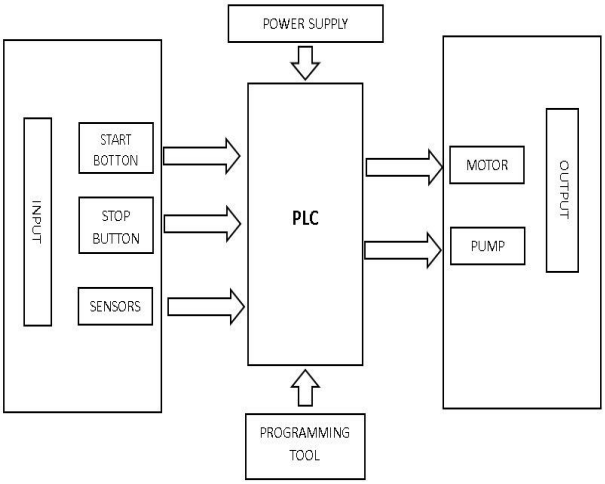


Fig 1 Block Diagram of Proposed System

Working of System:

The conveyor motor will begin to move once the power supply button is touched. The conveyor motor will stop moving and the DC pump will begin to feed liquid into the bottle when the infrared sensor identifies the bottle. The DC pump shuts off when the filling process is finished. As a result, the bottle moves away from the DC pump and the conveyor motor begins to move. If another bottle is detected, the same procedure will be carried out.

A. *Hardware Specifications*

1) ***PLC****:* An instruction and logic storage microprocessor is the foundation of a programmable logic controller. Because PLC is more convenient to use than Arduino, it is employed in this project instead of the latter. Once more, adopting PLC enables more dependable and adaptable operations. An Arduino micro controller's software can be altered somewhat tough, while PLC ladder logic can be modified with relative ease as needed.

2) ***Infrared sensor****:* Infrared Sensor: An infrared sensor is a high-tech apparatus that can identify items that are almost in the distance without making touch with them. This sensor is utilized in this investigation to identify the precise location of bottles on the conveyor belt.

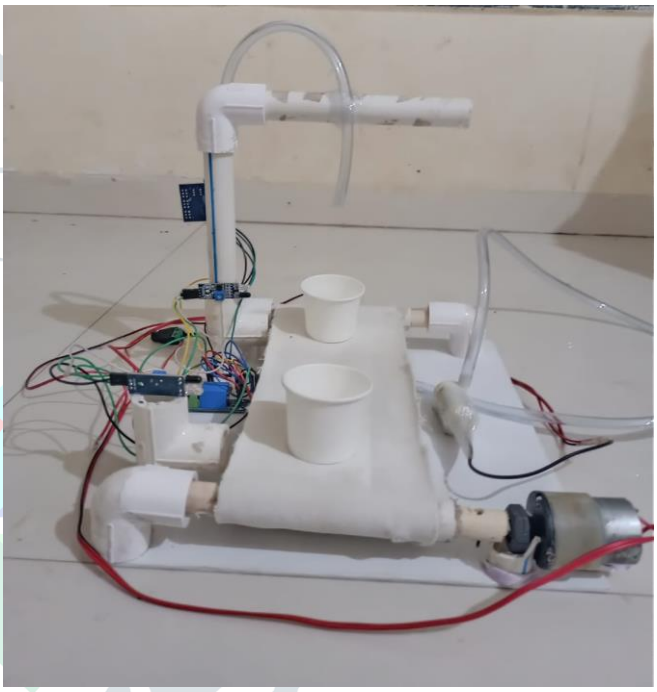
3) ***Conveyor Belt:*** Conveyors are material handling devices, such as belt conveyors. It is employed in the mechanical industry to transport materials between locations. Cotton belt is utilized in this project since it is more flexible and less expensive.

4) ***Pulley:*** A pulley is just a wheel that is used to support a belt as it moves. In this project, the conveyor belt is driven by a pulley.

5) ***Bearing****:* A bearing is a portion of a machine that reduces friction between moving parts and limits relative motion. Ball bearings are employed in this project to support radial or axial loads and to reduce rotational friction. The bulk load is carried by it.

6) ***Brushless DC motor:*** brushless DC motor is also referred to as a synchronous motor. It runs on direct current, which an inverter converts from alternating power to the opposite form. This motor has several advantages, including electric control and high speed.

IV. Results



V. Conclusion

This project involves designing and building an automatic bottle filling mechanism. Every component is operating at peak efficiency. In three seconds, it can fill a 200 ml bottle.
It can fill 67 milliliters per second and has a time-based control system. Compared to the conventional filling method, it offers a few advantages. This filling machine is reasonably priced. It saves time and human effort. It is applicable to small-scale bottle filling operations in the beverage industry, including juice and coffee shops.

References

1. Lu, Y.-D., et al., Analysis and Design of PLC-based Control System for Automatic Beverage Filling Machine. Advance Journal of Food Science and Technology, 2015. 7(1): p. 28-31.
2. Baladhandabany, D., et al., PLC based automatic liquid filling system. International Journal of Computer Science and Mobile Computing, 2015. 4(3): p. 684-692.
3. Sidik, M. and S.C. Ghani, Volume Measuring System Using Arduino for Automatic Liquid Filling Machine. International Journal of Applied Engineering Research, 2017. 12(24): p. 14505-14509.
4. Gong, Q., Application of Computer Image Technology in Automated Liquid Filling Machine. Chemical Engineering Transactions, 2017. 62: p. 859-864.
5. Chakraborty, K., et al., Controlling the Filling and Capping Operation of a Bottling Plant using PLC and

SCADA. Indonesian Journal of Electrical Engineering and Informatics (IJEEI), 2015. 3(1): p. 39-44.

6. Kulkarni, S.L. and M. Elango, Development of PLC based controller for bottle filling machine, in International Journal Of Innovations In Engineering Research And Technology. 2016. p. 1-10.
7. Kiran, A.R., et al., The principle of programmable logic controller and its role in automation. International Journal of Engineering Trends and Technology, 2013. 4(3): p. 500-502.
8. Ahuja, H., et al., Automatic filling management system for industries. International Journal of Emerging Technology and Advanced Engineering, 2014. 4(1): p. 241-244.
9. Schwager, A., et al. MIMO PLC: theory, measurements and system setup. in 2011 IEEE International Symposium on Power Line Communications and Its Applications. 2011. IEEE.
10. Silva, J.M. and B. Whitney, Evaluation of the potential for power line carrier (PLC) to interfere with use of the nationwide differential GPS network. IEEE Transactions on Power Delivery, 2002. 17(2): p. 348-352