



AUTOMATIC BOTTLE FILLING AND CAPPING SYSTEM USING PLC

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Abstract: The project is about filling different size bottles with the fluid and identifying the empty bottle during the process and automatically removing the line through air pressure. PLC is the major element of the whole process. It is a powerful device to control the production system. It is used as a digital computer to automate industrial activities. The advantages of using PLC are smooth operation, low cost, and high filling speed. To improve filling accuracy, it is necessary to apply PLC in an automatic filling system. This system can be made with Arduino but flexibility will be less. The Arduino programming language is more complex than PLC ladder logic. The PLC ladder logic is symbol-based that's why it can be changed easily. The ladder logic can be changed easily so they use PLC instead of Arduino.

The liquid filling machine works when the pressure is high. This can be classified as liquid pressure filling, which means the liquid flows into the bottle based on its weight when the amount of pressure of the liquid reservoir is equal to the amount of air present in the bottle. These liquid fillers are easy to control and fill the exact amount of liquid into gallons or containers. There is a filling mechanism that allows the machine to adjust the different sized bottles without replacing parts and also has a "No Bottle-No Fill" mechanism which means the machine will automatically stop the process when there is no bottle available on the belt.

Key words: - PLC, Ladder logic, Automatic

1.Introduction:

Filling is defined as the method by which liquid is packed into a bottle such as water and other beverages. It can be automated by using a Programmable Logic Controller (PLC). The project is about filling different size bottles with the fluid . PLC is the major element of the whole process. It is a powerful device to control the production system. It is used as a digital computer to automate industrial activities.

The advantages of using PLC are smooth operation, low cost, and high filling speed. To improve filling accuracy, it is necessary to apply PLC in an automatic filling system.

This system can be made with Arduino, but flexibility will be less. The Arduino programming language is more complex than PLC ladder logic.

The PLC ladder logic is symbol-based that's why it can be changed easily. The ladder logic can be changed easily so they use PLC instead of Arduino.

A bottle filling system with PLC allows the user-defined selection volume in percentage which uses the ladder language. Ladder logic is used to control the process. The filling operation is based on the user-defined volume through which the user can choose the volume of liquid to be filled. A sensor that is placed in the conveyor is used to sense the bottle placed under the tank and the corresponding tank is switched on to fill the bottle. The filling is done by using various methods using a motor, sensors, conveyor belt, PLC, and solenoid valve.

2.Problem definition:

Automation can be described as the advancement by which a system or method is performed without human help. In bottle manufacturing companies, it is important to make sure that bottles are completely filled with the desired fluid that is required to be filled.

The present machines can fill only a particular type of container of a specific volume and pressure capping the bottle automatically by using wooden cork. This machine can be used in different industries like water, oil, and chemicals. This project is used in small-scale industries and other areas which have a low budget for the purpose of auto bottle filler machines that are suitable for the customer.

3. Literature Review:

- “PLC Based Automatic Bottle Filling” Author-Jaymin Patel
- “PLC Based Automatic Bottle Filling and Capping System” Author- Zar Kyi Win, Tin Tin Nwe
- “Automated Bottle Filling System By Using PLC” Author- Ashwani Kapoor, Vivek Jangir, Jaswant Kumar, Gaurav Tiwari
- “PLC Based Automatic Bottle Filling and Capping System With User Defined Volume Selection” Author- T.Kalaiselvi, R.Praveena, Aakanksha, Dhanya
- “Automatic Bottle Filling System Using PLC” Author- Prof. (Dr.) Alok Kole
- “Automatic Liquid Filling to Bottles of Different Height Using Programmable Logic Controller” Author- Mamatarani Panny, Dr. M. S Aspalli
- “Development of PLC Based Process Loop Control for Bottle Washer Machine” Author- Jaykumar Patela, Prof. Alpeshkumar Patelb, Mr. Raviprakash Singh
- “Hybrid Method For Automatically Filling Of The Chemical Liquid Into Bottles Using PLC & SCADA” Author- JAGAT DHIMAN
- “Automated Bottle Filling & Capping Machine using ARDUINO” Author- Mr.Lakshmeesha, Mr.Prajwal Kotian, Mr.Shetty Ganesh, Mr.Sriganesh
- Literature on “Automated Packaging Machine Using PLC” Author- Alhade A. Algitta, Mustafa SIbrahim F., Abdalruof N. and Yousef M.

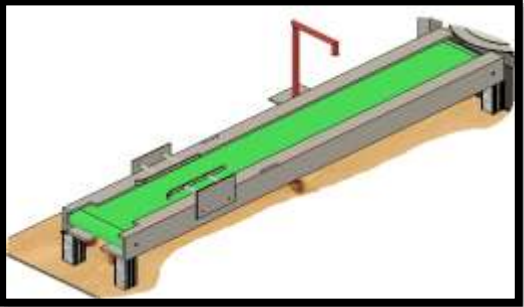
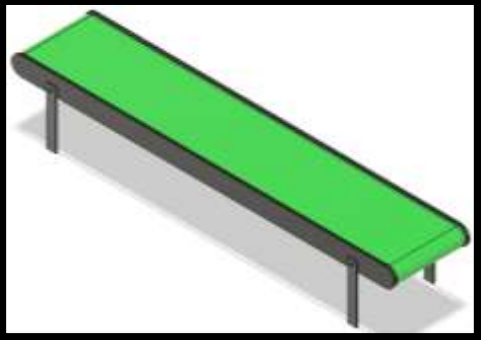
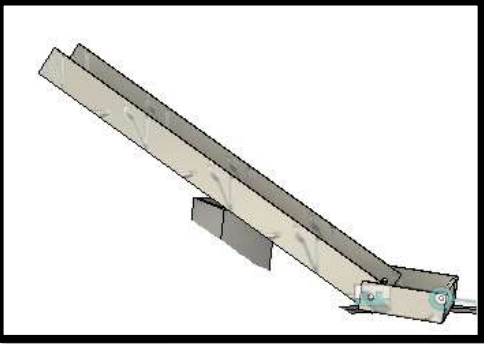

4. Components:

- Proximity sensor
- Conveyor belt
- Roller
- Solenoid valve
- PLC
- PLC Extender
- Submersible Water pump
- DC motors
- Steeper motor
- Actuator
- USB to Serial Converter
- Compressor
- Pneumatic cylinder
- Relay board
- Wire(Single core)
- SMPS
- Push button
- LED

5. Basic Material Used:

- Mild steel: - MS used for constructing basic structure (skeleton)
- Aluminium- used for structure frame 1
- Rubber roller
- Nylon conveyor
- Rubber bush for base
- Plastic Tubes

Table 1: Design and parts

Sr. No.	Design And Parts	Description
1	 <p>Main frame with water dispenser and conveyor belt</p>	<p>This part is fitted with two rollers and a conveyor belt.</p> <p>This part consists of a main structure where the bottle is filled and is guided through guider</p>
2	 <p>Frame-2 with conveyor belt</p>	<p>This part is fitted with a conveyor its placed after the capper, to guide the filled and capped bottle to final place.</p>
3	 <p>Cap dispenser</p>	<p>The job of this part is to properly release the cap on top on the bottles as they pass.</p>
4	 <p>Capper</p>	<p>This part contains a pneumatic cylinder and a motorized capper.</p> <p>It's job is to push the cap on top of the bottle and seal it with rotational motion.</p>

6. Design Of Assembly:

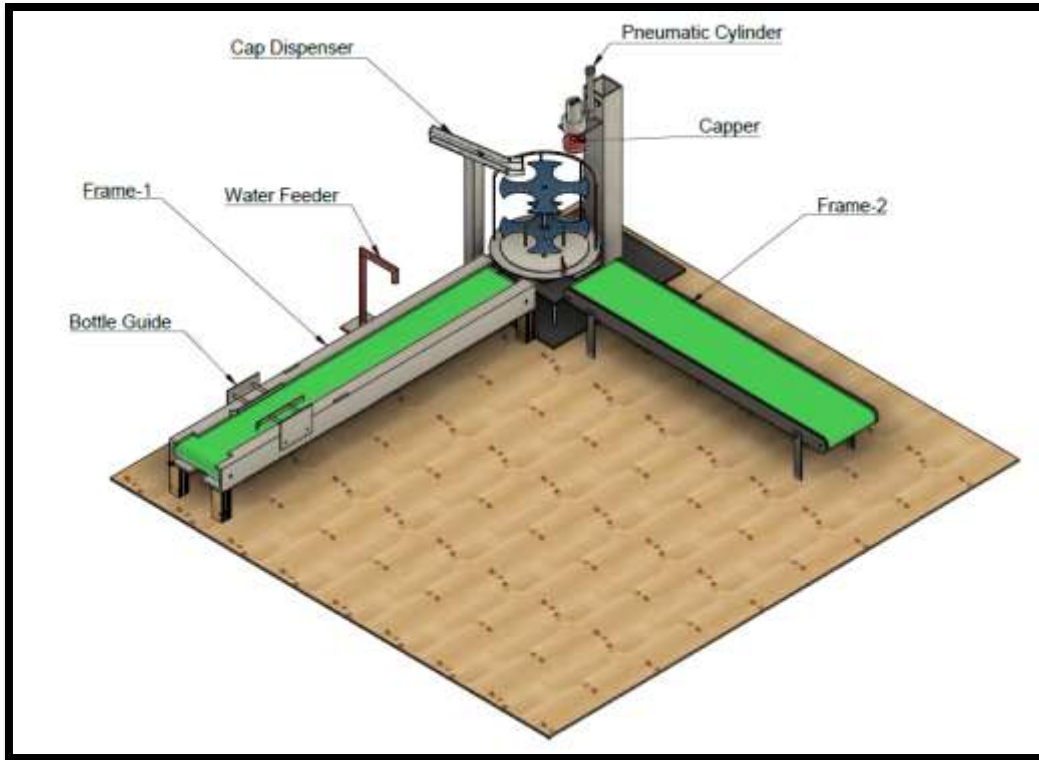


Figure 1. Final assembled design

7. Block Diagram:

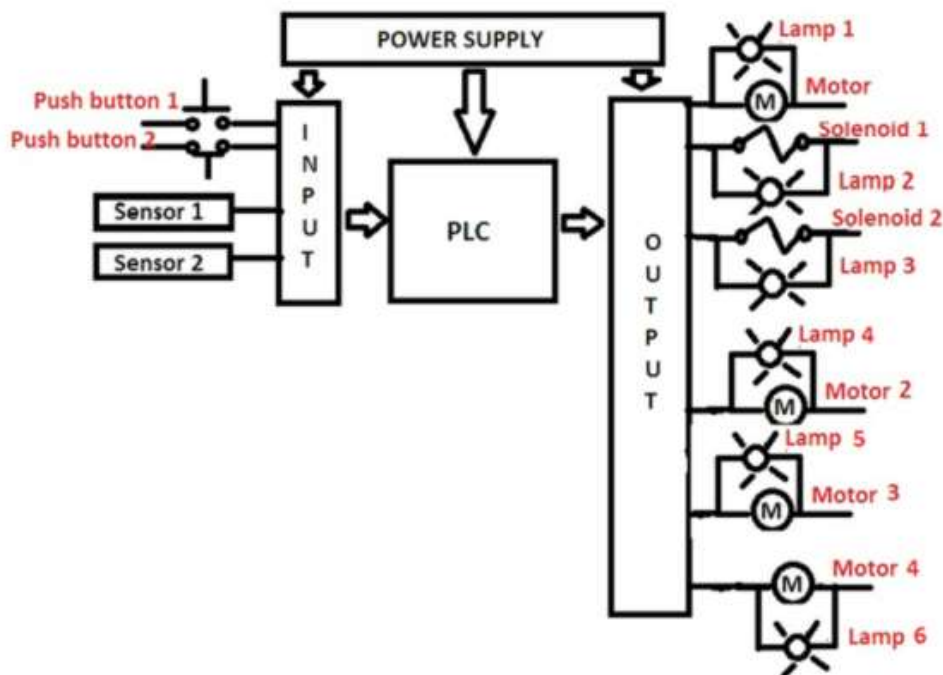


Figure 2. Block diagram of the final device

8. Actual Setup:

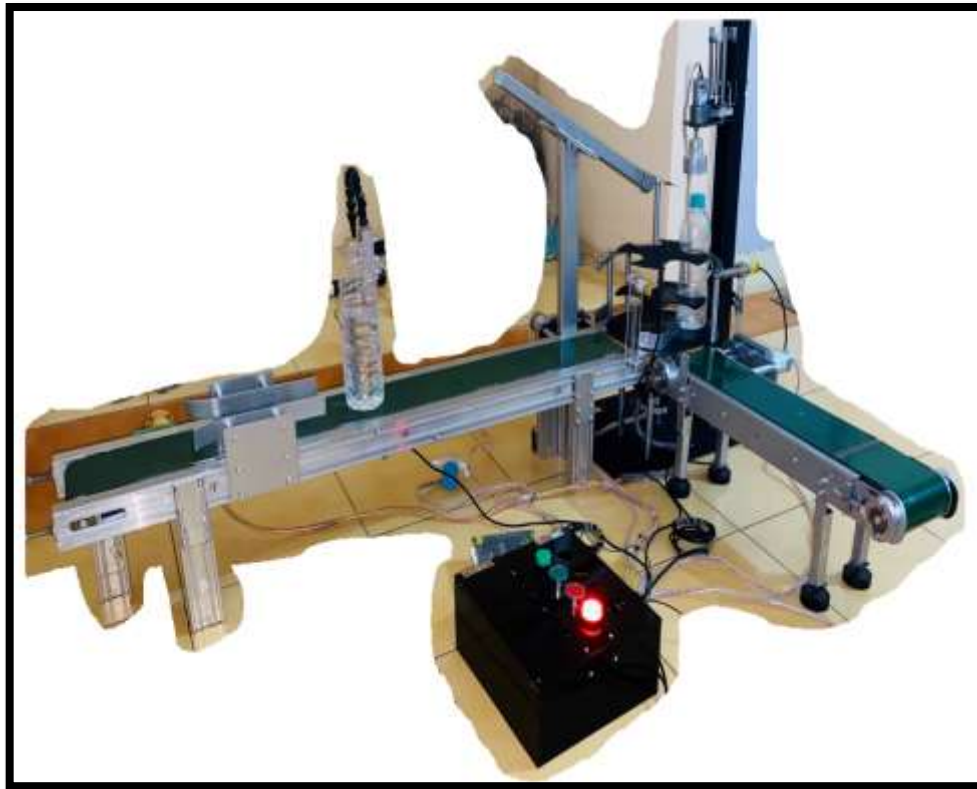


Figure 3.Final device

9. Testing and result:

We have successfully developed our project and tested it takes about 1-2 min for the bottle of 500 ml to be filled and capped, simultaneously adding a second bottle on the conveyor after the first filled and capped bottle exits the rotary disk. No error was detected while filling and capping the bottle.

Time for Bottle filling- 30 Sec

Time for Capping- 4 Sec

Rotation angel for cap dispensing- 90 Degree

Rotation angel for cap fitting from start-180 Degree

Stroke length-55 mm

Software structure for programming- Ladder Logic

10. Conclusion:

With the current scenario in mind a lot of startups are emerging in the consumer goods market which provide herbal and cosmetics solutions for the customer they usually provide the solution in form of liquid fill containers varying in sizes, or the ranges offered by them. The startup usually requires a tool for filling and capping bottles for large orders and for fulfilling that application they require a certain machine that helps them to ease their work, our “Automatic Bottle Filling with Capping using PLC” helps them achieve this with the addition of autonomous system using PLC it helps them to reduce the human component in the system.