



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

# IJIRSET

International Journal of Innovative Research in  
**SCIENCE | ENGINEERING | TECHNOLOGY**



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 2, February 2024

**ISSN** INTERNATIONAL  
STANDARD  
SERIAL  
NUMBER  
INDIA

Impact Factor: 8.423



9940 572 462



6381 907 438



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# Design and Implementation of PLC Based Automatic Bottle Filling

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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.

**KEYWORDS:** PLC, Photo sensor, Conveyor system, Solenoid Valve, Ladder Logic, Motor

## I. INTRODUCTION

Market offers various opportunities that can be easily transformed into success, only by those companies that make the use of high end technology. Various challenges are faced by the industries other than competition. Due to the increase in the production level, stress has been created on the existing systems which have increased the maintenance requirements. After all, if all the process undertaken in the company are perfectly co-ordinated with each other and a reliable and strong communication have been established between them it becomes much easier to tackle the bigger challenges. Automation is used for all the control systems and hence to achieve automation in industries PLC is used widely. PLC plays an important role in the automation industry. In this project we have used a PLC to control the filling of the liquid and capping of the container. A bottle filling system allows filling the container with user defined volume in percentage and this is achieved with the help of ladder diagram. Ladder logic is the widely used technique for the locations programming of the PLC. Various types of sensors are used for the positioning of the bottle

### 1. Problem Identification and Problem Statement

From the above literature review we found that the non-conventional resources available are about to extinct. So, there is need of working on renewable resources for fulfilling future needs.

In recent years automation has influenced wide variety of sections beyond manufacturing by reducing process time increasing system output and process control. Although all these are in market local firm prefer use the manual methods to filling bottles. The use of manual filling methods results in poor efficiency production and losses through spillage. The research outlines design and development of an automated low cost bottle filling system.

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.

### 2. 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, JaswantKumar, 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 Aspathi
- “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

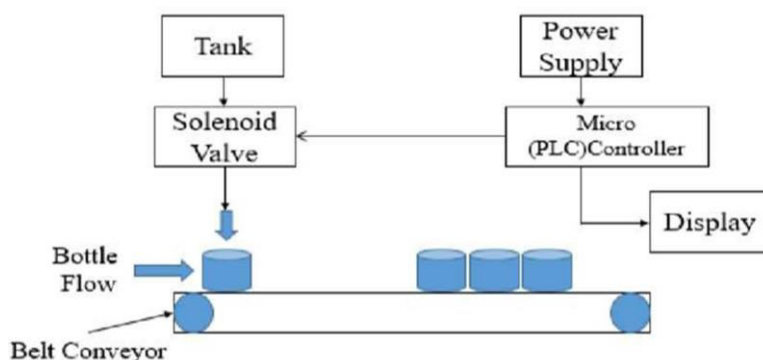
### 3. Advantages of filling machine.

1. Manual effort is reduced.
2. Operating time is less.
3. It consumes less time to fill liquid.
4. Power consumption is less.
5. Design is very simple.
6. Easy fabrication.
7. It occupies less floor area.
8. Net weight is less.
9. Maintenance cost less

## II. RELATED WORK

### Working Principle

Flow chart of working principle is shown in Fig.2. The PLC ladder logic of this filling machine is shown in figure 3. If the button of the power supply is pressed, the conveyor motor will start to move. When the infrared sensor detects the bottle, the conveyor motor stops to move and the dc pump will start to flow the water to fill the bottle. After completing the filling operation, the dc pump stops. Hence the conveyor motor starts to move and the bottle goes away from the dc pump. This process will be repeated if another bottle is sensed.



Fg No 2.1. Actual Working Block Diagram

#### 4. Components:

- Proximity sensor
- Conveyor belt
- Roller
- Solenoid valve
- PLC
- DC motors
- Relay board
- Wire( Single core )
- SMPS
- Push button
- LED

### Programming devices

#### 1. DELTA-PLC (Programmable Logic Control)



Fg No.2.4. 1.DELTA-PLC (Programmable Logic Control)

Programmable logic controller (PLC) is a control system using electronic operations. Its easy storing procedures, handy extending principles, functions of sequential/position control, timed counting and



input/output control are widely applied to the field of industrial automation control. Delta's DVP Series: High-Speed and Reliable: Delta's DVP series PLCs ensure high-speed, stable, and reliable applications across various industrial automation machines. Fast logic operation, a multitude of instructions, and compatibility with multiple function cards make DVP-PLC a cost-effective and efficient choice.

## 2. Solenoid Valve

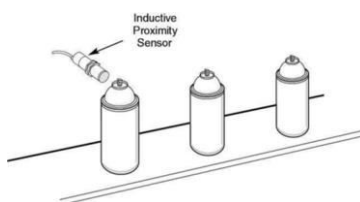
It is an electromagnetic valve which is used to control the flow of various types of liquids by opening and closing the valve on the application of current. The overhead tank will provide the necessary liquid to the solenoid. As the liquid is filled then the valve will switch OFF automatically. In our project we have connected our solenoid valve to the water tank

## 3. Proximity sensor



**Fg No.2.4.2. solenoid valve**

Proximity sensors are used to detect any object which moves in the operating zone. The sensors can detect both conductive and non-conductive elements based on the connection. We have used both type of sensors i.e. Inductive and Conductive. To sense the metal object inductive sensors are used widely and for the sensing of the non-metal objects we use capacitive sensors. These sensors work on voltage between 10V – 40V and the sensitivity depends upon the size of the sensor.



**Fg No.2.4.3. Proximity Sensor**

## 4. Dc motor

The main use of the DC motor is for the Conveyor system. With the help of the conveyor belt we can transfer or move products from one place to other. The motor used in our project works on 12V DC supply. We are using a Gear box which is used to increase the torque. The speed of the motor is 8-10 RPM. We have chosen less speed as we require more torque for our application.

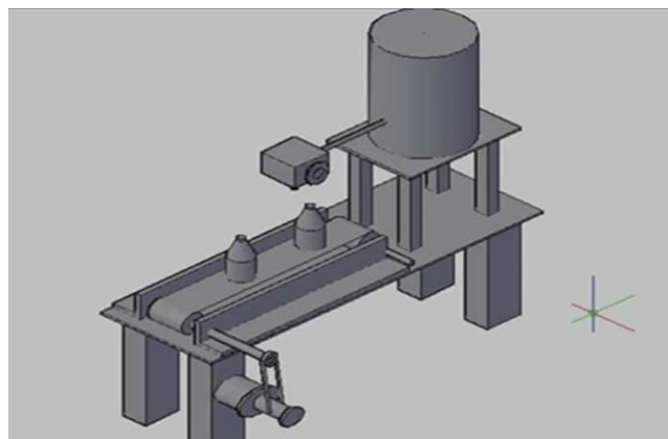


**Fg.no.2.4.4. Dc motor**

### III. METHODOLOGY

A conveyor belt is placed between the two rollers, over roller which drives it and another roller which pulls the belt has belt travels. On the table frame the conveyor belt and roller are mounted. In order to detect the container, the IR sensor is mounted on the dark screen in certain location. The bottle are placed on the conveyor belt, using support of a tank or sink is mounted the control the rotary pump is done by arduino. Which delivers frame which are driven by 12V DC supply and 30 RPM. The electric circuitry, panel and keyboard are installed along with battery on top of table frame.

First switch is made ON the motor and conveyor belt start moving. The used DC gear type motor is a DC motor the shaft of which coupled directly to the roller. At the same time the bottle is put on conveyor belt the sensor detects the bottle and conveyor stops working while bottle approaches IR sensor. As the conveyor stops the water starts filling the bottle. After given period over the water flowing stops and conveyor belt starts moving. Then the bottle is moved towards the disc, IR sensor senses the bottle cap holder is lowered and capping bottle is completed. The cap holder moves upward and disc rotates the bottle with help of limit switch bottle is placed on another belt



Fg.no 3.1:- 3D layout diagram

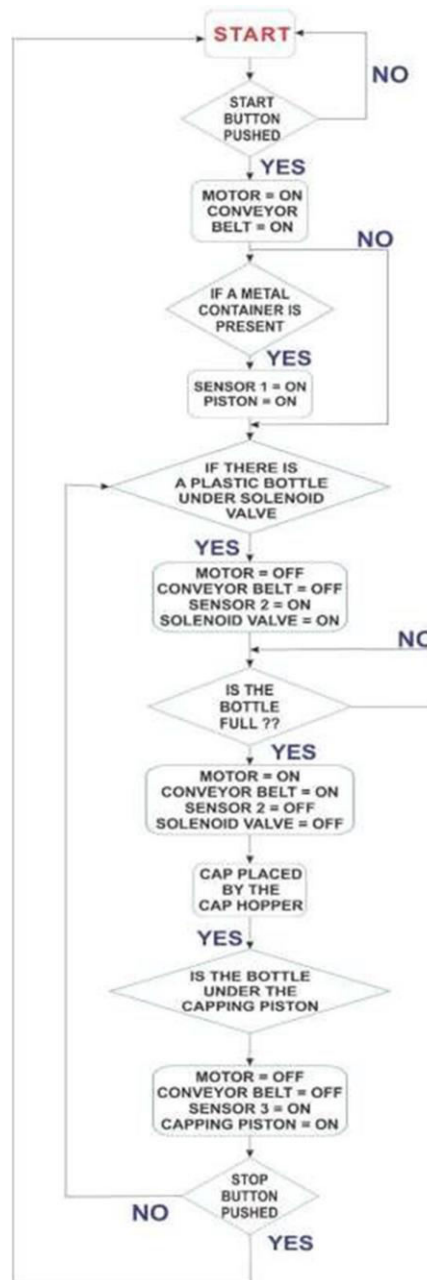


Figure 3.2. Flow Chart of entire process

#### IV. EXPERIMENTAL RESULTS



FG NO . 4.1 .ACTUAL SETUP OF FINAL DEVICE

#### V. CONCLUSION

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.

The main purpose of the project was to build up an automated process of PLC based bottle filling machine. Friction, vibration, mechanical alignment, current ratings were the main problems to run the project properly. IC, transistor, voltage regulator had to be changed for several times. To fill 200 ml it took about 20-25 seconds. This project can be developed in future time for better performance.

Reduced human effort means more frequent filling of bottle which results in increase in overall cleanliness and supports healthy well-being.

Small steps in technological advancement like this will have higher impact in long run in future, making India a better country.

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