

# Automatic Bottle Filling System

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**Abstract-** Filling of product is one of the important processes for various industries. By considering the factors like accuracy, productivity and time most of the industries have implemented automation for this process. A compact system, reduced cost and flexible programming will enable the medium as well as small scale industries to work with automatic bottle filling system.

*This paper introduces such a user friendly system. It consists of a Programmable Logic Controller (PLC) that works as the brain of system to control it. One simple rotating disc for loading and unloading of bottles is used. Its movement is controlled with a gear motor and Variable Frequency Drive (VFD). The bottles are detected by sensors and the flow of liquid which is pumped from the tank is obstructed with solenoid valves.*

**Keywords-** PLC, VFD, Rotating Disc, Proximity Sensor, Solenoid Valve.

## I. INTRODUCTION

Automation has a great impact in every field. It emphasizes on making any process automatic that increases productivity, accuracy and safety by reducing time and human efforts. PLC plays a vital role in the world of automation.

Industrially used traditional bottle filling systems include a conveyor assembly to carry the bottles. In this special efforts are needed for guiding the bottles [5] and their proper positioning at the filling point. Also it takes considerably larger area for implementation with conveyor. Fixed mounted bottle level sensors [2] will restrict the operation to use only specific sized and shaped bottles also with the specific quantity to be filled [3][4]. Frequently making ON and OFF may affect the performance and life of the pump [4] [5].

This paper represents a compact system that uses a single disc for loading empty bottles to and unloading the filled bottle from it. The controller used is Crouzet PLC which is programmed in ladder language. The system is able to be used for filling bottles according to different batches based on quantity. To fill the bottles without frequently switching the pump, two solenoid valves are used. Out of them one will be open throughout the process passing the

pumped liquid into tank again. Only while filling the bottle it gets closed and liquid flows through second solenoid valve to fill the bottle. Two proximity sensors are there. One of them detects the presence of bottle at filling point while another sensor checks for the unloading of filled bottle. At the end of operation when there is no bottle on the disc, the PLC waits for 1 minute and automatically shuts the whole system off.

The paper is presented into several sections. Section 2 describes about the hardware of project and its selection criteria. It is subdivided into four parts as power supply, controller, input section and output section. In section 3 the software logic behind the operation is presented. Section 4 gives limitations of implemented system. Future scope for project is described in section 5. And the section 6 represents the results and conclusion.

## II. HARDWARE

### 2.1 COMPONENT SELECTION

#### 1) Power Supply

- O/P Voltage: 24 VDC
- O/P Current: 5Amp.

The regulated power supply is used to power up the PLC, sensors and solenoid valves.

#### 2) Controller

PLC: Crouzet 88970161

This PLC is selected based on

- No. of inputs and outputs.
- Timers.
- Software.

The dedicated software for this PLC is Millenium 3 and is programmed using ladder language.

#### 3) Input Section

The input section includes:

##### Proximity Sensors-

To make the system usable for any of metallic and non metallic bottles, capacitive type proximity sensors are used.

Sensors are selected based on

- Operating voltage
- Output voltage
- Range

**4) Output Section:**

The output section includes:

**A] Variable Frequency Drive (VFD)-**

VFD (Yaskawa V1000) is used.  
VFD is selected according to the motor.

**B] Gear Motor-**

AC Gear motor is used to operate the disc.

**Specification-**

Power: 0.75hp  
Speed: 1320/80 (at 50Hz)

**C] Solenoid Valves-**

Two solenoid valves are mounted in a particular design and operated with specific logic so as to maintain the constant pressure within the piping which otherwise may differ the quantity of product filled.

**2.2 HARDWARE DESCRIPTION**

**Sensor-**

The sensor usually plays its vital part as an input signal transmitter for the PLC in this system. Capacitive Proximity generates an electrostatic field and reacts to changes in capacitance caused when a target enters the electrostatic field.

- Proximity Sensor I - to detect position of bottle at filling point.
- Proximity Sensor II - to confirm the unloading of bottle.

**PLC (Programmable Logic Controller) -**

The PLC is the brain of the system.

Table -1: I/O of PLC

Input to PLC	Output to PLC
Proximity Sensor I	VFD
Proximity Sensor II	Pump
Auto/Man Selector Switch	Solenoid Valve I
Start Push button	Solenoid Valve II

The quantity of product to be filled is controlled with the timer in PLC.

**VFD-**

It stands for Variable Frequency Drive.

It is used for controlling the rotational speed of motor by controlling the frequency of the electrical power supplied to the motor. It is also useful to minimize the jerk produced while start and stop of motor.

**AC Gear motor-**

It is used to operate the disc. In this motor the initial speed of motor shaft is reduced down with the help of gear assembly.

**Rotating Disc-**

It is used for the loading of bottles. It holds the bottle during entire process. The disc contains total 8 bottle mounting sockets. The movement of disc is controlled by gear motor.

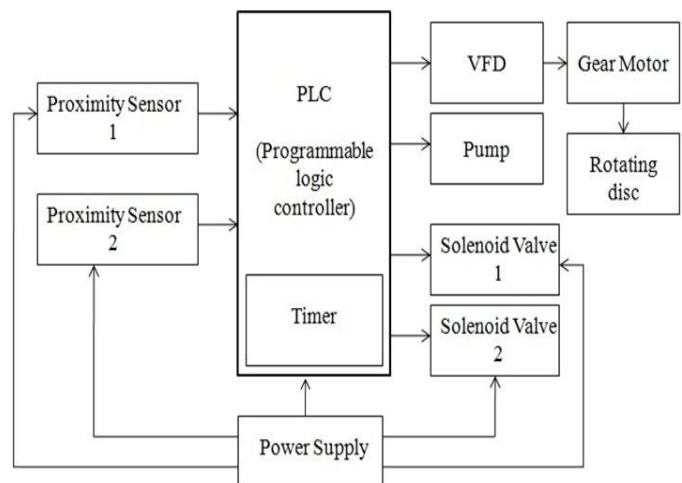


Fig -1: Block diagram

**Solenoid Valve-**

These are the normally closed solenoid valves that get opened by the output signal from PLC.

- Solenoid Valve I - kept continuously open except for the time of bottle filling
- Solenoid Valve II - is used at the exact filling point.



Fig -2: Prototype of Hardware

### III. SOFTWARE DESCRIPTION

Millenium 3 is the software dedicated to the PLC used in project. One of the simple programming languages 'Ladder Diagram' is used for programming the PLC.

#### Features of Millenium 3:

- Millenium 3 is the software dedicated to the PLC used in project.
- Programming languages used: Ladder Logic
- Simulation can be possible without connecting to the hardware.
- The Millenium 3 is easier than ever to program for simple timing, counting or logic functions, as well as complex systems using high-speed count, PID control or sequencing.

#### Algorithm-

1. Press the START push button.
2. Motor starts, disc rotates, pump gets ON and solenoid valve1 gets opened.
3. Loaded bottle comes at filling point.
4. Motor and disc stop.
5. After 2 seconds solenoid valve1 gets closed and solenoid valve2 gets opened. (Liquid gets filled into bottle for 25 seconds through solenoid valve2).
6. After 25 seconds SV2 gets closed and SV1 gets opened.
7. 5 seconds later motor gets ON and disc starts rotating.
8. If sensor2 detects the unloaded bottle then motor and disc stop.
9. When bottle is unloaded motor gets ON and disc starts rotating.
10. If the disc is rotating without having any bottle, after 1 minute the whole system shuts OFF.

### IV. LIMITATIONS

The manual loading-unloading and few bottles get filled in a minute as only one bottle is filled at a time.

### V. FUTURE SCOPE

- With the use of robotic arm the limitation of manual loading and unloading can be eliminated.
- By introducing a simple access control (with authorized tokens or card) at unloading point, the system can be used at public places like coffee or cold drink shops having self service.
- Capping system can be implemented at the same disc before unloading.

### VI. RESULT & CONCLUSIONS

We have implemented a compact, economic and use friendly 'Automatic bottle filling system'. It is flexible in terms of filling various batches based on quantity of liquid to be filled.

This paper has proposed an application of automation illustrating a PLC based automatic bottle filling system. Aim of the project is to develop a system that can help to extend its use over wider area. We have got the experience of brainstorming for logical thinking to developing the program.

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