**Available Online at www.ijcsmc.com**

**International Journal of Computer Science and Mobile Computing**

**A Monthly Journal of Computer Science and Information Technology**

**ISSN 2320–088X**

***IJCSMC, Vol. 4, Issue. 3, March 2015, pg.684 – 692***

**RESEARCH ARTICLE**

# PLC BASED AUTOMATIC LIQUID FILLING SYSTEM

**D.Baladhandabany, S.Gowtham, T.Kowsikkumar, P.Gomathi**
UG Student, Department of EEE, INFO Institute of Engineering, Coimbatore
**P.Vijayasalini**, Assistant Professor, Department of EEE, INFO Institute of Engineering, Coimbatore, Tamilnadu, INDIA

**ABSTRACT**: Filling is the process in which a machine packs the liquid products such as water, cool drinks etc. This method includes placing bottles onto a conveyor belt and filling bottles one at a time. This aim of this paper is to describe the methods for filling more than one bottle at a time. In a conveyor system, stepper motor is used for its efficiency. It includes the user defined volume selection at the desired level. Our system includes less number of sensors, so it is less expensive. Filling is controlled by PLC (Programmable Logic Controller) using ladder logic method. In the bottle filling system the PLC gets the sensor feedback and controls the solenoid valve timing as well as controls the conveyer belt. By programming the PLC, the entire system is being controlled. Sensor stands as the most important part for bottle filling. Normally in all automation industries, PLC is considered as the heart of any system. The entire system is made more flexible, time saving and user friendly. Every result leads to the conclusion that the operation of PLC in is very inspiring.

**Keywords – DELTA TYPE DVP PLC, PHOTO ELECTRIC SENSOR, FLOW SENSOR, CONVEYOR BELT, SOLENOID VALVE, HMI.**

## I. INTRODUCTION

Automation is used for all control systems and the technologies in PLC is use to reduce the human work and helps in increasing the production. PLC plays an important role in the world of automation industry [4]. It acts a major function in the automation field which tends to reduce the complexity, increases safety and cost efficient. In this system we have applied a PLC based control system in an automatic bottle filling station. The paper is divided into several sections where the first phase of the paper explains the description of the product. The second phase then gives the functional description of the product. PLC (Programmable Logic Controller) acts as a major function in automation fields where, small PLC have a fixed number of built-in connections for inputs and outputs. 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[3]. The filling operation is based on the user-defined volume through which user can choose the volume of liquid to be filled. A sensor which 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[2]. Filling is done by using various methods using motor, sensors, conveyor belt, PLC, solenoid valve.

## II. DESCRIPTION OF OUR PROPOSED DEVICE

It is based on plc automation, which consists of various components and are divided into two parts namely:

**1. Hardware part:**

Our device consist of a PLC (DELTA DVP 16.sp) [4], 24V DC Relay, Photo electric sensor (3), Flow sensor(3), Solenoid valve, DC motor, conveyer belt, 24 V DC Source, ON-OFF button and some connectors. The ON-OFF button works as the input device. The PLC controls the input and output according to the program given.


- **PLC:**

A Programmable Logic Controller, PLC is a digital computer used for automation. It is an interface between program and the inputs. It is a programmable software.


Figure 2.1: Typical of PLC

A PLC is an example of a real time application and therefore used to control various devices. The PLC works depending by the inputs given and their state, turning on/off its outputs. The user enters a program, usually through software which gives the results. PLC is used in many "real world" applications. For all application that needs some type of electrical signals, PLC works on the basis of inputs given by the user.

- **OPERATIONS OF PLC:**

PLC works by a programmable support with some criteria. The PLC is connected with some components and it is made to run with the help of program.

PLC executes the program by one instruction at a time, where, if the first input is ON then it should turn on the first output. Hence it already knows which inputs is on/off, from the previous process. PLC updates the status of the outputs. First the PLC checks the input status and it scans

the input by user defined programming. Next the process is executed and finally it checks the output status.

**2. Software Part**

In software part we are going to discuss about the programs and the logics used. There are some programming languages for control systems:

Block diagram (BD)

Ladder diagram (LD)

In our proposed device the Ladder Diagram (LD) is used. This is to interface the ON-OFF button, programming logic. There are several programming softwares available but in our device ladder logic is used. It is easy to understand and the programming is made more flexible to users.

## III. LADDER LOGIC

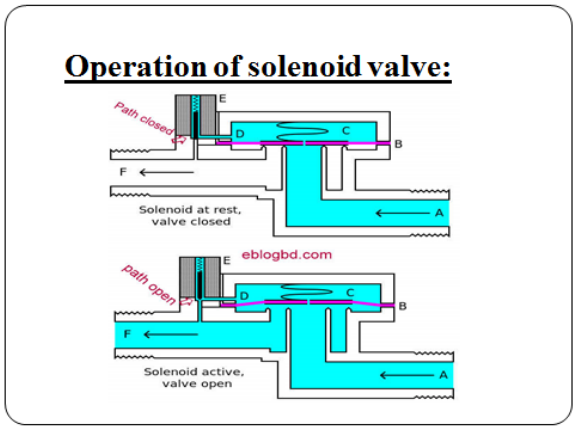
Ladder logic is the main programming method used in PLC. Ladder logic is based on mimic relay logic. The relay logic diagrams are difficult, hence we have selected ladder logic as main programming method. In modern control systems they used relay but these are not used for logic.

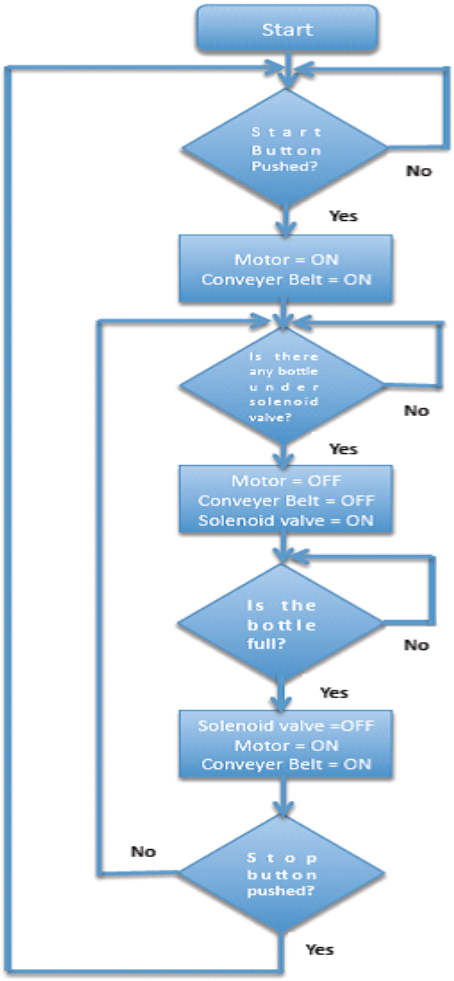
A relay is a device that controls a switch using magnetic field. Relays are used as one power source close a switch for another power source, while keeping isolated. A simple ladder logic diagram is shown below.

- **Solenoid Valve**

It is an electromagnetic valve used to control various types of liquids by opening and closing automatically. Various types of applications are performed by using this solenoid valve.



When the start button is pushed, the motor starts hence the conveyer belt starts moving. When the bottle is under the solenoid valve, the bottle is sensed and the motor stops hence the conveyer belt stops. Then the solenoid valve operates and the bottle starts filling the water. When the bottle completes filling process, the solenoid valve is closed and the motor starts, the conveyer belt starts moving and carries the bottle away from the solenoid valve. If another bottle is sensed then the above process will be repeated. When stop button is pressed or activated then the entire process will be stopped.

## IV. SELECTION OF PLC

There are some main factors to choose a PLC for any application. They are:

- Input and output
- Memory size
- System speed
- Compatibility to HMI
- Easily communicable

Different PLCs have different number of I/O ports. And in some, adding external I/O cards can increase number of I/O ports

In the proposed device DELTA DVPt-16.sp is used. In DELTA DVP t-16.sp, there are 8 inputs and 4 relay type outputs. 4 ms full programs scanning time and memory is enough for the automatic bottle filling . So it is chosen.

## V. PROTOTYPE DESIGN OF PLC BASED AUTOMATIC BOTTLE FILLING STATION

## VI. SYSTEM SPECIFICATION

1. Input: 220 V AC
2. Capacity: 3 BPM
3. Maximum bottle height: 6.6''
4. Maximum bottle diameter: 4.6''
5. Maximum pressure: 200 pascal
6. 3 filling Nozzle
7. Automatic shut off when bottle is full
8. Best liquid: Water

## VII. LIMITATION

It can only fill approximately one bottle at a time. The process can be efficiently used in water filling system. These types of fluids are handled mainly by the solenoid valve and nozzle used. So the range of fluid types is not so wide. Positioning the solenoid valve is a critical issue and proper care is needed. Another disadvantage is, no proper guidance for the bottles to move. And making the system to cause imbalance vibration. This system is constrained by height (max 6.6'' inch) of the bottle of a specific volume.

## VIII. RESULTS

The device can fill up to 2 or more bottles of maximum height of 6.6'' and maximum bottle diameter of 4.6" in 1 minute. There is no need of any external pumps and only two types of sensors are used. It is a time based control by which the pulse is generated in flow sensor and filling process is done. It can be used commercially in various coffee shops, juice shops, cold drink shops and reduce human effort. So the practical research result is much satisfactory. It also helps to understand the necessity of PLC in industrial automation and also to realize the necessity of studying it.

## IX. FUTURE WORK

By the installation of jet nozzle and strong solenoid valve can reduce the time to fill bottles and can efficiently increase productivity. A guide way could be used in case of vibration.

A capping section could also be introduced. The nozzle positioning must be given more care and concenteration. The system could be redesigned for increased bottle size and productivity.

## X. CONCLUSION

Automation systems are used to increase productivity, which in turn brings economic progress. The main purpose of PLC in automation is used to control the whole system. The cost of installation is not cheap but it can efficiently run for a long period of time. The performance, flexibility and reliability is based on the investment. A PLC based control system was applied to the automatic liquid filling station previously specified and the performance was measured. The entire system is more reliable, time saving and user friendly.

## REFERENCES

[1] **"PLC Based Automatic Bottle Filling and Capping System With User Defined Volume Selection "** T.Kalaiselvi , R.Praveena, Assistant professor, Easwari Engineering College, Chennai. **International Journal of Emerging Technology and Advanced Engineering (ISSN 2250-2459 )2012.**

[2] **"Implementation and performance analysis of bottle filling plant using ladder language"** 1 SavitaM.tech,R.N College of Engineering & Management,Rohtak,India.2 Lokeshwar Assistant Prof, R.N College of Engineering&management,Rohtak,India. **International Journal of Science and Research (ISSN 2319-7064) 2012.**

[3] **"Industrial Application of PLCs In Bangaladesh"** 1 Ahmed Ullah AbuSaeed,2 Md.Al-Mamun,3 A.H.M.ZadidulKarim, Department of EEE, University of Pacific,Dhanmondi,Dhaka. **International Journal of Scientific & Engineering Research (ISSN 2229-5518)2012.**

[4] **"Automatic liquid filling to bottles of different height using programmable logic controller" 1Mallaradhya H M, 2 K R Prakash**1Department of Industrial Automation Engineering, VTU-RO, Mysore, Karnataka, India. 2Department of Mechanical Engineering, National Institute of Engineering, Mysore, Karnataka, India.**International Journal of Mechanical and Production Engineering, ISSN: 2320-2092, Oct-2013**.

[5] "**Automation of Packaging and Material Handling Using Programmable Logic Controller",** Joanna Marie M. Baroro, Melchizedek I. Alipio, Michael Lawrence T. Huang, Teodoro M. Ricamara, Angelo A. Beltran Jr. School of Graduate Studies, Mapua Institute of Technology, Philippines.**International Journal of Scientific Engineering and Technology(ISSN: 2277 – 1581) June 2014.**

[6**] "Programmable Logic Controller"** D.Ahuja1, N.Chaudhary 2 Department of Electrical and Electronics Engineering, YMCA University of Science and Technology, Faridabad, 121006, India. **International Journal of Information and Computer Science, 2012, 1: 115-120 - 104 - Published Online August 2012.**

**[7] "The Principle of Programmable Logic Controller and its role in Automation",** Avvaru Ravi Kiran#1, B.VenkatSundeep*2, Ch. SreeVardhan #3, Neel Mathews!4#Electronics and Communications, KL University, Guntur, Andhra Pradesh, India**,***Assistant Professor, Electronics and Communications, KL University, Guntur, Andhra Pradesh, India. General Manager Mobility Solutions, Mahindra Reva Electric Vehicles Pvt Ltd, Bangalore, India. **International Journal of Engineering Trends and Technology- Volume4 Issue3(ISSN: 2231-538) 2013.**

**[**8**] "Application of PLC for Arranging Bottle in Beer Filling Production Line"** ZHANG Tianxia, DONG Feng , YUAN Hao Tianjin Key Laboratory of Process Measurement and Control, School of Electrical Engineering and AutomationTianjin University, Tianjin 300072, China.