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An Automatic Fluid Filling Mechanism Using Delta PLC

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Abstract. This project is carried out using Programmable Logic Controller, which is the main component of the proposed system. It is an industrial oriented machine system used to fill water in the empty bottles automatically, which reduce the usage of man power, low power consumption, accuracy. The system is implemented in various soft drink industries, water packaging industries and food industries. The filling process gets efficient, when our filling machine is combined with an automatic conveyor to increase the speed of filling process. The conveyor belt roll-up the empty bottles and an analog timer is used to adjust the timing of the water flow. The empty bottles are sensed by photo electric sensors and it detects the empty bottles present in the conveyor, stops the conveyor, then the valve is opened up to fill the bottles. This sequential process will continue for each and every water bottle filling process. A Programmable Logic Controller machine is preferred due to its and cost efficient high ratings. The proposed method will reduce the cost for small scale industries and help them in setting up and an automated decision for filling water bottles.

Keywords: Programmable Logic Controller, Analog Timer, Counter, Photo-Electric Sensor, Conveyor.

1. Introduction

The field of automation has a great impact in wide range of industries beyond manufacturing. In this method we use the automation concept for continuous production of water bottles. Empty water bottles are detected using photoelectric sensor. A proximity sensing setup is one which the radiation is transmitted using light transmitter, must reflect off the object and the object is detected



by photoelectric receiver. The Photo-electric sensor senses whether the object is present in the conveyor belt. These type of sensor is mainly used in the automation system for easy identification of object and it needs upto 24V DC supply. It's size is about 40mm, a controlled relay output and has a quick response time about 20ms. This sensor consists of a red beam of light rays and a larger sensitivity. The Analog Timer is used to measure the time for the initial setting purposes. We can also set up the constant time for the specific type of water bottles and can also reset the timing for further purposes if any different kind of bottles is passed on the conveyor. It is a programmable type timer for which it can be programmed for particular time and its size is about 22.5mm. It supply a particular voltage of 230V AC and a relay contact of 1 SPDT.

Programmable Logic Controller(PLC) is a control system used for easy storing procedures and mainly used in the industrial automated applications. It has 8 inputs, 6 outputs and its program capacity is 8000 steps. The pulse output is max 10kHz and communication port is RS232. The DVP-SS series PLC provides execution faster and reliable with real-time monitoring capability. It's output form is in negative, which is more efficient than positive output. The DVP-SS2 saves parameters automatically after the Proportional Integral Derivative auto temperature tuning is completed. The DC motor is used for conversion of electrical energy into mechanical energy. Its main use in this project is to run the conveyor belt from one place to another place and works on 12V DC supply. The valve is electrical units with motors that are sealed used to suck water from the tank and provide same amount of water each time. They are economical and low cost. The digital LED Counter consists of 6 digit display and red color 7-segment display. This counter has features of high accuracy, good stability and easy installation in any of the machines. This type of digital counters can be fully automated with their microcontrollers which can resist upto a tolerance level of 5%. It is compact and consists of built-in sensor supply of 12V DC. It's height is about 35mm and has approximate length about 102mm, also it has the capability to store the data which has an internal memory in it. The counter only counts in upward direction which cannot be changed we can only reset.

2. Literature Survey

The PLC used for more productivity with less time compactable and is implemented to fill the bottles with water [1]. For detecting the empty bottles designed prototype sensor is used and to fill up the bottle submersible pump were used. [2]. The IR sensor is used to monitor the bottles in the system, the whole process should be completed without inference of human in it. Arduino using C++ language programming, used to control various components. [3]. The work involves control loops using microcontroller like Arduino, Ladder Logic and UNO microcontroller are used to connect

heavy components. Arduino using C language programming. [4]. The Sprocket is metal steel with teeth on the outside which is in motor and that is used to rotate the conveyor belt. [5]. The Volumetric filling is the type of filling with the speed of piston and its cost is more expensive than gravitational filling. The piston attach in the volumetric will make entire system fast. [6]. The Water Float Switch is dipped in the water to monitor the water level and to get energize the pumps [7]. To control the process using RASPBERRY PI, which is developed to used for different industries like oil, chemical. [8]. To detects the object which are positioned in particular place on the conveyor belt, Infrared sensor is used here. Brushless DC motor is used to control the electric speed. [9]. The PLC & SCADA is used to monitor and control plant equipment. It stores the all the data and it can be viewed anywhere, not just on site [10]. Filling bottles by using SOV and Microcontroller AT89C51 is implemented here to control the project. It is 4KB of Flash programmable and read only memory [11]. The Proximity sensors have been used here to detect the presence of the empty bottle. Ladder logic is used for the programming of the PLC [12]. The Capping system using GRAFCET, GEMMA and WinCC for flexible and good working. GRAFCET is a graphical representation and analysis of an automatism. The GEMMA is used to speed up the system process. [13]. The Proximity sensor and load cell is to monitor the empty bottles on the conveyor belt. [14]. The Ladder logic programming using GX work 3 which used to control as well as operate in extreme rush environment conditions. [15]. The design of the proposed bottle washer machine for RGBs has been created in the Creo software. The implementation of the PID temperature control and auto-tunning. [16]. This system using Arduino for controlling the PLC by using Programming and rotary pump is used to fill up the bottles.

3. Proposed System

This proposed work is mainly applicable for the production of water bottles with the less usage of time and man power with the assistance of automation. The working model consists of conveyor belt, photo electric sensor, analog timer, counter and water solenoid valve, outer casing frames and etc,. The conveyor belt is operated to roll-up the empty bottle cases. The photo electric sensor is used to identify the position of the empty bottles and then the counter is used to count the bottles during the filling process. To carry the empty bottles from one place to another place safely and efficiently conveyor belt is used. The belt type is modulator which has long lifespan and consists of wheels to rotate the belt. To fill up the bottles based on the water (ml) which takes duration time (seconds), to manage and fill the bottles analog timer is employed. The PLC is used to operate and control the process again and again for continuous filling purposes. Once the sensor senses the bottles then the

conveyor operation will be stopped and the bottles will be filled by valve. Depending upon the size and shape of the bottle water filling operation is carried out. The process will be continued for successive filling of bottles based on the requirement. It has a switch mode working from either auto to manual or manual to auto. The photo-electric sensor (E3JK-RR11) is used to sense whether the empty bottles are present in the conveyor belt for filling the water in the bottles and transport them for packing purposes. The analog timer (selec-800S-1-ON-60S-230) is also used in input section for the initial measurement of filling the bottles for trail and error and the preferred time is set up.

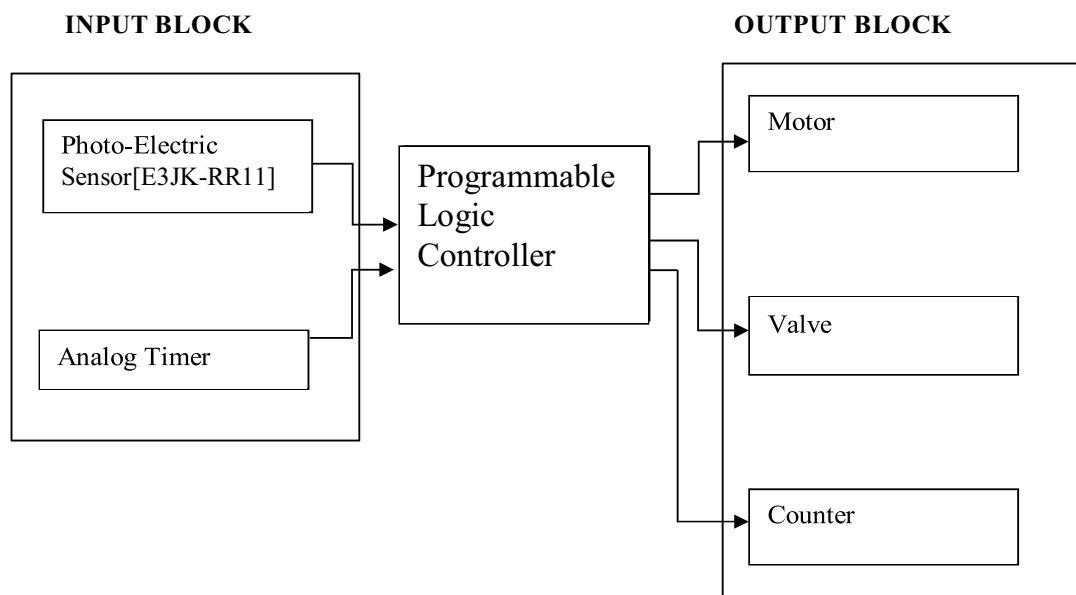


Figure: 1 Block Diagram of automatic fluid filling mechanism.

The Delta PLC is the control system which adapts the industrial automation and controls the production system with efficient program with high reliability. It controls the inputs given from the user end and process the in-built program dumped into it and the resulting product is received as an output. It is arranged of digital and analog I/O and they resist from vibrations. The programs used in PLC are stored in the non-volatile memory which is erasable and editable. It consists of CPU which controls inputs and outputs, the memory unit for storing purpose, an interface to connect the external devices and a power supply unit. The DC motor is used to convert electrical energy to mechanical energy which generates a force for the water to flow through the valve for filling purposes. The valve is the main output for this filling machine which directs the water flow into the bottle and with the help of input analog timer the motor stops and the valve stops the water flow from it. The counter

(selec-XC410-24) helps the machine to count the filled water bottles received from the conveyor and as a result it displays the number of water bottles filled in the LED display.

4. Result and Discussion

The working model is designed to fill water bottles of various sizes. The amount of water filled in the bottle is related to the time duration set in analog timer. The valve operation duration was determined by trail and error method. The calculated time is fed into analog timer with this adjustment bottles with various sizes were filled. The valve is closed, the filled bottles were counted by counter then conveyor move the bottle to outlet of the machine. This model gives an output of the filled water bottles and the even sized filled bottles are given to the packing unit for future usage.



Figure 2



Figure 3

Figure: 2, 3 Working Model of Proposed System.

The progress of the machine should be monitored because non-occurrence of bottles is possible in this method. The process is continued for continuous filling of the same size of bottles. The analog timer will be changed for the other types and sizes of bottles and the below tabulation shows the survey of various types of water bottles filled in the trail and error method.

Table I Measurement of Timing of Various Capacity

S.No.	Capacity (ml)	Time Duration (sec)
1.	50	3
2.	100	6.5
3.	200	13.5

4.	250	17
5.	500	34
6.	750	51
7.	1000	68

5. Conclusion

In this paper, an empty bottle is placed into a machine using a conveyor belt. It is used to move the bottles in and out of the machine. The Photo-electric sensor detects the empty bottles. **After detection the valve opens and the process of filling the bottle starts, depending upon the time fed into machine by using analog timer.** The filled water bottles are counted by using counter and moved out of the machine for packing unit. This automatic filling machine exhibits a quality of effective production of water bottles in a short time period compared to man fitting system. When the bottle size changes, this machine is capable of altering to various quantities by setting the analog timer. It can be tested for other liquids also such as soft drinks and other beverages for the future purposes. This machine can be used efficiently in small scale industries, medium scale industries and even in large scale industries which can be programmed for different types of bottles which varies with respect to litres (ml).

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